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Epidemiology of Diabetes Mellitus in Al-Baidha Governorate, Yemen

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ABSTRACT

Objectives: To identity the magnitude of diabetes and its epidemiological profile at Al-Baidha Governorate, Yemen, and assess the potential role of the inter-family marriage in increasing the risk of diabetes.

Method: This is a descriptive and analytic epidemiological study of 2458 diabetic patients profile reported at Al-Baidha Governorate population in Yemen covering the period (2007-2009). Data sources included reviewing the patients' files and health statistical reports of the governorate Health office. Additional primary data on family history and diabetes treatment types were collected by a group of researchers (medical students) through conducting home visits for the diabetic patients during the study period.

Results: The percentage of diabetes mellitus is estimated to be 14.8% among males and 10.2% of females. The percentage of diabetes appeared to be increasing among urban areas (20.7%) than that of rural areas (4.3%). The overall age-adjusted proportions obtained from the study showed that 564 (23.2%) individuals were less than 30 years of age and the majority1864 (76.8%) were above 30. The study demonstrated that 2071 (84.3%) diabetic individuals are on oral hypoglycemic agents and that 381 (15.7%) were on insulin injections. Tracing the family history of 801 diabetic men and women demonstrated that the father was diabetic in 39.8%, mother in 26.8%, Grandfather 14.8%, grandmother 10.5% and second degree relative 8.4%. Also, the study showed that 58% of diabetic patients have marriage with first degree or second-degree relatives.

Conclusion: The results of this study indicated that diabetes has become a major health problem in Yemen. Further studies are needed to clarify the potential role of interfamily marriage and genetic susceptibility in the aetiology of diabetes.

***Keywords*:** Diabetes, Aetiology, Odds Ratio, Chi-Squares Tests, Yemen

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INTRODUCTION

Diabetes is defined as a group of metabolic diseases that are characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both [1]. The disease is one of the leading causes of death, blindness and lower limb amputation. Diabetic retinopathy remains a major cause of blindness worldwide [2]. Currently, diabetes is responsible for one death every 10 sec, and an amputation every 30 sec with a mortality rate of approximately 4 million per year [3].

The international diabetes federation estimated in 2003 that 194 million people have diabetes, and that by 2025, 333 million people will have this disease [4, 5]. In 2007 it was estimated that global health expenditure on diabetes and its complications would be at least $232 billion [6]. Treatment and adapting preventive care programs in persons with diabetes can slow the progression of end stage complications and reduce the risk of microvascular and microvascular complications of type 2 diabetic [7, 8]. The aims of this study were to examine the prevalence of diabetes in the urban and rural community in Al-Baidha Governorate in Yemen and to highlight on the potential role of the family and cousin marriage in the development of diabetes.

The objective is to examine the proportion of diabetes among urban and rural community in Al-Baidha Governorate, review the treatment lines being used by patients and to assess the potential role of the inter-family marriage in increasing the risk of diabetes.

METHOD

AL-Baidha Governorate is situated at a distance of 280 km south east of Sana'a and its population is about 680000. This study is a community based study conducted in rural and urban areas of 7 districts of Al-Baidha Governorate in Yemen. The study comes from a sample of 2458 diabetic patients living in these districts. Some of the data were collected from patients' files and documents in the offices of the Ministry of Health in the region. Seven committees, each of 3 students were distributed to Provinces, and visited diabetic patients and their families. Patients and their families were asked about diabetic history in the family and type of the treatment they had received. The students pursued the family history along two correlated lines: first, knowing the father's status and his genealogy up to the grandfather and including the diabetic brothers, sisters, and second degree relatives; and second, knowing the mother's status in the same way. Also, the family history included the cousin marriage in diabetic individuals. Periodic medical examinations were done weekly by doctors in district hospitals and biochemical analysis was done as well. Blood sugar measurements were done twice daily: in the early morning and before bedtime. Diabetes was diagnosed as per WHO criteria, the treatment of each patient (oral hypoglycemic agents or Insulin) recorded and all treatment lines were reviewed. Some diabetic patients that are not registered in the registry of the Ministry of health were traced and recruited in the study. It is estimated that 5-15% of diabetic individuals are not included in the study due to some technical & social difficulties (e.g. refusal of the patient or his family to meet the team and participate in the study). The diabetic men and women were divided according to age and gender into four groups: GI of men with age class 7 to 30 years, GII of males with age class 31 to 70 + years, GIII of females with age class 7 to 30 years and GIV of females with age class 31 to 70 or more years.

RESULTS

The total number of subjects examined was 2458, with 1460 males (59.4%) and 998 (40.6%) women. The registered diabetic individuals were 2231 (90.8%) (1373 men and 858 women), 227 patients (9.2%) : 87 men and 140 women were not registered. Table 1.1 and figure (1) shows the distribution of diabetic individuals in the seven districts and shows that the number of unregistered women is almost double the number of unregistered men. The percentage of diabetes was estimated to be 14.8% among males and 10.2% among females (table 1.2). The percentage of diabetes mellitus appeared to be increasing among urban areas (20.7%) than that of rural areas (4.3%) (Table 1.2).

The overall age-adjusted prevalence obtained from the study showed that 564 (23.2%) individuals were under 30 years of age and the majority 1894 (76.8%) were above 30. Tables 2.1, 2.2 show the distribution of diabetes according to age and sex. The study demonstrated that 2071 (84.3%) diabetic individuals are on oral hypoglycemic agents and that 381 (15.7%) were on insulin injections (table 3).

Tracing the family history for 801 diabetic men and women demonstrated that the father was diabetic in 39.8%, mother in 26.8%, Grandfather in 14.8% grandmother 10.5% and second degree relative 8.4% (tables 4.1, 4.2). Moreover, the study shows that 58% of diabetic patients have marriage with first or second-degree relatives and this might explain the high prevalence of diabetes in some Yemeni community sectors.

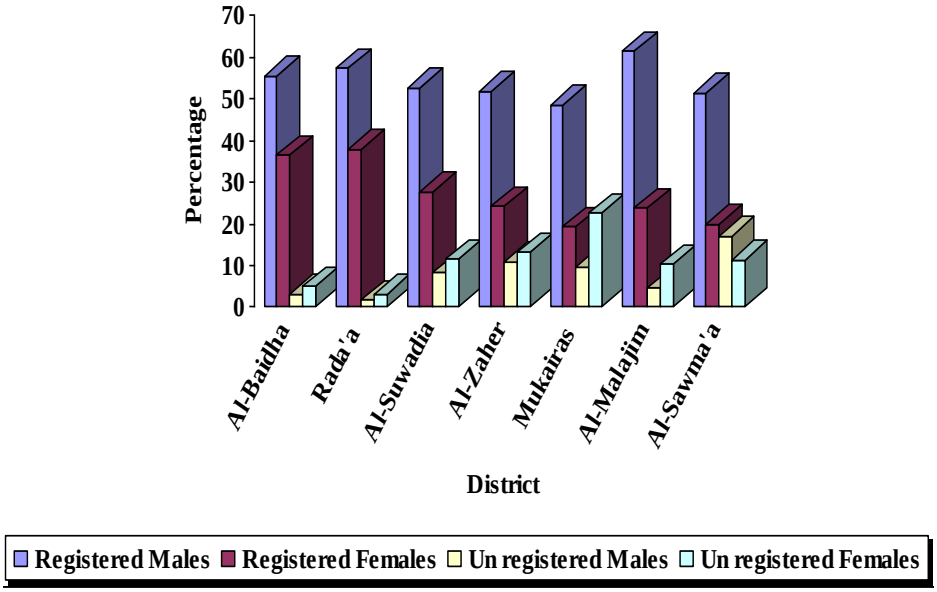

Figure (1): Percentage of diabetic patients by district, Al-baidha governorate.

Table (1.1): The distribution of diabetic patients in seven districts of Al-Baidha Governorate

Area	District	Registration				
		Registered		Unregistered		Total
		Males	Females	Males	Females	
Urban	Al-Baidha	581	381	32	53	1047
	Rada'a	565	374	17	31	987
Rural	Al-Suwadia	82	43	13	18	156
	Al-Zaher	43	20	9	11	83
	Mukairas	30	12	6	14	62
	Al-Malajim	54	21	4	9	88
	Al-Sawma'a	18	7	6	4	35
Total		1373	858	87	140	2458

Table (1.2): Test of Significance using Chi-Squares Tests of Gender vs Registration vs Area.

Gender	Registration	Area	Number of Cases	Chi-Squares Value	P-value
Male	Registered	Urban	1146	1373	P<0.0001
		Rural	227		
	Unregistered	Urban	49	87	P<0.0001
		Rural	38		
Female	Registered	Urban	755	858	P<0.0001
		Rural	103		
	Unregistered	Urban	84	140	P<0.0001
		Rural	56		
Overall			2458	125.03	P<0.0001

Ratios of diabetes estimation			
Ratio of diabetes among gender		Ratio of diabetes by Area	
Males	14.8	Urban	20.7
Females	10.2	Rural	4.3

Table (2.1): Diabetic Patients according to age class and Gender

	Diabetic Patients' Age classes				Total
	7 - 30	31 - 70	7 - 30	30 - 70	
Sex / Group	Males		Female		
I	365	-	-	-	365
II	-	1065	-	-	1065
III	-	-	199	-	199
IV	-	-	-	799	799
Total %	15.5	44.5	8.01	31.99	2428

Table (2.2): Diabetic Patients according to age class and Gender

Gender	Age class (years)		Total		Chi-Squares Test for any variation	
	< 30	≥ 30				
Male	365	1065	1430		Chi-Square value	p-value
Female	199	799	998			
Total	564	1864	2428		10.26	P<0.05

Table (3): Anti-diabetic Agents

	Type	of taken	Percent
Insulin (Intermediate acting) 100 Iu/m / vial	I	30	0.6
Insulin Human mixtared (30/70) 100 Iu/m /vial		153	2.8
Insulin Human R (Actnapid) 100 Iu/m /vials		195	3.6
Glibenclamide 2.5 and 5mg Smg Tablets	II	979	18.0
Glimepiride 1 and 3mg		380	7.0
Gliclazide 80 mg Tablets		210	3.9
Metformin HCL 500 mg Tablets		194	3.6
Insulin Human mixtared (30/70) 100 Iu/m /vial		131	2.4
Insulin Human R (Actnapid) 100 Iu/m /vials		176	3.2
Chi-Square goodness-of-fit tests	Chi-squares		P-value
	730.5		P<0.0001

Table (4.1): Distribution of the family's history of 808 Diabetic Patients

Group	No. of diabetic patients	Family's history demonstrated that the following family members are associated with a diabetic disease:				
		Percent of Fathers	Percent of Mother	Percent of Grand-father	Percent of Grand-mothers	Percent of Second degree Relatives
I	321	+	-	-	-	-
II	214	-	+	-	-	-
III	121	-	-	+	-	-
IV	85	-	-	-	+	-
V	67	-	-	-	-	+
Total	808	39.8	26.5	14.8	10.5	8.4
Overall Test of Significance						
P-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table (4.2): Analysis of Odds ratios for testing the relationship between the diabetes mellitus occurrence among fathers, mothers, grand-fathers, grand-mothers, second-degree relatives and offspring's.

Groups	Fathers	Mothers	Grand Fathers	Grand Mothers	Second degree relatives
I	1.0 (**)	1.5 (***)	2.7 (***)	3.8 (***)	4.8 (***)
II		1.0 (**)	1.8 (***)	2.5 (***)	3.2 (***)
III			1.0 (**)	1.4 (**)	1.8 (***)
IV				1.0 (**)	1.3 (**)
V					1.0 (**)

NB: $(**) = P < 0.001$ and $(***) = P < 0.0001$

Statistical analysis

Table 1.1 shows the distribution of registered and unregistered diabetic males and females patients by the district of Al-Baidha governorate. The right column of Table 1 displays the test of significance resulted from testing for any significant difference among diabetic patients in the seventh districts. The multiple comparisons test yielded significant results as implied by their p-values (p<<0.05). Figure 1 also confirms this conclusion.

The results in Table 1.2 reveal that the mean difference of patients with diabetes in urban and rural areas is significant at the 0.05 level. The percentage of diabetes mellitus appeared to be increasing among urban areas (20.7 %) than that of rural areas (4.3 %). Similarly, the diabetes mellitus occurrence among males is clearly much more than that among females. Table 1.2 shows that percentage of diabetes mellitus is estimated to be 14.8 % among males and 10.2 % of females. Table 2.1, displays the statistical test results produced to the diabetic patients as distributed by age class and gender. The last column (to

the right) of Table 2.1 shows the probability values which indicate highly significant results with respect to group differences of their counts.

Table 2.2 displays the statistical test results produced to the diabetic patients as distributed as a 2×2 contingency table. The obtained results indicated that the diabetes occurred among males and female varies significantly (P<<0.05) according to the age class and gender of the patient's. Across the age class and gender of the patients, the estimated proportions (P) of diabetes are summarized as follows: For males and females with age class under 30 years, the proportions of being diabetics are, respectively, given by 25.5 % for males and 19.9 % for females. Furthermore, for combined sex, the proportion is given by 23.2%. Similarly, for males and females with age class 30 years and more, the respective proportions of being diabetics are given by 44 % for males and 81% for females. For combined sex, the overall proportion is given by 76.8% as well.

In Table 3, the types of Antidiabetic agents were tested for any significant difference. As can be seen from the corresponding probability values in the last column (to the right) of Table 3, the test of between subject effects is clearly significant at the 0.05 level. Meanwhile, the two types of Antidiabetic agents were also compared using Pairwise comparisons test. The two types of Antidiabetic agents were found to differ significantly. Table 4.1 shows the overall test to the family's history of diabetic disease factors across the five groups of diabetic patients. The Chi-Squares test was used to check for any significant relationships of diabetic fathers, mothers, grand-fathers, grand-mothers and second degree relatives. The Chi-Squares test yielded that these factors are significantly associated (P<<0.05). Moreover, the odds ratios test results displayed in Table 4.2 show that the occurrence of diabetic disease among fathers, mothers, grand-fathers, grand-mothers and second-degree relatives are not statistically independent. This might be due to inheritance factors. The coefficient (termed as Kappa) representing the similarity between factors was found to be -0.25.

DISCUSSION

This study showed a male predominance, but this might be explained by the under-registration of diabetic women for social, cultural and religious reasons. This opinion is supported by the result in this paper which showed that the number of unregistered women almost double the number of unregistered men. In this study, type 2 diabetes in Yemeni was diagnosed in 564 (23.2%) patients under the age of 31 years. Gunaid and others reported type 2 diabetes in 16% under the age of 40 years [9]. Several authors showed that in Asia the age at which type 2 diabetes development has decreased and the prevalence of the disease has risen in children and adolescents [10].

This study has shown that the onset of type 2 diabetes in younger age-groups was similar to that reported in developing countries but different from that reported in developed countries [11, 12, 13]. Moreover, the current study showed that among 801 patients having diabetes the father was diabetic in 39.8%, mother in 26.8%, grandfather in14.8%, grandmother 10.5% and 58% of diabetic patients had interfamily marriage.

These results might support evidence that the genetic factors play an important role in the pathogenesis of diabetes mellitus in some Yemeni patients. Gunaid in a study on 191 Yemeni patients with type II diabetes showed a considerable familial clustering of type II DM [14]. Bone-Tamir and others reported that Yemeni Jews who have unusually high incidence of diabetes differ by gene clustering from all other Jews [15]. On the other hand,

we believe that environmental factors play an important role in the development of diabetes. This includes the change in life-style of Yemeni individuals; mainly sedentary life and consuming diet rich in fat and carbohydrates and low in fibers even in rural areas in Yemen. Another environmental factor might play a role in the development of diabetes in Yemeni population is the Yemeni habit of chronic chewing of khat sprayed with pesticides. In a study conducted by Mancioli and Parinello on 27410 Yemeni subjects, they found that 60% of males and 35% of females were chronic daily khat chewers and that 30% of males and 24% of females chew khat in weekends and special occasions [16].

It is estimated that 70% of pesticides imported or smuggled to Yemen are used on qat [17]. The study showed high ratio of diabetes in Yemeni sampled society, reaching 20.7% in urban areas and 4.3% in rural areas. The prevalence of diabetes is increasing in developing countries more than the developed countries, for example, the prevalence rates of type 2 diabetes in Korea, Indonesia and Malaysia have increased three fold to five-fold during the past 30 years [12, 18, 19]. In the countries of the Gulf Co-operation Council, the prevalence is also increasing; reaching 10% to 20% of the population. In Saudi Arabia the prevalence rates have increased from 12.3% in the mid 1990 to 24% in 2004 [20, 21, 22].

For Yemen and other developing countries, prevention of diabetes must take first priority, because it is more cost-effective to start prevention policies than the treatment of diabetes and its complications. Strong public actions and well-planned government policies are crucial to control the epidemic of diabetes.

CONCLUSION

The results of this study indicate that diabetes is an increasing health problem in Yemeni society and affects young age groups. Further studies are needed to clarify the potential role of interfamily marriage and genetic susceptibility in the aetiology of diabetes. It is strongly recommended that Yemen and developing counties start to implement prevention policies against the diabetic epidemic.

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دراسة وبائية عن داء السكّري في محافظةِ البيضاء، اليمن

أحمد محمد الحضراني، إسماعيل أبو عساف ، منصور على عطاء و خالد الصريمي

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ملخص

الأهداف: التعرف على حجم مشكلة مرض داء السكّرِ ومدى انتشاره في محافظةِ البيضاء، اليمن، وتقييم الدور الوراثي المحتمل في زيَادَة خطرِ مرض السكّرِ نتيجة للزواج بين الأقارب.
الطريقة: هذه دراسة عبارة عن دراسة وبائية وصفية وتحليلية لـ 2458 حالة من مرضى السكر المسجلة بين سكان محافظة البيضاء، للفترةَ (2007-2009). تَضمّنتْ مصادرُ البياناتِ مُرَاجَعَة ملفاتِ المرضى والتقاريرَ الإحصائيةِ لمكتبِ الصحةِ في المحافظةَ. كما تم جمع بيانات أساسية إضافية عن التاريخ العائلي وأنواعِ المعالجات لحالات مرض السكّر بوسطة مجموعةِ من الباحثين (طُلاب كلية الطب بجامعة ذمار) من خلال إجْراء الزيارة المنزلية للمرضى بالسكرِ أثناء فترةِ الدراسةَ.
النَتائِج: وجد أن النسبة المئوية لانتشار مرض داء السكّري تقدر بـ 14.8 % بين الذكورِ و10.2 % بين الإناث. كما لُوحظ أن النسبة المئويةُ لانتشار مرض السكّر تتزايد بين سكان المناطق الحضريةِ (20.7 %) بينما تقل نسبة انتشار داء السكر في المناطق الريفية البعيدةِ (4.3 %). كما أظهرت الدراسة أن عدد و نسبة المصابين وفقاً للفئة العُمرية كما يلي: 564 (23.2 %) كَانوا من الفئة العمرية أقل مِن 30 سنةً والأغلبيةِ 1864 (76.8 %) كانوا من الفئة العمرية فوق 30 سنة. بَيّنتْ الدراسةُ أيضاً بأنَّ 2071 (84.3 %) من مرضى بالسكر كانوا يتلقون Oral hypoglycemic agents وأن 381 (15.7 %) كَانوا يتلقون العلاج عن طريق حُقَنِ الأنسولين. كما تم في الدراسة تتبع العلاقات الوراثية باقتفاء التأريخِ العائلي لـ 801 رجلِ وامرأة مرضى بالسكرِ وتبَيّن بأنَّ الأبَّ كَانَ مريض بالسكرَ في 39.8 %، والأمّ في 26.8 %، والجَدّ في 14.8 %، والجدة في 10.5 % والقريب من الدرجةِ ثانية في 8.4 %. ووجد أن هناك دلالة إحصائية معنوية لهذه النتائج ($P < 0.05$). كما بينت الدراسةَ أيضاً بأنّ 58 % مِنْ المرضى بمرض السكرِ لديهم حالات زواجُ من
الاستنتاج: نَتائِج هذه الدراسةِ أشارتْ بأنّ مرض السكّرِ أَصْبَحَ مشكلة صحيةِ رئيسيةِ في اليمن خصوصا في المناطق الريفية. وتوصي هذه الدراسة بعمل دِراسات أخرى وذلك لتَوضيح الدورِ المحتملِ للعوامل الوراثية للزواجِ من الأقارب ودورها كمسببات في انتقال الأمراض الوراثيةِ وبصورة خاصة مرض داء السكّرِ.

الكلمات الدليلية: مرض السكّر، عِلْم أسباب المرض، نسبة الاحتمال، اختبارات مربع كاي

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Etiological Spectrum of Obstructive Jaundice:
"Our Experience in Two University Hospitals in Yemen"

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ABSTRACT

Background: Obstructive jaundice is a surgical emergency with preoperatively uncertain diagnosis. Its early diagnosis and treatment is important to avoid fatal complications.
Objective: to determine the etiology of obstructive jaundice.
Patients and methods: The data of patients, who were operated for obstructive jaundice at department of Surgery in Sana'a University Hospital and Thamar University Hospital between January 2004 and December 2008, were prospectively analyzed in relation to the causes of obstructive jaundice. The study included 134 patients (91 females and 43 males). Their ages varied from 8-90 years.
Results: Among 9 underlying causes of obstructive jaundice, the common bile duct stones were the most common cause, 68 patients (50.7%). Malignancies of pancreas and hepatobiliary tract came in the second place, 33 patients (24.6%), followed by 13 patients with stenosis of papilla of Vater (9.7%) and benign strictures of extrahepatic biliary ducts, 10 patients (7.4%).
Ascaris in common bile duct was found in 3 patients. Mirrizi's syndrome was found in 2 patients. Obstruction due to ruptured hydatid cyst was found in 2 patients. Two patients had amoebic liver abscesses One patient had pancreatic pseudocyst.
Conclusion: Obstructive jaundice of Yemeni patients in our series was most often due to common bile duct stones followed by malignancy of pancreas and hepatobiliary tract. Cancer of the pancreas was the most common malignant cause. Rare causes such as ascaris in common bile duct was detected. Cooperation between surgeon and radiologist is highly recommended

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INTRODUCTION

Jaundice in general is being defined as an increase in the concentration of bilirubin in the serum leading to yellowish discoloration of the skin and sclera [1]. However, obstructive jaundice implies partial or complete mechanical obstruction of the flow of the bile into the intestinal tract [2,3]. The most common causes of obstructive jaundice are common bile duct stones and malignancies of pancreas and biliary ducts [3,4,5,6,7]. Rare causes of obstructive jaundice include acquired disorders (worms, scarring from previous surgical procedures, bile duct inflammations) and congenital anomalies such as Choledochal cyst, biliary atresia, localized strictures and stenosis, compression of the extrahepatic bile ducts by vascular abnormalities and the stenosis of the ampulla of Vater [7]

While most of studies [3,4,6,8] reported hepatobiliary and pancreatic malignancies as the most common cause of obstructive jaundice, other studies [5] gave priority for common bile duct (CBD) stones to be the most common cause of obstructive jaundice. Unlike jaundice due to stones in CBD that is usually painful and intermittent with sudden onset, jaundice due to malignancy is painless and progressive with gradual onset.

The early diagnosis and timely treatment of obstructive jaundice is of a great importance, since pathological changes [purulent cholangitis or secondary biliary cirrhosis] may occur if obstruction is not relieved [1,2,9]. Therefore, the early surgical intervention may prevent development of such pathological complications. Our study is to determine the underlying causes of obstructive jaundice among Yemeni patients operated in two university hospitals between 2004 and 2008.

PATIENTS AND METHODS

One hundred forty four patients with obstructive jaundice were admitted to the Department of Surgery in Sana'a University Al-Kuwait hospital (123 patients) and Thamar University Al-Wahdah hospital (21 patients) between January 2004 and December 2008. There were 97 females and 47 males with mean age at 50.4 years. Ten patients of this number were excluded from the study because they died during preoperative period before surgical intervention was carried out due to advanced malignancies of the pancreas and hepatobiliary tract.

Therefore, the study included 134 patients. There were 91 females (68%) and 43males (32%) cases with age groups varying from 8 to 90 years with mean age of 50.2 years.

The diagnosis of obstruction was based on history, clinical examination and investigation which included liver function test (LFTs) and imaging methods (abdominal sonography, abdominal CT and ERCP). Intraoperative finding and results of histopathology were used either to confirm or to correct preoperative diagnosis.

The types of surgical procedure performed depended upon the nature of obstructive jaundice and intraoperative finding.

Operative procedures

The surgical treatment of obstructive jaundice was performed depending on the cause and extension of the disease, general condition and age of the patient and experience of the surgical staff. For benign causes such as CBD stones and benign strictures, cholecystectomy and choledocho-duodenostomy or choledocho-jejunostomy, transduodenal papillosphincterotomy was carried out. Amoebic abscesses and ruptured hydatid cysts were

managed by cavity drainage. In cases of hydatid cysts T-Tube was inserted in CBD after the clearance of CBD lumen from daughter cysts and debris. Endoscopic retrograde papillosphincterotomy and stones extraction from CBD was used as late as 2005. Eleven patients (8.2%) with stone in CBD were managed by this modern method.

Hepaticojejunostomy was mostly performed for cholangiocarcinomas. Whipple's procedure (pancreatoduodenectomy+partial gastrectomy) was performed for pancreatic malignancy with gastric outlet obstruction. Two cases of obstructive jaundice due to malignancy of the pancreas with bad condition were managed just by cholecystostomy. Transhepatic drainage was applied for cases of inoperable hepatocellular carcinoma.

Explorative laparotomy was performed for advanced and irresectable malignancies.

RESULTS

The most common cause of obstruction of hepatobiliary ducts was common bile duct stones. Out of 134 patients, 68 patients (50.7 %) had jaundice due to stones in CBD. There were 46 females and 22 males with mean age at 39 years. Malignancy cases came in the second place in 33 patients (24.6 %). There were 23 females and 10 males with mean age at 54 years. Among these malignant cases, 16 patients had cancer of the pancreas to occupy the first place (48% of malignant cases, or 12% of all cases) followed by hepatocellular malignancy in 6 patients (18% of malignant cases, or 4.4 % of all cases). Cancer of the gallbladder comes in the last place before advanced inoperable cancer of the stomach. Distribution of malignancy causing obstructive jaundice is shown in (Table 1).

Thirteen patients (9.7%) were diagnosed as stenosis of papilla of Vater. These cases had mildly dilated common bile duct and increased preoperative LFTs, but neither stones in common bile duct, nor tumors or strictures were found. Preoperative sonography of extrahepatic biliary ducts in this group failed to reveal the causes of obstruction. It wrongly reported stones or sludge in CBD.

Table 1: Distribution of malignancies causing obstructive jaundice.

	Type of malignancy	Male	Female	Total	%
1	Malignancy of pancreas	4	12	16	%12
2	Hepatocellular malignancy	2	4	6	%4.4
3	Cholangiocarcinoma	1	3	4	%3
4	Periampullary carcinoma	1	3	4	%3
5	Cancer of the gallbladder	1	1	2	%1.5
6	Advanced gastric cancer (inoperable)	1	0	1	%0.7
	Total	**10**	**23**	**33**	**%24.6**

Ten jaundiced patients have benign strictures of extrahepatic biliary tree that cause obstructive jaundice (7.4%). Out of these 10 cases, 7 cases were caused by iatrogenic injury to extrahepatic ducts during previous operation for gallstones. Out of 7 iatrogenic cases, 2 cases have complete injury of right hepatic duct and five cases had postoperative strictures of common bile duct. Six of 7 iatrogenic cases were sent to our hospital from smaller hospitals. The remaining 3 cases had primary strictures of common bile duct.

