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Cardiogenic Shock Among Yemeni Patients Presented With Acute Coronary Syndrome (ACS). Data From Gulf Registry of Acute Coronary Events Phase (Gulf Race I)

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ABSTRACT

Introductions & Aims: Acute Coronary Syndrome (ACS) and its magnitudes is one of the most common cardiac diseases world-wide. Yet in Yemen; GULF RACE I data are the first nation- wide information that highlight the magnitude of this problem. Cardiogenic shock is a miserable complication of ACS. Pointing out this problem among Yemeni with ACS, its prognostic importance and impact in patients outcomes is a major aim of this study.

Methods and Patients: Yemen data arm was a part from the GULF RACE I, which is a prospective, multinational, multicentres survey of consecutive patients hospitalized with the final diagnosis of ACS in six Arabian Peninsula/Gulf countries over a period of six month. Yemeni patients were 1054 patients included from 20 major hospitals all over the country with ACS including cases of ST Elevation Acute Myocardial Infarction (STEMI), non ST Elevation Acute Myocardial Infarction (NSTEMI), newly developed Left Bundle Branch Block (LBBB) and unstable angina pectoris (UA). Patients with Acute Heart Failure (AHF) and presented with cardiogenic shock were pointed out. The end point of this study was all causes of in-hospital mortality.

Results: Out of 1054 hospitalized with ACS, 181 patients (17.3%) had AHF on presenting to the hospital or during hospitalization itself. Out of those patients with AHF there were 74 patients who developed Cardiogenic Shock. They were relatively older 64.7±9.7 (SD) years (P <0.001) with male predominance (63.5%). In spite of Anterior/Anteriolateral STEMI was a common feature of presentation (70.2%), echocardiographic feature were more

consistent with cardiogenic shock , Left Ventricular Ejection Fraction (LVEF) was (36.5% Vs 51% P <0.001). Those patients were in co-morbid condition more than the rest of the group of ACS & evidently were less treated utilizing evidence based treatment. Cardiogenic shock was linked to higher in hospital mortality (66.2% Vs 4.8% with P < 0.001).

Conclusion: Yemeni patients with acute coronary syndrome complicated with cardiogenic shock had more worse prognosis regarding in-hospital morbidity and mortality.

Key words: Yemen, Acute Coronary Syndrome, Acute Heart Failure, Cardiogenic shock, Mortality.

BACKGROUND

Cardiogenic shock is defined as a systolic blood pressure of less than 90 mmHg for at least 30 minutes, which is secondary to myocardial dysfunction[1]. It is associated with clinical signs of hypoperfusion. Cardiogenic shock is state of reduced cardiac output and signs of tissue hypoxia. Cardiogenic shock complicates 5% to 10% of cases with ACS and remains the leading cause of death in patients hospitalized with AMI.[2,3]. It is a consequence of Acute Heart Failure (AHF); AHF is a complex syndrome that can result from any structural or functional cardiac disorder leading to inability of the left ventricle to fill with or eject blood. It is a result of many conditions including cardiovascular diseases. Its high morbidity and mortality represent a major economic burden[4]. Yemen is one of the low income country group where rheumatic heart disease is still highly prevalent[5], while in more developed the most common cause of HF is no longer hypertension or valvular heart disease, but coronary artery disease (CAD)[6]. Data from phase I of The *gulf registry* of acute coronary events (*GULF* RACE I), indicate that CAD is a leading health problem that cause AHF in the gulf countries including Yemen[7]. Cardiogenic shock complicating ACS was not studied before in Yemen. A major aim of this study is to highlight the magnitude of this condition among ACS Yemeni population participated in phase I GULF RACE. As well as to describe the incidence, patient characteristics, treatment patterns and in hospital outcomes of cardiogenic shock complicating ACS in those patients.

METHODS

Design and Study Population

GULF RACE I is an initiative from the Gulf Heart Association; it is a prospective, multinational, multicentre survey of consecutive patients hospitalized with the final diagnosis of ACS in six Arabian Peninsula/Gulf countries (Kuwait, Oman, United Arab Emirates, Yemen ,Qatar, and Bahrain). Patients were enrolled in a pilot phase that lasted for 1 month in May 2006 and a subsequent study phase from January 2007 to June 2007. All patients were included in the present analysis[8,9]. All patients with ACS were eligible with no upper age cap or other restrictions on study sample. Patients were managed according to the judgment of the treating physician. An institutional review board or equivalent at each participating hospital approved the protocol. All hospitals that care for patients with ACS in Kuwait, Bahrain, and Qatar participated, as did the majority of such hospitals (serving 85% of the population) in Yemen, United Arab Emirates, and Oman. Over this period of six month, 1054 Yemeni patients were included from 20 major hospitals all over the country with ACS including cases of ST Elevation Acute Myocardial Infarction (STEMI), non ST

Elevation Acute Myocardial Infarction (NSTEMI), newly developed Left Bundle Branch Block (LBBB) and unstable angina pectoris (UA) with manifestations of CHF. The determinants of CHF in those patients and the impact of CHF on their outcome were studied. The ACS with HF cohort included patients with CHF at presentation (Killip class II/III), cardiogenic shock and death.

Data Collection & statistical analysis:

All patients gave informed consent to process their anonymous data. Data were collected on record forms by treating physicians. Completed data sheets were sent to the central data-processing center for uniform monitoring and registration. Patients' characteristics are presented as proportions, medians, or mean _ SD as appropriate. Whenever possible, rates were used to describe patient populations. The frequencies of categorical variables were compared using the chi-square test and by calculating odds ratios (ORs) and 95% confidence intervals (CIs). Continuous variables were compared using the 2-tailed Student's *t* test. Variables influencing in-hospital mortality were assessed using multiple logistic regression after adjustment for all confounders (i.e., age, gender, heart rate, blood pressure, and diabetes mellitus). ORs, 95% CIs, and p values are reported for significant predictors. A p value 0.05 was considered significant. All p values were the results of 2-tailed tests. All data analyses were carried out using SPSS version 20 (SPSS, IBM, California).

RESULTS

1054 patients were documented to have ACS during study period, heart failure was a result of ACS in 181 patients (17.3%). Patients who developed manifestations of cardiogenic shock were pointed out 74 patients (40.9%) of patients with AHF developed this consequence. The base line characteristics of those group of cardiogenic shock patients was illustrated in table 1. The mean age (SD) was 64.7 years (±9.7 SD). Male gender was mostly affected than female, 47 males (63.5%) with P value < 0.001. The risk factors predisposing to IHD and cardiogenic shock were prominent in those with hypertension & DM type II was 34 (45.9%) in each group and P value was significant in both < 0.001. Hyperlipidemia was seen in 20 (27%) patients with P value of 0.001. Smoking of different forms of tobacco was recorded in 24 patients (32.4%) with P value of 0.210. Khat chewing habit was very prominent (49) patients was chewers with a P valve of 0.061.

Previous history of AMI , CABG & Stroke worsen the patient's condition and enhances cardiogenic shock representing 28 patients (37.8%), 9 patients (12.2%) and 14 patients (18.9 %) correspondingly and P value for all was < 0.001. History of angina pectoris was noted in 32 (43.2%) with P value of 0.001. History of PVD 7 patients (9.5%) with P value 0.04. History of previous PCI was least to develop cardiogenic shock Five patients were post PCI (6.8%) with P value 0.910. All patients with cardiogenic shock were symptomatic at presentations and the most frequent symptoms were: angina chest pain 43 patients (58.1%), Dyspnea 17 patients (23%) & Atypical chest pain 2 patients (2.7%) with P value <0.001. ST elevation MI (STEMI) was a noticeable category of ACS with P value < 0.001; The patients number at presentation with those subtypes were; STEMI 59 (79.4%), NSTEMI 6 (8.1%), UA 1 (1.4%) & LBBB MI 8 (10.8%).

Table 1: Cardiogenic shock complicated ACS Patients characteristics.

Variables	CARDIOGENIC SHOCK	Rest of AHF	Total ACS	P VALUE
Number (%)	74(40.9%)	107 (59.1%)	1054 (100%)	
Mean Age in Years (SD)	64.7±9.7	62.1±11.2	58.7±11.5	< 0.001
Male (%)	47(63.5%)	84 (78.5%)	836 (79.3%)	< 0.001
Female (%)	27(36.5%)	23 (21.5%)	218 (20.7%)	0.005
Khat chewing	49(66.2%)	70 (65.4%)	757 (71.8%)	0.061
Smoking	24(32.4%)	47 (43.92%)	501 (47.5%)	0.140
Arterial Hypertension	34(45.9%)	49 (45.8%)	353 (33.5%)	< 0.001
Diabetes Mellitus	34(45.9%)	47 (43.9%)	282 (26.8%)	< 0.001
Hyperlipidemia	20(27.0%)	15 (14.3%)	126 (12%)	0.001
History of angina	32(43.2%)	39 (36.4%)	308 (29.2%)	0.001
History of MI	28(37.8%)	31 (29%)	201 (19.1%)	< 0.001
Post CABG	9(12.2%)	(5 (4.6%	36 (3.4%)	< 0.001
Post PCI	5(6.8%)	(8 (7.5%	80 (7.6%)	0.910
Post Stroke	14(18.9%)	6 (5.6 %)	46 (4.4%)	< 0.001
History PVD	7(9.5%)	4 (3.7%)	31 (2.9%)	0.04
Symptoms at presentation				< 0.001
IHD chest pain	43(58.1%)	77 (72%)	870(82.5%)	
Dyspnea	17(23.0%)	24 (22.4%)	86 (8.2%)	
Atypical chest pain	2(2.7%)	4 (3.7%)	68 (6.5%)	
ACS diagnosis				< 0.001
STEMI	59(79.4%)	(67 (62.6%	751 (71.3%)	
NSTEMI	6(8.1%)	(17 (15.9%	117 (11.1%)	
UA	1(1.4%)	(15 (14%	151 (14.3%)	
LBBB MI	8(10.8%)	(8 (7.5%	31 (2.9%)	
Site of STEMI –ECG				< 0.001
Anterior / anteriolateral	52(70.2%)	58 (54.2%)	574 (54.5%)	
Inferior / inferoposterior	12(16.2%)	20 (18.7%)	289 (27.4%)	
Echocardiography				
Done	30(40.5%)	97 (90.7%)	832 (78.8%)	
LVEF%	36.5% (19-59)	(40 % (31-49	49.5 (40-61)	< 0.001
LVEF ≤40%	18 (24.3%)	57 (53.2%)	153 (14.5%)	< 0.001

STEMI population showed ECG changes of anterior/anteriolateral in 52 patients (70.2%)while inferior / inferoposterior 12 patients (16.2%) giving P value of <0.001. LBBB was a prominent ECG feature with cardiogenic shock (10.8% Vs. 2.9%). Echocardiographic features were mainly reduced EF% and LVEF ≤40% were noted in 18 patients (24.3%). Cardiogenic shock especially that due to ACS is one of the emergency situations thrombolytic therapy utilization either pharmacologic or mechanical should started as soon as possible. In this study utilizing such agents were very low among all the patients especially those with cardiogenic shock; 10 patients with cardiogenic shock (13.5%) in contrast with 15 with AHF but no manifestions of cardiogenic shock (14.1%) P value 0.912.

Asprin was used in most of the patients with cardiogenic shock 69 patients (93.2%) in contrast with 101 patients (94.3%) with AHF but without cardiogenic shock , Clopidogrel was used in 66.2% and 73.8% in both groups and P value was not significant for both medications , Anticoagulation by IV heparin was used widely in cardiogenic shock group 91.9% while AHF without cardiogenic shock group was used in 78.5% with significant P value of 0.004. Using inotropes as Dopamine, Dobutamine, Epinephrine & Norepinephrine in cardiogenic shock was abundant; 69 patient (93.2%) with cardiogenic shock in

comparison of 18.7% patient with AHF without cardiogenic shock. Mechanical ventilation was employed in 68.9% of cases with cardiogenic shock and intra-aortic balloon pump in 8.1 % of the cases with significant P value < 0.001 (Table 2). Morbidity and mortality were high among cardiogenic shock population, P value was <0.001; strokes were noted in 18.9 % of those patients, while major bleeding was seen in 2 patients. Death was very high among cardiogenic shock patients 66.2% to 5.6 % for AHF without cardiogenic shock patients. (Table 2).

Table 2: Cardiogenic shock complicating ACS patients; management and in-hospital outcome.

Variables	Cardiogenic shock	Rest AHF	P value
Thrombolytic therapy	10(13.5%)	15 (14.1%)	0.912
Treatment on admission			
Aspirin	69(93.2%)	101 (94.3%)	0.834
Clopidogrel	49(66.2%)	79 (73.8%)	0.023
IV Heparin	68(91.9%)	84 (78.5%)	0.004
LMW Heparin	3 (4.1%)	(12 (11.2 %	0.002
Beta Blockers	14(18.9%)	40 (37.4%)	0.003
ACE I / ARBs	33(44.6%)	102 (95.3%)	< 0.001
Calcium CB	0	1 (0.9%)	0.110
Statins	60(81.1%)	98 (91.6%)	0.031
Nitrates	39(52.7%)	94 (87.9%)	< 0.001
Diuretics	33(44.6%)	65 (60.7%)	< 0.051
Inotropes	69(93.2%)	20(18.7%)	< 0.001
IABP	6(8.1%)	1 (0.9%)	< 0.001
Ventilation	51(68.9%)	4 (3.7%)	< 0.001
Morbidity & mortality			
Acute MR	2(2.7%)	22(20.6%)	<0.001
Stroke	14(18.9%)	20 (18.7%)	< 0.081
Major bleeding	2 (2.7%)	0	< 0.001
Death	49(66.2%)	6 (5.6%)	< 0.001

DISCUSSIONS

A evident outcome of this study is that Acute Coronary Syndrome in Yemen is a major underlying cause for acute heart failure and its resultant cardiogenic shock. As a first of its kind study in the country, this study shows that in between every 5-6 patients one will develop AHF. Patients present late for any thrombolytic methods. Older males are more predisposed to AHF and cardiogenic shock. The morbidity in form of strokes & major bleedings were extremely high while mortality was the fate of most of the patients with cardiogenic shock. Framingham Heart Study suggests that the most common cause of AHF is no longer hypertension or valvular heart disease, as it was in previous decades, but rather CAD[10]. Cardiogenic shock in this study shows its gloomy face where its high prevalence was recorded in contrast of some of the neighborhood registries (Table 3) in Yemen 40.9% of the patients with AHF developed cardiogenic shock , while the whole Gulfrace I was 11.6%. The prevalence was low 4.3% as mentioned in SPACE [11] registry (The Saudi Project for Assessment of Coronary Events). GRACE [12,13] (Global Registry of Acute Coronary Events Investigators) showed slightly higher prevalence than SPACE data but less than

Yemen data (4.6%) with older male predominance. Kolte et al 2014 had reported that the incidence of cardiogenic shock in USA complicating STEMI has increased during the past 8 years together with increased use of early mechanical revascularization and intra-aortic balloon pumps. There has been a concomitant decrease in risk adjusted in-hospital mortality[14]. Investigators from GUSTO-I trial had reported occurrence of cardiogenic shock in STEMI population as 8.3% but after the first year, 2% to 4% of patients died each year regardless of whether they had cardiogenic shock or not[15.] In-hospital medications in Yemeni patients was shown in Table 2 pointed out inadequate cardiogenic shock management especially in lacking the facilities of performing primary PCI , which shows good improvement in management and prognosis of cardiogenic shock in particular in developed countries[15].

The in-hospital prognosis and its outcomes concerning the morbidity and the mortality among cardiogenic shock group pointed out a sad outcome of the Yemeni patients and was a big complications in cases of AHF as Strokes in 11% , cardiogenic shock 40.9% major bleeding 1.1% and death 30.4% in contrast to other registries especially Gulf Race I and SPACE (table 3). The Table reflect the quality of care in Yemeni tertiary hospital , late presentation of the patient to health facilities , adequacy of the emergency referral system and the performance of medical teams handling those patients.

Limitations of the **study**

The results presented here are only from major hospitals in Yemen with or without a Catheterization Laboratory facility. This could have led to a higher contribution of patients with ACS and a low percentage of patients who had undergone coronary angiography and hence low utilization of primary PCI during hospitalization. The utilization of natriuretic peptides as a marker for HF and cardiogenic shock is nearly lacking were determined in only few patients. The absence of data about prior history of pre - hospitalization with HF represent a major limitation of the study and that surly affects the outcomes post- hospital discharge. The loss of contact with the patients after discharge represent another limitation to know the long run outcome in those groups.

Table 3: In-Hospital Major outcomes in some close neighborhood ACS registers.

OUTCOMES	YEMEN DATA	GULF RACE I	SPACE
Stroke	11.0%	1.3%	0.9%
Cardiogenic shock	40.9%	11.6%	3.5%
Major bleeding	1.1%	1.5%	0.7%
Death	30.4%	7.9%	4.4%

CONCLUSION AND RECOMMENDATIONS

Acute coronary syndrome in Yemeni patients is a major cause for cardiogenic shock and had more worse prognosis regarding in-hospital morbidity and mortality**.** In this observational study, ACS patients with cardiogenic shock were older, more likely to have hypertension, diabetes, lower LVEF, and hemodynamically unstable status. These findings potentially explain the higher incidence of in- hospital adverse outcomes in ACS patients with cardiogenic shock. More aggressive treatment of these patients may be warranted to

improve prognosis. Introduction of heart failure biomarkers as natriuretic peptides is mandatory to improve the quality of clinical practice. Establishing a comprehensive primary PCI program after improving health systems is mandatory to overcome limitations in handling those patients. More studies on Khat as a potential risk factors are needed.

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الصدمة القلبية بين مرضي متلازمة الشرايين التاجية الحادة في اليمن

(معلومات مستقاة من السجل الخليجي لمتلازمة الشرايين التاجية الحادة –المرحلة الاولى)

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ملخص

المقدمة والأهداف: متلازمة الشرايين التاجية الحادة ومدى انتشارها هي واحدة من أكثر امراض القلب شيوعا في العالم. وتعتبر المعلومات المستقاة من السجل الخليجي لمتلازمة الشرايين التاجية الحادة في اليمن هي اول معلومات صحية توضح الوضع لذلك المرض في اليمن. اما الصدمة القلبية فهي واحدة من اسوء المضاعفات التي ممكن حدوثها لمرضى متلازمة الشرايين التاجية الحادة. وتحديد هذه المضاعفة الخطيرة بين مرضي هذه المتلازمة في بلادنا وكذا اهمية التكهن الطبي بما قد يحدث لهؤلاء المرضى هو هدف رئيس لهذه الدراسة.

طرق الدراسة والمرضى: تمثل معلومات اليمن الطبية في السجل الخليجي لمتلازمة الشرايين التاجية الحادة حجر الزاوية في المعلومات الكلية للسجل. وسجل الخليج لمتلازمة الشرايين التاجية الحادة هو سجل استقصائي مسبق ويشمل ست دول عربية في جزيرة العرب منها اليمن ومن كل دولة شمل عدة منشأت طبية رئيسية وشمل السجل كل الحالات المرقدة تحت تشخيص نهائي لحالتهم: متلازمة الشرايين التاجية الحادة. تم تسجيل الحلات لمدة ستة أشهر من الاستقصاء وكان عدد الذين شملتهم الدراسة 1054 مريض تم حصرهم وتسجيل بيانتهم بعد ترقيدهم في المشافي وعمل الفحوصات الضرورية وذلك في 20 مشفى في عموم اليمن. وشملت متلازمة الشرايين التاجية الحادة كل المرضى الذين تم تشخيصهم على اساس احتشاء عضلة القلب ذو ارتفاع او انخفاض قطعة ST في تخطيط القلب الكهربائي وكذلك حالات احصار الحزمة اليسري حديثة المنشأ وايضا حالات الذبحة القلبية غير المستقرة. من بين كل هذه الحلات تم اختيار حالات الفشل القلبي الحاد والذين دخلوا في مضاعفة الصدمة القلبية. وكانت نقطة النهاية في هذه الدراسة هي تحديد كل الاسباب المؤدية للوفاة داخل المشافي محل الدراسة.

النتائج: من بين مجموع 1054 مريضا بمتلازمة الشرايين التاجية الحادة كان هناك 181 مريضا يعانون من فشل القلب الحاد (17.3%) وذلك عند دخوله المشفى محل الدراسة او عند ترقيده به. من 181 حالة فشل قلبي حاد تم حصر 73 حالة دخلت في مرحلة الصدمة القلبية وكانت معظم شريحة هؤلاء المرضى من الذكور (63.5 %) كبار السن بمعدل عمري (64±9.7 سنة) وكانت الدالة الإحصائية ذات دلالة كبيرة ($P < 0.001$) . وكان المصابون باحتشاء عضلة القلب المتميز بارتفاع قطعة STفي الموقع الأمامي والأمامي الجانبي في تخطيط القلب الكهربائي الشريحة الأكبر من المرضى (70.2%) من اجمالي المرضي . وكان فحص القلب بالموجات الصوتية والدوبلر يتماشي مع معطيات المرضى المصابون بالصدمة القلبية فكان معدل قذف الدم من البطين الايسر 36.5% وحتى 51% وكانت الدلالة الإحصائية ذات مدلول كبير ($P<0.001$) . وكان الوضع الطبي لشريحة مرضى الصدمة القلبية أسوء بكثير من كل شريحة المرضى مع متلازمة الشرايين التاجية الحادة بدون صدمة قلبية وكانت مجموعة الصدمة القلبية عرضة للوفاة اكثر من بقية المجموعة بمعدل 66.2% مقابل 4.8% لكل المرضى وكانت الدالة الإحصائية ايضا كبيرة ($P < 0.001$) .

الإستنتاج : المرضي اليمنيون والذين يعانون من متلازمة الشرايين التاجية الحادة وحصلت لهم مضاعفات في شكل الصدمة القلبية كان تطور الوضع الصحي والطبي لحالتهم سيئ جدا فيما يخص تعقيد هذا الوضع طبيا أو معدل الوفاة المرتفع جدا.

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TUJNAS

Prevalence of Mitral Valve Prolapse and Its Adverse Sequelae in Healthy Adult Yemenis

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ABSTRACT

Background: Mitral valve prolapse is a common cardiac disease with frequent complications.
Objectives: To study the prevalence of mitral valve prolapse in healthy Yemenis associated with the prevalence of its adverse sequelae.
Methods: We performed echocardiography for 1164 healthy Yemeni individuals: 615 women and 549 men (mean age ± SD 45.7 ± 10 years).Classical mitral valve prolapse was defined as a superior displacement of mitral valve leaflets at least 2 mm with a maximal leaflets thickness of at least 5 mm during diastasis. On the other hand, nonclassic prolapse was defined as displacement of more than 2 mm with a maximal thickness of less than 5 mm.
Results: 74 subjects (6.3 percent) had mitral valve prolapse, 40 (3.4 percent) had classic prolapse and 34 (2.9 percent) had nonclassic prolapse. None of the patients with prolapse had a history of heart failure nor anyone had atrial fibrillation except one patient (1.3 percent) had cerebrovascular disease and two patients (2.7 percent) had syncope, as compared with unadjusted prevalence of these findings on the individuals without prolapse of 0.0, 0.0, 0.0 and 1.3 percent, respectively. Chest pain, dyspnea and electrocardiographic change frequencies were similar between two groups.
Conclusion: The prevalence of mitral valve prolapse in adult Yemenis was 6.3 percent, which is similar to the results of other studies in different countries but with low prevalence of adverse sequelae in comparison to those studies.
Keywords: Mitral valve Prolapse, Echocardiography, Prevalence.

INTRODUCTION

Mitral valve prolapse (MVP) is a condition characterized by systolic displacement of an abnormally thickened, redundant mitral valve leaflets into

the left atrium during systole[1]. It is a health problem associated with mid–systolic click, late systolic murmur and serious complications such as bacterial endocarditis, severe mitral regurgitation, atrial fibrillation, syncope and stroke[2–7].Echocardiography is considered the ideal non–invasive method for recording the movement of prolapsing mitral valve leaflets. However, the continually changing echocardiographic methods and criteria for diagnosis of MVP for the last three decades disturbed our perfect understanding of this disorder with regard to prevalence, complications rate, ect[8].

During the past decade, new echocardiographic criteria for MVP have been established on the basis of understanding the 3–dimensional structure of mitral valve[9]. patients were defined as having classical prolapse of displacement exceeded 2 mm and maximal thickness was at least 5 mm. Nonclassic prolapse of displacement exceeded 2mm but the maximal thickness was less than 5 mm. Recent studies, that used these criteria, have shed new light on the prevalence and complications of MVP in the general population[10].So that we used this criteria in our present study

Mitral valve prolapse is a common cardiac disorder with prevalence, generally ranging from 5–15 percent in most studies and up to 35 percent in some studies[11–17]. However, previous studies, estimating the high prevalence of mitral valve prolapse, were limited to usage of hospital based individuals or highly selected patients visiting cardiac centers because of mitral valve prolapse and more likely of having clinical complications[18–19].In addition, those studies relied on M–mode or two–dimensional echocardiographic criteria and views that are not specific for the diagnosis of mitral valve prolapse[12,17,20,21].

To the best of our knowledge; however, no Yemeni investigator has evaluated the prevalence of MVP and its potential complications in Yemeni population by using the recently recommended echocardiographic criteria. Therefore, our present study is designed to determine the prevalence of mitral valve prolapse and its clinical adverse sequelae in unselected individuals of outpatient department.

MEHTODS

Study Population

The present study was conducted in Kuwait University Hospital–Sana'a from 2004 to 2008 as a prospective study of 1164 healthy Yemeni individuals: 615 women and 549 men, ranging in age from 18–70 years with (mean age ± SD 45.7 ± 10 years).

Population includes presumably healthy individuals, accompanied the patients who have been referred to Echocardiographic and Abdominal Ultrasonographic Department, were informed about the study. Furthermore, those who agreed to participate in the study and known to be with no specific history of cardiac disease had underwent clinical evaluation and selected for the study.

Echocardiography

Individuals underwent two–dimensional echocardiography through commercially available system (Sonos 5500, Hewlett–Packard) that used a 2.5–MHz transducer. Images were recorded on a videotape with complete parasternal, apical, and subcostal views and color Doppler assessment of valvular regurgitation.

Measurements were performed by a Sony offline cardiac analysis system. The two–dimensional echocardiographic criteria, based on the three–dimensional shape of the annulus and clinical correlation, were used to diagnose mitral valve prolapse in accordiance

with the maximal superior displacement of the mitral valve leaflets during systole, relating to the line connecting the annular–hing points. The thickness of the mitral valve leaflets during diastasis was measured from the leading to the trailing edge of the thickest area of the mid–portion of the leaflets.

Patients were defined as having classical prolapse of displacement exceeded 2 mm and maximal thickness was at least 5 mm. Nonclassic prolapse of displacement exceeded 2 mm but the maximal thickness was less than 5mm.

The degree of mitral regurgitation was assessed as the ratio of the maximal regurgitant jet area to the area of the left atrium and graded as trivial, mild, moderate, or severe on the basis of the ratio of > 0 to 10, > 10 to 20, > 20 to 40, and > 40 percent, respectively.

Clinical Characteristics

Several clinical variables such as age, sex, BSA (square root of product of the weight in kg times the height in cm divided by 3600), and symptoms of chest pain and/or dyspnea were evaluated. World Health Organization definition was recommended for hypertension (as systolic blood pressure of at least 140 mmHg or diastolic blood pressure of at least 90 mmHg on each of two successive readings obtained by the clinical physician or as current use of antihypertensive medication), presence of diabetes mellitus (glucose level of at least 140 mg per deciliter after a 12 hour fast or the use of insulin or an oral hypoglycemic agent, current cigarette smoking, and presence of hypercholesterolemia (defined as a serum cholesterol level of at least 240 mg per deciliter)[24,25].Cerebrovascular disease (defined as stroke or transient ischemic attack). The two groups were compared in regard to the above mentioned variables as well as heart failure, atrial fibrillation and syncope.

The physical examination included measurements of body mass index (the weight in kilograms divided by the square of the height in meters),waist–to–hip ratio, systolic and diastolic blood pressure, and assessment of mitral systolic murmur and mid–systolic click.
Electrocardiographic assessed variables included the presence of atrial and ventricular ectopy, left atrial enlargement (defined as a terminal P–wave force of 1 mm by 1 mm in lead V1), and left ventricular hypertrophy (defined as the presence of increased voltage with a pattern indicating strain)[26].

Statistical analysis

We used statistical software (version 6.11, SAS Institute, Cary, N.C.) in all calculations in our study. The differences of clinical variables between individuals with mitral valve prolapse and those without prolapse were tested with Waldchi–square test for logistic–regression analysis after making the adjustment for age, sex, and body–mass index. Continuous variables (for measurable variables including body mass index, waist to hip ratio) were evaluated by the analysis of covariance.

The difference in age was adjusted for sex. The body mass index and waist–to–hip ratio were adjusted for sex, age and body mass index. Values are given as least–squares means and standard errors. Ultimately, we used all comparisons by comparing all subjects with prolapse to those without prolapse. P–value was two–sided.

RESULTS

Prevalence of Mitral Valve Prolapse

Qualitative analysis revealed that 74 subjects (6.3 percent) had mitral valve prolapse, 40 (3.4 percent) had classical prolapse and 34 (2.9 percent) had nonclassical prolapse.

Table 1: Prevalence of Mitral Valve Prolapse

Type of MVP	All Subjects(N=1164)	Men(N=549)	Women(N=615)
Classical	40(3.4%)	19(1.6%)	21(1.8%)
Non–Classical	34(2.9%)	16(1.4%)	18(1.5%)
Total	74(6.3%)	35(3.0%)	39(3.3%)

Among subjects with classical prolapse, the mean (± SD) maximal leaflets displacement was 3.1± 1.1 mm, the mean thickness of anterior leaflets was 5.0 ± 0.3 mm, and the mean thickness of the posterior leaflets was 5.3 ± 0.4 mm. The corresponding values in the subjects with non–classical prolapse were 2.9 ± 0.7 mm, 3.2 ± 0.4 mm, and 4.0 ± 0.5 mm.

Age and Sex

The range of age for all population was 18–70 years. The distribution of age and sex for the subjects with prolapse was similar to those without prolapse.

The sex adjusted mean (± SE) age of the patient with classic prolapse was 47.6 ± 1.6 years, as compared with a mean age 44.5 ± 1.7 years for those with non–classic prolapse and with 43.08 ± 0.3 years for those without prolapse (P= 0.18).

Table 2 indicates that among 74 subjects with mitral valve prolapse none had a history of heart failure nor atrial fibrillation, but one subject (1.3 percent) had cerebrovascular disease and two subjects (2.7 percent) had syncope, as compared with unadjusted prevalence of these findings on the group without prolapse of 0.0, 0.0, 0.0 and 0.09 percent, respectively.

Table 2: Prevalence of Various Clinical Findings According to the Presence or Absence of Mitral Valve Prolapse

Clinical Findings	Mitral Valve Prolapse (N= 74)	No Mitral Valve Prolapse(N=1090)
Atrial Fibrillation	0	0
Cerebrovascular Disease	1 (1.3%)	0
Syncope	2 (2.7%)	1(0.09%)
Heart Failure	0	0

It has been observed that subjects with classical prolapse had mild regurgitation (on average) in comparison to those with non–classical prolapse who had trace regurgitation.

Doppler study revealed that the mean (± SE) ratio of the jet area to the left atrial area was 14.9 ± 1.5 percent among subjects with classical mitral valve prolapse, 7.8 ± 1.9 percent among subjects with non–classical prolapse, and 2.2 ± 0.7 percent among 60 control subjects without prolapse, ($p < 0.001$).

The prevalence of palpitations, chest pain and dyspnea were similar among the patients with prolapse and those without prolapse as in Table 3.

The prevalence of risk factors for coronary heart disease, including smoking, hypertension, diabetes, and hypercholesterolemia are made clear in Table 3.

Table 3: Prevalence of Various Clinical Characteristics.

Characteristics	Classical MVP(N= 40)	Non–Classical MVP(N=34)	No MVP(N= 1090)	P–value
Chest Pain	4 (10%)	3 (8.8%)	95(8.7%)	N.S
Dyspnea	3 (7.5 %)	3 (8.8%)	80(7.3%)	N.S
Cigarette Smoking	7 (17.5%)	6 (17.6%)	110(10.09%)	N.S
Hypertension	6 (15%)	5 (14.7%)	150(13.8%)	N.S
Diabetes Mellitus	0	0	0	N.S
Hypercholesterolemia	5 (12.5%)	6 (17.6%)	140(12.8%)	N.S

–The P values are for comparing all subjects with MVP and those without prolapse.
–All percentages were adjusted for age, sex, and body mass index.

Physical Findings

Table 4 Show no significant differences between the two groups in systolic or diastolic blood pressure, but subjects with prolapse were significantly lower on the basis of body mass index and waist–to–hip ratio, in addition to having systolic murmur and mid–systolic clicks than those without prolapse.

Table 4: Physical Findings:

Variables	**Classic MVP (N= 40)**	**Non–Classic MVP (N = 34)**	**No MVP (N= 1090)**	**P– values***
Body–mass Index **	23.3 ± 0.3	23.1± 0.1	26.1± 0.2	< 0.001
Waist–to–hip Ratio **	0.8 ± 0.11	0.79 ± 0.01	0.89 ± 0.001	0.007
Systolic Blood Pressure in mmHg ***	120 ± 1.3	120.1.2	123 ± 0.1	N.S
Diastolic Blood Pressure in mmHg	70 ± 0.1	70 ± 0.4	72 ± 0.2	N.S
Systolic Murmur ****	20 (50%)	16 (47%)	45 (4.1%)	< 0.001
Mid–systolic Click****	19 (47.5%)	11 (32%)	3 (0.3%)	< 0.001

* The P–values are for comparison of all subjects with MVP and those without MVP.
** Values were adjusted only for age and sex.
*** Values were adjusted only for age, sex and body–mass index.
**** All percentages were adjusted for age, sex and body–mass index.

E.C.G. Findings

Table 5 revealed that there were no significant differences between the two groups in the prevalence of E.C.G. abnormalities.

Table 5: Electrocardiographic Findings

Variables	**Classic MVP (N= 40)**	**Non–Classic MVP(N=34)**	**No MVP (N= 1090)**	**P–values****
Atrial Ectopy ****	3 (7.9 %)	1 (3.0 %)	15 (1.4%)	< 0.05
Ventricular Ectopy ****	1 (2.5%)	0	0	N.S
LeftAtrial**** Enlargement	0	0	0	N.S
Left Ventricular Enlargement****	0	0	0	N.S

* The P–values are for comparison of all subjects with MVP and those without MVP.
** All percentages were adjusted for age, sex and body–mass index.

DISCUSSION

Mitral valve prolapse has been described as the most common cardiac valvular abnormality in industrialized countries[22]. Previous studies showed large variations of prevalence ranging from 5% up to 35%[11–17], but the subjects had largely been volunteers[12,13,16], some were self–referred and some others were self–selected. In two studies[13,16], subjects were selected from large clinic or hospital practices. Such studies were subject to many contradictions and they did not reflect prevalence in general population. In addition, previous studies used old criteria for diagnosing MVP by M–mode echocardiography or less specific two–dimensional criteria (including displacement of the anterior mitral valve leaflets in the apical four chambers view) to diagnose mitral valve prolapse. But, new criteria as mentioned above has revealed marked reduction in the prevalence of mitral valve prolapse by several recent studies to be on the range of 2–4% in general population studies[27].

Our present study shows a prevalence of mitral valve prolapse by 6.3%, which is between the higher prevalence seen on many previous studies[11,12] and near the lower prevalence revealed by Framingham Heart Study[27], which is considered a community–based study and it is consistent with other studies[13].

Chest pain and dyspnea were similar in the group of subjects with mitral valve prolapse and those without prolapse and that is consistent with previous reports[23,26]. Moreover, as reported previously[11,14,15], in our study, subjects with prolapse were leaner (lower body–mass index and waist–to–hip ratio) than those without prolapse. Subjects with prolapse were more likely to have mitral regurgitation ($P<0.001$) although with mild average regurgitation.

In contrast to previous reports[6], we found that the rate of heart failure, atrial fibrillation were not different among subjects with mitral valve prolapse and those without prolapse. Also the rate of cerebrovascular disease and syncope was slightly significantly higher among the group of mitral valve prolapse. This relatively low prevalence of complications among subjects with prolapsed is consistent with those reported in some previous studies[28]. And this low prevalence and low risk of complications can be explained by the non–selective, non–referral population in our study. In addition, the low sensitivity of clicks and murmurs for prolapse may reflect the relatively mild nature of prolapse in the general population, as compared with referral–based series and as does the absence of significant differences in the prevalence of ventricular ectopy between those with prolapse and those without prolapse. This is consistent with previous findings that serious ventricular arrhythmias and sudden death are more likely in patients with severe mitral regurgitation and left ventricular dysfunctions[22].

Evaluation of the prevalence of mitral valve prolapse in the general population is important to define the magnitude of the condition and provides a basis for determining the validity of proposed associations. It also allows researchers to address whether prolapse occurs more frequently among patients with presumed complications, such as stroke, than it occurs among the general population. In addition, both prevalence and complication rates are important factors in balancing the potential risks and benefits of antibiotic prophylaxis against endocarditis[29].

CONCLUSION

The prevalence of mitral valve prolapse in adult Yemenis was 6.3 percent, which is similar to the results of other studies in different countries but with low prevalence of adverse sequelae in comparison to those studies.

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معدل شيوع تدلي الصمام الميترالي وعواقبه الضارة بين اليمنيين الاصحاء

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ملخص

الخلفية: ان تدلي الصمام الميترالي يعد أحد الامراض القلبية الشائعة وله مضاعفات متعددة.
الهدف: لقد تم اجراء الدراسة الحالية لتحديد معدل انتشار تدلي الصمام الميترالي وكذا معدل انتشار عواقبه الضارة بين اليمنيين الاصحاء.
الطرق: لقد قمنا بإجراء تخطيط صدى القلب ل ١١٦٤ شخصآ: منهم ٦١٥ اناث و٥٤٩ ذكور، تراوحت اعمارهم بين ١٨-٧٠ عام. يعرف تدلي الصمام الميترالي الكلاسيكي بانه يتمثل بإزاحة شفرتي الصمام ٢مم نحو الاذين الايسر وسمك الشفرتين خلال الانبساط البطيني لا يقل عن ٥مم. وعلى نحو اخر يعرف تدلي الصمام الميترالي غير الكلاسيكي بإزاحة شفرتي الصمام الميترالي ٢مم نحو الاذين الايسر ولكن بسمك الشفرتين اقل من ٥ مم.
النتائج: بينت الدراسة ان هناك ٧٤ شخصآ (٦,٣٪) لديهم تدلي في الصمام الميترالي، ٤٠ شخصآ (٣,٤٪) منهم يعانوا من تدلي كلاسيكي و٣٤ شخصآ (٢,٩٪) لديهم تدلي غير كلاسيكي. ولا يوجد من مرضى التدلي الميترالي من لديه تاريخ مرضي لقصور قلبي او رجفان اذيني ما عدى شخص واحد (١,٣٪) لديه تاريخ مرضي لسكته دماغيه ومريضين (٢,٧٪) لديهم تاريخ مرضي لإغماء، مقارنه بمعدل شيوع ما ذكر بين الاشخاص الذين لا يعانون من تدلي الصمام الميترالي ب ٠,٠، ٠,٠، ٠,٠ و١,٣٪ على التوالي. وقد كانت الاعراض المرضية مثل الآم الصدر وضيق التنفس وتغيرات التخطيط الكهربائي للقلب متساوي بين المجموعتين.
الخاتمة: خلصت الدراسة الى ان معدل انتشار تدلي الصمام الميترالي بين اليمنيين هو ٦,٣٪، ويتساوى ذلك مع نتائج لدراسات مماثله في دول مختلفة ولكن بمعدل شيوع اقل للعواقب الضارة مقارنه بتلك الدراسات.
مفتاح الكلمات: تدلي الصمام الميترالي، تخطيط صدى القلب، معدل انتشار.

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Coronary risk factors in Acute Coronary Syndrome Patients in Yemen

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ABSTRACT

Background: A comparative retrospective study has made to compare the distribution of risk factors and complications in acute coronary syndrome (ACS) patients and other cardiac patients.
Methods: Records of 768 patients from Sana'a city and other cardiac patients in Yemen. To assess the risk factors for acute coronary syndrome (ACS); age, hypertension, diabetes mellitus, hyperlipidemia, cigarette smoking and reported history and family history of coronary artery disease (CAD). To assess the complications such as heart failure, arrhythmias and cerebro-vascular accident (CVA).
Results: The mean age of acute coronary syndrome patients was significantly lower than other cardiac disease patients 56.8 year vs. 55.3 years; p= 0.007. History of hyperlipidemia was significantly higher acute coronary syndrome patients than other cardiac patients 49.2% vs. 38.3%; p=0.002. Reported history of coronary artery disease was also significantly higher among ACS patients. Hypertension, history of diabetes mellitus, cigarette smoking and reported family history of coronary artery disease were comparable among acute coronary syndrome patients and other cardiac patients. In-hospital complications: Cerebro-vascular accident was significantly higher among ACS patients than other cardiac patients 7.8 % vs. 4.4 %; p= 0.0001. Heart failure and arrhythmias rates were comparable. Wall motion abnormalities were comparable 79.2 vs. 73.2; p=0.51. While Ejection Fraction was lower in ACS patients than other cardiac patients 49.8.8% vs. 54.8; p=0.0001.
Conclusions: The mean age was higher among acute coronary syndrome patients. History of hyperlipidemia and history of coronary artery disease were higher among acute coronary syndrome patients. Cerebro-vascular accident rate was higher in acute coronary syndrome patients.
Keywords: Acute coronary syndrome, risk factors, Yemen.

INTRODUCTION

Acute Coronary Syndrome (ACS) is defined as a wide spectrum of conditions, ranging from silent ischemia and exertion-induced angina, through unstable angina, to **acute** myocardial infarction. Unstable angina occupies the centre of this spectrum, causing disability and risk greater than that of chronic stable angina but less than that of **acute** myocardial infarction (AMI). Coronary Artery Disease (CAD) is characterized by atherosclerosis in the coronary arteries. Coronary artery disease is a well-established major cause of death and disability in developed countries as well as in developing countries (1). Coronary artery disease (CAD) continues to be a leading cause of morbidity and mortality among adults in Europe and North America (2). Twelve million individuals in the USA and 143 million worldwide have coronary artery disease (3). Although cardiovascular mortality has been diminishing in all of Western Europe and North America for the past decades, it is still one of the major contributors to mortality, especially premature death (*4*).

Despite a recent decline in developed countries, both CAD mortality and the prevalence of CAD risk factors continue to rise rapidly in developing countries (5, *6*). Traditional risk factors for CAD are age, male sex, family history, diabetes mellitus (DM), dyslipidaemia, hypertension, obesity, and cigarette smoking. These risk factors are useful for assessment of each individual's cardiovascular risk (*7*). Many other risk factors for, however, have not fulfilled these criteria or are still under scientific scrutiny (8, 9). Several studies have shown classical risk factors partially explain the prevalence of CAD (10, 11 and 12). Differences geographical in and genetic factors lead to differences in the incidence of CAD worldwide (13, 14).

Geographical variations in CAD prevalence and risk factors have been reported both between and within countries (15). Evidence for this is so far conflicting. Many studies have examined risk factor profile for CAD among population. Results showed that there are differences in the prevalence of CAD and its risk factors at different geographical regions.

Objectives

(1) To estimate the prevalence of risk factors in acute coronary syndrome (ACS) patients versus other cardiac patients.
(2) To investigate the clinical presentation and complications among acute coronary syndrome and other cardiac patients.

METHODOLOGY

Study design: A comparative retrospective study design was employed for this study.

Population samples

This study was done for diagnosed adult acute coronary syndrome Yemeni patients aged 30-69 years.

Study Area

Sana'a city, Republic of Yemen.

Case Selection

We selected the acute coronary syndrome Yemeni Patients admitted to cardiac centre, Al-Thawrah Modern hospital, Sana'a, Yemen. Records of consecutive patients were received respectively.

Inclusion Criteria

Age 30 – 69 years and diagnosed as acute coronary syndrome (clinical symptoms and / or ECG and /or significant cardiac enzyme elevation).

Exclusion Criteria

Including Congenital heart disease, rheumatic heart disease and, chronic obstructive pulmonary disease, chronic medical illness (e.g. end stage liver /renal failure), and malignancies.

Sample Size

A total of 768 acute coronary syndrome and other cardiac disease admitted in cardiac centre, Al-Thawrah Modern hospital, Sana'a were studied. Some384 patients were from acute coronary syndrome (ACS) patients and equal number with other cardiac dieses.

Study Protocol

The following data were collected:

1. Clinical presentation: - Typical chest pain, atypical chest pain and shortness of breath

2. Type of ACS: -AMI including Q wave MI, Non Q wave MI and unstable angina.

3. Clinical examination: - Clinical examination findings especially blood pressure (BP), heart rate (HR) and cardio vascular system.

Reported history of coronary artery disease risk factors including hypertension, diabetes mellitus, smoking cigarette, lipid profile disturbance and history of CAD were collected.

4. Laboratory investigations and procedures: -

4.1. Laboratory investigations: -Definitions: -

Diabetes mellitus

The fasting blood glucose (FBG) was interpreted using WHO criteria: (<7 mmol l-1(<120 mg/ dl): negative for diabetes mellitus and >7 mmol l-1: (>120): positive for diabetes mellitus.

Hypercholesterolemia

Defined as mild cholesterol values between 5.2 – 6.2 mmol/l. Moderate-sever cholesterol values >6.2 mmol/l and consider a major risk factor for CAD while HDL greater than 1.6 mmol/l was consider a negative risk factor for CAD. Total cholesterol/HDL ratio values between 5 was normal and 6.5 characterized the individual at intermediate risk for CAD and more than 6,5 wile values ratio more than 6.5 characterized individuals at high risk of developing CAD (36). Laboratory investigations needed were CBC, total cholesterol, HDL-C, LDL-C, Triglycerides, FBG, RBG, CK and CK-MB.

4.2. ECG: - ECG reports at the day of admission and at the discharge day. ST elevation with or without Q wave, Q wave, T wave changes, R wave changes and arrhythmias

4.3. Echocardiography: -Measurement of intact are LV function (EF), any segmental wall motion abnormalities (hypokinesia, akinesia, or dyskinesia) and detection of any complications of ACS such as thrombus, aneurysmal formation, and valvular abnormalities.

