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Original Article

Prevalence of Human Cytomegalovirus Infection in Pregnant Women in Yarim City, Yemen

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ABSTRACT

To determine the Seroprevalence of cytomegalovirus in pregnant women in Yarim, Ibb governorate. A cross-sectional study was conducted in different medical centers at Yarim, Ibb Governorate, During the period between 2022 to 2023. A total of 190 blood samples of pregnant women were collected and examined. Seroprevalence of human cytomegalovirus, immunoglobulin G and immunoglobulin M was determined by enzyme-linked immunosorbent assay. Out of the 190 pregnant women enrolled in the study, 154 were seropositive for cytomegalovirus infection with overall prevalence rate as 81.05%. Furthermore, out of 190 pregnant women participated in this study, 144(75.79%) were seropositive for CMV-IgG antibodies and 10 (5.26%) for CMV-IgM antibodies. Signification differences (P<0.05) were observed between seroprevalence rate and type of immunoglobulins. The highest CMV IgG seroprevalence rate77.65% was recorded in pregnant women with age group between 20-30 years of age; whereas the lower rate 60% in pregnant women with age group of 31-40 years. Significant differences (P<0.05) were existed between IgG seroprevalence of and age groups of pregnant women tested. Similarly, the highest CMV IgM seroprevalence rate 10% was recorded in pregnant women with age group between 31-40 years of age; whereas the lower rate 4.71% in pregnant women with age group of 20-30 years old. Person`s Chi square analysis showed that there were statistically significant differences between the age and CMV-IgM. In Conclusion: Human cytomegalovirus infection is prevalent in pregnant women in study area. Proper hygienic environment, good diagnosis, introduction of vaccines and antiviral therapies could be helped in control of HCMV and related abnormalities in pregnant women and neonatal babies. Further study is required to study the epidemiology of HCMV in study area and other areas of Yemen as well.

INTRODUCTION

Human cytomegalovirus(HCMV) is a virus that infects the huge number of people wide world (Mahallawi et al., 2022; Alfaqih et al., 2023). Cytomegalovirus is a virus belongs to the herpesvirid family and only develops within human cells. This virus is the larger than others in this family, the human herpes virus 5 has a 220 nm diameter and a

genome composed of 235,000 double-stranded DNA macromolecules. Its DNA assembles as circular DNA and replicates best within human fibroblasts (Bennett *et al*., 2015).

The International Forum of Infectious diseases (IFID, 2019) has documented that the disease spreads by close interpersonal contact via body fluids like the saliva, blood, genital secretions, urine, and breast milk, or through the placenta of a pregnant woman. This virus has a lifelong latency in the cells of the premature myeloid lineage, particularly monocytes and granulocytes (Collins-McMillen et al.2018, Elder et al., 2019).

Following primary infection, infection could be associated or not with clinical manifestations (Alfaqih et al., 2023). HCMV has a profound impact on the human body and can prevail for a long time. HCMV can lead to severe sickness such as fever, liver disease, pneumonitis, abdominal pain, diarrhea, and mononucleosis in healthy individuals (Hasannia et al., 2016; AlMaghrabi et al., 2019). HCMV reactivation episodes may occur repeatedly, HCMV reactivation can lead to life-threatening conditions and organ failure, and can lead to life-threatening conditions (Ljungman et al., 2019; Sufiawati et al., 2021).

The HCMV is one of the most common congenital infections that complicate pregnancies and the well-being of newborns (Leruez-Ville and Ville., 2020). When infected, the mother can vertically transmit the virus to the fetus through the placenta or to the newborn during labor and breastfeeding, the transplacental transmission rate varies with gestational age; hence, the mother and the fetus must be thoroughly evaluated (Leruez-Ville and Ville., 2020).

The diagnosis of CMV infections is rarely performed in the common population, but it is necessary during pregnancy and in immunosuppressed patients. Multiple testing methods are nowadays available, such as antibody serum detection, direct detection from human fibroblast cultures, and quantitative real-time polymerase chain reaction (PCR) for the detection of viral DNA (Bennett et al., 2015; Alfaqih et al., 2023).

HCMV infection has been associated with numerous effects in the patients, especially in infants and immunocompromised individuals. It is therefore necessary to prevent rather than to treat the disease. This could be achieved by avoiding transplantation of CMV seropositive blood, fluid or organ to seronegative patients (BTS, 2011). Developing vaccines against HCMV have met many setbacks because of inherent genetic variability among HCMV strains. Recently, DNA capable of generating antibody response in healthy individuals has been produced (BTS, 2011; Ifeanyi and Ogbonnaya, 2017).

Globaly, the HCMV seroprevalence varies widely among geographical regions, with a seroprevalence of 66% in the European region, 75% in South and North America, 86% in the Southeast Asian region, 88% in Africa and the Western Pacific, and 90% in the Eastern Mediterranean region (Zuhair et al., 2019).

In Yemen, a few studies have investigated the prevalence of HCMV infection among pregnant women in the Northern Governorates; Sana’a, Hodeida, which found a seroprevalence of 100%, 98.7 % respectively (Yeroh et al., 2014, Alghalibi et al., 2016). whereas in southern Governorates; in Ad-Dhale'e city, the seroprevalence was as 97.6%.

The current study was designed to determine the seroprevalence of immunoglobulin G (IgG) and IgM anti-HCMV antibodies among pregnant women in Yarim, Ibb governorate, Yemen. The study findings might assist in the prevention of HCMV transmission to pregnant women in study areas.

MATERIALS AND METHODS

Study area and setting

The study was carried out in Medical Centers (Modern Diagnostic Laboratories) at Yarim district, Ibb Governorate between the years of 2022- 2023. Yarim located in Ibb governorate Yemen. Ibb located at an elevation of 1956.47 meters (6418.86 feet) above sea level, Ibb has a Subtropical desert climate. The city's yearly temperature is 24.76ºC (76.57ºF) and it is -0.77% lower than Yemen's averages.It`s typically receives about 202.99 millimeters (7.99 inches) of precipitation and has 207.9 rainy days (56.96% of the time) annually (Anonymous, 2023).

Study population

The study population were pregnant women (age range, 20 to 40 years) attending to Medical centers (the antenatal clinics, Modern Diagnostic Laboratories) at Yarim district, Ibb governorate, Yemen for routine examination.

Inclusion criterion

The study included pregnant women aged between20-40 years attending medical centers (the antenatal clinics) at Yarim district, Ibb Governorate, who consented to participated in the study.

Exclusion criterion

The study excluded non-pregnant women, women <20 years or above 40 years, pregnant women whose ages fell within the acceptable age group but did not consent to participate in the study.

study design

This is a cross-sectional was conducted during the period between 2020-2023, it was performed on pregnant women (age range, 20 to 40 years) attending medical center (antenatal clinics) Yarim district, Yemen.

Collection of samples and processing

Five milliliters of venous blood sample were collected from each participant using a needle and syringe. The blood was transferred into a test tube and labeled properly with patient's identification number. The samples were collected in laboratory under aseptic condition. The sera were separated from the whole blood and stored in the freezer until usage. The sample size was calculated based on previous studies with 95% confidence interval (P) and ±5% precise error. The sera were tested for IgG and IgM antibodies at a dilution of 1:100 Detection of CMV using an enzyme-linked immunosorbent assay (ELISA) technique using DRG kit manufacturer DRG InternationalInc US and keys given by Lamarre et al. (2016).

Semi-quantitative estimation of antibody concentration: the optical densities of the standards against their concentration were plotted and a line was drawn through the points. Sample values below 3 IU/ml were labeled as negative; whereas, values above 3 IU/ml were considered as positive. Samples giving values above 30 IU/ml were re-assayed at a higher dilution as technique described by Kumar et al. (2017).

Statistical analysis

The data collected from this study were analyzed using SPSS version 20 software. To establish the connection between age variable information and prevalence rates, the Pearson Chi-square test was employed with a 95% confidence interval and a significance level set at 0.05.

Ethical considerations

Ethical approval was obtained from the Research and Ethical Committee (REC), Albaydah University. Before commencing the study, the nature and purpose of research was explained to each participant using an informed consent form for literate participants and verbal explanation for illiterate participants.

RESULTS

In this study, 190 serum samples were collected from pregnant women from different Medical centers in Yarim, and examined, 154 were found seropositive for cytomegalovirus infection with overall seroprevalence rate 81.05 % as presented in Table 1. Furthermore, out of 190 pregnant women participated in this study, 144(75.79%) were seropositive for CMV-IgG antibodies and 10 (5.26%) for CMV-IgM antibodies. Significant differences (P=0.0122) were observed between seroprevalence rate and type of immunoglobulins as depicted in Table 2. In the current study, the highest CMV IgG seroprevalence rate (77.65%) was recorded in pregnant women with age group between 20-30; whereas the lower rate (60%) in pregnant women with age group of 31-40 years old. Significant differences (P=0.0122) were existed between IgG seroprevalence of and age groups of pregnant women tested. Similarly, the highest CMV IgM seroprevalence rate (10%) was recorded in pregnant women with age group of 31-40 years old; whereas the lower rate (4.71%) in pregnant women with age group of 20-30 years old. Person`s Chi square analysis showed that there was significant association between the age and immunoglobulins type as presented in Table 3.

Table. 1. Overall Seroprevalence of cytomegalovirus infection in pregnant women in Yarim, Ibb Governorate

No. of subjects examined	No. subjects seropositive	Seroprevalence%	95%Cl
190	**154**	**81.05**	

Table 2. Seroprevalence of cytomegalovirus IgG and IgM among all pregnant women(n=190)

CMV IgG		CMV IgM		P valu
Positive	**Negative**	**Positive**	**Negative**	P=0.0122
144 (75.79%)	46 (24.21%)	1. 10 (5.26%)	180 (94.74%)	

Table 3. Seroprevalence of anti-cytomegalovirus IgG and IgM among different age groups of pregnant women

Age group	No. of subjects screened	CMV IgG		CMV IgM		P value
		+Ve	-Ve	+ve	-Ve	0.0153
20-30	170	132 (77.65%)	38 (22.35%)	8 (4.71%)	162 (95.29%)	
31-40	20	12 (60%)	8 (40%)	2 (10%)	18 (90%)	
Total	190	144	46	10	180	

+ve= seropositive, -ve=seronegative

DISCUSSION

Human Cytomegalovirus (HCMV) is a ubiquitous virus which is transmitted either vertically and/or horizontally. The virus is incriminated as an opportunistic infection in many parts of the world (Hamid et al., 2014).

Occurrences of CMV in pregnant women have been reported. Infection of pregnant women may bring about devastating effects on the feotus, including reduced growth, enlargement of liver and spleen, jaundice and central nervous system disorder, retinitis, neurological damage, gastrointestinal problems, hepatitis, pneumonitis and adrenalitis (Springer and Weinberg, 2004; Hamid et al., 2014).

The prevalence of CMV is varies and depends upon the socioeconomic status, living conditions, and hygienic practices. In developing countries, the prevalence rate is higher than 90% in children and adults as well as in low socioeconomic groups in developed countries. In developed countries the rate is from 40% to 70% in adults in high socioeconomic groups (Colugnati, et al., 2007; Binsaad. and Taleb). In this research work was carried out on pregnant women selected from different areas of Yarim district, Ibb Governorate with main objective to determine the seroprevalence rate infections of Cytomegalovirus in relation to age.

The results of this study revealed that the overall seroprevalence of Cytomegalovirus infection among pregnant women was 81.05 %. These results are lower than findings of previous studies performed for determination of CMV in pregnant women in different regions of the world and Yemen (Neirukh et al., 2013; Hamid et al., 2014; AlMaghrabi eta l., 2019; Al-Arnoot et al., 2020; Gorun et al., 2020; Akele et al., 2023) who reported the prevalence rates ranged from 87.9-98.7%),and higher than seroprevalence rate recorded by Edrees (2010); Bagheri et al. (2012) and Lamarre et al. (2016) who reported the prevalence rates ranged from 40.1 % - 72.1%. Furthermore, Alghalibi et al. (2016) cited the prevalence rate of CMV in Arab, African and Asian countries was as following: in Saudi Arabia (92.1%), Qatar (96.5%), Bahrain (100%), Iraq (100%), Palestine (99.6%), Egypt (100%), Sudan (97.5%), and Tunisia (96.3%); and also Turkey (100%), Iran (98.8%), and the African countries Nigeria (94.8%), **Ethiopia** (88.5%), and Benin (100%). The discrepancy between results of current study and findings of above studies could be attributed to the endemicity, differences in the living and hygienic standards, differences in environmental conditions, socioeconomic statuses, social habits, lack of personal and community hygiene, and different in educational levels of the studied populations (Yeroh et al., 2014). In addition, it was reported that variations in CMV seroprevalence among women could be based on ethnical and/or racial groups (Colugnati et al., 2007).

The IgG immunoglobulin was reflected the previous infection. The presence of it doesn't prevent the re-infection or reactivation of latent infection, but may reduce the severity of pathogenesis; While, IgM immunoglobulin was considered as evidence of recent or acute infection which is formed immediately after infection and disappeared after short period 16-20 weeks (**Al**-Baiati et al., 2014).

Screening of pregnant women for CMV IgM antibodies is necessary so that the gynecologist or pediatrician can be alerted about the risk of infection to the newborn. Newborns in such cases can be tested for CMV IgM antibodies which will help in timely therapy of the infected neonate and will also prevent the spread of infection to other children. In addition, primary infection in pregnancy poses a higher risk of producing symptomatic congenital infection and fetal loss. However, infected newborns can be asymptomatic at birth with the development of late sequelae such as visual and auditory

defects in 10- 15% of the cases (Wong et al., 2000).

In the present study, out of 190 pregnant women participated in this study, 144(75.79%) were seropositive for CMV-IgG antibodies and 10 (5.26%) for CMV-IgM antibodies. Significant differences were observed seroprevalence rate and type of immunoglobulins. These results are in agreement with findings of Akele et al., (2023) and Fowler et al., (2022) who recorded a high seroprevalence of CMV IgG antibodies and low CMV IgM antibodies in pregnant women. The higher seroprevalence rate of IgG and lower rate of IgM could be explained in view of Akele et al., (2023) who suggested that the high prevalence rate of CMV IgG in the population may be due to a high herds immunity to work towards a possible elimination of CMV from the community. This is necessary because presence of CMV IgM suggest that there is still an ongoing infection and reinfection among the population.

In this study, the CMV seroprevalence was gradually decreased in the elderly age groups, these results are in agreement with findings of Alghalibi et al. (2016) and in contrary with previous study of (Binsaad and Taleb, 2022) in which the seroprevalence was increased with age. The reason behind differences in seroprevalence in between age groups may be related to the sexual activity in young age group, as sexual contact is significant source of CMV transmission (Pass, 2004; Yeroh et al., 2014). In addition, mother-to-child transmission during pregnancy is very important as infected children shed virus in their saliva and urine for years, providing an opportunity for virus spread to their parents, other family members, and other groups of children (Fields, 2002; Binsaad and Taleb, 2022). In addition, Al-Jiffri et al. (2013); Binsaad and Taleb, (2022) reported the CMV seroprevalence was reduced in women of the age group of 35-44 years old in their study. The reason could be attributed to the waning immunity in old age.

CONCLUSION

Human cytomegalovirus infection is prevalent in pregnant women in study area. Proper hygienic environment, good diagnosis, introduction of vaccines and antiviral therapies could be helped in control of HCMV and related abnormalities in pregnant women and their neonatal babies. Further studies are required to study the epidemiology of HCMV in pregnant women in study area and other geographic zones of Yemen as well.

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COMPETING INTERESTS

The Author declare that they have no competing interests.