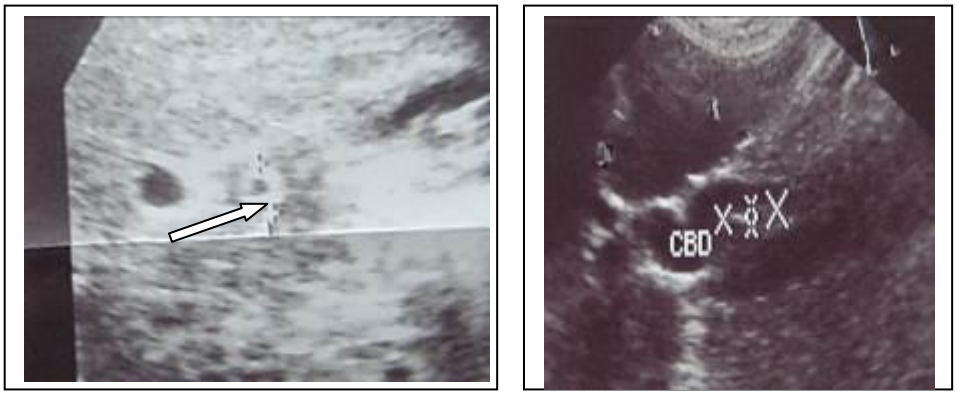
Three patients (2.2%) with jaundice had worms (Ascaris) in their common bile ducts (one female and 2 young male patients). No marked dilatation of biliary tree was found in this group Fig 1.

Two patients (1.4%) had Mirrizi's syndrome as a cause of obstructive jaundice.

Another cause of obstructive jaundice in this study was ruptured hydatid cysts that obliterated hepatic ducts and CBD in two patients (1.4%) Fig2.

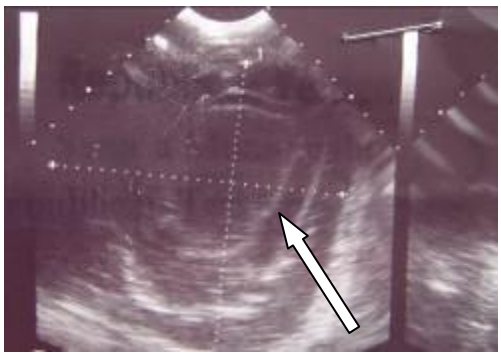
Two patients (1.4%) had big amoebic abscesses of the liver. The largest one is about 21x14cm and occupying almost the entire right hepatic lobe Fig 3.

One case with posttraumatic pseudocyst of the pancreas was found to be the cause of obstruction of biliary duct in one 8-year-old child. The causes of biliary obstruction in our study are shown in (Table2).



a) Transverse view "bull's eye" (b) Longitudinal shadow in CBD

Figure (1): ultrasound finding: Ascaris in common bile ducts.



Arrow: detached laminated membrane

Figure (2): Ultrasound finding: Ruptured liver hydatid cyst Causing obstructive jaundice

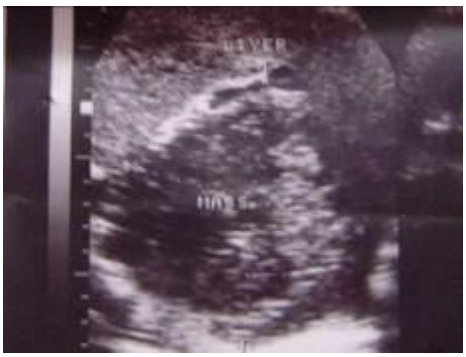


Fig. 3: Ultrasound finding: Liver amoebic abscess

Regarding operative mortality and complications, 11 patients (8 %) died postoperatively within 2 weeks. There were 6 females and 5 males with mean age at 61.4 years. The majority of them succumbed to their primary diseases. As for operative complications, there were 9 (6.7%) cases with wound infection (5 females and 4 males); 5 females and 2 males (5.2%) had bile leakage that was conservatively dealt with and 6 patients (4.4%) with Chest infection. Sixteen patients (12%) had diarrhea; they were 9 females and 7 males. Immediate postoperative mortality is shown in (Table 3).

Table (2): The causes of biliary obstruction.

	Cause of obstructive jaundice	Male	Female	Total	%
1	Common bile duct stones	22	46	68	%50.7
2	Malignancy	10	23	33	%24.6
3	Stenosis of papilla of Vater	4	9	13	%9.7
4	Benign strictures of extrahepatic biliary tree	2	8	10	%7.4
5	Ascaris in CBD	2	1	3	%2.2
6	Mirrizi's syndrome	1	1	2	%1.4
7	Liver hydatid cyst	0	2	2	%1.4
8	Liver abscesses	1	1	2	%1.4
9	Pseudopancreatic cyst	1	0	1	%0.7
	Total	**43**	**91**	**134**	**%100**

Table (3): Immediate postoperative mortality

	Type of malignancy	Male	Female	Total%
	Inoperable hepatocellular carcinoma	1	2	3 %2.2
	Inoperable gastric cancer	1	0	1 %0.7
	Inoperable pancreatic cancer	2	3	5 %3.7
	Cholangiocarcinoma	1	1	2 %1.4
	T o t a l	**5**	**6**	**11 %8**

DISCUSSION

Obstructive jaundice has wide variation of etiology; it is not therefore a definitive diagnosis at the time of presentation. The obstructive jaundice syndrome is now common and its prevalence has increased with female preponderance [5]. Unlike obstructive jaundice due to stones in CBD that is usually painful with sudden onset and intermittent course, the jaundice due to malignancy has gradual and painless onset and it is progressive in course [6,7].

In the literature, the most common cause of obstructive jaundice is malignancy of pancreas and biliary ducts [3,4,6,7,8,10]. Muhammad S. et al [3] reported 54.17% of their patients having malignant causes of obstructive jaundice. Sharma MP et al [4] reported that 75.3% of their patients had malignancies of pancreas and hepatobiliary.

In our study, the most common cause of obstructive jaundice was stones in common biliary ducts (50.7%) followed by malignancy (24.6%). Grandic et al [5] reported similar findings. In our study, common bile duct stones are the most common cause of obstructive jaundice due to the nature of the jaundice, low health awareness among our patients and

lack of adequate equipments of our health institutions. Regarding the nature of the jaundice, patients suffering from stones in CBD usually search for medical service urgently because of sudden and painful onset of their complaint. They seek medical help earlier and usually receive treatment at the beginning of their complaint. In contrast, patients with obstructive jaundice due to malignancy have insidious and painless onset of their complaint. Thus they don't seek medical help as early as those with CBD stones. Most of these patients therefore present with an inoperable disease [11]. The patients mostly die before reaching the hospital or they die during preoperative period. This fact is apparent in our study: 10 patients with malignancy were excluded from the study because they died during preoperative period.

Stenosis of papilla is the second common cause of postcholecystectomy syndrome after missed stones in CBD [12] . It is postulated that stenosis of papilla is usually resulted from repeated injury of papilla and Oddi's sphincter during the passage of small stones through papilla to the duodenum or due to inflammation of the duodenum or pancreas [12,13]. In our study, 13 patients (9.7%) had benign stenosis of the papilla of Vater to become the third common cause of obstructive jaundice after CBD stones and malignancy. Surprisingly, there were no stones in common bile duct that might cause obstructive jaundice despite preoperative ultrasound reported either stones or sand sludge in CBD in all these cases. Therefore, stenosis of papilla can be explained in our study by repeated episodes of inflammation of papilla and its surroundings followed by healing by fibrous stenosing non-elastic tissue.

One further cause of obstructive jaundice was benign strictures of extrahepatic biliary ducts. An iatrogenic injury of biliary ducts is more likely to happen during simple cholecystectomy rather than during complicated cholecystectomy[12]. Undue self-confidence of the surgeon during simple cholecystectomy, insufficient approach and inappropriate lightening of operative field, bad assistance and inappropriate anesthesia, structural anomaly in Calot's triangle and impatience of the surgeon may lead to technical mistakes and iatrogenic injury of biliary ducts.

In our study, 10 patients (7.4%) had benign strictures of extrahepatic biliary ducts. Unfortunately, 7 of these patients with obstructive jaundice had iatrogenic injury of extrahepatic biliary ducts during previous operations. Only one case occurred in our department, while others were transferred to our hospital from smaller peripheral hospitals. It is postulated that bad assisting increases possibility of injury of surrounding structures. It is not uncommon that our surgeons perform cholecystectomy alone and sometime do CBD exploration just with scrubbing nurse assistance. This inevitably leads to iatrogenic injury to surrounding structures.

Ascaris lumbricoides is the most common nematode found in the human gastrointestinal tract with a greater prevalence in developing tropical and subtropical countries [13,14]. It normally inhabits the small intestine and have propensity to migrate through the ampulla of Vater to lodge in the gallbladder and biliary tract [15] and may give rise to serious conditions such as biliary colic, acute cholecystitis, acute pancreatitis, acute cholangitis and hepatic abscess [16,17,18].

The cause of obstructive jaundice in 3 of our patients (2.2%) was the presence of ascaris in common bile duct. Manzor Salim [19] reported higher percentage at (10.26%). It is attributed to the high incidence of parasites infestation in our developing country probably due to low socioeconomic conditions and poor sanitation. Since there was no dilatation of

CBD, we managed these cases by milking the worms to the duodenum followed by postoperatively albendazole tab 400mg as a daily single dose for 3 consecutive days. We did not try to extract worms through choledochotomy in order to avoid the possibility of worms' immigration to the peritoneal cavity through stitches.

Another etiological factor of obstructive jaundice is amoebic cysts and abscesses in the liver. Amoebiasis is the infection of the human gastrointestinal tract by Entamoeba histolytica, a parasite that is capable of invading the intestinal mucosa and may spread to other organs; mainly the liver usually in right lobe [20]. Amoebic Liver Cyst (ALC) might be infected to become Abscess (ALA) [21]. It is usually solitary in (30% - 70%) of patients and large enough to produce compression syndrome and obstructive jaundice [20, 21]. Amoebiasis is common in Asia, Africa, South America and the Middle East, probably because of poor sanitation and low socioeconomic conditions [21, 22]. In our study there were 2 cases (1.4%) of ALA that were compressing upon the biliary ducts and produced a feature of obstructive jaundice. They were managed surgically by open drainage. Amoebicidal Metronidazole was postoperatively given in 500mg tid for 10 days. However, one ALA case developed a biliary leak through the drainage site that stopped spontaneously within 2 weeks.

In the literature, the Mirrizi's syndrome is frequently used to describe a rare entity consisting of an anatomic variation of the cystic duct or neck of the gallbladder, an impacted gallstone in the cystic duct, and a benign mechanical obstruction of the hepatic duct causing jaundice and cholangitis [23].

In our study we found 2 patients with obstructive jaundice due to Mirrizi's syndrome (1.4 %).

Alam A. M et al [24] reported almost a similar (1.6%) finding among 60 patients who underwent cholangiography for obstructive jaundice.

Hydatid disease may affect any organ of the body; and liver is involved most commonly. The rupture of the cyst is a serious complication [17]. After cyst rupture into the biliary system, daughter cysts and membranes pass into biliary ducts producing obstructive jaundice. We found 2 cases (1.4%) of obstructive jaundice due to rupturing liver hydatid cysts into biliary tree. Both cases were managed surgically. An excision of the dome, evacuation and drainage of cyst cavity was performed. Cholecystectomy and T-Tube insertion in the common bile duct was performed. Albendazole tab was given in 600 mg in 2 divided doses for 2 months. The clinical outcome was good except one patient who developed wound infection.

The less common cause of obstructive jaundice is pseudo-cyst of the pancreas. Usually pseudo-cyst of pancreas is regarded a complication of pancreatitis. However, pancreatitis in our country is very rare. Our case of one 11 year-old young patient had history of trauma to the abdomen one year ago. Therefore, we attribute this finding to that trauma rather than to pancreatitis.

CONCLUSION

Stones of common and hepatic bile ducts are the most common cause of obstructive jaundice in our study. In the second place come malignancies of pancreas and hepatobiliary tract. The cancer of the pancreas was the most common malignant cause of obstructive jaundice.

Cooperation between surgeon and radiologist to diagnose the underlying cause of obstructive jaundice and identify its location should be a routine practice, and has a priority because the outcome of surgical treatment of obstructive jaundice depends on the stage of the disease at the time of presentation. The early surgical intervention therefore prevents developing fatal complications especially in malignant cases.

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طيف أسباب اليرقان الإنسدادي
"تجربتنا في مستشفيين جامعيين في اليمن"

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ملخص

يُعد انسداد القنوات الصفراوية حالة جراحية طارئة يصعب تحديد أسبابها قبل إجراء العملية الجراحية ، والتشخيص المبكر لتلك الأسباب وبالتالي العلاج المبكر للحالة يقلل من المضاعفات الخطيرة المحتملة.

هدفت هذه الدراسة إلى معرفة الأسباب المختلفة لانسداد القنوات الصفراوية.

المرضى وطرق البحث:

تم دراسة وتحليل المعلومات المتعلقة بالمرضى الذين خضعوا لعمليات جراحية بسبب انسداد القنوات الصفراوية في قسمي الجراحة العامة بمستشفى الوحدة الجامعي بجامعة ذمار ومستشفى الكويت الجامعي بجامعة صنعاء وذلك في الفترة من يناير 2003 وحتى ديسمبر 2008 بهدف معرفة وتحديد أسباب انسداد القنوات الصفراوية. شملت الدراسة 134 مريضا (91 من الإناث و 43 من الذكور) وتراوحت أعمارهم من 8 إلى90سنة.

النتائج:

تم تحديد 9 أسباب لانسداد القنوات الصفراوية ، وان حصوات القنوات الصفراوية هي أكثر الأسباب وجودا حيث سببت انسداد تلك القنوات عند 68 مريضا (50.7%). كما إن سرطان البنكرياس والكبد والقنوات الصفراوية قد تسبب في انسداد القنوات الصفراوية عند 33 مريضا (24.6%) يتصدرها سرطان البنكرياس. في المرتبة الثالثة تأتي تضيق "بؤبأة فاتر" لدى 13 مريضا (9.7%) ثم تضيقات القنوات الصفراوية لدى 10 مرضى (7.4%). كما تسببت دودة الإسكارس في انسداد القنوات الصفراوية عند 3 مرضى، ميريز سيندروم عند 2مرضى، و تسببت الأكياس المائية في الكبد والأميبية عند حالتين من المرضى، أما الأكياس الكاذبة للبنكرياس فقد تسببت في انسداد القنوات الصفراوية عند حالة واحدة.

الخلاصة:

هناك تسعة عوامل تسببت في انسداد القنوات الصفراوية في دراستنا، وتعتبر حصوات القنوات الصفراوية السبب الرئيس، ثم سرطان البنكرياس والكبد والقنوات الصفراوية حيث يأتي سرطان البنكرياس في المقدمة. ومن الأسباب النادرة لانسداد القنوات الصفراوية وجود دودة الإسكارس في تلك القنوات.

ننصح بالتعاون والتكامل بين الجراح وأخصائي الأشعة لتحديد ومعرفة الأسباب قبل إجراء التدخل الجراحي.

الكلمات الدالة:اليرقان الإنسدادي- انسداد القنوات الصفراوية- الأسباب.

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TUJNAS

Bacterial Contamination in Some Hospitals in Thamar

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ABSTRACT

Contamination of hospital departments is a major cause of hospital acquired infections (nosocomial infection). Multi reservoirs have been reported as being responsible for hospital contamination, particularly delivery theaters, intensive care units (I.C.U), instruments, canuola, stethoscopes, etc. This study was carried out in 2010, and aimed to evaluate the incidence of bacterial contamination of Thamar hospital and Alwehda teaching hospital in Thamar city/Yemen. 263 swabs collected from instruments, equipments, devices, mobiles, blankets, gowns, and others, of different hospital departments, and examined for bacterial contamination. Resistance to commonly used antimicrobials is evaluated in positive cultures. This study showed that the rate of positive cultures in Thamar hospital is 28% (44 were positive out of 156 examined). Of the 44 positive cultures: 77.2% were Gram positive and 22.7% were Gram negative. Staphylococcus aureus (S. aureus) was the most common isolate, represent 41% and present in almost all items examined, whereas non-coagulase staphylococcus, which is the predominant in second place, represent 18.2%. The rate of positive cultures in Alwehda teaching hospital is 7.5% (8 were positive out of 107 examined). Of the 8 positive cultures: 87.5% were gram positive and 12.5% were Gram negative. Non-coagulase staphylococcus was the most common isolate represent 50%, whereas S. aureus came second, represent 37.5%. The resistance rate to commonly used antimicrobials in isolated bacteria from hospitals departments and instruments varied and no clear pattern was found except that all isolates showed a high resistance rate to Ampicilin. S. aureus showed a high resistance rate to Ampicilin (85% resistant), while it showed a low resistance rate to vancomycin (4.8%).

INTRODUCTION

Nosocomial infections are infections which are a result of treatment in a hospital or a healthcare service unit. Infections are considered nosocomial if they first appear 48 hours or more after hospital admission or within 30 days

after discharge. This type of infection is also known as a hospital-acquired infection (HAI) (or more generically healthcare-associated infection) [1, 15, 2].

Nosocomial infections occur worldwide and affect both developed and resource-poor countries.

A prevalence survey conducted under the auspices of WHO in 55 hospitals of 14 countries representing 4 WHO regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections at any time and over 1.4 million people worldwide suffer from infectious complications acquired in hospitals [4]. The so-called hospital infections are among the main causes of morbidity and mortality in hospitals. Also, they increase hospital stays and costs [10]. The hospital acquired infection is estimated to more than double mortality, and morbidity risk of any admitted patient [9], and probably result in as many as 70,000 death per year, in the United States [17].

Nosocomial infections can cause severe pneumonia and infections of the urinary tract, bloodstream and other parts of the body[1].

Hospital contamination is the most probable cause of nosocomial infection. Contaminations of hospital equipments, hands of staff , and improper use of detergent, disinfectant, and antibiotics, affect patient directly, and may result in nosocomial infection [7, 14].

20% of hospital patients suffer from infection: half of them are admitted with, and often because of, their infection (community acquired); the other half develop their infection during their hospital stay (hospital acquired)[18, 19].

Multi reservoirs have been reported as being responsible for hospital contamination, particularly delivery theater, instruments, intensive care units (I.C.U), canola, and stethoscope, operating theaters, purified water systems, personal phones and hospital air [6, 13, 14, 16, 17, 18].

Some patients are at greater risk than others for acquiring HAIs due to the presence of certain risk factors which alter their susceptibility to infection. These risk factors may be roughly divided into 2 groups: intrinsic and extrinsic. Intrinsic risk factors are factors inherent to the patient and include the presence of acute medical/surgical disease, and severity of illness. Extrinsic risk factors relate to the types of medical practice performed at individual staff or hospital level and the mix of patients within hospitals. For example, urinary catheterisation, parenteral nutrition, mechanical ventilation, tracheostomy, and surgical contamination are significantly associated with HAIs [7].

Many factors promote infection among hospitalized patients such as: decreased immunity among patients, the increasing variety of medical procedures, invasive techniques creating potential routes of infection and the transmission of drug-resistant bacteria among crowded hospital populations, where poor infection control practices may facilitate transmission frequency of infection [7,8] . Infection rates are higher among patients with increased susceptibility because of old age, underlying disease, or chemotherapy.

The majority of hospital acquired infections are due to common organisms, example; urinary infections due to coliform, wound infection due to S. aureus, pneumonia due to Streptococcus pneumonia, septicaemia is the most serious infection, and is associated with significant mortality: most often due to coliforms, S. aureus, S. epidermidis[18].

Many reports worldwide have indicated the strong involvement of bacteria in hospital contamination and consequently in nosocomial infection [3, 4, 5, 6, 11, 16].

In Baghdad/Iraq (2001-2002), a study [6] on "Microbial contamination in the operating theaters", showed that in 2001 the rate of positive cultures were 3.7%, and 4% in 2002. In 2001 S. epidermidis was the most common isolate in 39%, followed by P. aeurginosa that was 30.4%, whereas in 2002 coliform bacteria where the highest 62.5%, followed by P. aeruginosa 25%. In Kerman, Iran in 2009, a study[16] showed that nearly 40% of health care worker's dominant hands, and 32% of their mobile phones were contaminated with S. epidermidis (77% of bacterial contamination), followed by 12.5% contaminated with S. aureus, the percentage of contamination in all mobile phones is about 32.5% and , 59% of hands. Bernard, et al (1999) found that 85% of hospital physicians ' stethoscope were contaminated, of which 9% showed the common isolated pathogen, S. aureus [4].

The microbiota from the uniforms of 31 professionals from the general intensive care unit was analyzed [11]. 39% of pathogenes were Gram negative and 61% were Gram positive. S. aureus, was among the isolated pathogens. Some of these isolates were multi-resistant to antibiotics. Bacterial Distribution Analysis in the Atmosphere of two Hospitals in Ibb/Yemen was studied by Al-shahwani [13]. and revealed a high level of bacterial counts.

Nosocomial infections caused by multi-drugs resistance Gram positive organism, such as, S. aureus, MRSA, VERSA and Enterococcaus species are a growing problem in many health care institutions [5, 12].

Intensive use of broad spectrum antibiotics has likewise facilitated the emergence of resistance among gram-negative bacteria. Enterobacteriaceae, Pseudomonas species, and other gram-negative bacteria have become increasingly resistant to most first-line antibiotics, including third-generation cephalosporins, monobactams, aminoglycosides, and quinolones [8].

This study aimed to evaluate the incidence of bacterial contamination in Thamar and Alwehda teaching hospitals in Thamar city/Yemen, to identify contaminating agent and their distribution within different theaters and to identify the resistance rate of isolated bacteria to some of commonly used antibiotics.

MATERIAL & METHODS

Material

263 swabs were collected from different departments of Thamar hospital and Alwehda teaching hospital in Thamar city,Yemen .

The samples were as follow:

a. 156 samples from Thamar hospital; 50 samples from Operation rooms, 52 samples from the nursery, 8 samples from the doctor’s mobiles, 15 samples from the blankets of the patients, 8 samples from the doctor’s stethoscopes, 23 samples from others (Lock of door, floor, gowns (hospital staff uniforms), Medicine table, sink).
b. 107 samples from Alwehda teaching hospital: 50 samples from Operation rooms, 9 samples from intensive care unit (ICU), 10 samples from the doctor’s mobiles, 15 samples from the blankets of the patients, 7 samples from the doctor’s stethoscopes, 16 samples from others (Lock of door, floor, gowns, Medicine table, sink).
c. Controls included in this study were as follows: sterile swabs were selected randomly and cultured on Blood, Chocolate and MacConkey agar.

Methods

Samples were collected by taking a smear of selected devices, instruments, mobiles and others, using a moist sterile swabs. Samples were then returned to the laboratory and Agar plates were marked according to the sites. Swabs obtained were cultured directly on prepared Blood, Chocolate and MacConkey agar. by streaking method, and standard method of inoculation. The inoculated plates were incubated aerobically overnight at 37 °C, for 24 hours while chocolate agar plates were incubated anaerobically at 37 °C for 24-48 hours.

All bacterial growths were then subjected to identification: Morphology of colony on culture media, appearance of colony, such as : hemolytic pigmentation, mucous production, swarming phenomena and lactose fermentation. Further identifications were done by biochemical tests, including: the oxidase ,catalase , gelatinase , KIA, MIU, and citrate tests.

Bacterial isolates were inoculated in Muller Hinton Agar , and several antimicrobial were added to observe inhibition zones. The following types of antibiotics were used in this study: Cephotaxime , Ampicillin , Augmentin , Gentamicin ,Vancomycin. 52 positive cultures were subjected to sensitivity tests

RESULTS

Culture results

The total number of swabs cultured were 263 ; 156 from Thamar hospital and 107 from Alwehda teaching hospital.

All control samples were negative. Out of 156 samples cultures, 44 samples were positive (showing bacterial growth), making the percentage of contamination in Thamar hospital 28%. The distribution of positive cultures in Thamar hospital is presented in table;1

Table (1): Distribution of positive samples cultures in Thamar hospital.

Department	No. of samples examined			Type of bacteria
	Total	+ve	-ve	
Operation room	50	6 (12%)	44 (88%)	S. aureus , Proteus spp., Bacillus cereus, Non-coagulase stapylococcus
I.C.U	-	-	-	
Nursery	52	18 (34.6%)	34 (65.4%)	Proteus spp., K. pneumonia, Pseudomonas spp., streptococcus, S. aureus , non-Coagulase staphylococcus., Streptococcus spp.,
Mobiles	8	1 (12.5%)	7 (87.5%)	S. aureus
Blankets	15	10 (66.7%)	5 (33.3%)	S. aureus ,non-Coagulase staphylococcus., Streptococcus spp., Bacillus cereus
Stethoscopes	8	1 (12.5%)	7 (87.5%)	S. aureus.
Gowns	12	2 (16.7%)	10 (83.3%)	S. aureus
Others	11	6 (54.5%)	5 (45.5%)	S. aureus , Proteus spp., Pseudomonas spp.
Total	156	44 (28%)	112 (72%)	

Of the 44 positive cultures: *S. aureus* was isolated in 18 samples (41%), *non-coagulase staphylococcus* in 8 (18.2%), *Bacillus cereus* in 6 (13.6%), *Proteus* spp. in 5 (11.4%), *Pseudomonas* spp. in 3 (6.8%), *Streptococcus* spp. in 2 (4.5%), *K. pneumonia* in one culture, and *E. coli* is also isolated in just one culture (2.3% for each) (table; 2)

Table (2): Distribution of bacterial contamination in Thamar hospital

Types of bacteria	Hospital departments.								
	Operation room	I.C.U	mobiles	blankets	Stethoscopes	gowns	Others	nursery	Total
S. aureus	2 (33.3 %)	-	1 (100%)	6 (60%)	1 (100%)	2 (100%)	2 (33.3%)	4 (22.2 %)	18 (41%)
Proteus spp.	1 (16.7%)	-	-	-	-	-	2 (33.3%)	2 (11.1%)	5 (11.4 %)
Non-coagulase stapylococcus.	1 (16.7%)	-	-	1 (10%)	-	-	1 (16.7%)	5 (27.8%)	8 (18.2 %)
Pseudomonas spp.	-	-	-	-	-	-	1 (16.7%)	2 (11.1%)	3 (6.8%)
Streptococcus spp.	-	-	-	1 (10%)	-	-	-	1 (5.6%)	2 (4.5%)
K .pneumonia	-	-	-	-	-	-	-	1 (5.6%)	1 (2.3%)
Bacillus cereus	2 (33.3%)	-	-	2 (20%)	-	-	-	2 (11.1%)	6 (13.6%)
E.coli	-	-	-	-	-	-	-	1 (5.6%)	1 (2.3%)
Total	6	-	1	10	1	2	6	18	44 (100%)

In Alwehda teaching hospital, out of 107 cultures, 8 were positive, making the percentage of contamination 7 .5%. The distribution of positive cultures in Alwehda teaching hospital is presented in table; 3.

Table (3): Distribution of positive samples cultures in Alwehda teaching hospital.