Statistical Analysis: -Data were entered in a personal computer, processed by SPSS program to calculate percentages, mean ± standard deviation. The (two-tailed) test was used to assess the difference between continuous variables. Chi Squared (χ^2) tests will be used to compare categorical variables. The Odds ratio was calculated. We set the level of the statistical significance at a P value of < 0.05. Statistical tests with P < 0.10 and > 0.05 will be considered to be of borderline significance.

RESULTS

Data from seven hundred sixty eight consecutive patients were analyzed.

1-Age and Clinical diagnosis:

The mean age of ACS patients was significantly higher than other cardiac diseases 56.8 year vs. 55.3 years, *P*= 0.007 (Table 1).

Acute myocardial infarction (AMI) at ACS patients was higher 76.8 % vs. 72.1 % as well as unstable angina 27.9 % vs. 25.5% respectively (Table 2).

Table 1: Patient's characteristic age, blood pressure and heart rate among ACS patients and other cardiac patients (No=768).

Patients		***№***	***Mean***	***Std. Deviation***	***T***	***p***
Age year	ACS	384	55.3	8.24	2.72	0.007
	Other	384	56.8	7.14	2.50	
Systolic BP mmHg	ACS	384	135	24.95	2.50	0.013
	Other	384	130	23.23		
Diastolic BP mmHg	ACS	384	84	16.71	2.62	0.009
	Other	384	81	17.71		
Heart Rate Beat/min	ACS	384	89	17.55	4.73	< 0.0001
	Other	384	83	16.89		

Table 2: Shows the diagnosis of ACS Yemeni patients and other cardiac disease (No=768).

Altitude	***Diagnosis***				***Total***	
	Acute MI		Unstable Angina		**№**	**%**
	№	percent	№	percent		
ACS patients	295	76.8 %	89	27.9 %	384	100 %
Other Cardiac patients	277	72.1 %	107	23.2 %	384	100 %

Chi- sq 2.2, P value 0.136

2. Clinical presentation:

Heart rate of ACS patients was significantly other cardiac patients 89.13% vs. 83.25%; *P*=0.000 (Table 1).

Measurement of blood pressure; Systolic blood pressure among ACS patients was significantly higher than other cardiac patients 130mmHg vs. 135mmHg (P=0.013). Diastolic blood pressure was also significantly higher among ACS patients 84 mmHg vs. 81mmHg; P= 0.009 (Table 1).

3. Prevalence of history of coronary artery disease risk factors:

The prevalence of history of hyperlipidemia was significantly higher in ACS patients than other cardiac patients 49.2% vs. 38.3%; p =0.002 (table 3). Prevalence of reported history of CAD was significantly higher among ACS patients 16.7% vs. 9.4%; p=0.003 (Table 3).

The prevalence of history of hypertension among ACS Yemeni patients was higher than other cardiac patients 49.2% vs. 45.1%; p=0.49 (table 3).

Prevalence of history of DM was also higher among ACS patients 30.7% vs. 25.3%; p=0.091 (Table 3).

Prevalence of smoking among ACS patients was also higher than other cardiac patients 64.1% vs. 57.8%; p =0.076 (Table 3).

Reported family history of CAD among ACS patients was non significantly higher 17.2% vs. 15.4%, p =0.49 (Table 3).

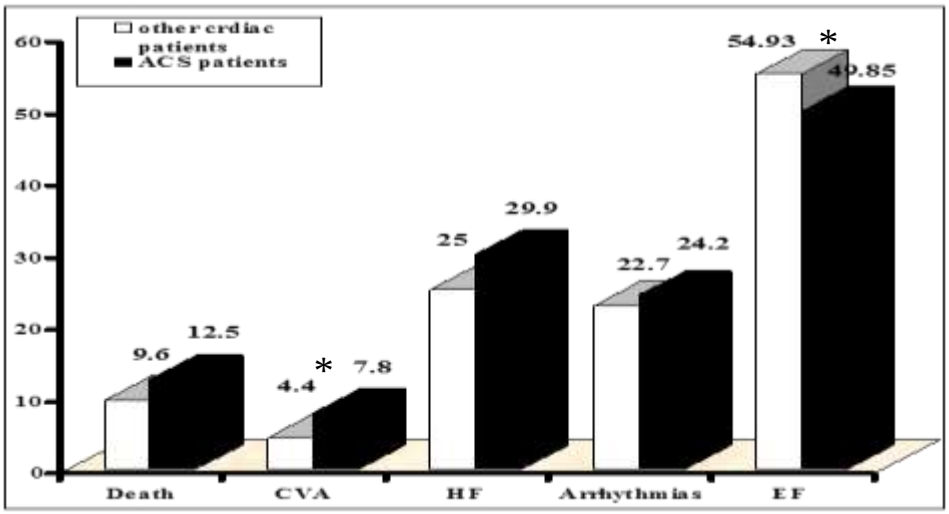
Table 3: Prevalence of risk factors for ACS.

Altitude	History of HT	History of DM	History of smoking	History of CAD	Family History of CAD	History of hyperlipedaemia
ACS patients	49.2 %	30.7%	64.1%	16.7%	17.2%	49.2%
Other cardiac patients	45.1%	25.3%	57.8%	9.4%	15.4%	38.3%
Chi-squire	133	2.8	3.15	9.01	0.46	9.3
P	0.247	0.091	0.076	0.003	0.494	0.002

4. In-hospital complications of ACS Yemeni patients and other cardiac patients:

In-hospital complication: Cerebro-vascular accidents (CVA) was significantly higher among ACS patients 7.8 % vs. 4.4 %; P= 0.0001. Heart failure and arrhythmias were slightlyhigher among ACS patients than other cardiac patients (Figure 1),

Wall motion abnormalities detected by echocardiography was higher among ACS patients 79.2 vs. 73.2; P=0.51 (table 4). While EF was lower among ACS patients 49.8.8% vs. 54.8 P=0.0001 (Figure 1).



* Significant difference (Chi-sq = 3.830 *P*= 0.050)

Figure 1: Shows in-hospital complications among ACS Yemeni patients and other cardiac patients (N=867).

Table 4: Wall motion abnormalities detected by echocardiography in ACS Yemeni patients and other cardiac patients (N=768)

Altitude	***IHD***				***Total***	
	Yes		No		***№***	***%***
	№	percent	**№**	percent		
ACS patients	304	79.2 %	80	20.8 %	384	100 %
Other cardiac patients	281	73.2 %	103	26.8%	384	100 %

Chi-sq 3.79 P value 0.51

5. Laboratory findings:

Biochemical findings

Creatinine Kinase (CK) among ACS patients was significantly higher than other cardiac patients as well as CK-MB (table 5). Total Cholesterol in ACS patients was significantly higher in ACS patients than other cardiac patients. LDL-C was high in ACS patients 136.3mg/dl vs. 128.5mg/dl, while HDL-C was higher in other cardiac patients 44.2mg/dl vs. 40.1mg/dl (table 5). Triglycerides (TG) were higher in ACS patients than in other cardiac patients 205.8mg/dl 184.04mg/dl P=<0.0001 (table 6). Fasting and random blood sugar were significantly higher among ACS patients than in other cardiac patients, P=0.000 (Table 5).

Table 5: Biochemical findings finding among ACS patients

Patients		***N***	***Mean***	***Std. Deviation***	***T***	***P***
LDL-C	ACS	384	136.36	33.265	3.363	0.001
	Other	384	128.53	31.251		
HDL-C	ACS	384	40.10	9.467	5.852	0.000
	Other	384	44.20	9.950		
TG	ACS	384	205.82	71.160	4.988	0.000
	Other	384	184.04	47.481		
FBG	ACS	384	116.04	48.63	3.77	0.000
	Other	384	103.99	39.320		
RBG	ACS	384	161.3	80.18	2.84	0.005
	Other	384	146.2	65.9		

DISCUSSION

Our study was performed on 768 ACS Yemeni patients. There age range was 30 - 69 years with a mean age 56.1 ± 7.7 years.

Our results reveal that the mean age of ACS Yemeni patients was lower than all previous reports in developed countries such as in ACS European patients 65 years (37).

The mean age was similar to those of ACS Saudi patients which was 57 years (38). The mean age of other cardiac diseases patients was significantly higher 56.8 year vs. 55.3 years; P= 0.007. Our ACS Yemeni patients' age is comparable with the mean age of life expectancy at birth 59.8 (39).

Past history of DM among ACS Yemeni patients was slightly higher than other cardiac patients. Blood glucose levels (fasting and random blood glucose) were significantly higher among ACS patients; P<0.0001. The prevalence of history of DM among ACS patients is 28%. This prevalence is higher than the prevalence of DM in general adult Yemeni population which is 9.75 % (40). However our diabetic prevalence is higher than those reported by the major European survey among European ACS patients which was 23% (37). Diabetes increases the risks of cerebrovascular disease, peripheral vascular disease, and congestive heart failure (41). Diabetes and its associated metabolic abnormalities favor an imbalance in the coagulation/fibrinolytic systems that support clot formation and stability (42). These various abnormalities may contribute to heightened susceptibility to the thrombotic complications of atherosclerosis.

The prevalence of hyperlipidaemia among ACS Yemeni patients was significantly higher than other cardiac patients. Total cholesterol and LDL-C in ACS Yemeni patients were significantly higher. Our result agrees with some other studies (22, 33, and 35). Epidemiological studies showed that elevated concentrations of serum total cholesterol and LDL-cholesterol are independent risk factors for CVD (43). There is much evidence to suggest that the process of atheroma is triggered by hyperlipidaemia, with deposition of lipids in the arterial wall. Various scientific organizations, including the American Heart

Association, National Heart, Lung, and Blood Institute have recommended reductions in dietary total fat and saturated fat intake to treat or prevent CAD (44).

The prevalence of hypertension in general adult Yemeni population is 17.1 % (40). The prevalence of past history of hypertension among ACS Yemeni patients is comparable with other cardiac diseases patients 47.1. Measurement of systolic and diastolic blood pressure was significantly higher among ACS patients. The prevalence of hypertension among ACS patients in Europe was 48% (37). While the prevalence of hypertension among ACS Saudi patients was 46.9% (21). Hypertension is a strong independent risk factor for the development of cardiovascular disease. In primary prevention, the relationship between blood pressure and cardiovascular risk appears to be positive (45).

Heart rate of ACS Yemeni patients was significantly higher

The prevalence of smoking among ACS Yemeni patients was comparable 64.1% vs. 57.8 %. Our rate of smoking was comparable to the other developing countries. Prevalence of smoking among ACS Yemeni patients was76.9% (1), while the prevalence of smoking among ACS European ACS patients was lower 48 %(37).

Smoking affects atherothrombosis by several mechanisms. In addition to accelerating atherosclerotic progression (46). Long-term smoking may enhance oxidation of LDL-C and reduce levels of HDL-C (47). Smoking also impairs endothelium-dependent coronary artery vasodilatation; has multiple adverse hemostatic effects (48).

Reported family history and history of CAD at high altitude were higher than at low altitude ACS patients. A family history of CAD is an independent risk factor for MI, and that the number of relatives and the age at which they were affected is related to the strength of the association. There is a multiplicative effect on relative risk factors between family histories (49).

Hemoglobin was significantly higher among ACS patients. The increase in hemoglobin leads to increased atherosclerotic process. Leukocytes were significantly higher among high altitude patients. In men and women of all ages with the spectrum of ACS, initial leukocyte count is an independent predictor of hospital death and the development of heart failure (50).

The prevalence of ACS complications during hospitalization; Cerebro-vascular accident was significantly more common among ACS patties, while death, HF, and arrhythmias were comparable between ACS patients and non ACS patients.

The presence of wall motion abnormalities detected by echocardiography (hypokinesia, akinesia, and dyskinesia) was significantly higher at ACS patients than non ACS patients.

Ejection fraction (EF) was significantly lower among ACS patients. The Ejection fraction increases when the necrosis parts of the heart are less. So we hypothesize that ACS patients have more necrosis in heart muscle than non ACS patients.

CONCLUSION

The mean age was higher among other cardiac patients than ACS patients in Yemen. History of hyperlipidemia and history of CAD were higher among ACS patients than other cardiac patients. In-hospital complications; A Cerebro-vascular accident (CVA) rate was higher among ACS patients, while heart failure (HF) and arrhythmias were comparable between ACS and other cardiac patients. Ejection fraction was lower among ACS patients than other cardiac patients in Yemen.

ABBREVIATIONS

ACS; acute coronary syndromes, BP; blood pressure, CAD; coronary artery disease, CK; creatine kinase, CK-MB; creatine kinase –MB iso-inzyme, DM; diabetes mellitus, ECG; electrocardiography, EF; ejection fraction, FBG; fasting blood glucose, HA; high altitude, Hb; hemoglobin, HDL; high-density lipoprotein, HF; heart failure, HT; hypertension, IHD; ischemic heart disease, LA; low altitude, LDL; low-density lipoprotein, MI; myocardial infarction, NonQMI; none Q wave myocardial infarction, QMI; Q wave myocardial infarction, RBG; random blood glucose, T.G; triglycerides.

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عوامل الخطورة لمرضى متلازمة الشريان التاجي الحادة في اليمن

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ملخص

خلفية: لقد أجريت الدراسة (استعادية المقارنة) لمقارنة توزيع عوامل الخطر والمضاعفات لدى مرضى متلازمة الشريان التاجي الحادة في اليمن.

الطرق: تمت دراسة سجلات 768 مريضا من مدينة صنعاء ومقارنتهم بأشخاص ليس لديهم المرض. لتقييم عوامل الخطر لمتلازمة الشريان التاجي الحادة؛ العمر، وارتفاع ضغط الدم وداء السكري، وفرط الكولسترول والدهون بالدم، وتدخين السجائر وذكرت التاريخ والعائلة تاريخ من أمراض الشريان التاجي. وكذلك لتقييم المضاعفات للمرض مثل فشل القلب، وعدم انتظام ضربات القلب، والإصابات الأوعية الدموية الدماغية.

النتائج: كان متوسط عمر المرضى متلازمة الشريان التاجي الحادة أقل منه لدى غير المرضى 55.3 سنة مقابل 56.8 سنة (ع = 0.007). كان الكولسترول والدهون أعلى بكثير لدى مرضى متلازمة الشريان التاجي مقارنة بغير المرضى 49.2٪ مقابل 38.3٪ (ع = 0.002). كان الضغط الدموي أعلى لدى مرضى متلازمة الشرايين التاجية، وكذلك مرض السكري. تدخين السجائر كان أعلى قليلا لدى مرضى متلازمة الشرايين التاجية عنه لدى غير المرضى التاجي وضعها الطبيعي.

المضاعفات: كانت الإصابات الدماغية الوعائية أعلى بكثير بين مرضى متلازمة الشرايين التاجية الحادة منه لدى غير المرضى 7.8% مقابل 4.4% (ع=0.0001). كان قصور القلب وعدم انتظام ضربات القلب أعلى لدى مرضى الشرايين التاجية الحاد مقارنة بغير المرضى بالمتلازمة الحادة 79.2% مقابل 73.2% (ع=0.51). معدل الضخ القلبي كان أقل لدى متلازمة مرضى الشرايين التاجية الحاد 49.8% مقابل 54.8% لدى غير المرضى بالمتلازمة.

الاستنتاجات: كان متوسط العمر أقل بين المرضى الذين يعانون متلازمة الشريان التاجي الحادة. كان ارتفاع الدهون والكولسترول اعلي لدى مرضى الشرايين التاجية. القصة العائلية للإصابة بمتلازمة الشرايين التاجية كانت اعلي لدى مرضى المتلازمة مقارنة بغير المرضى. الإصابات الوعائية الدماغية واضطراب نظم القلب كانتا اعلي لدى مرضى الشرايين الحادة مقارنة بغير المرضى بمتلازمة الشرايين التاجية الحادة.

كلمات مفتاحية: متلازمة الشريان التاجي الحادة، عوامل الخطر، اليمن.

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Malignant Hypertension in the Al-Thawarah Hospital-Sana'a

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ABSTRACT

Background: Malignant hypertension (MHTN) is characterized by very high blood pressure (BP), and organ damage. It is a complication of uncontrolled hypertension. Malignant hypertension requires immediate treatment and admission to the hospital to manage and control the high elevation of the blood pressure. Systemic hypertension is increasing in our society in recent years due to the changes in the lifestyle of the Yemenis and chewing Khat in large scale in most governments than before. Hypertension is a silent disease in which the majority of patients do not have symptoms. Lack of early detection, proper management of hypertension, routine medical check up and awareness of the society, lead to the malignant hypertension and its end organ damage.

Aim of the study: To study the clinical presentation and complications of the malignant hypertension in patients admitted to the cardiac centre at Al thawrah hospital (TMGH), Sanaa in one year time (May 2009-May 2010)

Method of the study: Descriptive Study including all patients admitted to the cardiac centre at TMGH, Sanaa with a diagnosis of MHTN between May 2009-May 2010.

Results: 16 cases were reported, with a mean age of 54.7± 7.8 years. 65.3% of them were male. A 62.5% (10 patients) discovered to have HTN on admission, and 37.5 % (6 patients) were presented with history of hypertension, only 2 of them (12.5%) were on antihypertension medication but with improper doses and 25% (4 patients) refused to take medications. The measurement of the systolic BP on admission showed 81.2% (13 cases) had systolic BP between 180-200 mmHg ,12.5% (2cases) were between 210-220 mmHg and 6.25%(1case) the reading was 240mmHg , 50% (8 patients) had a diastolic BP of 130 mmHg, 25% (4 cases) had >130mmHg and 18.7% (3 cases) was <130mmHg.

Conclusion: Malignant hypertension in Yemen presented with

high morbidity. This can be explained by an inadequate drug therapy, poor adherence and follow up, khat chewing, lack of society awareness and poverty. These findings emphasise the importance of early detection, patient education, proper treatment and close follow up of hypertensive patients.
Keywords: Malignant hypertension, Thamar university, Khat chewing.

INTRODUCTION

Hypertension (HTN) is a major risk factor for the development of cardiovascular diseases. It is associated with a high mortality all over the world. Hypertension still a major health problem worldwide. Each year, 7.1 million deaths in the world are attributed to HTN [1, 2]. Despite the advances in drug therapy, guidelines in management of hypertension, evidence-based data which provide better management of HTN that reduce the incidence of cardiovascular events; the control of hypertension in the United States and throughout the world has been grossly inadequate [3]. Severe HTN can lead to life-threatening complications that are usually considered hypertensive crisis. This is a serious condition which is associated with end-organ damage or may result in end-organ damage if left untreated. Prompt and rapid reduction of blood pressure is essential in patients who have acute end-organ damage [4].

The term hypertensive emergency is defined as severe HTN or a sudden increase in blood pressure with evidence of acute injury to target organs (i.e., cardiovascular, renal, and central nervous system).It implies the need for hospitalization to immediately lower blood pressure with parenteral therapy, in order to protect vital organs function [5]. Delay in treatment may cause irreversible organ damage and death [6].

The primary goal of intervention in a hypertensive crisis is to safely reduce BP. Immediate reduction in BP is required only in patients with acute end-organ damage (i.e. hypertensive emergency) which are best treated in an intensive care unit. Hypertensive emergencies frequently present with chest pain, dyspnea and neurological deficit, end-organ damage include cerebral infarction, acute pulmonary edema and hypertensive encephalopathy, as well as cerebral hemorrhage. The most important factor that limits morbidity and mortality from these disorders is prompt and carefully considered therapy [7]

It has been estimated that approximately 1% of patients may develop a hypertensive crisis during their lives[8]. The annual incidence of hypertensive emergencies being about 1-2 cases per 100000 patients [9]. Significantly higher rates have been recently reported in ethnic minorities (i.e., African Americans) and in low socio-economic states as well as in developing countries[10,11]. In the other hand the treatment of HTN has shown marked improvement and better control that reduces its complications mainly in developed countries[12].

METHODS

The study was a descriptive study; all patients admitted to the Cardiac centre at TMGH, Sanaa, with the diagnosis of malignant hypertension were enrolled during the period from May 2009 to May 2010.

Severe hypertension associated with; papilledema, exudates with or without haemorrhage. Patients with hypertensive encephalopathy, secondary malignant

hypertension, hypertension with cardiac disease and hypertension with kidney disease were included.

The study was built on the different age groups, both genders, patients presented with severe hypertension, previous history of hypertension with or without past drug history. Height, weight and BMI were measured, BP was taken on admission and then serially and fundoscopy was performed to all patients on admission. Drugs on admission and during hospital stay as well as investigations and the outcome were included.

RESULTS

16 cases were enrolled, with a mean age of 55 ± 8 years. 65% of them were males. 62.5% (10 patients) were discovered to have HTN for the first time on admission, and 37.5 % (6 patients) had a previous history of hypertension prior to admission. Among these 6 patients only 12.5% (2 patients) used to have antihypertensive medication but with improper doses. The other 25% (4 patients) refused to take their prescribed medications.

Forty four percent [44%] (7 patients) presented with pulmonary oedema, 37.5% (6 patients) with myocardial infarction, 18.8% (3 patients) with renal failure, 12.5% (2 patients) with hemiplegia and one patient presented in coma.

75% (12 patients) of our patients were khat chewers, and 50% (8 patients) were active smoker. BMI measurement was taken for all patients. 25% (4 cases) had a BMI less than 20; 37.5% (6 cases) between 21-25 and 37.5% (6 cases) had a BMI above 25. No one of our patients was obese.

The measurement of the systolic BP on admission showed 81.2% (13 cases) had systolic BP between 180-200 mmHg, 12.5% (2 cases) systolic BP was between 210-220 mmHg and 6.25% (1 case) the reading was 240mmHg. The diastolic BP was 130mmHg in 50% (8 patients), more than 130mmHg in 25% (4 cases) and less than 130mmHg in 18.7% (3 patients).

Fundus examination revealed grade IV retinopathy changes in 68.7% (11 patients), and 31.25% (5 patients) had grade III changes. Left ventricular hypertrophy was found in 56.2% of patients by ECG and in all patients (100%) by Echocardiography.

Intravenous antihypertensive drugs was given for 93.7% (15 patients), 43.75% (7 patients) had nitro-glycerine infusion, 18.7% (3 patients) nitroprusside and 31.25% (5 patients) had taken both. A 93.7% of the patients (15 patients) received angiotensin converting enzyme inhibitors (ACEI) on admission. B-blocker (BB) was given to 50% (8 patients), and Ca channel blocker (CCB) was given to 2 patients only (12.5%). BB and CCB were used in addition to ACEI (Table 1).

During the first 24 hours after admission and institution of antihypertensive medications, 43.7 % had a systolic BP <140mmHg, 31.2% 140 mmHg and 25% between 150-170mmHg Diastolic BP in the first 24 hours was 90 mmHg in 50% of them, 80 mmHg in 18.7%, 70mmHg in 12.5%, 100 mmHg in 12.5% and 6.25% had a diastolic BP of 120 mmHg.

The hospital course showed that 50% (8 patients) complicated with heart failure, 18.8% (3 patients) had CVA, 18.8% (3 patients) had pulmonary oedema and only 12.5% (2 cases) had no complications. One of the CVA patients died in the hospital representing 6.3% in-hospital mortality.

Table 1: In-Hospital Medications.

Sodium Nitrprusside	50 % (8 pts)
Nitroglycerine	75% (12 pts)
Lasix	75% (12 pts)
ACEI	93.8% (15 pts)
Calcium Channel Blocker	18.8% (3 pts)
B-Blockers	43.8 % (7 pts)
Spirinolactone	6.3% (1 pts)

DISCUSSION

Systemic HTN is one of the common cardiovascular diseases in Yemen. Modernization and changing of the lifestyle of the Yemenis in recent years lead to increase prevalence of the HTN. Diet has been changed to be more unhealthy, fatty and salty food. Overweight, lack of physical activity and tension are among the other factors, which contributed to the increase prevalence of HTN. Khat chewing, an herb with sympathomimetic action, had been reported to increase heart rate and systemic hypertension [13]. This increase of BP and heart rate was concomitant with the level of the main gradient of khat leaves, the cathinone, in the blood [14]. Khat chewing not only increases BP but also leads to difficulty in controlling BP and it is a risk factor for cerebral hemorrhage [15]

There is a poor awareness in the society about the problem of HTN and its complications. The lack of routine medical checkup and medical services in the rural areas make HTN (the silent killer) under diagnosed and poorly managed. HTN discovered mainly in the medical clinics via BP measurement by the BP devices. Many hypertensive patients live with high BP without symptoms and without management and they present to the hospital with complications. Furthermore, some patients with diagnosed high BP are not adherent to the prescribed drugs and the instructions of their physicians for better BP control. Non-adherence to medication was reported to be the most important factor associated with hypertensive crisis [16].

Table (2) show the characteristics of our patients where the majority of them (62.5%) were discovered to have HTN for the first time and were not taking any drugs for their HTN. Among those who knew that they are hypertensive 12.5% (2 patients) refuse to take the antihypertensive therapy,12.5% (2 cases) stopped the antihypertensive drugs perhaps they believe that they are well as long as they do not have any symptoms, and 18.75% (3 patients) were taking antihypertensive drugs with an inadequate dose to control their high BP. Therefore, 81.3% of our patients were not taking any drugs for their severe HTN and 18.8% had inadequate therapy. As a result, 87.5% (14 patients out of 16) had complications (table 3). Uncontrolled HTN had been reported in patients with hypertensive urgency where the high BP without end organ damage was associated with an increase risk for subsequent cardiovascular events[17].

Despite the simplicity of diagnosis of malignant HTN, it still a common medical problem in particular in the developing countries where the hypertensive population is growing and patients present with clinical symptoms only at a late stage with the development of irreversible end organ damage[18].

Malignant HTN should be considered by the clinician as a sequel to various forms of benign HTN if not managed properly. Therefore early detection, proper hypertensive management, antihypertensive campaign, hypertensive clinics and close medical follow up may reduce the prevalence of malignant HTN.

Table 2: Baseline Characteristics of the malignant HTN patients.

Mean age	54.7± 7.8 years
Male	65.3%
Hx of HTN	37.5% (6 patient)
HTN discovered on admission	54.3% (9 patient)
Family Hx	12.5% (2 patients)
MI	37.5% (6 patients)
Pulmonary oedema	43.8% (7 patients)
CVA	18.8% (3 patients)
BMI;	
Overweight ≥25	50% (8 patients)
Normal weight ≤ 24.9	50% (8 patients)
Khat chewing	75% (12 patients)
Smoking	50% (8 patients)
1st Systolic BP;	
180-199	56.25%
200-240	43.75%
1st diastolic BP;	
>130	31.25%
100-130	68.75%

Table 3: Complications & in-hospital course.

Impaired Creatinine	31.3 % (5 patients)
Heart Failure	43.8 % (7 patients)
Pulmonary oedema	25.0% (4 patients)
EF < 50%	37.5% (6 patients)
CVA	18.8% (3 patients)
LVH	43.8% (7 pts)
Eye ;	
Papillae Oedema	75% (12 pts)
Flame shape Hge	18.8% (3 pts)
Exudates	6.3 % (1 pts)

Limitations of the study

The study done only on the patients admitted to ICU of cardiac center in AlThawra General Hospital and not involved patients those who may admitted to other ICUs in the hospital or other hospitals.

CONCLUSION AND RECOMMENDATIONS

Malignant HTN is a serious medical problem, which needs immediate and proper therapy to avoid its serious complications. Improving society awareness about the disease, change in patient's lifestyle including stopping khat chewing, routine checkup, early detection and proper management of the systemic HTN are the best ways to prevent malignant HTN and its complications.

We recommend the-health authorities to establish an educational programs about HTN that encourage regular routine BP chick up for every person above 18 years old.

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ارتفاع الضغط الشرياني الخبيث عند المرضى الذين تم ادخالهم الى مستشفى الثوره العام بصنعاء

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ملخص

ضغط الدم الشرياني الخبيث يتميز بارتفاع شديد في ضغط الدم الشرياني ال\اي يسبب اعطاب او اصابه لبعض الاعضاء الهامه في جسم الانسان ، وهو يعتبر مضاعفات لارتفاع ضغط الدم الشرياني الذي لا يتم معالجته وضبطه الى المعدل الطبيعي.

ضغط الدم الشرياني الخبيث يحتاج الى ادخال المريض الى العناية المركزه بالمستشفى والى المعالجات السريعة والمباشرة وبدون تأخير لكي يتم ضبطه بشكل سريع ومن ثم تقليل اثاره ومضاعفاته على بقيه الاعضاء في الجسم.

حديثا هناك تزايد في حالات ارتفاع الضغط الشرياني في مجتمعنا ودلك بسبب التغيرات في نمط الحياة لدى المجتمع اليمني وكذلك بسبب زيادة تعاطي القات بشكل واسع في معظم محافظات الجمهوريه.

ارتفاع ضغط الدم الشرياني يعتبر القاتل الصامت لان كثير من المرضى لا يشعرون بأي اعراض له وكذلك لعدم فحص ضغط الدم لجميع المرضى الدين يزورون الاطباء ومن ثم عدم التشخيص المبكر والمعالجة المناسبة للمرض مما يؤدي الى حدوث خالات ارتفاع ضغط الدم الشرياني الخبيث.

هدف الدراسة: تهدف الدراسة الى معرفه الملامح السريريه والمضاعفات للضغط الشرياني الخبيث لدى المرضى الدين يتم ادخالهم الى العناية المركزه بمركز القلب بمستشفى الثوره بصنعاء حلال الفترة من (2009-2010).

طريقه عمل الدراسة: هي دراسة وصفيه تضم كل المرضى الدين يتم ادخالهم الى العناية المركزه بمركز القلب بمستشفى الثوره بصنعاء وتم تشخيصهم على ان لديهم ارتفاع ضغط الدم الشرياني.

نتائج الدراسة: ستة عشر حاله تم دراستها وبمتوسط عمر 55_+8 سنه. 62.5% منهم كانوا ذكور ، و 62.5% (10 حالات) تم اكتشاف ارتفاع الضغط الشرياني لديهم عند ادخالهم للمستشفى فقط ، 37.5% (6 حالات) كان لديهم تاريخ مرضي سابق بارتفاع ضغط الدم ، وحالتين منهم فقط (12.5%) كانوا يستخدمون علاجات للضغط ولكن بجرعات غير مناسبة او غير كافيه ، و 25% (4 حالات) كانوا يرفضون استخدام العلاج بالرغم من تشخيصهم سابقا بان لديهم ارتفاع في ضغط الدم الشرياني.

اظهر قياس ضغط الدم الشرياني الانقباضي للمرضى عند دخولهم للعناية ان 81.25% (13 حاله) كان لديهم ضغط الدم الانقباضي ما بين 180— 200 مم زئبقي ، و12.5% (حالتين) كان بين 210—220 مم زئبقي ، و6.25% (حاله واحده) كان 240 مم زئبقي. 50% (8 حالات) كان الضغط الانبساطي لديهم 130 مم زئبقي و 25% (4 خالات) كان عندهم الضغط الانبساطي اكثر من 130 مم زئبقي و 18.75% (3 حالات) كان اقل من 130 مم زئبقي.

الاستنتاج: تظهر الاصابه بارتفاع الضغط الشرياني الخبيث في اليمن بنسبه عاليه وهدا يمكن تفسيره بعدم المعالجه الدوائية الكافيه لمرضى ارتفاع الضغط الشرياني وبعدم المتابعه الطبية المنتظمة وتجاوب المرضى لاستخدام العلاج بصوره صحيحة ومنتظمة.

هده النتائج تشدد على ضرورة الاكتشاف المبكر لارتفاع الضغط الشرياني عند المرضى ، وأيضا ضرورة عمل برامج تثقيفية وتوعيه عن المرض وإخطاره وطرق المعالجه المناسبة والمتابعة الطبية المنتظمة لمرضى ضغط الدم الشرياني.

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Case Study

Rare Presentation of Rectal Carcinoma in a Yamani Patient

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ABSTRACT

Carcinoma of the rectum often presents as painless bleeding per rectum, abdominal discomfort and rarely as intestinal obstruction or bowel perforation. The studied case was presented with large perianal fistula and signs of intestinal obstruction.
Keywords: Adenocarcinoma, Rectum, Perineal fistula.

INTRODUCTION

Overall, colorectal cancer is the second most common malignancy in western countries; the rectum is the most frequent site involved.

Carcinoma of the rectum can occur early in life, but the age of presentation is usually above 55 years, when the incidence rises rapidly.

Bleeding is the earliest and most common symptom, tenesmus; alteration in bowel habit is the next most frequent symptom[1].

Rectal cancer is more common in men, with women having a higher incidence of more proximal cancers[2].

Colorectal cancer occurs in hereditary, sporadic, or familial forms. Hereditary forms characterized by family history, young age at onset, and the presence of other specific tumors and defects. Familial adenomatous polyposis (FAP) and hereditary non-polyposis colorectal cancer (HNPCC) have been the subject of many recent investigations that have provided significant insights into the pathogenesis of colorectal cancer.

Sporadic colorectal cancer occurs in the absence of family history[3]. The most common histological type is adenocarcinoma. Other rare variants of epithelial tumors include squamous cell carcinomas, adenosquamous carcinoma (adenoacanthoma), undifferentiated carcinomas, small cell, and neuroendocrine cancers[4].

There are four types of possible tumor differentiation: well, moderately,poorly and undifferentiated tumours[5].

The incidences of colon and rectum cancer in the Arab world are relatively low[6].

In Yemen, the frequency of colorectal cancer according to prospective study worked at oncology unit Al-Gumhoria teaching hospital, Aden, Yemen, was studied over a period of 12 months (January to December 2008) was 50 case, 34% were female and 68% were male, the main age at presentation was 48 years for female and 56 years for male.

Abdominal pain was (70%), bleeding per rectum was (50%) were the main presenting complaint the most common site was rectum 34 % and the most common histological type was adenocarcinoma 82% and the most patient came in third and fourth stage of tumour[7].

Metastasis from rectal adenocarcinoma can occur by lymphatic, haematogenous, direct or peritoneal spread. The most common sites of colorectal metastasis are the liver and lung[8].

Involvement of the skin and skeletal muscles are quite rare and occur in 4% of all patients with

diagnosis of rectal cancer[9].

CASE

A 70 year old male patient presented to Al-wahda Teaching Hospital of Thamar University; with bleeding per rectum for last seven months & ulcer in the left buttock for last one month. initially patient noticed passage of small amount of fresh blood per rectum during defecation only but in the last month, the bleeding was aggravated and became continuously dripping in small amount, also the patient complained of pain during defecation and this made patient to restrict his feeding, hens, worsen the complaint of constipation but when the patient underwent conservative treatment the condition improved. In the last one month, the patient noticed the presence of painful swelling in the left buttock (2x2cm) with red head, which ulcerated with white discharge then the ulcer gradually increased in size to attain the present size.

On physical examination, the patient was cachexic with severe pallor. The abdomen was soft. there was an ulcer in the left buttock, irregular in shape, size was 4 x 3.5 cm, the margin of the ulcer was undermined, the floor of ulcer was covered by necrotic tissue, the depth of ulcer was approximately 5cm. On per rectal examination there was ulcerated mass palpable about 5 cm from the anal verge.

On investigation, the flexible proctosigmoidscopy revealed an ulcerated polypoid mass about 5 cm from the anal verge & there was also a polyp at the level of 35 cm from the anal verge. Then the rectosegmoid polypoid mass biopsied and sent for histopathological examination.

Histopathology report showed focal villotubular adenomatous growth with moderate to high-grade dysplasia, negative for invasive malignancy. re-biopsy was advised to rule out invasive malignancy, therefore, the procedure repeated but the histopathological report revealed the same result as before; so we decided to collect new samples in operative theatre using rigid proctoscope by direct tissue cutting forceps then the histopathology report revealed presence of hyperplastic glandular change in the mucosa with focal infiltration by few malignant glandular growth seen in the mucosa & submucosa consistent with adenocarcinoma.

CT scan showed luminal narrowing with asymmetrical wall thickening of mid and distal parts of the rectum forming(8x5x4.5 cm) lobulated heterogeneously enhancing mass in the left side associated with, haziness of the surrounding fat with effacement of the ischiorectal fossa, infiltration of the subcutaneous fat of the adjacent parts of the left gluteal region, multiple lymphadenopathies in the mesenteric and ipsilateral inguinal groups, average sized liver with an about 7.5 x 7.2 cm well defined focal lesion of large necrotic area & rapid washout of the contrast in the portal & delayed phases.

Findings are suggestive of malignant rectal tumor with local infiltration of the surrounding fat, nodal involvement & distant (hepatic metastasis)

The blood level of carcinoembryonic antigen was 213 ng / ml (normal level 0-5 ng /ml).

The biopsy taken from ulcer edge, from the external opening of fistula and sent for histopathological examination and the result was infiltration with the signs of adenocarcinoma of rectum.

Then, the patient was referred to oncology center to start chemotherapy and the first session was started but the patient was severely malnourished and failed to tolerate further sessions and came back again for supportive treatment to improve his general condition.

Figure: CT scan shows liver metastasis from rectal carcinoma

DISCUSSION

Rectal cancer occasionally invades adjacent organs. However, rectal cancer with perineal invasion is uncommon. Massive invasion of rectal cancer to the perineal skin is considered extremely rare, since the sensation of a perianal lump, altered bowel habits, bleeding or soiling,usually leads to diagnosis prior to the occurrence of massive invasion to the perineal area. Patients with perineal skin invasion by rectal cancer present with symptoms of severe pain, continuous bleeding and distressing discharge, which significantly affect their quality of life[10].

The most common presentation is bleeding per rectum and change in bowel habit and there are only few cases presented with gluteal invasion and recto-perianal fistula.

CONCLUSION

Perianal fistula is extremely rare presentation of rectal carcinoma, so with the presence of perianal fistula and bleeding per rectum, colonoscopy should be considered to rule out colorectal carcinoma and an adequate histopathological sample should be taken from both the primary lesion and the sides of fistula or ulcer to exclude presence of malignancy and local infiltration

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دراسة حالة

مريض مصاب بسرطان المستقيم
حضر الينا بشكوي مرضية نادرة

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ملخص

سرطان المستقيم يظهر علي المريض بأعراض تشمل نزيف من الدبر غير مصحوب بألم، تغير في قضاء الحاجة الي التبرز، عدم ارتياح في البطن وفي حالات نادرة بانسداد في الامعاء أو حدوث ثقب في الامعاء. المريض الذي نعرض حالته حضر الينا بناسور كبير في منطقة الالية حول فتحة الشرج مع بعض علامات الانسداد المعوي.

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Bacterial Etiology of Acquired Community Pneumonia Among Yemeni Patients Whose Diagnosed Clinically as A Pulmonary Tuberculosis Patients

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ABSTRACT

This study was conducted to determine the incidence of bacterial pneumonia among Yemeni patients whose diagnosed clinically as a pulmonary tuberculosis infection attending the

All patients were out patients and sent to the laboratory for laboratory investigation. Patien
and were from both sexes.

Three hundreds and eighty eight sputum samples were collected from the patients, stained and cultured on the appropriate media. Sociodemographic and health information were collected using questionnaire filled by the patients.

Results showed that the rate of infection by Mycobacterium tuberculosis was 13/388 (3.4%) whereas the infection by bacterial pneumonia other than tuberculosis was 166/388 (42.8%).

Isolated bacterial etiologies were; Staphylococcus aureus (17.5%), Streptococcus pneumonia (12.4%), Klebsiella pneumonia (9.8%), and Pseudomonas aeruginosa (3.1%).

Pneumonia was most predominant among the age group 46-55 years and occurred more commonly among females (44%) than males (41.4%). There was statistically significant correlation between family size and pneumonia infection but the correlation between pneumonia and other predisposing illness like diabetes mellitus, arthritis, Kidney and liver diseases were not significant.

Keywords: Pneumonia, Yemeni, Bacteria, Infection, Tuberculosis.

INTRODUCTION

Pneumonia is one of the most common causes of morbidity and mortality worldwide, particularly in developing countries where it kills more than 1.6 million people each year (UNICEF, 2006 and WHO, 2011).

Bacterial pneumonia is the most important complication of the lower respiratory tract and classified as either community acquired or nosocomial infection (El Sheikh, *et al*., 1998 and Garner, *et al*., 1988).

Although, children under five years and elderly patient are the most susceptible groups affected by the infection, there are some predisposing factors including uncontrolled diabetes mellitus, arthritis, urinary disease and liver disease (Gilbert, *et al.,* 2010; Joseph and Mazgred, 2008; and Masria, 2008).

Pneumonia currently accounts for 20% of annual deaths in low-income countries compared to only 4.3% in high-income countries (Black, *et al.,* 2010).

Yemen is considered one of the largest countries in southern Arabia both in area and in population (24,407,000). However, according to income, most of the population is below the poverty line.

Pneumonia has been studies poorly in Yemen. One study in Al-Sabe'en Hospital, Sana'a-Yemen, among children under 5 years suffering from acute respiratory tract infection, reported a mortality rate of 221/2554 (8.7%) and mostly among infants under 6 months of age (Banajeh, *et al.,* 1998) and (Abdo, *et al.,* 2006).

According to latest report by WHO, (2010) Yemen was classified in the countries where almost no observable decline in infectious diseases including respiratory tract infection.

This study was carried out to determine the prevalence of bacterial etiologies pneumonia among patients whose suffering from pneumonia disease and diagnosed clinically as a pulmonary tuberculosis infection. The effect of sociodemographic factors on the disease were investigated.

METHODS

Ethical consideration

This study approved by the university ethics committee. Consents was obtained from the each participants or their legal guardian before enrollment in the study.

It was carried out during a period of six months, starting in February - September 2011.

Samples collection

A total of 388 early morning sputum samples were collected from patients referring the National Tuberculosis Control Center in Sana'a city-Yemen.

Demographic information was obtained from the patients through a questionnaire containing parameters including; presence of other diseases, family size and income.

-95 years and were from both sexes.

Sputum samples were collected in sterile, screw cap containers.

The expectorated sputum was obtained by asking the patient to cough deeply into the container.

Part of specimen was inoculated into Blood Agar with 10% human blood, Chocolate Agar with 10% human blood, and MacConkeys Agar (Oxiod, UK) and incubated at 37 ºC

aerobically and anaerobically for 24-48 hours for detection of pathogenic bacteria that cause pneumonia (MacFaddin, 2000).

Isolated bacteria were identified by colony morphology, hemolytic characteristics, lactose fermentation, Gram stain and biochemical reactions including catalase and coagulase tests for Gram-positive cocci and oxidase, citrate utilization test, urease, for Gram-negative bacteria (Cheesbrough, 2006).

The confirmation of identified isolated bacteria was accomplished using automated technique Vitek 2 compact biomriex, following the procedure described by the manufacturer (bioMerieux Inc. Hazelwood, MO, USA).

The other part of specimen was processed for diagnosis of *Mycobacterium tuberculosis.* Direct smears were prepared from the samples and stained by Ziehel-Nelseen stain for detection of acid fact bacilli (AFB), all samples that yield positive AFB were cultured on special egg based solid media (Ogawa) medium according to the National Tuberculosis Institute (NTI) program and Japan International Cooperative Agency (JICA) in Yemen.

Statistical analysis

The data were coded, tabulated and analyzed using SPSS program version (11.5). Relative risk (RR) was calculated to detect ratio of incidence among different groups $P < 0.05$ was used as the cut-off level of significance.

RESULTS

This cross sectional study was included 388 patients, whom 181 were males (46.6%) and 207 were females (53.4%). Their age ranged from 6 to >56 years with a mean age of 38.7 years and a standard deviation (SD) of ± 18.2 years (Table 1).

The rate of incidence by *M.tuberculosis* was 13/388 (3.4%) whereas infection by other bacterial pneumonia was 166/388 (42.8%) and the disease affecting all age groups with highest prevalence rate among age group 46 56 years (56.6%) with significant in $p< 0.05$ as describe in (Table 1).

Table 1: Prevalence of pneumonia infection according to the age

Age/years	Total (n = 388)		Positive pneumonia (n= 166)		RR	χ^2	*P*
	NO	%	NO	%			
6 -15	27	7	12	44.4	1.04	0.03	0.98
16 -25	96	24.7	39	40.6	0.93	0.14	0.7
26 -35	68	17.5	28	41.2	0.95	0.09	0.87
36 – 45	61	15.7	25	41	0.95	0.86	0.45
46 – 55	53	13.7	30	56.6	1.4	4.8	0.02
≥56	83	21.4	32	38.6	0.88	0.77	0.37
Crude Total	**388**	**100**	**166**	**42.8**			

χ^2 $P < 0.05$ (Significant), RR >1 (at risk).

Staphylococcus aureus was the most commonly isolated bacteria (17.5%), followed by *Streptococcus pneumonia* (12.4%), *Klebsiella pneumonia* (9.8%) and *Pseudomonas aeruginosa* (3.1%) which present in table (2).

Table 2: Distribution of bacterial species other than *Mycobacterium tuberculosis* causing pneumonia among patients.

Staphylococcus aureus		*Streptococcus pneumonia*		*Klebsiella pneumonia*		*Pseudomonas aeruginosa*		Total	
No	%	No	%	No	%	No	%	No	%
68	17.5	48	12.4	38	9.8	12	3.1	166	42.8

A strong relationship between pneumonia incidence and the rate of individual income rate compared with size of family, which clear present in table (3)

Table 3: Effect of family size and income rate risk factors on the incidence of pneumonia.

Character		**Positive pneumonia**		**Negative pneumonia**		**Total**		**X^2**	**OR**	**P**
Family Size	1-3	NO	%	NO	%	NO	%			
		19	40.4	28	59.6	47	12.1	0.12	0.9	0.727
	4-7	57	39.6	87	60.4	144	37.1	0.96	0.8	0.328
	>8	90	45.7	107	54.3	197	50.8	1.4	1.3	0.241
Income	Medium	96	38.6	153	61.4	249	64.2	5.1	0.6	0.024
	Low	70	50.4	69	49.6	139	35.8	5.1	1.6	0.024

Statistically no significance correlation between the occurrence of bacterial pneumonia among predisposing illness listed diseases and patients not suffering from those underlying diseases which shown in table (4).

Table 4: Effect of co factors on the incidence of pneumonia.