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الانتشار المصلي لفيروس مضخم الخلايا بين النساء الحوامل في مدينة يريم، اليمن

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الملخص

فيروس المضخم للخلايا أو (CMV) ويعرف أيضا باسم فيروس الهربس herpesvirus. ينتقل الفيروس (CMV) من الأم إلى الجنين أثناء الحمل بعد اصابة الأم بالفيروس، وقد يؤدي الى حدوث عيوب خلقية للجنين مثل تأخر النمو او موت الجنين داخل الرحم. هدفت هذه الدراسة الي تحديد معدل الانتشار المصلي للفيروس المضخم للخلايا لدى النساء الحوامل في مدينة يريم بمحافظة إب. أجريت هذه الدراسة العرضية المقطعية في عدد من المراكز الطبية في يريم بمحافظة إب خلال الفترة ما بين 2022 إلى 2023. تم جمع وفحص ما مجموعه 190 عينة دم من النساء الحوامل المشاركات بالدراسة. تم تحديد نسبة الانتشار المصلي للفيروس والجلوبيولين المناعي G والجلوبيولين المناعي M بواسطة اختبار الامتصاص المناعي المرتبط بالإنزيم. كشفت نتائج الدراسة ان من أصل 190 امرأة حامل تم معاينتهن، كانت 154 امرأة إيجابية المصل لعدوى الفيروس المضخم للخلايا وبنسبة انتشار كلي (81.05%). من بين 190 امرأة حامل شاركت في هذه الدراسة، كانت 144 امرأة (75.79%) إيجابية مصليًا للأجسام المضادة CMV-IgG و10 (5.26%) للأجسام المضادة CMV-IgM .لوحظ فروق إحصائية ذو دلالة (P <0.05)معنوية بين نسبة الانتشار المصلي ونوع الغلوبولين المناعي. سجل اعلى نسبة للانتشار المصلي (77.65%) لـ CMV IgG في النساء الحوامل اللاتي تتراوح أعمارهن بين 20-30 سنة؛ بينما اقل نسبة (60%) في النساء الحوامل اللاتي تتراوح أعمارهن بين 31-40 سنة. وبالمثل، تم تسجيل أعلى نسبة للانتشار المصلي (10%) لـ CMV IgM في النساء الحوامل اللاتي تتراوح أعمارهن بين31-40 سنة، و اقل نسبة 4.71% لدى النساء الحوامل اللاتي تتراوح أعمارهن بين 20-30 سنة. لوحظت فروق ذات دلالة إحصائية (P <0.05) بين نسبة الانتشار المصلي للفيروس وعامل العمر للنساء الحوامل اللاتي شاركت بالدراسة. خلصت الدراسة الى إن عدوى الفيروس المضخم للخلايا البشرية منتشرة بين النساء الحوامل في منطقة الدراسة. يمكن أن تساعد البيئة الصحية المناسبة والتشخيص الجيد واستخدام اللقاحات والعلاجات المضادة للفيروسات في السيطرة على فيروس HCMV والتشوهات المرتبطة به عند الأطفال حديثي الولادة. يجب اجراء المزيد من الدراسات الوبائيات على فيروس HCMV في منطقة الدراسة والمناطق الأخرى في اليمن ككل.

الكلمات المفتاحية: الفيروس المضخم للخلايا، النساء الحوامل، الانتشار المصلي، يريم، اليمن

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Original Article

Echinococcus granulosus in human and cattle: an epidemiology and economic losses of condemned organs

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ABSTRACT

The study was conducted between 2016 and 2019, on epidemiology of *E. granulosus* infection (cystic echinococcosis) in humans and cattle and it`s economics' losses on condemned organs at Dhamar city. In human, a retrospective study was conducted by reviewing the records of patients hospitalized in government and private hospitals, out of 323 records reviewed, 46 (14.24. %) cases were found positive. The higher infection rate of *Echinococcosis granulosus* infection was recorded in liver (13.93%); whereas, the lower in lung (0.31%). The infection was more among female patients (8.05%) compared to male (6.19%) and age group of 30-35 years old (5.88%). The higher prevalence rates recorded were 9.91%,2.17%, 6.5% and 9.29% in rural, month of January, Dhamar General Hospital Authority(DGHA) and Ultrasound technique respectively. Significant differences (P<0.05) were observed between the infection rate and age and diagnostic techniques used; whereas none with other factors investigated. In animals, using prospective study. Out of the 323 cattle examined by postmortem inspection and serodiagnosis tests, 40 (12.38%) were found positive for *E. granulosus* infection. The distribution of different cysts in different organs were 4.64%, 4.04% and 3.72 in liver, lungs and mixed infection respectively. Significant differences (P<0.05) were observed in distribution of hydatid cysts in different organs of animal. Fertility and viability tests revealed that, 63(44.68%) were fertile, 64 (45.39%) sterile, and 14(9.93%) calcified cysts. There were significant differences (P<0.05) in fertility of cysts of different organs (P<0.05). The cysts of lung origin were highly fertile. The higher prevalence rates were recorded in age groups of 5 ≥ years old (16%), Females (9.29%), Month of January (1.55%) and Post mortem examination (8.98%). Significant differences (P<0.05) were observed between prevalence rate of infection and all variables investigated with exception sex variable. The total economic losses due to organ condemnation and meat production in cattle slaughtered at Dhamar municipal abattoir is estimated as 2727387.52 YR ($ US 7.312.03). In conclusion, *E. granulosus* infection is prevalent in study areas and represent an important health problem for human and cattle, which requires appropriate strategies for its control.

INTRODUCTION

E. granulosus infection or Cystic echinococcosis (CE) is a severe zoonosis caused by the cyclophyllidean cestode *Echinococcus granulosus*. The disease has a worldwide distribution, with endemic regions in many countries of the Mediterranean basin, North and

East Africa, Western and Central Asia, China, South America, and Australia (Jenkins, 2005). Although the distribution of *E. granulosus* is considered worldwide, it is higher in developing countries in tropics and subtropics, especially in rural communities where there is close contact between dogs and various domestic animals (Regassa et al., 2010; Arif et al., 2013; Mwangi, 2019; Khan et al., 2021; Tekeste et al., 2023).

The adult parasites are found in the small intestine of the carnivores particularly dogs and hydatid cysts in ungulates and humans. Eggs are released from the digestive tract of the carnivore into the environment (Regassa et al., 2010; Rashikj et al., 2022). After oral uptake of eggs by the intermediate host, a larva stage penetrates the intestinal wall and reach visceral organs such as liver, lung, heart and kidney of animals and humans. In these internal organs the larva grow and develop to hydatid cysts (Hui etal., 2012; Wang et al., 2014; Biniamin and Anwar, 2018). In animals, *E. granulosus* infections disease not apparent to farmers, but causes consider economic and public health impacts, in their animals (Moro and Schantz, 2009; Ahmadi, 2011).

The economic importance of echinococcosis in livestock, besides to its public health importance, infection has severe economic implications in ruminants' industry (Nigo et al., 2022) due to the condemnation of the Partial or whole edible carcasses and offal such as liver, lung, heart and other organs (Torgersonetal., 2000). In severe infection, the parasite may cause retarded performance and growth, reduced quality, yield of meat and milk. In addition, the costs of treatment and control which have been estimated to be over USD 3 billion annually worldwide (Getaw et al., 2010; Efrem et al., 2015; Belmamoun et al., 2017; Nigo et al., 2022).

Human is infected with *E. granulosus* during natural transmission of the disease from carnivores to domestic animals by inadvertently consuming eggs of *E. granulosus* through contaminated food, water and soil, or through direct contact with dogs (Wang et al., 2014). The clinical manifestations of cystic echinococcosis (CE) are variable and are determined by the site, size and condition of cysts (Moro and Schants, 2009). In general, the cysts can cause life-threatening illness associated with liver failure, pulmonary edema (Brehm et al., 1999), rapture of the cyst, which may cause fatal anaphylactic shock in human (Regassa et al., 2010). Overall economic losses in human in world due to this disease are estimated as two billion US$ annually and CE is believed to affect more than one million people worldwide (Dakkak, 2010; Joanny et al., 2022).

Cystic Echinococcosis is one of the major parasitic disease in humans and livestock, various studies have been reported the exist and prevalence of the disease in Yemen and other countries of world (Lahmar et al., 1999; Bardonnet et al., 2003; M'rad et al., 2005; Bhattacharya et al., 2008; Zanini et al., 2008; Acosta-Jamettet al., 2010; Muqbil et al., 2012; Al-shebani et al., 2012; Singh et al., 2013; Al-Shaibani et al., 2021).

Despite the above studies, the *E. granulosus* infections has not been investigated sufficiently, and information related to its prevalence and economic impact is still limited especially in Dhamar city areas; Therefore, the aim of this study was to study an epidemiology of *E. granulosus* infection in humans and cattle and it`s economics' losses on condemned organs at Dhamar city, Dhamar governorate, Yemen.

MATERIALS AND METHODS

Study areas

The study was conducted in Dhamar city, Dhamar governorate, Yemen with main objective to epidemiology of *E. granulosus* infections in humans in some medical centers at Dhamar. Similarly, Study on cattle was carried out at slaughterhouse of Dhamar city. Dhamar is located approximately 100 km south to Sana'a, the capital of the country. Its lies between 14° 58 'N latitude, 44° 43'E longitude and at altitude of 2330 meter above sea level (NIC**, 2021)**. The area receives average rainfall ranging from 64.2 to 68.8 mm. The mean temperature and relative humidity are 16.5°C and 59.7% respectively. Majority of population are working in Agriculture and related field.

Study on human

Study subjects, size and collection of samples and data processing

A retrospective study was conducted by reviewing the records of patients in Dhamar hospitals to study epidemiology of *E. granulosus* infections (cystic hydatid; echinococcosis) among 323 patients hospitalized in government and private hospitals including: Dhamar G.H, Queen Arwa , Dar AlShifa and Alnada hospitals and Alawlagi

laboratory in Dhamar city between March 2016 and February 2019. All medical records of patients treated surgically to remove the cysts were reviewed and collected. The general information regarded of each patient as follows: Age, sex, residency, the anatomic location of cysts and diagnostic used where obtained. Records were brought to Department of Veterinary parasitology, Faculty of Agriculture &Veterinary Medicine, Thamar University for further processing and analysis according to the guidance of Saida and Nouraddin **(2012).**

The sample size for both human and cattle studies was calculated according to keys given by Thrufield (2007) by considering 30% expected prevalence and 5% accepted error at 95% confidence interval using this formula: N=1.962 *Pexp(1-Pexp)/d2; *where, N=required sample; Pexp=expected prevalence; d=desired absolute precision.* Accordingly, a total of 323 cattle were sampled by simple random sampling method**.** Three hundred twenty-three records of patients were Reviewed and analyzed in this study.

Study on animals

A cross sectional observational study method was carried out on cattle between period of 2016 -2017 to study epidemiology and economic losses of *E. granulosus* infection in slaughtered cattle in Dhamar municipal slaughterhouse, Dhamar city.

Study animals

The study animals were indigenous and non-indigenous cattle brought to the abattoir for slaughter from districts around the Dhamar city. slaughtered animals were with different age and sex.

Sample Size and Sampling Method

Similarly, the sample size was calculated according to keys given by Thrufield (2007) by considering 30% expected prevalence and 5% accepted error at 95% confidence interval using this formula: N=1.962 *Pexp(1-Pexp)/d2; *where, N=required sample; Pexp=expected prevalence; d=desired absolute precision.* Accordingly, a total of 323 cattle were sampled by simple random sampling method**.**

Study methodology

Ante-mortem examination

Regular visits were made to conduct ante mortem examination of animals brought for slaughtering to slaughterhouse. The animals arrive early morning on the day of slaughtering or the day before to make the ante mortem, during this time, individual animals were identified with regard to sex and body condition score and the results were recorded accordingly. The animals were divided into five-age categories (1 year ≤, 2yrs, 3yrs, 4yrs and 5≥ years). Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by De Lahunta and Habel (1986). All the animals were identified based on enumerated marks on their body surface using ink.

Post-mortem examination

The slaughtering of animals was carried out according to Islamic method of ritual slaughter then post-mortem inspection of offal's and carcasses was performed under the responsibility of veterinary inspectors and researcher. Postmortem examinations were thoroughly carried out by visual inspection, palpation, and systematic incision of each visceral organ particularly the lung, liver, spleen, kidney, and heart carried out according to procedures recommended by Parija (2004), Regassa et al. (2010) and Haftu & Kebede **(2014).** Infected organ was kept in aseptic and clean container with properly labeled information necessary for analysis and brought to Department of Veterinary Parasitology laboratory, Faculty of Agriculture and Veterinary Medicine, Thamar University, for processing and examination.

Laboratory examination

In the laboratory, the size (diameter in centimeters) of each and individual cysts randomly selected was measured, and the number of cysts per organ was counted and recorded. The cysts randomly selected and collected from different organs were subjected to fertility tests. All organs harboring hydatid cysts were partially or totally condemned and judged according to guidelines on meat inspection for developing countries Herenda et al., (1994). According to their size, hydatid cysts were then classified as small classified as small (1-2cm, medium (3-4 cm), and large (above 5 cm) in diameter; according to Oostburg et al. (2000)

Azordegan and Pour Liakbar (2007) and Fakhar et al. (2007).

Examination of Cysts and Viability of Protoscoleces

In fertility test, the cyst wall was carefully opened with scalpel blade and the contents were poured into a clean glass Petri dish or using syringe and examined under a microscope (×40) for the presence of hydatid protoscolices. If the protoscolices were present, seen as white dots on the germinal epithelium or brood capsule or hydatid sands within the suspension, the cyst was categorized as fertile according to technique described by Haftu and Kebede (2014). Furthermore, infertile cysts were further classified a sterile or calcified. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling up on incision.

Serological study

Blood samples were collected from cattle in a septic manner and brought to parasitology laboratory, Department of Veterinary Parasitology, Faculty of Agriculture and Veterinary Medicine, Thamar University and private laboratory. In laboratory, serum was separated and stored at 20 Celsius. ELISA assay was used to detected the presence of antibody against *E. granulosus* in serum according to the manufactures instructions and guidance of Hui et al. (2012).

Economic analysis

The economic losses due to *E. granulosus* in cattle, both direct and indirect losses were estimated following the guidance given by Endrias et al., (2010). and Haftu et al. (2014). The calculation of the direct losses is based on condemned organs (lung and liver,) and the indirect losses were assessed based on live weight reduction due to hydatidosis. In calculating cost of condemned edible organs and carcass weight loss, six Different meat sellers were interrogated randomly to establish the price per unit organ and the collective price of lung and liver was determined. Average price was drawn out from that data and this price index was later used to calculate the meat loss in terms of Yemeni Rial (YR). Average annual slaughter rate of cattle in Dhamar municipal slaughterhouse was estimated based on retrospective analysis of data recorded one year (2017). A 5% estimated carcass weight loss due to bovine hydatidosis was taken into account to determine the carcass weight loss. Average carcass weight of an indigenous and non-indegenous was taken as 126 kg. using the following formula:

Direct loss from organ condemnation Annual economic loss=(PI1x TkxC1) + (PI2xTkxC2) + (PI3xTkxC3).

Where PI1=Percent involvement of lung out of the total examined, PI2=Percent involvement of liver out of the total examined, PI3 Percent involvement of Liver and lung out of the total examined, C1=Average market price of liver, C2=Average market price of lung, C3=Average market price of liver and lung, TK=Average annual kill of bovines.

Indirect loss from carcass weight loss Annual economic losses due to carcass weight loss=Ns × Ci × Pa

Where Ns=Total number of animals slaughtered and positive for hydatidosis; Ci=Carcass weight lost in individual animals; Pa=Average market price of a kg of beef in Dhamar. Annual economic losses were calculated by adding both direct and in direct losses.

Statistical Analysis

The categorical data for each respective analysis were organized in contingency tables and were analyzed with Pearson's Chi-square Test for Independence. Values were presented as percentage from the total specimen count in the corresponding groups. The significance level was set at $p<0.05$..