Deparment.	No. of samples examined			Type of bacteria
	Total	+ve	-ve	
Operation room	50	2 (4%)	48 (96%)	S. aureus, proteus spp.
I.C.U	9	1 (11%)	8 (89%)	Non-coagulase staphylococcus
Mobiles	10	-	10 100%	-
Nusery	-	-	-	-
Blankets	15	4 (26.7%)	11 (73.3%)	S. aureus ,non-coagulase staphylococcus
Stethoscopes	7	-	7 (100%)	-
Gowns	8	-	8 (100%)	-
Others	8	1 (12.5%)	7 (87.5%)	S. aureus
Total	107	8 (7.5%)	99 (92.5%)	-

Of the 8 positive cultures, *S. aureus* was isolated in 3 cultures (37.5%), *non-coagulase staphylococcus* in 4 cultures (50%) and *Proteus spp*. in just one culture (12.5%) (table;4)

Table (4): Distribution of bacterial contamination in Alwehda teaching hospital.

Types of bacteria	Hospital departments.								
	Operation room	I.C.U	mobiles	blankets	Stetho -scopes	Gowns	Others	nursery	Total
S. aureus	1 50%	-	-	1 (25%)	-	-	1 (100%)	-	3 (37.5%)
Proteus spp.	1 50%	-	-	-	-	-	-	-	1 (12.5%)
Non-coagulase stapylococcus	-	1 100%	-	3 (75%)	-	-	-	-	4 (50%)
Total	2	1	-	4	-	-	1	-	8 (100%)

Sensitivity results

The resistance rate of the isolated bacteria to the antibiotics in this study was: 25% for Vancomycin, 25.5% for Augmenten, 33% for Cephotaxime, 53% for Gentamicin and 81% for Ampicillin (table;5)

Table (5): Bac,terial resistance to antibiotics

Type of antibiotics	Sensitive %	Resistant %
Ampicillin	19%	81%
Cephotaxime	67%	33%
Augmenten	74.5%	25.5%
Gentamicin	47%	53%
Vancomycin	75%	25%

The resistance rate of *S. aureus* to the antibiotics used in this study was as follow: 85.7% resistant to Ampicilin, 57% to Gentamicin, 47% to Cephotaxime, 33.3% to Augmentin and 4.8% to Vancomycin (Figure 1)

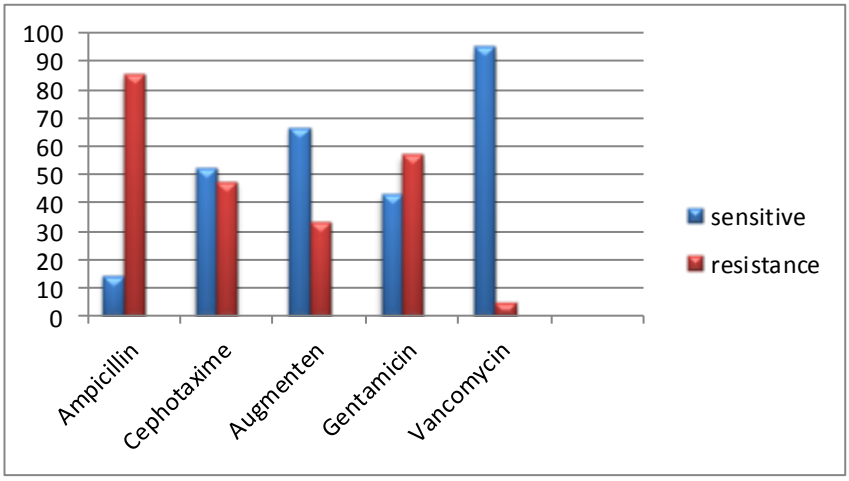

Figure (1): S. aureus resistance to antibiotics

DISCUSSION.

This study was carried out in the year 2010, to evaluate the incidence of bacterial contamination of two largest hospitals in Thamar city/Yemen.

In this study the percent of bacterial contamination in Thamar hospital and Al-Wehda teaching hospitals was: 28% & 7.5% respectively.

The contamination percentage differ from one theater to another, the highest contaminated department in this study was the nursery in Thamar hospital (34.6%).

The results of this study regarding types of bacteria isolated are similar to other studies published[4, 6, 16], but the percent of hospital contamination in this study is higher, especially than that of Ensayef et al,[6] who reported a low contamination rate compared to this study (3.7% in 2001 and 4% in 2002).

This might be due to the level of hygiene in different countries. In this study, 12.5% (1 out of 8 examined) of doctor's mobiles in Thamar hospital found to be contaminated with

S. aureus. The results of this study is lower than that reported by Sephehri et al,[16] in Iran who isolated the same bacteria but reported high rate of contamination (32.5%).

Regarding physicians' stethoscopes, *S. aureus* was isolated from one out of 8 swabs examined (12.5%) in Thamar hospital. The rate of contamination of this study is much lower than that of Bernard, et al [4] who reported 85% of physicians ' stethoscope were contaminated with bacteria, of which 9% showed the common isolated pathogen, *S. aureus*).

The isolation of *Bacillus* cereus in this study has not been reported before in hospital theatres except in an investigation [3] into two cases of post-operative *Bacillus cereus* meningitis which revealed that hospital linen was heavily contaminated by *Bacillus cereus* spores. Spores of *Bacillus cereus* can be found widely in nature, including samples of dust[23]. The bacteria isolated in this study may be from the dust as Thamar city is known for its dusty weather.

In this study 16.7% (2 out of 10) of professional uniforms in Thamar hospital were found to be contaminated with *S. aureus*. These results are, in part, in agreement with those related in other reports [11, 20, 22], which detected certain pathogens, e.g. *S. aureus* which was the only Gram-positive pathogen isolated.

The isolation of pathogens from uniforms of hospital staff reinforces the need for more care with clothing.

In this study, 10 out of 15 blankets examined for bacterial contamination in Thamar hospital were culture positive. In Alwehda teaching hospital, only 4 blankets out of 15 examined were positive. *S. aureus*, non-Coagulase *Staphylococcus*, *Streptococcus* species and *Bacillus cereus* were isolated. In any environment, blankets can become a haven for bacteria. These bacteria usually represent a spectrum of Gram positive and Gram negative organisms capable of producing infections. In a hospital environment, fever and sweat are common and an excellent source of bacterial contamination [21].

This study also aimed to identify the resistance rate of contaminating bacteria to some antibiotics. The following types of antibiotics were used in this study as they are commonly given by doctors for bacterial infections: Cephotaxime, Ampicillin, Augmenten, Gentamicin, and Vancomycin.

S. aureus showed a high resistance rate to Ampicilin (85% resistant), while showed a low resistance rate to vancomycin (4.8%).

Today, *S. aureus* has become resistant to many commonly used antibiotics. In the UK, only 2% of all *S. aureus* isolates are sensitive to penicillin with a similar picture in the rest of the world[26] The most effective defense used today against methicillin-resistant *S. aureus* (called MRSA) is vancomycin. However, the increasing use of vancomycin has set the stage for the evolution of vancomycin-resistant *S. aureus* (called VRSA). Scientists expect strains of the bacterium *S. aureus* that are fully resistant to the antibiotic vancomycin to evolve soon[25]. All types of bacteria isolated in this study showed a high resistance rate to Ampicilin and most of the isolated bacteria had some resistance to other antibiotics commonly used in therapy. The similar resistance profile of some microorganisms of the same species isolated from different items suggests that these could have had a common source of contamination. Also, the widespread use of antibiotic for these organisms might cause the resistance. Careful use of anti-microbial agents, such as antibiotics, is vital.

CONCLUSION

In summary the result of this study showed that there is bacterial contamination in both Thamar and Alwehda teaching hospitals, which may cause nosocomial infection to patients who stay in hospitals, and to medical staff and visitors.

The percent of bacterial contamination in Thamar hospital and Al-Wehda teaching hospitals was: 28% & 7.5% respectively. *S. aureus* & non-Coagulase *Staphylococcus* were the most common isolates. All bacterial isolates showed high resistance rate to Ampicilin. *S. aureus* was highly sensitive to Vancomycin.

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التلوث البكتيري لبعض مستشفيات محافظه ذمار،اليمن

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ملخص

يعتبر التلوث البكتيري للمستشفيات هو السبب الرئيس للعدوى المكتسبة للمرضى من المستشفيات. أجريت هذه الدراسة في عام 2010 حيث هدفت إلى تقييم التلوث البكتيري في مستشفيات محافظه ذمار في اليمن: مستشفى ذمار العام ومستشفى الوحدة التعليمي.

تم جمع 263 مسحة من أدوات ومعدات وأجهزة هواتف نقالة وبطانيات المرضى وبالطو الأطباء والممرضات وأشياء أخرى مختلفة وتم تقييم التلوث الجرثومي والتعرف على نوع البكتيريا المعزولة من العينات وكذلك تم تقييم حساسية هذه الجراثيم لعدد من المضادات البكتيرية التي تستخدم بشكل واسع لمعالجه الالتهابات البكتيرية للمرضى المترددين.

أظهرت هذه الدراسة أن معدل العينات التي وجدت فيها تلوث بكتيري كانت 28% (44 موجبة من 156 عينة تم فحصها) في مستشفى ذمار العام وكان من ال44 عينة موجبة 77.2% جرام موجب و22.7% جرام سالب و كانت البكتريا الأكثر شيوعا هي الستافيلوكوكاس اوريوس (41%) والنانكواوكيوليس ستافيلوكوكاس (18.2%)

أن معدل العينات التي وجدت فيها تلوث بكتيري في مستشفى الوحدة التعليمي كانت 7.5% (8 موجبة من 107 عينة تم فحصها) وكان من ال8 عينات موجبة 87.5% جرام موجب و12.5% جرام سالب وكانت البكتريا الاكثر شيوعا هي النانكواوكيوليس ستافيلوكوكاس (50%) و الستافيلوكوكاس اوريوس (37.5%) وأظهرت جميع أنواع البكتريا المعزولة في هذه الدراسة مقاومة عالية لمضاد الامبيسيلين وأظهرت بكتريا الستافيلوكوكاس اوريوس مقاومة عالية للامبيسيلين (85%) بينما أظهرت مقاومة قليلة للفانكومايسين (4.8%).

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TUJNAS

Septum Pellucidum Cyst in Patient with Parkinson's Disease-minimally Invasive Staged Therapy

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ABSTRACT

Background: The aim of the case report is to present the minimally invasive staged treatment of a patient with motor complications of Parkinson's disease with a large septum pellucidum cyst.
Material and Method: A two-stage surgical strategy was proposed by the movement disorders team: neuroendoscopic cyst fenestration with subsequent implantation of deep brain stimulation electrodes (subthalamic nucleus) depending on the effect of neuroendoscopic treatment.
Results: Despite the technical success of a neuroendoscopic cyst fenestration, as evidenced by a reduction in cyst volume, intraoperative ventriculocystography and postoperative CT showing free communication between the cyst and the ventricular system the motor symptoms caused by Parkinson's disease remained unchanged. A bilateral subthalamic deep brain stimulation system was implanted with good functional results as documented by her UPRDS III score in the off-medication state (52 points preoperative and 34 point after 6 years postoperative) and reduction of L-DOPA equivalent dose (60% of the pre-deep brain stimulation level).
Conclusion: Minimally invasive therapy-neuroendoscopic cyst fenestration, followed by a bilateral subthalamic stimulation implantation-led to the substantial and lasting improvement of the patient's symptoms.
Key words: septum pellucidum cyst, Parkinson's disease, deep brain stimulation, neuroendoscopy

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INTRODUCTION

The cavum septi pellucidi and cavum vergae are fluid collections between the leaflets of the septum pellucidum. The prevalence in children declines with age and in adults varies significantly depending on the criteria used for diagnosis as some remnant can be present in all patients. The prevalence of abnormal cavum septi pellucidi (cavum septi pellucidi contained on four or more 1,5 mm MRI slices) is 10,3 % for normal subjects [1]. The cavities may occasionally enlarge into cysts (by definition laterally bowing walls 10 mm apart or greater) and cause neurological symptoms. Although the causal relationship with neurological and psychiatric symptoms remains unclear, there are data reporting the association of septal cysts with some functional brain disorders (epilepsy, psychiatric problems) [2,3]. The aim of this paper is to present a case report of a patient referred for subthalamic deep brain stimulation (DBS) with a large midline cyst discovered by presurgical imaging studies. Minimally invasive therapy – neuroendoscopic cyst fenestration, followed by a bilateral subthalamic stimulation – led to the substantial and lasting improvement of the patient's symptoms.

MATERIAL AND METHODS

A 51-year-old female with late motor complications of Parkinson's disease (PD) was referred for deep brain stimulation. There was no family history of PD, and the patient did not complain of any previous neurological or psychiatric problems. She had been suffering from PD for 12 years, since the age of 39. L-DOPA therapy was started one year after the onset of symptoms. A positive therapeutic effect from this treatment lasted for 8 years, when "wearing-off" symptoms and disabling biphasic dyskinesias affecting the neck and upper and lower extremities appeared. The symptoms were uncontrollable by medication. No intellectual, cognitive, or memory dysfunctions were detected during the routine presurgical evaluation. The patient was scheduled for bilateral DBS subthalamic electrode implantation. A routine presurgical MRI revealed a large midline cyst with the bulging of the lateral walls and interventricular foramina narrowing (Fig.1). Although there were no symptoms indicating intracranial hypertension, a two-stage surgical strategy was proposed by the movement disorders team: neuroendoscopic cyst fenestration and subsequent implantation of DBS electrodes.

The first step (septum pellucidum cyst neuroendoscopic fenestration) was performed using frame based stereotactic system (ceramic frame Leibinger, 3D T1 WI, Zamorano Dujovny, Praezis Plus). The trajectory for a safe neuroendoscopic surgery was planned, with the entry site selected so as not to complicate the planned DBS implantation – anterior to the presumed point in front of the coronal suture (Fig. 2). Thinned and bulging walls suggesting expansive behaviour of the midline cysts together with slit like foramina of Monro were observed immediately after the endoscope entered the ventricular system (Fig. 3). After an uneventful fenestration (of both cyst walls), intraoperative ventriculocystography and postoperative CT showed free communication between the cyst and the ventricular system.

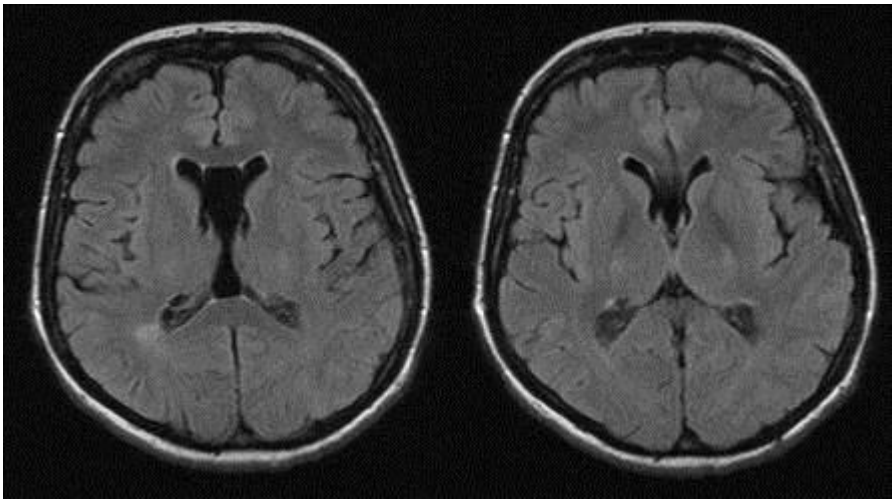


Figure (1): MRI findings - cyst wall bulging, the width of the cyst 16 mm

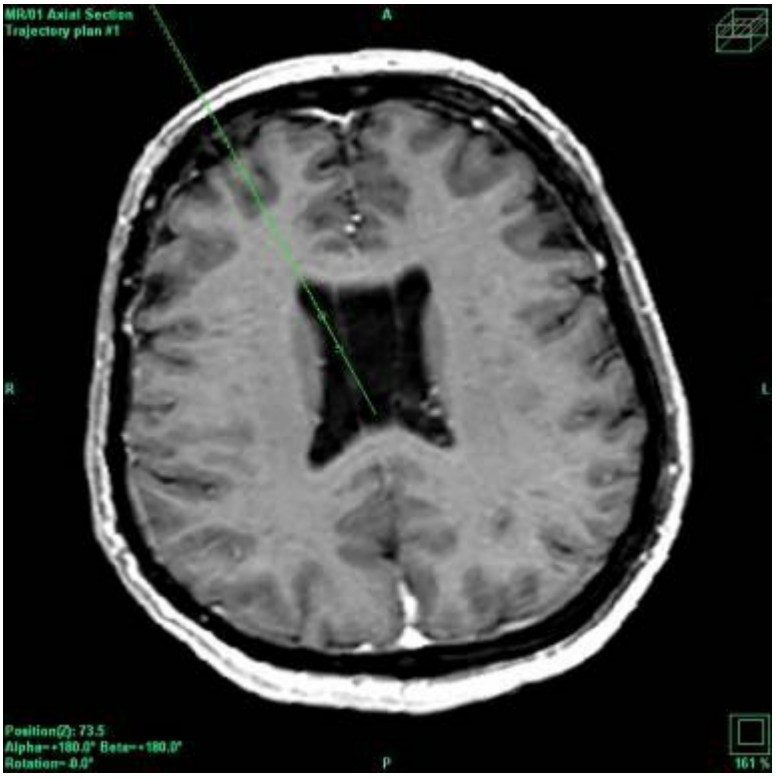


Figure (2): Presurgical planning of neuroendoscopic cyst fenestration

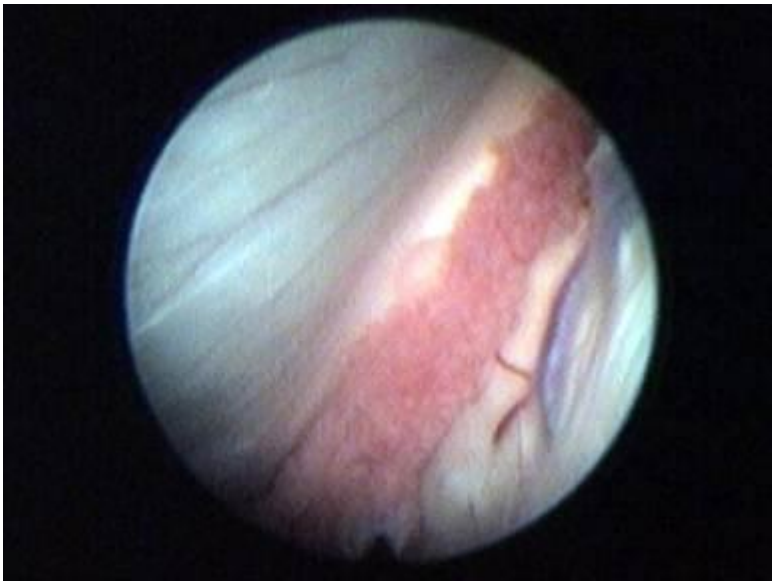
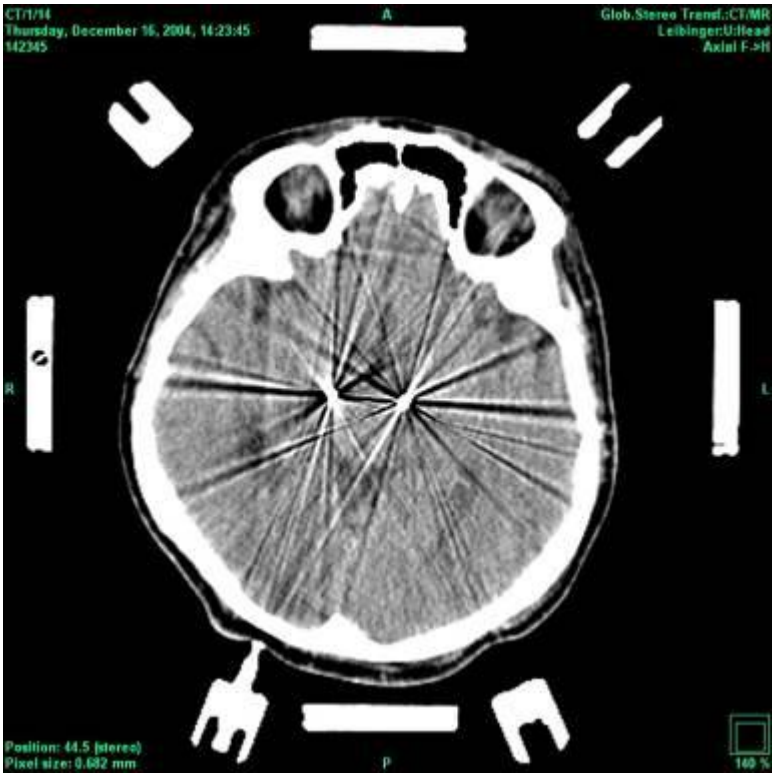


Figure (3): Endoscopic findings during surgery - bulging and thinning of the cyst walls

RESULTS

A volumetric MRI follow up (one month after surgery) also showed a reduction of cyst volume (7,8 cm3 before surgery and 6,4 cm3 after surgery, 17,9 % reduction of cyst volume). However, the patient's problems remained unchanged by the follow-up period 2 months after surgery. The patient then underwent an implantation of bilateral subthalamic DBS electrodes supported by intraoperative microrecording and macrostimulation. Clear subthalamic nucleus recordings were present on two (central and posterior) tracks of both sites out of four microelectrode trajectories. The central trajectories, with the tip of the electrode on the target or 1 mm below the targets, were selected for the definitive placement of DBS electrodes (Model 3389, Medtronic Inc, Minneapolis, MN, USA)(Fig. 4). The stimulator was implanted during the second stage of the surgery. After six years of stimulation, the patient significantly benefits from the procedure, as documented by her UPRDS III score in the off-medication state (52 points preoperative, 28 points after 3 years postoperative, and 34 point after 6 years postoperative). After six years, the patient's stimulation parameters are set at 3.4 V / 90 microsecond and 130 Hz. Medication (L-DOPA equivalent dose) is at 60% of the pre-DBS level.



Figure(4): Final position of the implanted electrodes

DISCUSSION

Three main issues were discussed when preparing the optimum treatment strategy for this individual patient:

- the relationship of clinical symptoms and cystic midline anomaly
- the indication for treatment of cystic lesion before DBS implantation
- the choice of appropriate surgical therapy

A search of the available literature did not find any paper suggesting a causal association between a midline cystic anomaly and parkinsonian symptoms. There was a frequent association between the cavum septi pellucidi and schizophrenia (30.4 %) and affective disorders (20 %) [2].

The main symptoms of midline cystic anomalies are intracranial hypertension, epileptic seizures and emotional instability [4]. A possible cause of the clinical symptoms associated with midline cysts is the compression of the interventricular foramen, the vascular structures, and the hypothalamoseptal triangle [3].

Only case reports or small clinical series of patients after neuroendoscopic surgeries for midline cystic anomalies have been reported. The main indication for neuroendoscopic cyst fenestration (cystoventriculostomy by fenestration of septal leaflet) is expansive behaviour of the cyst that may result in hydrocephalus caused by the obstruction or narrowing of the

interventricular foramen [5]. Meticulous attention should be paid to presurgical planning and ventricular entry to avoid injury to the fornices, thalamus, internal capsule, caudate nucleus, or the septal and thalamostriate veins. In a large surgical series of 10 patients (paediatric and adult cases) the main clinical symptoms were headaches, accompanied with dizziness, vomiting, and epileptic seizures; however, 2 of the patients presented with epileptic seizures only. Endoscopic septostomy (rigid endoscope via frontal approach) led to symptom relief and cyst size reduction in all patients, with no cyst recurrences [6].

From a group of 32 septostomies in 30 patients presented by Oertel, et al., 3 patients were operated on for septum pellucidum cyst. Long-standing cerebrospinal fluid pathway restoration was achieved by endoscopic septostomy [7].

Steerable endoscope was used for the treatment of a 6-year-old boy and a 42-year-old female presenting with headaches and syncopal episodes. Fenestration of the cyst walls allowed communication with both lateral ventricles and adhesions between the cyst wall and the interventricular foramen were lysed with endoscopic cautery [8]. Fenestration of both septal walls using ultrasound followed by cyst regression was reported in one patient, an 11-year-old boy [5].

Our indication for neuroendoscopic surgery was supported mainly by graphic findings suggesting expansive cyst behaviour (cyst walls bulging and foramen of Monro narrowing), because there were no clinical symptoms of intracranial hypertension. The manufacturer's policy contraindicates routine MRI follow up after DBS, therefore CT would be the only graphic modality for graphic cyst follow up. Moreover, artefacts from implanted electrodes may interfere with cyst volumetric analysis and anatomical study.

The literature data show that bilateral subthalamic nucleus deep brain stimulation has long-term beneficial effects in Parkinson's disease patients. A retrospective study performed by Kleiner–Fishman, et al., summarises the clinical evidence on the effectiveness of subthalamic nucleus deep brain stimulation (Medline and Ovid databases 1993-2004), with the identification of some prognostic factors for short and long term results [9]. Bilateral subthalamic nucleus stimulation is beneficial in the long term for Parkinson's disease motor symptoms, but does not prevent disease progression or the occurrence of axial L-DOPA unresponsive symptoms in some patients. There is a 50% improvement in the scales evaluating the quality of life in patients after deep brain stimulation [10] which corresponds with the final outcome of the reported patient.

CONCLUSION

Both neuroendoscopy and stereotactic neurosurgery are parts of the complex of minimally invasive neurosurgery. In this particular case of coincidence of an expansive midline cyst and Parkinson's disease, a combined treatment approach was utilised to maximise the functional outcome of the patient avoiding another surgery with DBS implant in situ.

ACKNOWLEDGEMENTS

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كيسة الحاجز الشفاف(Septum Pellucidum Cyst) في مريض يعاني من مرض الباركنسون (Parkinson's Disease) مراحل وطرق المعالجه

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ملخص

خلفية: الغرض من هذا التقرير لهذه الحالة المرضية هو تقديم العلاج المناسب والحديث لهذا المريض الذي كان بالإضافة للمشكلات الحركية التي سببها مرض باركنسون كان يعاني من وجود كيس كبير في الحاجز الشفاف.
المواد والطريقة تمت على مرحلتين اقترح استراتيجية الجراحية من قبل فريق الاضطرابات الحركية بان تتم الجراحة على النحو التالي، يتم ثقب الكيس بواسطه التنظير الجراحي ومن ثم تزرع أقطاب كهربائية لاحقة للتحفيز الدماغي العميق الى نواة تحت المهاد اعتماد على تأثيرِ معالجةِ التنظير.
النَتائِج: بعد النجاح التقني في ثقب الكيس وتوصيله بالنظام البطيني عن طريق التنظير الجراحي تم التأكد من صغر حجم الكيس واتصاله بالنظام البطيني اثنا العملية كذلك بعد العملية تم عمل اشعه مقطعيه حيث شوهد ان الاتصال بين الكيس و النظام البطين حر ، الأعراض الحرّكية لمرض باركنسنِ بَقيت بدون تغيير، نظام التَحْفيزِ الدماغِي العميق لخلايا تحت المِهادي التي تم زُرعَها من الجانبين عملت على التحسن الوظيفي للحركة بشكل جيد كما هي موثّقة من قبل يو بي آر دي إس الدرجة الثَّالثَة في حالةِ خارجِ الدواءَ (52 نقطة ما قبل الجراحة و34 نقطة بعد 6 سَنَواتِ ما بعد الجراحةِ) و تخفيض جرعة L-DOPA الى (60 % مِنْ مستواه قَبْلَ التَحْفيزِ الدماغِ العميقِ).
الخلاصة: العلاج الجراحي بواسطه التنظير الجراحي الدماغي لثقب الكيس الموجود في الحاجز الشفافي ،والذي تلاها زرع التحفيز الدماغي العميق لتحت المهاد الثنائية - أدى إلى تحسن كبير ودائم من أعراض المريض.
الكلمات الدليلة: كيسة الحاجز الشفاف، مرض باركنسون ، المخ، التنظير الدماغي.