Character	**Positive pneumonia**		**Negative pneumonia**		**Total**		**X^2**	**OR**	**95% CI**	**P**
	No	%	No	%	No	%				
Diabetes mellitus	9	2.3	12	3.1	21	5.4	0.000	1.5	0.499-4.521	0.470
Arthritis	4	1.0	5	1.3	9	2.3	0.010	0.181	0.017-1.882	0.152
liver disease	1	0.3	8	2.1	9	2.3	3.776	0.162	0.020-1.309	0.050
Renal insufficiency	4	1.0	6	1.6	10	2.6	0.038	0.581	0.125-2.710	0.490
Chi-square , OR =Odds ratio ,95%CI =confidence intervals ,P = P Vale = X^2										

*χ^2 $p< 0.05$ (Significant), OR >1 (at risk).

DISCUSSION

Pneumonia is the sixth leading infectious cause of death in young and older age particularly in developing countries worldwide (Black, *et al.,* 2010). In Yemen, there has been inadequate information on the prevalence of bacterial causing pneumonia among Yemeni patient.

Although all patients were suffering from acute respiratory tract infection and diagnosed clinically as a pulmonary tuberculosis out patients and sent to the National Tuberculosis - Yemen for confirmatory the diagnosis. But the results yielded that only 13/388 (3.4) was infected by *M.tuberculosis* .

The rate of prevalence of bacteria causing pneumonia other than *tuberculosis* was (42.8%). This prevalence rate was high and nearly similar to that reported from India in 2004 (Shailaja, *et al*., 2004), Southern Estonia in 2006 (Leesik, *et al.,* 2006) and Iran in 2010 (Hashemi, *et al.,* 2010).

In Yemen the low health services, absence of medical health insurance, and high rate of population poverty increasing the size of infection.

We found that the higher prevalence of pneumonia were noted in the age group 46-55 years and this result was highly statistically significant with value of $p< 0.029$.

This result was different from that observed by Alghamdi in the Western region of Saudi Arabia which they found that most affected age group was 26-45 years (Alghamdi, *et al*., 2009) and results reported from Finland and UK in which the peak of bacterial pneumonia occurred in very old patients over age of 60 years (Hashemi, *et al.,* 2010 and Leesik, *et al.,* 2006).

Staphylococcus aureus was the most commonly isolated bacteria (17.5%), followed by *Streptococcus pneumonia* (12.4%), *Klebsiella pneumonia* (9.8%), *Pseudomonas aeruginosa* (3.1%). This result was nearly similar to a previous study reported in Yemen (Abdo, *et al.,* 2006).

Regarding to the income rate highest percentage of infection was found in the medium and low-income rate with a percentage of 50.4% and 38.6% respectively. This result can be explained the medium income individuals had better chance to the health services than low-income individuals, which might be reflected in our result.

In addition, this result insured us that the low rate incidence by tuberculosis among the medium income patients because tuberculosis is considered the disease of the poor.

The high rate of bacterial pneumonia infection in association with Co factors was found in Diabetes mellitus with percentage 2.3% followed by renal insufficiency with percentage 1% and arthritis with percentage 1%. All these results were not statistically significant with value $p<0.47$, $p<0.152$, respectively except for renal insufficiency $p<0.052$.

This result was nearly similar to that reported in Finland in 2001, with Diabetes mellitus 8% and liver disease 0.7% (Jokinen, *et al.,* 2001).

Our results were different from the result reported from Finland and Spain in which arthritis, diabetes mellitus (DM), liver disease or renal insufficiency found to be significant risk factors of contracting bacterial pneumonia (Lim, *et al*., 2001; Nagalingam, *at al*., 2005; and Arancibia, *et al*., 2002).

CONCLUSION

The prevalence rate of bacterial pneumonia infection among suspected TB patients was high and is roughly similar in both sexes. The most commonly isolated bacteria were *Staphyllococcus aureus* and *Streptococcus pneumoniae.*

Family size rate is important factor contributed to the occurrence of the disease significantly.

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البكتيرية المسببة لالتهاب الرئة بين المرضى اليمنيين واللذين تم تشخيصهم سريرياً كمرضى مصابين بمرض السل الرئوي

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3- المستشفى الحديث ، صنعاء ، اليمن

ملخص

تم اجراء هذه الدراسة بغرض تحديد معدل انتشار البكتيريا المسببة لالتهاب ذات الرئة بين المرضى المترددين على المركز الوطني لمكافحة الدرن في العاصمة صنعاء-اليمن. جميع المرضى هم غير مقيمين في المستشفيات وقد تم تشخيصهم سريريا كمرضى مصابين بالسل الرئوي وارسالهم الي المختبر التابع للمركز الوطني لمكافحه الدرن بغرض التأكد من اصابتهم بالبكتيريا المسببة لمرض السل. تم جمع 388 عينة بصاق من المرضى من الجنسين حيث كانت أعمارهم تتراوح ما بين ست الي ستة وخمسون عاما من مختلف المناطق في اليمن. المعلومات الشخصية والحالة الاقتصادية والمعيشية والتاريخ المرضي للمرضى تم جمعها من خلال تعبئه الاستبيان الخاص بالبحث بواسطة المرضى. تم زراعة جميع عينات البصاق على الأوساط الزراعية المختلفة واستخدام الصبغات التفريقية للتعرف على انواع البكتيريا المسببة لالتهاب ذات الرئة باستخدام تقنية معيارية. اظهرت النتائج إن معدل انتشار البكتيريا المسببة للسل الرئوي كانت 388/13 (3.4%) بينما الإصابة بالبكتيريا المسببة لالتهاب ذات الرئة كانت 166/388 (42.8%). وان أكثر البكتيريا حدوثا هي*Staphylococcus aureus* (17.5%). *Klebsiella* pneumonia (12.4%), *Streptococcus pneumonia* (9.8%) and *Pseudomonas aeruginosa* (3.1%)

كان معدل الإصابة بين الاناث (44%) أعلى من الذكور (41%) واعلى نسبه للإصابة كانت في الفئة العمرية ما بين (46 -55) سنه. كما أظهرت النتائج ان هناك علاقة بين معدل الإصابة بالتهاب ذات الرئة ومعدل عدد افراد الاسرة كانت علاقة ذات دلاله إحصائية بينما العلاقة بين معدل الإصابة ووجود أمراض أخرى مثل مرض السكري وامراض الكلى والكبد والتهابات المفاصل لم تكن ذات دلاله إحصائية.

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On Study C^h-Trirecurrent Finsler Space

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ABSTRACT

The concept of C^h- recurrent Finsler space has been studied by M.Matsumoto [6] . H.Izumi ([4],[5]) gave the concept of *P- spaces which was the generalization of C^h-recurrent spaces and P2-like spaces of M.Matsumoto ([6],[7]). R.Verma [15] discussed C^h-birecurrent spaces where these spaces are generalization of C^h-recurrent spaces of M.Matsumoto [6] .Besides the correlation of C^h- birecurrent spaces which C^h- recurrent space , some special C^h- birecurrent spaces has been discussed . The result concerning h- isotropic C^h- recurrent space due to M.Matsumoto [6] has been extended to C^h- birecurrent spaces by P.N. Pandey and R.Verma [15]. C.K.Mishra and G.Lodhi [9] studied the properties of C^h-recurrent and C^v- recurrent for torsion tensor field of the second order in Finsler spaces .

The purpose of the present paper is to study the properties of C^h- trirecurrent torsion tensor field and the recurrence covariant vector field of the third order in Finsler spaces .

Keywords: h- Trirecurrent Tensor , C^h-Trirecurrent Finsler Space , C^h-Trirecurrent Affinely Connected Space and P*-C^h- Trirecurrent Space.

INTRODUCTION

Let us consider an n-dimensional Finsler space F_n equipped with a metric function F(x^i, y^i) satisfying the requestic conditions of a Finslerian metric[10],the corresponding symmetric metric tensor g_{ij} ** and Cartan's connections parameters .

The relations between the metric function F and the corresponding metric tensor g_{ij} are given by

(1.1) $$g_{ij} = \frac{1}{2}\dot{\partial}_i\dot{\partial}_j F^2 \quad ***$$.

Corresponding to each contravariant vector y^i , there is a covariant y_i , such that

(1.2) $y_i = g_{ij}y^j$.

The (h) hv –torsion tensor C_{ijk} defined by M.Matsumoto [6]

(1.3) $C_{ijk} := \frac{1}{2}\dot{\partial}_i g_{jk} = \frac{1}{4}\dot{\partial}_i\dot{\partial}_j\dot{\partial}_k F^2$,

it is positively homogenous of degree -1 in y^i and symmetric in all its indices .

The (v) hv- torsion tensor C^i_{jk} which is the associate tensor of C_{ijk} and is defined by

(1.4) $C^i_{jk} := g^{ip}C_{jpk}$.

For an arbitrary vector field X^i , É. Cartan deduced ([1] , [2])

(1.5) $X^i_{|k} := \partial_k X^i - \left(\dot{\partial}_r X^i\right) G^r_k + X^r \Gamma^{*i}_{rk}$,

where the functions Γ^{*i}_{rk} and G^r_k are defined by

(1.6) a) $\Gamma^{*i}_{rk} := \Gamma^i_{rk} - C^i_{mr}\,\Gamma^m_{sk}y^s$

and

b) $G^r_k = \Gamma^{*r}_{sk}\,y^s$.

The functions Γ^{*i}_{rk} defined by (1.6a) are called *Cartan's connection parameters*. These are symmetric in its lower indices are positively homogenous of degree zero in y^i .

The equation (1.5) gives a process of covariant differentiation known as *h-covariant differentiation (Cartan's second kind covariant differentiation)* .M.Matsumoto ([6] ,[7]) calls this derivative as " *h-covariant derivative*" .

The associate tensor g^{ij} of the metric tensor g_{ij} is covariant constant with respect to the above process , i.e.

(1.7) $g^{ij}_{|k} = 0$.

The h-covariant derivative of the vector y^i vanishes identically , i.e.

(1.8) $y^i_{|k} = 0$.

The commutation formula for Cartan's covariant differentiation of an arbitrary vector field X^i expressed as follows:

(1.9) $X^i_{|j|k} - X^i_{|k|j} = R^i_{hjk}\,X^h - H^h_{jk}\,X^i_{|h}$.

The h-curvature tensor R^i_{jkh} (which is the third of Cartan's curvature tensors) is defined by

(1.10) $R^i_{jkh} := \partial_h\Gamma^{*i}_{jk} + \left(\dot{\partial}_l\,\Gamma^{*i}_{jk}\right)\Gamma^{*l}_{sh}y^s + C^i_{jm}\left(\partial_k\Gamma^{*m}_{sh}y^s - \Gamma^{*m}_{kl}\Gamma^{l}_{sh}y^s\right) + \Gamma^{*i}_{mk}\,\Gamma^{*m}_{jh} - {}^{k}/_{h}$.

The (hv)- curvature tensor P^i_{jkh} (which is the second of Cartan curvature tensor) is defined by

(1.11) $P^i_{jkh} := C^i_{kh|j} - g^{ir}C_{jkh|r} + C^r_{jk}P^i_{rh} - P^r_{jh}C^i_{rk}$.

This tensor satisfies tensor

(1.12) $P^i_{jkh}y^j = P^i_{kh} = C^i_{kh|r}\,y^r$.

The tensor P^i_{kh} is called *v (hv) – torsion tensor.*

1. C^h −Trirecurrent Finsler Space

M.Matsumoto [6]defined an –recurrent Finsler space by the condition

(2.1) a) $C_{ijk|l} = \lambda_l C_{ijk}$, $C_{ijk} \neq 0$

or equivalent to the condition [9]

(2.1) b) $C^i_{jk|l} = \lambda_l C^i_{jk}$, $C^i_{jk} \neq 0$,

where λ_l is non-zero covariant vector field .

R.Verma [15] defined an C^h –birecurrent Finsler space by the condition

(2.2) a) $C_{ijk|l|m} = a_{lm}C_{ijk}$, $C_{ijk} \neq 0$
or equivalent to the condition [10]
(2.2) b) $C^i_{jk|l|m} = a_{lm}C^i_{jk}$, $C^i_{jk} \neq 0$,
where $a_{lm} = \lambda_{l|m} + \lambda_l\lambda_m$ is a recurrence covariant tensor field of second order.
Taking h- covariant differentiation of (2.1a) with respect to x^m , we get
(A) $C_{ijk|l|m} = \lambda_{l|m}C_{ijk} + \lambda_l\lambda_m C_{ijk}$.
Again taking h-covariant differentiation of (A) with respect to x^n , we get
(2.3) $C_{ijk|l|m|n} = a_{lmn}C_{ijk}$, $C_{ijk} \neq 0$,
where
(B) $a_{lmn} = \lambda_{l|m|n} + \lambda_{l|m}\lambda_n + \lambda_{l|n}\lambda_m + \lambda_l\lambda_{m|n} + \lambda_l\lambda_m\lambda_n$.

Definition 2.1. The space in which the (h) hv- torsion tensor C_{ijk} satisfies the condition (2.3) , where a_{lmn} is recurrence covariant tensor field of third order defined by the equation (B) , the space and the tensor satisfying the condition (2.3) will be called C^h – *trirecurrent* and *h-trirecurrent tensor* respectively , we shall denote such space and tensor briefly by C^h–*TR-*F_n and *h-TR* respectively.

If we assume the condition (2.3) which is the characterizing equation of C^h–TR-F_n , where a_{lmn} is the recurrence covariant tensor field of third order , it does not imply the condition (2.1a) in general.
Therefore the condition (2.3) is more general than the condition (2.1a) .In this case the recurrence covariant tensor field $a_{lmn}$of third order need not to be of the form (B) .
Thus , we conclude

Theorem 2.1. Every C^h–recurrent Finsler space (for which the recurrence vector field satisfies (B) is not zero) , is C^h–TR-F_n .

Corollary 2.1. In C^h- TR-F_n , the (v) hv-torsion tensor is h-TR .

Proof

Let us consider C^h- TR-F_n characterized by (2.3) .
Transvecting (2.3) by g^{qj} and using (1.7) and (1.4) , we get
(2.4) $C^q_{ik|l|m|n} = a_{lmn}C^q_{ik}$, $C^q_{ik} \neq 0$.

Now , transvecting (2.4) by $y^l$and using (1.8) and (1.12) , we get
(2.5) $P^q_{ik|l|m} = a_{lmn}y^l C^q_{ik}$,
Also , let us consider a C^h- TR-F_n characterized by (2.3) which is also a P* –Finsler space. For such space we have the condition (2.5) and the equation
(2.6) $P^q_{ik} = \phi C^q_{ik}$,
where ϕ is non-zero scalar.
Taking h-covariant differentiation of (2.6) with respect to x^m , we get
(2.7) $P^i_{ik|m} = \phi_{|m}C^q_{ik} + \phi C^q_{ik|m}$.
Transvecting (2.7) by y^m and using (2.10) , we get
(2.8) $P^i_{ik|m}y^m = \phi_{|m}\, y^m C^q_{ik} + \phi P^q_{ik}$.
In view of (2.6) , the equation (2.8) can be written as
(2.9) $P^i_{ik|m}y^m = \phi_{|m}\, y^m C^q_{ik} + \phi\phi\, C^q_{ik}$.
Taking h-covariant differentiation of (2.9) with respect to x^n and using (1.8) , we get
(2.10) $P^q_{ik|m|n}\, y^m = \phi_{|m|n}\, y^m C^q_{ik} + \phi_{|m}\, y^m C^q_{ik|n} + 2\phi\phi_{|n}\, C^q_{ik} + \phi\phi\, C^q_{ik|m}$.

In view of (2.5) and (2.10) , we get

$$a_{lmn}y^l\, y^m C^q_{ik} = \phi_{|m|n}\, y^m C^q_{ik} + \phi_{|m}\, y^m C^q_{ik|n} + 2\phi\phi_{|n}\, C^q_{ik} + \phi^2\, C^q_{ik|m}$$

or

$$C^q_{ik|n} = \left(\frac{a_{lmn}y^l y^m - \phi_{|m|n}y^m - 2\phi\phi_{|n}}{\phi_{|m}y^m + \phi^2}\right) C^q_{ik}$$

which shows that the space is C^h −recurrent provided

$\left(\frac{a_{lmn}y^l y^m - \phi_{|m|n}y^m - 2\phi\phi_{|n}}{\phi_{|m}y^m + \phi^2}\right) = 0$.

Thus , we conclude

Theorem 2.2. The C^h–TR-F_n *is* C^h–recurrent if it is a P^* –Finsler space and $\phi_{|n} \neq 0$, ϕ being defined in (2.6) .

Commutating (2.4) with respect to the indices m and n and using commutation formula (1.9) , we get

(2.11) $$C^h_{ik}R^q_{hmn|l} - C^q_{hk}R^h_{imn|l} - C^q_{ih}R^h_{kmn|l} - C^q_{ik\,l}\ H^h_{mn|l} - C^h_{ik|l}R^h_{hmn} - C^q_{hk|l}R^h_{imn} - C^q_{ih|l}R^h_{kmn} - C^q_{ik\,h|l}H^h_{mn} = (a_{lmn} - a_{lnm})C^q_{ik}\ .$$

Note 2.1. An affinely connrcted space is characterized by any one of the following equivalent conditions

a) $G^i_{jkh} = 0$ and b) $C_{ijk|h} = 0$.

Thus , we may conclude

Theorem 2.3. If the C^h–TR-F_n is affinely connected space , the recurrence covariant tensor field of third order a_{lmn} is symmetric in its last two indices .

Contracting the indices q and i in (2.11) and putting C_k for C^q_{qk} , we get

(2.12) $$(a_{lmn} - a_{lnm})\, C_k = -C_{h|l}R^h_{hmn} - C_{k\,h|l}H^h_{mn} - C_h R^h_{kmn|l} - C_{k\,h}H^h_{mn|l}\ .$$

Due to the skew –symmetric of R_{hkmn} in its last two indices , we have

(2.13a) $$C_h R^h_{kmn|l}C^k = R_{hkmn|l}C^h C^k = 0$$

and

(2.13b) $$C_{h|l}R^h_{kmn}\, C^k = R_{hkmn}C^h_{|l}C^k = 0\ ,$$

where $C^k = g^{ik}C_i$.

Transvecting (2.12) by C^k and using (2.13a) and (2.13b) , we get

(2.14) $$(a_{lmn} - a_{lnm})\, C_k C^k = -C_{k\,h|l}C^k H^h_{mn} - C_{k|h}C^k H^h_{mn|l}$$

which can be written as

(2.15) $$(a_{lmn} - a_{lnm})\, C_k C^k = -C_{k\,h|l}C^k R^h_{rmn}y^r - C_{k|h}C^k R^h_{rmn|l}y^r\ .$$

Transvecting (2.15) by C_r and using (2.13) , we get

$$(a_{lmn} - a_{lnm})\, C_k C^k C_r = 0\ .$$

This implies at least one of the following :

(2.16) a) $a_{lmn} - a_{lnm} = 0$ and b) $C_k C^k C_r = 0$.

The condition (2.16a) , implies that the recurrence covariant tensor field a_{lmn} of third order is symmetric in its last two indices .

The condition (2.16b) , implies $C_r = 0$ which in view of Deicke's theorem [4] implies that the space is Riemannian .

Thus , we conclude

Theoram 2.4. A C^h–TR-F_n either its recurrence covariant tensor field of third order is symmetric in its last two indices or Riemannian space .

Suppose that there exists a non-null covariant vector field λ_l such that

(2.17) a) $H^i_{rmn|l} + H^i_{rhm|l} + H^i_{rnh|l} = 0$

and

b) $\lambda_h H^i_{rmn} + \lambda_n H^i_{rhm} + \lambda_m H^i_{rnh} = 0$.

Transvecting (2.15) by λ_q , we have

(2.18) $b_{lmn}\lambda_q C_k C^k = -C_{k\,h|l}\,\lambda_q C^k H^h_{rmn} y^r - C_{k\,h}\lambda_q C^k H^h_{rmn|l} y^r$,

where $b_{lmn} = a_{lmn} - a_{lnm}$.

Taking skew-symmetric part of (2.18) with respect to the indices m, n and q , we get

$$(b_{lmn}\lambda_q + b_{lqm}\lambda_n + b_{lnq}\lambda_m)\, C_k C^k = -C_{kh} C^k y^r (\lambda_q H^h_{rmn} + \lambda_n H^h_{rqm} + \lambda_m H^h_{rnq}) - C_{k|h|l} C^k y^r (\lambda_q H^h_{rmn} + \lambda_n H^h_{rqm} + \lambda_m H^h_{rnq}) .$$

In view of (2.17) , the above equation implies

(2.19) $(b_{lmn}\lambda_q + b_{lqm}\lambda_n + b_{lnq}\lambda_m)\, C_k C^k = 0$.

This implies at least one of the following :

(2.20) a) $b_{lmn}\lambda_q + b_{lqm}\lambda_n + b_{lnq}\lambda_m = 0$

and

b) $C_k C^k = 0$.

The condition (2.20b) implies $C_k = 0$ which in view of Deicke's theorem[4] implies that the space is Riemannian.

That is , if a C^h–TR-F_n admits the identity (2.17) , the space is either admits (2.20a) or Reimannian space .

Thus , we conclude

Theorem 2.5. If a C^h–TR-F_n admits the identity (2.17) , the space either admits (2.20a) or Reimannian space .

Since a R^h–recurrent Finsler space [15] , a K^h–recurrent Finsler space [11] and a H–recurrent Finsler space [13] admit the identity (2.17) .

Similarly, we may conclude

Corollary 2.2. *A* C^h–TR-F_n is either admits (2.20a) or Reimannian space provided if satisfies one of the following :

(1) It is a R^h–recurrent Finsler space ,

(2) It is a K^h–recurrent Finsler space ,

(3) It is a H–recurrent Finsler space .

If the deviation tensor H^i_h of C^h–TR-F_n vanishes identically . In view of $H^i_{kh} = \frac{1}{3}(\dot\partial_k H^i_h - \dot\partial_h H^i_k)$, the equation (2.14) reduces to $(a_{lmn} - a_{lnm})\, C_k C^k = 0$. This implies that the space either its recurrence covariant tensor field of third order is symmetric in its last two or Riemannian space .

In the later case , the equation (2.12) reduces

(2.21) $C_{h|l} R^h_{kmn} = C_h R^h_{kmn|l}$.

Thus , we conclude

Theoram 2.6. *A* C^h–TR-F_n with vanishing deviation tensor if either its recurrence tensor field of third order is symmetric in its last two indices or Reimannian space , then the curvature tensor R^i_{jkh} satisfies (2.21).

Taking h- covariant differentiation of (2.2a) with respect to x^n , we get

(2.24) $C_{ijk|l|m|n} = a_{lm|n}C_{ijk} + a_{lm}C_{ijk|n}$, $C_{ijk} \neq 0$.

If the (h) hv- torsion tensor C_{ijk} is h-TR , the equation (2.24) can be written as

(2.25) $C_{ijk|l|m|n} = b_{lmn}C_{ijk}$, $C_{ijk} \neq 0$,

here

(C) $b_{lmn} = a_{lm|n} + a_{lm}\lambda_n$.

If we assume the condition (2.25) is characterizing equation of C^h–TR-F_n , where $b_{lmn}$is the recurrence covariant tensor field of third order , it does not imply the condition (2.2a) in general . Therefore the condition (2.25) is more general than the condition (2.2a) . In this case the recurrence covariant field b_{lmn} of third order need not to be of the form (C).

Thus, we conclude

Theorem 2.6. If the (h) hv- torsion C_{ijk} is h-TR , then every C^h–TR-F_n (for which the reucerrence vector field satisfies the equation (C) is not zero). is C^h–TR-F_n.

Corollary 2.3. In C^h–TR-F_n , the (v) hv- torsion tensor C^i_{jk} is h-TR provided C^i_{jk} is h-recurrent .

Proof

Let us consider C^h–TR-F_n characterized by (2.3) .

Transvecting (2.3) by g^{qj} and using (1.7) and (1.4) , we get

(2.26) $C^q_{ik|l|m|n} = b_{lmn}C^q_{ik}$, $C^q_{ik} \neq 0$.

Let us transvecting (2.26) by y^l and using (1.8) and (1.12) , we get

(2.27) $P^q_{ik|l|m|n} = b_{lmn}\, y^l\, C^q_{ik}$.

Let us consider a C^h–TR-F_n characterized by (2.3) which is also a P* –Finsler space. For such space we have the condition (2.27) and the equation (2.6) .

In view of (2.6) , the equation (2.8) can be written as

$$P^q_{ik|m}\ \phi\, y^m = (\phi_{|m}\, y^m + \phi^2)\, P^q_{ik} \quad .$$

Note 2.2. P* –Finsler space is characterized by the condition ([4], [5])

$$P^i_{kh} = C^i_{kh|j}y^i = \phi C^i_{kh} \quad , \phi \neq 0 \ .$$

Thus , we conclude

Theorem 2.8. If the C^h–TR-F_n is P* –Finsler space , the h- covariant derivative of the v(hv) –torsion tensor P^q_{ik} is proportional to the tensor P^q_{ik} for which the recurrence $\phi_{|m}\, y^m + \phi^2 \neq 0$.

In view of (2.6) , the equation (2.5) can be written as

(2.28) a) $P^q_{ik|m|n} = \frac{1}{\phi} a_{lmn} y^l P^q_{ik}$

or

b) $\phi P^q_{ik|m|n} = a_{lmn} y^l P^q_{ik}$.

Thus, we conclude

Theorem 2.9. If the C^h–TR-F_n is P* –Finsler space , the v(hv) –torsion tensor P_{ik}^q is birecurrent for which the recurrence covariant tensor field of second order $a_{lmn}\frac{y^l}{\phi}$ is not zero.

or

Theorem.2.10. If the C^h–TR-F_n is P* –Finsler space , the second h- covariant derivative of the v(hv) –torsion tensor P_{ik}^q is proportional to the second directional derivative of the tensor P_{ik}^q in the directional of $y^n \ \ and \ \ y^m$.

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ثلاثي المعاودة C^h — دراسة حول فضاء فنسلر

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قسم الرياضيات – كلية التربية / عدن – جامعة عدن

ملخص

في هذه الورقة قدمنا فضاء فنسلر F_n الذي يحقق فيه $(h)hv$–الموتر الالتوائي C_{ijk} الحالة التالية: $C_{ijk} \neq 0$, $C_{ijk|l|m|n} = a_{lmn}C_{ijk}$، على x^l , x^m , x^n من الرتبة الثالثة بالنسبة إلى المؤثر التفاضلي المتحد الاختلاف h–هو $|l|m|n$احيث ثلاثي C^h–هو حقل متجهي متعدد الاختلاف غير صفري من الرتبة الثالثة. أسميناه بفضاء a_{lmn} التعاقب ، موتر ثلاثي المعاودة. h – المعاودة وأطلقنا على الموتر الذي يحقق خاصية ثلاثي المعاودة بـــ ثلاثي المعاودة وذلك من خلال دراسة : خواصه في أنواع معينة C^h– الغرض من هذه الورقة هو تطوير فضاء من الرتبةa_{lmn} وكذلك حقل الموتر المتجهي C^i_{jk} الموتر ألالتوائي $(v)hv$– في فضاء فنسلر وأيضا سلوك الثالثة. ثلاثي المعاودةC^h–ثلاثي المعاودة، فضاء C^h– موتر ثلاثي المعاودة، h – فضاء فنسلر.

كلمات مفتاحية : ثلاثي المعاودة. $C^h - P^*$– ،فضاء الـ Affinely Connected

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A Proposed Model for Focused Crawling and Automatic Text Classification of Online Crime Web Pages

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ABSTRACT

With the exponential growth of textual information available from the Internet, there has been an emergent need to find relevant, in-time and in-depth knowledge about crime topic. The huge size of such data makes the process of retrieving and analyzing and use of the valuable information in such texts manually a very difficult task. In this paper, we attempt to address a challenging task i.e. a crawling and classification of crime-specific knowledge on the Web. To do that, a model for online crime text crawling and classification is introduced. First, a crime-specific web crawler is designed to collect web pages of crime topic from the news websites. In this crawler, a binary Naive Bayes classifier is used for filtering crime web pages from others. Second, a multi-classes classification model is applied to categorize the crime pages into their appropriate crime types. In both steps, several feature selection methods are applied to select the most important features. Finally, the model has been evaluated on manually labeled corpus and also on online real world data. The experimental results on manually labeled corpus indicate that Naive Bayes with mutual information and odd ratio feature selection methods can accurately distinguish crime web pages from others with an F1 measure of 0.99. In addition, the experimental results also show that the Naive Bayes classification models can accurately classify crime documents to their appropriate crime types with Macro-F1 measure of 0.87. Our results also on online real word data show that the focused crawler with two-level classification is very effective for gathering high-quality collections of crime Web documents and also for classifying them.

Keywords: Crime Data Mining, Web Mining, Focused Crawling, Classification

1. INTRODUCTION

As of today, the indexed web contains more than 50 billion web pages[1] and continues to grow at a rapid pace. With the rapid growth of the World Wide Web, the volume of the crime information that is available on the web is growing exponentially. Since there has been an explosion of media reports for different kind of crime news, this makes the process of analyzing and processing them manually a very difficult task. It is also widely known that general purpose search engines are not tailored at providing topic specific information (Samarawickrama and Jayaratne 2011). Finding relevant and in time information from these crime documents are crucial for many applications and can play a central role in improving crime-fighting capabilities, helping to enhance public safety and reducing future crime. Therefore, the huge amounts of crime news need to be organized in an effective way. One way of organizing this overwhelming amount of data is to gather these crime web pages from the Internet and classify them into their appropriate categories. This organized and classified data is essential to many information retrieval tasks such as constructing or expanding web directories (web hierarchies), improving search results, helping question answering systems and building domain-specific search engines. To gather such domain-specific web pages, domain- specific web crawler has to be developed to collect web pages from the Internet by choosing to gather only pages related to this domain. This type of web crawler does not need to gather every web page from the Internet. In fact, during the focused crawling process of a search engine, the crawler uses an automatic classification mechanism to determine whether the Web page being considered is ‘‘on the specific topic” or not(Özel 2011; Qi and Davison 2009).

Text classification or Web page classification is the task of classifying natural language documents or Web pages into a pre-defined set of categories from a predefined classes or topics. It has become one of the key methods for organizing online information. Many machine learning methods have been proposed for text classification in the previous years such as N-gram (Farhoodi et al. 2011; Suzuki et al. 2010), Naïve Bayes (Chen et al. 2009; Fan et al. 2001; Metsis et al. 2006), Nearest Neighbors (Sun and Lim 2001), decision tree (Li et al. 2011),and support vector machine (Joachims 2001).

Our contribution: In this paper, we describe a new model for online crime text crawling and classification which seeks, acquires, maintains and classifies pages on crime topic. This model consists mainly from two main modules: a crime-specific crawling system and a text classification system. The crime-specific crawler is used to collect as many crime web pages as possible from the news websites and avoid irrelevant ones. This focused crawler is guided by a binary supervised classifier (crime filter) which learns to recognize the relevance of a web page with respect to the crime topic and it is also utilized a set of domain specific keywords. The text classification system is a multi-class text classification model which has been applied to categorize the crime Web pages into their appropriate crime sub-classes. In addition, we also compare between the two-level classification approach and the flat classification approach in the context of crime Web pages categorization.

This paper is organized as follows: In Section 2, we give a summary of related works in focused crawling, Web page classification and Crime data mining. Section 3 describes our

[1] http://www.worldwidewebsize.com/

model for crime Web pages classification. Section 4 describes the evaluation methods. The data sets used in this study, the experimental results and discussion on the results are presented in Section 5. Finally, Section 6 concludes the study and gives some future work.

2. RELATED WORK

Focused crawling is a promising approach to improving the recall of expert search on the Web. A variety of methods for focused crawling have been proposed (Batsakis et al. 2009; Can and Baykal 2007; Ehrig and Maedche 2003; Hsu and Wu 2006; Liu et al. 2006; Samarawickrama and Jayaratne 2011; Wang et al. 2010; Yang 2010a, b; Zheng et al. 2008). The term focused crawler was first coined by Chakrabarti in 1999. Chakrabarti (1998) uses a canonical topic taxonomy and seed documents to build a model for classification of retrieved pages into categories. Earliest work on focused crawling dealt with simple key-word matching or regular expression matching. Related research in focused web crawling algorithms is presented in (Liu and Lu 2007; Novak 2004). Topic specific crawlers attempt to focus the crawling process on pages relevant to the topic. They try to keep the overall number of downloaded web pages for processing as minimum as possible and maximizing the percentage of relevant pages (Batsakis et al. 2009). Angkawattanawit (2002) deal with improving recrawling performance by utilizing several databases (seed URLs, topic keywords and URL relevance predictors) that are built from previous crawl process and used to improve harvest rate. Several works (Martin and Khelif 2011; Yang 2010b) utilize search engines as a source of seed URLs and back–references.

Web classification is considered to be an important and challenging task(Özel 2011). It has attracted more and more research work in recent years(HUSSAIN and ASGHAR 2012). In the detailed survey of Qi and Davison (2009) , the Web page classification problem has been divided into many problems such as subject classification, functional classification, genre classification, binary/multi-class classification, single/multi-label classification, and hard/soft classification. Due to domain diversity and complexity, there remain many problems not solved.

In the recent decade, several studies have been performed on crime data mining. The results are usually used in developing new software applications for detecting and analyzing crime data. Oatley et al. (2005) introduce a general overview on applying intelligent crime analysis methods including neural networks, Bayesian networks, and genetic algorithms in predicting and matching crime incidents. Adderley (2007) have applied neural networks for crime data clustering and crime data classification through using both supervised and unsupervised learning methods. Keyvanpour et al. (2011) applied a SOM clustering method in the scope of crime analysis and then they use the clustering results to identify crime matching patterns. The COPLINK project (Atabakhsh et al. 2001; Chung et al. 2005; Hauck et al. 2002; Hauk and Chen 1999) represents a prominent framework for text mining, classification and clustering of crime data aiming. Nath (2006) and Phillips and Lee (2009) used clustering algorithms to detect the crimes patterns and speed up the process of solving crime. (Ghosh et al. 2016) used a Machine Learning approach to automate and help crime analysts identify the connected entities and events by collecting, integrating and analyzing diverse data sources to generate alerts and predictions for new knowledge and insights that lead to better decision making and optimized actions.. (Sharef and Martin 2015) introduces the evolving fuzzy grammar (EFG) method for crime

texts categorization. The learning model is built based on a set of selected text fragments which are then transformed into their underlying structure called fuzzy grammars.

3. ONLINE CRIME TEXT CLASSIFICATION

The objective of our proposed task is to classify crime-specific web pages to help the user to find relevant, in time and in-depth knowledge about crime topic. In this study, we use a two stage classification approach to online crime text classification. In this scenario, web pages are first crawled and classified to crime or irrelevant class. Then, web pages which are classified as crime, as shown in (Figure 1), are passed to a second level of classification (multiclass classification system) which then classifies this crime information to their classes. Before execution of any of the classification level in the crime web classification, the features should be extracted and expressed at first.

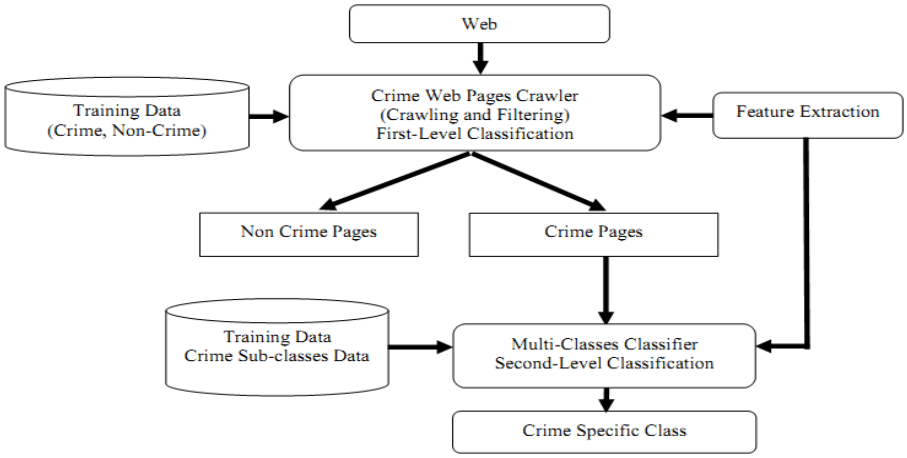

Figure 1: The Two Level Crime Web Pages Classification System.

3.1 Architecture of the Focused Crawler

As the size of the Web grows, topic-specific Web Crawlers are becoming more important due to their ability to acquire, and maintain a collection of Web pages relevant to a certain topic .The success of such topic-specific search tools depends on their ability to locate topic-specific pages on the Web while using limited resources.

In this section, we describe the architecture of our crime-specific crawler which represent the first level. (Figure 2) shows the architecture of our crime-topic crawler. The proposed crawler has the following components: 1) a URL Ranking algorithm which determines the relevancy of each URL in the starting URLs to the crime topic. 2) A URL Queue which contains ordered URLs obtained from search engine's starting URLs and from crawled pages. 3) A preprocessor module which is used for parsing the web page to remove stop words and the entire HTML tags. 4) A Page Downloader which download

pages from WWW. 5) A binary classifier which makes relevance judgments on pages crawled and filters crime pages from non crime pages.

The detailed process of our crime-topic crawler as suggested in Figure 3. In Algorithm 1, the first step is to determine the starting URLs or the starting point of a crawling process. The crawler is unable to traverse the Internet without starting URLs. Moreover, the crawler cannot discover more relevant web pages if starting URLs are not good enough to lead to target web pages. In this step, the crawler sends crime keywords to a search engine 2 in order to build an initial set of seed URLs. The search engine returns a set of URLs with their titles and description texts, the crawler will use both titles and description texts to compute topic similarity scores to order the URLs in that set. The topic similarity score (rank) of each URL is easily obtained by computing the similarity between the profile of the URL title and description text and the profile of the crime class that were calculated from a manually crawled crime corpus. In this work, we use a vector matching operation, based on the cosine similarity (in Eq. (1)), to compute URLs similarity scores and to rank them.

$$score(URL_i) = sim(d_i, q) = \frac{\vec{d}_i \,.\, \vec{q}}{|\vec{d}_i| \,.\, |\vec{q}|} = \frac{\sum_{j=1}^{n} w_{j,i} \times w_{j,q}}{\sqrt{\sum_{j=1}^{n} w_{j,i}^{2}} \times \sqrt{\sum_{j=1}^{n} w_{j,q}^{2}}} \qquad (1)$$

where q is a crime corpus, d_i is the title and the description text of the ith URL in the starting URLs, q is the profile of the joined crime documents in the manually crawled corpus, and $w_{j,i}$ stands for the weight of the term w_i in document j.

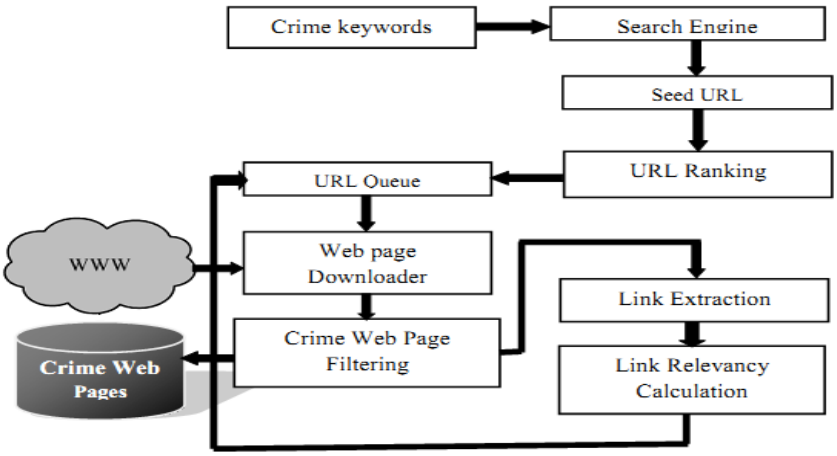

Figure 2: The Architecture of the Crime-Topic Crawler.

[2] www.Bing.com

Starting URLs will then be put into a URL queue and sorted by their scores. Then, the crime crawler selects the highest score URL from the URL Queue. A page downloader downloads the page associated with this URL. Then, a preprocessing module is used for parsing the web page, performing stop word removal, and removing all the HTML tags. After that, a crime filtering (binary classifier) is used determine whether the downloaded web page is crime page or not. If the web page is classified as crime web page, the algorithm extracts all the new URLs from this page. For each new URL, its relevancy (priority) to crime is deduced by merging its page score and the similarity score of the crime corpus with the following three values together(the link information); the anchor text associated with the link, the heading of the section where the link is found and the text of the paragraph containing the link. The priority of link i in the crawled page p is depend on two values; the similarity of the page to the crime corpus and the similarity of the link information to crime corpus:

$$Priority(link_i) = \lambda\ score(p) + (1-\lambda) score(link\_information) \quad (2)$$

New extracted URLs will be ordered by their scores and then be put into a URL queue.

3.2 Crime Classification Phase

The objective of phase is to classify crime-specific web pages to their crime topics: Arson, Drugs, Fraud, Kidnap, Money Laundering, Murder, Sexual Crime, Theft, and Traffic Violation. To do this, we use a two level classification model to online crime text classification. As shown in (Figure 2), the major function of the crime web pages filtering module (first-level classification) is to define whether a web page has crime information or not. For those web pages, which have been classified as crime web page in the first level, there is a further classification (second level classification) which will be conducted for the crime subtype classification. The second level of classification is a multi-classes classification which classifies each crime web page to their specific crime topic.

In this study, we used the Naive Bayes (NB) classifier which is used in both level of crime text categorization due to their simplicity and they are very effective in text categorization (Feng et al. 2015; Metsis et al. 2006; Tang et al. 2016). The main advantages of Naive Bayes classifiers is that they are easy to implement, they have a linear computational complexity, and their accuracy especially in filtering, which is comparable to that of more elaborate learning algorithms (Metsis et al. 2006; Nath 2006). For more details about NB classifier, see (Chen et al. 2009; Schneider 2003).

Algorithm 1. Crime Web Pages Crawling (Crime Keywords)

```
Starting_urls:=search Engine (crime keywords);
For each (url in Starting_urls)
        Url_Info:=Join(url.Title,url_Description);
        Sim_Score:= Score (Url_Info,CRIME_CORPUS);
        Enqueue (Url_Score,url,Url_Info, Url_Queue);
Endfor
while Url_Queue is not empty do
   url   := Dequeue_url_with_max_score(Url_Queue);
   page:=Crawel_Document(url);
   page_content:=Preprocess (page);
   page_type:=Binary_Classification(page_content ,CRIME_CORPUS);
   if  page_type  is crime do
      Save_Page(page);
      For each(link in page_links)
         link_Info:=Join(link. AnchorText, link_sectionHeadingText, link_surroundingParagraphText );
         link_score:=Score(host page score, link_Info, CRIME_CORPUS);
         Enqueue (link_score ,link, , Url_Queue);
      endfor
   endif
endwhile
```

Figure 3: The Crime-Topic Crawler. Algorithm

3.3 Feature Selection

Feature selection is a process which selects a subset of features that is considered as important. Such selection can help in building faster, cost effective and accurate models for data processing. The process typically involves certain metrics that are used for finding utilities or importance level of features. However, in this work, in the first level of classification, the feature selection methods extract the global feature vector to optimize the work of crime filter. The global feature vector is extracted from all the crime documents. In the second level of classification, these feature selection methods extract and construct feature vectors of each crime type. However, we have used the following feature selection methods in both classification levels to calculate the score of term (t) belonging to category c_i (Chen et al. 2009; Feng et al. 2015; Li et al. 2015) :

$$\chi^2(c,t) = \frac{N \times (\text{AD-BC})}{(A+C)(B+C)(A+B)(C+D)} \qquad (3)$$

$$MI(c,t) = \log_2\left(\frac{A \times N}{(A+C)\times(A+B)}\right) \qquad (4)$$

$$OddR(c,t) = \frac{AD}{CB} \qquad (5)$$

$$\text{GSS}(c,t) = \frac{(\text{AD-BC})}{N^2} \qquad (6)$$

where ***A*** is the number of times *t* and *c* co-occur, ***B*** is the number of times *t* occurs without *c*, ***C*** is the number of times *c* occurs without *t*, ***D*** is the number of times neither *c* nor *t* occurs, and ***N*** is the total number of documents

4. EVALUATION METHODS

In order to evaluate the components of our model, several experiments have been conducted. Fist, we have evaluated the performance of the classification modules in both levels i.e. the binary NB classification algorithms and the multi-label classification modules. We have measured the performance of these classification algorithms on manually labeled crime data sets. For binary classification task, we use the following metrics:

$$\text{Precision} = \frac{\text{TP}}{(\text{TP} + \text{FP})} \quad (7)$$

$$\text{Recall} = \frac{\text{TP}}{(\text{TP} + \text{FN})} \quad (8)$$

$$\text{F}_1 = \frac{2 * \text{Recall} * \text{Precision}}{(\text{Recall} + \text{Precision})} \quad (9)$$

In the multi-label classification, the Macro-averaged (Macro-F1) (Forman 2003) is used. The macro-averaged F-measure is the traditional arithmetic mean of the F-measure computed for each problem.

$$F_1^{\text{macro}} = \frac{1}{m}\sum_{i=1}^{m} F_1(i) \quad (9)$$

In addition, we also evaluate and compare both the two-level classification approach and the flat classification approach in the context of crime text categorization. In this context, we use the accuracy measure (Sun and Lim 2001) denoted by Ac_i for category C_i :

$$Ac_i = \frac{\text{TP}_i + TN_i}{\text{TP}_i + TN_i + FP_i + FN_i} \quad (10)$$

Secondly, we empirically evaluate the effectiveness of our model through evaluating the components of the model on online real world data. The crawler performance is typically measured by the harvest rate i.e. the percentage of downloaded pages that are relevant to the crime topic.

$$Harvest\_rate = \frac{relevant\_pages}{pages\_downloaded} \quad (10)$$

5. EXPERIMENTAL RESULT

5.1 First-Level Classification Experiment

In this experiment, our corpus consists of 2179 crime documents and 2257 non-crime documents, collected from Malaysian news web pages, is used to train the classifier. A test set consists of 472 files are used to test the classifier. The feature selection methods, that have been discussed, have been implemented to reduce the size of each feature set under each category.

For testing the effectiveness of the binary classification models phase, we have investigated the performance of the NB classifier according to each feature selection method (MI, CHI, GSS and OddR) by varying the size of the top rated features. These

features are selected from feature space at different size 500, 750, 1000, 1500, 1750 and 2000.