RESULTS AND DISCUSSION

In human study, 323 patients recorded were selected and examined from different public and private hospitals and diagnostic laboratory of Dhamar city, 46 patients were found positive and 277 negatives for *E. granulosus* infections. The overall prevalence rate recorded is 14.24% (46/323).

The higher infection rate of *E. granulosus* infection was recorded in liver (13.93%); whereas, the lower in lung (0.31%). No cases infections were detected on other organs of subjects examined. Significant differences ($P<0.05$) were observed in prevalence rate of infection between the affected organs (Table 1).

The distribution of *E. granulosus* infection according to age, sex, residence, month variation, Medical centers and diagnostic techniques are presented in Tables 1&2. Accordingly, the higher rate of infection was recorded in age group of 30-35 years old (5.88%); whereas, the lower rate in age group of 40-45 years old (1.86%). Significant differences (P<0.05) were observed between prevalence rate and age groups. Infections were more among females (8.05%); compared to males (6.19%). Significant differences (P<0.05) were not observed between prevalence rate and sex groups of patients.

On the basis of residence, Medical centers (Hospitals or Laboratory) and diagnostic techniques, the higher prevalence rates were recorded in Rural, DGHA. and Ultrasound technique as 9.91%, 6.5% and 9.29% respectively; whereas, the lower prevalence rate in Urban, Tiba hospital and diagnostic technique used as 4. 33%, 0.0% and 1.86 % respectively. Statistically, significant differences (P<0.05) were observed between prevalence rate and residence and diagnostic technique used; whereas, none with medical centers subjected to investigation (Table 1). The distribution of *E. granulosus* infection in human according to month variation or season (Table 2). As shown, the prevalence rate was recorded in month of January (2.17%) and the lower in months of November (0.62%). Significant differences were not observed between prevalence rate and month variable.

Results of animal's study

Out of 323 cattle slaughtered and examined, 40 (12.38%) were found harbored hydatid cysts of E. *granulosus* either in single or in multiple number. The result of distribution of *E. granulosus* infection in cattle according to breed, age, sex, organ and diagnostic technique used are presented in Table 3. The higher prevalence rate of *E. granulosus* infections was recorded in indigenous breeds (10.84%) compared to Non-indegenous (imported) breeds (1.55%).

The higher prevalence rate (5.6%) of infection was recorded in animal group of 3 years old; whereas, the lower rate (0.3%) in 2 years' age group. Sex-wise data indicated that the higher infection was recorded in females (9.29 %) compared to males (3.10%). The higher rate of infection was recorded in liver (4.64%) compared to lung (4.02). Mixed infection was observed in this study with infection rate researched to 3.72%. Two types of diagnostic techniques were used for diagnosis of *E. granulosus* infection including: Post mortem examination and serological techniques both techniques detected 29 cases (8.98%) and 11(3.11%) respectively. Statistically, significant differences were observed (P < 0.05) between the prevalence rates of infection and breed, age, sex, organ and diagnostic technique used.

The effect of month variation (season) in distribution of *E. granulosus* infection in cattle during different months of year is presented in Table 4. As shown, the higher infection rate was recorded in the month of January (1.55%); whereas, the lower rate was in the month March (0.62%). No significant differences (P<0.05) were observed in prevalence of *E. granulosus* infections and month variation.

The correlation between the prevalence rate *E. granulosus* infection in cattle and meteorological data including Monthly mean of temperature, relative humidity and rainfall during the year of study period are presented in Fig. 1. As shown, there are slightly increased in prevalence rate of infection in the month of January compared to other month of the year. Statistically, significant differences were not observed (P < 0.05) between the prevalence rates of meteorological data.

The systematic size measurement of the cysts revealed that majority of large, medium and small sized cysts were found in lungs while, the low number of small and medium sized cyst were found in liver. The size of cysts was categorized as 1-2cm, 3-4 cm and 5 and above cm for small, medium and large cysts respectively. There were significant differences (P<0.05) among size of cysts of different organs as presented in Table 5.

The fertility and sterility rates of *E. granulosus* cysts are presented in Table 6. As shown, the results of fertility and sterility, reveals, in general, 44.68%, 45.39% and 9.93% were fertile, sterile and calcified respectively. There were significant differences (P<0.05) between fertility and sterility rate of cysts in different organs.

Economic losses study:

The data of economic losses study due to *E. granulosus* infection in cattle slaughtered at slaughterhouse of Dhamar city annually are presented in Table 7. The annual economic loss due to organs condemnation was estimated as follows:

I. **Annual economic loss due to organ condemnation**=(PI1xTkxC1)+ (PI2xTkxC2) + (PI3xTkxC3)= (0.0404 × 13528 × 200) + (0.0464 × 13528 × 3200) +(0.0372 × 13528 × 1700=2724106.3YR.
II. **Annual economic losses due to carcass weight loss**=Ns × Ci × Pa = =0.1238 × 0.05 × 146.23 × 3625 = 3281.3 YR.
III. **Annual economic loss**=Annual economic losses due to organ condemnation + Annual economic losses due to carcass weight loss. Annual economic loss= 2724106.3 + 3281.3= 2727387.52 YR. Hence, the total loss from organ condemnation and meat production loss in cattle slaughtered at Dhamar municipal abattoir is estimated at 2727387.52 YR, considering the $US one Dollar equivalents 373YR in 2017; thus, The annual economic loss due to organs condemnation estimated in Dollar is $ US 7.312.03

Table 1. Distribution of *E. granulosus* infection in human according sociodemographic characteristics, anatomical site and Diagnostic techniques (n=323)

Characteristics	Categories	No. of Subject Infected	Prevalence %	P value
Organ	Liver	45	13.93	0.00
	Lung	1	0.31	
Age group	20 ≤	10	3.10	0.01
	30-35 Yrs	19	5.88	
	40-45 Yrs	6	1.86	
	50≥	11	3.41	
Sex	Female	26	8.05	0.135
	Male	20	6.19	
Residence	Rural	32	9.91	0.039
	Urban	14	4.33	
Medical centers	Dhamar G.H.	21	6.50	0.516
	Alawlagi	13	4.02	
	Almaleka	6	1.86	
	Dar AlShifa	3	0.93	
	Alnada	3	0.93	
	Taiba	0	0.00	
Diagnostic Technique	Ultrasound	30	9.29	0.000
	Serological test	10	3.10	
	Clinical signs	6	1.86	

Table 2. Distribution of *E. granulosus* in human according to month variation(n=323)

Month	No. of Subjects infected	Prevalence %	P value
Dec	3	0.93	
Oct	3	0.93	
Apr	4	1.24	
January	7	2.17	0.675
Nov	2	0.62	
Feb	4	1.24	
Mar	4	1.24	
Jun	3	0.93	
Jul	4	1.24	
Aug	6	1.86	
May	4	1.24	
Sep	2	0.62	

Table 3. Distribution of *E. granulosus* infection cattle according to animal characteristics, anatomical site and diagnostic technique used (n=323)

Characteristics	Categories	No. of Subject Infected	Prevalence %	P value
Breed	Local breed	35	10.84	0.004
	Imported breed	5	1.55	
Age group	one year≤	3.0	1.3	0.002
	2yrs	1.0	0.3	
	3yrs	18.0	5.6	
	4yrs	2.0	0.6	
	5≥yrs	16.0	5.0	
Sex	Female	30	9.29	0.000
	Male	10	3.10	
organ	Liver	15	4.64	0.000
	Lung	13	4.04	
	Mix infection	12	3.72	
Diagnostic Technique	Post mortem	29	8.98	0.000
	Serological test	11	3.41	

Table 4. Distribution of *E. granulosus* in cattle according to month in at Dhamar city(n=323)

Month	No. of animals infected	Prevalence %	value
Dec	4.0	1.24	0.999
Oct	4.0	1.24	
Apr	2.0	0.62	
Jan	5.0	1.55	
Nov	3.0	0.93	
Feb	3.0	0.93	
Mar	2.0	0.62	
Jun	3.0	0.93	
Jul	4.0	1.24	
Aug	4.0	1.24	
May	3.0	0.93	
Sep	3.0	0.93	

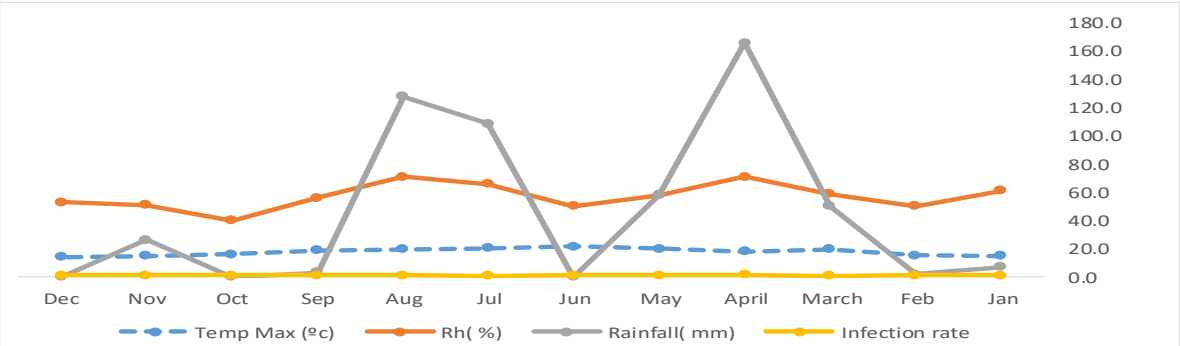

Fig. 1. Correlation between the Prevalence rate of *E. granulosus* infection in cattle and Meteorological data atDhamar in Study Period

DISCUSSION

Study in Human

The epidemiology of *E. granulosus* infection in human in many countries has been investigated, but at Dhamar Yemen little data available. The results of this study revealed that cystic echinococcosis is common prevalent in humans at Dhamar city, Yemen. These results are in agreement with findings of Azazy et al. (2000), Alghoury, et al. (2010); Al-Shebani et al. (2012) who carried out studies in human's echinococcosis in Yemen and other studies in elsewhere in world (Acosta-JamettMan et al., 2010; Rahimi et al., 2011; Manfredi et al., 2011; Mandal and Mandal, 2011; Khan et al., 2013; Singh et al., 2013; Karshima et al.,2022; Hogea et al., 2024).

In this study, the overall prevalence of *E. granulosus* infection in humans in Dhamar was 14.24 %. This prevalence higher than prevalence rate reported by Kebede et al. (2000); Zanini et al. (2009); Acosta-Jammett et al. (2010); Alghoury, et al. (2010); Mandal and Mandal (2011) and Saida and Nouraddin (2011); Al-Shaibani et al. (2015); Li et al. (2019); Karshima et al.(2022). Who reported prevalence rate ranging between 0.9-10 %, and it's lower than findings of Zhenghuan et al. (2008); AlShibani et al.(2012),; Singh et al. (2013), who reported the prevalence rate up to 15.8 percent. The differences in the prevalence rate recorded in this study and above workers may be attributed to socio-economic, cultural status, standard medical services and size of the samples.

The higher rate of infection was recorded in liver compared to lung. No cases infections were detected on other organs of subjects examined. These Results are in complete agreement with findings of Djuricic et al. (20210); Saida and Nouraddin (2011); Al-Shebani et al. (2012) and Habtie (2019; Eshraghi et al., 2022). Moreover, Derfoufi (et al., 2012) Suggested that, in humans, the parasite may, in principle, infest all organs but exhibits a predilection for the liver (70%-80% of cases), followed by the lung (20%-30%). Less commonly involved are the spleen, central nervous system, and other organs. The differences in the prevalence rate recorded between liver and lung could be explained in view of Djuricic et al. (2010) who cited that Hepatic cysts were found more frequently than pulmonary cysts, at a ratio of 2:1. Pathophysiological influences on the anatomic location of cysts are still unknown; however, likely the liver is more commonly infected because oncospheres penetrating the intestinal wall are preferentially disseminated to the liver via the portal vein.

In the present study, the higher infection rate of *E.granilosus* was recorded in age group of 30-35 years old. The results of this study are in consistent with findings of Al-Shebani et al. (2012; Eshraghi., 2022) and in contrast with findings of Zanini et al. (2009), Saida and Nouraddin (2011), who studies the epidemiology of echinococcosis in humans and animals. The Higher prevalence rate of echinococcosis infection in age group of 30-35 years old might be due to the exposure to the contaminated environment. Stray dogs mostly occupy open areas like those that parks which are preferred sites for majority of people thus are exposed to parasite eggs. Parasite eggs survive and remain infective for months under favorable conditions such as high humidity and low temperature (Fomda et al., 2015). In addition, Al-Shebani et al. (2012) suggested that human cystic echinococcosis may be occur in the subjects/patients in between 1-75 years of age, but high prevalence rate recorded in age groups from 20-40 years old.

The higher infection rate in females compared to males found in this study are in the line with findings of previous studies(Alghoury, et al. (2010); Al_Shebani et al. (2012); Babadjanov et al., 2021) who reported that females are more prone to infection compared to males. On other hand, these results are contrary with finding of Fomda et al. (2015) who reported that males are more influencing by the infection of echinococcosis in India. Traditionally, in Yemen, the females are more associated to animals either in the home or in field. This association may be increased the risk of infection and transmission of diseases to them (Al-Shaibani et al., 2015).

The risk factors such residence, month's variation, Medical centers (hospitals and Lab) and diagnostic techniques and their influencing in distribution of *E. granulosu* prevalence in individual investigated. The results revealed that, the higher prevalence rates were recorded in Rural, month of January, Dhamar G.H and Ultrasound technique respectively; whereas, the lower prevalence rate were recorded in Urban, November, Tiba hospital

and clinical signs diagnostic technique used respectively.

The higher prevalence rate of infection in rural are in agreement with findings of Djuricic et al., (2010) and Fomda et al. (2015) and in contrary with finding of Eshraghi et al. (2022)in Iran and Ullah et al., (2023) in Pakistan . The higher prevalence rate of infection in rural areas may be due to the people are closely related to animals and echinococcus biological cycle, poor economic conditions, low education levels and poor medical services, Contamination of soil by dog feces. In addition, farming is the main occupation in rural areas thus rural population is at a high risk of acquiring infection because people come in contact with contaminated soil and inhale dust containing eggs during farming activity (Siddharth et al., 2012).

In current study, the higher rate of infection recorded in January; whereas, the lower rate in November. These results are in agreement with findings of Mohamadin and Abdelgadir (2011); Al-Shaibani et al., (2015). The reason behind that could be attributed to that in January, the environmental is suitable for survival and development of parasites.

The patients who admitted either in governmental or in private medical centers for clinical examination or surgical operation due to echinococcosis during same period of study were more in Dhamar G.H comparing to other medical centers. This could be attributed to the size and source of the samples examined.

Echinococcosis lesions of the liver or other organs are detected by means of diagnostic imaging methods, such as ultrasonography, magnetic resonance imaging (MRI), or computed tomography (Stojkovic et al., 2012; Babadjanov et al., 2021). The diagnosis of Echinococcosis using serological methods remains controversial (Schweiger et al., 2012). Serological methods currently employed in the diagnosis of Echinococcosis include the enzyme-linked immunosorbent assay (ELISA), the indirect hemagglutination test (IHA), the latex agglutination tests, and immunoblots (Nunnari et al., 2012; Eshraghi., 2022). In this study Ultrasound technique detected more cases of Echinococcosis compared to other techniques used. Ultrasonography is the diagnostic method of choice recommended for the work-up of cystic liver lesions and Echinococcosis (Tabain et al., 2010). Ultrasound represents a safe and cost-efficient method that is superior to both computed tomography (CT) and magnetic resonance imaging (MRI) in the visualization of the morphology of cystic lesions (Liang et al., 2005). In addition, ultrasound facilitates the recognition of cystic echinococcosis in asymptomatic disease stages (Kilimcioğlu et al., 2006).