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Geological and Geochemical Investigation of Host Rocks of Ni-Cu in Suwar Area North Western Yemen

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ABSTRACT

The Suwar Ni-Cu sulfide host rocks are located at the northwest of Yemen, about 18 km of Hajjah city. The host rocks at Suwar are associated with the ultramafic component of differentiated gabbroid intrusive.

The results of chemical analysis of the major elements present in host rocks of Ni-Cu in Suwar area shows that, the magnesium oxide ranges from 20 to 30% , the silica oxide has an average 40% and iron oxids is also variegate between 14.4 and 18%.

Based on the comparison between the results of the studied Ni-Cu sulfides in Suwar area with that obtained from famous international host rock, it is clear that there is a possible large collection of sulfides and Suwar host rocks which belong to the group which contains magnesium oxide (MgO) ranged between 15 and 33%, associated with high percentage of nickel and low percentage of copper. It also indicates similarity to Jinchuan and Kambalda magmatic bodies in China and Australia respectively. In addition, it shows that the nickel increases in ore with the increase of MgO contents in hosted rocks. Thus, there is a possibility of increasing percentage of nickel concentration in Suwar ore while the study is in progress.

***Keywords*:** Suwar, North Western Yemen, Geochemical analysis, Nickel, Cupper Magnesium oxide and Host rock.

INTRODUCTION

Nickel and copper ores play an important role in the industry because of their multi-usage in different types of alloys. The Suwar Ni-Cu sulfide ores are hosted in ultramafic body located at the southeast of Hajjah city as shown in Fig. (1). The Suwar gabbroid body and its mineralized ultramafic zone are exposed over a length of about 6 km and a maximum width of 2,5 km (Shybani, 2003). Suwar mineralization is exposed on the surface with the chain of gossans shape, which formed in extent that expands about 3 km in the northeast side parallel to the main fault direction.

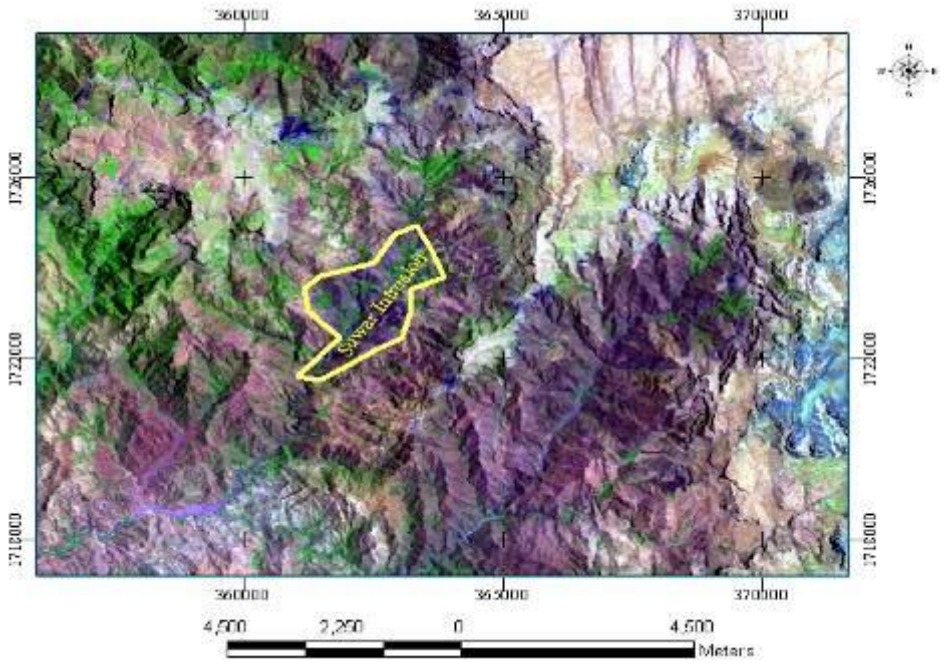


Figure (1): Location map (Landsat-7) of Suwar area

The Ni-Cu showings are located is a lower proterozoic package of mafic rocks intruding a foliated to gneissic dioritic meta-igneous complex. The showings were discovered within an ultramafic complex consisting of peridotite, pyroxenite, gabbro, diorite and minor anorthosite (Ogryzlo, 1997). The showings are easily identified by malachite staining in the mafic and ultramafic rocks. Gossan zone is prominent and is used as a guide for mineralization.

The geology and Ni-Cu sulfide mineralization of Suwar ore body have been documented and this magmatic is considered to be ultramafic related, based on the mineralogic characteristics of the host rocks.

A correlation is carried out between Suwar magmatic body in the study area and the similar Ni and Cu host rocks of famous areas all over the world for defining the geological and geochemical properties of host rock in the study area.

The host rocks of the Ni and Cu ores are subdivided into three groups according to their thickness, areal extent and the concentration of MgO and nickel-copper. Consequently, it was concluded that, the larger one of the differentiated magmatic body was, the more were the possibilities of sulfides of nickel and copper concentration.

Magmatic size bodies fit with the power quality of these bodies as Smirnov (1981) pointed out that energy sources are essential issues in ore formation theory. Magmatic formations associated with sulfides nickel and copper are changing in content from gabbro-dolerite, as Noril'sk deposits in Russia (Borodabeavskaya 1987) to gabbro-troctalite, as

Duluth deposits in United States (Ripley 1981) and to pyroxenite – peridotite –dunite, as Kambalda deposits in Australia (Naldrett, et al, 1977), Jinchuan deposits in China (Chai, et al, 1992) and Suwar deposits in Yemen (Ogryzol,1998). This change is identical to MgO content which takes the percentage from 8-15% in the former areas to 15-33% in the later areas, as mentioned above. Thus, it's observed that there is a clear relationship between mafic coefficient in magmatic rocks and elements percentage of Ni/Cu in ores.

METHODOLOGY

The methods of study include:

1- The field work was carried out and collecting four representative samples of host rocks of nickel and copper in Suwar magmatic body .
2- The laboratory work was carried out for the chemical analysis of the four samples to determine the major oxides contents as SiO2, MgO, total iron oxids etc. The chemical analysis was carried out using Perkin Elmer atomic absorption instrument. It was carried by preparing a solution from the rock powder after burning it at temperature up to 1000°C and then the burned samples were digested with nitric acid and filtrated through filter paper to produce the soultion.

Geological setting

The Suwar Ni-Cu ore occur in the area covering a part of the Proterozoic basement rocks exposed by the headwater of the local Wadi system.

The Precambrian basement of the northwestern part of Yemen is an extension of the Arabian shield to the north and is petrogenetically similar to accreted oceanic arc terrains constituting the Nabitah orogenic mobile belt (Shybani et al, 1997, Canadian, 2000). The Nabitah suture zone may extend to Hajjah in northwest Yemen, as indicated by the presence of deformed ophiolites (Canadian, 2000). The Precambrian basement rocks of northern Yemen are Late Proterozoic in age and they consist the north to northwest trending belts and composed of metavolcanic and metasedimentary rocks, intruded by granitic and granodioritic plutons

The Proterozoic rocks in this area are mostly medium to coarse grained, granitic gneisses, which are extensively faulted and intruded by diabase dykes characterized by steeply dipping northeasterly trending foliation predominates. The gabbroic body intrudes into granitic gneiss and magmatic country rocks (Fig.2 and 3). The Precambrian rocks of study area are overlapped uncomfortably by relatively thin sequences of continental to epicontinental sediments. The flat lying Paleozoic and Jurassic sediments, which cover much of the northern part of the area, including the Permian Akbara shale, which consists mainly shale and siltstone. The Jurassic sediments composed of the Kohlan sandstone and the Amran limestone.

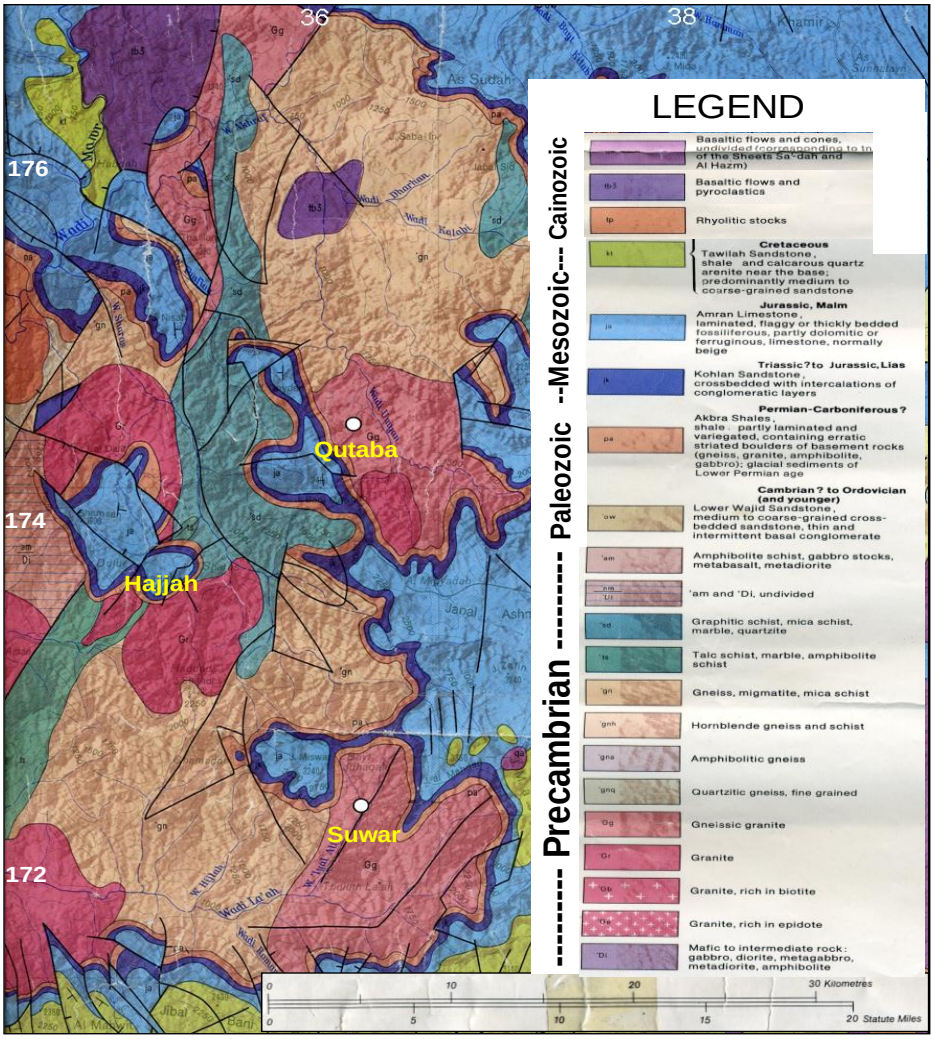


Figure (2): Geological map of the Hajjah region, showing the studied locality of Suwar, southeast of Hajjah City. The map is adapted from the geological map of Al-Hudaydah sheet, prepared by Kruck (1984).

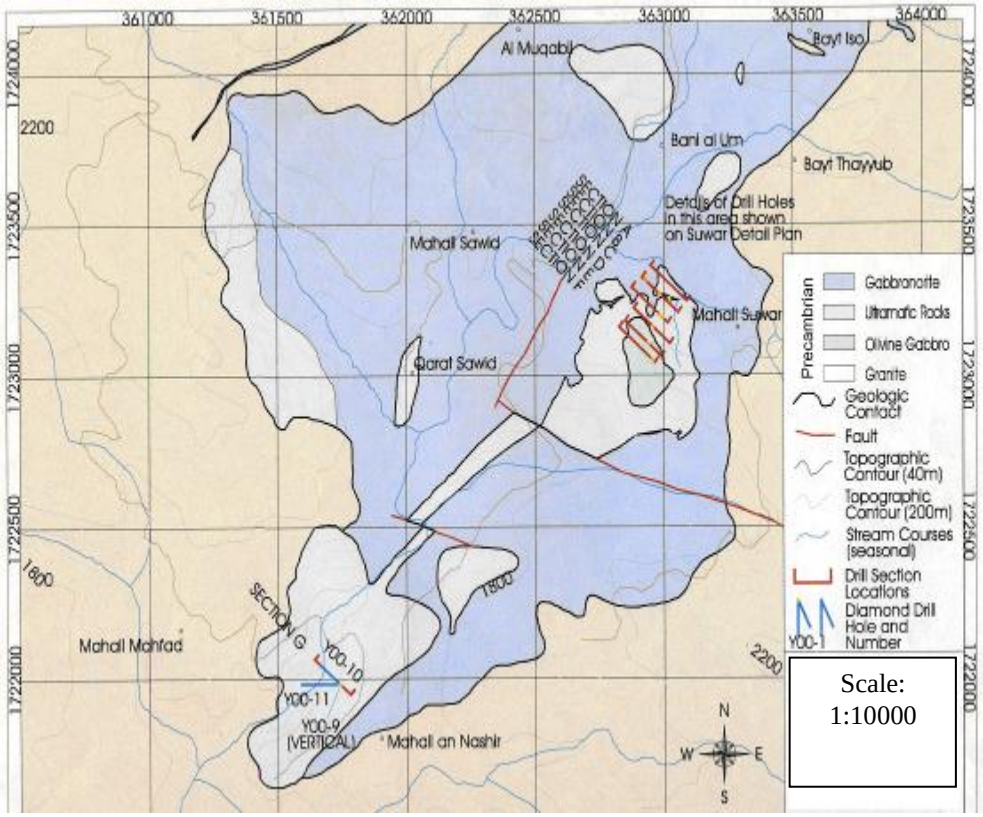


Figure (3): Preliminary geology, Suwar area showing all drill hole locations. Prepared by Canadian Mountain Minerals Yemen LTD.

Geological and Geochemical Characteristics of the Suwar Ore

Sulfide deposits of nickel and copper form a particular group for metallic ore magma. There are lots of huge host rocks in some parts of the world; so these elements in particular play an important role in the economical life. The most important areas are old shields such as Canadian shield (Naldrett, 1986), Australian shield (Ross et al, 1981) and the active platforms, which share the appearance of the magmatic trap in some districts as Noril'sk in Russia (Genkin et al, 1973) and Ensizwa in South Africa (Stump et al, 1982).

Group of magmatic rocks, which hosted nickel and copper ore deposits of variegated ages occurred in different parts of the world are characterized by some identical features like mineralogy and chemical constituent of the hosted rocks and ores. This indicates the existence of one particular type system in the formation and generation of magmatic-hosted nickel. The noticed difference may be as a result of erosion level and the variegated percentage of coming, also nickel concentrations and the productive of ore magmatic bodies. As supported by Smirnov, 1982 who pointed out the magmatic processes and their relation in formation of nickel and copper are similar in all metalugentic epoch from Archaean to Cainozoic.

Nickel and copper Sulfides originated from magma chamber where they are concentrated are mainly related to the fractionation and the gradual melting of the sulfide-bearing magma, which approach in its constituent from chondrite and pyrolite. When the mantle substance melts, it results in the different magmatic material and ore-bearing magma (Lekachev, 1973). The percentage of sulfides in the primitive mantle derived magma substance is not much and approaches less than 1%; so the sulfides concentrate in the parts which have been already influenced by primary melting and getting out the magmatic products which are free of sulfides or sulfides-poor magma (Godlevski, 1968). This means the movement of sulfides-bearing magma are preceded by getting out high of magmatic materials free or poor percentage of sulfides.

The geochemical characteristics of nickel and copper are not identical and the largest nickel percentage is present in the ultrabasic and is 35 times more than in the general percentage in clarke (Salobeb, 1990). For the copper, its largest percentage is present in the basic and intermediate rocks; so it is noticed that the nickel percentage is larger than the copper in the basic rocks (Salobeb, 1990).

For comparing and getting more geological and geochemical characteristics in the mineralization of nickel and copper in Suwar district with the similar and famous mineralization in the world, the researcher has gathered and interpreted some information about many host rocks in the world and this information included standardizations like: thickness and extent of the hosted rocks mineralization, mineralogic composition, the change in MgO concentrations in the hosted rocks and its relation to the concentration of nickel and copper. Accordingly, based on the previous parameters nickel and copper host rocks have been divided into three groups

Group I

This group is characterized by huge intrusive bodies of 1000m thickness and extends to more than 10000m. They are composed of intermediate and basic rocks, and characterized also, by very high degree of secondary changes and recomposition, and may not be involved in the process of auto-metamorphism. The present ore bodies have different forms like veins, layering, and lens. The essential minerals include variegated quantity pyrhotite, pentlandite and chalcopyrite (Makarov, 1989).

Group II

Group II host rock is smaller than the former one and has dimensions ranged from 150 to 700 m thick and length extension ranges between 500 and 8000 m. This group is characterized by complicated differentiation for the magmatic bodies which are basic and ultrabasic. The intrusive ore bodies of this group exposed to the secondary changes more than group I. Parts of this group's bodies are exposed to auto-metamorphism, such serpentinization (Makarov, 1989). Moreover, the ore body is found in different forms such as layering and lens. Mineralogically they are composed of chalcopyrite, pentlandite and pyrhotite, the relation between these minerals is that they are swaged in a large scope.

Group III

The size of the magmatic bodies of this group is less than 100m, it includes metamorphism and the differentiated magamtic bodies which composed of basic and ultrabasic rocks. Nevertheless, the rule of differentiation process in this group is not important because of the

small size of the differentiated bodies. Also the magamtic bodies in this group in particular have large product of ore. The ore body morphology is different, even in the same area, and has different shapes as layering, lens and veins. Ore mineral composition is similar to group I and II, the basic minerals show greater variation in their distribution. In some ores, Pyrite is found as a main mineral, which gets a percentage of 16% (Abdo, 1992).

In the study area Suwar gabbroid and its contained mineralized, ultramafic zone is exposed over a length about 6 Km and width of 2000 m (Shybani, 2003), (Fig.1). The ultramafic rock, exhibits extensive metasomatism, but little metamorphism, being consistent with intrusion at a late or post tectonic stage. The complex body has been subjected to at least one generation of flattening and diabase intrusion. The geological setting of the study area is confirmed as a broadly differentiated basic to ultrabasic intrusive host, this compares favorably in size and character to the several mines and host rocks which are commonly identified as "gabbroid type" as described by Ogryzlo, 1997. The immediate host lithology is usually ultramafic zones associated with a large noritic gabbroid body. Nickel deposits associated with this geological environment constitutes the major, high-grade source of world's nickel (Ross and Travis, 1981).

Accordingly, Suwar host rock belongs to the Group I in extension and thickness. And we notice also that there is a huge approximation in the size of these magmatic bodies that hosted Ni-Cu in Jinchuan intrusions in China where it is 8 km long and about 1000 m in wide (Jia,1986) and Suwar intrusions which are 6 km long and 2000 m wide (Shybani, 2003).

The geochemical characteristics of nickel and copper host rocks are highly variegated as in the following.

The highest nickel content is present in the ultrabasic rocks and is 35 times more than that in the general percentage in Clarke (Salobeb, 1990). For the copper, its highest concentration occurred in the basic and intermediate rocks; so it is noticed that the nickel concentration is higher than the copper in the basic rocks (Salobeb, 1990).

According to the concentration of MgO and its relation ln Ni/Cu. Magmatic rocks, which hosted nickel and copper, are divided into three groups (Abdo, 1992).

These groups are:

I- Mafic rocks with less than 8% MgO and associated with iron and titanium ores

II- Mesomafic rocks. (komatiite) contain MgO ranging from 8 to 33% with nickelefereous magma that characterized by continental magmatic rocks (Borodabeavskaya, 1987).

Mesomafic rocks can be divided into three classes according to the concentration of magnesium and percentage of both nickel and copper:

Class 1: Rocks have Low percentage of magnesium (MgO 8-10%), contain high grade of copper comparing to nickel (Ni: Cu=1:2-4) (Abdo,1992) like Duluth host rock in United States and Kurissk deposit in Cibirc platform (Ripley, 1981 and Borodabeavskaya, 1987).

Class 2: In which MgO content is ranged from 10 to 15% and middle grade of nickel to copper (Ni: Cu=1:1-2) like Naril'sk deposit in Russia (Genkin et. al, 1973).

Class 3: Magnesium concentration variegated between 15 and 33% which is Characterized by high grade of nickel and low grade copper (Ni: Cu=1-10:1) like Kambalda deposit in Australia, Sudbury and Mont Calm deposits in Canada, and Jinchuan deposit in China (Naldrett et al, 1977, Ross et al, 1981, Naldrett, 1989, and Chai, et al,1992).

III- Ultramafic rocks. In which MgO content rich to more than 33% and have high content of silicate, chromites and platinum (Campbell et al, 1984).

The primary sulfide mineralization at Suwar area is composed essentially of pyrhotite, pentlandite and chalcopyrite. Both magnetic (hexagonal) and non-magnetic (orthorhombic) pyrhotite appear to be present in the study area (Canadian, 2000).

The major and trace elements distribution of four rocks samples studied from Suwar host rocks are shown in Table (1)

Table (1): Major and trace elements distribution of the studied samples from Suwar area.

Sample No.	Ca O%	MgO%	SiO_2%	Fe_2O_3%	Al_2O_3%	P_2O_3%	TIO_2	MnO%	Na_2O%	K_2O	LOI	Ni %	Cu %	Ni/Cu ratio	Co%	Ag gm \ton
SR-1	5.19	20.54	45.69	14.40	9.66	0.04	0.53	0.21	1.75	0.25	1.83	0.93	0.367	31	0.044	0.49
SR-2	1.74	30.63	35.39	17.93	3.71	0.04	0.42	0.22	0.76	0.10	9.40	2.03	0.350	6.71	0.095	0.88
SR-3	3.36	24.79	38.55	14.81	7.67	0.05	0.57	0.18	1.29	0.12	8.76	1.36	0.730	21	0.384	2.17
SR-4	3.80	22.50	40.30	14.61	8.21	0.05	0.53	0.21	1.70	0.20	7.9	1.08	0.470	2.31	0.190	3.16
average	3.5	24.6	40	15.4	7.3	0.05	0.51	0.21	1.38	0.17	6.97	1.35	0.479		0.18	1.68

The results of chemical analyses of host rocks of Ni-Cu in the Suwar area indicated that concentration of MgO is variegated from 20.5 to 30.63 % with an average of 24.6 %, while the average of silica oxide concentration is 40% associated with total iron oxide ranges from 14.4 to 17.93 % with an average of 15.4% as shown in Table (1). These results indicate that Suwar host rocks belong to mesomafic rocks. So host rocks of Ni-Cu in Suwar area belong to the group which contains percentage of MgO of 15-33% and they have a high grade of Ni which is ranged between 0.93 and 2.03 % with an average of 1.35 % and low grade of Cu its concentration is variegated from 0.35 % to 0.73 % with an average value o.479% such as host rocks of Kambalda in Australia and that of Jinchuan in China (Naldrett et al, 1977, Jia, 1986).

The relationship between Ln (Ni/Cu) and percentage MgO is shown in figure (4). The huge change of values of certain relations Ni/Cu and the possibilities of changing the

statistic of distribution from the natural value. Therefore, values of natural logarithms are used in analyzing concentration of elements Ni/Cu. So the process of analyzing for relations isn't simple because the available information in the literature give us contents of elements which are often considered to be changing values such as deposit of Sudbury. It is shown in figure (4) that the values have a linear relationship with the formula: LnNi/Cu=o.143 MgO- 1.722. Using the formula, we can predict the relation of Ni/Cu from concentration of MgO in rocks. As shown in figure (4) and formula refers to increasing of nickel in ore with the increasing of percentage of MgO in rocks. The calculated Ni content of the ore shows excellent linear relation with MgO%. These are typical features of magmatic Ni deposits (Naldrett, 1989). The position of values in the figure generally confirms with linear relation for Ln Ni/Cu- MgO. The measured values of Ni content as shown in Table (1) and figure (4) show that the Suwar host rocks is identical to host rocks of Kambalda, Petchenge and Jinchuan.

The AFM ternary diagram (fig.5) of the selected samples shows that the host rocks of Ni-Cu are mesomafic to ultramafic. The total alkali-silica classification diagram (fig.6) shows that the studied host rocks of Ni-Cu of Suwar area are basaltoid.