However, we first examined the impact of the number of features on the effectiveness of the NB classifier with the feature selection methods (MI, CHI, GSS and OddR). As shown in (Figure 4), the NB-MI and NB-GSS achieve important improvement, when the size of features is 2000, of approximately 1.3% over their results, when the size of features is 500. The best performances in term of Macro-F1 achieved by NB-MI and NB-GSS are 0.99 for both when the number of terms is 2000. From these results, we can conclude that Naïve Byes classifiers are highly accurate crime filtering models.

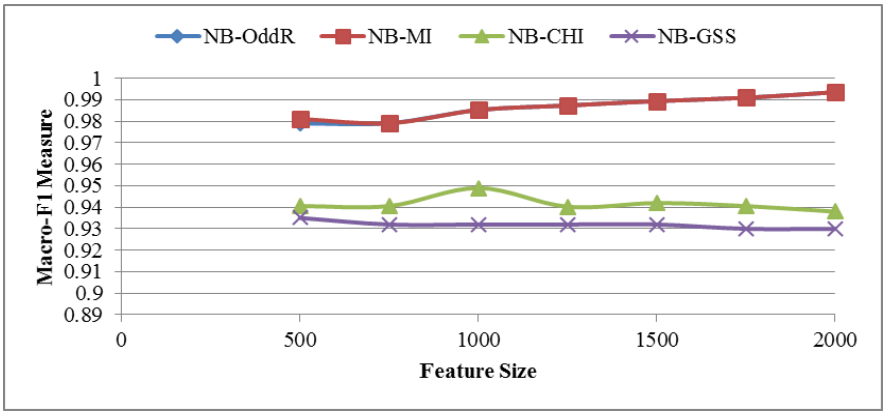

Figure 4: Macro-F1 Values of the Feature Selection Methods with NB Classifier (Crime Text Filtering)

5.2 Second-Level Classification Experiment

In the second experiment, our training corpus which consists of 2179 crime documents is used. The data in the corpus is divided into nine crime categories i.e. Traffic Violation, Theft, Sex Crime, Money laundering, Murder, Kidnap, Fraud, Drugs, and Arson (Chen et al., 2004). A test set which consists of 532 files is used to test the classifiers. The feature selection methods that have been discussed have been implemented to reduce the size of the feature set under each category. For testing the effectiveness of these classification models, we investigated the effectiveness of the four NB models namely, NB-MI, NB-CHI, NB-OddR, and NB-GSS. From (Figure 5), we can see that in NB-MI gets the highest categorization performances. We can also see that NB-CHI model leads to the worst performance overall.

In addition, we have investigated the performance of the NB classifier with each feature selection method (MI, CHI, GSS and OddR) by varying the size of the top rated features. These features are selected from feature space at different size 500, 750, 1000, 1500, 1750 and 2000. Fig. 4 shows the macro-averaged F-measure for each of the feature selection metrics as we vary the number of features to select. The results of these experiments

indicate that overall the best results are achieved with 2000 features, as one might have expected. As shown in (Figure 5), the performances of the classification models, NB-MI, NB-CHI, NB-OddR, and NB-GSS, are generally improved as the size of features used is increased. The best performance is obtained by NB-MI which is according to Macro-F1 is 0.84 when the number of features is 2000.

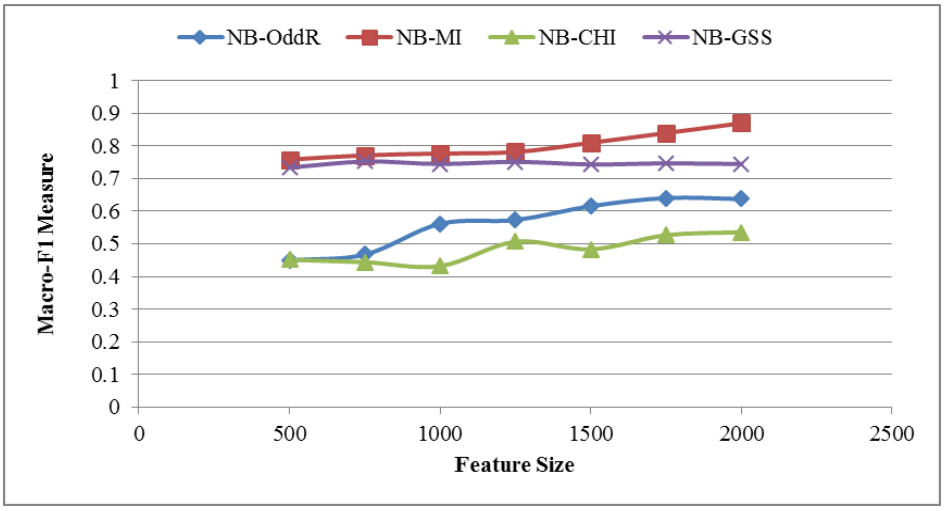

Figure 5: Macro-F1 values of the feature selection methods with NB Classifier (Crime Text Classification

5.3 Flat Classification VS Two Level Classification

In this experiment, we also evaluate both the two level (hierarchical) classification approach and the flat classification approach in the context of crime text categorization. The data set used in this experiment is classified to ten categories: traffic violation, theft, sex crime, money laundering, murder, kidnap, fraud, drugs, and arson and the others.

In the flat classification experiment, 2000 features have been extracted according to the type of the crime web pages, and each of them was assigned a weight based on their emerge frequency. The performance of classifying the crime dataset with a single NB-MI classifier is evaluated. The detailed results are shown in Table 1.

In the second experiment (two levels), first the same data set is separated into two sets: crime data set and non-crime data set. Then, we utilize the global feature vector. After that, the performance of classifying the dataset with first NB-MI classifier is evaluated. After the results has been produced. The documents which have been classified as crime documents by the first classifier have been used as the test set for the second level classifier.

The results of web page classification using the two-level classification model are list in Table 1. Comparing the two-level approach with one-level (flat) classification, the classification accuracy achieved by the two-level approach is 88% while the classification accuracy achieved by one-level approach is 83%. A 5% increase is gained. So it is obviously that the two-level classification is better than the one- level classification.

Table 1: Result of Crime Text Classification with One-Level and Two-Level Classifier

Quantity	Class	NB-MI			
		Hierarchal Classification Two Levels		Flat Classification One Level	
		Accuracy	Correct Classification	Accuracy	Correct Classification
Arson	41	1.00	41	0.83	34
Drugs	65	0.69	45	0.91	59
Fraud	56	0.88	49	0.82	46
Kidnap	71	0.94	67	0.94	67
Money Laundering	49	0.80	39	1.00	49
Murder	55	0.69	38	0.93	51
Sexual Crime	56	0.68	38	0.66	37
Theft	57	1.00	57	0.89	51
Traffic Violation	27	0.89	24	0.85	23
Non-crime	192	0.69	132	0.98	188
Average		**0.83**		**0.88**	

5.4 Crawler Evaluation

In this section, we present the evaluation of our crime specific crawler and classifier. At the initial stage, the crawler is initialized using a set of seed URLs for each keyword. These URLs are selected automatically from the fetched results of Bing search engine. All crawling and searching processes are limited to Malaysian news web pages. Then, the URLs are put into a priority queue according to the cosine similarity of their description and the crime corpus. After that, the crawler begins to download these web pages according to their URLs priority. Hyperlinks are extracted from the downloaded web pages and put into the priority queue.

The results for each method are represented by a plot showing the number of relevant pages returned by the method as a function of the total number of downloaded pages. The results of the crawler using both two levels classification and one-level classification approaches are shown in (Figure 6). The x-axis shows the total number of pages crawled. The y-axis shows the number of crawled crime web pages. As shown in (Figure 6), the total number of relevant crawled web pages of the crawler which uses two-level classification is higher than the total number of relevant crawled web pages of the crawler which uses flat classification. However, the harvest rate of both crawlers are high, all crawlers download large number of crime web pages. In the crawler with the flat classification model, the crawled web page is classified directly to irrelevant class or one of the crime classes. This means the multi-classes classification module is a part of the crawler. While in hierarchal crawling and classification, two-level classifier, the crawled web pages are first classified as crime page or irrelevant. Then, it is classified to its appropriate crime class using the second level classifier.

To analyze the data further, we studied the nature of these downloaded crime web pages and the percentage of each crime type during different stages of the crawling process. For

each crime type, we calculated the number of relevant pages that belong to this type along the crawling process. (Figure 7) shows the size of each crime type from the crawled web pages. As shown in the (Figure 7), sexual crimes constitute the highest percentage of crimes followed by theft, murder….etc. Although these experiments are carried at certain time, the results may indicate the most frequent types of crimes in the community or it may indicate the types of crimes topics that attract the press more to write about them.

In general, it can be observed that all NB models are highly accurate crime filters. In addition, their performances are increased when the number of features is increased. The two-level NB classification approach has better performance than flat NB classification approach based on classification accuracy. In the crime web pages crawling and classifying task, the crime-focused crawling approach with two-level classification can crawl relevant crime web pages more effectively than its counterparts with flat classification throughout the whole crawling process. However, both approaches have high harvest rates.

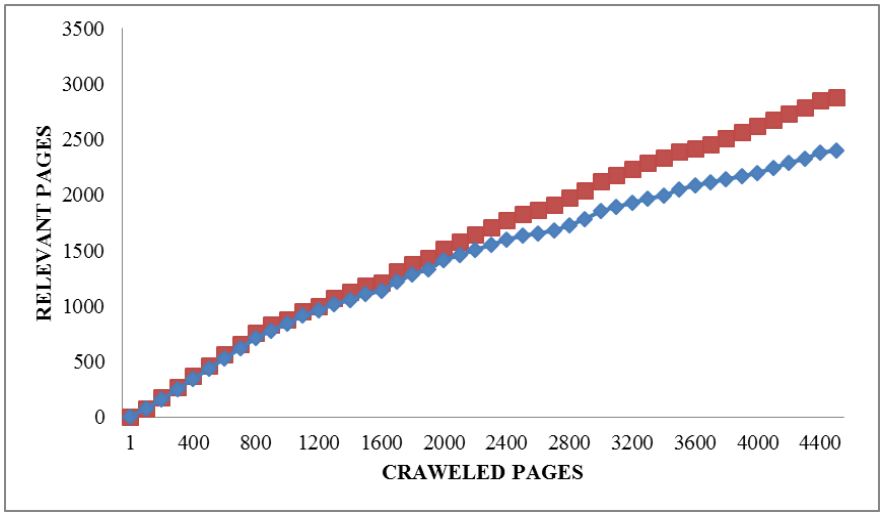

Figure 6: Harvest Rate of the Crime-Topic Crawler with Two-Level and Flat Classification methods

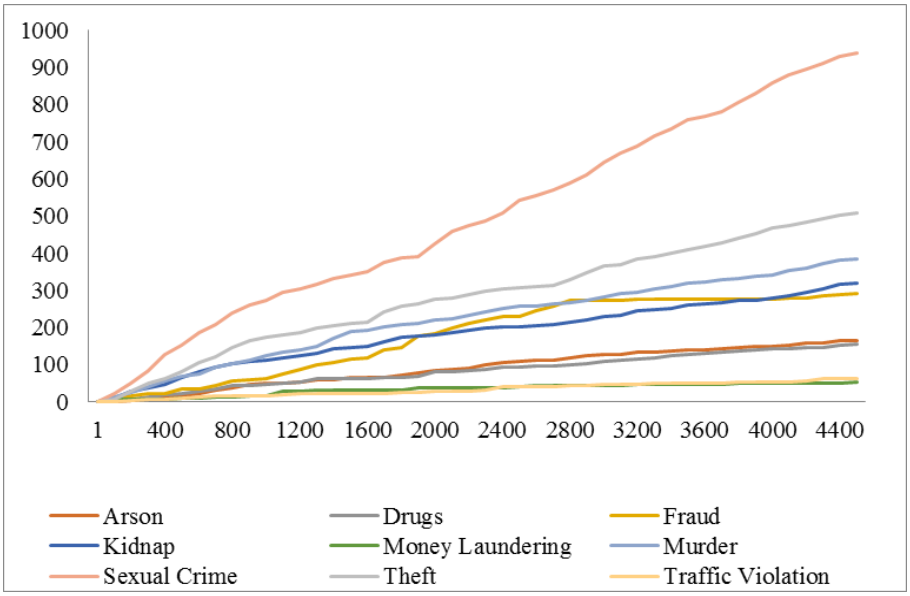

Figure 7: Harvest rates of the crawled pages for different crime classes (Percentage of Each Crime Type from the Crawled Pages)

6. CONCLUSION

This paper describes our work in crawling and classification the crime Web pages. In particular, we have proposed a new model for online crime text crawling and classification. The model consists of two levels. In the first level, crime-topic web pages is proposed to crawl web pages and to filter them to crime and non-crime documents using Naïve Bayes binary classification. In the second level, ,a multi-classes Naïve Bayes classification models are proposed to assign each crime documents to its appropriate crime type. The empirical study conducted using offline crime dataset has verified that the two-level proposed two level Naïve Bayes classification models are reliable classifiers for crime web pages. The empirical study also conducted using online Malaysian news web pages has verified that the proposed crawling and classification models creates high-quality web pages collections for each crime type.

In the future, we have identified several important directions for future research. We plan to will expand the multi-class classification methods into multi-label and multi-classes classification models in which a crime document can be assigned to more than one class. We also plan to integrate utilizes natural language processing technology and machine learning algorithms to analyze content, extracting useful information and to provide clear insight into the content of crime Web pages.

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نموذج مقترح لاسترجاع وفلترة وتصنيف بيانات الجرائم اون لاين من صفحات الويب

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ملخص

مع النمو الهائل للمعلومات النصية المتاحة من خلال الإنترنت، تواجدت الحاجة الملحة لاستخلاص المعرفة في الوقت المناسب حول موضوع الجريمة. الحجم الضخم لهذه البيانات يجعل من عملية استرجاع وتحليل واستخدام المعلومات القيمة في هذه النصوص يدويا مهمة صعبة جدا. هذه الورقة البحثية تحاول معالجة مهمة صعبة ونقصد بها هنا استرجاع واستخلاص بيانات الجرائم على شبكة الانترنت. للقيام بذلك، قدمت هذه الورقة البحثية لاستنباط المعلومات المتعلقة بالجرائم وتصنيفها. أولا، تم تصميم زاحف عنكبوتي على شبكة الإنترنت متخصص في ايجاد واسترجاع بيانات الجرائم الموجودة على الشبكة من المواقع الإخبارية. في هذا الزاحف، يتم استخدام نموذج تصنيف ثنائي بتقنية بايز لفلترة صفحات الجرائم من الصفحات الاخرى. ثانيا، يتم تطبيق نموذج تصنيف الى فئات متعددة لتصنيف صفحات الجرائم وتحديد نوع الجريمة. في كل الخطوات، يتم تطبيق عدة طرق لاختيار أفضل الميزات الأكثر أهمية. وأخيرا، تم تقييم النموذج على بيانات معدة يدويا وأيضا على بيانات العالم الحقيقي على الانترنت. النتائج التجريبية تظهر أن نموذج تصنيف بايز يمكن أن تصنف بدقة بيانات الجرائم وتحدد نوع الجريمة المناسب بنسبة 87 في المائة. وتشير نتائجنا أيضا على بيانات العالم الحقيقي على الانترنت ان الزاحف الذي يحتوي على مستويين لفلترة وتصنيف صفحات الجرائم فعال جدا وله قدرة جيدة لاسترجاع وتصنيف بيانات الجرائم من صفحات الويب

كلمات البحث: تنقيب بيانات الجرائم، تنقيب صفحات الويب، تصنيف الجرائم.

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Synthesis and Structural Characterization of Three Homotrinuclear Metal Complexes Stabilized by tetradentate N-isopentylidine hydrazinedithiocarbamate Schiff base Ligand

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ABSTRACT

The new tetradentate Schiff base ligand (L), which was used as stabilizers for homotrinuclear metal complexes were prepared from condensation of 3-pentanone and ammonium hydrazinedithio–carbamate have been used into in situ reactions with metal chlorides in molar ratio of 3 : 2 (M : L) in ethanol, leads to the Schiff base homotrinuclear metal complexes of the general formula [M3(L)2Cl2(H2O)2] where L = N-isopentylidine hydrazinedithio–carbamate and M= Co (II), Ni(II) and Cu(II), which have been characterized by elemental analysis, molar conductivity and magnetic susceptibility measurements, FT-IR and UV-Vis spectroscopy as well as MM2 calculation by using CsChem3D Ultra program package. The spectroscopic evidences and magnetic data exhibits presence of mixed properties for both the square planar configuration around the center metal ion and the tetrahedral configuration around the two terminal metal ions within the homotrinuclear units.

INTRODUCTION

Coordination chemistry of Schiff bases derived from dithiocarbamate with various metal ions leading to mono- or poly-nuclear complexes [1,2]. A successful of this strategy allowing for the control of the nuclearity consists in the ingenious use of compartmental ligands [3,4] which are organic molecules able to hold together two or more metal ions.

Moreover, discrete homo and hetro-polynuclear complexes have contributed to understanding of the factors governing the sign and magnitude of exchange interaction between paramagnetic ions, either identical or different [5]. Transition metal complexes of Schiff bases containing nitrogen and sulfur and other donors have been widely studied due to M-S, M-N and other bonds in their structure and the effects of the bonding on diversified applications basically in biological field [6,7]. In the 70s,M. Iskander and L. El. Sayd. used hydrazinedithiocarboxylic acid, as a precursor for the synthesis of Schiff base which behaved as monobasic bidentate ligand and giving only mononuclear nickel (II) complex containing a new Schiff base type N-isopropylidine hydrazinedithiocarbamate [8]. In this study we synthesized the homotrinuclear metal complexes containing a new tetradentate Schiff base type N-isopentylidine hydrazinedithiocarbamate by in situ reactions with metal chlorids, Co (II), Ni(II) and Cu(II), in 3 : 2 molar ratio metal ions to ligand (Fig. 1). The spectroscopoic and magnetic data confirm the presence of mixed properties for both the square planar configuration around the central metal ion and the tetrahedral configuration around the two terminal metal ions within homotrinuclear units.

EXPERIMENTAL

Chemicals

Hydrazine hydrate, carbon disulphide, ammonium hydroxide, $CoCl_2$. $6H_2O$, $NiCl_2$. $6H_2O$ and $CuCl_2$. $2H_2O$, 3-pentanone and ethanol (96%) were of analytical reagent grade (BDH, Aldrich or Fluka).

Instruments

The Schiff base homotrinuclear complexes were analyzed for carbon, hydrogen and nitrogen using 1106 (Carlo Erba) microanalyser. Infrared absorption spectra were recorded on a Unicam SP-2000 spectrophotometer as CsI discs in the range 4000-200 cm^{-1}. The magnetic susceptibility measurements were made by the Faraday method at room temperature using a Bruker B.M. 6 instrument. The electronic spectra were recorded on a Shimadzu UV/Vis spectrophotometer (range 200-1100 nm), model 160 Koyoto (Japan) using acetonitrile as a solvent. Conductivity measurements were carried out on 10^{-3} M solutions of the complexes in acetonitrile at room temperature on a digital conductivity meter, model 4070 (Jenway). The optimized geometry, steric energy and MM2 calculated of the prepared complexes were done using CsChem3D Ultra program package.

Preparation of the ligand

Ammonium hydrazinedithiocarbamate ($NH_2NHCS_2^-NH_4^+$) was prepared by the reaction of hydrazine hydrate with carbon disulphide in presence of ammonium hydroxide by known method [9].

Preparation of the complexes

0.033 mol of the hydrated metal chloride ($CoCl_2$. $6H_2O$, $NiCl_2$. $6H_2O$ and $CuCl_2$. $2H_2O$) was added to an ethanolic solution of the 0.022 mol of the ammonium hydrazinedithiocarbamate with 0.05 mol 3-pentanone. The mixture was refluxed for 15 min. and then cooled to room temperature. The product was then washed with ethanol and dried over P_2O_5 in a desiccator vacuum for 24 hr.

RESULTS AND DISCUSSION

Syntheses and physical Properties

The physical properties of the homotrinuclear metal complexes are tabulated in Table 1, the FT-IR data are listed in Table 2 and the UV–Vis and molar conductivities of the complexes are listed in Table. 3. The elemental composition of the prepared complexes $[M_3(L)_2Cl_2(H_2O)_2]$ is shown in Fig. 1, which is corresponds to 3 : 2 (metal : ligand). These complexes are insoluble in most organic solvent but are soluble in DMSO and DMF. They are quite stable in air and decompose above 250 ºC as shown in Table. 1.

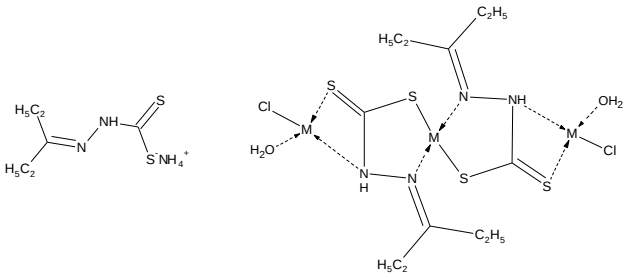

Figure 1: The Schiff base ligand and the suggested structures of complexes, where M=Co(II), Ni(II) and Cu(II).

Molar conductivity measurements

The conductivity of the three complexes are showed values ranging between 14.4-19.5 $ohm^{-1}cm^2\,mol^{-1}$ and are listed in Table 3, indicating non-electrolyte in DMSO [10].

Table 1. Physical properties of the Schiff base complexes.

Com. Seq.	Complex	Color	M.P (ºC)	% Analysis, found (calcd)			μ_{eff} (B.M)
				C%	H%	N%	
1	$[Co_3(L)_2Cl_2(H_2O)_2]$	Gray	250	20.88 (21.54)	3.08 (3.29)	7.96 (8.37)	2.92
2	$[Ni_3(L)_2Cl_2(H_2O)_2]$	Brown	300	21.32 (21.56)	3.17 (3.29)	8.19 (8.37)	3.85
3	$[Cu_3(L)_2Cl_2(H_2O)_2]$	Brown	260	20.78 (21.10)	3.17 (3.20)	7.98 (8.20)	1.02

IR spectra and mode of bonding

IR spectra and the mode of bonding values are shown in Table. 2.The significant increase and decrease in the absorption IR bands υ(C=N) and υ(C-S) and the appearing of a new bands υ(M-N) and υ(M-S) the most important band which appeared at 1663-1652 cm^{-1}

due to the υ(C=N) stretching in the homotrinuclear metal complexes, the shifted to the lower frequency which proves very clearly that the Schiff base had been formed during their in situ reactions with the metal chloride [10-14]. Another important band which at 1040-1025 cm^{-1} due to υ(C-S) stretching in the all complexes [14], the shifted to the higher frequency, which indicated that the ligand has a coordinate with two or more metal ions [15]. Addition support to this the appearance of new bands in the region 450-430 and 380-363 cm^{-1} due to υ(M-N) and υ(M-S) ,respectively, are further evidence of coordination [16,17]. These spectra also show bands in the region 280-247 and 510-483 cm^{-1} which may be due to υ(M-Cl) and υ(M-OH_2) stretching frequencies[18,19].

Table 2: Selected IR bands (cm^{-1}) of the complexes

Com. Seq.	υ(C-S)	υ(C=S)	υ(C-N)	υ(C=N)	υ(H_2O)	υ(M-N)	υ(M-S)	υ(M-Cl)
1	1040 m	973 s	1482 s	1652 m	483 s	448 s	363 m	270 m
2	1025 w	978 m	1467 s	1663 m	510 w	450 m	380 s	280 m
3	1032 m	980 s	1464 m	1658 m	496 m	430 s	367 s	247 m

For IR spectra, S = strong; m = medium; w = weak

UV-VIS spectra and magnetic susceptibility Measurement

The magnetic properties with μ_{eff} value of cobalt (II) complex 1 is 2.92 B.M. (Table. 1), which is in good agreement with the structure complex of both the square planer configuration around the central cobalt ion (Low spin) and the tetrahedral configuration around the two terminal cobalt ions (High spin) [20-25]. The slitly lower value is due to antiferromagnetic exchange interaction occurred when the ligand is coordinated with three cobalt ions. The electronic spectral band of the complex appearing at 11534 cm^{-1} (Table. 3), which attributed to the transition dxy→dyz in the square planer configuration [26,27] could be attributed to the tetrahedral configuration, which is the transition $^4A_2(F)\rightarrow{}^4T_1(F)$ (ν_2). The strong bands appeared at 13106-18021 cm^{-1} which attributed to the transition $^4A_2(F)\rightarrow{}^4T_1(P)$ (ν_3) in the distorted tetrahedral configuration and could be also attributed to the square planer configuration, which is the transition $^2A_1g\rightarrow{}^2E_1g'$.

The nickel (II) complex 2 gave μ_{eff} of 3.85 B.M. (Table. 1), the proportion higher value due to some orbital contributions for both the two terminal nickel ions (High spin) in the tetrahedral configuration, whereas the central nickel ion (Low spin) appeared to be diamagnetic [20,21,23]. This argument was supported by electronic spectral of obtained for this complex in the Table. 3. The electronic spectral bands at 13003-16320 cm^{-1} attributed to the transition $^3T_1(F)\rightarrow{}^3A_2(F)$ (ν_3), which is again assigned to a distorted tetrahedral configuration and could be also attributed to the square planer configuration, which is the transition $^1A_1g \rightarrow {}^1A_2g$ [28]. A single band at 21490 cm^{-1} due to transition $^1A_1g\rightarrow{}^1B_1g$ in the square planer configuration [29,30].

The copper (II) complex 3 showed magnetic properties with μ_{eff} value of 1.02 B.M. (Table. 1) [31], the lower value may be attributed to antiferromagnetic exchange interaction occurred on the adjacent copper ions within homotrinuclear units. The electronic spectra of

complex (Table. 3) showed one band at 16025 cm^{-1} attributed to the transition $^2B_1g \rightarrow {}^2Eg'$ in the square planer configuration [31,32], since the tetrahedral structure does not, usually, give electronic band in the range 10000- 20000 cm^{-1}.

Table 3: Electronic spectra and molar conductivity of the complexes (in DMSO).

Com. Seq.	Spectra (cm^{-1})	Λ_M ohm^{-1} cm^2mol^{-1}
1	11534, 13106, 14934, 18021, 21834, 27100, 28490, 29239, 32274, 35222	15.6
2	13003, 14341, 16320, 21490, 25706, 27027, 29498, 32467,33222	19.5
3	11086, 16025, 28985, 32467, 34222	14.4

Molecular modeling studies

In order to get finer structural details of these complexes, we have optimized and MM2 calculated the molecular structure of complexes. Therefore we could obtain the optimized geometry for each complex by competing the minimum steric energy and the theoretical physical parameters, such as bond lengths and bond angles using CsChem3D Ultra program package. The optimized structures of complexes 1 and 2 (Fig. 3 and 4) were some selected calculated parameters in coordination sphere (Table. 4 and 5). In complexes, coordination by chelation involving the various modes of sulfur, nitrogen, oxygen and chloride are possible. These results reveal presence of mixed properties for both the square planar geometry around the central metal ion and the tetrahedral geometry around the two terminal metal ions. All three studied complexes reveals minimum steric energies values (7.75 kcal/mol for Schiff base ligand, 59.78 kcal/mol for complex **1**, 52.28 kcal/mol for complex **2** and 86.236 kcal/mol for complex **3**) associated with mixed properties geometries. MM2 calculated is in good agreement with the experimental results and confirms the expected of mixed properties geometry.

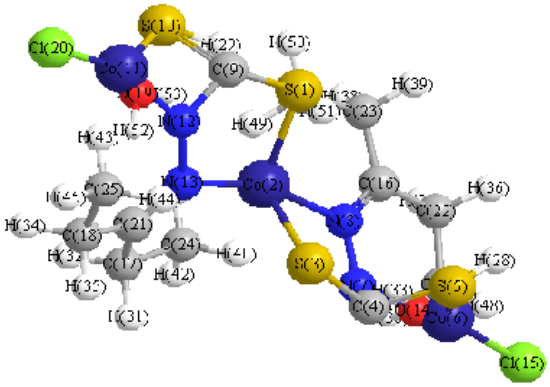

Figure 2: Optimized structure of cobalt (II) complex **1**

Table 4. Some selected calculated parameter of the **cobalt (II)** complex. **1**.

Bond lengths Å (Central ion)		**Bond lengths Å (Terminal ions)**			
S(7)-Co(1)	2.18	Co(10)-O(17)	0.60	N(5)-Co(13)	1.84
Co(1)-S(6)	2.18	Co(10)-Cl(16)	2.15	Co(13)-O(15)	0.60
N(4)-Co(1)	1.84	N(3)-Co(10)	1.84	Co(13)-Cl(14)	2.15
Co(1)-N(2)	2.16	S(7)-Co(1)	2.18	S(12)-Co(13)	1.88
Bond angles^{o} (Central ion)		**Bond angles^{o} (Terminal ions)**			
S(7)-Co(1)-S(6)	169.2	N(3)-Co(10)-O(17)	168.52	N(5)-Co(13)-O(15)	168.12
S(7)-Co(1)-N(4)	90.00	N(3)-Co(10)-Cl(16)	24.55	N(5)-Co(13)-Cl(14)	21.76
S(7)-Co(1)-N(2)	90.00	N(3)-Co(10)-S(11)	65.45	N(5)-Co(13)-S(12)	68.24
S(6)-Co(1)-N(4)	90.00	O(17)-Co(10)-Cl(16)	143.9	O(15)-Co(13)-Cl(14)	146.36
S(6)-Co(1)-N(2)	79.17	O(17)-Co(10)-S(11)	126.1	O(15)-Co(13)-S(12)	123.64
N(4)-Co(1)-N(2)	90.00	Cl(16)-Co(10)-S(11)	90.00	Cl(14)-Co(13)-S(12)	90.00

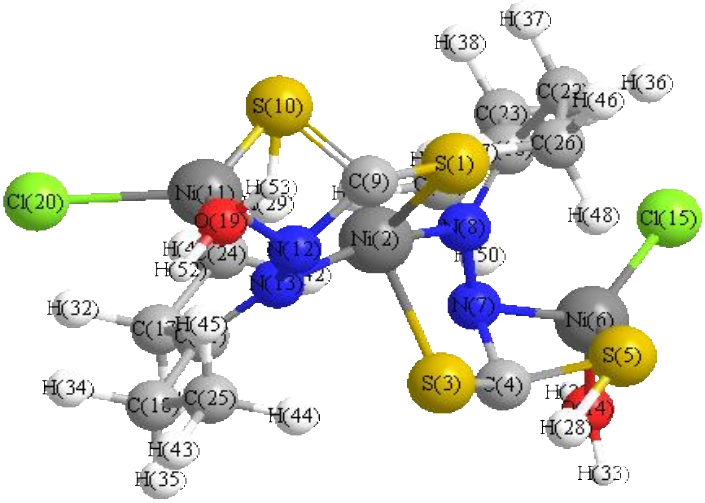

Figure 3: Optimized structure of nickel (II) complex **2**

Table 5: Some selected calculated parameter of the **nickel (II)** complex. **2**.

Bond lengths Å (Central ion)		**Bond lengths Å (Terminal ions)**			
N(8)-Ni(2)	2.13	N(7)-Ni(6)	1.83	O(19)-Ni(11)	1.79
N(13)-Ni(2)	1.83	Ni(6)-Cl(15)	2.14	S(10)-Ni(11)	1.91
S(3)-Ni(2)	2.17	S(5)-Ni(6)	1.69	Ni(11)-N(12)	1.83
S(1)-Ni(2)	2.17	O(14)-Ni(6)	1.79	Ni(11)-Cl(20)	2.14
Bond angles^o (Central ion)		**Bond angles^o (Terminal ions)**			
N(8)-Ni(2)-N(13)	96.49	O(14)-Ni(6)-S(5)	129.24	O(19)-Ni(11)-S(10)	131.4
N(8)-Ni(2)-S(3)	76.92	O(14)-Ni(6)-N(7)	129.24	O(19)-Ni(11)-N(12)	131.4
N(8)-Ni(2)-S(1)	109.5	O(14)-Ni(6)-Cl(15)	93.07	O(19)-Ni(11)-Cl(20)	91.83
N(13)-Ni(2)-S(3)	160.5	S(5)-Ni(6)-N(7)	72.62	S(10)-Ni(11)-N(12)	67.93
N(13)-Ni(2)-S(1)	90.00	S(5)-Ni(6)-Cl(15)	117.7	S(10)-Ni(11)-Cl(20)	118.6
S(3)-Ni(2)-S(1)	109.5	N(7)-Ni(6)-Cl(15)	117.7	N(12)-Ni(11)-Cl(20)	118.6

CONCLUSION

New N-isopentylidine hydrazinedithiocarbamate Schiff base ligand with their of the type $[M_3(L)_2Cl_2(H_2O)_2]$ were synthesized. The mixed properties structures of the homotrinuclear metal complexes were characterized by FT-IR and UV-Vis spectroscopy and magnetic susceptibility measurement in addition to MM2 calculation by using CsChem3D Ultra program package. The spectroscopic and magnetic data confirms presence of mixed properties for both the square planar configuration and the tetrahedral configuration. The tetradentate Schiff base is used as stabilizer ligand for homotriuclear metal complexes and according to the measurements and MM2 calculations, the Co (II), Ni(II) and Cu(II) complexes have mixed properties for both the square planer geometry around the central metal ion and the tetrahedral geometry around the two terminal metal ions. The MM2 calculations were performed to obtain the theoretical information on the geometry which is identical with the experimental results.

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تحضير و تشخيص ثلاثة من المعقدات الفلزية ثلاثية النوى المتجانسة استقرت بليجاند قاعدة شيف الرباعية السن n–ايزوبنتليدين هيدرازين ثنائي ثايوكارباميت

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ملخص

ليجاند قاعدة شيف الجديدة رباعي السن (L) استعملت لاستقرار المعقدات الفلزية ثلاثية النوى المتجانسة. حيث تم تحضيرها بالتفاعل موضعيا و ذلك بتكثيف 3-بنتانون و هيدرازين ثنائي ثايوكارباميت الامونيوم مع كلوريد الفلزات وبنسبة مولية 2 : 3 (فلز : ليجاند) في الايثانول، تمتلك المعقدات الفلزية ثلاثية النوى المتجانسة الصيغة العامة $[M_3(L)_2Cl_2(H_2O)_2]$ حيث n = L- ايزوبنتليدين هيدرازين ثنائي ثايوكارباميت وM= Co (II), Ni(II) and Cu(II) . لقد تم تشخيص المعقدات عن طريق التحاليل الدقيق للعناصر و التوصيلية المولارية الكهربائية و الحساسية المغناطيسية و اطياف الاشعة تحت الحمراء و الاطياف الالكترونية بالإضافة الى حساب MM2 عن طريق (CsChem3D Ultra program package). إذ دلت القياسات المغناطيسية و الطيف الالكتروني على وجو خليط من ترتيب المربع المستوي حول ايون الفلز الوسطي و ترتيب الرباعي السطوح حول ايوني الفلز في الاطراف ضمن وحدات ثلاثي النوى المتجانسة.

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Development of Thermal and Electrical Properties of Poly(vinyl alcohol)/ Poly(ethylene glycol) Based on solid Electrolyte and Nanocomposite

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ABSTRACT

Polymer Nano composites and lithium polymer electrolytes are always scientifically speaking. It is formed by dissolving Multiwalled carbon nanotubes(MWNT) and lithium salt in poly(ethylene glycol), poly(vinyl alcohol) blends with the aim of developing new types of polymer composite characterized by enhanced thermal stability, as well as by improved electrical properties. The interaction of the MWNT and LiNO3 with the polymer blend were confirmed by a Fourier transform infrared (FTIR) spectroscopy study. The thermal properties of the polymer blend with the MWNT were carried out by means of differential scanning calorimetry (DSC). It is evident from DSC that the polymer/MWNT had a decreased of Tm and heat crystalline fusion(ΔHc) with of increased MWNT. Scanning electron microscopy is used to study the dispersion of the MWNT and LiNO3 in the polymer blend. Electrical conductivity was observed for PVA/PEG/MWNT containing 0.40 wt % MWNT was 7.98 X10-7S/cm where the PVA/PEG was 8.31 X10-8S/cm also electrical conductivity of PVA/PEG/LiNO3 containing 40wt % was 1.02 X10-7S/cm. Relative changes in the conductivity of blends with different concentrations and temperatures are analyzed.

INTRODUCTION

In recent years solid polymer electrolytes have become a subject of great interest due to their potential applications in rechargeable batteries, fuel cells, sensors, electrochromic display devices, smart windows and other applications[1,2].

The development of solid polymer electrolytes with high ionic conductivity at ambient and sub-ambient temperature has been made extensively due to its potential applications in electrochemical devices, such as high energy-density batteries, electrochromic devices and chemical sensors[3,1]. The PVA based lithium salts complexed electrolytes for the application in electric double layer capacitors was studied. Magnesium acetate $Mg(CH_3COO)_2$ and magnesium nitrate $Mg(NO_3)_2$are mixed in equal wt% and are used as the salt for this system[4]. Most of the solid polymer electrolytes are reported based on alkali metal salts[5], alkaline earth and other divalent and trivalent metal salts [6]. Polyethylene glycol (PEG) based composite gel electrolytes using polyvinyl alcohol (PVA) as guest polymer have been synthesized with 1M solution of ammonium thiocyanate (NH_4SCN) in dimethylsulfoxide(DMSO)[7]. In addition to the discovery of carbon nanotubes (CNT) in 1991[8] which was the realization of their unique physical properties including mechanical, thermal, and electrical, many investigators have endeavored to fabricate advanced CNT composite materials that exhibit one or more of these properties[9,10,11].

CNT owing to their outstanding electrical conductivity, small diameter, light weight, high aspect ratio, high thermal and air stabilities, are superior fillers for electrically conductive polymer composites. One of the main reasons for the incorporation of conductive nanoparticles into a polymer matrix is the production of conductive materials ambiguous new applications, such as electromagnetic interference (EMI) shielding, electrostatic dissipation and gas sensors[12,13].

Electrical conductivity can be explained by the established percolation theory[14] with an onset of the conductivity when a critical filler concentration commonly named percolation threshold is reached to form conductive pathways. The percolation threshold of nanotubes filled composites primarily is dependent on the processing methods, eventually on the dispersion of the SWNT or MWNT in a matrix. Direct blend of carbon nanotubes and a thermoplastic polymer by melt processing results in a high threshold since the dispersion of the very thin tubes is not facile[15].

Miscible polymer blends are attractive host materials to which CNT can be inserted because this type of mixture has a degree of mixing down to the molecular level. Many literature reports deal with the addition of CNT as fillers into polymer matrices; however, just a few researchers have investigated the effect of adding CNT to a polymer matrix specifically formed by a miscible polymer blend. Because of CNT are typically insoluble in organic solvents and severely bundled, their homogeneous dispersion in a desired polymer matrix is difficult to achieve. The dissolution of CNT in common organic solvents has been described[16–18]. We investigate the effects of different ratios of MWNT and $LiNO_3$ on the morphology, thermal and electrical properties of PVA/PEG blends. The interaction of the MWNT and $LiNO_3$ with the polymer blend were confirmed by a Fourier transform infrared (FTIR) spectroscopy study.

EXPERIMENTAL

Materials

Polyvinyl alcohol (PVA) of molecular weight 67000 was supplied by Fluka, Polyethylene glycol (PEG) with an average molecular weight of 3500-4500 and melting point (mp=58-64◦C) was obtained from Scharlu, dimethylsulfoxide (DMSO) was supplied by Aldrich with purity 99.9%. Multi-walled carbon nanotubes (MWNT) with diameter 10

nm, length 0.1–10 micron and purity 90%, was supplied by Nanocyl S. A, Lithium Nitrate ($LiNO_3$) was supplied by Merck.

Preparations

The blends were prepared by solution casting using DMSO as solvent. In the first part of the work PVA/PEG were blended in several weight percent ratios and dissolved in DMSO. The solutions are stirred overnight and then poured into glass dishes and allowed to evaporate at 120 ºC under vacuum.. The selected weight ratio PVA:PEG (50:50) was selected for the second part of the experiments. Here, different weights of MWNT (0.1, 0.2, 0.3, 0.4wt %) and (10, 20, 30, 40 wt %) from $LiNO_3$ were mixed into the chosen ratio of PVA/PEG.

Instruments

Differential scanning calorimetry (model-DSC-910) was used to measure the thermal properties for prepared samples. The sample was heated at a scanning rate of 10°C/min from 20 to 500 °C under a nitrogen gas.

FTIR spectra (SHIMADZU, FT-IR Spectrometer, Scimitar) was used to measure the polymer blends and its composites carried out with KBr pellets

SEM (JSM-6380 LA) used to examine the surface morphology and microstructure or to investigate the inner microstructure from fracture cross-sections.

RESULTS AND DISCUSSIONS

The DSC thermal analysis results for PVA/PEG(1:1) and PVA/PEG(1:1) + 0.1wt% MWNT are shown in Figures 1 and 2 respectively show typical DSC curves of PVA/PEG and PVA/PEG/MWNT Nano composite at the range from 20–500ºC. The results and the area of heat crystalline fusion (ΔHc), Tm, and thermal degradation of PVA/PEG blend, and PVA/PEG/MWNT, were shown in Table 1.

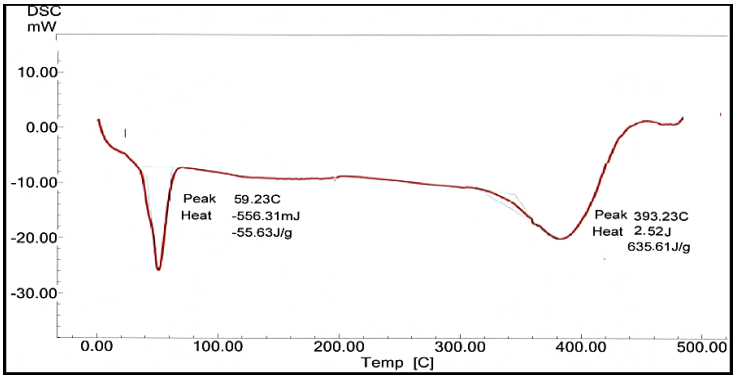


Figure 1: DSC curve of PVA/PEG blend (1:1).

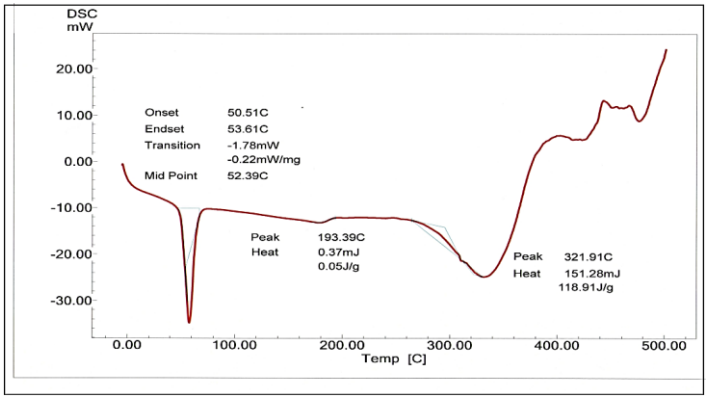


Figure 2: DSC curve of PVA/PEG blend (1:1)+ 0.1wt%MWNT.

The DSC of PEG shows an endothermic peak at 62.21ºC with a Heat of fusion of 186.57 J/g. with increased the ratios of PVA in the blends from (186.57J/g) for a net PEG to (55.63J/g), (24.63J/g) and (3.91J/g) for the ratios (1:1), (2:1) and (3:1) of PVA in the blend. This behaviors clearly observed with the decreased in the area of melting crystalline peaks.

The T_m was about (59.56ºC) and (57.86ºC) respectively for the higher ratio of PEG with (1:2) and (1:3). The heat of crystalline fusion of blend (ΔH_c) increased as the PEG content increased from (55.63 J/g) in equal ratio to (135.45J/g) for (1:3) PVA/PEG in blend. Higher arise in the heat of fusion indicates a higher crystallinity of the PEG in blend composites.

The effect of the MWNT composition on the thermal degradation T_d values of the PEG/PVA/MWNT; there was an apparent decrease in the T_d of the PEG/PVA film from 339.23ºC to approximately 321.19ºC in content of MWNT(1:1) and decrease with increasing MWNT content (0.1–0.2 wt %). Also T_m increasing when increased of MWNT contents (0.1–0.2 wt %) from 50.51 to 57.68ºC. This decrease in the crystallinity was due to the nanotubes impeded the crystallization formation[19].

Figure 3 Shown the FTIR spectra of the PVA/PEG/MWNT composites were analyzed to confirm the interaction between the polymer blends and the MWNT. The PVA/PEG blend (1:1) spectrum shows absorbance peak of (OH) at 3440 and shifted to 3384cm^{-1} for PVA /PEG/MWNT[20] these change were more broadened in (b, and c) and disappearance in (d, and e) with increases of MWNT content. The (PVA/PEG) band, originally appearing at 1600 cm^{-1}, shifted slightly to 1640 cm^{-1} for the PVA/PEG/MWNT composite which demonstrates a small shift of the (PVA/PEG) and OH peaks following the MWNT embedding compared PVA/PEG blend.

Table 1: The results of DSC curves for all samples (Tm, ΔH_C, ΔHm, Td).