In cattle study

The current study reveals that the prevalence rate of *E. granulosus* infection in cattle was 12.38%. Previous studies carried out on *E. granulosus* infection in cattle in Yemen (Muqbil et al., 2012; Lahmar et al., (2013);AlShaibani et al., 2015; Hezam et al., 2016) reported the prevalence rate ranging between 7.2 -15.2%; whereas, in different countries of world reported different prevalence rates of *E. granulosus* infection either low or higher rates for example; in Turkey, Umur (2003a); in Morocco, Azlaf and Dakkak (2006); Fakhar, 2007; in Wale, Daryani et al., 2009; in Ethiopia, Regassa et al. (2010); in S. Arabia, Ibrahim (2010); in Sudan, Moamadin and Abdelgadir (2011); in Ethiopia, Fikire et al. (2012); in Iran, Azami et al. (2013); in Libya, Tamarozzi et al., (2020) in European, Mediterranean and Balkan countries, Kassem et al. (2013) in Pakistan, Khan et al., (2021), the prevalence rates reported by the above workers were ranged from 2.5- 68.73%. The contrary between the prevalence rate recorded in this study and rates reported by above workers may be attributed to size of samples, difference in strains of *E. granulosus* that exist in different geographical regions, difference in culture, social activity, and availability of dog in study area (Regassa et al., 2010). In addition, Zewdu et al., (2010) cited that *E. granulosus* is known to be important in livestock and public health in different parts of the world and its prevalence and economic significance has been reported by different workers in different geographical areas.

The prevalence rate of *E. granulosus* infections in indigenous cattle were comparatively more than non-indigenous breed. These results are in agreement with suggestion of AlShaibani et al. (2021) who cited that, the varying in infection percentages among livestock in the countries could be attributed to the animals' management system, abundance of definitive hosts, stock population, breed of animals and slaughtering process. Furthermore, Gusbi et al. (1990) reported varying ecological zones of echinococcosis in different areas of country leading to varying infection rates have

been reported in various domestic herbivores in Libya and other countries.

In the current study, the higher rate of infection was recorded in animals of 3years old and elder animals; whereas, lower rate in younger animals age group. The results of this study are in line with findings of Kassem et al. (2013) in Libya and Saleem et al.,(2023) in Pakistan, who observed that elder animals are more infected with *E. granulosus* infection compared to younger animals. The higher infection rate recorded in elder animals group may be due to aged animals have longer exposure time to eggs of *E. granulosus* compared to younger animals.

Sex risk factor was found to be positively associated with *E. granulosus* infection, females' cattle being more likely to be positive than males. These results are in agreement with the findings of Daryani et al. (2007), who observed that the prevalence rate was higher in females than males. The higher rate of infection in female animals may be attributed to more female animals are bought to abattoir and slaughtered compared to male during study period.

The higher infection rate was recorded in the month of January (1.55%); whereas, the lower rate was in the month March (0.62%). These results are parallel with findings of Mohamadin et al. (2011) who also documented a higher prevalence rate in winter. The increase incidence\prevalence of the disease in winter may be due to the survival of the cyst in the organs for several days under colder temperatures as compared to hot summers. However, in contrast with findings of Mansoor lakooraj et al. (2011) who evaluated the month variation or seasonal effects on the condemnation of infected organs of cattle with *E. granulosus* infection. The reasons for a higher number of infections recorded during winter could be attributed to the fact that there was also a higher inflow of cattle for slaughter in winter as compared to other seasons or month or the season of winter favorable for spreding of E. *granulosus* infection (Khan et al., 2013).

The results of this study revealed that, the prevalence rate of *E. granulosus* cysts was slightly higher in liver compared to lungs organs of investigated in cattle. These results are in agreement with findings of kouidri et al. (2012); Azami et al. (2012); Melaku et al. (2013); who evaluated the prevalence rate of hydatid cysts in liver of cattle and reported liver are more infected with hydatid cysts compared to other organs examined in their studies. However; these results in contrary with findings of by Kebede et al. (2006), Getaw et al. (2010), Zewdu et al., (2010) and Banda et al., (2013) who reported that prevalence rate of infection in lung was more than liver. The differences could be due to the fact that liver possesses the first capillaries sites encountered by the migrating Echinococcus onchosphere which adopt the portal vein route and primarily hepatic filtering system sequentially before any other peripheral organ is involved (Urquhart et al., 2003; Kebede et al., 2009; Getaw et al., 2010).

In the current study, the *E. granulosus* cysts count was the highest in lung compared to liver. In addition, lung harbored a higher frequency of large, medium, and small cysts; whereas, liver found to harbor low number of cysts. This fact can be explained in view of Getaw et al. (2010) who suggested that the relative softer consistency of lung and liver allowed easier development of the pressure of cyst. Furthermore, Banda et al., (2013) suggested that, the lungs however have a larger capillary bed than any other organs and this could account for the observed higher number of cysts than seen in the other organs. The higher number of small cyst observed in both organs in this study may be indicate late infection of the animals as a result of heavy rainfall and continuous grazing in the past raining season or due to immunological response. Rainfall and moisture favor the survival of eggs of echinococcus species and at the same time eggs may get chance to be disseminated by flood (Urquhart et. al., 2003). Furthermore, suggested that, such variations in cyst abundance are mainly due to the spatial distribution and the infectivity (biotic potential) of *E. granulosus* eggs and to the susceptibility and defensive capabilities of the host.

Fertility and sterility of hydatid cysts in various organs of cattle are important indicators of potential sources of infection to perpetuate the disease in dogs (Mulatu et al., 2013). The fertility and sterility of cysts collected and tested from various infected organs of cattle in present study in general, were 63.0% and 45.39% respectively. These results are in partial agreement with findings of Zewdu et al. (2010) and these rates are less than rates reported by Muqbil et al. (2012) and Kouidri et al. (2012) and higher than rates reported by Melaku et al. (2013). The contrary between the results of this study and above workers may be due to strains of *E. granulosus*. Furthermore, hepatic cysts

presented the majority of fertile cysts; however, pulmonary cyst presented all of calcified cyst in current study. These results are in agreement with findings of Bardonnet et l.(2003) and in contrast with findings of Melaku et al., (2012). Variations in fertility and sterility within different animal species depend on the strain, geography, ecology, host, organic location and type of cysts (Thompson, 1995).

Several techniques have frequently have been used for diagnosis of *E. granulosus* in farm animals, but post mortem inspection is still, the gold standard technique for detection the disease. In this study, the higher rate of *E. granulosus* infection was detected by post mortem inspection followed by serological and clinical signs techniques. The differences in the efficacy of diagnostic tools used may be due to human error or the limitations of equipment used (AlShaibani et al., 2021).

In abattoirs of various locations, researchers indicated that hydatidosis/ Echinococcus is widespread in different countries of the world with great economic and public health significance (Efrem et al., 2015; Tekeste et al., 2023). It`s among the major causes of organs condemnation of carcass as reported by Melaku and Bogale(2012); Alembrhan and Haylegebriel (2013); Ochi (2015); Ibrahim et al. (2016; Cai et al., 2023) .

In the current study, it was emphasized to carry out an assessment on annual economic loss due to bovine hydatidosis at Dhamar municipal slaughterhouses. Losses from organ condemnation and carcass weight loss (meat production loss) in infected cattle were assessed and estimated as 2727387.52 YR ($US 7.312.03). The current estimate is approximately greater than (2.069.0) that estimated by Kebede et al., (2009) in Ethiopia and Ochi (2015) in South Sudan (US$ 2,035.77). However, it is lower than that estimated ($US 138.563.49) by Regassa et al. (2010) in Hawassa municipal abattoir and Belmamoun et al., 2017 ($ US 10368.16) in Algeria. The difference in economic loss estimates in various abattoir/regions may be due to the variations in the prevalence of disease, mean annual number of cattle slaughtered in different abattoirs, and variation in the retail market price of organs (Haftu and Kebede (2014). Considering the current results, hydatidosis is an important disease of cattle in Dhamar and its surroundings, causing substantial visible and invisible losses.

CONCLUSIONS

This study confirmed that *E. granulosus* infection in humans and cattle is prevalent in Dhamar city areas. *E. granulosus* was found to be highly prevalent in human compared to cattle this could be a potential threat to human health and public health. *E. granulosus* infection is associated with significant economic losses among cattle slaughtered at Dhamar slaughterhouse. Based on the findings of current study, it`s recommended that a serous measure action should be undertaken to reduce the prevalence of the infection in humans and cattle. The results of this study showed the importance of this neglected infection in the study area and strongly prompt public health authorities to implement surveillance strategies and control programme for both human and animal infections. Further studies on epidemiology of cystic echinoccoccosis in Dhamar and other geographical zones of country are needed.

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CONFLICTS OF INTEREST

The authors of this article declare that no conflict of interest regarding to this article.

ETHICAL CONSIDERATIONS

The Faculty of Agriculture & Veterinary Medicine had been approved this study before commencing the research work. all information was anonymized and used for research purpose only.

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دراسة عن المشوكة الحبيبية في الانسان والابقار: الوبائية والخسائر الاقتصادية

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الملخص

جريت الدراسة في الفترة ما بين مارس 2016 وفبراير 2019، لدراسة وبائية المشوكات الحبيبية في الانسان والماشية والخسائر الاقتصادية التي تسببها في أعضاء الحيوانات المذبوحة في مدينة ذمار. ففي دراسة الإنسان، أجريت دراسة بأثر رجعي من خلال مراجعة سجلات المرضى في المستشفيات الحكومية والخاصة في ذمار، من أصل 323 سجل تمت مراجعتها، 46 (14.24٪) من الحالات كانت ايجابية. كانت نسبة الإصابة بحسب اعضاء الجسم، في الكبد (13.93٪).، وفي الرئة (0.31٪). لم يتم تسجيل اى حالة اصابة في أعضاء أخرى في الأشخاص الذين تم فحص سجلاتهم. كانت الإصابات مرتفعة بين المرضى الإناث (8.05٪) مقارنة بالذكور (6.19٪)، وفي الفئة العمرية ما بين 30-35 سنة (5.88٪). تأثير عوامل الخطورة على انتشار الاصابة بين المرضى مثل الإقامة، والشهور(الموسم)، والمراكز الطبية وطرق التشخيص، كانت نسبة الاصابة المسجلة هي: 65.22%٪، 1.86٪، 6.5٪ و9.29 في الريف، في شهر يناير، في هيئة مستشفى ذمار، وتقنية الموجات فوق الصوتية على التوالي. إحصائياً، لوحظت فروق ذات دلالة إحصائية (P <0.05) بين نسبة الإصابة والعمر وطرق التشخيص المستخدمة. في حين لم يتم ملاحظة اي فروق معنوية مع العوامل الأخرى. في دراسة الابقار، باستخدام الدراسة المستقبلية او عرضية القطاع، من بين 323 بقرة تم فحصها بعد الذبح واختبارات التشخيص المصلي، وجد ان 40 (12.38٪) كانت إيجابية لعدوى المشوكة الحبيبية. كان توزيع الأكياس المختلفة في الأعضاء المختلفة 4.64٪ و4.04٪ و3.72 في الكبد والرئتين والعدوى المختلطة على التوالي، ولم يتم العثور على كيس في أعضاء أخرى. لوحظت فروق ذات دلالة إحصائية (P <0.05) في توزيع الأكياس العذرية في أعضاء مختلفة من الحيوان. أظهرت اختبارات الخصوبة والحيوية للأكياس، أن 63 (44.68٪) كانت خصبة، 64 (45.39٪) عقيمة، 14 (9.93٪) كيسات متكلسة. لوحظ فروق ذات دلالة إحصائية (P <0.05) في خصوبة الاكياس بين الأعضاء المختلفة (P <0.05). كانت الأكياس ذات الأصل الرئوي شديدة الخصوبة. وسُجلت اعلى نسبة انتشار للعدوى في الفئات العمرية في عمر 5 سنوات (16٪) والإناث (9.29٪) وشهر كانون الثاني (1.55٪) وفحص ما بعد الوفاة (8.98٪). إحصائيا، لوحظت فروق ذات دلالة إحصائية بين نسبة انتشار العدوى وجميع عوامل الخطورة تم دراستها مع استثناء عامل الجنس. يقدر إجمالي الخسائر الاقتصادية الناتجة عن إعدام الأعضاء في الأبقار المذبوحة في مسلخ بلدية ذمار بمبلغ 2727387.52 ريال يمني (7.312.03 دولار أمريكي). عدوى المشوكات الحبيبية من الامراض المشتركة والمنتشرة في منطقة الدراسة، وتشكل مشكلة صحية كبيرة، لذا يتطلب تصميم طرق فاعلة ومناسبة للمكافحة والسيطرة عليه.

الكلمات المفتاحية: المشوكة الحبيبية، الانسان، الابقار، ذمار، اليمن

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Original Article

Q. fever among staff workers and goats in slaughterhouses at Dhamar city, Yemen

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ABSTRACT

The study was conducted to determine the *Coxiella burnetii* antibodies among staff workers (Veterinarians &Butchers) and goats in slaughterhouses at Dhamar city. 250 blood samples were collected from staff workers and 263 samples from goats and tested. Staff worker's sera samples were screened for IgG antibodies against *C. burnetii* phase I & II antigen by ImmunoDOT assay; while, in goat, by-Goat Anti-Q Fever ELIZA test. The results revealed that, out of 250 staff workers, 13(5.2%) showed the presence of antibodies against *C. burnetti* in their sera samples. The distribution of Seroprevalence rate of *C. burnetii* antibodies among the staff workers according to their demographic characteristics was as following: The higher rate was recorded (3.20 %) in age group of 31-40Yrs, 4.0% in workers had between 6 to 10 years of experience; 3.6% in Butchers and 1.20 % in March (spring season). The common symptoms in patients were flu-likes, fever, chest pain, endocarditis and hepatitis. The results of logistic regression confirmed the results of chi square analyses and revealed that there is a significant association between the seroprevalence of *C. burnetii* infection and the characteristics/risk factors of staff workers such occupation (OR=4.822; 95%CI: 1.363-17.064; P=0.015); symptoms (OR=1.820; CI: 1.345-2.463; P=0.000); whereas, no with Age, experience and seasons risk factors. In goats' study, out of 263 sera samples tested, 23(8.57%) showed seropositivity for *C. burnetii* antibodies. The results of logistic regression showed that there is a significant association between the seroprevalence of *C. burnetii* antibodies and the characteristics/variables of goats such sex (OR=0.029; 95%CI: 0.007-.123; P=0.000); season (OR= 0.265; CI:0 .812-1.059; P=0.000), source of animal (OR=1.38; CI: 1.005-1.894; P=0.046) and ticks presence (OR=5.70; CI: 13.661-111.534; P=0.000): whereas, no with Age, breed and slaughterhouses localities factors. The results of Pearson`s correlation analysis revealed that strong association (r= 0.243; P= 0.000) between Seroprevalence of *C. burnetii* antibodies and relative humidity; while, no with temperature and rainfall (precipitation). In conclusion, seroprevalence of *C. burnetii* antibodies are prevalent among staff workers in slaughterhouses and goats at study areas. Research regarding spread of this pathogen within a country and its control is necessary.

INTRODUCTION

Query' fever or Q. fever was first observed in slaughterhouses workers in Brisbane, Queensland, Australia in 1933. It was initially described by Derrick as a self-limiting febrile illness of unknown etiology (Parker et al., 2006; Pexara et al., 2018). Q fever is a zoonotic infection caused by *Coxiella burnetii*, an obligate intracellular, Gram-negative organism (Klemmer et al., 2018; Abdullah et al., 2019; Epelboin et al., 2023).

Q fever is widespread in livestock and its seroprevalence had increased in recent years. Q fever can persist in a herd causing great financial losses on the long term. The main source of infection is domestic ruminants (cattle, sheep and goats) which represent the main reservoir for pathogen that infect wide variety of hosts such as mammals, birds, fish, reptiles and arthropod (Porter et al., 2011; Abdullah et al., 2019).