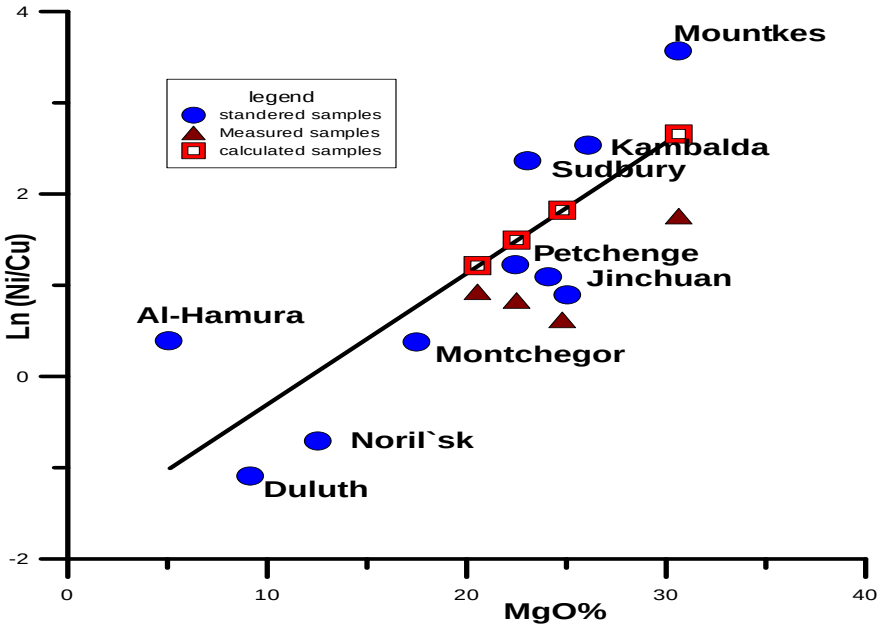


Figure (4): Relationship between MgO % and lin (Ni/Cu)

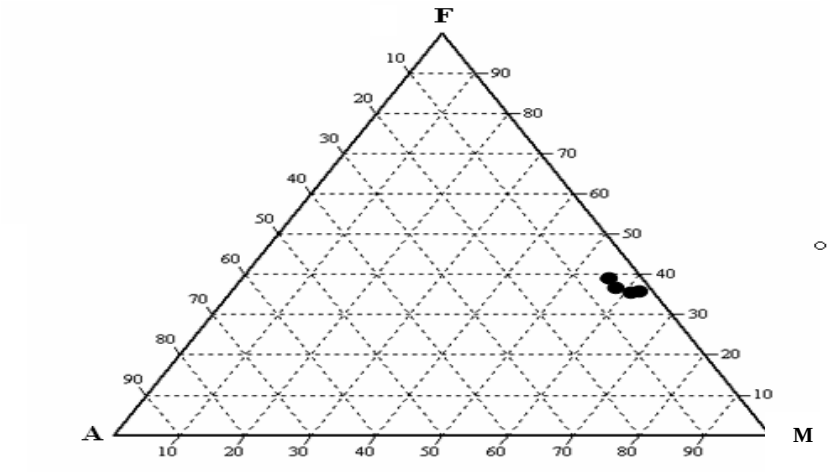
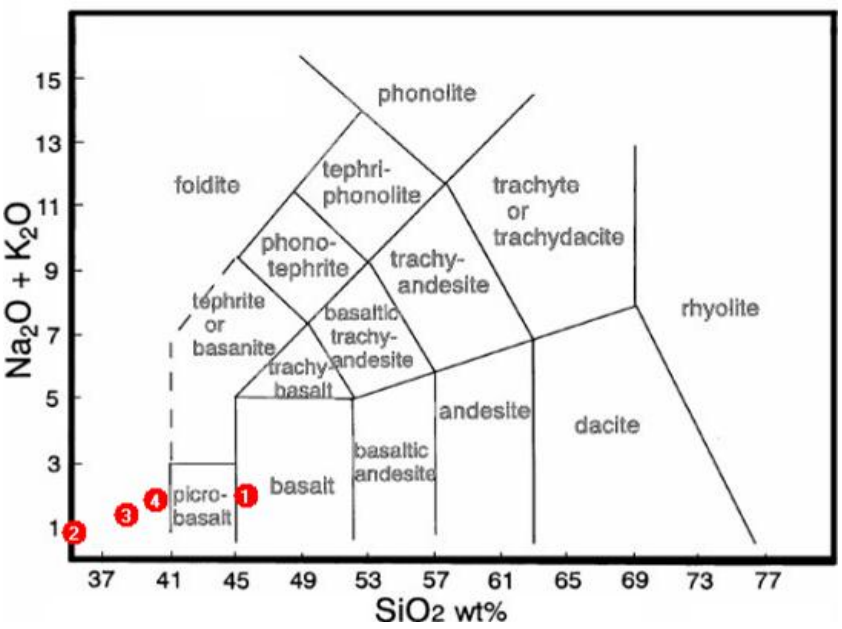


Figure (5): AFM Ternary diagram showing the composition of the host rocks of Ni-Cu from the Suwar area. A=Na_2O+K_2o F=Fe O+Fe_2O_3 and M=M gO IUGS (Le Bas et al, 1986)



Figure(6): Total alkali-silica classification diagram after IUGS (Le Bas et al.1986) showing the basaltoid composition of the host rocks of Ni-Cu.

DISCUSSION

There is a possibility of ores concentration in huge intrusive bodies in crystallization area due to the huge size of these bodies in which a temperature dramatically decreases and variegated. Thus, result in possibility of gathering and concentrating of sulfides.

Geochemical study of major and trace elements of the Suwar intrusion as previously mentioned indicates that the primary magma for the Suwar intrusion which have high MgO content variegated from 20 to 30% is a basaltic magma and that the Ni : Cu ratios in Suwar mineralization is variegated also between 1.86: 1 and 5.8 :1 which is comparable to the magma of Jinchuan complex (Chai, et al, 1992) and the magma of Kambalda complex in Western Australia (Naldrett, et. al, 1977).

The percentage of nickel content in Suwar ore, increase with the increasing of MgO percentage in hosted rocks.

The chemical analysis of hosted rocks of Ni-Cu in Suwar area show that the percent of silica variegated from 35% to 45% with an average 40% and refers to the ultramafic rocks .The percentages of magnesium, iron and calcium oxides refer to the presence of olivine and pyroxene minerals.

Platinum group elements mineralization is always associated with sulfide ores (Naldrett et al, 1989). Naldrett (1981) has indicated that sulfides associated with ultramafic komatiites, which have been crystallized from magmas containing more than 20% MgO, have a platinum group element. In addition to the basic element Ni-Cu in Suwar magma focus should be made on the associated elements like cobalt and platinum group elements and those are found in Jinchuan magmatic bodies (China) and in the host rock that include a high percentage of MgO ,and these elements are extracted during the process of basic elements extraction.

The characteristics of the nickel-copper sulfide mineralization and its host rocks at Suwar, are associated with the ultramafic component of large differentiated, noritic, gabbroid intrusive. Well documented mines and deposits of this type are the Jinchuan mine in China (Chai and Naldrett, 1992b) and Kambalda deposits in Western Australia (Naldrett, et.al, 1977).

Major characteristics of this type of deposit are:

1-Majority of the sulfides is massive pyrhotite, pentlandite and chalcopyrite.

2-The sulfides are closely associated with ultramafic sections of the Intrusive usually within the ultramafic rock.

3-It contains magnesium oxide with percentage of (20-30%).

4-The main sulfides are concentrated with the host ultramafic rocks in structural traps.

CONCLUSIONS

Through geological and geochemical study of host rocks of Ni-Cu in Suwar, we got these results:

1-The deposits of nickel and copper are similar in some features for mineral and chemical composition for ore.

2-In the huge and differentiated magmatic bodies, there is possibility of concentration ores directly in crystallization area when temperature gets down.

3-The host magmatic rocks for Ni-Cu which contains the percentage (MgO 15-33%) have a high grade of Ni and a low grade of Cu.

4-The results of chemical analysis for host rocks of Ni-Cu in Suwar area showed that they contain (MgO 20-30%) and have a high grade of Ni reached up to 2.03 gm/ton in some areas and a low grade of Cu.

5-Through the comparison of the geological and geochemical features between the similar global magmatic bodies and that of Suwar area, we found out that magma of Suwar is similar somehow to Ginchuan deposit of Ni and Cu in China and in Kambalda at Australia.

6-When we keep on studying the ore in Suwar area, it is possible to predict an increase of concentration Ni with the increasing percentage of Mg in host rocks.

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الدراسة الجيولوجية والجيوكيميائية للصخور المضيفة للنيكل والنحاس في منطقة سوار شمال غرب اليمن

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ملخص

يقع مكمن سوار لسلفيدات النيكل والنحاس شمال غرب اليمن ،على بعد 18 كم من مدينة حجة. الصخور المضيفة في سوار ترتبط بمركبات فوق قاعدية لمندسات الجابرويد المتمايزة.

نتائج التحليل الكيميائي للعناصر الأساسية في الصخور المضيفة للنيكل والنحاس في منطقة سوار أوضحت إن نسبة أكسيد المغنيسيوم تتراوح من20 إلى 0 3% وأكسيد السيليكا بمتوسط 40 % واكاسيد الحديد تتراوح بين 14.4 و 18%.

من دراسة المقارنة لسلفيدات النيكل والنحاس في منطقة سوار مع المكامن العالمية المشهورة تبين وجود إمكانية كبيرة لتجمع السلفيدات وان الصخور المضيفة في سوار تنتمي إلى المجموعة التي تحتوي على أكسيد المغنيسيوم بين 15 إلى 33% والتي تتميز بنسبة عالية للنيكل ومنخفضة للنحاس وتتشابه مع الأجسام المجمائية المتمايزة في جنشوان وكمبالده في كل من الصين واستراليا على التوالي . علاوة على ذلك تبين إن النيكل يزداد في الخام مع ازدياد أكسيد المغنيسيوم في الصخور المضيفة. لهذا توجد إمكانية لازدياد نسبة تركيز النيكل في خام سوار عند مواصلة الدراسة.

كلمات دليلة: سوار، شمال غرب اليمن، التحليل الجيوكيميائية ،النيكل، النحاس، أكسيد المغنيسيوم والصخور المضيفة.

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Synthesis and Spectroscopic Study of Some New 1,2,4-Triazino[5,6-b]indole Derivatives

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ABSTRACT

The Scheme of this work included the synthesis and characterization of new two series of 1,2,4-triazino[5,6-b] indole and 8-bromo-1,2,4-triazino[5,6-b] indole derivatives according to the starting material used. Both, derivatives of 3-thione-1,2,4-triazino[5,6-b] indole and 8-bromo-3-thione-1,2,4-triazino[5,6-b] indole (3a & 3b) were prepared by using Isatin and 5-bromo isatin as a starting material, the new schiff`s bases (5a & 5b) were synthesized by the reaction of hydrazino indole derivatives (4a & 4b) with aromatic aldehydes. Tetracyclic derivatives (7a & 7b) were prepared by the reaction of hydrazino derivatives (4a & 4b) with carbon disulfide in the presence of pyridine. Also 3-(N-phenyl thiocarbamoyl hydrazino)-1,2,4-triazino-[5,6-b] indole, and 8-bromo-3-(N phenyl thiocarbamoyl hydrazino)-1,2,4-triazino-[5,6-b] indole (6a & 6b) were prepared by the reaction of the compound (4a & 4b) with phenyl thio isocyanate in the presence of DMF. Finally, new Mannich bases (9a & 9b) were prepared by the reaction of the new acetylenic indole derivatives (8a & 8b) with paraformaldehyde and secondary amine in the presence of coprous chloride as catalyst.

These compounds were identified by their melting points and spectral data (IR & UV), and elemental analysis (C,H,N) and thin layer chromatography (TLC) were used.

Keywords: Isatin, 5-bromo isatin, synthesis, derivatives & characterization.

INTRODUCTION

Indole derivatives are widely present in the unit of biologically active nature of products, and are very important heterocycles in the structure of many medicines [1]. The indole ring system is one of the most important heterocyclic ring generated by the fusion of a benzene ring to the 2,3-positions of a pyrrole. Therefore, the chemistry of indole ring is dominated

by its very easy electrophilic substitution, the heterocyclic ring is very electron rich, by comparison with a benzene ring, so the attack by the
electrophiles always takes place in the pyrrole ring; the β-position is preferred to yield β-indole derivatives [2].

Also, indoles underwent the Mannich reaction and Vilsmeier-Haack reaction to produce 3-(dimethyl amino methyl) indole (gramine) which is the natural component of wheat and indole-3-carboaldehyde, respectively [2]. The most widely used synthesis of indole derivatives is Fischer synthesis or Bischler`s synthesis [2,3].
Isatine (2,3-indolindione) is a very useful derivative for the synthesis of indoles and other heterocycles; it readily undergoes aromatic substitution reactions at C-5 and ketonic reactions at C-3 carbonyl group [4]. Recently, there has been a great deal of interest in the synthesis of derivatives possessing various functional groups. This research is concerned with the development of synthetic methods of indole derivatives by different routes. These derivatives were characterized by spectroscopic method (IR, UV), and their elemental analysis (C,H,N) and TLC.

EXPERIMENTAL

Instrument and Chemical

Melting points were determined on an electrothermal melting point apparatus. IR spectra were recorded using KBr disc on a pye-Unicam Sp3-1000 spectrophotometer. The UV-visible absorption were determined in ethanol 95% using Hitachi U 2000 spectrophotometer. Elemental analysis (C,H,N) were performed on an elemental analysis system. Thin layer chromatography (TLC) was carried out using Fertigfollen precoated sheets type polygram SilG and the plates were developed with iodine vapour.
Preparation of compound (5-bromoindoline-2,3-dione) (1b)

To a solution of p-bromoaniline, (17.3 g, .01 mol) in concentrated hydrochloric acid with water (55 : 60) were added to a mixture of chloral hydrate (18.19 g, 0.11 mol) and aqueous solution of sodium sulfate (250 g). Then aqueous solution of hydroxyl amine hydrochloride (22 g, 0.33 mol) in water (100 ml) was added. The resulting mixture was refluxed for half hour. The yellow precipitate was formed on cooling, 4-bromo isonitroso acetainilide was collected and recrystallized from chloroform m.p. 142 °C (ref. 143°C) [17a].

The addition of 4-bromoisonitroso acetanilide (12.2 g, 0.05 mol) to concentrated hydrochloric acid portion twice, the mixture was heated at 30-40 °C for half an hour with stirring. Then it was heated at 80 °C for 15 min. the resulting mixture was poured in a beaker containing ice-water (about 10 times the volume of solution). The orange precipitate was formed, filtered off and recrystallized from glacial acetic acid m.p. 196 °C (ref. 198 °C) [17b].

Preparation of compound 2H-[1,2,4]triazino[5,6-b]indole-3(5H)-thione) & (8-bromo-2H-[1,2,4]triazino[5,6-b]indole-3(5H)-thione) (3a,b) [18]

A mixture of compound (1a or 1b) (7.3 g or 11.3 g, 0.05 mol), thiosemicarbazide (5 g, 0.005 mol) and solution of potassium carbonate (10.2 g, 0.075mol) in water (200 ml) was refluxed for 7-12 hrs. After cooling, the salt was filtered off; the filtrate was acidified with

glacial acetic acid. Finally, the product (3a or 3b) was collected and recrystalized from ethanol. See Physical properties (Table 1) and spectral data (Table 3).

Preparation of compound 3-hydrazinyl-5H-[1,2,4]triazino[5,6-b]indole & (8-bromo-3-hydrazinyl-5H-[1,2,4]triazino[5,6-b]indole) (4a,b) [19]

A solution of compound (3a or b) (4.04 g or 5.62 g, 0.02 mol) and hydrazine hydrate (20-30 ml) was refluxed (on water bath) for 5-8 hrs. After cooling, the hydrazide derivative (4a or 4b precipitated, filtered off, washed with ethanol, dried and recrystallized from DMF. See physical properties (Table 1).

Preparation of compound 5H-[1,2,4]triazino[5,6-b]indol-3-yl)hydrazinyl)methyl) derivatives & ((2-(8-bromo-5H-[1,2,4]triazino[5,6-b]indol-3-yl)hydrazinyl)methyl) derivatives (5a,b)

To the hydrazide derivatives (4a or 4b) (0.2 g, 0.001 mol), a solution of an appropriate aldehyde (0.001 mol) in DMF (15 ml) was added. The resulting mixture was refluxed as shown the refluxed time (Table 1). After cooling the precipitate 5a,b (Schiff`s bases) was filtered off and recrystalized from appropriate solvent (Table 1).

Preparation of compound 3(-5H-[1,2,4]triazino[5,6-b]indol-3-yl)-N-phenyltriazino-1-carbothioamide & (3-(8-bromo-5H-[1,2,4]triazino[5,6-b]indol-3-yl)-N-phenyltriazino-1-carbothioamide) (6a,b) [20]

A mixture of compound (4a or b) (0.0025 mol) and phenyl isothiocyanate (0.0025 mol) in DMF (15 ml), was refluxed (Table 1 as shown the refluxing time). After cooling, the precipitate was filtered off and recrystalized from appropriate solvent (Table 1). Preparation of compound 2,3-dihydro-1-thioxo-1,2,4-triazolo[3,4-c]-1,2,4-triazino[5,6-b] indole & 8-bromo2,3-dihydro-1-thioxo-1,2,4-triazolo[3,4-c]-1,2,4-triazino[5,6-b] indole (7a,b)

To the solution of hydrazide compound (4a or b) (2.02 g or 2.819g, 0.01 mol) in dry pyridine (30 ml), carbon disulfide (5 ml) was added. The resulting mixture was refluxed for the time mentioned in (Table 1). After cooling, the benzene (30 ml) was added with several drops of hydrochloric acid and diluted with water (30 ml), filtered off, dried and recrystalized from appropriate solvent (Table 1)

Preparation of compound 3-(prop-2-ynylthio)-5H-[1,2,4]triazino[5,6-b]indole) & (8-bromo-3-(prop-2-ynylthio)-5H-[1,2,4]triazino[5,6-b]indole) (8a,b)

A solution of compound (3a or b) (2.02 g, 0r 2.81 g) (0.01 mole) and triethyl amine (1.1 g, 0.01 mol) was heated gently; then propargyl bromide (1.2 g, 0.01 mol) was added. The mixture was heated under reflux for the time mentioned in (Table 1). After cooling and diluting with water, the solid was filtered off, dried and recrystalized from appropriate solvent (Table 1).

Preparation of compound 8-bromo-3-(but-2-ynylthio)-5H-[1,2,4]triazino[5,6-b]indole amine derivatives) (9a,b) (Mannich Bases).

A solution of compound (8a or b) (0.0026 mol) and paraformaldehyde (0.0026 mol) in dioxane (15 ml) was heated gently, then cuprous chloride (0.5 g) and secondary amine (0.0026 mol) were added. The resulting mixture was refluxed with stirring (on water bath) for the time mentioned in (Table 1). After cooling, the salt was filtered off. The filtrate was

diluted with ice water (25 ml). The precipitate was filtered off and recrystalized (Table 1 physical properties).

RESULTS AND DISCUSSION

The indole derivatives have a wide spread interest due to their key role in medically important species such as those displaying antiestrogen [5], analygcsic [6], antimicrobial [7], antiallergy, neuroleptic [8], and in cancer chemotherapy [9].

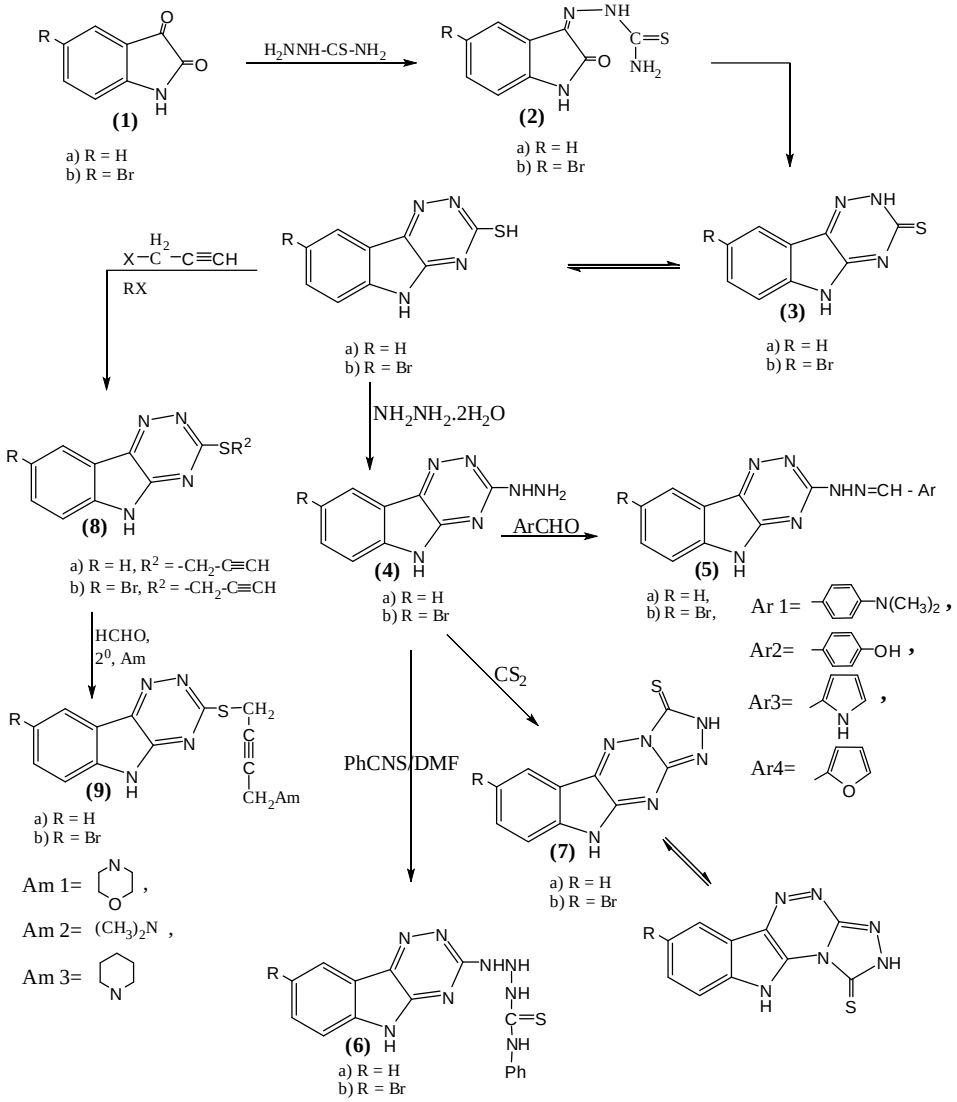
The synthesis and reaction of indoles have been a topic of research interests for over a century because a number of their derivatives occur in nature and the possess a variety of important biological activities [10]. Bromo indole alkaloids have been isolated as secondary metabolites of marine organism, which are promising sources of new biological active molecules [11], moreover, a bromo groups is a useful functional groups. In this paper, we have reported the synthesis of two series of 1,2,4-triazino[5,6-b] indole derivatives. Due to the importance of these compounds in organic chemistry research, the isatine (1a) and 5-bromo isatin (1b) were used as starting materials to prepare the two series of the derivatives. The reaction of (1a and 1b) with thiosemicarbazide in alkaline medium in the presence of potassium carbonate to give the corresponding thiosemicarbazone (2a and 2b) as a result of nucleophilic attack to the amino group of thiosemicarbazide to the β-carbonyl group in the (1a or 1b), followed, as it will undergo the internal cyclization in alkaline medium to give the corresponding 3-thione 1,2,4-triazino [5,6-b] indole derivatives (3a, 3b), which were in a tautomerism forms for thiol group (-SH to C=S), were isolated as yellow crystals as illustrated in scheme I; their structures were confirmed by physical properties (Table 1) and IR spectra (Table 3) showed the presence of C=N stretching absorption band at (1600 – 1630 cm^{-1}), S-H stretching absorption band at (2550 – 2600 cm^{-1}), C=S stretching absorption at (1050 – 1250 cm^{-1}) and disappearance of stretching absorption band of carbonyl group C=O at (1720 cm^{-1}), stretching band C-Br (600-750 cm^{-1}). Their UV spectrum showed λmax 371.5 nm (C=N, SH) (n $\rightarrow \pi^*$) and λmax 247.5 nm ($\pi \rightarrow \pi^*$) for aromatic ring [12].

Reaction of compounds (3a,b) with hydrazine hydrate in ethanolic solution, due to the high reactivity of the amino group towards nucleophilic attack to thiol group, is normally to obtain hydrazino derivatives (4a & 4b) [13].Their structure was identified by physical properties (table 1), and IR spectra showed stretching absorption band (3200-3400 cm^{-1}) for NH2 & NH and disappearance of stretching absorption band of SH.

Treatment of compound (4a & 4b) with equimolar of selected aldehydes aromatic or heterocyclic (p-dimethylamino benzaldehyde, p-hydroxy benzaldehyde, α-pyrrol carboxyaldehyde and α-furfural) afforded the corresponding Schiff`s basses (5a & 5b) and their structures were confirmed by their physical properties (table 1), spectral data (table 3) & elemental analysis (C,H,N) (Table 2). TLC in mixture of hexane-ethylacetate in ratio (3:1) shows that the reaction occurred.

The importance of synthesizing hydrazine and triazole derivatives due to their potential biological activity [14], reaction of compounds (4a & 4b) with carbon disulfide in alkaline medium caused cyclization by internucleophilic attack to give the corresponding triazole derivatives (7a & 7b), either cyclization occur at N2 or N4. However, the cyclization at N4 was preferred because it is planar (planarity) the aromatic system of indole (10 πe). The products were confirmed by physical properties (Table 1), elemental analysis (Table 2). IR

spectra showed a stretching absorption band at (1250 cm^{-1} C=S) but the absorption band of (NH_2) disappeared; and UV spectra (Table 3) and TLC also showed that the reaction occurred.



Scheme (1)

In an extension of the results, we have studied further improvement of the reactions. In this paper, we report that the reaction of hydrazino derivatives (4a & 4b) with phenyl thiocyanate in DMF as solvent by nucleophilic attack to give the corresponding compound

(6a & 6b). Their structures were confirmed by elemental analysis (C,H,N) (Table 2) spectral data (Table 3).

Due to the importance of synthesizing new acetylenic derivatives arising from their potential biological activity [15], as well as their industrial and medical applications, there are many acetylenic derivatives which are found in the composition of plants. They do have medical effects since they are easily absorbed by the body and have minimal toxic effects. On refluxing compounds (3a & 3b) with propargyl bromide in the presence of trimethyl amine, the compounds (8a & 8b) were produced. The structures which were identified by physical properties (Table -1-), spectra data (table -3-) showed the presence of $\equiv C-H$ stretching absorption band at (3200 cm^{-1}) and $-C\equiv C-$ stretching absorption at (2100 cm^{-1}) and disappearance of the stretching band of (2250-2600 cm^{-1}) due to the SH, elemental analysis (Table -2-) and TLC (mixture) hexane: ethyl acetate (3:1) showed the Rf values for starting material and product.

Consequently, the compounds (8a & 8b) which were heated under reflux with paraformaldehyde and different secondary amines (dimethyl amine, morphine, piperidine) in the presence of coprous chloride CuCl as catalyst to increase the nucleophilicity of acetylenic carbon atom in the presence of dioxane were used as solvent to give the corresponding Mannich base (9a & 9b) [16]. The structures were confirmed by physical properties (Table -1-) spectra data (Table -3-) showing the presence of CH2 stretching absorption band at (2850-2900 cm^{-1}) (C-N aliphatic) (1020-1255 cm^{-1}) and absence of the stretching band at (3200 cm^{-1}) due to $\equiv C-H$. See Elemental analysis (Table -2-) and TLC (hexane & ethyl acetate).