Compound	ΔH_C [J/g]	T_m [ºC]	ΔH_m [J/g]	Thermal degradation Td [ºC]
PVA	-439.61	224.35	-	-
PEG	-186.57	62.21	-	-
PVA/PEG (1:1)	-55.63	59.23	635.61	393.23
PVA/PEG (2:1)	-24.63	54.53	-	-
PVA/PEG (3:1)	-3.91	55.51	-	
PVA/PEG (1:2)	-129.61	59.56	-	-
PVA/PEG (1:3)	-135.45	57.86	-	-
PVA/PEG (1:1)+ (0.1wt.%)MWNT	-	50.51	118.91	321.19
PVA/PEG (1:1)+ (0.2wt.%)MWNT	-76.76	57.68	85.26	310.24

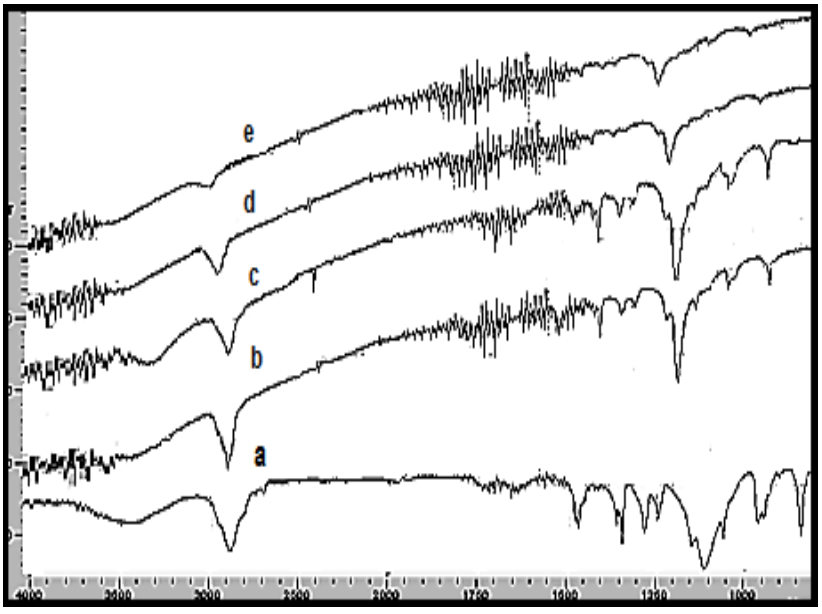


Figure 3: FTIR spectrum for (a)[(PVA/PEG)blend(1:1)], [(b, c, d, e) for blend(1:1)+ (0.1, 0.2 , 0.3 and 0.4wt.%) of MWNT respectively.

The FTIR spectra of the PVA/PEG/$LiNO_3$ blends were analyzed to confirm the interaction between the polymer blends and the $LiNO_3$. The PVA/PEG/$LiNO_3$ spectrum shows absorbance peaks at 2741 cm^{-1} of (-CH_2), 3440 cm^{-1} of (-OH), to blend of (PVA/PEG), characteristic of the polymer composite. The inset in Figure 4 demonstrates a change (-OH) band from3450 to more broadened in (b, c) and disappearance in (d,e) with increases of $LiNO_3$ concentrations. The peak for (C-O-) can be observed this change at ~(1248)cm^{-1}which shift to ~(1253,1257)$cm^{-1}$and from ~(1344)cm^{-1} to ~(1347-1352)cm^{-1} in

(b) to (c)respectively, this change due to coordination of lithium ions to the oxygen atom which has been reported elsewhere [21,22]. The absorption peak can be de-convoluted into two components centered at about ~(685 and 750) cm^{-1}, respectively. The band at ~(685) cm^{-1} is attributable to the free NO_3^- and the (750,776) cm^{-1} mode is assigned to the ion-pair formation or the contact of NO_3^- with lithium ion. The ratio of peak areas in (685) and (750,776) cm^{-1} can be used as an index of the degree of ionization of the lithium salt in the polymer blend electrolytes[23].

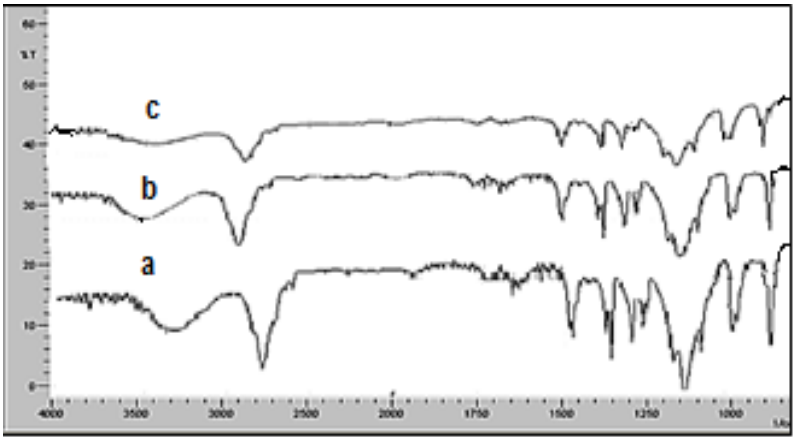
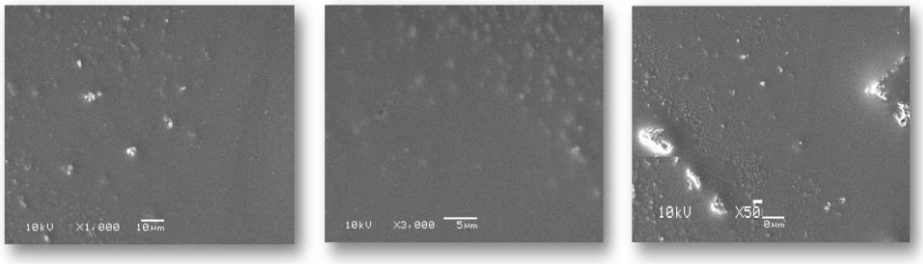


Figure 4: FTIR spectrum for (a)[(PVA/PEG)blend(1:1)], [(b,c)]for blend(1:1)+ (10,and 40wt.%) of $LiNO_3$ salt respectively.

The morphology of PVA/PEG films and MWNT dispersion in PVA/PEG composite films were observed by scanning electron microscopy (SEM) to determine miscibility of polymer blends. The uniformity of the dispersion of the solution cast films of PVA and PEG ratio (1:1), PVA/PEG with $LiNO_3$ and PVA/PEG with MWNT blend compositions were examined through SEM and the corresponding micrographs are as shown in Figure5(a, b and c). Figure5, b shows that in the PVA/PEG blend (1:1) with (0.4wt.%) of MWNT was observed network structure and relatively good dispersion of MWNT in PVA/PEG(1:1) blend. The similar result by electron microscopy was shown improve uniformity of the PEG/nano composite[24]. Whereas Figure 5, c shows the PVA/PEG blend(1:1) with (10wt.%) of $LiNO_3$ salt, which shows that the size of spherules have been reduced and dispersed completely and showed single phase while adding $LiNO_3$ content to the blend as observed in previous literature[25].



(a) (b) (c)

Figure(5):a; SEM for (PVA/PEG)blend (1:1), b; SEM for (PVA/PEG)blend(1:1)+0.4 wt.% MWNT, c; SEM for (PVA/PEG)blend (1:1) +10 wt.% $LiNO_3$.

The measurements of the ionic conductivity of the PVA/PEG blend (1:1) and PVA/PEG/MWNT composites were carried out at different concentrations in the temperature range (303 – 343) K.

The conductivity activation energy of the polymer composite at 303K were calculated by using flowing equation

$$\sigma = \sigma_o \exp\left[\frac{-E_a}{k\ T}\right]$$

Whereas Ea is the conductivity activation energy, K is Boltzmann's constant, and σ_o is the pre-exponential factor and includes the charge carrier mobility and density of state

Conductivity activation energy for PVA/PEG/$LiNO_3$ has been calculated in the same way connectivity for calculating for PVA/PEG/MWNT in accordance of above equation. The semi logarithmic plots of Ln σ vs. T^{-1} illustrated in figure 6. Activation energy Ea values of 325.23 and 296.3 m.ev for PVA/PEG and PVA/PEG/$LiNO_3$, respectively. The corresponding values of activation energies are shown in Table 2. For all compositions of PVA/PEG blend with $LiNO_3$ salt, the conductivity increases with increase of temperature. It was for PVA/PEG without Lithium salts about 8.3×10^{-8} S/cm at 303K and about 9.68×10^{-8} S/cm at 343K. The increase of temperature causes the increase in conductivity due to the increase of free volume and their respective ionic and segmental mobilities. This increase in free volume would facilitate the motion of ionic charges[26]. However, the conductivity is found to increase with increase of salt content which was added to blend and showed conductivities range from 8.66×10^{-8}S/cm to1.02×10^{-7} S/cm at 303K for different salt ratios. It was also found that the activation energy values increased with increasing concentration of $LiNO_3$.This may be due to the fact that the addition of salt forms charge transfer complexes in the host lattice[27]. These charge transfer complexes increase the electrical conductivity by providing additional charges in the lattice, resulting in a decrease of activation energy.

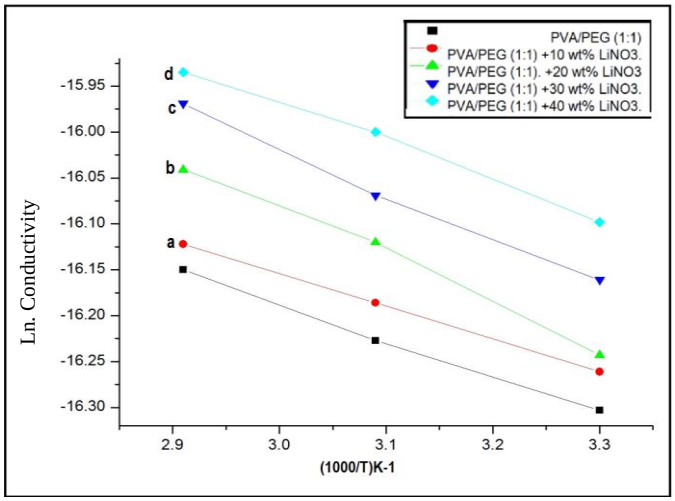


Figure 6: Arrhenius plots of PVA/PEG/$LiNO_3$ composites with (a) 10 wt %., (b) 20wt %, (c) 30 wt %, (d) 40 wt % of $LiNO_3$.

Table 5: Activation energy for PVA/PEG/$LiNO_3$ electrolyte.

Compound	σ (S/cm)	Ea (m.eV)
(PVA/PEG) blend (1:1).	8.31×10^{-8}	325.23
blend (1:1) +10wt.% $LiNO_3$ salt.	8.66×10^{-8}	296.3
blend (1:1) +20wt.% $LiNO_3$salt.	8.82×10^{-8}	432.1
blend (1:1) +30wt.% $LiNO_3$ salt.	9.58×10^{-8}	408
blend (1:1) +40wt.% $LiNO_3$salt.	1.02×10^{-7}	348.5

Conductivity of a neat PVA/PEG has increased by two orders from 1. 8.3×10^{-8} s/cm at 303K to 9.66×10^{-8} S/cm when (0.1wt%) MWNT was added, where a value of activation energy Ea decreased from 325.46 to 167.1 respectively . Generally, activation energy Ea values, still low with further increase of MWNT content in composite, as shown in Table 3. A sharp increase of conductivity was observed at 0.3wt%. The main factor influencing in conductivity for composite was the concentration of the filler particles. At low filler content the conducting particles are separated and the electric current is low[28]. While at filler content increase the percolation threshold appears. So, the conductivity rises over several orders. Conductivity for composite increases with an increase of MWNT content Up to (0.4wt%) MWNT in blend, the conductivity increases to [7.98×10^{-7} S/cm] at the same temperature which increased by (two orders) of magnitude as compared with pure PVA which is about 10^{-10}S/cm, and one orders of magnitude compared with neat PVA/PEG. This result also shows improvement in conductivity when added MWNT to blend comparison with PVA/MWNT composite which observed by Literature[29] .

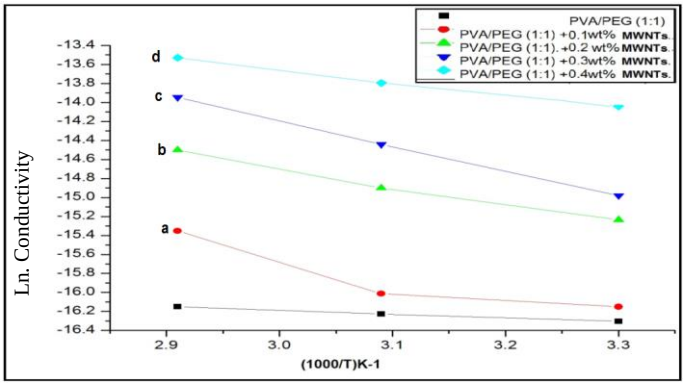


Figure 7: Arrhenius plots of PVA/PEG/MWNT composites with (a) 0.1 wt%, (b) 0.2 wt %, (c) 0.3 wt % and (d) 0.4 wt % of MWNT.

Table 3: Activation energy for PVA/PEG/MWNT composites.

Compound	σ (S/cm)	Ea (m.eV)
(PVA/PEG)blend (1:1)	8.31×10^{-8}	325.23
blend(1:1)+(0.1wt.%) MWNT	9.66×10^{-8}	167.1
blend(1:1)+(0.2wt.%) MWNT	2.42×10^{-7}	155.8
blend(1:1)+(0.3wt.%) MWNT	3.12×10^{-7}	220
blend(1:1)+(0.4wt.%) MWNT	7.98×10^{-7}	108.6

CONCLUSION

The studied Poly(vinyl alcohol)/Poly(ethylene glycol) composites containing Multiwalled carbon nanotubes or $LiNO_3$ have been successfully prepared through solution cast method.

The thermal properties, morphology and interaction between studied polymers have been characterized by using DSC, SEM and FTIR. The PEG showed miscible with the high molecular weight PVA and show that the PVA/PEG blend with ratio (1:3) has greater enthalpy (135.45J/g) than blend with (3:1) which was (3.91 J/g) and the blend was appeared thermal stability (393.23°C) for an equal ratio .The SEM technique indicates that, the PVA/PEG with an equal ratio in blend were given network structure, relatively good dispersion, and sizes of spherules have been reduced. It was confirmed by appearance of newly peak and shifted the wave numbers for other peaks in FT-IR spectrum.

Composites were produced by solution mixing of PVA/PEG with different weight ratios of $LiNO_3$ and MWNT. The addition of 40wt.% $LiNO_3$ exhibits an improving in conductivity with a value of 1.07×10^{-7} S/cm by one ordered magnitude. It was found that the electrical conductivity of PVA/PEG(1:1) is 8.66xl0^{-8}S/cm where the highest electrical conductivity was observed for PVA/PEG/MWNT containing 0.40wt.% MWNT with a

conductivity of 7.98×10^{-7} S/cm. In comparing with PVA/PEG/$LiNO_3$ (40wt.% $LiNO_3$) and PVA/PEG/MWNT (0.40 wt.% MWNT), it was found that the electrical conductivity improved by one ordered magnitude and two ordered magnitude respectively.

As a result, the thermal and electrical properties of PVA/PEG/MWNT composites are significantly better than PVA/PEG blends and PVA/PEG/$LiNO_3$. These composites promise a new opportunity for the design of low cost polymer composites for numerous future applications such as solar energy utilization, sensors and electronic devices.

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تطوير الخصائص الحرارية والكهربائية للبولي (فينيل الكحول) / بولي (جلايكول الإثيلين) معتمداً على الالكتورليت والخلائط النانوية

عبدالله الحسام و نايف الطيار و جميل قاسم

قسم الكيمياء ، كلية العلوم التطبيقية ، جامعة ذمار ، ذمار، اليمن

ملخص

نظرا لتزايد الاهتمام بمركبات النانو بوليمر وبوليمرات املاح الليثيوم الاليكتروليتية فقد تم تحضير خلائط بوليمرية وذلك بإذابة كل من (MWNT) و ملح نترات الليثيوم كلا على حده في خليط البولي إيثلين جليكول مع البولي فينيل الكحول (PVA/PEG) بهدف تطوير وتعزيز صفات هذا الخليط البوليمري كزيادة الاستقرار الحراري وتحسين الصفات الكهربائية. تداخل وتشابك كلا من (MWNT) و ملح نترات الليثيوم كلا على حده في خليط البولي إيثلين جليكول مع البولي فينيل الكحول تم اثباته بواسطة طيف الاشعة تحت الحمراء (FTIR) . الصفات الحرارية لخليط البوليمر مع (MWNT) قد تم دراستها بواسطة المسح الحراري المسعري (DSC) والذي بين ان قيم (ΔH_c , Tm) تتناقص مع زيادة نسبة (MWNT) في الخليط. المسح الاليكتروني الميكروسكوبي (SEM) استخدم لدراسة انتشار وتوزيع ($LiNO_3$, MWNT) في الخليط البوليمري. التغيرات النسبية في التوصيلية الكهربائية للمخاليط البوليمرية المحضرة بنسب تراكيز مختلفة لكل من ($LiNO_3$, MWNT) وعند درجات حرارة متغيرة تم دراستها والتي اوضحت تحسن في التوصيلية الكهربائية عنها في خليط (PVA/PEG) بمفرده.

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Synthesis, Characterization and Study of DC Electrical Conductivity of Poly[MWCNT/Ester] Composites

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ABSTRACT

The Poly [MWCNT/ester] composites were synthesized by solution blending method from reacted MWCNT-COOH with Hydroquinone (HQ), Catechol (CA) and Ethylene glycol (EG).The obtained poly-composites were characterized by FT-IR, UV-Vis, XRD, TEM, SEM, TGA, DSC and DC electrical conductivity. The formation of Poly[MWCNT/ester] composites was confirmed. The DC electrical conductivity of poly-composites was in the range 10-6-10-4 S/cm due to the interaction between the nanotubes.

Key words: MWCNT; Polymer nanocomposites; Solution blending; Polyester; Catechol; Hydroquinone; Ethylene glycol; FTIR;SEM, TEM, XRD; UV; DSC; TGA and DC electrical conductivity.

1 INTRODUCTION

Polymer nanocomposites with CNT filler have been around almost as long as CNTs themselves, with the publication of the first report on this topic by Ajayan *et al.*[1] in 1994.The interest in this area stems from the fact that polymers offer many desirable qualities, such as toughness, space saving, low

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weight, good surface finish, flexibility, and low cost. Using CNTs as a property enhancing nanofiller for a high performance, lightweight composite is one of the lynchpins of nanocomposite research. The exceptional and unique properties of CNTs offer a significant advantage for the production of improved composites; but their utilization within a matrix depends primarily on the relationships between the matrix and nanoconstituent, specifically the particle's spatial orientation and interactions at the particle interface[2]. There are currently several methods used to process polymer/carbon nanotube composites, including melt mixing[3], in situ polymerization[4] and Solution Blending[5]. Many research efforts have been directed toward producing MWCNT/Polyester Nanocomposites. Abuilaiwi *et al.*[6]reported the functionalization of MWCNTs via the Fischer esterification method. Four functional groups: phenol, dodecylamine, 1-octadecanol and polyethylene glycol were covalently attached to MWCNTs via amidation or esterification. A similar reaction was reported by Sobkowicz *et al.*[7]. Fischer esterification of surface hydroxyl groups on multi walled carbon nanotubes. E.Y. Malikov *et al.*[8] reported that Fischer esterification approach was used to graft poly vinyl alcohol (PVA) to oxidized MWCNTs by connecting the MWCNTs to the PVA via ester groups. Other examples of esterification reactions include the grafting of poly(bisphenol-A-co-epichlorohydrin) chainstooxidized MWCNTs by a reactive blending process and the grafting of hyper-branched polyester based on 2,2-bis (methylol) propionic acid to the surfaces of MWCNTs [9],[10].

In this paper, we report on synthesis, characterization and DC electrical conductivity at room temperature of four Poly[MWCNT/Ester] Composites. These Poly[MWCNT/Ester] Composites were obtained via polymerization of the MWCNT-COOH with HQ, CA and EG. These composites have been characterized by FTIR, SEM, TEM, XRD, UV, DSC, TGA and DC electrical conductivity.

2 EXPERIMENTAL

2.1 Materials

Carboxy Multi Walled Carbon Nanotubes (MWCNT-COOH) were purchased from Timesnano (Chengdu Organic Chemicals Co. Ltd., Chinese Academy of Sciences) China. The diameter and length of MWCNT ranged between 8-15 nm and 50 μm respectively. Purity was over >95%, and the carboxyl group coverage over the nanotube surface of (2.56 %wt.). Catechol (CA), Hydroquinone (HQ) and Dimethylsulfoxide (DMSO) were purchased from Scharlau. N,N-Dimethylformamide (DMF 99%), Tetrahydrofuran (THF 99.9%), Ethylene glycol (EG) were purchased from Aldrich. Ethanol (96%) was purchased from Fluka and used as received without any further treatment in this study.

2.2 Instrumentation

The FTIR spectra were recorded using the KBr disc technique on a JASCO 410 FTIR Spectrophotometer (at Sana'a University, Sana'a, Yemen). The melting points were measured with an electrothermal melting point apparatus (at Sana'a University, Sana'a, Yemen). The thermal analyses (TGA and DSC) were carried out on a Mettler Toledo TGA/SDTA851e analyzer, and Mettler Toledo DSC823e analyzer, respectively, at 23 to 1000 ºC under 20 ml nitrogen per minute and a heating rate of 10 ºC per minute (at UPM AND UM Universities, Kuala Lumpur, Malaysia). UV-vis absorption spectra were measured using a Specord 200, Analytik Jana, Germany in DMF (~10-4 mol/dm3) (at

Sana'a University, Sana'a, Yemen). The X-Ray diffraction was carried out on a BrukerAxs Da Advance, Germany (at UPM AND UM Universities, Kuala Lumpur, Malaysia). Electrical conductivity measurements were taken on a Keithley Picoammeter/Voltage Source Model 6487 using a double probe locally fabricated conductivity bridge cell (at Sana'a University, Sana'a, Yemen). The Scanning Electron Microscope (SEM) was carried out on a (SEM HITACHI S-3400N) (at UPM AND UM Universities, Kuala Lumpur, Malaysia). The Transmission Electron Microscope (TEM) was carried out on a Phillips CM-12, USA, the samples were prepared by Leica ultracut UTC ultramicrotome (JEOL, Japan) with an accelerating voltage of 100 kV.

2.3 Preparation of Poly[MWCNT/ester] composites

The method employed to prepare the Poly-composites was solution blending. This method is the most widely used for dispersing nanotubes on the laboratory scale because it is effective and it can be used to fabricate small amounts of a sample. Solution processing begins by dispersing nanotubes in solvent, followed by mixing with the monomer that is dissolved in a suitable solvent. The poly-composite is then formed by precipitation or by evaporation of the solvent [11,12].

2.3.1 Preparation of poly-composites of MWCNT-COOH with HQ or CA

0.3 g of MWCNT-COOH was dispersed in 15 ml of DMSO and 0.2 g of (HQ or CA) was dissolved in 10 ml of ethanol and added to the MWCNT-COOH dispersion in DMSO. The mixture was then stirred at 180 °C for 24 h under reflux. After cooling to room temperature, the mixture was vacuum-filtered through a 0.22 µm membrane and was thoroughly washed several times with little amount of ethanol. The filtered solid was then dried in a vacuum oven at 90°C.

2.3.2 Preparation of poly-composite of MWCNT-COOH with EG:

0.3g of MWCNT-COOH was dispersed in 15 ml of DMF and 1 ml of EG was added to the MWCNT-COOH dispersion in DMF. The mixture was then stirred for 24 h at 90 °C under reflux. After cooling to room temperature, the mixture was vacuum-filtered through a 0.22 µm membrane and was thoroughly washed several times with ethanol. The filtered solid was then dried in a vacuum oven at 90 °C.

3 RESULTS AND DISCUSSION

3.1 Characterization

Poly[MWCNT/ester] composites were prepared by reaction MWCNT-COOH with (HQ, CA and EG) in refluxing solvent (DMSO) to give poly-composites products. The method used to prepare the Poly[MWCNT/ester] composites was solution blending. The chemical reaction of Poly[MWCNT/ester] composites is shown in Figure 1. Table 1 summarizes the physical properties (melting point, color, percentage yield and solubility) of MWCNT-COOH and Poly[MWCNT/ester] composites. Generally, these compounds showed good solubility mainly in DMSO, and either partially soluble or insoluble in the other common organic solvents.

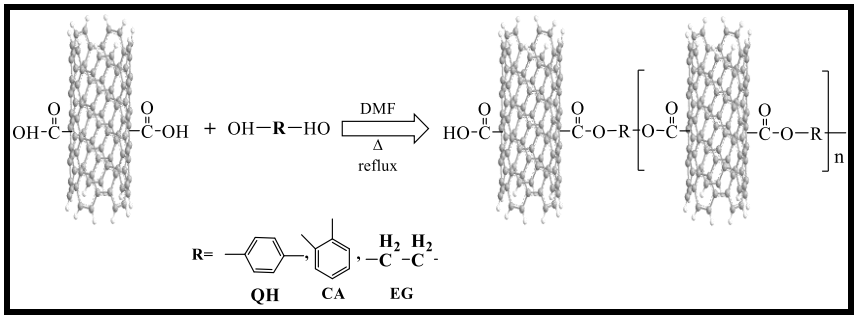

Figure 1: Synthesis of Poly[MWCNT/ester] composites.

Table 1: Physical properties of MWCNT-COOH and of Poly[MWCNT/ester] composites.

No	Symbol	%Yield	Color	M.P.	Solubility		
					DMSO	DMF	EtOH
1	MWCNT-COOH	-	Black	> 350°C	++	+	-
2	Poly[MWCNT/HQ]	98%	Black	> 350°C	++	+	-
3	Poly[MWCNT/CA]	90%	Black	> 350°C	++	+	-
4	Poly[MWCNT/EG]	95%	Black	> 350°C	++	+	-

(++;Soluble, +;Partially Soluble,-; Not Soluble.

3.2 Fourier Transform Infrared Spectroscopy (FTIR)

The infrared spectroscopy (IR) is a common method for characterizing chemical bonds. Comparison of the IR spectra of MWCNT-COOH was made before and after functionalization might show whether new bonds were formed.

The FT-IR spectra of MWCNT-COOH and Poly[MWCNT/ester] composites are given in Figure 2, and the results are summarized in Table 2.

In Figure 2(a), the IR spectra of MWCNT-COOH show a broad peak at 3434 cm^{-1} which can be attributed to the O-H stretching of carboxyl groups (COOH). The peak at 1542 cm^{-1} can be associated with the C=C stretching vibration of the MWCNT backbone[13]. The peak at 1637 cm^{-1} is related to the C=O stretching vibration of the carbonyl group acid[14].

Figure 2 (b, C and d) show the IR spectra of MWCNT-COOH after functionalization with HQ, CA and EG respectively. The figure shows that the peaks at (1654, 1646 and 1653 cm^{-1}) can be attributed to the C=O stretch of the ester which is overlapped with the unreacted C=O acid. The peaks at (1024, 1026 and 1048 cm^{-1}) arise from the C−O stretching of the ester group respectively.

The broad peaks at (3433, 3432 and 3436 cm^{-1}) can be assigned to the O-H stretching of unreacted carboxyl groups, which means there is still a little amount of unreacted carboxylic acid group[15].

3.3 UV/Vis Spectroscopy

UV-visible absorptions of MWCNT-COOH and its Poly[MWCNT-ester]composites are summarized in Table 3. Figure 3 illustrates the electronic spectra of MWCNT-COOH and its esters. MWCNT-COOH shows three bands π-π* transition at λ_{max} 286,290 and 298 nm, and another two bands n-π^* transition at λ_{max} 320 and 338 nm. However, spectra of the Poly[MWCNT/HQ], Poly[MWCNT/CA] and Poly[MWCNT/EG] show a blue shift of π-π* transition at λ_{max} (283), (282,296) and (278,282) nm respectively. But, n-π^* transition shows a red shift λ_{max} at (312,340), (322) and (348) nm respectively. This confirms the ester formation.

Table 2: Main FT-IR absorption bands of the MWCNT-COOH and Poly[MWCNT/ester] composites.

Bands / Compound	O-H st.	C=Cst.	C=O st.	C-O st.
MWCNT-COOH	3434	1542	1637	1032
Poly[MWCNT/HQ]	3433	1560	1654	1024
Poly[MWCNT/CA]	3432	1578	1646	1026
Poly[MWCNT/EG]	3436	1557	1653	1048

st. = Stretching Vibration

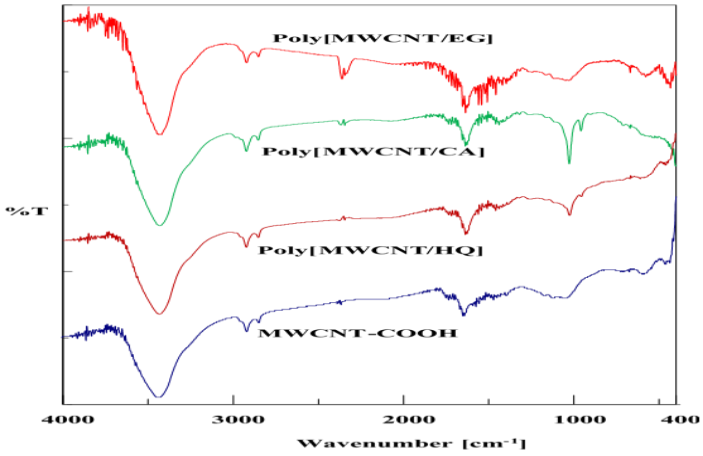

Figure 2:FTIRspectraof (a) MWCNT-COOH, (b) Poly[MWCNT/HQ], (c) Poly[MWCNT/CA] and (d) Poly[MWCNT/EG].

Table 3: UV-visible spectra of MWCNT-COOH and Poly[MWCNT/ester] composites

Compound	λ_{max}π-π*	λ_{max}n-π^*
MWCNT-COOH	286,290,298	320,338
Poly[MWCNT/HQ]	283	312,340
Poly[MWCNT/CA]	282,296	322
Poly[MWCNT/EG]	278,282	348

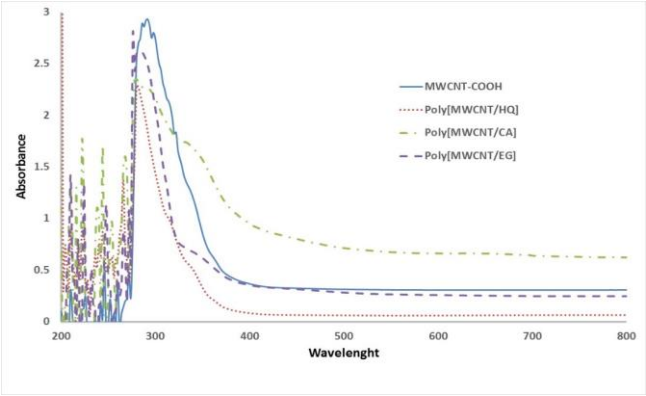

Figure 3:UV-vis spectra of MWCNT-COOH and Poly[MWCNT/ester]composites.

3.4 Microscopy Characterization (TEM, SEM)

3.4.1 Transmission Electron Microscopy (TEM)

Transmission electron microscopy (TEM) is often used to observe the length and diameter of carbon nanotubes. Figure 4 (a-h) displays TEM microphotographs of the MWCNT-COOH and Poly[MWCNT/ester] composites at different magnifications. Figure 4 (a and b) shows TEM images of MWCNT-COOH. It shows that MWCNT-COOH formed an entangled structure with an average diameter of 8-15 nm and their average length is approximately equal to 50μ mas announced by the supplier (Timesnano). In addition, a small spot shape was observed which might be ascribed to –COOH group.

As shown in Figure 4 (c-f) the TEM of MWCNT-COOH after polymerization HQ, CA and EG, respectively. Poly[MWCNT/ester] composites relatively exhibit good dispersion and less entangled except EG. The most entangled, showed on Poly[MWCNT/EG], may be due to EG is an aliphatic compound has only two carbons in backbone, which make a tight crossed connecting between the nanotubes.

The images clearly show that the spot shape for –COOH groups disappeared in Poly[MWCNT/ester] composites.

3.4.2 Scanning Electron Microscopy (SEM)

Scanning electron microscopy was used also to confirm the possible morphological changes on functioned MWCNT. Figure 5 (a-P) presents SEM microphotographs of the surface morphology and dispersion of the MWCNT-COOH and Poly[MWCNT/ester] composites at different magnifications. Figure 5 (a-d) shows that the group of MWCNT-COOH forms large agglomeration, random and curled structure, and possesses high aspect ratio; this may be because of the hydrogen bonds between the nanotubes. Figure 5 (e-l) shows MWCNT-COOH after polymerization with HQ and CA; many walls were broken and appear to be thicker compared to the MWCNT-COOH. In addition, it is noted that the conglomerates have become smaller and the ester bonds exist between MWCNT with HQ and CA, which reduced the hydrogen bonding.

On the other hand, Figure 5 (m-p) shows that the SEM of Poly[MWCNT/EG] forms large random masses, and possesses high aspect ratio, suggesting that covalent bonding of

ester exists between the MWCNT and EG, while EG is an aliphatic compound that has a small size, and which will form a tight crossed link between the nanotubes.

The images clearly show that the surface morphology of Poly[MWCNT/ester] composites is significantly different in contrast with MWCNT-COOH.

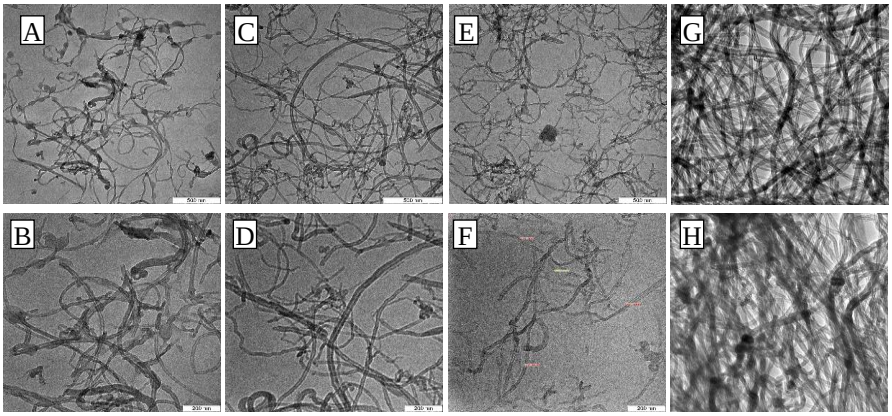

Figure 4: TEM microphotograph of MWCNT-COOH and Poly[MWCNT/ester] composites: MWCNT-COOH (a) ×50 000; (b) ×100 000, Poly[MWCNT/HQ] (c) ×50 000; (d) ×100 000, Poly[MWCNT/CA] (e) ×50 000, (f) ×100 000 and Poly[MWCNT/EG] (g) low magnification, (H) high magnification.

3.5 X-ray Diffraction

X–Ray diffraction (XRD) is used to identify materials by determining their crystallographic structure, and in this way it is a characterization tool on the scale of nanometers, and even angstroms, thus, providing a high degree of accuracy.

X-ray diffractions of the MWCNT-COOH and Poly[MWCNT/ester] composites are shown in Figure 6. The diffraction patterns having large diffraction peaks resulting from the nanoscale, suggest enhanced crystallinity. The sharp and strong diffraction peaks of MWCNT-COOH at 2θ=26.6°and 45.45° correspond to the hexagonal graphite structure support [16] in Figure 6(a). In Figure 6 (b and c) it would appear that the intensity of the Poly[MWCNT/HQ] is sharper than that of the Poly[MWCNT/CA]. This behavior may indicate that the crystallinityof Poly[MWCNT/HQ] is higher than Poly[MWCNT/CA] due to angle strain. The pattern of Poly[MWCNT/EG] is the highest crystalline due to straight-chain.

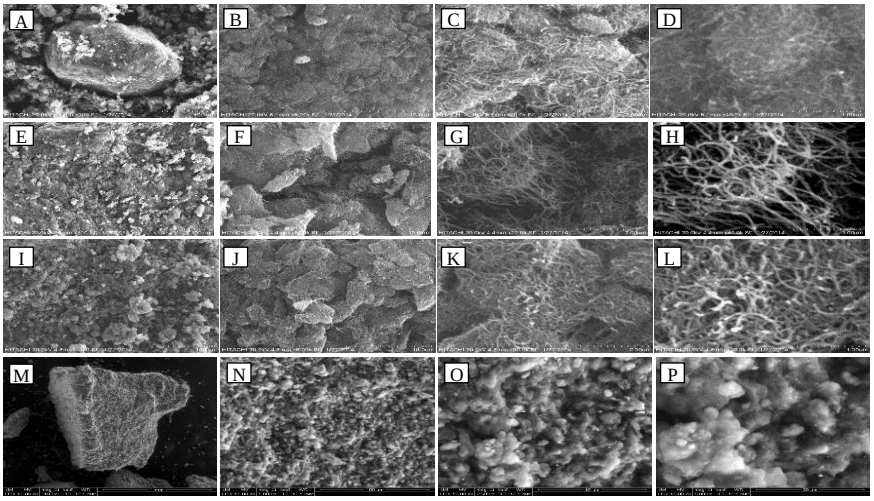

Figure 5: SEM microphotograph of MWCNT-COOH and Poly[MWCNT/ester] composites: (a) MWCNT-COOH (×300), (b) MWCNT-COOH (×5000),(c) MWCNT-COOH (×20 000), (d) MWCNT-COOH (×40 000) (e) Poly[MWCNT/HQ] (×300) (f) Poly[MWCNT/HQ] (×5000), (g) Poly[MWCNT/HQ] (×20 000), (h) Poly[MWCNT/HQ] (×40 000), (i) Poly[MWCNT/CA] (×300), (j) Poly[MWCNT/CA] (×5000), (k) Poly[MWCNT/CA] (×20 000), (f) Poly[MWCNT/CA] (×40 000), (m) Poly[MWCNT/EG] (×100), (n) Poly[MWCNT/EG] (×1000), (o) Poly[MWCNT/EG] (×2500), (P) Poly[MWCNT/EG] (×5000).

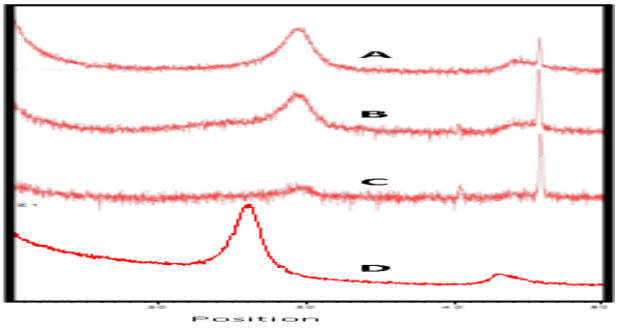

Figure 6: X-ray diffraction of MWCNT-COOH and Poly[MWCNT/ester] composites: (a) MWCNT-COOH, (b) Poly[MWCNT/HQ], (c) Poly[MWCNT/CA] and (d) Poly[MWCNT/EG].

3.6 Thermal properties: [Thermogravimetric analysis (TGA) and Differential Scanning Calorimetry (DSC)]

The TGA (TG and DTG) and DSC curves recorded for the MWCNT-COOH and Poly[MWCNT/ester]composites are given in Figures 7 and 8. These curves show the characterization and comparison of the thermal decomposition behaviour of the MWCNT-COOH and their poly-composites at 10 °C min^{-1} of the heating rate under nitrogen. In general, the curves show consecutive steps for almost uninterrupted weight losses in the

sequential decomposition of these four compounds over the experimental temperature range (25-1000 °C). Therefore, the T_{DTG} peaks are determined for all steps in the decomposition sequence with a maximum rate of weight loss in their DTG curve, and the peaks T_{DSC} are observed only for some steps in the DSC curves.

The thermal decomposition process of these four compounds may be describe as follows: In general, it was observed that the MWCNT-COOH was more stable than their poly-composites; and the order of thermal stability is MWCNT-COOH, Poly[MWCNT/HQ], Poly[MWCNT/CA] and Poly[MWCNT/EG].

The Poly[MWCNT/HQ] starts with two rapid and consecutive steps of mass losses (steps l and 2) followed by a slow bleed of mass loss (step 3 and step 4). The Poly[MWCNT/CA] decomposes rapidly in only two steps, one rapid step of mass loss (step l) followed by a slow bleed of mass loss (step 2). The Poly[MWCNT/EG] starts with two rapid and consecutive steps of mass losses (steps l and 2) followed by a very fast step of mass loss to evaporate all the material at 600 °C (step 3). On the other hand, the MWCNT-COOH decomposes only by a slow bleed of mass loss and rapidly in all steps (steps 1, 2, 3 and 4). These are summarized in Tables 4 and 5.

In conclusion, we noticed the highest thermal stability of MWCNT-COOH; such results are also related to the intra-hydrogen bond between carboxylic groups. The carboxyl group at the surface of MWCNTs grew to form a hexagon hydrogen bond net. This could enhance and increase the thermal stability of the material that is why decomposition temperature rose. The poly-composites that were prepared would make the COOH concentration disappear or reduce; furthermore, the terminal and unreacted carboxyl's group can create a little bit of H-bonded and decomposition temperature also obviously increased[17].

For comparison, in addition, we can say that the molecular weight and the staking of tubes factors play a key role in the thermal stability in the poly-ester composites; the order of thermal stability is MWCNT-COOH >Poly[MWCNT/HQ] >Poly[MWCNT/CA] > Poly[MWCNT/EG].

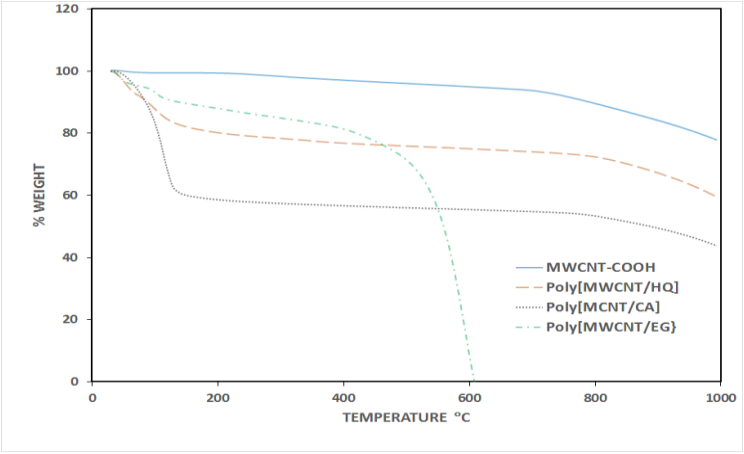

Figure 7: TGA curves of MWCNT-COOH and Poly[MWCNT/Ester] composites.

Table 4: %Weight loss at different temperature of the MWCNT-COOH and Poly[MWCNT/ester] composites.

Compound	% Wt Loss at					
	100°C	300°C	500°C	700°C	900°C	1000°C
MWCNT-COOH	0.57	1.30	1.63	2.10	10.9	6.02
Poly[MWCNT/HQ]	11.50	9.97	2.99	2.04	7.60	6.73
Poly[MWCNT/CA]	22.50	18.97	2.53	0.50	6.90	4.97
Poly[MWCNT/EG]	5.14	9.31	15.05		-	-

The differential scanning calorimetry (DSC) curves obtained for MWCNT-COOH and Poly[MWCNT/ester] composites are presented in Figures 8. The DSC curves of the four compounds show several peaks: endothermic peaks and exothermic peaks. All these peaks were associated with peaks in TGA in the same range, which corresponds to decomposition of the compound, Table 5. On the other hand, some peaks were not associated with peaks in TGA. This may be because of physical transformation, as glass transition.

Glass Transition Temperatures (T_g) of the MWCNT-COOH and Poly[MWCNT/ester] composites are shown in Table 6. It can be noticed that there are high variations in T_g for four compounds; these variations may be because of the ability to make Hydrogen bond. The highest T_g is for Poly[MWCNT/CA], whereas the lowest T_g is for Poly[MWCNT/HQ]. The Hydrogen bond could increase the cross-link density of the composites, thus increasing their glass transition temperatures.

Table 5: TGA and DSC results of the MWCNT-COOH and Poly[MWCNT/ester] composites.

Compound	Step	TGA				DSC		Res. %
		Wt. Loss %	T_i/°C	T_f/°C	T_{DTG}	T_{DCS}	Peak	
MWCNT-COOH	1st	0.78	33.46	149.99	52.54	31, 55	endo	99.22
	2nd	5.30	148.89	673.29	298.22	-	-	93.92
	3rd	8.19	673.23	880.34	753.55	*	*	85.73
	4th	8.30	880.17	1015.74	948.50	*	*	77.43
Poly[MWCNT/HQ]	1st	8.33	34.62	72.32	55.12	26, 66	endo	91.67
	2nd	12.19	80.03	134.61	101.80	130	endo	79.48
	3rd	2.93	141.71	514.56	355.94	360	endo	76.55
	4th	16.34	790.26	914.29	838.26	*	*	60.21
Poly[MWCNT/CA]	1St	44.99	39.41	197.19	59.55, 118.62	26, 84, 142	endo	55.01
	2nd	11.55	696.77	975.56	816.43	*	*	43.46
Poly[MWCNT/EG]	1St	5.13	36.24	80.19	48	30	exo	5.13
	2nd	4.58	82.19	128.93	104	129	endo	4,58
	3rd	90.29	465.00	631.66	664	*	*	0.00

endo; endothermic peak, exo; exothermic peak, *, out of the DSC range.

Table 6: Glass Transition Temperatures (T_g) for MWCNT-COOH and Poly[MWCNT/ester] composites.

Sample	T_g (°C)		T_m (°C)	
	Onset	Midpoint	Onset	Midpoint
MWCNT-COOH	232.49°C	233.65 °C	*	*
Poly[MWCNT/HQ]	153.01°C	160.25 °C	*	*
Poly[MWCNT/CA]	314.33°C	315.09 °C	*	*
	369.28°C	371.72 °C	*	*
Poly[MWCNT/EG]	152.00 °C	158.00 °C	165.7	167.4

* Out of range

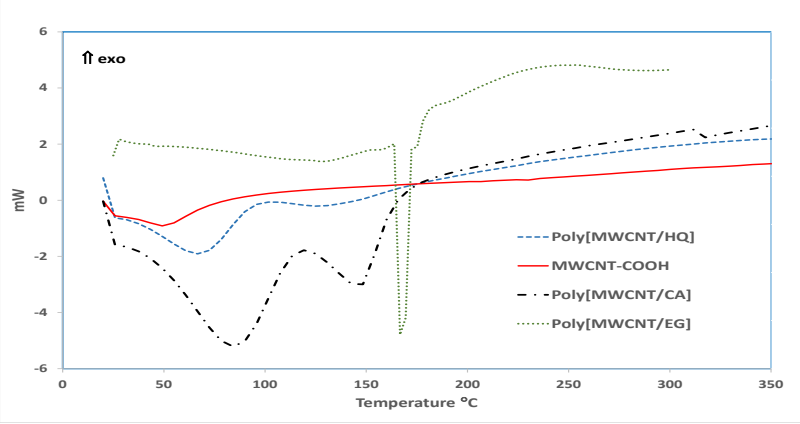

Figure 8: DSC curves of MWCNT-COOH and Poly[MWCNT/ester] composites

3.7 DC Electrical conductivity

The Poly[MWCNT/ester] composites consist of long chain-like molecules bonded by strong covalent and hydrogen bonds along the chains and only weak Van der Waals forces between the chains. If each repeat unit is considered a separate molecule, then the molecular orbitals, which are degenerated on each unit, will overlap to form a series of extended electronic states: the energy bands. Thus, the bonding and anti-bonding molecular unit orbitals lead to bulk valence and conduction bands, respectively. Consequently, the electronic properties of the π-electron system of the conjugated polymer or polymeric materials can be discussed in terms of band model with a characteristic bulk energy gap between the bulk valence band (B.V.B) and the bulk conduction band (B.C.B). The highest occupied molecular orbital (HOMO) is at the upper edge of the valence band. The edge of the conduction band is the lowest unoccupied molecular orbital (LUMO) supposedly at 0 K. Hence, polymers or polymeric is considered as organic semiconductors and the energy band theory can be used to characterize their electronic states and properties[18, ,19].