In human, the airborne pathway is the main

mode of transmission. The infection is usually caused by inhalation of infectious aerosols directly from birth fluids or via inhalation of dust contaminated by dried placental material, birth fluids and excreta of infected animals (Tissot-Dupont and Raoult 2008). The people at highest risk are veterinary surgeons, stock people, transport drivers and abattoir workers. The organism is highly resistant to desiccation and can infect individuals working with hides, fleece, food-processing chain, consuming contaminated milk products or bones of infected animals. Furthermore, transmission of infection via ticks, lice or fleas has been demonstrated (Shakespeare, 2009; Roest et al., 2013).

The clinical manifestations of Q fever in human and animal are highly variable and range from asymptomatic or mild disease with complete recovery to a variety of clinical signs such as acute flu-like illness, pneumonia, hepatitis and chronic endocarditis (Abed and abdul-Husien, 2010; Maurin and Raoult, 1999, Nielsen et al., 2013). In animals, reproductive problems can occur including abortion, stillbirth, retained placenta, infertility, and weak newborns (Angelakis and Raoult, 2010, Gwida et al., 2014; Woldehiwet, 2004; Waag and Fritz, 2012; Pexara et al., 2018).

Lipopolysaccharide (LPS) is the main *Coxiella burnetii* antigen and is found in two different phases on the bacterium surface. The phase I antigen is the complete form of LPS and is linked to the virulence. The phase II antigen is the truncated form that is obtained after several passages in cell culture, and it is the result of gene deletion and consequent loss of sugars from LPS (Toman et al., 2012; Anderson et al., 2013; Mioni et al., 2020). There are different serological tests available for Q fever diagnosis including Indirect FluorescentAntibody Tests (IFAT), Enzyme linked Immunosorbent Assays (ELISA) and complement Fixation Tests (CFT) (Wegdam-Blans et al., 2012; Mioni et al., 2020).

The Q fever is worldwide in distribution and can be considered severe public health problem in many countries (Porter et al., 2011).The disease has been reported in neighboring countries for example: Somalia (Botros et al., 1995), Oman (Scrimgeour et al., 2000), United Arab Emirates (Chaber et al., 2012), Saudi Arabia (Almogren et al., 2013), Ethiopia (Gumi et al., 2013; Khadem-Rezaiyan et al., 2023). In Yemen, the Q fever infection is exist in the country particularly in rural areas where livestock breeders consequently exposed and keep close contact with the livestock and their byproducts(Gray et al., 1999; Badi et al., 2019).

Considerable number of sero-epidemiological studies have been carried out in different parts of world on Q fever infection and it`s seroprevalence and they reported infection rate between 2% to 65% or more in human (Schimmer et al., 2014, Van den Brom et al., 2013, Vanderburg et al., 2014), and between 21.6 % and 75 % in animals(Abed and abdul-Husien, 2010, Cetinkaya et al., 2000, Gwida et al., 2014, Klaasen et al., 2014; Badi et al., 2019; Deressa et al., 2020; Khadem-Rezaiyan et al., 2023).

Despite the presence of Q fever in human and animals in Yemen (Badi et al., 2019), little is known about its current seroprevalence and geographic distribution. Therefore; the main objective of this study was to estimate the seroprevalence and associated risk factors of Q fever in staff workers and goats in slaughterhouses at Dhamar.

MATERIALS AND METHODS

Study areas

This cross sectional study was conducted between 2016-2019 in Dhamar city, Governorate of Dhamar, Yemen. Dhamar is located south of Sana`a, the capital of Yemen. The governorate is divided into 12 administrative districts, with Dhamar City as the capital of the governorate (Abbas et al. 2018; NIC 2021). The annual mean of temperature, relative humidity and rainfall is 26.41°C, 59.29% and 71.29.2 mm, respectively. According to the last Census in 2004, the total population of the governorate is about 1,330,108, which is expected to be 3,311,033 in 2034 (Abbas *et al*. 2018). Agriculture is the main activity in the area (AlShaibani et al., 2024).

Staff workers` Study

Study subjects

The study was conducted in slaughterhouses of Dhamar city to determine the sero-prevalence of Q. fever infections (*Coxilla burnittii*) among 250 Veterinarians and butchers. The slaughterhouses targeted were Dhamar central, western and northern slaughterhouses in the city between the period 2016 and 2019. The general bio-information of each worker as Age, duration of practicing work, symptoms and occupation were collected using questionnaires.

Size of sample

The sample size was calculated according previous studies (Vilibic-Cavlek et al., 2012; Whitney et al., 2009; Mohabbati et al., 2017) considering 21% expected prevalence and 95% confidence interval with a 5% desired absolute precision using the following formula: $N=(Z)^2P(1-P)/d^2$, *where, (p) expected prevalence and (Z) 95% confidence interval (Z= 1.96) and (d) a 5% desired absolute precision.* Accordingly, the size of sample is 255. However, the five case were excluded due to data bias.

Collection of data and samples

Using a questionnaire, demographic data such as age, experience, occupation were collected from each worker. For serological screening, five ml of blood samples in venouject tubes were taken from each individual. The blood tubes were transported under cool conditions to the Public health laboratory, Faculty of Agriculture and Veterinary Medicine, University of Thamar, Dhamar Yemen, for processing and testing for Q fever antibodies. In laboratory, the blood was centrifuged for 5-10 min at 1000 × g and the sera were stored at -20°C prior to the serological testing (Sabzevari et al., 2021). The clinical signs (symptom) were identified by clinical examination and reviewing the clinical records of all patients who had acute Q fever diagnosed during study.

Testing of sera samples

The sera samples of participants were tested for detecting IgG phases I and II, IgM antibodies of *C*. *burnetii*: using ImmunoDOT strip (GENBIO, San Diego, C A, USA) technique. The ImmunoDOT test procedure and results interpretation were performed according to the procedure of Manufacturer's instructions.

Goats`study

Study population

The study animals were indigenous and exotic goat breeds of both sex and different age brought to the abattoirs for slaughtering from districts around the Dhamar city.

Sample Size and Sampling Method

Since the prevalence of *Coxiella burnetii* in goats in Dhamar city as well Yemen has not been documented, the samples size was calculated according to previous studied (Ruiz-Fons et al., 2010; Vanderburg et al., 2014; Obaidat and Kersh, 2017) considering 22% expected prevalence rate, 95% confidence interval (CI) and 5% desired absolute precision using keys given by Thrusfield (2006). Accordingly, the sample size were 264 animals.

Collection of samples

Blood samples (5 ml) were collected from the jugular veins of goats. Blood samples were collected using disposable needles (18 and 19 gauges), labelled with necessary information and brought to public health laboratory, Faculty of Agriculture and Veterinary Medicine, Thamar University and private laboratory. Blood samples were then stored at room temperature for one hour to allow clotting. After then serum was liquated into cryo-vials and stored at -20 ℃ until tested.

Serological testing

Goat anti-Q Fever ELIZA kit, (Bioassay Technology Laboratory, Yangpu Dist. Shaghai China) was used to detect IgG antibodies to *Coxiella burnetii* infection following the manufacturer's instructions.

Statistical analysis

Data obtained from this study were loaded into Microsoft Excel spreadsheet and summarized by using Tables and line graphs. Descriptive and other statistical analyses were performed by using SPSS version 21 for Windows. (Version 21; SPSS Inc., Chicago, IL, USA). Chi square, logistic regression analyses were used to examine the relationship between seropositivity and explanatory variables. Pearson`s Correlation analysis was used to assess the association between the seropositivity and meteorological data. P value less than 0.05 (at 5% level of significance) was considered significant in all analysis.

RESULTS AND DISCUSSION

Seroprevelence of *Coxiella burnetii* infection on staff workers

The results revealed that, out of 250 staff workers, 13(5.2%) showed the presence of antibodies against *Coxiella burnetti* in their sera samples. Furthermore, 4.4% and 0.8% showed seropositivity for Phase-I & Phase-II and Phase-I respectively (Table 1).

Table 1. Seroprevalence of *Coxiella burnetii* antibodies among staff Workers in slaughterhouses of Dhamar city (n=250)

Reaction Type	No. of Subjects	Seropositive %	P value
Positive (Phase-I&II)	11	4.4	0.000
Positive (Phase-I)	2	0.8	
Overall	13	5.2	

These results in agreement with findings of Badi et al., (2019) who early studied the *C. burnetti* infection among workers and butchers in slaughterhouses at Dhamar with similar techniques. However, the seroprevalences rate was lower than findings of Tozer et al., (2011) in Australia ;Vilibic-Cavlek et al., (2012) in Croatia; Khalifa et al., (2016) in Egypt; El-Mahallawy et al. (2016) in China; Mohabbati et al. (2017_ Sabzevari et al., (2021); in Iran, Abbass et al. (2020) in Egypt; Bwatota et al. (2022) in Africa and Khadem-Rezaiyan et al. (2023) in Iran, who reported the seroprevalence rates as: 5.2%, 27.5%, 23.3%; 25% ; 19.80%, 17%, 53.3%, 15% and 56% respectively using Eliza and molecular techniques for detection of *C. burnetti* antibodies. In Europe, Georgiev et al. (2013) reported that the seroprevalence of C. *burnetti* antibodies *as* 12.2 to 24.0% in the Netherlands, 22.0% in Germany and 38.0% in Bulgaria. However, the seroprevalence rate was higher than rate reported by Anderson et al. (2009) in Unites States of America (3.1%). The consistent or discrepancies between the results of this study and above studies could be attributed to varieties in ecologic, social, cultural, behavioral and economic conditions and also levels of animal's infections, which affect the exposures of people in each of the regions of the world (Khalili et al., 2014; Mohabbati et al., 2017).

The results of this study also showed that out of 250 staff workers tested, 4.4% and 0.8% had phase I &II antibodies and phase I antibodies, respectively (Table 1). In human, serological assay may detect antibodies as phase II and phase I for *C. burnetii.* Phase II antibodies are more prevalent during acute infection, while chronic infection is characterized by a predominantly phase I antibody response (Forrnier et al., 1998; Khalili et al., 2014; Mioni et al., 2020). The IFA results are the most specific and sensitive for phase II and phase I IgG antibodies and, to a lesser extent, also for the phase II and phase I IgM antibodies (Setiyono et al., 2005).

The distribution of seroprevalence rate of *Coxiella burnetii* antibodies among the participants according to their demographic characteristics are presented in Table 2. As shown, the higher seroprevalence rate was recorded in age group of 31-40Yrs old (3.20 %); whereas, the lower rate in age group of ≥ 41yrs and above old(0.80%). These results are partially in agreement with findings of Sabzevari et al. (2021) who reported that people with an age of >40 years are more likely to be being infected with *Coxiella burnetii* than under 40 years old; however, our results are in contrast with findings of Whitney et al. (2009) who reported the high of infection in people or staff workers in age groups of >45 years. The differences in seroprevalence rate among different age groups may be attributed to the longer exposure to infection during their lifetime (Cardeñosa et al., 2006).

The occupational years' experience of participant was one of risk factor in this study investigated. Seropositive cases were higher (4.0%) in staff workers had between 6 to 10 years of occupational experience; whereas, the lower cases (1.2%) had between the 1<5 years of experience years as shown in Table 2. These results in parallel with findings of Cook et al., (2021). Who cited that, time worked in the slaughterhouse ranged from 0 to 59 years with a mean time of 10 years. This could be explained that slaughterhouses staff workers have a high risk of getting *Coxiella burnetii* seropositive because of long term contact with potentially infected livestock. In other studies, contact with livestock is described as an important risk factor for seropositivity (Dorko et al., 2008; Whitney et al., 2009).

On the basis of occupation, the seroprevalence rate of *Coxiella burnetii* antibodies in different categories of slaughterhouses` staff workers are depicted in Table 2. As shown, seroprevalence of *Coxiella burnetii* antibodies were recorded as 3.6% and 1.6% in butcher and veterinarians. These results are in agreement with findings of Chu et al. (2017) and Khadem-Rezaiyan et al. (2023). Based on the current results and aforementioned findings, it seems clear that the study group, people in contact with animals, are at a growing risk of acquiring Q fever infection. Many studies reported higher rates of Q fever seropositivity among slaughterhouses workers who come into direct contact with livestock than among those who do not (Chu et al., 2017).

It is known that there are regional variations

in the predominant presenting clinical signs of Q fever in human (Raoult et al., 2005). It has been suggested that the clinical form could be related to differences in the infecting strain, the inoculation dose, host factors, or the route of infection (Maurin and Raoult, 1999; Jado et al., 2012). Pneumonia is predominating in cases acquired by inhalation of infectious aerosol particles; whereas, hepatitis is predominating in cases acquired by ingestion of contaminated dairy products (Marrie et al., 1996). In our study, the distribution of Seroprevalence of *Coxiella burnetii* antibodies according to symptoms among participants are presented in Table 2. The symptoms showed by slaughterhouses workers were Flu-likes (0.80%), fever (0.40%), chest pain (0.80%), endocarditis (0. 4. %) and hepatitis (0.40%); whereas, 2.80% of participant showed no symptoms. The results of current study are in line with findings of Espejo et al., (2014) who studied the clinical presentation of acute Q fever in human in Spain and reported similar results or more. Moreover, Njeru et al. (2016) cited that Q fever in human may present as a flu-like illness with symptoms such as headache, myalgia, and/or atypical pneumonia. Symptoms such as hepatitis and endocarditis may be long lasting in chronic cases.

The effect of seasons (Month variation) in the distribution Seroprevalence of *Coxiella burnetii* antibodies among participants are presented in Table 2. As shown the more cases of Q fever were recorded during the months of spring (March) and winter (October-December) season. These findings are partially in line with findings of Espejo et al. (2014) who suggested that an increased number of cases of Q fever during the colder months may be attributed to a possible relationship between clinical presentation and seasonal factors. It is conceivable that during the cold and winter, viral infections increase the susceptibility of the respiratory mucosa to *C. burnetii*. Statistically, the chi square analysis revealed that there were significant differences between seropositivity of *Coxiella burnetii* and Occupation (P= 0.028) and Symptoms(p=0.000) characteristics/factors; whereas, no with age, time worked or experience and season factors.

The results of logistic regression confirmed the results of Chi square and showed that there is a significant relationship between the seroprevalence of *Coxiella burnetii* infection and the characteristics/risk factors of staff workers such occupation (OR=4.822; 95%CI: 1.363-17.064; P=0.015); symptoms (OR=1.820; CI: 1.345-2.463; P=0.000): whereas, no with age, work experience and seasons risk factors/ (Table 3).

Seroprevalence of *Coxiella burnetii* infection in goats

Q fever is a zoonotic infectious disease caused by *Coxiella burnetii*, with a worldwide distribution. It is an emerging public health threat as it causes reproductive failures and production losses in domestic ruminants (Shome et al., 2019). Animals can carry the infection for several years or lifelong, shedding the organism in various secretion and excreta, with increasing public health risk to animal farmers, veterinarians, abattoir workers and consumers of animal products (Zangue et al., 2022). This study was conducted to determine the seroprevalence rate and risks factors of *Coxiella burnetii* in goat's slaughterhouses in Dhamar city, Yemen.

The results of enzyme-linked immunosorbent assay (ELISA) used to screen serum samples for Q fever collected from goats are presented in Table 4. As shown, out of 263 sera samples tested, 23(8.75%) showed seropositivity for *Coxiella burnetii* antibodies in goats. These results are in agreement with previously studies of (Georgiev et al., 2013 in the Netherlands; 7.8%; Ullah et al., 2019 in Pakistan, 7.7%), and higher than seroprevalence rate reported by (Haider et al., 2015 in Bangladesh, 0.76%; Klemmer et al., 2018 in Egypt; 6.8%; Pape et al., 2019 in Greece, 6.6%) and lower than seroprevalence rate reported by Klaasen et al. (2014) in Gambia (24.2%), Ezatkhah et al (2015) in Iranian goats (22.4%), Obaidat and Kersh, (2017) in Jordan(56.0% Abushahba et al., (2017) at El Minya Governorate, Egypt(28.20%), Abbass et al., (2020) in Assiut, Egypt (53.3%). The differences among seropositivity rates of *Coxiella burnetii* in goats among different countries may be attributed to the extensive husbandry system, breeding, in close contact with others species of animals, wildlife, presence of ticks and different diagnostic tools used (ELISA) with each having different specificity and sensitivity.