Table (1): Characterization data of prepared compounds

Com. No.	Yield % (m.p.0C)	Formula	Color	Crystallization solvent	Refl. Time
5a,Ar1	30% 303-305)	C18H17N7	Deep yellow	DMF/water	3 hrs
5a,Ar2	33% (308-310)	C16H12N6O	Green-yellowish	DMF/water	3 hrs
5a,Ar3	36% (280-282)	C14H11N7	Pale yellow	DMF/water	3 hrs
5a,Ar4	36% (293-295)	C14H10N6O	Green-Yellowish	DMF/water	3 hrs
5b,Ar1	34% (240-243)	C18H16N7Br	Deep Red	DMF/Water	5 hrs
5b,Ar2	36% (270-272)	C16H11N6OBr	Orange	DMF/Water	5 hrs
5b,Ar3	39% (250-252)	C14H10N7Br	Red	DMF/Water	5 hrs
5b,Ar4	39% (249-250)	C14H9N6OBr	Pale green	DMF/water	5 hrs
6a	36% (240-243)	C16H13N7S	Gray	DMF/Water	2 hrs
6b	41% (250-252)	C16H12N7SBr	Brown	Ethanol/Water	5 hrs
7a	44% (>300)	C10H5N6S	Deep red	DMF/Water	5 hrs
7b	43% (229-230)	C10H4N6SBr	Orange	DMF/Water	10 hrs

8a	79% (110-112)	C12H8N4S	Pale yellow	Ethanol	3-4 hrs
8b	66% (143-145)	C12H7N4SBr	Brown	DMF	6-7 hrs
9a,Am1	57% (90-92)	C17H17N5SO	Black	Ethanol	3 hrs
9a,Am2	43% (70-72)	C15H16N5S	Black	Ethanol	3 hrs
9a,Am3	40% (85-86)	C18H20N5S	Brown	Ethanol	3 hrs
9b,Am1	60% (198-200)	C17H16N5SOBr	Brown	Ethanol	5 hrs
9b,Am2	45% (78-80)	C15H15N5SBr	Brown	Ethanol	5 hrs
9b,Am3	40% (158-160)	C18H19N5SBr	Brown	Ethanol	5 hrs

Table (2): Elemental analysis of prepared compounds

Comp. No.	Elemental analysis C,H,N calculated (C,H,Nfound)		
	C	H	N
5a,Ar1	65.45 (65.15)	4.84 (4.28)	29.09 (29.15)
5b,Ar1	49.87 (49.57)	3.89 (3.59)	25.45 (25.09)
6a	57.31 (57.08)	3.88 (3.49)	29.25 (29.12)
6b	46.37 (46.20)	2.89 (2.60)	23.67 (23.27)
7a	49.79 (49.83)	2.07 (2.12)	34.8 (34.41)
7b	37.5 (37.0)	1.25 (1.05)	26.25 (26.15)
8a	60.0 (59.52)	3.33 (3.12)	23.3 (23.0)
8b	45.14 (45.14)	2.19 (2.09)	17.55 (17.05)
9aAm1	60.17 (60.40)	5.01 (5.22)	20.60 (20.16)
9aAm3	64.09 (64.15)	5.63 (5.50)	20.77 (20.52)
9bAm1	48.80 (48.35)	3.80 (3.50)	16.74 (16.34)
9bAm3	51.92 (51.72)	4.32 (4.12)	16.81 (16.51)

Table (3): The spectra data of the prepared compounds (IR & UV)

Comp. No.	IR spectra*							UV. Visible**
	ν =C-H	ν CH3	ν C=N arom.	ν -C-N	ν C=C arom.	=C-H out of plane	Others	λ max (nm) (ε max)
3a	3000-3100	-	1600-1630	-	1400-1600	690-950	C=S (1050-1250), SH (2550-2600), N=N (1450), NH (3200)	247.5 (632), 371.5 (1627)
3b	3000-3100	-	1630	-	1400-1600	690-950	C=S (1050-1250), N=N (1450), C-Br (600-700), SH (2550-2600)	244 (1533), 298.0 (1505), 372 (1297)
4a	3100	-	1630	-	1400-1470	-	NHNH2 (3200-3400)	322 (1449), 401 (2418)
4b	3080	-	1630	-	1400-1460	-	NHNH2 (3200)	344 (1364), 454 (2977)
5a1	3100	2900-2840	1630	1070-1030	1490-1450	755	NH (3200-3400)	231 (1184), 252 (1322), 300 (1457)
5a2	3070	-	1630	1070-1020	1490, 1400	830	NH (3400-3200) & OH (3600)	250 (1390), 298 (1430), 372 (661), 382 (659)
5a3	3060	-	1630	1050 1020	1490, 1450	840	NH (3200-3400)	250 (1165), 307 (1197), 372 (621)
5a4	3080	-	1600	1120, 1060	1590, 1500	870	NH (3400-3200)	248.5 (1554), 300 (1563), 373 (1588), 384 (1667)
5b1	3080-3040	2940 2830	1630	1260, 1060	1470, 1400	840	NH (3200), OH (3600), C-Br (600-750)	244 (1238), 307 (1427)
5b2	3100	-	1630	1070 1030	1600, 1460	750	NH (3200), OH (3600), C-Br (600-750)	234 (1066), 257 (1146), 301 (1480)
5b3	3100	-	1600	1520 1080	1500, 1450, 1400	700	NH (3200), C-Br (600-750)	205 (103), 231 (654), 303 (1394)
5b4	3080	-	1600	1100, 1030	1480, 1400	680	NH (3200), C-Br (600-750)	245 (1129), 295 (1373), 372 (716)
6a	3100	-	1620	1070, 1030	1490, 1450	755	C=S (1250), NH (3400-3200)	254 (541), 316 (883), 414 (199.8)
6b	3100	-	1630	1060-1020	1490-1440	740	C=S (1250), NH (3200), C-Br (600-700)	246 (1372), 300(1521), 312 (1508), 372 (1379)
7a	3100	-	1630	1080, 1030	1500, 1460, 1400	750	C=S (1250), NH (3200)	246 (1562), 301 (1552), 372 (1018), 467 (710)
7b	3080	-	1630	1020-1250	1600, 1400	760	C=S (1250)	264 (354), 306 (751)
8a	3000-3100	2900-2960	1630-1600	1070-1030	1640-1600	755	$-C\equiv CH$ (2100), NH (3200), CHbend (3200)	244 (1562), 300 (1519), 372 (1582)
8b	3070	2900-2840	1630	1060-1020	1490-1400	830	CHbend (3200), $-C\equiv CH$ (2100), C-Br (760)	244 (1463), 295 (1580), 303 (1575), 372 (1359)

9a1	3100-3040	2960-2800	1630	1240, 1070	1586-1450	830	C-O-C (1100), NH (3300)	208 (370), 244 (1464), 301 (1595), 389 (2311)
9a2	3090	2960-2800	1630	1170, 1080	1480, 1400	840	NH (3300)	
9a3	3080	2950, 2910 2840	1600	1240	1490, 1450, 1400	750-850	NH (3300)	244 (1450), 307 (1575), 319 (1544), 396 (2404)
9b1	3100	2900, 2800	1600	1210-1080	1480, 1400	770	C-O-C (1100-1120), NH (3300)	
9b2	3080	2820, 2700	1600	1100-1030	1480 1400	680	NH (3300)	
9b3	3100	2980 2940 2840	1630	1250, 1080	1500 1450	770	NH (3300)	208 (172), 242 (1315), 296 (1295).

* KBr disc, **conc. 10-3, solvent ethanol 95%.

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تحضير ودراسة طيفية لمشتقات جديدة من 4,2,1-ترايزينو[6,5-بي] اندول

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ملخص

يتضمن هذا البحث تحضير و والتعرف على سلسلتين جديتين من 4,2,1-ترايازينو[6,5-بي] اندول و 8-بروميد-4,2,1-ترايزينو[6,5-بي] اندول ومشتقاتها وفقا للمادة المتفاعلة المستعملة. تم تحضير كل من مشتق 3-ثيون-4,2,1-ترايزينو[6,5-بي] اندول و 8-بروميد-3-ثيون-4,2,1-ترايزينو[6,5-بي] اندول (a3 & b3) من الايساتين و 5-بروميد ايساتين. كما تم تحضير قواعد شيف (5b&5a) بتفاعل مشتقات هيدرازينو اندول (4b&4a) مع الالدهيدات الاروماتية. كذلك تم تحضير المشتقات رباعية الحلقة (7b&7a) بتفاعل مشتقات هيدرازينو اندول (4b&4a) مع ثاني كبريتيد الكربون في وجود البريدين. كما حضر 3-(ن-فينيل ثيوكارباموبل هيدرازينو) -4,2,1- ترايزينو[6,5-بي] اندول و8-بروميد-3-(ن-فينيل ثيوكارباموبل هيدرازينو) -4,2,1- ترايزينو[6,5-بي] اندول (6b&6a) من تفاعل المركبات (4b&4a) مع فينيل ايزوثيوسيانات في وجود ثنائي ميثيل فورمامايد (DMF). وفي الاخير تم تحضير قواعد مانيش (9b&9a) من تفاعل المشتقات الجديدة للاندول الاسيتيلينية مع بارافورمالدهيد وامين ثانوي في وجود كلوريد النحاسوز كحفاز. تم التعرف على هذه المركبات عن طريق قياس نقط الانصهار، واطياف الاشعة تحت الحمراء وفوق البنفسجية، والتحليل العنصري للكربون والهيدروجين والنيتروجين، كما تم استعمال طرق الفصل الكروماتوجرافي (TLC).

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Maximal Subgroups of the Group PSL(11, 2)

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ABSTRACT

In this note, we will determine, up to the conjugacy, all the maximal subgroups of PSL(11, 2) by Aschbacher's theorem.

1. INTRODUCTION

The purpose of this paper is to prove the following main theorem:

Theorem (1.1): Let G = PSL(11, 2). If H is a maximal subgroup of G, then H isomorphic to one of the following subgroups:

1. A group $G_{(p)}$ or $G_{(9\text{-}\pi)}$, stabilizing a point or its dual, the stabilizer of a hyperplane. These are isomorphic to a group of form 2^{10}**.** SL(10, 2).
2. A group $G_{(l)}$ or $G_{(8\text{-}\pi)}$, stabilizing a line or its dual, the stabilizer of a 8-space. These are isomorphic to a group of form 2^{18}**.** (SL(2, 2) × SL(9, 2)).
3. A group $G_{(2\text{-}\pi)}$, or $G_{(7\text{-}\pi)}$, stabilizing a plane or its dual, the stabilizer of a 7-space. These are isomorphic to a group of form 2^{24}**.** (SL(3, 2) × SL(8, 2)).
4. A group $G_{(3\text{-}\pi)}$, or $G_{(6\text{-}\pi)}$, stabilizing a 3-space or its dual, the stabilizer of a 6-space. These are isomorphic to a group of form 2^{28}**.** (SL(4, 2) × SL(7, 2)).
5. A group $G_{(4\text{-}\pi)}$, or $G_{(5\text{-}\pi)}$, stabilizing a 4-space or its dual, the stabilizer of a 5-space. These are isomorphic to a group of form 2^{30}**.** (SL(5, 2) × SL(6, 2)).
6. A Singer cycle subgroup H = ΓL(1, 2^{11}).
7. PΓL(2, 23).
8. Mathieu group M_{24}.

Through this paper, ΓL(n, q) denote the group of all non-singular semi-linear transformation of a vector space $V_n(q)$ of dimension n over a field F_q with q is a prime power. *The general linear group* GL(n, q), consisting of the set of all invertible n×n matrices. In fact, GL(n, q) is a subgroup of ΓL(n, q) consisting of all non-singular linear transformations of $V_n(q)$. *The centre* Z of GL(n, q) is the set of all non-singular scalar matrices. The factor group

GL(n, q) / Z called *The projective general linear group* which is denoted by PGL(n, q). GL(n, q) has a normal subgroup SL(n, q), consisting of all matrices of determinant 1 called *the special linear group*. *The projective special linear group* PSL(n, q) is the quotient group SL(n, q) /(Z ∩ SL(n, q)). PSL(n, q) is simple, except for PSL(2, 2) and PSL(2, 3).

PG(n-1, q) will denote *the projective space* of dimension n-1 associated with $V_n(q)$. One, two and three- dimensional subspaces of $V_n(q)$ will be called *points*, *lines* and *planes* respectively. An (n-1)-dimensional subspace shall be called *a hyperplane*. An element $T \in GL(n, q)$ is called *a transvection* if T satisfies rank $(T - I_n) = 1$ and $(T - I_n)^2 = 0$.

A split extension (*a semidirect product*) A**:**B is a group G with a normal subgroup A and a subgroup B such that G = AB and A∩B = 1. *A non-split extension* A**.**B is a group G with a normal subgroup A and $G/A \cong B$, but with no subgroup B satisfying G = AB and A∩B = 1. A group G = A ∘ B is *a central product* of its subgroups A and B if G = AB and [A, B], the commutator of A and B = {1}, in this case A and B are normal subgroups of G and $A \cap B \leq Z(G)$. If A∩B = {1}, then A ∘ B = AB.

G = PSL (11, 2) is a simple group of order 76810543211826567053463158689628160 0, thus $|G| = 2^{55}.3^6.5^2.7^3.11.17.23.31^2.73.89.127$ acting as a doubly transitive permutation group on the points of the projective space PG(10, 2).

2. ASCHBACHER'S THEOREM

In this section, we will give some definitions before starting a brief description of Aschbacher's theorem (2).

Definition (2.1) :

Let V be a vector space of dimensional n over a finite field q, a subgroup H of GL(n, q) is called *reducible* if it stabilizes a proper nontrivial subspace of V. If H is not reducible, then it is called *irreducible*. If H is irreducible for all field extensition F of F_q, then H is *absolutely irreducible*. An irreducible subgroup H of GL(n, q) is called *imprimitive* if there are subspaces $V_1, V_2, \ldots, V_k$, $k \geq 2$, of V such that $V = V_1 \oplus \ldots \oplus V_k$ and H permutes the elements of the set $\{ V_1, V_2, \ldots, V_k\}$ among themselves. When H is not imprimitive then it is called *primitive*.

Definition (2.2):

A group $G \leq GL(n, q)$ is a *superfield group* of degree s if for some s divides n with $s > 1$, the group G may be embedded in $\Gamma L(n/s, q^s)$.

Definition (2.3) :

If the group $G \leq Gl(n, q)$ preserves a decomposition $V = V_1 \otimes V_2$ with $\dim(V_1) \neq \dim(V_2)$ then G is a *tensor product group.*

Suppose that $n = r^m$ for $m > 1$. If $G \leq Gl(n, q)$ preserves a decomposition $V = V_1 \otimes \ldots \otimes V_m$ with $\dim(V_i) = r$ for $1 \leq i \leq m$, then G is *tensor induced* group.

Definition (2.4):
A group $G \leq Gl(n, q)$ is *subfield group* if there exists a subfield $F_{q_o} \subset F_q$ such that G can be embedded in $GL(n, q_o)$ **.** Z.
Definition (2.5):
A p-group G is called *special* if $Z(G)= G'$ and is called *extraspecial* if also $|Z(G)| = p$.

Definition (2.6) :
Let Z denote the group of scalar matrices of G. Then G is *almost simple modulo scalars* if there is a non-abelian simple group T such that $T \leq G/Z \leq Aut(T)$, the automorphism group of T.

A classification of the maximal subgroups of GL(n, q) by Aschbacher's theorem (2), which may be briefly summarized as follows:

Result (2.7) (Aschbacher's theorem):- (2).
Let H be a subgroup of GL(n, q), $q = p^e$ with the center Z and let V be the underlying n-dimensional vector space over a field q. If H is a maximal subgroup of GL(n, q), then one of the following holds:

C_1:- H is a reducible group.
C_2:- H is an imprimitive group.
C_3:- H is a superfield group.
C_4:- H is a tensor product group.
C_5:- H is a subfield group.
C_6:- H normalizes an irreducible extraspecial or symplectic-type group.
C_7:- H is a tensor induced group.
C_8:- H normalizes a classical group in its natural representation.
C_9:- H is absolutely irreducible and $H /(H \cap Z)$is almost simple.

To prove theorem (1.1) by using Aschbacher's theorem (Result (2.7)), first, we will determine the maximal subgroups in the classes $C_1 – C_8$ of Aschbacher's theorem (Result (2.7)):

3. CLASSES C_1–C_8 OF ASCHBACHER'S THEOREM (RESULT (2.7))

3.1 The subgroups of C_1:

Let H be a reducible subgroup of G and W an invariant subspace of H. If we let d = dim (W), then$1 \leq d \leq 11$. Let $G_d = G_{(W)}$ denote the subgroup of G containing all elements fixing Was a whole and $H \subseteq G_{(W)}$. with a suitable choice of a basis, $G_{(W)}$ consists of all matrices of the form $\begin{pmatrix} A & B \\ 0 & C \end{pmatrix}$ where A and C are d × d and (11-d) ×(11-d) non-singular matrices of determinant 1, where B is an arbitrary d×(11-d) matrix. G_d is isomorphic to a group of the form $2^{d(11-d)}$ (SL(d, 2)) × (SL(11-d, 2)).

which give us the following reducible maximal subgroups of G:

1. A group $G_{(p)}$ or $G_{(9-\pi)}$, stabilizing a point or its dual, the stabilizer of a hyperplane. These are isomorphic to a group of form 2^{10}**.** SL(10, 2).

2. A group $G_{(l)}$ or $G_{(8\text{-}\pi)}$, stabilizing a line or its dual, the stabilizer of a 8-space. These are isomorphic to a group of form 2^{18}**.** (SL(2, 2) × SL(9, 2)).
3. A group $G_{(2\text{-}\pi)}$, or $G_{(7\text{-}\pi)}$, stabilizing a plane or its dual, the stabilizer of a 7-space. These are isomorphic to a group of form 2^{24}**.** (SL(3, 2) × SL(8, 2)).
4. A group $G_{(3\text{-}\pi)}$, or $G_{(6\text{-}\pi)}$, stabilizing a 3-space or its dual, the stabilizer of a 6-space. These are isomorphic to a group of form 2^{28}**.** (SL(4, 2) × SL(7, 2)).
5. A group $G_{(4\text{-}\pi)}$, or $G_{(5\text{-}\pi)}$, stabilizing a 4-space or its dual, the stabilizer of a 5-space. These are isomorphic to a group of form 2^{30}**.** (SL(5, 2) × SL(6, 2)).

Which prove the points (1), (2), (3), (4) and (5) of the main theorem (1.1).

3.2 The maximal subgroups of C_2:

If H is imprimitive, then H preserves a decomposition of V as a direct sum $V = V_1 \oplus \ldots \oplus V_t$, t >1, into subspaces of V, each of dimension m = n/t, which are permuted transitively by H, thus C_2 are isomorphic to GL(m, q)**:**S_t.

Consequently, there are no C_2 groups in PSL(11, 2) since 11 is a prime number.

Note: if q > 2, then there exist an imprimitive group $G_{(\Delta)}$ of order n! $(q-1)^{n-1}$ preserving a n-simplex points of PG(n-1, q) with coordinates in F_q and $G_{(\Delta)}$ interchanges them. Consequently, there is no $G_{(\Delta)}$ subgroup in PSL(11, 2), since q = 2 is not greater than 2.

3.3 The maximal subgroups of C_3:

If H is (superfield group) a semilinear groups over extension fields of GF(q) of prime degree, then H acts on G as a group of semilinear automorphism of a (n/k)-dimensional space over the extension field $GF(q^k)$, so H embeds in $\Gamma L(n/k, q^k)$, for some prime number k dividing n.

Consequently, there are no C_3 groups in PSL(11, 2) since 11 is a prime number.

Definition (3.3.1) : *A Singer cycle* of GL(n, q) is an element of order q^n-1.

Result (3.3.2): (14) , (20) and (31).

If n is a prime number, then there exist a Singer cycles group $H = \Gamma L(1, q^n)$ of order $d^{-1}(q^n-1)/(q-1)$, where d = gcd(n, q-1) and H is irreducible maximal subgroup of PSL(n, q) which it is the normalizer of the (cyclic) multiplicative group for $GF(q^n)$.

Consequently, there is a Singer cycle subgroup $H = \Gamma L(1, 2^{11})$ in PSL(11, 2), since 11 is a prime number which prove the point (6) of the main theorem (1.1).

3.4 The maximal subgroups of C_4:

If H is a tensor product group, then H preserves a decomposition of V as a tensor product $V_1 \otimes V_2$, where $\dim(V_1) \neq \dim(V_2)$ of spaces of dimensions k, m > 1 over GF(q), and so H stabilize the tensor product decomposition $F^k \otimes F^m$, where n = km, k ≠ m. Thus, H is a subgroup of the central product of GL(k, q) ∘ GL(m, q).

Consequently, there is no tensor product group in PSL(11, 2), since 11 can not be analysis to two different numbers.

3.5 The maximal subgroups of C_5:

If H is a subfield group, then H is the linear groups over subfields of GF(q) of prime index. Thus H can be embedded in $GL(n, p^f).Z$ where e/f is prime number and $q = p^e$.

Consequently, there are no C_5 groups in PSL(11, 2), since 2 is a prime number.

3.6 The maximal subgroups of C_6:

For the dimension $n = r^m$, if r is prime number divides q-1, then $H = r^{2m} : Sp(2m, r)$ is an extraspecial r-group of order r^{2m+1}, or if r = 2 and 4 divides q-1, then $H = 2^{2m} . O^{\epsilon}(2m, 2)$ normalizes a 2-group of symplectic type of order 2^{2m+2}.

Consequently, there are no C_6 groups in PSL(11, 2), since n = 11 is not prime power.

3.7 The maximal subgroups of C_7:

If H is a tensor-induced, then H preserves a decomposition of V as $V_1 \otimes V_2 \otimes \dots \otimes V_m$ where V_i are isomorphic and each V_i has dimension $r > 1$, $n = \dim V = r^m$, and the set of V_i is permuted by H, so H stabilize the tensor product decomposition $F^r \otimes F^r \otimes \dots \otimes F^r$, where $F = F_q$. Thus $H/Z \leq PGL(r, q) : S_m$.

Consequently, there is a tensor-induced group in PSL(11, 2), since n = 11 is not prime power.

3.8 The maximal subgroups of C_8:

If H normalizes a classical group in its natural representation, then H lies between a classical group and its normalizer in GL(n, q), so H preserves a classical form up to scalar multiplication. Thus H is a normalizer of such a subgroup PSL(n, q′), PSp(n, q′), PΩ(n, q′) or PSU(n, q′) for various q′ dividing q.

Consequently, there are no C_8 groups in PSL(11, 2), since 2 is not a square, and is odd number.

Finally, we will determine the maximal subgroups in class C_9 of Aschbacher's theorem {Result (2.7)}:

4. The maximal subgroups of C_9:

If H is absolutely irreducible and H /(H∩Z)is almost simple, then H is the normalizer of absolutely irreducible normal subgroup M of H which is non-abelian and simple group.

To find the maximal subgroups of C_9, we will determine the maximal primitive subgroups H of G which have the property that a minimal normal subgroup M of H is non abelian group.

The following corollary will play an important role in proving the main result of this section {theorem (4.2)}

Corollary (4.1): If M is a non abelian simple group of a primitive subgroup H of G, then M is isomorphic to one of the following groups:

a) PSL(2, 23).

b) Mathieu groups, M_{23} or M_{24}.

Proof: let H be a primitive subgroup of G with a minimal normal subgroup M of H is not abelian. So, we will discuss the possibilities of a minimal normal subgroup M of H according to:

(I) M contains transvections. {(section (4.1)}

(II) M does not contain any transvection. {(section (4.2)}

(III) M is doubly transitive. {(section (4.3)}.

4.1 Primitive subgroups H of G which have the property that a minimal normal subgroup of H is not abelian is generated by transvections:

To find the primitive subgroups H of G which have the property that a minimal normal subgroup of H is not abelian is generated by transvections, we will use the following result of Mclaughlin (25):

Result (4.1.1) (Mclaughlin Theorem) (25):

Let H be a proper irreducible subgroup of SL(n, 2) generated by transvections. Then n > 3 and H is Sp(n, 2), $O^{\epsilon}(n, 2)$, S_{n+1} or S_{n+2}.

In the following, we will discuss the different possibilities of Result (4.1.1), which will give us the following main result of section (4.1):

Corollary (4.1.2): There is no proper irreducible subgroup H of SL(11, 2) generated by transvections.

Proof:

From Mclaughlin Theorem {Result (4.1.1)}, M is isomorphic to one of the following groups: symplectic group, orthogonal groups O(11, 2), symmetric groups S_{12} or S_{13}.

1. There is no symplectic groups since n is odd number.
2. From the character table of the orthogonal group O(11, 2) by GAP:

```
gap> g:=GO(11,2);
GO(0,11,2)
gap> c:=CharacterTable("g");
CharacterTable( "4.2^4.S5" )
gap> k:=CharacterTable(c, 2);
BrauerTable( "4.2^4.S5", 2 )
gap> CharacterDegrees(k);
[ [ 1, 1 ], [ 4, 2 ] ]
```

And non of them of degree 11. Thus, if $O(11, 2) \subset G$, then it must be reducible.

3. From the character table of S_{12}, G contain no class of subgroups isomorphic to S_{12}.

[[1, 1], [10, 1], [32, 1], [44, 1], [100, 1], [164, 1], [288, 1], [320, 1], [416, 1], [570, 1], [1046, 1], [1408, 1], [1792, 1], [2368, 1], [5632, 1]]

(gap> CharacterDegrees(CharacterTable("S12")mod 2);)

And non of them of degree 11. Thus $S_{12} \not\subset G$.

4. From the character table of S_{13}, G contain no class of subgroups isomorphic to S_{13}.

[[1, 1], [12, 1], [64, 2], [208, 1], [288, 1], [364, 2], [560, 1], [570, 1], [1572, 1], [1728, 1], [2208, 1], [2510, 1], [2848, 1], [3200, 1], [8008, 1], [8448, 1]]

(gap> CharacterDegrees(CharacterTable("S13")mod 2);)

And non of them of degree 11. Thus $S_{13} \not\subset G$.

4.2 Primitive subgroups H of G which have the property that a minimal normal subgroup of H is not abelian and does not contain transvections:

In this section, we will consider a minimal normal subgroup M of H is not abelian and does not contain any transvections.

The following corollary is the main result of section (4.2):

Corollary (4.2.1):
If Y be a non - abelian simple subgroup of G which does not contain any transvection. Then Y is isomorphic to PSL(2, 23).

Proof:

We will prove Corollary (4.2.1) by series of Lemmas (4.2.2) through Lemmas (4.2.8) and Result (4.2.3).

Lemma (4.2.2):
Let Y is a primitive subgroup of G such that Y does not contain any transvection. If S(2) be a 2-Sylow subgroup of Y, then S(2) contains no elementary abelian subgroup of order 8.

Proof:

A 2-Sylow subgroup of G can be represented by the set of all matrices of the form:

$$\begin{bmatrix} 1 & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 & x_8 & x_9 & x_{10} \\ & 1 & x_{11} & x_{12} & x_{13} & x_{14} & x_{15} & x_{16} & x_{17} & x_{18} & x_{19} \\ & & 1 & x_{20} & x_{21} & x_{22} & x_{23} & x_{24} & x_{25} & x_{26} & x_{27} \\ & & & 1 & x_{28} & x_{29} & x_{30} & x_{31} & x_{32} & x_{33} & x_{34} \\ & & & & 1 & x_{35} & x_{36} & x_{37} & x_{38} & x_{39} & x_{40} \\ & & & & & 1 & x_{41} & x_{42} & x_{43} & x_{44} & x_{45} \\ & & & & & & 1 & x_{46} & x_{47} & x_{48} & x_{49} \\ & & & & & & & 1 & x_{50} & x_{51} & x_{52} \\ & & & & & & & & 1 & x_{53} & x_{54} \\ & & & & & & & & & 1 & x_{55} \\ & & & & & & & & & & 1 \end{bmatrix}$$

Where all entries are in F_2.

Let Y is a primitive subgroup of G such that Y does not contain any transvection. If S(2) be a 2-Sylow subgroup of Y, then inside S(2), there exist only two elementary abelian subgroups of the form:-

$$A = \left\{ \begin{bmatrix} 1 & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 & x_8 & x_9 & x_{10} \\ & 1 & . & . & . & . & . & . & . & . & . \\ & & 1 & . & . & . & . & . & . & . & . \\ & & & 1 & . & . & . & . & . & . & . \\ & & & & 1 & . & . & . & . & . & . \\ & & & & & 1 & . & . & . & . & . \\ & & & & & & 1 & . & . & . & . \\ & & & & & & & 1 & . & . & . \\ & & & & & & & & 1 & . & . \\ & & & & & & & & & 1 & . \\ & & & & & & & & & & 1 \end{bmatrix} \right\}$$ and

$$B = \left\{ \begin{bmatrix} 1 & . & . & . & . & . & . & . & . & . & x_1 \\ & 1 & . & . & . & . & . & . & . & . & x_2 \\ & & 1 & . & . & . & . & . & . & . & x_3 \\ & & & 1 & . & . & . & . & . & . & x_4 \\ & & & & 1 & . & . & . & . & . & x_5 \\ & & & & & 1 & . & . & . & . & x_6 \\ & & & & & & 1 & . & . & . & x_7 \\ & & & & & & & 1 & . & . & x_8 \\ & & & & & & & & 1 & . & x_9 \\ & & & & & & & & & 1 & x_{10} \\ & & & & & & & & & & 1 \end{bmatrix} \right\}$$

where the orders of A and B are equal to 2^{10}

A corresponds to transvections: $I + \begin{bmatrix} 1 \\ . \\ . \\ . \\ . \\ . \\ . \\ . \\ . \\ . \\ . \end{bmatrix} \begin{bmatrix} . & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 & x_8 & x_9 & x_{10} \end{bmatrix}$

And B corresponds to transvections : $I+\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \\ x_{10} \\ . \end{bmatrix}[. \ . \ . \ . \ . \ . \ . \ . \ . \ . \ 1]$

Since S(2) does not contain any transvections, then both A and B must be the identity element. Then S(2) contains no elementary abelian subgroup of order 8.