It is generally agreed that the mechanism of conductivity in the π-conjugated polymeric materials is based on the motion of charge defects within the conjugated framework. The charge carriers, either positive p-type or negative n-type, are the products of oxidizing or

reducing the material, respectively. The following overview describes these processes in the context of p-type carriers although the concepts are equally applicable to n-type carriers[20,21].

The infinite conjugation chain on either side can migrate in either direction without affecting the energy of the backbone, provided that there is no significant energy barrier to the process.

Figure 9 shows DC electrical conductivity of MWCNT-COOH and Poly [MWCNT/ester] composites at room temperature. There is no so much enhancement of DC conductivity after functionalization because MWCNT-COOH has already a long chain with conjugation. The order of DC electrical conductivity is MWCNT-COOH/HQ > MWCNT-COOH/CA >MWCNT-COOH/EG > MWCNT-COOH ((5.5838E-06, 4.47656E-06, 4.06701E-06 and 1.7181E-06 S/cm), respectively). In addition, we can say that the co-planarity factor plays a key role in the DC electrical conductivity of Poly[MWCNT/ester] composites. However, the long chain with conjugation does not make a good factor to improve the DC electrical conductivity; and it is not significant.

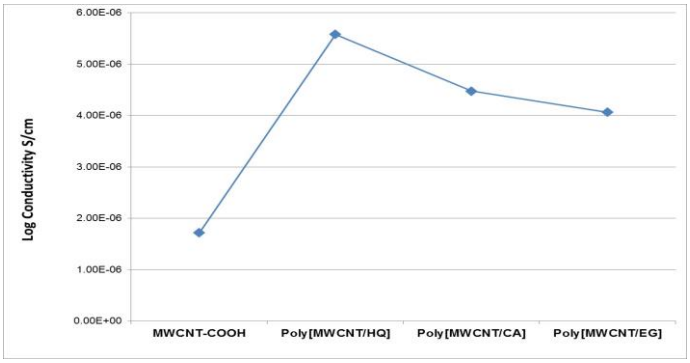

Figure 9: DC electrical conductivity of MWCNT-COOH and Poly[MWCNT/ester] composites at room temperature.

4 CONCLUSIONS

In summary, the Poly [MWCNT/ester] composites were synthesized by solution blending method from reacted MWCNT-COOH with (HQ, CA and EG).The obtained poly- composites were characterized by FT-IR, UV-Vis, XRD, TEM, SEM, TGA, DSC and DC electrical conductivity. The analysis of the FT-IR and UV-V provided an evidence for the formation of the poly-composites. X-ray diffraction confirms the crystallinity of the MWCNT-COOH and the poly [MWCNT/ester] composites. The formation of poly-composites on The MWCNT-COOH was confirmed by TEM and SEM. The MWCNT-COOH and the poly [MWCNT/ester] showed improvement in the thermal stability. The MWCNT-COOH were more stable than their poly-composites because of the intra-hydrogen bond between carboxylic groups. The thermal stability of the poly [MWCNT/ester] composites on the basis of the terminal and unreacted carboxyl group can create a little bit of H-bonded. The DC electrical conductivity of poly-composites increased

slightly due to MWCNT-COOH which already has a long chain with conjugation. The long chain with conjugation does not constitute a good factor to improve the DC electrical conductivity of poly-composites.

5 ACKNOWLEDGMENTS

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تحضير و تشخيص ودراسة التوصيل الكهربي المستمر لخلائط بولي [MWCNT/Ester]

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ملخص

تمتلك أنابيب الكربون النانوية خصائص كهربائية وميكانيكية وكهروميكانيكة ممتازة. عند إضافة أنابيب الكربون النانوية الى البوليمر لتكوين خلائط موصله كهربياً، تزداد التوصيلية الكهربية مع إضافة كميه قليله جداً من أنابيب الكربون النانوية. تهدف هذه البحث الى تحضير خلائط بوليمريه بتفاعل كربوكسي-متعدد أنابيب الكربون النانوية (MWCNT-COOH) مع مركبات ثنائي الهيدروكسيل وهي (الهيدروكينون والكاتيكول والإيثلين جلايكول) لتحضير خلائط متعدد الإستر. التحضير لهذ الخلائط تم بواسطة تقنية خلط السوائل. هذه الطريقة تتكون من ثلاث خطوات، عن طريق إذابة أنابيب الكربون النانوية في مذيب مناسب كذلك إذابة المركبات الأخرى في نفس المذيب، ثم يتم إضافته الى أنابيب الكربون النانوية حتى تتداخل المركبات مع أنابيب الكربون النانوية. في الخطوة الأخيرة، تترسب هذه الخلائط بواسطة تبخير المذيب.

هناك طرق عدة أُستخدمت لتشخيص الخلائط الجديدة المحضرة مثل (الأشعة تحت الحمراء والأشعة الفوق البنفسجية وانحراف اشعة إكس والميكروسكوب الإلكتروني النفاذ والميكروسكوب الإلكتروني الماسح والتحليل الوزني الحراري والماسح الكالومتري التفاضلي وكذلك قياس التوصيل الكهربي للتيار المستمر). نتائج ال FTIR وUV اثبتت تكوين الخلائط البوليميرية عن طريق تكوين روابط جديده. XRD اثبتت بلورية هذه الخلائط البوليميرية. SEM, TEM أكدت تكوين هذه المركبات. دراسة الخصائص الحرارية لهذه الخلائط اثبتت تحسين الإستقرارية الحرارية. بالنسبة للتوصيلية الكهربائي لهذه الخلائط تزداد قليلاً بسبب ان متعدد أنابيب الكربون النانوية لها سلسلة طويله في وجود اقترآن. زيادة السلاسل مع الاقتران لم تلعب دور هام في زيادة التوصيلية الكهربائية لهذه الخلائط. جميع النتائج السابقة اثبتت تحضير هذه الخلائط البوليمريه.

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Management of water Issues in Taiz basin, Yemen

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ABSTRACT

Generally, the study area including the city of Taiz, in particular is suffering from an acute shortage of water due to the increase of the growing demand on water for domestic and industrial needs as well as the water needs for agriculture in the region. In addition, the water resources in the study area are limited to the aquifers while water extraction rates exceed the natural recharge and the use is not effective. Therefore, it highlights the importance of water demand management to maintain the quantity and quality of drinking water and domestic use, irrigation and industry. The objectives of this study is to evaluate current and future vulnerability of water sources in the study area; Development of scenarios and analysis of future water balance to find out the best solution to the problem of water in Taiz basin as the study area; Select the appropriate scenario to resolve the water problem. The results of this study will assist decision makers in the field of water resources for better planning and management in the future. During the period 15/1/2013 to 15/4/2013 Implementation of the field study in 1501water points, these water points are distributed between 954 hand-dug well, 479 deep well, 50 springs, five water collection tanks, two dams, and six water retaining walls. For calculating the amount of water supply in the region and the amount of water deficit, in addition to knowing the amount of needs that must be secured in the future, Water Evaluation And Planning (WEAP) application as Decision Support System (DSS) to manage the supply and demand for water in Taiz basin as the study area. The analysis and results using WEAP program include the following themes: Ground water storage in the aquifers: The usable storage for the base year of the model (2013) has been calculated for the five sub-basins in the study area, Estimated ground water storage in alluvial aquifer (in Mm3) ranged 221.52-

415.36 Mm3 at best estimate at 332.29 Mm3, groundwater storage in Volcanic aquifer ranged 129.98-2599.52 Mm3 at best estimate 259.95, whereas groundwater storage in sandstone aquifer ranged 5.044- 50.44Mm3 at best estimate at 10.088; Unmet water demand, The gap between supply and demand for water in the study area was estimated as (47,692,840.9 m3). Preliminary, set of adaptation strategies that address water scarcity; Interpret the proposed set of adaptation strategies to solve water issue from improve water services and water management for the urban area as part of the study in Central and Al Hawban Sub Catchment:
(Increase the coverage rates for water services, Diversify water sources for the city, Efficient water management, Implementation of control and water quality program in water sources and drinking water factories, Development of specialized human cadres technically and administratively for the development of water management, Flow of water services from different water sources….. etc.); and Improve water projects and water management for the rural area as part of the study area Al Dabab Sub Catchment, Al Janad Sub Catchment and Thi- Sufal Al Haimah Sub Catchment: Commitment of the Commission basin management to Upper Rasyan Valley, The formation of committees Sub-water basin to ensure the management of water resources from the lower level, Resolving water conflicts in different regions of the study area and the basin provider of water to the city of Taiz, Community participation by establishment of water users associations (WUAs) in the sub- basin areas.
Keywords: Aquifer, Taiz basin, Water demand, Water supply, WEAP, Water scarcity.

1. INTRODUCTION

The Taiz city being the third largest city in Yemen has a great socio-economic importance. It is experiencing acute shortage of water as a result of increasing rate of water demand for municipal and industrial use, together with increasing agricultural demand. Water resources of the Taiz basin are dependent on rainfall, which varies quite a lot from one sub-area to another within the same catchments. While the mean annual precipitation for the whole area is around 568 mm, the highlands receive a significantly greater amount. Heavy rainfall on the highland areas generates run-off that flows into the valleys, causing flooding. The surface water flowing into the valleys is diverted for irrigation by means of natural ditches called" Sawaagi". The Taiz basin has three main aquifer systems, they are: (a) alluvial aquifers, (b) volcanic aquifers, and (c) Tawilah sandstone aquifers [1] . The water tables have been falling because of continued groundwater use. Some areas are worse hit than others [2]. For Al Haima zone one of the main sources of water supply, as a whole, the average decline in the groundwater level has been nearly 0.5 meter per year in the alluvial aquifer and more than 3 meters in the volcanic aquifer [3].

Water supply constitutes the most pressing problem in Taiz today due to significant shortage of supply (the average consumption is 23 L/d) caused by the depletion of existing water resources and the lack of a clear direction in dealing with the problem. This forces frequent water supply service interruptions (30-40 days) and the service is rarely extended to new users (only 57% of the population are covered). Sanitation is another daunting

problem. The poorly maintained, sewerage network covers only 44% of the population. In Several un-sewered areas to the north, east and west of the city, raw sewage is directly disposed to Valleys, which causes a health hazard and threatens to contaminate groundwater resources.

2. PROBLEM STATEMENT

The water problem in Taiz is complex and multidimensional

- **Request increase**: The population growth in urban Taiz over the past several decades has great pressure on the water supply, Taiz City's population increases by 3.9 % and rural population increases 2.6 % per year.
- **Physical water losses from the urban water supply distribution network** networks losses are assumed to be 25% of total production. However, 17% of this loss is assumed to percolate to shallow ground water and 8% is assumed lost through evaporation. Thus, the net benefit of reduction in transmission losses is only 8%. If the aquifer is deep and water lost from distribution cannot return to the aquifer, then the net benefit of reducing losses is the full 25% of the total consumption. This assumption is an extreme case, since in reality physical losses cannot be brought to zero.

- 75 % of supplied urban water goes back to the aquifer through the Waste Water Treatment Plant (WWTP) with a 10% system loss.
- Transmission, (agricultural conveyance) losses are included in the irrigation requirements which are based on overall irrigation "efficiencies."
- 30 % of applied irrigation water will percolate back to the aquifer.
- 30% of applied irrigation water is lost in evaporation.
- 40% of applied irrigation water is actually consumed by plants.
- Irrigated agriculture area is reduced at the same rate (7%) as the population of Tiaz City grows in the Central and Al Hawban Sub Catchment, indicating displacement of irrigation by urban development.

3. OBJECTIVES

A. Evaluate current and future vulnerability of water sources in the study area;
B. Development of scenarios and analysis of future water balance to find out the best solution to the problem of water in Taiz basin as the study area;
C. Select the appropriate scenario to resolve the water problem.
D. Preliminary, set of adaptation strategies that address water scarcity; Interpret the proposed set of adaptation strategies to solve water issue from Improve water services and water management for the urban and rural areas as part of the study.

4. THE STUDY AREA

4.1 Location

The study area is located in the upper part of Rasyan Valley, It is one of the seven major Valleys which form the Red Sea drainage basin [4] and which drain the high and mid-

land region of the country and flow in a westerly direction towards the Red Sea. According to [5] the total catchment area of Rasyan Valley "up to the mouth of the river at the sea" is 2,550 km2. However, the area of the upper and middle catchments (i.e., excluding the coastal or Tihama part of the catchment) is only 1,990 km^2 [4] .The study area which is defined as the catchment area upstream from the point 378 UTM E and 1510 UTM N. This area covers approximately 750 km2 (Figure 1).

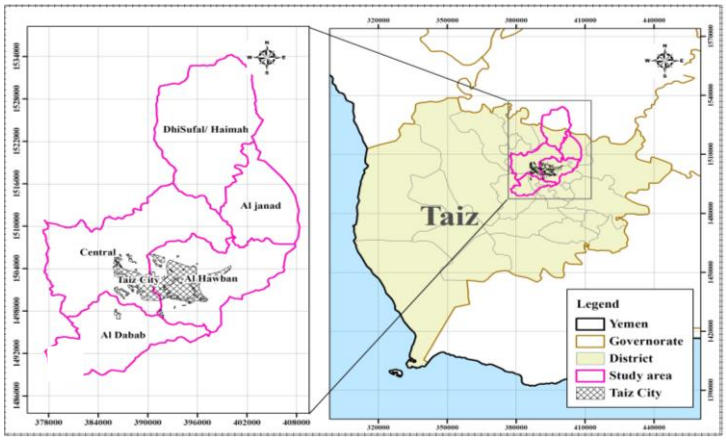

Figure 1: Location of the study area

4.2 Hydrology

Water resources of the area are heavily dependent on rainfall, which varies quite a lot from one sub-area to another within the same catchment. While the mean annual precipitation for the whole area is around 568 mm, the highlands receive a significantly greater amount. For example, the annual rainfall in the Thi-Sufal highlands is 826 mm on average while Jabal Saber sub-area receives about 621 mm. The pattern of rainfall in the region is bimodal with one peak occurring in April-May and the other in August-September. The intermediate months of June and July have fewer rains. The dry period lasts from mid October to mid March.

Heavy rainfall on the highland areas generates run-off that flows into the Valleys, causing flooding in the case of intense rainfall events. The surface water flowing into the Valleys is diverted for irrigation by means of Sawaaqi. These are excavated channels on both sides of the Valleys, which irrigate the adjacent fields. Valley Al-Haima receives about 3 million cubic meters of lateral surface inflow annually. Most of which is from the high rainfall area Thi Sufal. Al-Dhabab Valley receives about 0.5 million cubic meters of run-off water from both Jabal Habashi and Jabal Saber. Some of the run-off from the latter also finds its way into the Hawban zone which receives about half million cubic meters of run-off annually. The Central zone receives surface water flows from all zones in the upper Rasyan Valley catchment. The estimated volume of these flows is about 9 million cubic meters per year. The total volume of flow leaving the upper Rasyan Valley catchment area

every year does not exceed 12 million cubic meters [6] .However, the surface water flowing from the Central zone into the lower Rasyan catchment is highly polluted because of mixing with the untreated industrial and domestic wastewater. Average Annual rainfall at the various monitoring stations in the study area was collected from 1979 to 2012 from eight stations in the study area and given in Table (1).

Table 1: Annual Rainfall (mm) of the study area [7]

Aquifer / Sub basin	Year / Station	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Al Janad	Qurf	283.5	525	564.5	633	556	452.4	448.5	520	546	493.5	120.5	316	344	-		
Thi Sufal	Jadyia	750	43	1283.5	1025	1320.9	1075	871.5	1331.8	1234.5	981.2	-	-	-	-	-	-
	Sahalah	252	316	394.5	633	556	452.4	454.5	520	404.5	493.5	120.5	-	-	759	561	456
Central	Lougba	96	438	362	576.5	420	420	442	537.7	557	535.5	263	256	551.5	-	486	656
	Qurf	283.5	525	564.5	633	556	452.4	448.5	520	546	493.5	120.5	316	344	-		
	Hussien	6	5.5	244	462.8	289	298	381.5	324.3	331	712	213	340	597.5	-	320	0.0
Al Dhabab	Manum	398.5	887	720	734	720	684.4	852	805.8	833.6	727.5	476	536.5	545	551.5	413	681
	Miqap	518.5	1042.5	864	1062	996.5	886.9	754	847.3	943.5	932.5	716.5	102	759		841	595
Al Hawban	Miqap	518.5	1042.5	864	1062	996.5	886.9	754	847.3	943.5	932.5	716.5	102	759		841	595
	Qurf	283.5	525	564.5	633	556	452.4	448.5	520	546	493.5	120.5	316	344	-		
	Oss-aifrah	321	306	617	581.8	281	318	677	303	309	280	285	353.6	645	809	887	613

* The Records of 2013 no measurement

Annual rainfall distribution is record peaks in 1999,2000, and 2001,2002 2004,2005, Whereas less rainfall is measured in 2008 and 2009. The highland part of the upper Rasyan Valley catchment enjoys a higher average rainfall than any other part of Yemen, with the only exception of the Ibb region, which the study area borders. Summer rains occur with convective storms associated with spring inland winds. Cloud cover builds up from mid-day with rains usually in the afternoon. Storms are very localized with considerable differences in rainfall amount from any single event over short distances.

Hydrologic simulation in WEAP included partitioning of rainfall between runoff, infiltration, and evapotranspiration in the five sub-basins using a semi-distributed, lumped parameter hydrologic model embedded in WEAP (Yates et al., 2005). Each of these 5 sub-basins was linked to one of the six aquifers for purposes of simulating groundwater recharge. Irrigated, rain fed, and inactive land cover areas obtained from the National Water Resources Authority (NWRA) were included in this parameterization. Crop types delineated included Qat, grains, maize, and sorghum. Domestic demand was simulated using population projections for each of the sub-basins; see Table (2) and (Figure 2).

The Five Sub Catchments areas are:

1- Al Dabab sub-catchment (Comprising, in addition to Al Dabab, part of Jabal Habashi and part of Jabal Saber),
2- Al Hawban sub-catchment (SE part of the area, comprising Ursum valley , Hawban valley and tributaries),
3- Central sub-catchment (Lower part of Upper Rasyan Valley, downstream of all other sub catchments),
4- Al janad sub-catchment (plateau in eastern part of the area),
5- Thi-Sufal/ Haimah sub-catchment (NE part of the area).

Table 2: List of Sub basins, Area (Km^2) and average slope (Dar El-Yemen and SOAS, 1997)

No	Sub Basin	Area (km^2)
1	Al Dhabab	115
2	Al Hawban	144
3	Central	217
4	Al Janad	86
5	Thi- Sufal/ Haimah	188
	Total	750

4.3 Groundwater

The Ta'iz region has three main aquifer systems. They are (a) alluvial aquifers, (b) volcanic aquifers, and (c) Tawilah sandstone aquifers. To exploit these aquifers, a total of 1993 dug wells and 306 boreholes had been constructed until 1996, some of which have become dry due to high rate of abstractions.

The alluvial aquifers are the uppermost layer. They are composed of sediments of varying sizes, ranging from boulders to silt, found along the Valley beds and filling up depressions. The primary means of alluvium recharge is from floods and from irrigated areas. The alluvial aquifers are quite shallow. In most areas, their thickness does not exceed 30 to 40 m although, they locally can be up to 70 m in thickness. The thickest alluvium is found in Thi-Sufal/Al-Haima and Ad-Dhabab areas. The depth to water in alluvial aquifers is less than 20 meters but in most cases, water can be found at 11 to 13 meters below the ground surface. The smaller depth to water makes this aquifer exploitable by hand-dug wells, which are found in abundance in the area. In many zones, the alluvial aquifers are prone to over exploitations. The quality of water is generally good especially in the alluvial wells in Thi- Sufal, Al-Haima, Al-Dhabab and in upstream areas of Shara'b zone. However, being the uppermost water bearing formation, the alluvial aquifers are vulnerable to manmade pollution. This is specially the case in Al-Hawban and Central zones [6] . In addition to the alluvium deposits, water is also found in fractures in the volcanic rocks that dominate the sub-surface in the study area. The thickness of these rocks in the study area is estimated to be 600-700 meters. The Volcanics are generally not a very productive source and yields of wells dug in these strata are low. The water is also low quality. This is specially the case where the fractures are connected to overlying alluvial aquifers in the polluted zones, although poor water quality in the Volcanics also has natural causes (e.g. naturally occurring salinity in some zones). Major source of groundwater in the area is the

deep-seated Tawilah sandstone. This formation has proved very productive elsewhere in Yemen and is the focus of exploratory efforts in Ta'iz region as well. However, the sandstone aquifer in the planning area is not fully exploited except in Thi- Sufal zone where NWSA wells, in addition to some farmers' wells, tap into this aquifer. These wells have high yields and quality of water is also good. In other areas, the presence of the sandstone aquifer is indicated by studies. However, exploratory efforts in other locations have not met with a lot of success. This is at least in part due to the difficulties in carrying out exploratory drilling in the face of growing opposition from local communities.

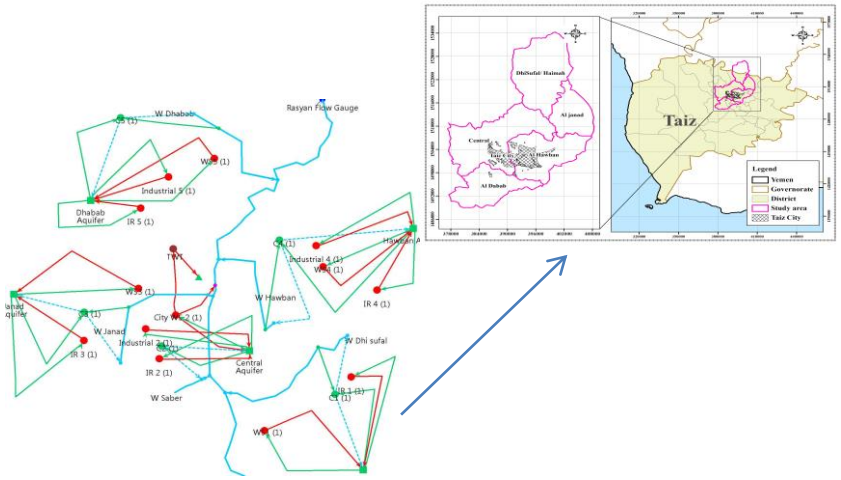

Figure 2: Schematic Representation of Zones with Demand Supply for Taiz Basin.

5. METHODOLOGY

We have used data from WEAP model and formulated a simple method to quantify increases in aquifer life for the five aquifer zones. We developed an Excel Microsoft that presents the results of our alternative scenarios in a very understandable way. We implement each scenario in the WEAP and transfer the results to the Excel model. We maintain the WEAP model as a tool to look at monthly variations and effects of climate change on the aquifer lives. In this study we identified the following scenarios to help improve water availability to Taiz Basin:

- Improve Urban Water Supply;
- Irrigation improvement;
- Improving industrial production technology;
- Rainwater harvesting from rooftops; City streets; streams Valleys; Dams, and Barriers water.
- Importing desalinated Red Sea water;
- Re- use Waste water from treatment plant.

- WEAP Model Application

On the basis of hydrologic and physiographic characteristics, the study area was divided into six main sub-areas or sub-catchments. The boundaries were chosen and plotted to help delineate the quite complex drainage pattern of the area and to provide a framework for discussing various land and water characteristics of the study area, which would facilitate the subsequent use of the data for management planning [6] , Boundaries of the study area included the following areas within the divisions of the study mentioned above.

- **WEAP input**

- Long term climate data (rainfall, runoff, temp. evaporation, Evaport. etc.).
- Land use and cropping pattern.
- Groundwater abstraction and use.
- Irrigation area.
- Estimated groundwater storage and spring flow in area.
- Estimated groundwater storage in the three aquifers.
- Annual natural recharge and water use in Ta'iz Region.

6. RESULTS and DISCUSSIONS

Tables (3) and (4) show the estimation of the groundwater storage in the aquifers of the study area, whereas Table (5) shows the estimated annual natural recharge and water use in study area.

Table 3: Estimated groundwater storage in the alluvial aquifer

Aquifer/ Sub basin	Alluvial area, km^2	Average depth to water, m	Average alluvium thickness, m	Average saturated thickness, m	Volume of saturated alluvium, Mm^3	Storage of Sub Catchment Mm^3/Year	Total Spring Flow m^3/Year
Al Dhabab	9.8	8	39	31	303.8	36.456	1803.903
Al Hawban	41.7	11.59375	16.3	4.70625	196.25063	23.550075	677.075
Central	55	5.754559	24	18.245441	1003.4993	120.41991	184.59875
Al janad	36.4	9	17	8	291.2	34.944	184.59875
Thi- Sufal/ Haimah	34.7	9.9221649	38	28.077835	974.30088	116.91611	
					2769.0508	332.28609	

Table 4: Estimated groundwater storage in the three aquifers.

Aquifer/ Sub basin	Groundwater Storage Mm^3	
	range	best estimate
Alluvium	221.52- 415.36	332.29
Volcanic	129.98- 2599.52	259.95
Sandstone	5.044- 50.44	10.088
Total quantity of GW storage =		602.328

In the Reference scenario, the climate sequence for future years was developed by repeating historical data for the period 1979 to 2013 and assuming a similar periodicity through 2050.

The results show WEAP program used for decision support systems in the study area development and scenarios Options for multiple development and water resources development and management of the multiple uses to solve the water problems in the city of Taiz and the overall study over the years 2013-2050. Table (6) presents a synopsis of our hydrologic for the various scenarios for the Study area. The following are the implications of the results of our analyses in our proposed priority of implementation.

The current water situation sub-basins of the study area and the extent to keep up with water needs, as results showed that the age of aquifers in the central region will supply the city of Taiz with water to the year 2024, equivalent to 11 years, while the sub-Hawban basin supply the city 3.1 year, which calls for urgent interventions to supply the city water, in order to ensure the continuation of human life and the living of the population.

Desalination of sea water of Mokha area on the Red Sea are necessary to meet the needs of Taiz City by water amount of up to 27,375,000 m^3 / year first phase, extend the life of aquifers in urban areas from 10.3 to 17.7 years, and the countryside more than 50.6 years old level, providing a steady source to supply the city with water for all uses, ensuring attract local and foreign investment to the city to ensure that more of the standard of living and social stability of the population of the province in general, the development of towns and villages stretching from Mokha and even the city of Taiz and to ensure the improvement of living style to these communities by providing water needs and operating efficiencies technical, administrative and professional during and after the implementation of the project. Note that the desalination process is too expensive to maintain irrigated agriculture, as well as support the implementation of the project components, excess population growth for the city of Taiz with desalinated water to provide a permanent basis and the possibility of the worsening security and administrative risks during operation of the project Figure (3).

Rainwater harvesting from rooftops scenario and the construction of dams and barriers of water is a practical solution to cover agricultural, domestic and industrial needs at the level of rural and urban areas, as it flows into the water resources in the region, including the equivalent of 16,450,000 m^3 / year, extend the life of aquifers 25.35 - 85.35 years for water sources in rural areas of the study area, but in urban society stretching 2.1 years, the use of surface water for irrigation, for industries and with preventing the continued use of groundwater in these areas, the implementation of this option save the right amount of water to the city of Taiz, including droughts, sub-surface storage of the water, will have a positive effect on water quality in Al-Hawgalah and Hawban water fields whom suffer from high in salinity and will greatly reduces the evaporation rate, recharging aquifers, surface waters and aquifers for wells in the same area. Reduce the flash floods on the soil in the valleys and therefore drains towards the sea without benefitting from the water, Reduce the amount of sediment carried by the flood to Al-a'amerah Dam Lake at the central region of the study area, maintaining the cleanliness of channels and corridors valleys from pollutants associated with floods. Ensure social stability of the population and thus the provision of

health conditions. Stimulate and attract local investment, which will ensure increased per capita income. Decrease employment, migration and the operation of labor during and after the implementation of the project. Knowing that implementation of the project need large tracts of land in the eastern and western areas of the city, to issue regulations necessary and binding on Population and legislation city building tanks to harvest rain water within the private courtyard housing spaces, provide adequate funding to buy land and design of technical and environmental studies etc and implementation of components of the project, as well as that this option is affected by changing natural conditions from one season to another and from one year to another Figure (4).

Table 5: Estimated annual natural recharge and water use in the Study Area.

Aquifer	Al Dabab Sub Catchment	Al Hawaban Sub-Catchment	Central Sub-catchment	Al Janad Sub Catchment	Thi- Sufal Al Haimah Sub Catchment
Natural recharge MCM	2.3	2.15	4.28	1.54	4.2
Urban (2013) pop	0	133302.4	769940.1	0	0
Rural (2013) pop	33927.5	0	0	108416.6	36878.9
Commercial Urban (2013) pop	0	47834.3	111272.3	0	0
Commercial Rural (2013) pop	4799	0	0	3287.3	1364
Industrial Urban (2013) production Unit	0	96	96	0	0
Industrial Rural (2013) production Unit	48	0	0	0	0
Urban use in 2013 MCM	0	1.2	28.1	0	0
Rural use in 2013 MCM	2.4	0	0	1.98	0.67
Commercial Urban use (2013) MCM	0	0.72	3.2	0	0
Commercial Rural use (2013) MCM	0.02	0	0	0.02	0.02
Industrial use (MCM in 213)	4.3	10.9	10.1	0	0
Irrigated area in 2013 (ha)	392.3	450.1	590.7	123.4	90.9
Irrigated use in 2013 MCM	5.3	49.8	47.2	1.2	1.1
Water balance in 2013					
Available storage	303.8	196.3	1003.5	291.2	957

Improvement of water distribution networks in the urban areas of the City of Taiz extends the life of the aquifer in the central region at a rate of 11.1years, in general and in Al Hawban estimated for supplying water resource application of this scenario is 3.7 years, although the cost is too high to improve the network, but as a priority for the city because it reduce losses of water purchase prices are expensive and that are currently being brought in to cover the existing deficit in the city of Taiz, it provides and maintains improvement of the system of distribution amount of water by 5,163,837.3 m^3/year, reduce operating and maintenance cost of the current system of distribution, save pro extra waste from water loss etc.

Table 6: Output from WEAP Scenario in the study area.

Scenario	Extended Life of Aquifer		Priority
	In Urban	In Rural	
Improve urban water supply delivery	3.7 to 11.1		Medium to High
Improving irrigation Efficiency	7.4 to 11.84	6.7 to 18.5	Medium to High
Improving industrial production technology	1.7 to 2.6	2.7	Medium
Rainwater harvesting	2.1	25.35 to 85.35	Medium to high
Importing desalinated water from Mocha City	10.3 to 17.7	50.6	High
Re- use Wastewater from treatment plant	1.1 to 2.1	0.8 to 1.1	Low

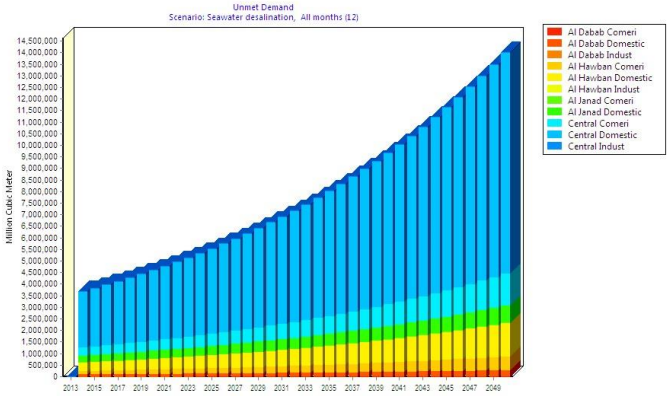

Figure 3: Water Balance with Importing desalinated water from Mokah city scenario

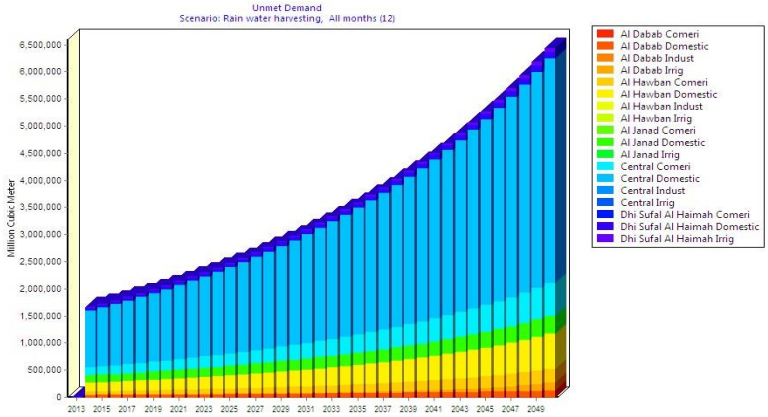

Figure 4: Water Balance with Importing Rain water harvesting.

Improving irrigation means contributes to reduce the amount of used water to irrigate crops, by 40% (42,277,451.3) m^3 / year and extends the life of the aquifers in Thi Sufal and

Haimah area by 18.5 years and in Hawban area increased by 11.84 years, and extends the life of the aquifer in Central region to 7.4 years. Knowing that localization of modern irrigation technology, which requires high-cost funding addition to the lack of awareness among farmers of the importance of the use of modern irrigation techniques. Figure (5).

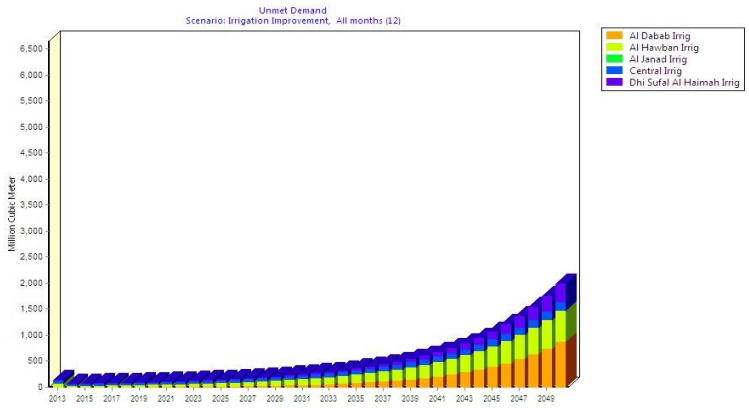

Figure 5: Water Balance with Irrigation improvement Scenario

Improving industrial production technology extends the life of the aquifer at a rate of 2.6 years in Hawban, Central region at a rate of 1.7 years The Al-Dhabab estimated prolongation 2.7 years equal to 5,065,294.26 m3 / year, it contributes to reducing the cost of industrial products by reducing the amount used of water in production processes and reduce the cost of pollutants resulting from these processes in the industrial facilities. Knowing that the replacement of old technology by modern techniques of high cost and lack of awareness on the importance of the industrial sector for adopting of the technology of water rationalization at industries Figure (6).

Re-use of treated wastewater to reduce the allocated water and kept for drinking a fresh water, to supplement the water resources in the central region of the study area and additional vendor estimated 7,200,000 m3 / year, providing water sources alternative less expensive can be used in agriculture, especially after treatment, water containing treatment on Nitrogen, Phosphorus and other nutrients for the growth of nutritious component. Reduce of waste and thus prevent pollution, which costs a great financial burden for re-contaminated water body rehabilitation. This option has disadvantage such as the rehabilitation of part of the sewerage networks and existing treatment plants. Extension of the city which does not accompanied by expansion of the sewage network. The lack of funds for the establishment of sewerage networks, treatment plants, low environmental and health awareness with regard to the use of wastewater by the neighboring population to the main pipe and the treatment plant in Al Burayhi area Figure (7).

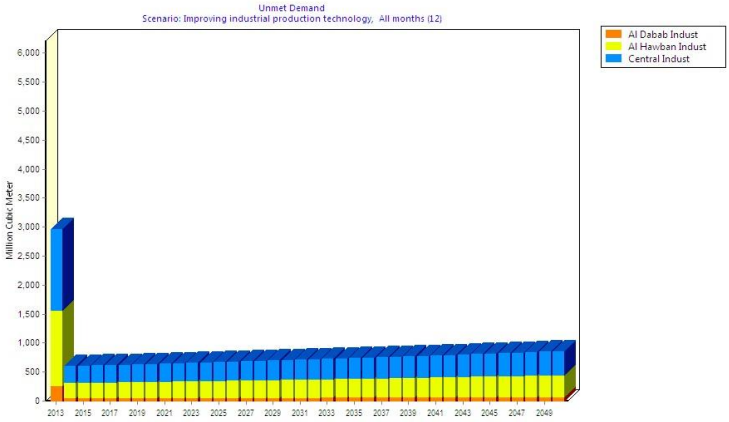

Figure 6: Water Balance with improving industrial production technology Scenario

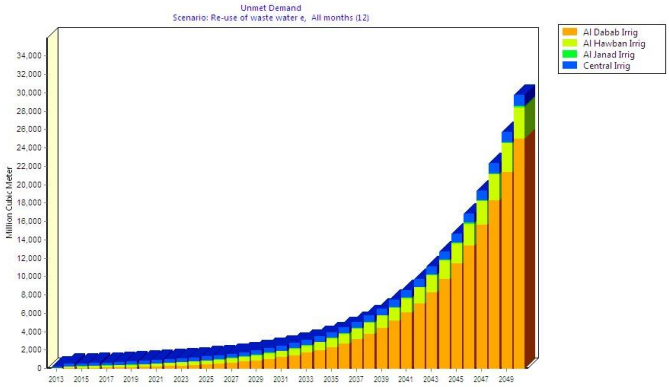

Figure 7: Water Balance with Re- use Wastewater from treatment plant Scenario

Figures (8 and 9) forms illustrate summary of results of the discussion:

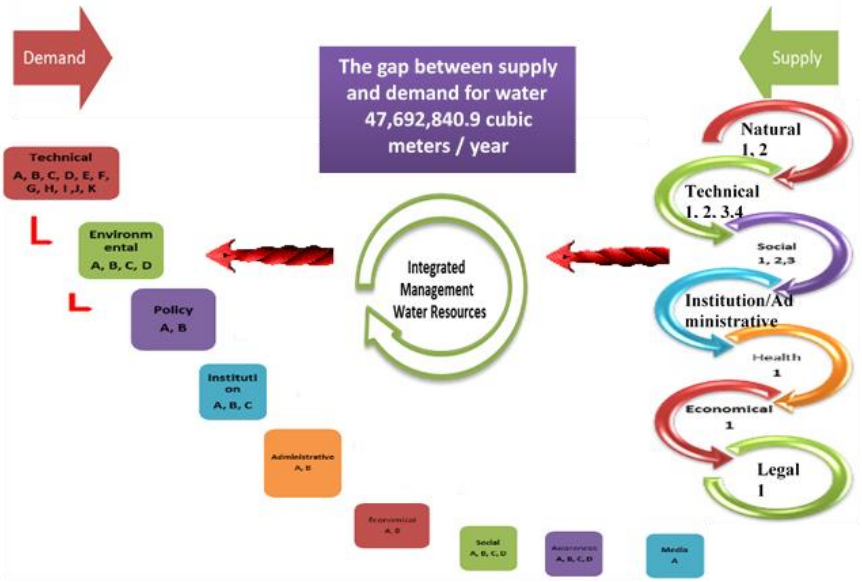

Figure 8: Integrated Water Resource Management in region Taiz Basin.

Supply

Natural

1-Scarcity of available water resources

2- Available Water in the study area is 112m^3 /capita. year

Technical

1-Degradation of water quality

2-The absence of enough wastewater treatment

3-Random Urbanization

4-Soil pollution

Social

1-Increase of population growth

2-Migration from the countryside to the city

3-Conflicts and competition on available water resources

4- Random drilling

Institution/Administrative

1-Gap between water users and policy makers

2-The absence of applying IWRM principles

Health

-Transmissions of diseases due to low water quality

Economical and Environmental

1-Excessive use of agriculture pesticides

Legal

1-The absence of enforcing laws and implementation of rules

Demand

Technical :

A- Rainwater harvesting.

b- Desalination of sea water at Mokha City.

c- Improve water transfer and distribution system

D- Improving industrial production technology based on rational water use.

e- Adoption of modern irrigation technology.

f- Development and maintenance of agriculture terraces in the jabal Saber watershed.

g- Implementing reservoirs and agriculture terraces upstream of the wells at the areas of water basin.

h- Replace damaged sewage networks.

i- Complete sewerage system for Taiz city

j- Rehabilitation of the existing wastewater treatment plant

k- Construct new WWTP in Taiz city

Environmental:

A- Applying environmental and health guidelines in water and wastewater services

b- Manage the solid waste emerging from the city

c - Force Industries, Labs and hospitals to treats their effluents according to the environmental guidelines

d- Re-use of treated wastewater.
Policy:
a-Water sector governance.
b- limit urban and industrial expansion in the water basin area.
Institution:
A-Restructuring of water resources management.
B- Institutional Development of the water management sector.
C-Activating the role of the commission basin.
Administrative:
a- Decentralization of Management of main and sub water basins.
b-Recognizing the role of women in the provision and management and conservation of water
Economical:
a- Dealing with water as a commodity and as a depleted natural resource.
b- Reconsider the water tariff to cover the real cost.
Social:
a- Activating the role of the private sector in the field of water service .
b- Resolve social conflicts by applying the participatory approach with beneficiaries .
C-Formation of WUAs at the water basins
d- Formation of water and environment friends at the city
Awareness:
a- Introduction of water awareness in the curriculum of all education stages
b- Take advantage of the role of mosques and religious scholars in raising awareness of the need for rationalization of water use.
c- Activating the role of lectures and seminars on Water
d - Implementation of awareness campaign for risks and threats to water resources.
e- Supporting research themes to solve different issues of water and environmental problems
Media:
A-The adoption of the official media to the theme of water as a fundamental and vital issue

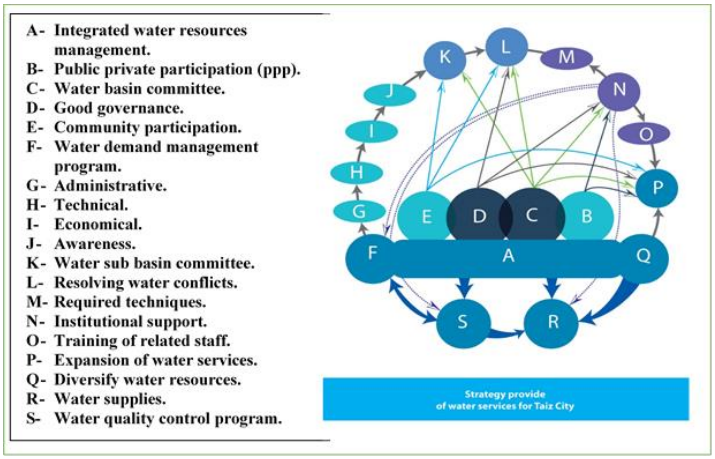

Figure 9: Improvement of water service, water projects and water management in Taiz basin.

7. CONCLUSIONS

Through what was presented in the context of the study on the current status of water in the region, we conclude the following:

- The amount of water available currently in the water resources of the study area is not enough to various water needs, according to the few water points' data.

- ❖ Observed during the study and a large gap between supply and demand for water in the study area, with the deficit reaching 29%.
- ❖ Scarcity of available water sources in order to meet the demand for water for various uses in the study area and therefore the per capita water does not exceed in the study area 112 m^3 / year:

Increase of population growth for Taiz City amounting to 3.85% , Rural area 2.6%, migration from the countryside to the city, and urbanization random ... etc., which offset a lack of available water resources and the emergence of social, economic, environmental and health problems in the city

-Sum of water points that have been counted in the study area 1501 point, divided between: (wells (954 Hand-dug, 479 Deep), 50 Springs, 10 water tank collections, 2 dams and 6 water retaining walls).

-Despite the paramount importance of rainwater harvesting projects in the study area, the interest and make use of them is still limited, with carrying capacity of the dams and ponds established in the study area 1542000 m^3.

Despite the issuance of the Water Law No. (33) for the year 2002 and the declaration of the national strategy for water for the year 2009-2014 AD by the Ministry of Water and Environment, however, that those texts are still read-only and did not then turn to the plans and executive programs for the water sector in the Ministry and its affiliated bodies and government institutions at the central level and localities in the provinces, as well as the existing gap in the general structural and planning, implementation and control of water resources at the country level between water users on the one hand and policy makers and legislation on the other.

Despite the existence of a committee to manage the water basin of the Upper Rasyan Valley from a number of bodies of water relationship, headed by the governor of the province (Taiz) and a number of water users associations in the study of the basin water area, but the practice of the principles of integrated management of water resources in the basin unrealized.

Weakness of groundwater recharge in the urban part of the city of Taiz as a result of the realization of the asphalt pavement and streams valleys area of 81 km^2 of the study area amounting to an area of 750 km^2.

Observed Qat cultivation in the north-eastern areas of the city of Taiz (Al-Haimah and Habir) a total area of 90.9 hectares and the spread of fodder crops in the central region of the study area with a total area reaches 208 hectares using rain water and seasonal water available from water wells and springs, as well as using wastewater in parts of the Central Catchment area (AL-Bureihi and parts of AL-Aamerah), knowing that the amount of this water is used without treatment.

The water conflicts in different parts of Taiz water basin (Jabal Saber, Al-Haimah and Habir .... etc.) due to of the scarcity of water resources, population growth and neglecting the traditional systems concerning the water rights and arrange its uses for drinking water ... etc. and the intensive competition for water resource according to property rights and group influence in different areas of the basin

The present and future of water supply in different sectors needs to be calculated (domestic, agricultural, industrial ... etc) for the base year 2013, according to the standards

of the World Health Organization (WHO) and Food and Agriculture Organization (FAO) and the Indian Specifications and American (APHA, ASTM), and long-term climate data in the study area for the years from 1979 to 2013, and hydrologic data for the region, agricultural land used and the pattern(s) of crops and groundwater extracted and their use .... Etc as an input necessary for the implementation of decision support systems program WEAP in the field of water resources management.