The distribution of seroprevalence of *Coxiella burnetii* antibodies in goats according to risk factors or characteristics are presented in Table 4. As shown, the higher seroprevalence rate of *Coxiella burnetii* antibodies was in age groups of 6-10 months old (4.94%); whereas, lower rate in goats'

group of less than 5< months (1.52%) as presented in Table 4. The results of this study are accordance with studies of (Ibrahim et al., 2020; Bwatota et al., 2022) who reported that higher risk of exposure is in older age groups animals. Moreover, pathogen contact rate tends to increase with age simply as a consequence of a higher probability of contact with life span, a feature that herein was observed for sheep and goats (Ruiz-Fons et al.,2010).

The results of risk factor identification among animals showed that males (6.08%) were at significantly at high risk of infection with *Coxiella burnetii* compared to females (2.66%) as depicted in Table 4. These results are in contrast with findings reported by Abushahba et al., (2017) who reported the rate as 14.28% and 31.25% for males and females respectively. The reason for higher seroprevalence rate of *Coxiella burnetii* among males could be attributed to that, the laws in Yemen limited or prohibited slaughtering of female's animals to safe generations. Therefore, higher rate of Q. fever recorded in males.

The results of present study revealed that, higher seroprevalence rate of *Coxiella burnetii* antibodies was recorded in indigenous breeds (7.50 %) compared to exotic breeds (2.66%) as indicated in Table 4. Previously, studies indicate that Q fever is common in all breeds of farm animals, with different rate of seroprevalence. The differences here could be partly attributed to differences in management and prevailing climatic conditions, and genetic factors. (Jarelnabi et al, 2018). In addition, the higher infection in indigenous breeds may due to the decrease importing animals from neighboring countries during ongoing aggression war against Yemen.

Considering the effect of slaughterhouses location on distribution *Coxiella burnetii* antibodies in goats, the seroprevalence rare recorded in central slaughterhouse was 5.32%; whereas, the lower rate recorded in western slaughterhouse (1.90%) of Dhamar city. The difference in seroprevalence rate could be explained in view of Vanderburg et al., (2014) who suggested that, that management, geography and climate could be potential reasons for the differences in seroprevalences at different regions.

In current study, the higher seroprevalence of *Coxiella burnetii* antibodies in goats was recorded in spring and autumn seasons (3.04%) and the lower rate in summer season (2.66%). These results are in line with view of Swai et al., (2005) who suggested that seroprevalence of *Coxiella burnetii* antibodies could be due to the breeding system in the study areas, the animals are generally crossed in the dry season (October to March) so that the birth takes place during the rainy season and the female can benefit from the quality grass in order to feed her newborn. The onset of the rainy season leads to the development of ectoparasites and ticks in particular, which are vectors of *C. burnetii*.

Anss district was the important sources for goats slaughtering in slaughterhouses (4.18%) of Dhamar compared to other districts as presented in Table 4. These results are in parallel with findings of Klaasen et al., (2014) who reported different seroprevalence rate of *Coxiella burnetii* among animals brought from different localities of district/city for slaughtering in slaughterhouses in Gambia. Since, these animals might originate from entirely different populations with different Management system.

In this study, there were strong association (P<0.0) between the presence of tick and seroprevalence of *Coxiella burnetii* as presented in Table 4. The results of this study are in consistent with findings reported by Norlander, 2000; Hussain et al., 2022 who studied *Coxiella burnetii* in bovine in Pakistan. Furthermore, they cited that, ticks are considered major reservoirs of *Coxiella burnetii* and are responsible for the transmission of coxiellosis to domestic and wild animals.

Statistically, the chi square analysis revealed that there are significant differences between seropositivity of *Coxiella burnetii* and sex (P= 0.000), seasons (P=0.000), source of animals (0.036) and tick's presence (P=0.000); whereas, no significant differences with age, breed and location of slaughterhouses (Table 4). The results of univariate logistic regression showed that there is a significant association between the seroprevalence of *Coxiella burnetii* antibodies and the characteristics /variables of goats such sex (OR=0.029; 95%CI: .007-.123; P=0.000); season (OR=0.265; CI: .812-1.059; P=0.000), Source of animal (OR=1.38; CI: 1.005-1.894; P=0.046) and ticks presence (OR=5.70; CI: 13.661-111.534; P=0.000): whereas, no with Age, breed and location of slaughterhouses (Table 5).

The association between mereological data and seroprevalence of *Coxiella burnetii* antibodies in goats also were investigated in this study as depicted in Figure.4 The results of correlation analysis revealed that there were strong association (r= .243; P=.000) between seroprevalence of

Coxiella burnetii antibodies and relative humidity; while, no with temperature and rainfall (precipitation). These results are partially in agreement with findings of Nusinovici et al. (2015) and Bwatota et al. (2022) who cited that, data environmental factors including temperature, wind speed, precipitation, and solar radiation were all positively associated with *Coxiella burnetii* seropositivity in dairy cattle.

Conclusion: It could be concluded from this study that, seroprevalence of *Coxiella burnetii* antibodies prevalent among staff worker's in slaughterhouses at Dhamar. Seroprevalence of *Coxiella burnetii* antibodies among staff workers in slaughterhouses in Dhamar is influenced by occupation factor in human; whereas, in goats by sex, season, source of animals and presence of ticks in study area. An epidemiological control programme should be put in place to minimize *Coxiella burnetii* infection and its effects on staff workers in slaughterhouses and community as well. Further studies on the seroprevalence of *Coxiella burnetii* antibodies among population of Dhamar city. The attention of veterinary and public health authorities is requires using One-Health approach in order to control *Coxiella burnetii* infection occurrence and save human lives.

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ETHICS CONSIDERATION

This study was approved by the Faculty of Agriculture and Veterinary medicine, Thamar University, Dhamar. Before commencing the experiment, Oral consent was obtained from staff workers who showed consent to participate in the study after explanation the purpose of the study.

CONFLICTS OF INTEREST

The authors of this article declare that no conflict of interest regarding to this article.

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The Authors did not receive any funds for this study.

Table 2. Distribution of Seroprevalence of *Coxiella burnetii* antibodies according to characteristics of participants(n=250)

Characteristic	Categories	No. of seropositive Subjects	Seropositivity %	P Value
Age	20-30Yrs	3	1.20	0 .131
	31-40Yrs	8	3.20	
	41& above	2	0.80	
Experience	1<-5Yrs	3	1.20	0.068
	6-10Yrs	10	4.00	
	11 and above	0	0.00	
Occupation	Veterinarian	4	1.60	0.028
	Butchers	9	3.60	
Symptoms	flulike	2	0.80	0.000
	fever	1	0.40	
	chest pain	2	0.80	
	Endocarditis	1	0.40	
	Hepatitis	1	0.40	

Continue Table 2.

Month Variation	Jan	0	0.00	0.831
	Feb	1	0.40	
	Mar	3	1.20	
	April	1	0.40	
	May	2	0.80	
	Jun	0	0.00	
	Jul	0	0.00	
	Aug	1	0.40	
	Sep	2	0.80	
	Oct	1	0.40	
	Nov	1	0.40	
	Dec	1	0.40	

Table 3. Results of logistic regression analysis for risk factors associated with Seroprevalence of *Coxiella burnetii* antibodies among staff workers in slaughterhouses at Dhamar city(n=250)

Risk factor	Categories	No. of positive Subjects	Seropositive %	OR	95%	P value
Age	20-30Yrs	3	1.20	0.532	0.249-1.138	0.104
	31-40Yrs	8	3.20			
	41& above	2	0.80			
Experience	1<-5Yrs	3	1.20	0.833	0.364-1.907	0.666
	6-10Yrs	10	4.00			
Occupation	Veterinarian	4	1.60	4.822	1.363-17.064	0.015
	Butchers	9	3.60			
Symptoms	flulike	2	0.80	1.820	1.345-2.463	0.000
	fever	1	0.40			
	chest pain	2	0.80			
	Endocarditis	1	0.40			
	Hepatitis	1	0.40			
	Asymptom	7	2.80			
Month Variation	Jan	0	0.00	0.949	0.796-1.131	0.558
	Feb	1	0.40			
	Mar	3	1.20			
	April	1	0.40			
	May	2	0.80			
	Jun	0	0.00			
	Jul	0	0.00			
	Aug	1	0.40			
	Sep	2	0.80			
	Oct	1	0.40			
	Nov	1	0.40			
	Dec	1	0.40			

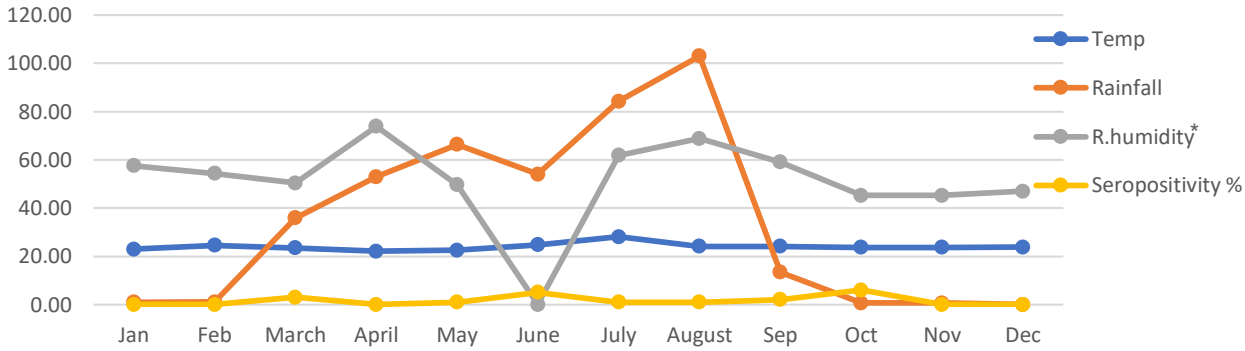

Fig. 1. Correlation of *Coxiella burntii* seropositivity in goats with weather conditions in Dhamar city

Table 4. Overall Seroprevalence of *Coxiella burnetii* antibodies and according to characteristics of Goats (n=263)

Characteristic	Categories	No. of seropositive animals	Seropositivity %	P Value
Age	5<Months	4	1.52	0.889
	6-10M	13	4.94	
	11M &above	6	2.28	
Sex	Male	16	6.08	0.000
	Female	7	2.66	
Breed	Indigenous	15	5.70	0.082
	Exotic	7	2.66	
	hybrid	1	0.38	
Slaughterhouses	Central	14	5.32	0.079
	Eastern	4	1.52	
	Western	5	1.90	
Season	Winter	0	0.00	0.000
	Spring	8	3.04	
	Summer	7	2.66	
	Autumn	8	3.04	
Source of animal	AlHada	8	3.04	0.036
	Anss	11	4.18	
	Anis	0	0.00	
	Myfaa Ans	2	0.76	
	Rousaba	2	0.76	
Ticks' presence	Yes	13	4.94	0.000
	No	10	3.80	
Overall prevalence	263	23	8.75	

Table 5. Results of logistic regression analysis for risk factors associated with *Coxiella burnetii* infection in Goats(n=263)

Risk factor	Categories	No. Seropositive animals	Seropositivity %	OR	95% CI	*P* value
Age	5<Months	4.0	1.52	1.146	0.584-2.25	0.692
	6-10M	13	4.94			
	11M &above	6.0	2.28			
Sex	Male	16	6.08	0.029	0.007-.123	0.000
	Female	7.0	2.66			
Breed	Indigenous	15	5.70	0.921	0.492-1.723	0.797
	Exotic	7.0	2.66			
	Hybrid	1.0	0.38			
Slaughterhouses	Central	14	5.32	1.128	0.659-1.930	0.660
	Eastern	4.0	1.52			
	Western	5.0	1.90			
Season	Winter	0.0	0.00	0.265	0.812-1.059	0.000
	Spring	8.0	3.04			
	Summer	7.0	2.66			
	Autumn	8.0	3.04			
Source of animal	AlHada	8	3.04	1.38	1.005-1.894	0.046
	Ans	11	4.18			
	Anis	0	0.00			
	Myfaa Ans	2	0.76			
	Rousaba	2	0.76			
Ticks presence	Yes	13	4.94	39.034	13.66-111.53	0.000
	No	10	3.80			

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الحمى المجهولة بين العاملين والماعز في مسالخ مدينة ذمار، اليمن

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الملخص

اجريت الدراسة في الفترة ما بين 2016 الى 2019م، لتحدد مدى انتشار الاجسام المضادة *لبكتيريا Coxilla burnettii*المسببة للحمى المجهولة بين العاملين (الجزارين و الأطباء البيطريين) والماعز في المسالخ في مدينة ذمار، اليمن. تم جمع 250عينة دم من العاملين والاطباء البيطريين القائمين على فحص اللحوم في مختلف مسالخ ذمار، استخدم الاختبارات المصلية المناسبة للكشف عن الاجسام المضادة من نوع IgG، IgM لبكتيريا *C.burnettii*. كشفت النتائج وجود الاجسام المضادة للحمى المجهولة في امصال العاملين والأطباء البيطريين بنسبه كلية (5.2%). أظهرت نتائج الدراسة ان نسبة انتشار الإصابة كانت مرتفعة في الاعمار ما بين 31-40 سنة (3.20%)مقارنة بالأعمار التي تزيد عن 41 سنه بمعدل (0.80%)، وفي العاملين بحسب فترة عملهم ما بين 6-10سنوات مقارنه بالأخرين والذين كانت فتره عملهم اقل من خمس سنوات. وفي العمال بحسب الوظيفة بنسبة 3.6% مقارنة بالأطباء البيطريين التي كانت بنسبة 1.6%، لوحظت فروق معنوية بين نسبه الاصابة وعامل الخطورة بحسب الوظيفة او نوع العمل(P =0.028) . كما لوحظ فروق معنوية بين العلامات السريرية ونسبة الإصابة(P=.000). في دراسة الماعز، استخدم الاختبار المناعي غير المباشر ELISAللكشف عن الاجسام المضادة من نوع IgG لبكتيريا *C. brunetti*. في دم 263 حيوان من الماعز من كلا الجنسين. اوضحت النتائج وجود اجسام مناعية من نوع IgG المضادة لبكتريا *C burnitti* في 23عينة من مصل الماعز وبنسبة 8.75 % من العدد الكلي للعينات المفحوصة، وكانت نسبة الاصابة في الذكور (6.08%) مقارنة بالإناث (2.66%). لوحظت فروق معنوية بين نسبة انتشار الاصابة بين الجنسيين (P=0.001). اظهرت نتائج تحليل الانحدار ان هناك فروق ذات دلالة إحصائية بين نسبة الإصابة وجميع عوامل الخطورة المتمثلة في مصدر الحيوان والموسم ووجود القراد مع استثناء عامل العمر والسلالة وموقع المسلخ. نستنتج من هذه الدراسة ان عدوى الحمى المجهولة منتشرة بين عمال المسالخ والماعز في منطقة الدراسة، وعليه يجب مكافحة المرض والسيطرة عليه لمنع حدوث الإصابة وتقليل الخسائر الاقتصادية في الانسان والحيوان.