Result (4.2.3): (1)
Let Y be a simple group. Assume that the 2-Sylow subgroup of Y contains no elementary abelian subgroup of order 8. Then Y is isomorphic to one of the following groups: A_7, PSL(2, q), PSL(3, q), PSU(3, q) with q odd or PSU(3, 4).

We will proceed to determine which of these groups satisfy the conditions of Corollary (4.2.1).

Lemma (4.2.4): $A_7 \not\subset G$

Proof:

Since the irreducible 2-modular characters for A_7 by GAP are:
[[1, 1], [4, 2], [6, 1], [14, 1], [20, 1]]
(gap > CharacterDegrees (CharacterTable ("A7") mod 2));
And non of them of degree 11.

Lemma (4.2.5): If PSL(2, q) $\subset$ G, q odd, then q = 23.

Proof:

PSL(2, q) has no projective representation in G of degree < (1/2)(q-1) {(22) and (29)} and (1/2)(q-1) > 11 for all odd q > 23. Hence we need only to consider the cases when q ≤ 23.

a. PSL(2, 3) is not simple.

b. PSL(2, 5) ≅ PSL(2, 2^2),
The irreducible 2-modular characters for PSL(3, 5) by GAP are:
[[1, 1], [2, 2], [4, 1]],
(gap > CharacterDegrees (CharacterTable (" L2(5) ") mod 2));
But non of them of degree 11. Therefore if PSL(2, 5) $\subset$ G, then it is reducible.

c. PSL(2, 7) ≅ PSL(3, 2),
The irreducible 2-modular characters for PSL(2,7) by GAP are:
[[1, 1], [3, 2], [8, 1]],
(gap > CharacterDegrees (CharacterTable (" L2(7) ") mod 2));
But non of them of degree 11. Therefore if PSL(2, 7) $\subset$ G, then it is reducible.

d. For PSL(2, 3^2) ≅ A_6:
The irreducible 2-modular characters for PSL(2, 3^2) by GAP are:
[[1, 1], [4, 2], [8, 2]].
(gap > CharacterDegrees (CharacterTable (" L2(9) ") mod 2));

But non of them of degree 11. Therefore if PSL(2, 3^2) $\subset$ G, then it is reducible.

e. For PSL(2, 11):

The irreducible 2-modular characters for PSL(2, 11) by GAP are:

[[1, 1], [5, 2], [10, 1], [12, 2]].

(gap > CharacterDegrees (CharacterTable ("L2(11) ") mod 2));

But non of them of degree 11. Therefore if PSL(2, 11) $\subset$ G, then it is reducible.

f. For PSL(2, 13):

The irreducible 2-modular characters for PSL(2, 13) by GAP are:

[[1, 1], [6, 2], [12, 3], [14, 1]].

(gap > CharacterDegrees (CharacterTable (" L2(13) ") mod 2));

But non of them of degree 11. Therefore if PSL(2, 13) $\subset$ G, then it is reducible.

g. For PSL(2, 17):

The irreducible 2-modular characters for PSL(2, 13) by GAP are:

[[1, 1], [8, 2], [16, 4]],

(gap > CharacterDegrees (CharacterTable (" L2(17) ") mod 2));

But non of them of degree 11. Therefore if PSL(2, 17) $\subset$ G, then it is reducible.

h. For PSL(2, 19):

The irreducible 2-modular characters for PSL(2, 19) by GAP are:

[[1, 1], [9, 2], [18, 2], [20, 4]],

(gap > CharacterDegrees (CharacterTable (" L2(19) ") mod 2));

But non of them of degree 11. Therefore if PSL(2, 19) $\subset$ G, then it is reducible.

i. For PSL(2, 23):

The irreducible 2-modular characters for PSL(2, 23) by GAP are:

[[1, 1], [11, 2], [22, 1], [24, 5]]

gap> CharacterDegrees(CharacterTable("PSL(2,23)")mod 2);

Hence, there are two classes of degree 11. Therefore PSL(2, 23) $\subset$ G

Lemma (4.2.6): PSL(3, q) $\not\subset$ G, for all q.

Proof:

PSL(3, q) has no projective representation in G of degree $<q^{n-1}-1 = q^2-1$ {(22) and (29)}, and it is clear that $q^2-1 > 11$ for all $q \geq 4$. Thus, we need to test PSL(3, 2) and PSL(3, 3) as primitive subgroups of G ?

- PSL(3, 2) $\not\subset$ G, [see lemma (4.2.5)]
- PSL(3, 3) $\not\subset$ G, since the irreducible 2-modular characters for PSL(3, 3) by GAP are:

[1, 1], [12, 1], [16, 4], [26, 1]],

(gap > CharacterDegrees (CharacterTable (" PSL(3, 3) ") mod 2));

Hence, non of these is of degree 11, therefore if PSL(3, 3) $\subset$ G, then it is reducible.

Lemma (4.2.7): PSU(3, q) $\not\subset$ G, for all q.

Proof:

PSU(3, q) has no projective representation in G of degree < q(q-1), (29), and it is clear that q(q-1) > 11 for all $q \geq 4$. Thus, we need to test PSU(3, 2) and PSU(3, 3) are primitive subgroups of G ?

- PSU(3, 2) is not simple.

- PSU(3, 3) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 9) by GAP are: [[1, 1], [6, 1], [14, 1], [32, 2]]

(gap> CharacterDegrees(CharacterTable("U3(3)")mod 2)).

and non of these of degree 11.

Lemma (4.2.8): PSU(3, 4) $\not\subset$ G.

Proof:

PSU(3, 4) does not satisfy the conditions of this section, since PSU(3, 4) is not simple.

4.3 Primitive subgroups H of G which have the property that a minimal normal subgroup of H which is not abelian is doubly transitive group:

In this section, we will consider a minimal normal subgroup M of H is not abelian and is doubly transitive group:

The following Corollary is the main result of this section:

Corollary (4.3.1): If M is a non abelian simple group of doubly transitive group H, then M is isomorphic to one of the following groups:

a) PSL(2, 23).

b) Mathieu groups, M_{23} or M_{24}.

Proof:

Since every doubly transitive group is a primitive group (3), then we will use the classification of doubly transitive groups { (13) and (26) }. And we will prove Corollary (4.3.1) by series of Lemmas (4.3.3) through Lemmas (4.3.15) and Result (4.3.2).

Result (4.3.2): { (13) and (26)}.

If Y be a doubly transitive group, then Y has a simple normal subgroup M^*, and $M^* \subseteq Y \subseteq Aut(M^*)$, where M^* as follows:

1. A_n, $n \geq 5$;
2. PSL(d, q), $d \geq 2$, where $(d, q) \neq (2, 2), (2, 3)$;
3. PSU(3, q), $q > 2$;
4. the Suzuki group Sz(q), $q = 2^{2m+1}$ and $m > 0$;
5. the Ree group Re(q), $q = 3^{2m+1}$ and $m > 0$;
6. Sp(2n, 2), $n \geq 3$;
7. PSL(2, 11);
8. Mathieu groups M_n, n = 11, 12, 22, 23, 24.
9. HS (Higman-Sims group);
10. CO_3 (Conway's smallest group).

In the following, we will discuss the different possibilities of Result (4.3.2);

Lemma (4.3.3): $A_n \not\subset G$, for all $n \geq 5$.

Proof:

From (30) , A_n for all $n > 8$, has a unique faithful 2-modular representation of least degree, this degree being (n-1) if n is odd and (n-2) if n is even, so, the 2-modular representation of least degree is greater than 11 for all $n \geq 14$. Thus $A_n \not\subset G$ for any $n \geq 14$.

$A_5 \not\subset G$: since the irreducible 2-modular characters for A_5 by GAP are:

[[1, 1], [2, 2], [4, 1]]

(gap > CharacterDegrees (CharacterTable ("A5") mod 2));

$A_6 \not\subset G$: since the irreducible 2-modular characters for A_6 by GAP are:
[[1, 1], [4, 2], [8, 2]]
(gap > CharacterDegrees (CharacterTable ("A6") mod 2));
$A_7 \not\subset G$: since the irreducible 2-modular characters for A_7 by GAP are:
[[1, 1], [4, 2], [6, 1], [14, 1], [20, 1]]
(gap > CharacterDegrees (CharacterTable ("A7") mod 2));
$A_8 \not\subset G$: since the irreducible 2-modular characters for A_8 by GAP are:
[[1, 1], [4, 2], [6, 1], [14, 1], [20, 2], [64, 1]]
(gap > CharacterDegrees (CharacterTable ("A8") mod 2));
$A_9 \not\subset G$: since the irreducible 2-modular characters for A_9 by GAP are:
[[1, 1], [8, 3], [20, 2], [26, 1], [48, 1], [78, 1], [160, 1]]
(gap > CharacterDegrees (CharacterTable ("A9") mod 2));
$A_{10} \not\subset G$: since the irreducible 2-modular characters for A_{10} by GAP are:
[[1, 1], [8, 1], [16, 1], [26, 1], [48, 1], [64, 2], [160, 1], [198, 1], [200, 1], [384, 2]]
(gap > CharacterDegrees (CharacterTable ("A10") mod 2)).
$A_{11} \not\subset G$: since the irreducible 2-modular characters for A_{11} by GAP are:
[[1, 1], [10, 1], [16, 2], [44, 1], [100, 1], [144, 1], [164, 1], [186, 1], [198, 1], [416, 1], [584, 2], [848, 1]],
(gap > CharacterDegrees (CharacterTable ("A11") mod 2));
$A_{12} \not\subset G$: since the irreducible 2-modular characters for A_{12} by GAP are:
[1, 1], [10, 1], [16, 2], [44, 1], [100, 1], [144, 2], [164, 1], [320, 1], [416, 1], [570, 1], [1046, 1], [1184, 2], [1408, 1], [1792, 1], [5632,1].
(gap > CharacterDegrees (CharacterTable ("A12") mod 2));
$A_{13} \not\subset G$: since the irreducible 2-modular characters for A_{12} by GAP are:
[[1, 1], [12, 1], [32, 2], [64, 1], [144, 2], [208, 1], [364, 2], [560, 1], [570, 1], [1572, 1], [1728, 1], [2208, 1], [2510, 1], [2848, 1], [3200, 1], [4224, 2], [8008, 1]]
(gap > CharacterDegrees (CharacterTable ("A13") mod 2));

Lemma (4.3.4): If PSL(2, q) $\subset$ G, then q = 23

Proof:
We have two cases:
Case (1). q is even:
PSL(2, q) has no projective representation in G of degree < (1/d)(q-1), d = g.c.d(2, q-1) {(22) and (29)}, and (q-1) > 11 for all even q $\geq$ 16. Also,

- PSL(2, 2) not simple.
- PSL(2, 4) $\not\subset$ G, since the irreducible 2-modular characters for PSL(2, 4) by GAP are:

[[1, 1], [2, 2], [4, 1]],
(gap > CharacterDegrees (CharacterTable (" L2(4) ") mod 2));
and non of these of degree 11.

- PSL(2, 8) $\not\subset$ G, since the irreducible 2-modular characters for PSL(2, 8) by GAP are:

[[1, 1], [2, 3], [4, 3] , [8, 1]],

(gap > CharacterDegrees (CharacterTable (" L2(4) ") mod 2));
and non of these of degree 11.
Thus, PSL(2, q) $\not\subset$ G for all q is even.
Case (2). q is odd:

If PSL(2, q) $\subset$ G, q is odd, then q = 23. [see Lemma (4.2.5)]

Lemma (4.3.5): PSL(n, 2) $\not\subset$ G for all n.
Proof:
PSL(n, 2) has no projective representation in G of degree < $q^{n-1}-1 = 2^{n-1}-1$ { (22) and (29)}, and it is clear that $2^{n-1}-1 > 11$ for all n > 4. Thus, we need to test PSL(2, 2), PSL(3, 2) and PSL(4, 2) are primitive subgroups of G ?

- PSL(2, 2) is not simple.
- PSL(3, 2) $\not\subset$ G. Since PSL(3, 2) $\cong$ PSL(2, 7), and PSL(2, 7) $\not\subset$ G. [see Lemma(4.2.5)]
- PSL(4, 2) $\not\subset$ G. Since PSL(4, 2) $\cong A_8$, and $A_8 \not\subset$ G [see Lemma(4.2.5)]

Lemma (4.3.6): If PSL(n, q) $\subset$ G, then n = 2 and q = 23
Proof:
PSL(n, q) has no projective representation in G of degree < $(q^{n-1}-1)$ {(22) and (29) }, which > 11 for all for all q $\geq$ 3 and n $\geq$ 4. Thus, we need to test PSL(2, q), PSL(3, q) and PSL(n, 2) as primitive subgroups of G ?

- If PSL(2, q) $\subset$ G, then q = 23 [see lemma (4.3.4)].
- PSL(3, q) $\not\subset$ G for all q [see Lemma (4.2.6)].
- PSL(n, 2) $\not\subset$ G for all n [see Lemma (4.3.5)].

Lemma (4.3.7): PSU(2, q) $\not\subset$ G, for all q.
Proof:
PSU(2, q) $\subseteq$ PGL(2, q). But PGL(2, q) has no projective representation in G of degree < (q-1), provided q $\neq$ 9 (29), which > 11 for all q > 13.
Thus, we need to test PSU(2, 2) , PSU(2, 3), PSU(2, 4), PSU(2, 5), PSU(2, 7), PSU(2, 9), PSU(2, 11) and PSU(2, 13) are primitive subgroups of G ?

- PSU(2, 2) is not simple.
- PSU(2, 3) is not simple.
- PSU(2, 4) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 4) by GAP are: [[1, 1], [2, 2], [4, 1]]
  (gap> CharacterDegrees(CharacterTable("U2(4)")mod 2))
  and there is non of degree 11.
- PSU(2, 5) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 5) by GAP are: [[1, 1], [2, 2], [4, 1]]
  (gap> CharacterDegrees(CharacterTable("U2(5)")mod 2)).
  and there is non of degree 11.
- PSU(2, 7) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 7) by GAP are: [[1, 1], [3, 2], [8, 1]]
  (gap> CharacterDegrees(CharacterTable("U2(7)")mod 2)).
  and there is non of degree 11.

- PSU(2, 9) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 9) by GAP are: [[1, 1], [4, 2], [8, 2]]
  (gap> CharacterDegrees(CharacterTable("U2(9)")mod 2)).
  and there is non of degree 11.
- PSU(2, 11) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 11) by GAP are: [[1, 1], [5, 2], [10, 1], [12, 2]]
  (gap> CharacterDegrees(CharacterTable("U2(11)")mod 2)).
  and there is non of degree 11.
- PSU(2, 13) $\not\subset$ G, since the irreducible 2-modular characters for PSU(2, 13) by GAP are: [[1, 1], [6, 2], [12, 3], [14, 1]]
  (gap> CharacterDegrees(CharacterTable("U2(13)")mod 2)).
  and there is non of degree 11.

Lemma (4.3.8): PSU(n, 2) $\not\subset$ G, for all n.

Proof:

PSU(n, q), n $\geq$ 3, has no projective representation in G of degree < $q(q^{n-1}-1)/(q+1)$ if n is odd, and PSU(n, q) , n $\geq$3, has no projective representation in G of degree < $(q^n-1)/(q+1)$ if n is even. { (22) and (29)}, Thus the minimal projective degree for PSU(n, 2) is > 11 for all n $\geq$ 6.

Thus, we need to test PSU(2, 2) , PSU(3, 2), PSU(4, 2) and PSU(5, 2) are primitive subgroups of G ?

- PSU(2, 2^2) is not simple.
- PSU(3, 2^2) is not simple.
- PSU(4, 2) $\not\subset$ G. Since the irreducible 2-modular characters for PSU(4, 2) by GAP are: [[1, 1], [4, 2], [6, 1], [14, 1], [20, 2], [64, 1]]
  (gap> CharacterDegrees(CharacterTable("U4(2)") mod 2)).
  and non of these of degree 11.
- PSU(5, 2) $\not\subset$ G, since the irreducible 2-modular characters for PSU(5, 2) by GAP are: [[1, 1], [5, 2], [10, 2], [24, 1], [40, 4], [74, 1], [160, 2], [280, 2], [1024, 1]]
  (gap> CharacterDegrees(CharacterTable("U5(2)") mod 2)).

Lemma (4.3.9): PSU(n, q) $\not\subset$ G.

Proof:

PSU(n, q), n $\geq$ 3, has no projective representation in G of degree < $q(q^{n-1}-1)/(q+1)$ if n is odd, and PSU(n, q) , n $\geq$3, has no projective representation in G of degree < $(q^n-1)/(q+1)$ if n is even. { (22) and (29)}, Thus the minimal projective degree is > 11 for all n > 3 and q $\geq$ 3.

Thus, we need to test PSU(n, 2), PSU(2, q) and PSU(3, q) are primitive subgroups of G ?

- PSU(n, 2) $\not\subset$ G, [see Lemma (4.3.8)].
- PSU(2, q) $\not\subset$ G, [see Lemma (4.3.7)].
- PSU(3, q) $\not\subset$ G, [see lemma (4.2.7)].

Lemma(4.3.10): Sz(q) $\not\subset$ G, $q = 2^{2m+1}$ and m > 0.

Poof:

The irreducible 2-modular characters for Suzuki groups by GAP are:

[[1, 1], [4, 3], [16, 3], [64, 1]]

(gap > CharacterDegrees (CharacterTable (" Sz(8) ") mod 2));

and non of these of degree 11, thus Sz(q) $\not\subset$ G.

Lemma (4.3.11): Re(q) $\not\subset$ G, q = 3^{2m+1}.

Proof:

The irreducible 2-modular characters for Ree group Re(q) by GAP are: [[1, 1], [702, 1], [741, 2], [2184, 2], [13832, 6], [16796, 1], [18278, 1], [19684, 6], [26936, 3]]

(gap> CharacterDegrees (CharacterTable (" R(27) ") mod 2));

and non of these of degree 11, thus Re(q) $\not\subset$ G.

Lemma (4.3.12): PSp(2n, 2) $\not\subset$ G for all n $\geq$3.

Proof:

From {(22) and (29)}, PSp(2n, q), n $\geq$ 2 has no projective representation in G of degree < $(1/2)q^{n-1}(q^{n-1} - 1)(q-1)$ if q is even. And since q = 2, then $(1/2)q^{n-1}(q^{n-1} - 1)(q-1)$ > 11 for all n $\geq$ 4. Thus, we need to test PSp(6, 2) is a primitive subgroups of G ?

The irreducible 2-modular characters for PSp(6, 2) by GAP are: [1, 1], [6, 1], [8, 1], [14, 1], [48, 1], [64, 1], [112, 1], [512, 1]]

(gap> CharacterDegrees(CharacterTable("S6(2)")mod 2);

and non of these of degree 11, thus PSp(6, 2) $\not\subset$ G

Lemma (4.3.13): if the Mathieu groups M_n, n = 11, 12, 22, 23, 24 are primitive subgroups of G, then n = 23 or 24.

Proof:

- M_{11} $\not\subset$ G, since the irreducible 2-modular characters for Mathieu group M_{11} by GAP are:

  [[1, 1], [10, 1], [16, 2], [44, 1]],

  (gap > CharacterDegrees (CharacterTable (" M11 ") mod 2));

- M_{12} $\not\subset$ G, since the irreducible 2-modular characters for Mathieu group M_{12} by GAP are:

  [[1, 1], [10, 1], [16, 2], [44, 1], [144, 1]],

  (gap > CharacterDegrees (CharacterTable (" M12 ") mod 2));

- M_{22} $\not\subset$ G, since the irreducible 2-modular characters for Mathieu group M_{22} by GAP are:

  [[1, 1], [10, 2], [34, 1], [70, 2], [98, 1]],

  (gap > CharacterDegrees (CharacterTable (" M22 ") mod 2)).

- M_{23} $\subset$ G, since the irreducible 2-modular characters for Mathieu group M_{23} by GAP are:

  [[1, 1], [11, 2], [44, 2], [120, 1], [220, 2], [252, 1], [896, 2]]

  gap> CharacterDegrees(CharacterTable("M23")mod 2);

- M_{24} $\subset$ G, since the irreducible 2-modular characters for Mathieu group M_{24} by GAP are:

  [[1, 1], [11, 2], [44, 2], [120, 1], [220, 2], [252, 1], [320, 2], [1242, 1], [1792,

1]].

Gap> CharacterDegrees(CharacterTable("M24")mod 2);

Which prove the point (b) of Corollary (4.3.1).

Lemma (4.3.14): HS (Higman-Sims group) $\not\subset$ G;

Proof:

The minimal degrees of faithful representations of the Higman-Sims group over F_2 is 20, which is greater than 11, (Jansen, 2005).

Lemma (4.3.15): CO_3 (Conway's smallest group) $\not\subset$ G;

Proof:

The minimal degrees of faithful representations of the CO_3 over F_2 is 22, which is greater than 11 (Jansen, 2005).

Now, we will determine the maximal primitive group of C_9 :

Theorem (4.2): If H is a maximal primitive subgroup of G which has the property that a minimal normal subgroup M of H is not abelian group, then H is isomorphic to one of the following subgroups of G:

(1) PΓL (2, 23).

(2) Mathieu group M_{24}.

Proof:

We will prove this theorem by finding the normalizers of the groups of corollary (4.1) and determine which of them are maximal:

- The normalizer of PSL(2, 23) is PΓL(2, 23) { (16) , (17), (33) and (34)}. Thus PΓL(2, 23) is a maximal primitive subgroup of G.
- The normalizer of the Mathieu group M_{23} is the group M_{23} and the normalizer of the Mathieu group M_{24} is the group M_{24}, but M_{23} is a subgroup of M_{24} {(33) and (34)}. Thus M_{24} is a maximal primitive subgroup of G.

Which prove the points (7) and (8) of theorem (1.1), and this complete the proof of theorem (1.1).

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الزمر الجزئيه العظمى للزمره PSL(11, 2)

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ملخص

فى هذا البحث أوجدنا جميع الزمر الجزئيه العظمى للزمره الخطية PSL(11, 2) وذلك باستخدام نظريه أشبكا (2) لتعين الزمر الجزئيه العظمى للزمر الخطية ودونت النتيجه التى حصلنا عليها فى نظرية (1.1).

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دراسة مقارنة لإنتاجية و كفاءة عمل نماذج من المجمعات الشمسية الحرارية في الظروف المناخية المختلفة في بعض مدن الجمهورية اليمنية

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ملخص

يتناول البحث دراسة المجمعات الشمسية الحرارية المستوية ، المركّزات الشمسية البؤرية والمركزات ذي المقطع المكافئ الاسطواني ، لحل بعض مشكلات البيئة واستنزاف الوقود الاحفوري في اليمن ، واستثمارها في تشغيل أنظمة التسخين والتدفئة والتكييف الهوائي.
كما تمّ وضع منهج لحساب القدرة الحرارية للمتر المربع من سطحها الفاعل ، وكذلك حساب إنتاجيتها وكفاءة استخدامها في عدة مدن مختلفة المناخ والموقع الفلكي والطبوغرافي : صنعاء، وصعده ، وعدن، الحديدة ، وسيئون ، ومأرب و الريان.
استنتج من البحث أن : المجمعات الشمسية الحرارية المسطحة ، والمركزات الشمسية المحرقية و المركزات الشمسية ذي القطع المكافئ الاسطواني العاملة في المناطق اليمنية المدروسة تمتلك حسب ترتيبها النتائج الآتية :
القدرة الحرارية: 49-241W/m^2 و 153-792W/m^2 و W/m^2 350-2240. إنتاجية محطاتها الشمسية هي: 1.4-9 Mj/m^2 ، 5-30 Mj/m^2 و 10-81 Mj/m^2 ، ومعامل الاستخدام لقدرتها المنتجة: 52-96% ، 49-96% و45-95%.
هذه المؤشرات تؤكد إمكانية استخدام هذه المجمعات و المركزات الشمسية بفعالية في اليمن.
الكلمات الدليلة: إنتاجية حرارية ، مجمعات و مركزات شمسية ، اليمن، تدفئة و تسخين المياه.

المقدمة

في الوقت الحاضر أصبحت الطاقة الشمسية تلعب دوراً أساسياً في عملية التطوّر التكنولوجي والعمراني من خلال تحويل الطاقة الشمسية إلى طاقة حرارية وحركية وكهربائية وكذلك في التحويلات الفيزوحرارية في المحطات الشمسية ، التي يمكن استخدام دوراتها في نظام التبريد والتدفئة للمساكن الخاصة في المناطق الريفية ، و الحصول على درجات الحرارة التقنية المتوسطة والعالية والتي بدورها تستخدم في مراحل التصنيع وفي أعذاب مياه البحر و الصناعة و الزراعة والصحة[8].

إن تحويل الطاقة الشمسية وتجميعها لغرض الحصول على طاقة حرارية، حركية وكهربائية ، يحتاج إلى نظام تجميع شمسي حراري ، يطلق عليه نظام المجمعات الشمسية الحرارية المسطحة و المركزة ، وفي هذا البحث سوف نتطرق إلى دراسة

ومقارنة المجمعات الشمسية و نناقش مع تحليل نتائجها لمعرفة مدى إمكانية عملها في الظروف المناخية و الطقسية و الطوبوغرافيه للمدن الآتية: صنعاء ، وعدن، وصعده، والريان، والحديدة ، ومأرب و سيئون، لتعمل كنموذج يساعد على فهم كفاءة و عمل تلك المجمعات في اليمن عامة.

مشكلة البحث:

البحث يعمل في كيفية الاستفادة من الكميات الحرارية للطاقة الشمسية الساقطة على نماذج من المدن اليمنية المختلفة المناخ و الموقع الطوبوغرافي في عمليات التدفئة وتسخين المياه و تكييف الهواء وتوفير استهلاك الوقود الاحفوري خصوصا و إن اليمن يعاني من انخفاض محسوس في إنتاجه النفطي و خفض معامل التلوث في محيط هذه المدن . [1]

هدف البحث:

معرفة أمثل نماذج المجمعات و المركزات الشمسية الحرارية العاملة في بعض المدن اليمنية المختلفة في المتغيرات المناخية و المواقع الفلكية والطبوغرافية و تحديد قدراتها الحرارية و معدلاتها الإنتاجية و معامل استخدام قدرتها الإنتاجية لغرض استثمارها وقد تم اختيارنا للمواقع الآتية : عدن، وصعده ، وسيئون، والريان، والحديدة ، ومأرب و صنعاء .

طرق البحث وأدواته:

يسلك البحث المنهج الحسابي النظري ـ الإحصائي وتحليل النتائج لحل النقاط الآتية:

- لمحة مختصرة عن المجمعات الشمسية الحرارية المسطحة و كذا المركزات المحرقية و ذات المقطع المكافئ الاسطواني .