❖ The best choice to solve the problem of water supply for the city of Taiz and the provision of adequate water of the study area is generally over the years 2050 -2013 is to improve agricultural irrigation system. This will contribute to reduce the amount of used water in irrigation by 40% and extends the life of aquifers in a region Thi -Sufal and Al Haimah by 18.5 years, in Hawban area by 11.84 years, in the Central region by 7.4 years, and will reduce the gap between supply and demand in the study area by 89%. It is worth noting that the adopting of modern irrigation technology has high cost and lack of awareness among farmers of the importance of the use of modern irrigation techniques to accomplish the challenges in implementing this option.

8. RECOMMENDATIONS

8.1 Improve water services and water management strategy for; Central and Al Hawban Sub Catchments:

1. Increase the coverage rates for water services include all Beneficiaries service during a specific period of time.
2. Diversify water sources for the city for the purpose of continuity and sustainability in the provision of water service for all consumers and all uses of quantity and quality required.
3. Efficient water management in order to achieve the concept of good governance, so that lead to optimal use of water sources available, implement guidelines, awareness programs to rationalize water consumption , reducing losses and optimum exploitation of water projects …etc.
4. Implementation of control and water quality program in water sources and treatment drinking water Units multiple mobilize so as to prevent any contamination during transportation, distribution or storage and ensure the safety of those sources,
5. Development of specialized human cadres technically and administratively for the development of water management, in addition to providing supplies of techniques and materials required.... etc.
6. To ensure flow of water services from different water sources through the transport, storage, distribution and purification systems, wherever it is required.
7. Implementation of water demand management program for the purpose of economy in the consumption of water, the implementation of economic, technical and awareness programs..
8. Partnership with the private sector for the purpose of providing water service to the entire population. Implementation and operation of water projects, management of water service, participate in institutional development for entities operating in the water service.

9. Community participation through the formation of committees of Water and Environment friends in the Harrah and Neighborhood of the city to help TWSLC to prepare proposals to improve water services ... etc.
10. Ensure necessary investments to cover the expansion of water services in the urban area and the implementation of the proposed programs in the framework of these recommendations.

8. 2 Improve water projects, water services and water management strategy for; AL-Dabab area;

1- Increase the coverage rates for water services include all Beneficiaries service during a specific period of time.
2. Commitment of the Commission basin management to Upper Rasyan Valley, its functions in accordance with the Water law No (33)2003, and its implementing rules direct supervision on water basin management in the governorate.
3. To ensure flow of water services from different water sources across the transport, storage, distribution and purification system, wherever it is required.
4. Community participation through the formation of committees of Water and Environment friends in the Harra and Neighborhood of the part (Al-mudaffar district) from the city to help Taiz Water Supply Corporation to make proposals to improve water services ... etc.
5. The formation of committees Sub-water basin to ensure the management of water resources from the lower level to the top level with the principle of community participation, sustainability of the local development and the preservation of water resources.
6. Resolving water conflicts in different regions of the study area, by popular demand, given their economic, political, security and social effects. So it has to create community dialogues by the main Commission basin and sub- basin Committee in region conflict and representatives of water users associations in the same area to develop lasting solutions that ensure water transfer to other areas or the Taiz city and dealing the economic, social and environmental effects etc, as a result of transporting water or passing through region.
7. Community participation complete establishment of water users associations in the sub-basin areas to help provide practical suggestions to combat the random drilling of wells and development of water sources in the sub-basins areas and priorities for water use and rationalization of uses in the sub-basin water area.
8. Encourage of the house women on the participation of communities in the water management.
9. Limit urban and industrial expansion in the water sub-basin area.
10. Implementing reservoirs and agriculture terraces upstream of the wells at the area of water sub- basin.
11. Development and maintenance of agriculture terraces in the Jabal Saber watershed.
12. Necessary investments to ensure the implementation of the water projects, as well as water supply, sanitation systems, construction of water harvesting and irrigation technology, and proposed programs in the framework of these recommendations, in countryside of the study area.

8.2 Improve water projects, and water management strategy for; AL Janad area;

1. Commitment of the Commission basin management to Upper Rasyan Valley, its functions in accordance with the Water law No (33) 2003, and its implementing rules direct supervision on water basin management in the governorate and the formation of sub- water basin committees and approve operational plans and financial budgets for the development of water sources for the city and sub-basin areas supplied it generally and prioritize the use of water sources.
2. The formation of committees Sub-water basin to ensure the management of water resources from the lower level to the top level with the principle of community participation and sustainability of the local development and the preservation of water resources.
3. Community participation complete establishment of water users associations in the sub-basin areas to help provide practical suggestions to combat the random drilling of wells and development of water sources in the sub-basins areas and priorities for water use and rationalization of uses in the sub-basin water area.
4. Encourage of the house women on the participation of communities in the water management.
5. Limit urban and industrial expansion in the water sub- basin area.
6. Necessary investments to ensure the implementation of the water projects, as well as water supply, sanitation systems, construction of water harvesting and irrigation technology, and proposed programs in the framework of this strategic ,in countryside of the study area.

8.4 Improve water projects, and water management strategy for; Thi-Sufal area;

1. Commitment of the Commission basin management to Upper Rasyan Valley, its functions in accordance with the Water law No (33)2003, and its implementing rules direct supervision on water basin management in the governorate and the formation of sub- water basin committees and approve operational plans and financial budgets for the development of water sources for the city and sub-basin areas.
2. The formation of committees Sub-water basin to ensure the management of water resources from the lower level to the top level with the principle of community participation, sustainability of the local development and the preservation of water resources.
3. Resolving water conflicts in different regions of the study area, by popular demand, given their economic, political, security and social effects. So it has to create community dialogues by the main Commission basin and sub- basin Committee in region conflict and representatives of water users associations in the same area to develop lasting solutions that ensure water transfer to other areas or the Taiz city and dealing the economic, social and environmental effects etc, as a result of transporting water or passing through region.
4. Community participation complete establishment of water users associations in the sub-basin areas to help provide practical suggestions to combat the random drilling of wells, development of water sources in the sub-basins areas and priorities for water use and rationalization of uses in the sub-basin water area.

5. Encourage of the house women on the participation of communities in the water management.
7. Implementing reservoirs and agriculture terraces upstream of the wells at the area of water sub-basin
8.Necessary investments to ensure the implementation of the water projects, as well as water supply, sanitation systems, construction of water harvesting and irrigation technology, and proposed programs in the framework of these recommendations ,in countryside of the study area.

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إدارة قضايا المياه في حوض تعز/ اليمن

الخطيب الكبسي[1] ، عبدالرحمن بامطرف[2] ، محمد فارع الدبعي[1] ، سعاد الصبان[3]

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ملخص

تشمل منطقة الدراسة مدينة تعز التي يعاني سكانها من نقص حاد في المياه بسبب الطلب المتزايد على المياه لتلبية الاحتياجات المنزلية والصناعية فضلا عن الاحتياجات المائية للزراعة في المنطقة، بالإضافة إلى ذلك، تقتصر الموارد المائية في منطقة الدراسة على طبقات المياه الجوفية في حين تتجاوز معدلات استخراج المياه التغذية الطبيعية واستخدامها بشكل غير فعال. يركز البحث على أهمية إدارة الطلب على المياه للحفاظ على كمية ونوعية مياه الشرب والاستخدام المنزلي والزراعة والصناعة.

تهدف الدراسة إلى تقييم الوضع الحالي والمستقبلي لمصادر المياه في منطقة الدراسة، تطوير سيناريوهات وتحليل الموازنة المائية لمعرفة أفضل الحلول لمشكلة المياه في حوض تعز بالإضافة إلى اختيار السيناريو المناسب لحل مشكلة المياه. نتائج هذه الدراسة تساعد متخذي القرار في مجال الموارد المائية لتحسين التخطيط والإدارة للموارد المائية في هذه المنطقة مستقبلا. خلال الفترة 2013/1/15 إلى 2013/4/15 تم تنفيذ دراسة ميدانية لـ 1501 نقطة مائية موزعة هذه النقاط ما بين 954 بئر محفورة يدويا، 479 بئر عميقة، 50 ينبوع، 5 صهاريج تجميع المياه، 2 سد مائي، 6 أحواض مائية بجدران ساندة. تم حساب كمية المياه في المنطقة ومقدار العجز المائي، بالإضافة إلى معرفة كمية الاحتياجات المائية التي يجب تأمينها في المستقبل في إطار منطقة الدراسة، تم تطبيق DSS في نطاق نظم دعم القرار لإدارة العرض والطلب على المياه في حوض تعز. ولتحليل النتائج تم استخدام برنامجWEAP للمواضيع التالية: المخزون المائي في الطبقات الحاملة للمياه، كمية المياه القابلة للاستخدام لسنة الأساس 2013"م، تم احتساب كمية المخزون للأحواض الفرعية الخمسة في منطقة الدراسة ، حيث تراوحت في طبقة المياه الجوفية الغرينية 221,52الى 415,36 مليون متر مكعب، بينما أفضل تقدير بلغ 332,29 مليون متر مكعب وفي الطبقة البركانية تراوحت بين 129,98 و2500,52 مليون متر مكعب، بينما أفضل تقدير بلغ 295 مليون متر مكعب، في حين أن مخزون المياه الجوفية في طبقة الحجر الرملي تراوحت بين 5,044 إلى 50,44 مليون متر مكعب وأفضل تقدير لها بلغت 10,088 مليون متر مكعب، وقدرت الفجوة بين العرض والطلب على المياه في منطقة الدراسة 47,7 مليون متر مكعب. لحل قضية المياه في منطقة الدراسة اقترحت استراتيجية لتحسين خدمات المياه وإدارتها بكفاءة في المناطق الحضرية التي تشمل منطقتي الأحواض الفرعية للمياه الوسطى والحوبان وتتمثل بالاتي: زيادة معدلات التغطية لخدمات المياه ، تنويع مصادر المياه، الإدارة الرشيدة للمياه، تنفيذ برنامج التحكم والمراقبة على نوعية المياه ومصادرها ووحدات معالجة مياه الشرب المعبأة، تنمية الكوادر البشرية فنيا وإداريا لتطوير الإدارة المائية وضمان ضخ المياه بالكمية والنوعية المطلوبة من مصادرها المختلفة...الخ. كما تتضمن الاستراتيجية تطوير المشاريع الريفية بما فيها ضمان الإدارة الرشيدة لها في مناطق الأحواض الفرعية في الضباب، الجند ودي السفال والحيمة والمتمثلة بالاتي: تنمية مصادر المياه، تشكيل لجان للأحواض المائية الفرعية لإدارة الموارد المائية من المستوى الأدنى، حل النزاعات في قضايا المياه والمشاركة المجتمعية من خلال استكمال تأسيس جمعيات مستخدمي المياه في مناطق الأحواض الفرعية من منطقة الدراسة ....الخ.

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القسم A

الأبحاث باللغة الانجليزية

A(1-141)

The Basis of Dealing with Heritage in Sana'a City An Analytical and Critical Vision of the Architectural Changes Panorama 1972-1990

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Abstract

Sana'a city has its own conditions in dealing with its architectural heritage because it has not obtained its political nor social awareness but in late stages. It focused at the beginning of 1962 revolution on stabilizing its new political system and this created a modern capital fit with the major political transformation without paying attention to the form or architectural structure of this capital. Therefore, the modern architecture prevailed to become a characteristic of this city.

After ten years of revolution, and as a result of tracking what was going on in the world, discussing its events, conflicts and cultures through cultural and scientific exchange which began Yemen generally in and Sana'a especially strived to achieve with Arab and western countries, an individual, government and international awareness developed about the great importance of the cultural heritage of Yemen from a general scope and the importance of traditional architecture and the maintenance of the Yemeni identity whose architecture specially incarnates its most important cultural branches.

These social, governmental, and international authorities had adopted a special vision in dealing with heritage through learning lesson from the local experiences in building, through using local building materials and decorating frontages with traditional items incarnated with the values and spirit of traditional architecture to exposure the cultural and historical asset of the traditional architecture through modernity that being witnessed by the world in which Yemen is a part of.

Thus, governmental and architectural models found to use decoration items and traditional building materials for the first time that can be considered as a basis to start dealing with heritage at governmental and social level.

So, the research aims to tackle that perspective which represents the basis of dealing with heritage , analysis and criticism, as it represented a dominant concept which had a great impact on the architectural perspective at that time and later through forming a theoretical frames for heritage's concept in language and architecture, after then how to use it in the architectural works and

studying these works which appeared for the first time on a government level and then appeared in foreign and Yemeni designers' models, and therefore it changed the architectural view, at that time and affected it for later stages.

Key words: Roots, architectural heritage, traditional architecture, decorative elements.

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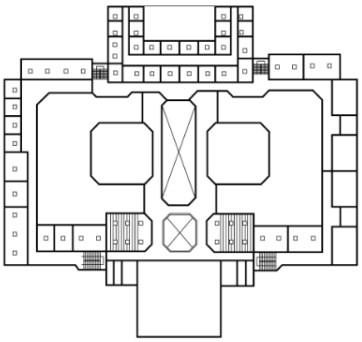
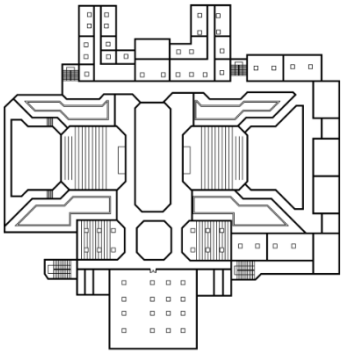
- نشر البحث ضمن كتاب يحتوي على مفهوم الموروث والمفاهيم المرتبطة به في الوقت الحاضر بهدف ترسيخه على مستوى الوعي الجمعي ولإعطاء الهوية المعمارية المحلية قيمتها في اليمن وخارجه.
- إضافة الدراسة لمناهج تاريخ ونظريات العمارة في الجامعات اليمنية وذلك لارتباطه بالواقع ولذلك يسهل استيعابه وربطه في الممارسة المعمارية المستقبلية.
- الانطلاق من الدراسة لبدء دراسات اخرى تبحث عن ايجاد طريقة تكاملية بين ممارسة الموروث المعماري والعمارة الحديثة بحيث تلبي الحاجة الروحية للانتماء للجذور الحضارية التاريخية بروح عصرية تضمن الاستمرارية الثقافية المعبرة عن المجتمع المحلي وخصوصيته المتفردة.

جدول (18) كلية التربية- جامعة صنعاء (المصدر: الباحثة)

صورة المبني	المساقط الأفقية للمبنى
	
	

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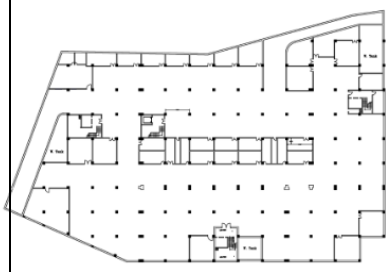
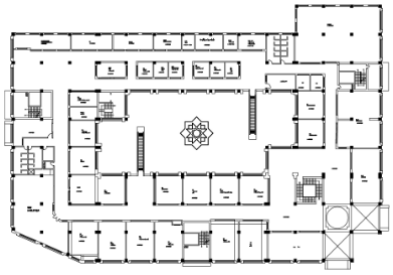
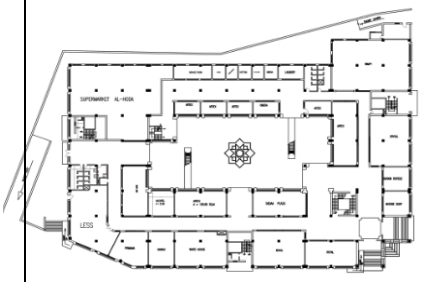
جدول (17) مركز صنعاء التجاري (المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
	
	

12- 2- 7 كلية التربية، جامعة صنعاء 1990

صمم المبنى مركز الدراسات التخطيطية والمعمارية (CPNS) في جمهورية مصر العربية بالشراكة مع المكتب الهندسي اليمني. وكلية التربية من ضمن مباني جامعة صنعاء الجديدة. نفذت المشروع شركة كربوزرياني الإيطالية الدولية. (الكوكباني 2000)

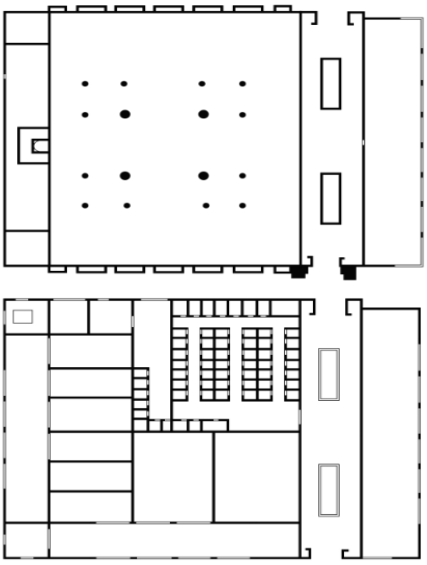
المسقط الافقي للمبني مستطيل ذو فناء داخلي كموزع بين الوظائف المختلفة للمبنى وهيكله الخرساني مغطى بالحجر التقليدي البني والأحمر الطوبي.

الواجهة الرئيسية للمبنى قوية ومؤكدة عن طريق رواق ذو اقواس نصف دائرية تمهيدية للدخول و لغة التشكيل المعماري اعتمدت محاكاة للعمارة التقليدية في استخدام شكل الفتحة الدائرية والعقد النصف الدائري، بالإضافة إلى استخدام زخرفة الحزام التقليدي ووضعها في نهاية المبنى لكن بطريقة حديثة اخذت وظيفة الحزام في العمارة التقليدية كمحدد لنهاية الادوار ولم تأخذ شكله التقليدي القديم. جدول (18)

13. الخلاصة والتوصيات

من خلال الدراسة السابقة التي وضحت بالتوثيق والتحليل والنقد جذور التعامل مع الموروث في مدينة صنعاء عن طريق استخدام مواد بناء محلية وتشكيل الواجهات بها وبمفردات معمارية من الموروث المعماري التاريخي وذلك من خلال تناول الرؤية الحكومية والخاصة التي تبنت البدايات لممارسة ذلك التوجه على نماذج معمارية أولى تم تنفيذها بالإضافة إلى أهم النماذج المعمارية التي ظهرت خلال الفترة (1972- 1990) واصبحت نمثل مفهوماً حاكماً اثر على المشهد المعماري في حينه وفي فترات لاحقة وذلك من خلال بناء اطار نظري لمفهوم الموروث في اللغة وفي العمارة ومن ثم كيفية التعامل معه في الاعمال المعمارية، وتناول تلك الاعمال التي ظهرت كبداية اولى على المستوى الحكومي ومن ثم ظهرت في نماذج لمصممين يمنيين واجانب. ومن خلال الدراسة يمكننا الخروج بعدة توصيات أهمها:

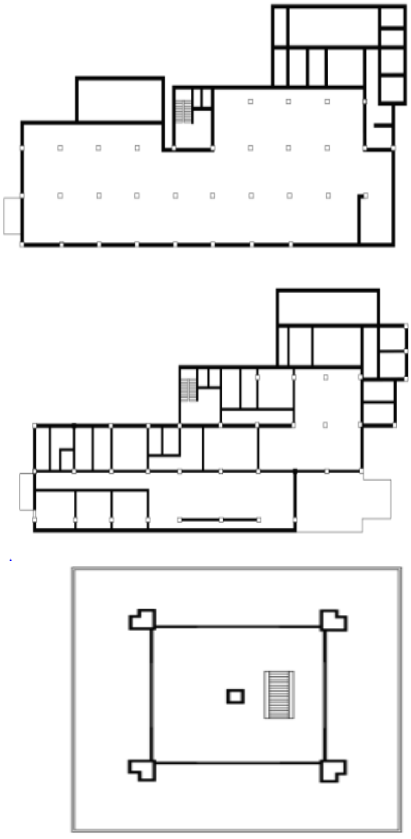
جدول (15) جامع الشهداء(المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
	

جدول (16) مجمع الاوقاف (المصدر: الباحثة)

صورة المبني	العناصر المميزة
	

جدول (14) المؤسسة العامة للاتصالات (المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
	

12- 2- 6 مركز صنعاء التجاري (المركز الليبي) 1990

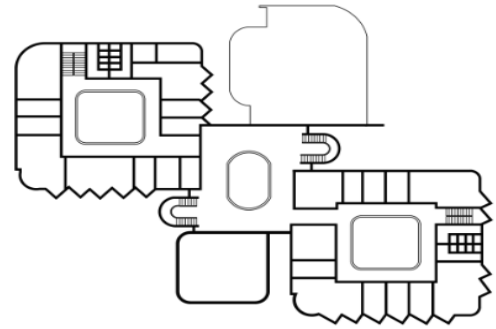
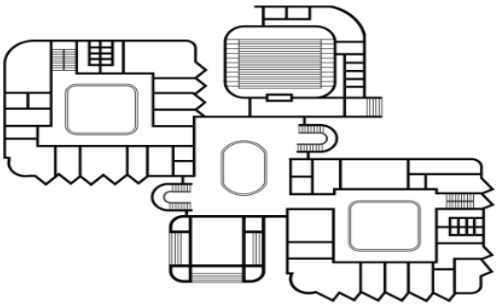
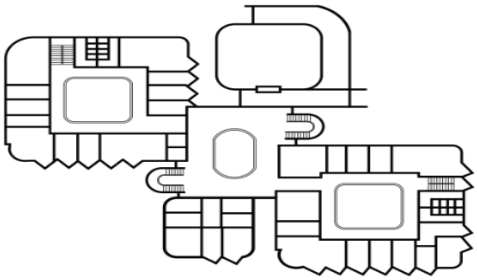
صمم المبنى الشركة العربية اليمنية الليبية القابضة ونفذته شركة التضامن اليمنية للمقاولات والهندسة بالتعاون مع شركات متخصصة محلية وعالمية تحت اشراف الدار اليمنية للهندسة. (الكوكباني 2000)

المسقط الافقي للمبنى مستطيل في الادوار السفلى وبرجين مربعين في الادوار العليا. اعتمد المسقط على الفضاء الداخلي كموزع محوري واضح وقوي لبقية عناصر المبنى في الادوار السفلية مع تعدد المداخل لمكونات الوظائف الاخرى للمبنى (تجاري، إداري، سكني) هيكلة الانشائي حديث من مادة الخرسانة مع تكسية للواجهة بمادة الحجر الاحمر بدرجاته المختلفة من الغامق للفاتح في اماكن متفرقة منسجمة ومتناغمة من المادتين.

واجهات المبنى غلب عليها الطابع الحديث بعناصر تقليدية كالعقد نصف الدائري وتأكيد نهايات المبنى بعناصر زخرفية في اجزاء منه وكتل خرسانية في الجزء الاخر. امتدت الفتحات بشكل رأسي من اسفل الى اعلى لتؤكد المحتوى الوظيفي للمبنى في كل جزء منه وهذا اوجد اتزان في المبنى بين المصمت والمفتوح. واظهر التناوب في بروز الكتل الخرسانية على الفتحات انسجام بين مادة الحجر والخرسانة. جدول (17)

السكن في الادوار العليا تميز بوجود عنصر الشرفة "البلكون" بطريقة حافظت على الخصوصية بارتفاعها من جانب واحد واستخدام الحجر مع التشكيل المنحني في الجزء المستمر ليؤكد المحاكاة للقديم، وهذا توجه معماري تميز به المصممان في المباني اللاحقة لهما في عدة مباني توزعت في انحاء مدينة صنعاء. جدول (16)

جدول (13) الجهاز المركزي للرقابة والمحاسبة (المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
	
	
	

استخدم الحجر التقليدي ذو اللون الابيض في واجهات المبنى كتكسية للهيكل الإنشائي الخرساني كتعبير عن التقليدية في استخدام مواد البناء وايضاً وتم استخدام الفتحة المربعة الرأسية على طول المبنى والمنتهية بعقد نصف دائري كمفردة تشكيلية رئيسية على كل الواجهات وهذا خلق انسجام مع الوظيفة وتوازن بين المفتوح والمغلق في الواجهة وعبر بشكل جيد عن روح العمارة التقليدية في تلبية الاحتياجات الوظيفية للمباني وفي انسجامه مع محيطه المعماري والعمراني. جدول (13)

12- 2- 3 مبنى المؤسسة العامة للاتصالات (تيليمن) 1983

يعتبر المبني من التصاميم المشتركة (محلية واجنبية) حيث صممت الشركة اليمنية الصينية للهندسة والإنشاءات المحدودة المبنى ونفذه مكتب المقاول عبد الملك الاصبحي. الكوكباني(2000)

المسقط الافقي للمبنى يتكون من جزئين، الاول مستطيل من ستة ادوار يعلوه برج مربع من خمسة أدوار. الهيكل الإنشائي من الخرسانة المسلحة وتكسية الجدران الخارجية من الحجر ذو اللون الاحمر الفاتح.

التصميم عموماً يؤكد على الحركة الرأسية في الارتفاع كتعبير عن وظيفة المبنى (اتصالات) وإمكانية عمل ابراج تقوية في الادوار العليا. وكون التصميم مشترك (يمني صيني) فهناك محاولة للمزج بين الرأسية في مباني العمارة التقليدية اليمنية وبين ناطحات السحاب الصينية. أيضاً مادة الحجر الرئيسية في البناء واستخدام العقد النصف دائري ذو الزجاج الملون فيه محاكاة صريحة للعمارة التقليدية ومزجها لوظيفة عصرية حديثة يقوم بها المبنى. اما التلاعب بالكتل في الواجهة من حيث السيطرة والتراجع وتأكيد ذلك بالزخارف الحجرية في نهايات الكتل جعل المبنى يتميز بالسيطرة والاتزان بين المصمت والمفتوح مما جعله مميزاً في موقعه وسط العاصمة صنعاء. جدول (14)

12- 2- 4 جامع الشهداء 1983

صمم المبنى للمؤسسة الاقتصادية العسكرية كلا من المعماريين: المهندس أمين عبده سعيد والدكتور عبدالله العابد ويقع داخل "مقبرة الشهداء" ونفذ المشروع مكتب الحاشدي للمقاولات. (الكوكباني 2000)

المسقط الافقي للجامع مربع تقريباً يحتوي الدور الارضي منه على الحمامات والمياضئ والمحلات التجارية الخاصة بوقف المسجد. وارتفعت قاعة الصلاة للدور الأول وهو عكس ما درجت عليه قاعات الصلاة في العمارة التقليدية التي تكون في الدور الارضي. هيكله الإنشائي خرسانة مسلحة وعليها تكسية للحوائط بالحجر التقليدي ذو اللون الاسود المائل الى الرمادي واللون البني. للجامع منارتان على نفس جهة القبلة "الشمال" مميزتان باستنساخهما من العمارة التقليدية في مواد البناء "الياجور" وفي الزخرفة الرأسية المكسية بمادة الجص وفي النهاية المنحنية البيضاء. وللجامع قبة بيضاء مسيطرة ويحيط بها قباب اصفر منها على بقية السقف المربع وهو متبع في المساجد التقليدية لمدينة صنعاء القديمة.

العناصر التشكيلية للواجهة من حيث استخدام الرواق ذو العقود النصف دائرية التي يعلوها الكتل الحجرية وعلاقتها بارتفاع المأذنتان والنهايات في القباب تؤكد رأسية المبنى كمصدر روحي باتجاه الإله. يؤكد ذلك التشكيل المعماري العام في كتلة الجامع المسيطرة والانتقال الى التشكيل الخاص في كل واجهة على حده، وتأكيد المدخلين الشرقي والغربي بارتفاع المبنى كاملاً. جدول (15)

12- 2- 5 مجمع الأوقاف "عصر" 1985"

يعتبر المبنى من اوائل المباني المتعددة الوظائف والاستخدام التي ظهرت في مدينة صنعاء (سكني، تجاري). صمم المبني المعماريان المهندس أمين عبده سعيد والدكتور عبدالله العابد والجهة المالكة له هي وزارة الاوقاف وقام بتنفيذ المشروع مكتب المهندسين. (الكوكباني 2000)

المسقط الافقي للمبنى مستطيل وغير مرتبط كثيرا بالمحيط الحضري من حوله نظراً لضخامة المبنى في تلك الفترة.

المبنى في مجملة يعتبر محاكاة للعمارة التقليدية في صنعاء القديمة وشبام حضرموت من ناحية مكوناتها المعمارية كالمنزل البرجي والتنوع المنسجم للفتحات، وخط السماء المميز للمدينة. ولذلك نجد أن الشكل العام متأثراً بعمارة شبام حضرموت من حيث الارتفاع وضيق الفتحات واتجاهها الرأسي. أما محاكاة للعمارة التقليدية في مدينة صنعاء القديمة فقد جاءت في عدة عناصر منها: تكسية الهيكل الخرساني للمبنى بالحجر البني واستخدام الفتحات ذات العقد النصف دائري المزين بالزجاج الملون الذي اصبح يطلق عليه لفظ "قمرية" بالإضافة الى استخدام الزخرفة بالحجر الاسود حولها في نهاية المبنى واركانه.. وأن كانت هذه الزخرفة قد اكدت على وظائف العناصر في واجهة المبنى الا ان كثرتها مع تراجع الكتلة العليا للخلف في الادوار المتعددة جعل الايقاع المتساوي باعثاً للملل.

12- 2 ثانياُ: النماذج المعمارية لمصممين يمنيين:

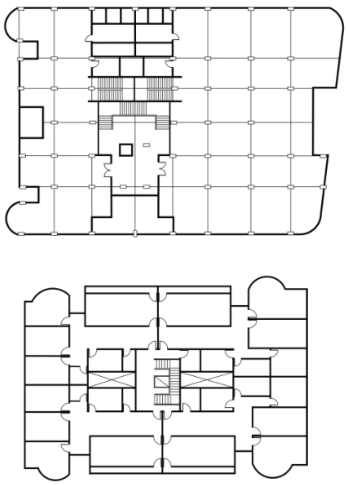
ظهرت نماذج معمارية تعاملت مع الموروث بذات العناصر التشكيلية الثلاثة في الفترة 72-90 وقد مثلت ثلاث انواع هي:

- اعمال ينفذها المقاولون وغالباً لا تعتمد على الدراسات المعمارية الا بشكل سطحي جدا.
- اعمال لنخبة من المصممين عادوا من الدراسة من الخارج وحاولوا تطبيق توجه دراساتهم على البيئة اليمنية.
- اعمال اما مشتركة بين يمنيين واجانب او اعمال لأجانب تم تعديلها بما يلائم البيئة اليمنية على أيدى مصممين يمنيين.

12- 2- 1 الهيئة العامة للمعاشات (بناية الاصبحي سابقاً)1982:

صمم ونفذ المبنى مكتب المقاول عبد الملك الاصبحي. الكوكباني 2000) ويعتبر اول مبنى تم تنفيذه في العاصمة صنعاء باستخدام مادة الحجر ذو اللون الاخضر بتدرجاته من الفاتح الى الداكن. .المسقط الافقي للمبنى مربع تقريبا ويرتبط به كتلة خارجية للمدخل لبعض الوظائف الامنية المرتبطة بالمبنى الرئيسي. اعتمد التنفيذ على الهيكل الانشائي الخرساني الذي تم تكسية واجهاته بالحجر الأخضر. تم استخدام ثلاثة انواع من الفتحات (الفتحة الدائرية، الفتحة المنتهية بنصف عقد دائري، والفتحة المربعة الصريحة) كعناصر تشكيل في الواجهة مرتبطة بالعمارة التقليدية بطريقة حديثة اختلفت في كبر حجم هذه الفتحات وفي استخدام الزجاج والألمنيوم لتغطية مساحاتها الكبيرة نوعاً ما. وهذا المزيج من العناصر التشكيلية افقد الواجهة الوحدة التصميمية والتنوع المطلوب للواجهات الاربع للمبنى وأصبحت كل واجهة تعبر عن ذاتها بمعزل عن الواجهة الاخرى .ويمكننا استنتاج ان هذا التنوع في تشكيل الواجهة قد يكون ناتج عن محاولة التصميم لتأكيد وظيفة المبنى وتنوع الفضاءات الوظيفية والشكلية معاً. جدول (12)

جدول (12) الهيئة العامة للمعاشات (المصدر: الباحثة)

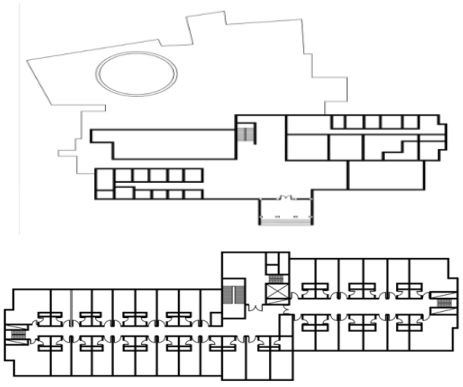
صورة المبني	المساقط الافقية للمبنى
	

12- 2- 2 الجهاز المركزي للرقابة والمحاسبة 1982

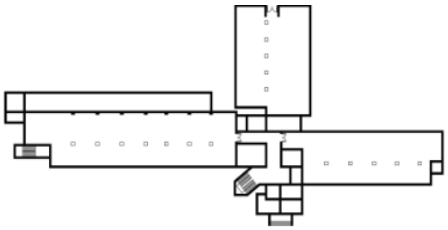
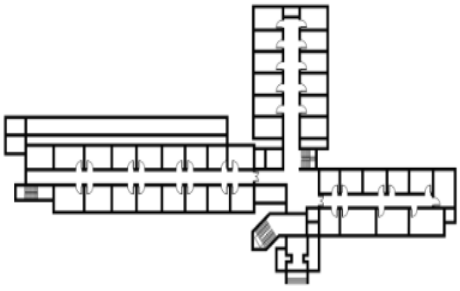
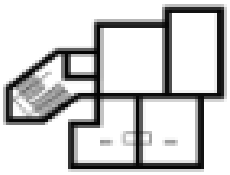
التصاميم المعمارية للمبنى للمهندسة العراقية أحلام الشاوي وقد تمت منذ وقت مبكر (1982) وتم تعديل التصاميم وتنسيق الموقع على يد الدكتور عبد الرقيب طاهر ومن ثم تنفيذ المشروع في العام 1996 بتمويل من الحكومة اليمنية وتنفيذ المقاول علي حمود الحاشدي. (الكوكباني 2000)

المسقط الافقي للمبنى عبارة عن مربعين تتوزع فيهما الفراغات الوظيفية للمبنى حول فناء ثانوي خاص بكل مربع ويتوسطهما الخدمات الاساسية المشتركة بين جميع اجزاء للمبني كفناء حركة مركزي فيه المصاعد والسلالم والخدمات العامة بالإضافة الى دورات المياه والكافتيريا. ساعد هذا التصميم على سهولة الحركة والتنقل بين اجزاء المبنى دون تقاطعات مربكة للوظيفة واستخدام هادئ لباقي الفضاءات المشتركة في المبنى كالصالة متعددة الاغراض وصالات الاجتماعات الكبيرة.

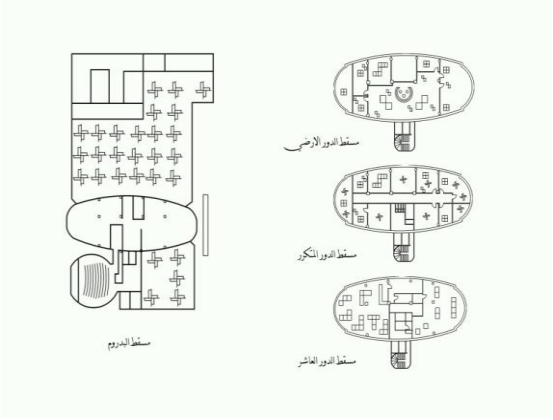
جدول (10) فندق ناج سبأ (المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
	

جدول (11) مبنى وزارة الصناعة (المصدر: الباحثة)

صورة المبني	المساقط الافقية للمبنى
  	  

جدول (9) مبني الخطوط الجوية اليمنية (المصدر: الباحثة)

صورة المبنى	المساقط الافقية للمبني
	

12- 1-3 فندق تاج سبأ 1978:

صمم المبنى الهندي "جون جهام" للمالك "شاهر عبد الحق" والشركة المنفذة "شركة المقاولين اليمنيين .(YCON). استخدمت الخرسانة المسلحة في الهيكل الانشائي ومادة الحجر الابيض في تكسية الواجهات. الفضاءات الداخلية ملائمة للوظيفة. فالمسقط المربع في الدور الارضي يحتوي على كافة الخدمات المتعلقة بالفندق (استقبال، مطاعم، دوراة مياه، مواقف سيارات، مسبح ونادي صحي) في حين مسقط الادوار الخمسة العليا مستطيل لغرف نوم من الجهتين تفتح على ممر يتوسطه بطارية الحركة من مصاعد وسلالم وغرف تخديم التصميم حديث من ناحية الانشاء والوظيفة (الكوكباني، 2000)

جاء الشكل الخارجي ليوائم بين التقليدية والحداثة باستخدام الحجر والعقد النصف دائري ذو القمرية الملونة في نهاية الفتحات للدور الاخير. هذه النهاية جعلت الكتلة عالية ومهيمنة رغم بساطتها الملائمة للوظيفة "نافذة لغرفة نوم". النوافذ جميعها متجانسة وبعيدة نوعاً ما عن الرتابة بخروج الكتلة الوسطية وتقسيم الواجهة عن يمينها وعن يسارها. بساطة الزخارف في نهاية الادوار وحول النوافذ واستخدام مادة الحجر والزجاج الملون اضفى تناغم بسيط ومريح للعين واقرب للتقليدية من للحداثة مما جعل المبنى لا يشكل عبئا بصرياً على المكان او نشازاً حضرياً على ارتفاعات تلك المنطقة في قلب مدينة صنعاء جدول (10)

12- 1- 4 وزارة الصناعة 1981

صمم المبنى "دار الهندسة للتصميم والاستشارات الفنية ومقرها بيروت" والجهة المالكة للمبنى هي الهيئة العامة للمعاشات والضمان الاجتماعي. نفذته شركة "يوكون" وهي شركة يمنية ايطالية. (الكوكباني2000)

اول استخدام للمبنى بعد إنشاءه كان مقر لوزارة الصناعة ومر باستخدامات حكومية مختلفة والمبنى حاليا اصبح من المباني الادارية المتعددة الاستخدامات بعد انشاء مباني للوزارات.

تأتي اهمية المبني في كونه اول المباني التي تم استخدام الجدران الخرسانية سابقة الصب "الجاهزة" وتكسيتها بالحجر الرمادي والاحمر. المسقط مستطيل مع ممر داخلي مركزي تفتح عليه فراغات المبني المتعددة مع بروز لكتلة الحركة الراسية.

التشكيل الخارجي للواجهة حاول فيه المصمم ان يستخدم الاسلوب التقليدي في استخدم العقد النصف الدائري حول كل فتحة وشكلت الواجهة صف طويل من النوافذ المتشابهة والمتراصة على المستوى الرأسي وعلى المستوى الافقي وهذا جعل الواجهة مهيمنة بعنصر واحد فقط متجانس مع بعضه في تكرار لإيقاع واحد مؤكدا على الوظيفة. جدول (11)

1- الصالة الرئيسية للجمهور المتعاملين وهي بارتفاع ثلاثة أدوار لتكوين الفراغ الداخلي الرئيسي للبنك، تطل عليه بعض العناصر الاخرى للمشروع مع الأخذ في الاعتبار الإضاءة الطبيعية لهذه الصالة من أعلى دون السماح لأشعة الشمس بالتسلل لداخلها.
2- المكاتب الرئيسية لإدارة البنك وملحقاتها من قاعة للاجتماعات ومكتبة وصالات استقبال في الدور الأول للمبنى.
3- مكاتب الموظفين وقد جمعت في برج من خمسة ادوار متكررة اعلى القاعدة الافقية للمبنى وصالة الجمهور.
4- خزائن حفظ النقود والمستندات والتي وضعت بالدور الاسفل وأقيمت جدرانها وأسقفها وأرضياتها من الخرسانة المسلحة وفقاً لأحدث التصميمات التي تؤمن سلامتها وأيضا حمايتها من الانفجار والحريق والسرقة.
5- الخدمات العامة وتشمل رصيفاً لتفريغ وشحن النقود من والى البنك، تحت اشراف غرف الحراسة واستراحات للعاملين مع ما يلزمها من غرف للملابس ودورات مياه، ثم صالات الاجهزة الميكانيكية والكهربائية خاصة اجهزة تكييف الهواء وغلايات المياه ووحدة احتياطية لتوليدالكهرباء، بالإضافة إلى مكاتب استلام وتسليم المراسلات اتوماتيكياً على المكاتب والمطبعة مع ما يلزمها من مخازن وورش.

جدول (8) البنك المركزي (المصدر: الباحثة)

صورة المبني	اهم العناصر التشكيلية
	

2-1-12 الخطوط الجوية اليمنية 1976:

قامت شركة I. Kalosالفرنسية بتصميم مبنى الخطوط الجوية اليمنية لشركة اليمنية للطيران الجوي، ونفذه المشروع شركة فار نيرو الايطالية. التصميم الحداثي للمبنى في الشكل البيضاوي المستمد رمزيته من شعار (الخطوط الجوية اليمنية) واستخدام مواد بناء حديثة (المنيوم+ زجاج) وارتفاع المبنى (10) أدوار. جميعها عوامل ساعدت على تميز المبنى في مدينة صنعاء وعلى اعتباره معلماً معماريا مميزا في نسيجها العمراني.

جاء الشكل الخارجي للمبنى مغايرا للعمارة التقليدية وغير ملائماً للظروف المناخية للمدينة باستخدام مساحة الزجاج الكثيرة والكبيرة ومادة الالمنيوم في شكلها الخارجي واستخدام الهيكل المعدني الصلب في طريقة إنشائها. لكن هذا التصميم للشكل البيضاوي ساعد على استخدام الفراغ الداخلي بشكل جيد ودخول الضوء للمساحات الداخلية بشكل متساوي، خاصة وان القواطع الداخلية لم تكن كثيرة مما جعل الفراغ حر في اداء وظيفته، في حين احتوى الجزء الزائد عن الشكل البيضاوي للخدمات الرئيسية للمبنى من سلالم ومصاعد ودورات مياه وكافتيريا. وبذلك تم عزلها عن الفضاءات الوظيفية وتوفير الخصوصية في اداء الخدمات دون تقاطع. جدول (9)

الحجر المحلي، الزخارف) لمصممين يمنيين ومصممين اجانب. ونظرا لما مثلته هذه النماذج من أهمية في البدء لتأسيس عمارة الحداثة في مدينة صنعاء وتطعيمها بعناصر تشكيل من الموروث التقليدي سنتناولها بالشرح والتحليل. واهم هذه التصاميم من الجانبين كالتالي:

12-1اولا: النماذج المعمارية لمصممين اجانب:

ظهرت النماذج المعمارية التي صممها غير اليمنيين في الفترة 72-90 نظرا للأسباب التالية:

- سرعة انجاز تلك التصاميم وتلبيتها لحاجة الدولة السريعة في إنشائها للوظائف الجديدة التي ظهرت وليس لدى اليمنيين خبرة بها.
- لم تكن الاقسام المعمارية قد ظهرت في الجامعات اليمنية لتتولى هي او طلابها مهمة عمل التصاميم اللازمة.
- نقص الخبرة لدى المصممين اليمنيين الذين درسوا خارج اليمن ادى الى اشتراط الشراكة بينهم وبين مكاتب اخرى دولية عربية واجنبية.

وأهم هذه التصاميم:[7]

12-1-1 البنك المركزي 1978 وتوسعة المشروع عام 1989

كتبت مجلة عالم البناء في عددها 18 لشهر يناير 1982 التي كان يصدرها مركز الدراسات التخطيطية والعمرانية برئاسة الدكتور عبد الباقي ابراهيم "مصر" انه "تم تصميم المبنى بعد دراسة الموقع وتحديد انسب الاماكن للمداخل المختلفة ثم تحديد اتجاهات الكتل المعمارية المكونة للمشروع نتيجة للظروف الجديدة السائدة في بالمدينة بالفصول المختلفة من السنة. وفي اطار الاعتمادات المالية المقررة امكن وضع التصميم العام للمبنى عام 1978م" ونفذ المشروع المقاول محمد سيف ثابت، وأعمال التشطيب النهائي نفذتها الشركة الكورية، اما المرحلة الثانية فقد نفذتها الشركة اليمنية للإنشاء والتعمير. جدول (8)

صمم المبنى مكتب (المهندسون الاستشاريون العرب، المعماريان صلاح زيتون، مصطفى شوقي والانشائيان د. احمد محرم، د. ميشيل باخوم) بالتعاون مع المكتب الفني المعماري بصنعاء. "يعتبر هذا المشروع من الاعمال المميزة في مدينة صنعاء. وكان الهدف من التصميم ليس فقط مواجهة المتطلبات الوظيفية للمبنى ولكن اظهار الطابع المعماري لمدينة صنعاء. لذلك قام المصمم بزيارة المدينة لاستنباط الملامح المعمارية المميزة واختيار ما يصلح منها للتطوير والاستخدام دون الاخلال باحتياجات العصر من طرق التشييد ومواد البناء وحسن الاستفادة من المبنى". بالإضافة الى فكرة التصميم على مبدأ التكعيبية في الكتل والخطوط الصريحة والاتزان لتسجم مع العمارة التقليدية التي يقع البنك بالقرب منها ويلاصق تقريباً سور المدينة القديمة.

المسقط الافقي للبنك مستطيل يعلوه مربع وتحددت فيهما وظائف البنك المختلفة وتوج المبنى بكتلة خرسانية ضخمة "المحرقة" في تشبيه لها بنهاية المباني التقليدية ب"المنظر" أعلى الادوار وأيضاً جعل الواجهة الشمالية "القبلية" الباردة مصمتة إلى حد كبير كالواجهة الشمالية في العمارة التقليدية التي كان يطلق على فتحاتها النوافذ الكاذبة.[8] المبنى هيكلي من الخرسانة المسلحة وتم تكسية الواجهات بالحجر. وفي استخدام الحجر كان هناك محاكاة للعمارة التقليدية في الترتيب والتدرج حيث كان الحجر الأسود "الحبش" في قاعدة المبنى والحجر المائل للأحمر في بقية المبنى مع استخدام الحجر الابيض كإطارات حول الشبابيك كمادة الجص "الجبس الأبيض" حول الشبابيك في العمارة التقليدية.