الكلمات المفتاحية: الحمى المجهولة، العاملين في المسالخ، الماعز، ذمار، اليمن

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الأمراض الشائعة بين الحيوانات في العيادات البيطرية في مدينة ذمار، اليمن: دراسة استرجاعية

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الملخص

أجريت الدراسة في مدينة ذمار، اليمن في عام 2021م، بهدف معرفة الامراض الشائعة المنتشرة بين الحيوانات التي تتردد على العيادات البيطرية الحكومية والخاصة. تم جمع البيانات المتعلقة بالحالات المرضية للحيوانات المختلفة مثل نوع الحيوان وجنسه، نوع المرض وتاريخ حدوث المرض من السجلات المتوفرة في العيادات البيطرية المستهدفة للعام 2020م. من اجمالي 2387 حالة تم تجميعها، بلغ عدد الحالات المريضة بين الحيوانات 2350 حالة وبنسبة 98.4%، وكانت نسبة الحالات المرضية في الإناث 64.2% بينما في الذكور 35،8%. سجلت اعلى قيمة للحالات المرضية في شهر سبتمبر (10.5%)، وادني قيمة في شهر اغسطس (6.6%)، كشفت النتائج ان الحالات المرضية في الجهاز الهضمي هي الأعلى حدوثا بين الحالات المرضية الجهازية تلتها الجلدية والجهاز التناسلي والعصبي والأيض (التمثيل الغذائي) ثم الجهاز التنفسي. والهيكلي الحركي، بينما أقل الحالات حدوثا كانت في الجهازين البولي والدوراني. سجلت اعلى نسبة (54.5%) للحالات المرضية في الأغنام، وتلتها الأبقار (27.7%) ثم الماعز (16.8%)، واقل الحالات المرضية كانت في الجمال والخيول والحمير والكلاب بنسبة 0.6% و0.05% و0.3% و0.1% على التوالي. كانت الإصابة بالطفيليات الخارجية في الأغنام هي الأعلى وبنسبة 26.2%، مقارنة ببقية الأمراض، وتلتها الإصابة بمرض الدوران والطفيليات الداخلية والالتهاب الرئوي. وفي الابقار، كانت إصابات التهاب الرحم هي الأعلى (22.2%)، تلتها الاصابة بالطفيليات الداخلية والتهاب الضرع. بينما في الماعز، كانت الاصابة بالطفيليات الخارجية هي الأعلى وبنسبة بلغت 27.5% ، تليها الإصابة بالخراجات. اما الحالات المرضية المتعلقة بالاضطرابات الايضية والتمثيل الغذائي والتدخل الجراحي فقد تفاوت نسبها بين الحيوانات المدروسة المختلفة وكانت حالات النفاخ هي الأكثر شيوعا. خلصت هذه الدراسة الى وجود العديد من الأمراض البكتيرية والفيروسية والطفيلية والتمثيل الغذائي والتدخل الجراحي بين الحيوانات المترددة على العيادات البيطرية في مدينة ذمار، وتتأثر نسبة انتشارها بعوامل الجنس والموسم، والأغنام كانت أكثر الحيوانات اصابة بالأمراض المختلفة. يوصى بأجراء مزيدا من الدراسات حول الامراض التي صيب الحيوان وانتشارها على مستوى اليمن، والاستفادة من نتائج هذه الدراسة لعمل خطط وبرامج للسيطرة على الامراض في منطقة الدراسة.

الكلمات المفتاحية:
الامراض الشائعة، الحيوان، دراسة استرجاعية، اليمن

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3.4.2024

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المقدمة Introduction

تشكل الثروة الحيوانية مصدرا اقتصاديا هاما لمختلف بلدان العالم، حيث تساهم بشكل كبير في توفير الأمن الغذائي، كما تعتبر أحد الركائز الهامة في دعم الاقتصاد للأسر الريفية. وتقدر مساهمة قطاع الثروة الحيوانية في اليمن حوالي 30% من إجمالي الناتج الزراعي في البلاد الذي يشكل حوالي 20% من إجمالي الدخل القومي (الصوفي، 2000؛ وزارة الزراعة 2005 ; Moore et al., 2021; CDR, 2000).

ان حجم وعدد الثروة الحيوانية الكبير في البلدان النامية لا يتناسب مع الإنتاج المنخفض وخاصة في قطعان الابقار بسبب الإنتاج المنخفض للسلالات ضعيفة الصفات الوراثية ونتيجة لإهمال الرعاية الصحية الحيوانية وعدم توفر سلسلة فعالة لرفع القيمة الغذائية ونقص مصادر التغذية والأعلاف وقلة الوعي (Ali and Hossain, 2021). وفي حين تعول الأسر الفقيرة كثيرا على قطاع الثروة الحيوانية لإعالتهم الا أن الممارسات السيئة لرعاية الحيوانات والظروف المناخية الجغرافية غير الملائمة تساعد في حدوث وانتشار الأمراض المختلفة بشكل كبير (Onneshan, 2014; Kappes et al., 2023).

تعتمد الأهمية الاقتصادية لحيوانات المزرعة على قيمة الإنتاج والخدمات التي تقدمها وتشمل اللحوم والحليب والصوف والجلود (Abusara and Abdelgadir, 2014). يواجه قطاع الانتاج الحيواني في اليمن العديد من المشاكل المرضية وخاصة الأمراض المعدية الناجمة عن الأمراض البكتيرية والفيروسية والطفيلية، وكذا تكاليف العلاج والسيطرة عليها (الصوفي، 2000؛ وزارة الزراعة، 2005؛ مهيدى وآخرون،2010). ويحتاج الحيوان الى بعض

الوقت للوصول إلى ذروة الإنتاج بعد الشفاء مرة أخرى مما يودي الى خسائر اقتصادية اضافية (El Hicheri, 1994; Kappes et al., 2023). ان أعداد الثروة الحيوانية في اليمن في تناقص مطرد فقد وجد أن اجمالي اعداد الثروة الحيوانية في اليمن قد تناقص من 21341000 رأس في عام 2015م الى 20299700 رأس في عام 2017م (المنظمة العربية للتنمية الزراعية، 2018). وهذا يثير التساؤل حول إمكانية انقاذ هذه الثروة من هذا التدهور الغير متناسب مع الزيادة في النمو السكاني وزيادة متطلباته من لحوم الحيوانات ومنتجاتها (المنظمة العربية للتنمية الزراعية، 2018: Smith et al., 2024).

تعتبر العيادات البيطرية الحكومية والخاصة من اهم المصادر الموثوقة للمعلومات عن الأمراض الحيوانية ومعالجتها (Sarker et al, 2013). وتحليل هذه السجلات الخاصة بالحالات المرضية يعطى فكرة شاملة حول المشاكل المرضية في منطقة الدراسة والمناطق المحيطة بها (Waly and Sayed, 2013). وحسب علمنا لا توجد معلومات كافية عن أنواع الامراض التي تصيب الحيوانات ونسبها بشكل منظم في مدينة ذمار، اليمن. لذا هدفت الدراسة العرضية المقطعية الاسترجاعية استقصاء الامراض المنتشرة بين الحيوانات المزرعية في مدينة ذمار وانتشارها وعوامل الخطورة المرتبطة بها.

المواد وطرائق العمل Materials & Methods

منطقة الدراسة

أجريت هذه الدراسة خلال الفترة من يناير الى ديسمبر 2020م في العيادات البيطرية الحكومية والخاصة في مدينة ذمار، بهدف التعرف على الامراض الشائعة المختلفة التي تصيب الحيوانات. جغرافيا، محافظة ذمار تقع في وسط اليمن، يتميز مناخها بدرجات الحرارة اليومية والموسمية المتفاوتة. فخلال الموسم الشديد البرودة بين ديسمبر إلى فبراير، يكون الطقس باردا جافا غالبا تصل درجة حرارة دنيا الى -10 درجة مئوية، يسود الطقس الجاف المعتدل بين مارس إلى أكتوبر وتصل درجة الحرارة 25 درجة مئوية خلال اليوم. الحد الاعلى لمعدل هطول الأمطار هو خلال الفترة من منتصف يوليو إلى سبتمبر، وتصل الرطوبة النسبية الى 68 ٪ في أغسطس. شملت الدراسة المستشفى البيطري التعليمي التابع لكلية الزراعة والطب البيطري في جامعة ذمار، العيادات البيطرية الحكومية التابع لمكتب الزراعة فرع ذمار، وثلاثة عيادات بيطرية خاصة في ذمار.

عينة الدراسة

شملت عينة الدراسة سجلات الحالات المرضية للأبقار والجمال والأغنام والماعز والخيول والحمير والكلاب في العيادات الانفة الذكر للعام 2020م.

حجم العينة

تكونت حجم العينة البحثية من 2387 حالة مرضية من واقع سجلات العيادات البيطرية المستهدفة. توزعت الحالات بين الحيوانات المتواجدة في مناطق مدينة ذمار والمحيطة بها.

تصميم الدراسة وجمع البيانات

اجريت هذه الدراسة العرضية المقطعية الاسترجاعية خلال العام 2020 م، وخلا ل فترة الدراسة، تم تقسيم العمل بين فريق البحث، كل فرد اوكل اليه تنفيذ جزء من الدراسة. كل فرد قام بدوره وبالمهمة التي كلف بها وفقا للجدول الزمنى وخطة الدراسة. تم التأكد والتقصي من سلامة ودقة المعلومات التي يتوجب الحصول عليها من العيادات التي شملتها الدراسة قبل الحصول عليها. تم جمع البيانات المطلوبة وفقا لأهداف الدراسة بالاستبانة الخاصة التي اعدت مسبقا من السجلات المحفوظة بالعيادات المستهدفة. شملت البيانات التي تم جمعها معلومات عن الحيوانات، ونوع الحيوان وجنسه، وتاريخ الحالة المرضية، اسم المرض، والجهة او المنطقة التي احضر منها الحيوان. تم احضار البيانات الى كلية الزراعة الطب البيطري، جامعة ذمار، واخضعت للتحليل الإحصائي للحصول على النتائج المتوخاة من هذه الدراسة.

التحليل الاحصائي

أجري التحليل الاحصائي للبيانات المتحصل عليها من خلال اختبارات مربع كاي والارتباط لتحدد الاختلافات بين المجاميع المختلفة باستخدام برنامج الحزم الإحصائية للعلوم الاجتماعية (SPSS) الإصدار 20. اعتبرت القيم ذات دلالة إحصائية عند $P< 0.05$ و$P<0.01$.تم عرض النتائج كنسب مئوية في جداول بحسب المتغيرات المدروسة.

النتائج والمناقشة Results& Discussion

في هذه الدراسة، تم تحليل البيانات المتحصل عليها من العيادات البيطرية المستهدفة في مدينة ذمار لعام 2020م. كشفت النتائج ان من أجمالي 2387 حالة مرضية تم فحصها من واقع السجلات في العيادات البيطرية في مدينة ذمار، وجد ان 2350 (98.4%) حالة كانت مصابة بأحد الامراض معدية او غير معدية. اتفقت نتائج هذه الدراسة مع توصل اليه (Sarker et al., 2015; Radostits et al., 2006)، وقد يعزو السبب في تسجيل نسبة عالية من الامراض في الدراسة الحالية لعدم توفرالرعاية الصحية للحيوانات، وجهل المربين بالإدارة الحديثة لتربية الحيوان في مناطق الدراسة.

الجدول (1): توزع الحالات المرضية ونسبة انتشارها بين الحيوانات وفقا لمتغير شهور السنة (ن=2350)

الشهر	عدد الحالات المصابة	نسبة الإصابة %
يناير	232	9.9
فبراير	183	7.8
مارس	195	8.3
ابريل	168	7.1
مايو	193	8.2
يونيو	201	8.6
يوليو	163	6.9
أغسطس	155	6.6
سبتمبر	247	10.5
أكتوبر	215	9.1
نوفمبر	206	8.8
ديسمبر	192	8.2

لوحظ فروق إحصائية ذو دلالة معنوية ($P<0.05$ بين نسبة الإصابة وعامل الموسم او الشهر

اظهرت نتائج الدراسة إن اعلي نسبة للإصابة سجلت في شهر سبتمبر (10.5%)، وادني نسبة في شهر اغسطس (6.6 %). لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة وأشهر الدراسة (الجدول 1). اتفقت نتائج هذ الدراسة مع ما ذكره Ola- Raquib et al. (2020) ; Fadunsin & Ibitoye, (2017) في دراستهم عن تأثير أشهر السنة او الموسم في توزع نسبة الإصابة بين الحيوانات بالأمراض المختلفة، وقد يعزو السبب في تسجيل اعلى نسبة للأمراض في شهر سبتمبر هو توافقها بين فصلي الصيف والشتاء وهي مواسم هطول الامطار، وهذا يشكل بيئة مناسبة لتكاثر وتوالد المسببات المرضية ونواقلها.

الجدول رقم (2) يوضح عدد الحالات المرضية ونسبة انتشارها بين الحيوانات بحسب مصدر او منطقة الحيوان، سجلت اعلى نسبة للحالات المرضية في منطقة الحدا، حيث بلغ عدد الحالات المرضية 804 حالات وبنسبة وصلت الى 34.21% من إجمالي عدد الحالات المرضية الكلية المسجلة، تلتها منطقتي عنس ومغرب عنس بعدد 599 و 423 حالة وبنسبة 25.49% و18%على التوالي، بينما كانت أقل المناطق في عدد الحالات المرضية هي: مناطق عتمة، وصاب وجهران وآنس، حيث كان عدد الحالات المرضية 28، 37،31، 87 حالة و بنسبة 1.19% 1.32,% 1.57%, % 3.70على التوالي. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة ومنطقة او مصدر الحيوانات التي خضعت للدراسة. وقد يعزو السبب في تفاوت عددا لحالات المرضية بين المناطق المختلفة الى عدد الحيوانات في منطقة الدراسة، طرق التربية والرعي، ومدى اهتمام المزارعين بحيواناتهم في تلك المناطق.

الجدول (2): عدد الحالات المرضية ونسبة انتشارها بين الحيوانات بحسب مصدر الحيوان (ن=2350)

المنطقة	عدد الحالات المصابة	نسبة الإصابة %
الحداء	804	34.21
عنس	599	25.49
مغرب عنس	423	18.00
انس	87	3.70
ذمار	341	14.51
وصاب	31	1.32
عتمة	28	1.19
جهران	37	1.57
الإجمالي	2350	100

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة ومصدر الحيوان، P<0.05

اوضحت النتائج ان عدد الحالات المرضية في الجهاز الهضمي هي الأعلى، فقد بلغت 653(27.8%) حالة من اجمالي عدد الحالات المرضية الكلية، تلتها الإصابات الجلدية 471 حالة وبنسبة (20.0%)، الجهاز التناسلي (13.2%)، والعصبي (13.0%)، والأيضي(11.2%)، الجهاز التنفسي(7.2%) والهيكلي الحركي (5.7%). بينما سجلت ادنى الإصابات في الجهازين البولي والدوراني وبنسب 0.6% و1.3% على التوالي. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة وأجهزة الجسم المختلفة(الجدول-3). اتفقت نتائج هذ الدراسة مع ما ذكره Sarker et al. (2015) ; Gurav et al. (2018) Kouamo et al. (2020) في ببنغلادش والكاميرون في دراستهم عن إصابة أجهزة الجسم بالأمراض المختلفة ونسبها، فقد وجدوا ان إصابات الجهاز الهضم كانت هي الأعلى مقارنة مع بقية الإصابات الجهازية، وتلتها الإصابات الجلدية. وربما يعزى السبب في ارتفاع الحالات المرضية في الجهاز الهضمي مقارنة مع بقية أجهزة الجسم الى طبيعة ما يتناوله الحيوان من أغذية وما يصاحبه من ثلوث بالجراثيم والسموم وغيرها من المسببات المرضية، كما يعتبر الفم اهم مداخل العدوى في الحيوان.