الحساب النظري للقدرة الحرارية للمجمع الشمسي الحراري المسطّح والمركزات الحرارية الشمسية المحرقية و المركزات ذي المقطع المكافئ الاسطواني.

- معرفة إنتاجية المحطات العاملة على هذه المجمعات و المركزات الشمسية .

معرفة مدى كفاءة عمل المجمعات و المركزات المختارة في المدن اليمنية : عدن ، وصعده، والحديدة ، والريان، وصنعاء، وعدن و سيئون و تحليل تلك النتائج باستخدام البيانات المناخية الاحصائية التجريبية لغرض المقارنة مع باقي مدن الجمهورية اليمنية.

أولاً: لمحة مختصرة عن أنواع المجمعات والمركزات الشمسية المختارة:

من المتعارف عليه أن هناك نوعان أساسيان من المجمعات الشمسية الحرارية هما: المجمعات المستوية والمجمعات البؤرية.

المجمعات المستوية: هي تلك المجمعات التي ليس لها تركيز بؤري أي أن الأشعة الشمسية الساقطة على تلك المجمعات يفقد جزء منها بسبب تشتتها وعدم تركيزها في نقطة واحدة وبذلك تعطي طاقة حرارية قليلة ، ومع ذلك فان ميزتها تتمثل في استقبال الأشعة الشمسية المباشرة والمشتتة والمنعكسة من الأجسام القريبة منها ، أي أنها تستقبل مجموع الأشعة الشمسية الساقطة في تلك المنطقة، ومعظم عملها يبنى على فكرة الصناديق الحرارية التي يسهل صنعها حيث تتطلب سطح له قابلية جيدة لامتصاص الأشعة الشمسية ويلامس هذا السطح مجموعة من الأنابيب التي يمر خلالها الماء أو أي مادة ناقلة للحرارة. ويغطى سطح هذه المادة التي تستقبل الأشعة الشمسية بمادة ذات لون اسود أو أي مادة ذات قدرة عالية على امتصاص الأشعة الشمسية ، ثم توضع هذه في

صندوق عازل للحرارة من اجل التقليل من الفقد الحراري، وهذه الصناديق يمكن أن تستخدم في تسخين المادة السائلة حيث تصل درجة حرارة العاملة فيها مابين 30-100oC وتعتمد على الظروف المناخية وخواص المجمع الشمسي وظروف الاستخدام. و معامل فعلها المفيد يبلغ مابين 30-50%. ونسبة المساحة التي تتطلبها100%، و لا تتطلب أي تتبع لمسار الشمس.

المركزات الشمسية : هي المجمعات التي من خلالها يتم تركيز الأشعة الشمسية الساقطة عليها لتصل درجة حرارتها العاملة مابين 500-1000oC وهذا يعني زيادة في مقدار الطاقة الحرارية التي يمكن الحصول عليها من هذه المجمعات مقارنة بالمجمعات الشمسية المستوية. ولهذا فإنها عادة تستخدم للحصول على درجات حرارية عالية ومتوسطة. علما بأنها لا يمكن لها استقبال الأشعة الشمسية المباشرة إلا بمساعدة ، ولهذا فهي تحتاج إلى آلية لمتابعة حركة الشمس خلال النهار من الشروق إلى الغروب. و معامل فعلها المفيد يبلغ مابين 50-75% و أما المساحة النسبية التي تتطلبها فتقع مابين 20-50% . ومنها ما يدور حول محور واحد المركز ذي المقطع المكافئ الاسطواني ، أو ما يدور حول محورين مثل المستلم المركز العامل في مجال العاكسات المسطحة الشمسية.

ومن أهم تلك المركزات الأكثر تعاملا في اليمن هي :

أ - المجمعات البؤرية . ب - المجمعات القطع المكافئ الاسطوانية [2,7].

ثانيا: حساب القدرة الحرارية المجمعات الشمسية المسطحة و المركزات البؤرية والمركزات ذي المقطع المكافئ الاسطواني المدروسة :

عند دراسة و تحليل عمل و كفاءة المجمعات الشمسية عند وضعها في بعض المدن اليمنية المختلفة المناخ والتضاريس : (عدن، وسيئون ، وصعده ، وذمار ، والريان، وصنعاء و تعز) ، فأن ذلك يتطلب ضرورة معرفة قيم الأشعة الشمسية الساقطة على المتر المربع لكل منطقة من هذه المناطق و معرفة القدرة الحرارية الشمسية الممتصة لكل متر مربع من أسطح هذه المجمعات الشمسية لهدف تقييم كفاءة عملها .و قد تم تقسيم هذا المنهج للحساب الحراري لهذه المجمعات الشمسية الحرارية إلى ثلاثة أقسام :

أ – حساب القدرة الحرارية للمجمعات الشمسية المستوية P_s ، W/m^2.

يتم حساب هذه القدرة الحرارية من خلال حل المعادلة الآتية [4,6]

$$P_s = I \times \alpha \times \gamma \times S \times Q_b \ldots\ldots\ldots(1)$$
$$Q_b = K(T_a - T_{o.c})$$

I : محصلة أشعة الشمس الفاعلة و الساقطة على سطح المجمع الشمسي W/m^2 .[3]

α : معامل امتصاص الإشعاع الشمسي.γ : معامل النفاذية للغطاء الزجاجي.

S :المساحة العاملة للسطح m^2 . Qь: محصلة الفقد الحراري،W

$T_{o.c}$;T_a: درجتي حرارة الوسط المحيط و الوسيط العامل لنقل الحرارة ^oK

K_c : معامل ضياع الحرارة الفاعل للمجمع الشمسي و تنحصر قيمته(1.2-10 $W/(m^2.^oC)$

ب – حساب القدرة الحرارية للمجمعات الشمسية البؤرية والقطع المكافئ P_c يتم كالآتي [5]:

$$P_c = I \times K \times \xi \times \alpha \times \rho \times S - Q_b \text{.....(2)}$$

ξ : معامل الكفاءة المفيدة البصرية للمركّز.K : معامل التركيز.
ρ : معامل الانعكاس لأطراف بؤرة الزجاج للمركّز.

ثانيا: حساب إنتاجية المجمعات المسطحة و المركزات المحرقية و ذي المقطع المكافئ الاسطواني الشمسي $Mj/m^2.Q$

و يتم الحصول على هذه القيم Q ، من خلال معرفة قيم القدرة الحرارية P (Ps, Pc)المشار إليهما في الأشكال 1,2,3 ، وبإيجاد قيم متوسط اليومي لعدد ساعات الإشراق لكل مدينة من المدن اليمنية المختارة قيم τ ، من جداول الإحصاء المناخي لمراكز الأرصاد اليمني ، و باستخدام المعادلة الآتية:[6]

$$W = P \times \tau \text{.....(3)}$$

W: الانتاجية الشهرية لمحطات الطاقة الشمسية، Mj/m^2.
P: القدرة الحرارية الشمسية و تؤخذ قيمها من بيانات الأشكال 1,2,3.
τ: المتوسط اليومي لساعات الإشراق المتواصلة ، ساعة.

ثالثا : حساب معامل الاستخدام للقدرة الحرارية المنتجة من المجمعات الحراريةη : المجمعات الشمسية المسطحة و المركزات البؤرية و ذي المقطع المكافئ الاسطواني:

معامل الاستخدام للقدرة المنتجة η يساوى النسبة بين المتوسط اليومي للقدرة الحرارية الواقعية للمجمع الشمسي P_L بالنسبة إلى القدرة الحرارية اليومية لنفس المجمع الشمسي عند السماء الخالية من الغيوم P_N .

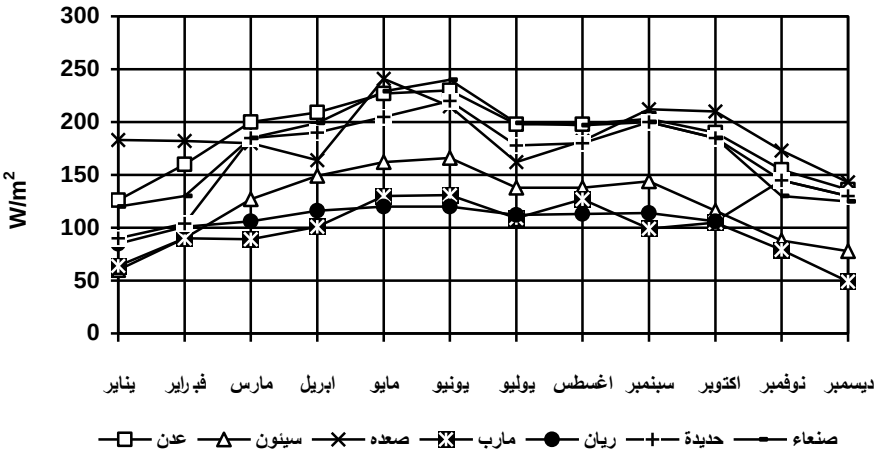
$$\eta = \frac{P_L}{P_N} \text{.....(3)}$$

η : بمعامل الاستخدام للقدرة المنتجة % .
P_L : المتوسط اليومي للقدرة الحرارية الواقعية للمحطة Mj/m^2.
P_N : القدرة الحرارية للمحطة عند السماء الخالية من الغيوم Mj/m^2..

النتائج و المناقشة:

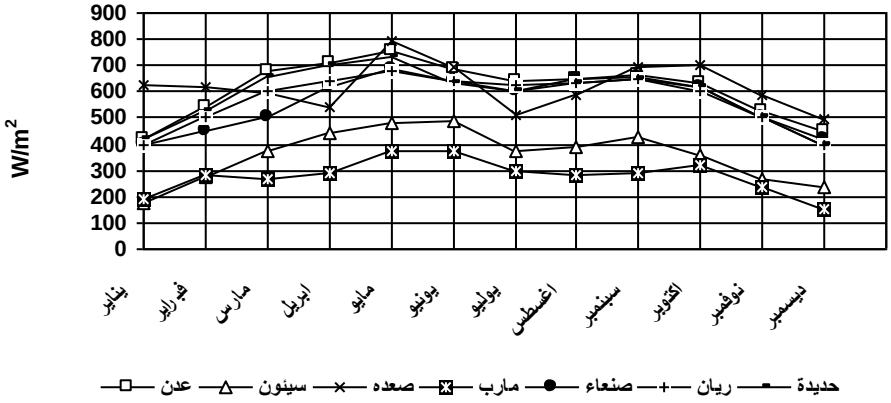
من خلال استخدام المعادلات الحرارية 1,2,3 وتحليل نتائجها واستخدام قيم عدد الساعات المشرقة في اليوم لكل المدن المدروسة تحصلنا على النتائج المبينة في الأشكال 1,2,3,4,5,6,7 . وهي تبين المقارنة بين القدرات الحرارية و إنتاجية المتر المربع من المجمع الشمسي الحراري المسطّح أو المركز الشمسي المحرقي أو ذو المقطع المكافئ الاسطواني و معرفة كفاءة عملها في كل المدن اليمنية المدروسة .

تبين الشكل 1 مقارنة نتائج حساب القدرة الحرارية للمتر المربع من السطح العامل من المجمع الشمسي الحراري المسطح في المدن اليمنية الآتية : عدن ، وسيئون ، وصعده، ومأرب وصنعاء، والريان و الحديدة ، إذ يلاحظ من تحليل نتائجه إن: صعده تمتلك أعلى قدرة حرارية تبلغ 241W/m2 في مايو مقارنة 120 W/m2 في الريان ، أما الانخفاض في القدرة حرارية في اطار المدن الضروسة فتقع في مأرب في ديسمبر وتبلغ $49W/m^2$ مقارنه $143W/m^2$ في صعده ، و ذلك في الشهر نفسه.



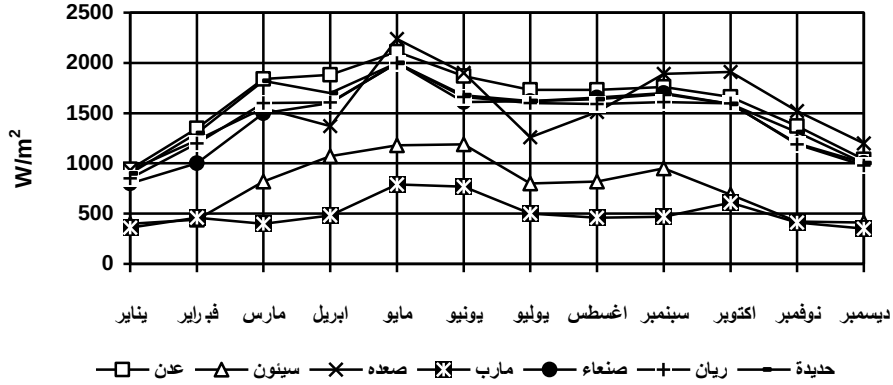
شكل (1): القدرة الحرارية للمجمع الشمسي المسطح و العامل بسطح امتصاص $1m^2$.

تبين النتائج المبينة في الشكل رقم 2 القدرة الحرارية للمركّز الشمسي الحراري البؤري ، الذي يمتلكها المتر المربع من سطح امتصاصه العامل، و يستنتج منها أن: أعلى قدرة حرارية له توجد في صعده و تقدر بحوالي 792 W/m2 في شهر مايو مقارنة بـ $377 W/m^2$ في مأرب للشهر نفسه، أما الانخفاض في القدرة الحرارية في إطار المناطق المدروسة فتقع في مأرب في شهر ديسمبر وتبلغ $153W/m^2$ مقارنه بـ $493 W/m^2$ في صعده ، في الشهر نفسه.



شكل (2): القدرة الحرارية للمركز الشمسي الحراري البؤري و العامل بسطح امتصاص $1m^2$

تبين النتائج المبينة في الشكل رقم 3 حساب القدرة الحرارية للمركّز الشمسي الحراري ذو المقطع المكافئ الاسطواني العامل بمتر مربع من سطح الامتصاص الحراري ، و يستنتج منها أن: أعلى قدرة حرارية له توجد في صعده و تقدر بحوالي $2240\ W/m^2$ في شهر مايو ، مقارنة بـ $790\ W/m^2$ في مأرب للشهر نفسه، أما الانخفاض في القدرة الحرارية في إطار المناطق المدروسة فتقع في مأرب في شهر ديسمبر وتبلغ $350\ W/m^2$ مقارنه بـ $1200\ W/m^2$ في صعده ، للشهر نفسه.



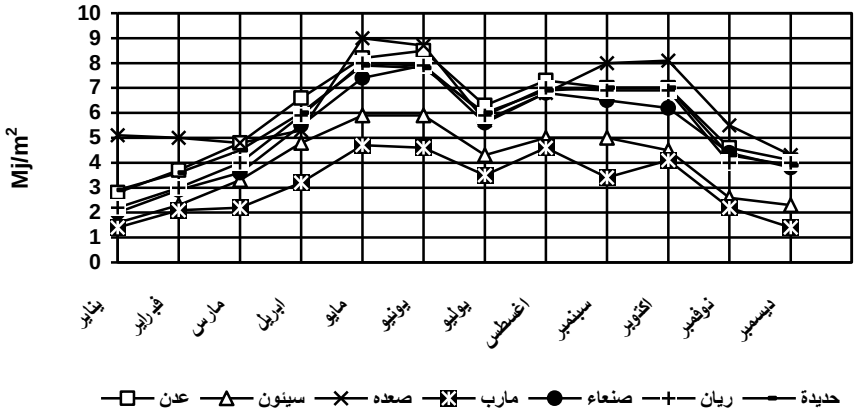
شكل (3): القدرة الحرارية للمركز الشمسي الحراري ذو المقطع المكافئ الاسطواني

من مناقشة بيانات الأشكال 1,2,3 يستنتج أن : المجمع الشمسي الحراري المسطح الأقل قدرة حرارية يليه المركز المحرقي في حين يمتلك المركز الشمسي القدرة الحرارة القيمة الأكبر، مثلا في شهر يونيو في مدينة عدن نجد أن: القدرة الحرارية الشمسية للمجمع المسطح $230\ W/m^2$ ، والمحرقي $687\ W/m^2$ ، و المركز ذو المقطع المكافئ الاسطواني $1870\ W/m^2$ و في شهر يناير

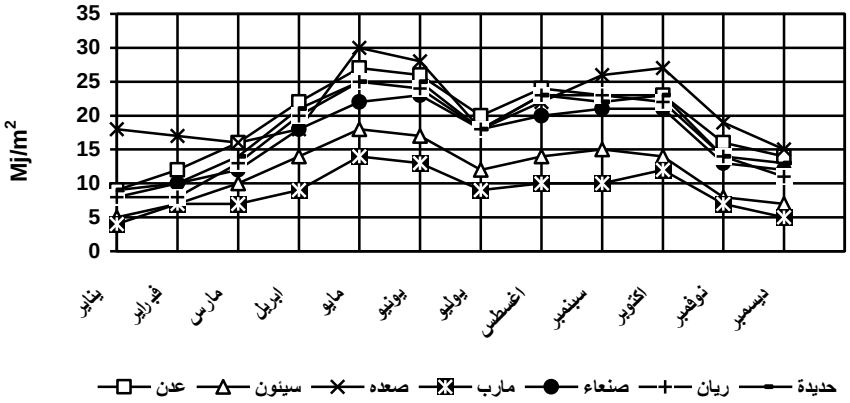
126 W/m^2 و419 ،940 .أما في صعدة بالنسبة لشهر يونيو نجد أن القدرة الحرارية للمجمع الشمسي المسطح 215 W/m^2 ، المحرقي 694 W/m^2 ، المكافئ الاسطواني 1900 W/m^2 .و في يناير : للمسطح 183 W/m^2 ، 628 ، 930.

كما تشير نتائج الأشكال 1,2,3 إلى أن فعالية عمل المركزات الشمسية العاملة على النظام المحرقي تكون جيدة في كل أنحاء اليمن في فصل الصيف ، أما في فصل الشتاء فيوصى باستخدامها في المناطق الجنوبية الغربية ، أما المركزات الشمسية الحرارية ذات المقطع المكافئ الاسطواني فتعمل في فصل الصيف بفعالية جيدة في جميع أنحاء مناطق اليمن، أما في فصل الشتاء فتعمل بفعالية أعلى في المناطق الشمالية و الجنوبية الغربية .

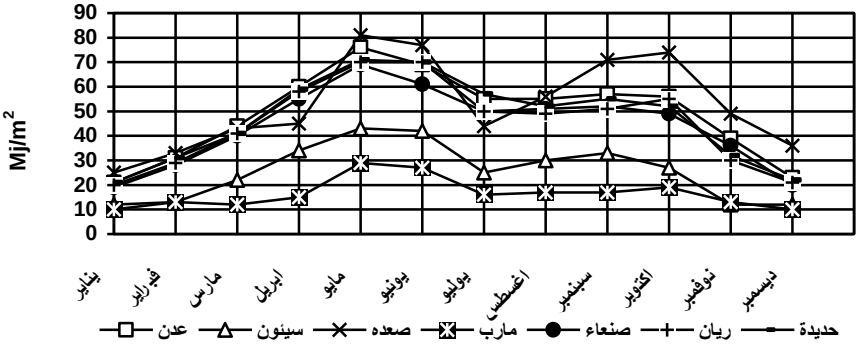
الأشكال رقم 4,5,6 فتبين نتائج حساب إنتاجية المتر المربع العامل من سطح للمجمعات المسطحة والمركّزات الشمسية الحرارية المحرقية و المركزات ذات المقطع المكافئ الاسطواني العاملة في محطات الطاقة في هذه المناطق، و يستنتج أن : الإنتاجية للمجمع المسطح تبلغ أعلاها في مايو و يونيو و اخفضها في يناير و نوفمبر .أما المركزات الشمسية المحرقية فإنتاجيتها تبلغ في أعظمها في شهر مايو و يونيو و يوليو و اخفضها في يناير و ديسمبر . المركزات الشمسية ذات المقطع المكافئ الاسطواني فتمتلك إنتاجية أعلى من المجمع المسطح و المركز المحرقي . من هنا يمكن استنتاج أن المجمع المسطح يمتلك أقل إنتاجية يليه المركز المحرقي أما المركز الشمسي ذو المقطع المكافئ الاسطواني يمتلك إنتاجية أكبر مقارنة بالمجمعين السابقين، هذا يعني أن المجمع الشمسي الحراري المسطح يمكن أن يستخدم عندما يتطلب إنتاجية صغيرة وهو قادر على العمل في كافة أنحاء مناطق اليمن و على مدار أيام السنة. أما المركزات الشمسية المحرقية فتمتلك إنتاجية جيدة على مدار أيام السنة ماعدا شهري ديسمبر و يناير ، أما المركزات الشمسية ذات المقطع المكافئ الاسطواني يمكن أن تستخدم في المحطات ذات الإنتاجية الحرارية الكبرى لإنتاج الطاقة الكهربائية وتعمل مابين أشهر ابريل ـ أكتوبر في كل مناطق اليمن ، ماعدا الشرقية منها.



شكل (4): إنتاجية محطة شمسية تعمل بالمجمع الشمسي الحراري المسطّح .

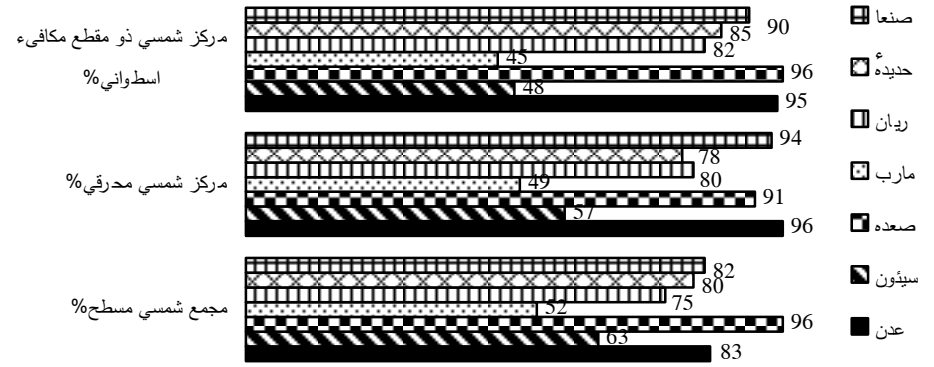


شكل (5): إنتاجية محطة شمسية تعمل بالمركز الشمسي الحراري المحرقي.



شكل (6): إنتاجية محطة شمسية تعمل بالمركز الشمسي ذي المقطع المكافئ الاسطواني .

أما بيانات الشكل 7 ، فتبين نتائج قيم معامل الاستخدام القدرة المنتجة من المحطات الشمسية العاملة بالمجمعات الحرارية المسطحة و المركزات الشمسية الحرارية المحرقية و ذات المقطع المكافئ الاسطواني ، والتي تشير إلى أن : معامل استخدام القدرة المنتجة للمجمع الشمسي الحراري المسطّح تتراوح مابين 96%-52 بالنسبة لصعدة و مأرب ، أما عند استخدام المركز الشمسي الحراري المحرقي ، فان قيمة المعامل تتراوح مابين 96%-49 بالنسبة لعدن و مأرب ، في حين بلغت قيمة معامل المركز الشمسي الحراري ذو المقطع المكافئ الاسطواني إلى ما بين 96%-45 بالنسبة لصعدة و مأرب.



شكل (7): معامل استخدام قدرة المحطات الشمسية الحرارية العاملة على : المركز الشمسي ذو المقطع المكافئ الاسطواني و المحرقي و المجمع المسطح لبعض المدن اليمنية %.

الخلاصة :

من خلال البيانات حول كمية الإشعاع الشمسي الساقط على المناطق المدروسة تم حساب القدرة الحرارية للمجمعات الشمسية الحرارية المسطحة و كذا حساب الإنتاجية الحرارية لكل من المركزات الشمسية الحرارية المحرقية و المركزات الشمسية الحرارية ذات المقطع المكافئ الاسطواني و الذي نتج عنه :

ـ تكون المجمعات الشمسية الحرارية المسطحة ملائمة للاستخدام خلال كل أيام السنة في كل أنحاء محافظات الجمهورية اليمنية ، شرط أن لا تكون القدرة الحرارية المطلوبة للاستهلاك كبيرة.

ـ المركزات الشمسية الحرارية ذات المقطع المكافئ الاسطواني ملائمة للاستخدام بفعالية في كافة مناطق اليمن مابين أشهر ابريل و حتى أكتوبر ، أما في باقي الأشهر فيمكن أن تستخدم فقط في الأجزاء الشمالية و الجنوبية الغربية منها.

ـ المركزات الشمسية الحرارية المحرقية، يمكن اعتبارها من أفضل المركزات الشمسية مقارنة بباقي المجمعات و المركزات الشمسية في اليمن. حيث يمكن استخدامها في كل أوقات السنة وفي كافة مناطق اليمن . إلا أن أكثر فعاليتها الإنتاجية تكون في المناطق الشمالية صيفا ، و في المناطق الجنوبية الغربية شتاءا.

ـ القدرة الحرارية العاملة للمجمعات الشمسية الحرارية المسطحة في المناطق اليمنية المدروسة تتراوح مابين W/m^2 49-241 و للمركزات المحرقية $153-792W/m^2$ وللمركزات الحرارية الشمسية ذات المقطع المكافئ الاسطواني $350-2240W/m^2$.

ـ إنتاجية المحطات الشمسية العاملة على المجمعات الشمسية المسطحة و المركزة الحرارية في المناطق اليمنية المدروسة تتراوح مابين $1.4-9Mj/m^2$ للمجمعات الشمسية الحرارية المسطحة و للمركزات الشمسية المحرقية Mj/m^2 5-30 ، و للمركزات الشمسية ذات المقطع المكافئ ألاسطواني $10-81 Mj/m^2$.

ـ معامل الاستخدام للقدرة المنتجة للمجمعات الشمسية تقدر قيمها كالآتي :

* معامل الاستخدام للقدرة المنتج من المجمعات الشمسية المسطحة تتراوح مابين 52-96%
* معامل الاستخدام للقدرة المنتج من المركزات الشمسية المحرقية تتراوح مابين 49-96%

* معامل الاستخدام للقدرة المنتج من المركزات الشمسية ذات المقطع المكافئ الاسطواني تتراوح مابين 95%-45.

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A Comparative Study of the Productivity and Efficiency of Thermo-Solar Collector Models in Different Climatological Conditions in Some Regions in Yemen

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Abstract

This research studies and analyzes the flat heating solar collectors, the focus solar concentrators and the parabolic cylinder concentrators in order to provide a solution to some environmental problems and the decrease of oil so as to invest operating the heating systems in Yemen. A method has been used to calculate solar heating power of meter square of effective surface, production and efficiency of usage in several zones in Yemen: Sana'a, sa'ada, Aden, Hodeida, Sayon, Ma'rib, and Rayyan.

The research concludes that flat heating solar collectors, the focus solar concentrators and the parabolic cylinder concentrators have the following results: The heating power for each is 49-241W/m^2, 153-792W/m^2 , 350-2240. W/m^2, respectively. The production solar energy stations of the above mentioned are: 1.4-9 Mj/m^2, 5-30 Mj/m^2 , 10-81 Mj/m^2 , and the usage ratio of the productive power is 52-96% , 49-96% 45-95% .

This indicates the potentiality of using these collectors and concentrators in different zones in Yemen.

Key Words: Solar collectors, Yemen, The heating power, The usage ratio