تأكيد الرأسية والأفقية على مستوي شكل المبنى المستطيل الذي يعلوه برج مربع وعلى مستوى شكل الفتحات المستطيلة التي تتوسط ارتفاع الدور والتي توجت في الدور الاخير بالعقود النصف دائرية المزينة بالزجاج الملون المتعارف عليها باسم (القمرية)، اضافة الى فتحات المداخل التي اكدتها الكتلة الطائرة اعلى الدور الارضي. وكان استخدام اللون في نقش المبنى مع الكتل الخرسانية تعبير عصري ومميز عن الزخرفة في اجزاء المبنى وجاءت الأحزمة صريحة وواضحة في نهايات الكتل وكل هذه المعطيات في الانسجام بين العمارة التقليدية والحديثة حقق توازن في تكوين كتل المبنى وفي علاقة الاجزاء المفتوحة والمصمتة.

والبنك مكون من الفضاءات المعمارية التالية:

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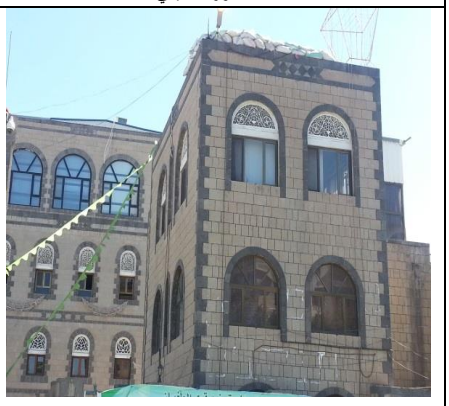
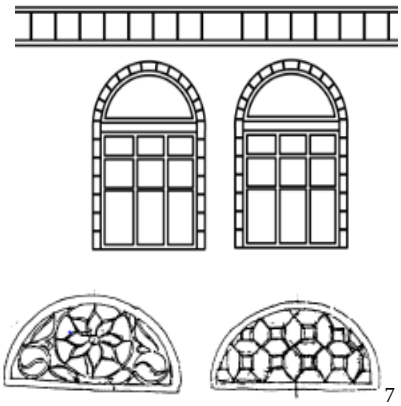
[7] نشرت الباحثة كل ما استطاعت الحصول عليه من مساقط افقية وليس جميعها نظراً لطول عمر المباني، وقامت الباحثة بالزيارة الميدانية واستكمال التحليل الوظيفي اما الشكلي فقد تم من خلال التصوير والرسم من ارض الواقع.

[8] النوافذ الكاذبة: هي الاماكن المصمتة الغير مفتوحة ولكنها تأخذ شكل النافذة وإطارها وزخرفتها وموقعها في الواجهة الشمالية وهي الواجهة الباردة والغير مرغوب فيها بالفتحات باستثناء البسيطة منها كفتحات التهوية وفتحات الحمامات والمطابخ. وتدل الفتحات الكاذبة على حب المعمار اليمني التقليدي للجمال بزخرفة هذه الفتحات والاهتمام بها مثل الفتحات الحقيقية.

الخارجي للمبنى فقد استخدم فيه مادة الحجر للجدران التي تتخللها فتحات نوافذ ذات عقد نصف دائري يعلوه زجاج ملون "قمرية" وزخرفة علوية بنهاية المبنى من ذات الحجر. (الكوكباني 2000) كما يبين هذا (جدول رقم 6)

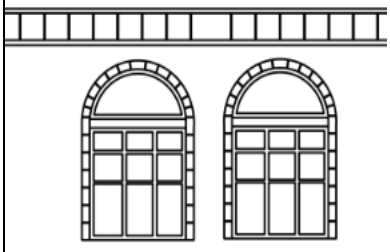
جدول (6) مكاتب وزارة الخارجية (المصدر: الباحثة)

صورة المبني	اهم العناصر التشكيلية
	

11- 5 المعهد الصحي 1972:

من المباني الحكومية التي تم انشاءها بالتزامن مع مستشفى الكويت التعليمي الذي تبنت تكلفته دولة الكويت الشقيقة عام 1970. (الكوكباني، 2000) والمبنى عبارة عن قاعات دراسية في الادوار السفلية للطلبة الملتحقين بدراسة التمريض في حين ان الادوار العلوية هي سكن للطلبة القادمين من المحافظات خارج العاصمة. وفي فترات متفاوتة تم استخدام السكن للموظفين القادمين من دول اخرى كالهند ويعملون في اقسام مستشفى الكويت المختلفة. والمبنى من اوائل المباني المتعددة في صنعاء حيث بلغ ارتفاعه اربعة أدوار استخدمت فيه الحجارة والفتحات المنتهية بعقد نصف دائري مزخرف بالقمرية الملونة. جدول (7)

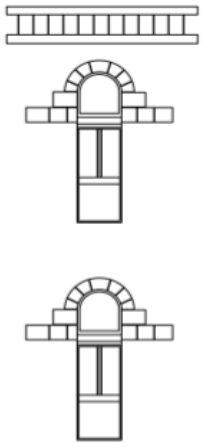
جدول (7) المعهد الصحي (المصدر: الباحثة)

صورة المبني	اهم العناصر التشكيلية
	

12. التصاميم الدولية والمحلية 1970- 1990

وبعد هذه النماذج الهامة من المباني الرائدة، بدأت في الظهور مباني بذات التوجه المحافظ على العمارة التقليدية في التشكيل الخارجي باستخدام مواد البناء المحلية و تأكيدها بعناصر تشكيلية خارجية تمثلت في (العقد النصف الدائري،

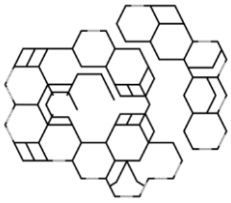
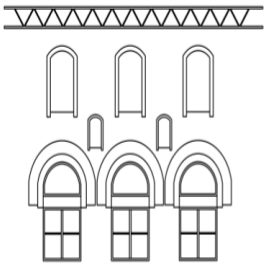
جدول (4) المعهد الوطني للعلوم الادارية (المصدر: الباحثة)

صورة المبني	اهم عناصر التشكيل
	

3-11 المدرسة الامريكية الدولية 1971:

تم افتتاح المدرسة في سبتمبر 1971 لتكون اول مدرسة خاصة للتعليم الأساسي والثانوي باللغة الانجليزية.[6] كانت في تلك الفترة، تبعد عن صنعاء مسافة سبعة كيلو متر، ونتيجة لتوسع مدينة صنعاء فقد اصبحت ضمن الجزء الشمالي لها. المدرسة مكونة من دور ارضي ودور اول وتحتوي على قاعات وفصول دراسية ومعامل وملاعب. جسدت واجهة المدرسة العمارة التقليدية بشكل كبير وذلك عن طريق استخدام مادة البناء المحلية (الياجور) واستخدام الفتحة ذات العقد النصف دائري ذو الزجاج الملون اعلى النوافذ. وفتحات التهوية وهو ما بعرف في العمارة التقليدية باسم "الشاقوص" اضافة الى مادة الجص لزخرفة النوافذ من الخارج واستخدام الحزام التقليدي في نهاية المبنى. جدول (5)

جدول (5) المدرسة الامريكية الدولية(المصدر: الباحثة)

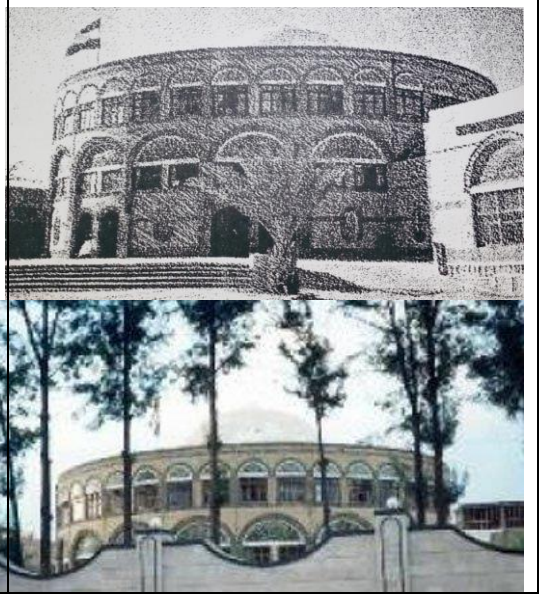
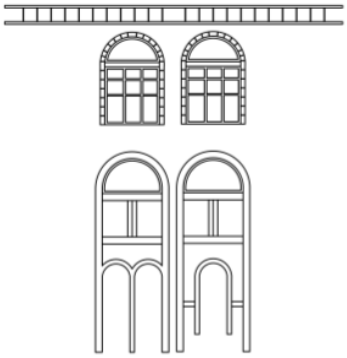
صورة المبني	المسقط الافقي	العنصر المميز للواجهة
		

4-11 مكاتب وزارة الخارجية 1971:

مبنى وزارة الخارجية في الاساس هو عبارة عن مبنى قديم يعود للعائلة الحاكمة في اليمن قبل قيام ثورة سبتمبر 1962. ونظرا لوظيفة المبنى الجديدة لم يعد كافياً لها لذلك تم اضافة مبنى ملحق بالوزارة وهو عبارة عن بناء مكاتب خاصة بالموظفين اتخذت في تشكيلها الفراغي من الداخل نظام الممر الذي تفتح عليه المكاتب الادارية. اما التشكيل

للمبنى لتأكيد نهاية المبنى وهي الطريقة التقليدية المستخدمة في نهايات الادوار ونهاية المبنى بما يعرف بالحزام. وهذا الشكل الدائري وعناصره بشكلها الحديث تحاكي اشكال وعناصر العمارة التقليدية بوظيفتها الحديثة التي توزعت داخلها الفراغات المعمارية للمكاتب الادارية للوزارة ولخدماتها المتعددة.

جدول (3) وزارة العدل (المصدر: الباحثة)

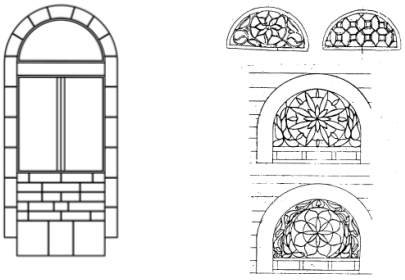
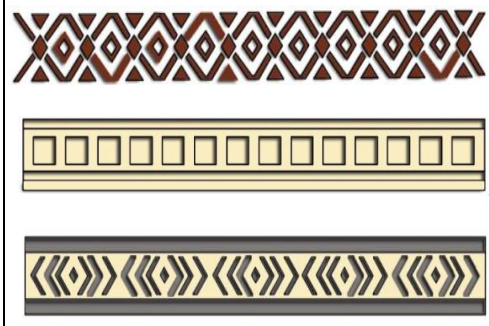
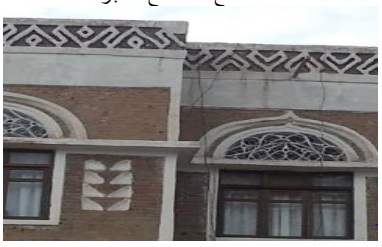
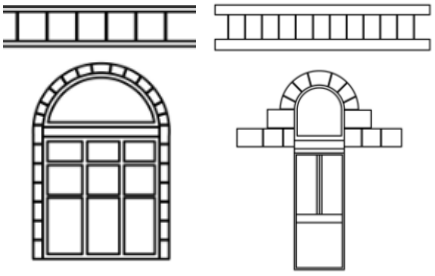
صورة المبنى	اهم العناصر التشكيلية
	

11- 2 المعهد الوطني للعلوم الادارية 1973:

اتجهت الحكومة بعد قيام ثورة سبتمبر 1962 الى تنفيذ عملية التحديث الاداري وأنشأت لذلك العديد من الاجهزة الادارية والتي كان من بينها (معهد الإدارة العامة والسكرتارية) عام 1963 وكان مقره عند التأسيس في القصر الجمهوري، ثم انتقل إلى مقر مستقل في شارع الزبيري ومن ثم انتقل الى مقره الحالي في عام 1973 في شارع "ابن الامير، بير الشايف" "شارع العدل حاليا" وسط العاصمة صنعاء وأصبح يحمل اسم (المعهد الوطني للعلوم الإدارية)[5]. يتكون المبني من دور ارضي ودور اول، التصميم الداخلي للمعهد اعتمد على فكرة الفراغات الوظيفية من الجانبين المفتوحة على ممر بينهما في حين تركزت الفضاءات الادارية والخدمية في منتصف المبنى وقريبة من المدخل. جسد المبنى في واجهته الخارجية العناصر التشكيلية التي سعت لتثبيتها الجهات الحكومية في تصاميم المباني المذكورة وهي "العقد النصف دائري ذو الزجاج الملون" الذي يعلو النوافذ والذي ظهر ايضا بقوه لتأكيد المدخل الرئيس للمبنى. بالإضافة الى استخدام مادة الحجر باللونيين الاسود كأسلوب زخرفي حول النوافذ وتحديد نهاية الادوار، والحجر البني الفاتح "البيج" كمادة رئيسية لإنشاء المبنى. جدول (4).

[5] http://nias.vacau.com/about_us1.php ديسمبر 2013

جدول (2) عناصر التشكيل المعماري واماكنها على الواجهات المعمارية (المصدر: الباحثة)

م	العنصر	الشكل
1	العقد النصف دائري 	
2	الحزام الزخرفي المحدد لنهاية كل طابق 	
3	العقد مع النافذة مع الحجر 	

11. أهم النماذج المعمارية العامة الرائدة

سنتناول أهم المباني العامة الرائدة .التي برزت في الفترة1972-1990 بالتوثيق والتحليل لما تمثله من اهمية تاريخية في تاسيسها للبدء في التعامل مع الموروث باستخدام مواد البناء المحلية والتشكيل بعناصر ومفردات تقليدية لكن بطريقة حديثة ومعاصرة للوظائف الجديدة التي احتاجتها العاصمة صنعاء:

11- 1 وزارة العدل 1972:

جسد الشكل الدائري جدول (3) لمبنى وزارة العدل العمارة التقليدية. فالمسقط الدائري يشبه الابنية الدفاعية والحصون وبعض المنازل الخاصة بالحراسة في العمارة اليمنية التقليدي، والتي كان يطلق عليها اسم "نوب" من تناوب الحراسة فيها للدفاع او لحماية المدن القديمة. واعتبر المبنى تصميما معاصرا طور وحافظ على العمارة التقليدية باستعمال مادة الحجر. البني الفاتح "البيج" في الجدران الحجرية الحاملة التي تتخللها الاقواس النصف دائرية التي يعلوها الزجاج الملون ويطلق عليه "قمرية" وبذلك تشكلت بعض خصائص العمارة اليمنية الحديثة بتقسيم عناصر وحدة النافذة بعزل العقد بعتب النافذة ومن ثم زخرفة العقد بمادتي الجص والزجاج الملون لتصبح النافذة عنصرا معبراً ومستقلاً بذاته. وفي نهاية المبني تم استخدام الزخرفة الافقية من مادة حجر ذات لون اسود مختلفة عن اللون السائد

3- تشكيل الحجر على الواجهات بمختلف الوانه.

ويبين شكل (1) الثلاثة العناصر التشكيلية التي تم استلهامها من الموروث المعماري القديم في المباني الحكومية والتي كانت سائدة في معظم المباني في صنعاء.

شكل (1) اماكن عناصر التشكيل في الواجهة (عقد، حزام، حجر) (المصدر: الباحثة)

وهذه الثلاثة عناصر كما في الجدول رقم (2) اصبحت تقليداً في المباني اللاحقة وتعبيراً عن الاصالة والحفاظ على التراث المعماري لتلك الفترة (1972- 1990) كبدايات. واذا كان الطابع في تعريفه "هو الشكل الذي يميز المدينة عن غيرها من المدن، ويساعدنا على التعرف عليها من جهة وعمل المقارنات الشكلية لتوضيح الفرق بين المدن" فان هذه العناصر الثلاثة قد نجحت في ان تصبح طابعاً مميزا لمدينة صنعاء حتى العام 1990. حيث تحول المشهد المعماري بعد العام 1990 واصبح معبرا عن التغيرات السياسية والاجتماعية والاقتصادية التي ظهرت في العام ذاته، ولعل ابرزها حرب الخليج الثانية وتداعياتها على المنطقة العربية واليمن من ضمنها. هذا ويوضح الجدول (2) هذه العناصر وأماكن تواجدها على الواجهة. (الكوكباني 2008)

10. المفهوم التشكيلي الحاكم

يعرف التشكيل أنه المظهر العام للمستوطنات الانسانية ويشتمل على مجموعة من الملامح العمرانية (المذحجي 2006) وبما انه لا يمكن ترجمة المفهوم الحاكم بصورة مباشرة إلى منتج ملموس، إلا أن التحليل الفلسفي للتاريخ يحدد مدى تأثير المفاهيم الحاكمة على النتاج المعماري والتشكيلي على مستوى النظريات والقوانين مجتمعة او على مستوى أحد هذه القوانين والنظريات والتي تتحد لتكون نموذجاً عالمياً انطلاقاً من المحددات المحلية. فعلي سبيل المثال فأن نظرية جاليليو التي ناقشت ان الارض تدور حول الشمس اصبحت نموذجاً في حد ذاته، وتحديداً أصبحت قانون عام للفضاء، وفي نفس الوقت اصبحت نظريته مجتمعة مع نظريات محلية أخرى في المنطقة كالنظريات الدينية والسياسية والتي تحدث تغير ملحوظ. (Kuhn 1992)

وعلى ضوء ما سبق فإن الإطار التشكيلي الحاكم هو "الإطار الذي يتعامل المجتمع من خلاله مع مجموعة العمليات والعلاقات المختلفة داخل المجتمع الواحد، أو داخل الحقل التصميمي الواحد، والتي تحدد في مجملها السلوك والتوجيهات" (Kuhn 1992)

الممكن العودة للعمارة التقليدية بكامل وظائفها نظرا للتحولات السياسية والاجتماعية والاقتصادية فانه يمكن الاتجاه الى استخدام رموز ومفردات معمارية تشكيلية تقليدية تؤكد الانتماء للموروث القادر على التعبير عن الاصالة والمعاصرة معاً، ومجسدة للهوية بمفهومها ومعناها اللغوي "جوهر الشيء"، الصحاح، 1998) وبمفهومها الفلسفي كما عرفها الجرجاني "هي الامر المتعقل من حيث امتيازه عن الاغيار" (وهبة، 1998) ويتأتى هذا الامتياز بالخصوصية والاختلاف عن الغير وليس الافضلية عن الغير.

اما مفهوم الهوية المعمارية فقد جسده المعماري الامريكي لويس سوليفان[3] Louis Sullivan" الهوية هي شكلا تبادليا بين العمارة والمجتمع يُعبر الانسان فيه عن تحولات ثقافته عبر التاريخ فيصبح للعمارة قيمة لأنها تحمل معنى وهوية اصحابها" (شيراز، 1999)

وانطلاقاً من اهمية الهوية اليمنية والحفاظ على العمارة التقليدية اهتمت الحكومة اليمنية في بداية السبعينيات بان تكون هي الداعمة لها وان تجسد مباني صنعاء روح الهوية المعمارية اليمنية بموادها وبتعبيرات التشكيل على واجهاتها، جاء قراراها في العام 1971 وبمساعدة برنامج الامم المتحدة الإنمائي (UNDP) ان تكون المباني الحكومية معززة للبيئة التقليدية اليمنية ومجسدة لقيم المجتمع الثقافية والبيئية والمناخية، ليتم بعد هذا التنبيه على ضرورة بناء المباني الحكومية بمادة الحجر المقطع يدويا والبدء في تنفيذ وتصميم العديد من هذه المباني ضمن هذا المشروع على يد المعماري البريطاني "Derek Matthews" والتي احتوت: مبنى مكاتب وزارة الخارجية، مبنى المعهد الصحي، مبنى المعهد الوطني للإدارة المحلية، المدرسة الدولية، وزارة العدل. (مسعود، 1999) واعتمد المصمم فيها على مرجعيات العمارة التقليدية في استخدام مواد البناء وفي عنصري الفتحات (النوافذ) والتشكيل الخارجي بها وبمادتي الحجر والياجور "الطوب المحلي".

8. السمات المعمارية لجذور التعامل مع الموروث

- استخدام حجر "الحبش" وهو من صخر الجرانيت الاسود فوق جدران الاساسات وفي الاركان وفي عقود النوافذ، وكزخرفة افقية في نهاية كل دور وهو ما يسمى بـ"الحزام". يقطع ويهذب على شكل مكعب ابعاده من 20- 30 سم. أما خحر "الجُعم" الاكثر صلابة وضخامة فتستخدم دون تشكيل في الاساسات.
- استخدام الحجر بمختلف الوانه (ابيض، احمر، بني فاتح، اخضر) وبمختلف انواعه (الحجر الاسود، الابيض، الاخضر والبني...) وعلى اختلاف مناطقه (صعدة. مارب، أبين، تعز، لحج، الحديدة.) وهذه الاحجار في مجملها صخور رسوبية اقل وزناً من حجر"الحبش الاسود" في تكسية الواجهات للأدوار العليا.
- استخدام الطوب الصناعي والطوب المحلي المسمى "الياجور" في تكسية الواجهات.
- استخدام العقد النصف دائري المعشق بالزجاج الملون بكثرة وأطلق عليه اسم "قمرية"[4]
- الميل إلى الافقية في البناء نتيجة لتوفر الأرض وأيضا نتيجة الميل الاجتماعي الى الاستقلالية والابتعاد عن السكن مع الاسرة خاصة من قبل الابناء.
- استخدام مواد البناء الحديثة كالخرسانة المسلحة للبناء الهيكلي وتكسية الواجهات بالحجارة.

9. دلالات عناصر التشكيل المعماري في الفترة 72 – 90

في بدايات التعامل مع الموروث من الجانب الحكومي والخاص تم استلهام ثلاثة عناصر من الموروث المعماري التاريخي لتعبر عن الأصالة التاريخية بوظائف حديثة لمكونات معمارية على ارض الواقع، وبذلك تُمكن هذه الثلاثة العناصر من الاستمرارية الحضارية باستجابتها لظروف البيئة المحيطة بازدواجية بين الأصالة والحداثة. وعلى ضوء ما سبق نجد سيطرة هذه العناصر التشكيلية على الواجهات و هي:

1- العقد النصف دائري ذو الزخارف الزجاجية
2- الحزام بمادة الحجر او الياجور وهو الزخرفة الافقية التي تحدد نهاية كل دورو نهاية المبنى.

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[3] لويس سولفان Louis Solivan(1856- 1924) معماري امريكي ورائد العمارة العضوية Organic Architecture باعتماده منهج (الشكل يتبع الوظيفة) ومن اشهر تلاميذه المعماري فرانك لويد رايت Frank Lloyd Wriht

[4] قمرية: نافذة دائرية تشبه القمر لان مادتها من حجر الرخام "الآليستر" تسمح بنفاذ الضوء. يعود استخدامها لدولة سبأ التي عبدت القمر ونقلها اليمني لبيته كنافذة لتذكره بمعبوده الإله (إلمقه) وفي صنعاء غير معروف اول استخدام لها إلا ما ذكره لسان العرب الحسن بن احمد الهمداني في كتابه "الاكليل ج 8" كعنصر من اهم عناصر تشكيل واجهة قصر غمدان التاريخي. اما العقد النصف الدائري المعشق ببلور الزجاج الشفاف والملون والذي بدأ استخدامه في بداية القرن العشرين فقد تم تسميته بالقمرية واستمرت التسمية حتى الان.

5. الحكومة وغياب تشريعات البناء

لم تتمكن الحكومة اليمنية في بداية الثورة من أن تفرض هيبة قوانينها او تسن تشريعات فيما يخص البناء والعمران لغرض الحفاظ على الموروث في المناطق التي يوجد لها موروث معماري لسببين هما:

1- انشغال الحكومة بتثبيت نظامها السياسي الجديد المتمثل في قيام الثورة وتكثيف جهودها في الوصول الى الاستقرار السياسي بالدرجة الاولى امام انقسامات متفرقة في انحاء الجمهورية الوليدة بين مؤيد لها ومعارض.

2- رغبة المجتمع "الشديدة" في رفض القديم مهما كان صالحاً ليتحرر من نظام سابق قمع الحرية الشخصية والعامة على السواء، والسير نحو إثبات الذات الحرة القادرة على ممارسة هذه الحرية في حياتها وفي ملكيتها الشخصية كالسكن و كالمرافق الحكومية والمنشآت الجديدة التي ظهرت متماشية مع الوضع الجديد للعاصمة صنعاء مثل السينما والمقاهي العامة والفنادق.

على ضوء ذلك نجد أن سيطرت المزاجية الشخصية على اعمال تلك الفترة 1962- 1972 وابتعادها عن كل الموروث المعماري الشكلي والوظيفي في غياب الدور الحكومي وغياب التشريعات المنظمة لعملية الممارسة المعمارية على الواقع.

6. الدراسات السابقة ورؤيتها للتعامل مع الموروث

تناولت الكثير من الدراسات ظاهرة البعد عن الموروث وكيفية التعامل معه في اكثر المدن العريقة ومنها مدينة صنعاء، وأرجعت الاسباب الى السرعة التي تم بها انشاء تلك المدن لتواكب العصر ومتطلباته وترضي المجتمع وهو في طور الانتقال الى عصر العلم والتطور التكنولوجي. وتوصلت معظم هذه الدراسات الى نتائج متقاربة في كون تلك المدن تعاملت مع الموروث بسطحية على مستوى الشكل ولم تراع الوظيفة التي فرضتها متطلبات العصر او الخصوصية المحلية للمجتمعات المختلفة بعاداتها وتقاليدها، وهذا افقد العمارة الحديثة هويتها الجديدة وافقد في ذات الوقت العمارة التقليدية استمرارها بمتطلبات العصر الحديث.[1]

على ضوء ما سبق نجد انه من الصعب القول ان البعد عن الموروث وترك الجذور هو نوع من السطحية كما توصلت اليه تلك الدراسات لأنها لم تتعمق في طرح الطرق والوسائل الممكنة للتعامل مع الموروث لتجاوز تلك السطحية على المستوى النظري والعملي معاً ليتمكن هذا الموروث من الاستمرار تحت ضغوط تحديات الوظائف الجديدة للفراغ المعماري وارتباطها بتكنولوجية جديدة لمواد البناء. وطرق الإنشاء ومن هنا يمكننا القول ان هذا البعد عن التعامل مع الموروث يعود الى ان لكل مدينة ظروفها السياسية والاجتماعية والاقتصادية التي جعلتها تسير في مسار الحداثة بسياق مختلف عن الآخر وهو ما يفضل ان تتم دراسته ومن ثم ربطه بالعمارة وتعاملها مع الموروث المعماري من هذه الزاوية، دون اغفال ضرورة ان اي جديد عليه التعبير عن قيم وتقاليد وأعراف مجتمع المدينة دون استنساخ تام للقديم او تقليد أعمى للجديد المغاير.

7. ماذا بعد!؟

مع استمرار متابعة ما يحدث في العالم ومناقشة احداثه وصراعاته وثقافاته تشكل وعياً فردياً طفيفاً بأهمية العمارة التقليدية والحفاظ على الهوية اليمنية والتي تجسد العمارة أهم روافدها الثقافية، والعودة لاستخدام مواد البناء المحلية بعد أن تم إهمالها في المرحلة السابقة، هذا بالإضافة إلى معرفة المبادئ والنظريات المعمارية والتخطيطية العربية والعالمية التي ظهرت من خلال التبادل الثقافي والعلمي الذي بدأت اليمن عموما وصنعاء خاصة تسعى اليه مع الدول العربية والغربية والاستفادة من الخبرات لإظهار المخزون الثقافي والتاريخي للعمارة التقليدية لكن من خلال الحداثة والمعاصرة التي يمر بها العالم والذي اصبحت اليمن جزء منه.

وإذا كنا قد اطلقنا على المرحلة الاولى (1962-1972) (فن البناء القائم على المهارة الحرفية للبنائين والأسطوات)[2] فان هذه المرحلة 1972- 1990 هي تحول فن البناء إلى هندسة معمارية ترسم على الورق وتخضع للطلب الرسمي "الحكومي" والخاص "الفردي" وهذا اوجد تنوع شكلي جديد ومختلف في الوقت ذاته عن سابقه. وبما أنه لم يكن من

[1] معظم هذه الرسائل ماجستير ودكتوراه من جامعات مختلفة تم استخلاص نتائجها في الفقرة. ونظراً لأنها لم تصدر على شكل كتاب يحوى نتائجها او توصياتها فقد ارتأت الباحثة ان تضع اهم النتائج فيما يخص موضوع البحث حتى لا يطول.

[2] الاسطى وجمعها اسطوات وهو البّناء التقليدي اليمني. او قد يكون معلم البناء.

الترميم والتأهيل، واستيعاب مفرداته المعمارية كنوع من التواصل الحضاري بين القديم والجديد في الاعمال المعمارية الحديثة، دون اغفال القيمة الحقيقية لهذا الموروث ولمفرداته التي لبت حاجة الانسان المادية الروحية معاً.

ولهذا يكون لكل مجتمع خصوصيته في التعامل مع الموروث، مرده ان لكل مدينة ظروفها السياسية والاجتماعية والاقتصادية التي جعلتها تسير في مسار الحداثة بسياق مختلف عن الآخر وهو ما يجب أن ندرس على ضوءه العمارة وتعاملها مع الموروث المعماري من هذه الزاوية دون ان نغفل ضرورة ان اي جديد عليه التعبير عن قيم وتقاليد وأعراف مجتمع المدينة دون استنساخ تام للقديم او تقليد أعمى للجديد المغاير.

جاء في بحث الدكتور محمد نعيم المعنون ب "خصوصية الممارسة المعمارية اليمنية في التعامل مع الموروث " في تعريفه للموروث الحضاري أنه (الذي يحدد خصوصية المكان والمجتمع، فله أصل ثابت وتعابير متعددة، يتصف بالاستمرارية بحضوره من الماضي وتداخله مع الحاضر لأجل المستقبل، وتستجيب عناصره لظروف البيئة المحيطة وتتفاعل معها ليتحقق من خلالها، فمن عناصره التراث، التاريخ، العادات والتقاليد، الاصالة...فهو كل الماديات والمعنويات التي يخلفها السلف للخلف) (نعيم، 1999)

4. ارهاصات الحداثة في مدينة صنعاء:

لمدينة صنعاء ظروفها الخاصة في التعامل مع الموروث، كونها لم تجد الوعي المجتمعي ولا الوعي السياسي إلا في مراحل لاحقة، واهتمت في بدايات الثورة 1962 الى تثبيت نظامها السياسي، وخلق عاصمة حديثة تليق بالتحول السياسي الكبير، دون الالتفات لشكل هذه العاصمة او بنيتها المعمارية. بالإضافة الى ذلك فقد ترسخ في ذلك الوعي المجتمعي أنه يواجه عصرا منفتحاً على العالم بلغة معمارية جديدة أختارها لتمثل ذاته ووعيه وتاريخه في تلك الفترة مبتعداً عن كل ما هو تقليدي و متأثرا في ذات الوقت بالعالم من حوله عن طريق وسائل الاتصال التكنولوجية المختلفة المقروءة والمسموعة والمرئية والمنتشرة في حينه كالاستماع إلى الاذاعات العربية وخاصة "صوت العرب من القاهرة" والى قراءة الصحف التي ظهرت بعد قيام الثورة مباشرة (صحيفة الثورة في صنعاء)، ورؤية الافلام السينمائية التي كانت تعرض بالتزامن مع صدورها في العالم.

ومما سبق نجد ان الوعي الجمعي في مدينة صنعاء في الفترة 62- 1972 وافق الى حد كبير الاتجاه الجديد لعمارة الحداثة الذي ظهر في الفترة التي تلت الحرب العالمية الاولى حيث رفض المعماريين اي اتصال بعمارة الماضي والابتعاد عن كل ما هو تقليدي، فظهر نمطاً بنائياً في مدينة صنعاء مختلفاً عما سبقه من موروث معماري تقليدي على ايدي بنائين حرفيين كانوا اداة لتنفيذ افكار كل من رفض العمارة التقليدية" القديمة" بموادها وبعناصرها التشكيلية وفراغاتها الداخلية، ليصبح المشهد المعماري للمدينة عبارة عن مباني حديثة ومغايرة للطابع التقليدي ومعبرا عن مرحلة تاريخية واجتماعية واقتصادية اثرت في سيرورة عمارة الحداثة. لتتحول تلك العمارة في مرحلة لاحقة إلى جزء من التاريخ السياسي والاجتماعي والاقتصادي لتلك الفترة ونقطة تحول لما تلاها من مراحل، وشكلت هذه في مجملها مفاهيم حاكمة انتجت الممارسة الخاصة بكل فترة.

هذا الاهمال لأهمية الموروث المعماري يبين غياب التخطيط العملي لعملية التنمية التي كان من الضروري ان ترافق نمو المدينة المعماري والعمراني وهذا ما تؤكده الموسوعة اليمنية بأن اليمن لم تدخل مرحلة التخطيط العملي للتنمية على أسس علمية إلا بعد الاستقرار السياسي بانتهاء الحرب الاهلية 1968 حيث انشئت الهياكل والأطر المؤسسية للقيام بمهام التخطيط المركزي، وفي العام 1972 قامت الحكومة بإنشاء الجهاز المركزي للتخطيط واعدت البرامج والخطط التنموية العلمية المدروسة، وقد حققت هذه الخطط والبرامج نجاحاً في تحقيق اهدافها ومثلت إطاراً تنظيمياً لعملية التنمية والاستقرار الاقتصادي لعقدي السبعينيات والثمانينيات. (الموسوعة اليمنية،2003). جدول (1)

جدول (1) الخطط التنموية التي وضعت في العام 1972

م	الخطة	الزمن
1	البرنامج الانمائي الثلاثي	1976/75 -1974/73
2	الخطة الخمسية الاولى	1981 /80 -7791/ 76
3	الخطة الخمسية الثانية	1986 -1982
4	الخطة الخمسية الثالثة	1991 -1978

(المصدر: الموسوعة اليمنية 2003)

و يشير الدكتور مطهر السعيدي في بحثه (تطور الاقتصاد اليمني من خلال خطط وبرامج التنمية) أنه: "بدأت مرحلة التخطيط العلمي في اليمن بإنشاء الجهاز المركزي للتخطيط عام 1972 الذي أضطلع بمهام المساهمة في تطوير الاستراتيجية العامة للتنمية ووضع خططها والإشراف على تنفيذها بالإضافة إلى جمع المعلومات الإحصائية وتفسيرها بهدف تطوير وتنمية الأوضاع الاقتصادية والاجتماعية ورفع مستوى معيشة الشعب".(السعيدي، 1986)

بأهمية الموروث الحضاري لليمن بشكل عام وبأهمية العمارة التقليدية والحفاظ على الهوية اليمنية والتي تجسد العمارة أهم روافدها الثقافية بشكل خاص.

ومن هنا جاء تبني جهات (مجتمعية، حكومية، دولية) رؤية خاصة في التعامل مع الموروث وذلك عن طريق الاستفادة من الخبرات المحلية في البناء من خلال استخدام مواد البناء المحلية وتشكيل الواجهات بمفردات تقليدية تتجسد فيها قيم وروح العمارة التقليدية لإظهار المخزون الثقافي والتاريخي للعمارة التقليدية من خلال الحداثة والمعاصرة التي يمر بها العالم وأصبح اليمن جزء منها. فظهرت نماذج معمارية حكومية وخاصة يمكن اعتبارها جذورا للبدء في التعامل مع الموروث على المستوى المجتمعي والحكومي.

لم تجد تلك الرؤية الاهتمام البحثي لذلك فأن هذا البحث وبضوء ما سبق يهدف الى تحليل ونقد الرؤية التي مثلت جذور التعامل مع الموروث كونها مثلت مفهوماً حاكماً اثر على المشهد المعماري في حينه وفي فترات لاحقة وذلك من خلال بناء اطار نظري لمفهوم الموروث في اللغة وفي العمارة ومن ثم كيفية التعامل معه في النماذج المعمارية، وتناول تلك النماذج التي ظهرت كبداية اولى على المستوى الحكومي والخاص ومن ثم ظهرت في نماذج لمصممين يمنيين واجانب وبذلك حولت المشهد المعماري في حينه وأثرت على المشهد المعماري لمراحل لاحقة.

2. مفهوم الجذور

يعرف المعجم الفلسفي "جذر" انه الأصل وجذر كل شيء أصله، ولهذا فأن الجذور هي أصول. (وهبة 1998) وفي معجم المعاني كلمة "الجَذر" بفتح الجيم او كسرها هي أصل كل شيء. وعند اللغويين تعني الأصل الذي يتفرع عنه الكلمات. والجذر من النبات هو جزؤه الذي بتشعب بالأرض ويحصل على السوائل اللازمة (Almaany 2014) و على ضوء ذلك نجد ان المفهوم الفلسفي والمعنى في المعجم يتسق مع مفهوم الجذور في التعامل مع الموروث من حيث بحثنا عن أصل التعامل مع الموروث في مدينة صنعاء كاتجاه معماري ظهر في فترة زمنية محددة ومنه تفرعت اتجاهات أخرى للتعامل مع الموروث.

3. ماهية الموروث:

نتناول هنا ما هو مفهوم الموروث في اللغة ومفهوم الموروث في العمارة بهدف بناء إطار نظري مفاهيمي يمكن من خلاله الولوج لفهم الموروث وكيفية التعامل معه من خلال النماذج المعمارية المختارة ومن خلال ذلك يمكن تحليلها ومن ثم نقدها بناء على ما قدمه هذا الاطار وسنتناول التالي:

3- 1 اولا: ماهية الموروث في اللغة:

لغوياً جاءت كلمة موروث من كلمة (الإرث او الميراث)، ونحوياً هي اسم مفعول من الفعل ورثَ، وهو ما يخلّفه الميت من مال فيورث عنه. و جاء في معجم المعاني (الإلكتروني): (موروث) مجموعة من العادات والأعراف ينظر إليها كسوابق تشكل الجزء الاساسي المؤثر على الحاضر (Almaany 2014) اما المستشرق الفرنسي "جاك بيرك" فيعرف الموروث تعريفاً موجزاً وبليغاً بقوله: "هو الماضي يحاور الحاضر عن المستقبل" (مصطفى، 2014) ، المعجم الفلسفي فيعرفه الموروث انه: "الميراث مادياً كان أو روحياً" (وهبة، 1998)

الموروث باللغة الانجليزية Tradition واصلها اللاتيني Traditio بمعنى النقل والتوصيل، اما كلمة Heritage تعني ميراث او تراث بمعنى منقول او متواتر، وبذلك نجد ان الموروث يحمل في لغتنا العربية وفي اللغة الانجليزية معنى التوارث والنقل اي ما ينقله الخلف عن السلف.(عبدالله، 2014)

وبالرغم من وضوح الكلمة لغويا واصطلاحا إلا ان لها تعريفات متشعبة لدى اهل الاختصاص كلاً حسب علمه ومنهجه ومجاله فيقال الموروث الثقافي، الموروث المعماري، الموروث الاسلامي... لذلك من المهم تناول موضوع تعريف التراث بأنواعه في إطار معنى المصطلح الأصل أي " ذلك الإرث الذي يتوارثه الخلف عن السلف" (عبدالله 1999) او كما عرفه محمد عابد الجابري "هو كل ما هو حاضر فينا او معنا من الماضي، سواء ماضينا او ماضي غيرنا. وبمعني فلسفي هو حضور الاب في الابن، حضور السلف في الخلف، حضور الماضي في الحاضر" (نعيم 1999)

3. 2 ثانياً: ماهية الموروث في العمارة:

يعرف "مايكل جريفر" العمارة التقليدية: "هي العمارة المستمدة من طابع المكان والأرض والاستفادة من المواد المتاحة في محيط المكان والاستجابة لمحددات الموقع وظروفه البيئية. (نعيم1999) وبذلك تكون العمارة الموروثة هي الشق المادي من الموروث الثقافي الذي وصلنا نتاجه عبر التاريخ وكان معبراً عن وعي جمعي في بيئة تقليدية لها جذور تاريخية اثرت على خصوصية المجتمع والعمران. ومن هنا تأتي اهمية المحافظة عليه من الاندثار، وإحياءه عن طريق

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جذور التعامل مع الموروث في مدينة صنعاء
رؤية تحليلية نقدية لتحولات المشهد المعماري 1972-1990

نادية يحيى الكوكباني

قسم الهندسة المعمارية، جامعة صنعاء، الجمهورية اليمنية

ملخـص

لمدينة صنعاء ظروفها الخاصة في التعامل مع موروثها المعماري كونها لم تجد الوعي السياسي ولا الوعي المجتمعي إلا في مراحل لاحقة، حيث اهتمت في بدايات الثورة عام 1962 الى تثبيت نظامها السياسي الجديد، وخلق عاصمة حديثة تليق بالتحول السياسي الكبير دون الالتفات لشكل هذه العاصمة او بنيتها المعمارية، لذلك انتشرت عمارة الحداثة حتى اصبحت السمة الغالبة للمدينة.

وبعد مرور ما يقارب عشر سنوات من قيام الثورة، ونتيجة متابعة ما يحدث في العالم، ومناقشة احداثه وصراعاته وثقافاته من خلال التبادل الثقافي والعلمي الذي بدأت اليمن عموما وصنعاء خاصة تسعى اليه مع الدول العربية والغربية، تشكل وعياً فردياً وحكومياً ودولياً بأهمية الموروث الحضاري لليمن بشكل عام وبأهمية العمارة التقليدية والحفاظ على الهوية اليمنية والتي تجسد العمارة أهم روافدها الثقافية بشكل خاص.

وتبنت هذه الجهات (مجتمعية، حكومية، دولية) رؤية خاصة في التعامل مع الموروث وذلك عن طريق الاستفادة من الخبرات المحلية في البناء من خلال استخدام مواد البناء المحلية وتشكيل الواجهات بمفردات تقليدية تتجسد فيها قيم وروح العمارة التقليدية وروحها لإظهار المخزون الثقافي والتاريخي للعمارة التقليدية من خلال الحداثة والمعاصرة التي يمر بها العالم وأصبح اليمن جزء منها.

لذلك ظهرت نماذج معمارية حكومية وخاصة استخدمت مفردات تشكيل ومواد بناء تقليدية لأول مرة و يمكن اعتبارها جذوراً للبدء في التعامل مع الموروث على المستوى المجتمعي والحكومي.

وبضوء ذلك فإن البحث يهدف الى تناول تلك الرؤية التي مثلت جذور التعامل مع الموروث من خلال التحليل والنقد، كونها مثلت مفهوماً حاكماً اثر على المشهد المعماري في حينه وفي فترات لاحقة وذلك من خلال بناء اطار نظري لمفهوم الموروث في اللغة وفي العمارة ومن ثم كيفية التعامل معه في الاعمال المعمارية، وتناول تلك الاعمال التي ظهرت كبداية اولى على المستوى الحكومي ومن ثم ظهرت في نماذج لمصممين يمنيين واجانب وبذلك حولت المشهد المعماري في حينه وأثرت على المشهد المعماري لمراحل لاحقة.

الكلمات المفتاحية: جذور، موروث معماري، عمارة تقليدية، عناصر تشكيلية.

1. مقدمة

لم يدرك الوعي المجتمعي في المرحلة الاولى لقيام ثورة سبتمبر 1962 ان لديه موروثاً حضارياً معمارياً غنياً أثبت نجاحه على مر السنين على المستوى المناخي والبيئي والاجتماعي بالإضافة إلى مقاومة هذا الموروث للتحولات السياسية وإلى الحروب والنزاعات التي كانت تظهر على مساحات متفرقة من اليمن على مر تاريخها.

مساحات متفرقة من اليمن على مر تاريخها. لذلك جاء التعامل مع الموروث في البدايات بنوع من الشعور بالخجل كون ذلك الموروث المعماري يُذكر بفترة يُراد عدم تذكرها وتجاوزها لبناء المستقبل.

لذلك اهتمت مدينة صنعاء في بدايات الثورة الى تثبيت نظامها السياسي الجديد، وخلق عاصمة حديثة تليق بالتحول السياسي الكبير دون الالتفات لشكل هذه العاصمة او بنيتها المعمارية لذلك انتشرت عمارة الحداثة حتى اصبحت السمة الغالبة للمدينة، نتيجة غياب الوعي السياسي والمجتمعي لأهمية الموروث المعماري الذي تتفرد به مدينة صنعاء. ومن خلال متابعة ما يحدث في العالم ومناقشة احداثه وصراعاته وثقافاته من خلال التبادل لثقافي والعلمي، تشكل وعياً فردياً وحكومياً ودولياً

كلمة رئيس التحرير

الاخوة القراء .. الزملاء الباحثون .. ها هي جامعة ذمار تصدر العدد السادس للعام 2016 من مجلة جامعة ذمار للعلوم الطبيعية والتطبيقية رغم العدوان والحصار على اليمن.. وهذا دلالة واضحة على توجه الجامعة الجلي بالاهتمام بالبحث والنشر العلمي .. المجلة محكمة وتحمل رقم النشر العالمي ISSN .. وتسعى لنشر الجديد والمتميز في مجالات العلوم الطبيعية والتطبيقية .. وهذا سيكون له تأثيراً إيجابياً على العملية التعليمية والبحثية في داخل الجامعة وخارجها.

في هذا العدد تم نشر أبحاث في مجالات متعددة .. منها تخصصات طبية وهندسية وعلوم الحاسوب والكيمياء والرياضيات وعلوم البيئة وعلوم الحياة .. والباحثون يتنوعون .. منهم من داخل الجامعة والبعض من الجامعات اليمنية والعربية..

نسعى إلي أن تنتشر المجلة بشكل أوسع .. من خلال استقطاب ونشر الأبحاث التي تتميز بالمعايير العالمية ..

وعليه أدعوا كافة الاخوة الزملاء للنشر العلمي .. مما يعزز موقف الجميع .. كمجلة وكجامعة وكذلك كأعضاء هيئة التدريس .. وسينعكس ذلك على الوطن ومقدراته .. بالنماء والازدهار والتقدم.. مما يمكن الجميع على التنافس اقليمياً وعالمياً.

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