الجدول (3): عدد الحالات المرضية ونسبة انتشارها بين الحيوانات بحسب أجهزة جسم الحيوان (ن=2350)

الجهاز	عدد الحالات المصابة	نسبة الإصابة %
البولي	14	0.6
التنفسي	170	7.2
الهضمي	653	27.8
العصبي	305	13.0
التناسلي	311	13.2
الحركي الهيكلي	133	5.7
الجلدي	471	20.0
الأيضي(التمثيل الغذائي)	263	11.2
الدوراني	30	1.3
الإجمالي	2350	100

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة الجهاز التشريحي للحيوان، P<0.0

اوضحت نتائج الدراسة ان الحالات المرضية في الأغنام كانت الأعلى في العدد (1281حالة) مقارنة مع بقية الحيوانات، تلتها الأبقار بعدد 652 حالة، ثم الماعز بعدد 395 حالة، وبنسبة 54.5% و27.7% و16.8% على التوالي. واحتلال الأغنام المرتبة الأولى بعدد وبنسبة الحالات المرضية ربما بسبب تعدادها الكبير مقارنة ببقية الحيوانات في اليمن حيث بلغ عدد الأغنام في عام 2017م، 9185440 رأس بينما عدد الأبقار 1671950 رأس فقط (المنظمة العربية للتنمية الزراعية 2018). اما عدد الحالات المرضية في الجمال والخيول والحمير والكلاب فقد سجلت بنسب ضئيلة وهي 0.6% و0.5% و0.3% و0.1% على التوالي. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة ونوع حيوان الدراسة (الجدول 4). وربما يعزى سبب قلة الحالات المرضية في الجمال والخيول الى قلة وندرة تربية الجمال والخيول في منطقة الدراسة، اما الحمير والكلاب فهي من الحيوانات المغفلة والتي لا تحظى بالاهتمام من قبل الفلاحين والمجتمع.

الجدول رقم (5) يبن عدد الحالات المرضية ونسبة انتشارها بين الحيوانات بحسب الجنس، كشفت النتائج ان عدد الحالات المرضية في الاناث كانت 1509 حالة وبنسبة 64.2% من عدد الحالات المرضية الكلية، بينما بلغت في الذكور 841 وبنسبة 35.8%. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة وجنس حيوان

الدراسة. اتفقت نتائج هذه الدراسة مع ذكر Rakha et al. (2020) Kouamo et al.; (2015)، في دراستهم على الحيوان في مصر والكاميرون عن تأثير الجنس على نسبة انتشار الامراض في الحيوان، وربما تعزو زيادة الإصابة بالإناث الى المشاكل الصحية المتعلقة بالتناسل في الاناث مثل التغيرات الفسيولوجيا والمناعة والامراض المصاحبة للولادة.

الجدول رقم (4) عدد الحالات المرضية ونسبة انتشارها بين بحسب نوع الحيوان (ن=2350)

نوع الحيوان	عدد الحالات المصابة	نسبة الإصابة %
اغنام	1281	54.51
ابقار	652	27.74
ماعز	395	16.81
جمال	13	0.55
خيول	1.0	0.04
حمير	6.0	0.26
كلاب	2.0	0.09
الإجمالي	2350	100

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة وعامل نوع الحيوان، P<0.00

الجدول (5): عدد الحالات المرضية ونسبة انتشارها بين الحيوانات بحسب الجنس (ن=2350)

الجنس	عدد الحالات المرضية	نسبة الإصابة %
الذكور	841	35.8
الاناث	1509	64.2
الاجمالي	2350	100

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة و عامل جنس الحيوان، P<0.05

في هذه الدراسة، سجلت حالات الإصابة بالطفيليات الخارجية والجرب في الأغنام اعلى نسبة اصابة 26.2% مقارنة مع بقية الامراض التي تصيب الاغنام، بينما سجلت الإصابة بمرض الدوران بنسبة 17.5%، توافقت هذه النتائج مع نتائج دراسة Badria (2004) حيث وجدت ان معدل الانتشار بالإصابة بالطفيليات الخارجية بدرجة عالية في الأغنام في العيادات البيطرية المختلفة التي خضعت للفحص في دراستها. كما سجلت الإصابة بالطفيليات الداخلية والالتهاب الرئوي نسباً عالية 14.7%، 12.3% على التوالي مقارنة ببقية الأمراض المختلفة. وكانت أقل نسب الإصابة للالتهاب الرئوي الاستنشاقي والإصابة بداء الكلب، حيث سجلت كل منها بنسبة 0.2% (الجدول 6). لوحظ فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة ونوع المرض في الاغنام.

الجدول (7) يعرض انواع الامراض الشائعة في الابقار ونسبة انتشارها، فقد كشفت النتائج ان الإصابة بالتهاب الرحم كانت هي الأعلى مقارنة بالأمراض المعدية الأخرى التي تصيب الابقار، حيث بلغت 22.16%، اتفقت نتائج هذه الدراسة جزئيا مع ما ذكرا Abusara and Abdelgadir (2014) في دراستهما للأمراض المنتشرة بين الحيوانات في العيادات البيطرية في الخرطوم في السودان، حيث ذكروا ان التهاب الرحم واحتباس المشيمة كانت اكثر الحالات المسجلة في الابقار. كما بينت نتائج الدراسة ايضا ان الاصابة بالطفيليات الداخلية بلغت 20.1% وكانت في المرتبة التالية في عدد حالات المرضية في الابقار.

الجدول رقم (6) الامراض البكتيرية والفيروسية والطفيلية الشائعة في الأغنام (ن=986)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
الالتهاب الرئوي	121	12.27
التهاب الرئة الاستنشاقي	2.0	0.20
التهاب الضرع	25	2.54
التهاب الرحم	29	2.94
البروسيلا	14	1.42
الخراجات	87	8.82
مرض الدوران	173	17.55
التهاب المفاصل	7.0	0.71
التهاب المسالك البولية	7.0	0.71
التهاب العين	47	4.77
المرض الأسود	25	2.54
داء الكلب	2.0	0.20
الجدري	14	1.42
طاعون المجترات الصغيرة	1.0	0.10
الحمى القلاعية	28	2.84
الطفيليات الداخلية	145	14.71
الطفيليات الخارجية	168	17.04
الجرب	91	9.23

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة والامراض المعدية التي تصيب الاغنام، P<0.05

اما حالات التهاب الضرع فقد سجلت بنسبة 11.68%، وهذ النسبة تتوافق مع النتائج التي ذكرها Noul

et al. (2009)، حيث لاحظوا في دراستهم زيادة معدل انتشار التهاب الضرع في الابقار. وأتت إصابة الابقار الخراجات في نهاية القائمة، حيث كانت نسبتها 0.9% من اجمالي الاصابات بالأمراض البكتيرية والفيروسية والطفيلية والفطرية التي تصيب الابقار. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة ونوع المرض في الابقار.

أظهرت نتائج الدراسة الحالية ان الاصابة بالطفيليات الخارجية في الماعز كانت هي الاعلى (27.5%) تلتها الاصابة بالخراريج (12.5%)، وسجل التهاب المفاصل والالتهاب الرئوي الاستنشاقي بنسب اقل وهي0.71% و0.36% على التوالي، كما هو موضح في الجدول رقم (8). لوحظت فروق إحصائية ذو معنوية (P<0. 05) بين نسبة الإصابة ونوع المرض في الماعز، اتفقت هذه الدراسة جزئيا مع وجدوا Islam et al., (2021) ، بينما اختلفت مع وماجدوه;Abusara and Abdelgadir (2014) في الامراض الشائعة في الماعز، حيث ذكرا الباحثون المذكورين ان الالتهاب الرئوي البلوري كان الاعلى انتشار بين في الماعز.

الجدول (7): الامراض البكتيرية والفيروسية والطفيلية الشائعة في الابقار (ن=334)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
الالتهاب الرئوي	22	6.59
الالتهاب الرئوي الاستنشاقي	2	0.60
التهاب الرحم	74	22.16
مرض الدوران	4.0	1.20
التهاب الضرع	39	11.68
التهاب العين	25	7.49
التهاب المفاصل	11	3.29
الخراجات	3.0	0.90
التهاب المسالك البولية	5.0	1.50
الحمى القلاعية	35	10.48
التهاب الجلد العقدي	26	7.78
الطفيليات الخارجية	6.0	1.80
الطفيليات الداخلية	67	20.06
الجرب	11	3.29
القوباء الحقلية	4.0	1.20

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة والامراض المعدية التي تصيب الابقار، P<0.05

الجدول (8): الامراض البكتيرية والفيروسية والطفيلية الشائعة في الماعز (ن=280)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
الالتهاب الرئوي	20	7.14
التهاب الرئة الاستنشاقي	1.0	0.36
التهاب الرحم	10	3.57
التهاب الضرع	17	6.07
التهاب العين	27	9.64
التهاب المفاصل	2.0	0.71
البروسيلا	7.0	2.50
مرض الدوران	26	9.29
الخراجات	35	12.50
الجدري	7.0	2.50
الحمى القلاعية	15	5.36
الطفيليات الداخلية	26	9.29
الطفيليات الخارجية	77	27.50
الجرب	10	3.57
الإجمالي	280	100.00

** لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة والامراض المعدية التي تصيب الماعز، P<0.05*

امراض التمثيل الغذائي(الايضية) والتدخل الجراحي التي تصيب الابقار في مدينة ذمار موضحة في الجدول (9). كشفت نتائج الدراسة ان حالات النفاخ سجلت بأعلى نسبة (31.1%)، تلتها حالات فقدان الشهية وبنسبة 28.9% من اجمالي امراض التمثيل الغذائي(الايضية) والتدخل الجراحي. اما حالات خلع القرون وعسر الهضم فقد بلغت نسبتها 2.8% و1.6% .على التوالي. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة وامراض التمثيل الغذائي في الابقار. اختلفت هذه الدراسة مع ما توصل اليه Meena et al., (2016)اللذين ذكروا ان البيلة الدموية (Hematuria) هي الأكثر انتشار في الابقار. ربما يعزو السبب في ارتفاع نسبة حالات النفاخ في الابقار الى طبيعة الغذاء ونوعه وحالته.

الجدول (9): الامراض الايضية والجراحية الشائعة في الابقار (ن=318)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
فقد الشهية	92	28.93
حمى الحليب	21	6.60
البيلة الدموية	19	5.97
النفاخ	99	31.13
اسهال	24	7.55
عسر هضم	5	1.57
عسر الولادة	49	15.41
خلع القرون	9	2.83
الإجمالي	318	100.00

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة والايضية والجراحية التي تصيب الاغنام، P<0.05

الجدول (10): يوضح الامراض الايضية والجراحية الشائعة في الاغنام (ن=295)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
فقد الشهية	82	27.80
حمى الحليب	19	6.44
النفاخ	88	29.83
الاسهال	65	22.03
عسر الهضم	4	1.36
كسور العظام	8	2.71
عسر الولادة	29	9.83
الإجمالي	295	100.00

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة والايضية والجراحية التي تصيب الابقار، P<0.05

الجدول (10) يعرض اهم الامراض الايضية والجراحية التي تصيب الاغنام في مدينة ذمار، وقد كانت حالات الاصابة بالنفاخ هي أعلى(29.8%) ، تلتها الاصابة بفقدان الشهية بنسبة 27.8% من اجمالي امراض التمثيل الغذائي. بينما كانت أقل النسب المسجلة هي لعسر الهضم وقد بلغت 1.4%. وهذا يتوافق مع ما ذكر (Sarker et al., 2015)، بينما اضطرابات الهضم سجلت نسبة اقل مقارنة ببقية الامراض. لوحظت فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة ونوع امراض التمثيل الغذائي والتدخل الجراحي في الأغنام. وقد يعزو سبب ارتفاع الحالات المرضية الايضية في الاغنام الى سلوك الاغنام ثناء الراعي وتناولها لأوراق الغضة والطرية مما يؤدى الى النفاخ خاصة قبل واثناء موسم التزهير للنبات.

الجدول (11): يوضح الامراض الايضية والجراحية الشائعة في الماعز (ن=115)

اسم المرض	عدد الحالات المصابة	نسبة الإصابة %
فقد الشهية	19	16.52
حمى الحليب	11	9.57
النفاخ	46	40.00
الاسهال	7.0	6.09
عسر الولادة	18	15.65
خلع القرون	9.0	7.83
كسور العظام	5.0	4.35
الإجمالي	115	100.00

لوحظ فروق إحصائية ذو دلالة معنوية بين نسبة الإصابة، والامراض الايضية التي تصيب الماعز، P<0.05

كما كشفت نتائج الدراسة الحالية أيضاً ان الاصابة بالنفاخ في الماعز كانت هي أعلى نسبة 40%، تلتها الاصابة بفقدان الشهية وعسر الولادة بنسبة 16.5% و15.7% من اجمالي امراض التمثيل الغذائي والتدخل الجراحي. وكانت أقل نسبة لحالات الكسور العظمية (4.3%).

لوحظ وجود فروق إحصائية ذو دلالة معنوية (P<0.05) بين نسبة الإصابة وأنواع الأمراض الايضية والجراحية في الماعز. اتفقت هذه الدراسة مع ما وجدالباحث (2020) ,.Rahman et al واخرون، بان النفاخ هو من أكثر الامراض انتشارا بين الماعز. وقد يعزو السبب في ارتفاع حالات النفاخ أيضا في الماعز لنفس الأسباب التي تحصل في الابقار والأغنام كون جميعهم من المجترات. وبشكل عام، ان اختلاف انواع الحالات المرضية ونوع الامراض التي سجلت في العيادات البيطرية بين الحيوانات في مدينة ذمار في هذه الدراسة يمكن ارجاعها الى أسباب إدارية وغذائية، وفصيلة الحيوان ونوعه والظروف بيئية.

الاستنتاجات

نستنتج من هذه الدراسة وجود العديد من الأمراض البكتيرية والفيروسية والطفيلية والتمثيل الغذائي وكذلك الحالات الجراحية بين الحيوانات في العيادات البيطرية في مدينة ذمار. يتأثر معدل انتشار الامراض بتغير المواسم. الأغنام هي أكثر الحيوانات معرضة للإصابة بالأمراض المختلفة. يوصى بأجراء المزيد من الدراسات الحقلية لتقصى بقية الامراض التي لم تسجل في هذه الدراسة في ذمار وعلى

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Common Diseases in Animals in Veterinary Clinics in Dhamar City: Retrospective Study

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ABSTRACT

This study was conducted in 2021 in city of Dhamar, Yemen with main aim to identify the common diseases infecting animals attending to Governmental and private clinics. Data were collected from the register records of 2020 containing all information on animals examined in targeted clinics such as, animal type, sex, month variation or season. Out of 2387 records studied, 2350 cases were clinically sick animals with prevalence rate 98.4%. The higher clinical cases were recorded in females (64.2%) and lower in the males (35.8%). Clinical cases were highest in September and lower in August. The higher number of clinical case were recorded in gastrointestinal tract, followed by skin, genital, nervous, respiratory and musclu-skeletal system; whereas, the lower number in the urinary and circulatory systems. The higher numbers of clinical cases were recorded in sheep (54.5%) followed by cattle (27.7%) and goats (16.8%); while, the lower clinical cases were recorded in camels, horses, donkeys and dogs as 0.6% ,0.05%, 0.3% and 1.0% respectively. The common diseases identified in sheep were external parasitic diseases followed by internal parasitic diseases and pneumonia; whereas, in cattle, the common diseases observed were internal parasitic diseases and mastitis. Similarly, in the goat, the common diseases were external parasitic diseases followed by abscesses. Regarding to the metabolic diseases, bloat and loss appetite were observed among all animals' species investigated. Statistically, significant differences ($P<0.05$) were observed between the clinical cases month variation, sex, animal species and type of diseases. It could be concluded that. Many clinical cases including bacterial, viral, parasitic and metabolic diseases are observed in different species of the animals in study areas. Season and sex effect significantly in distribution of common diseases among animals. Improving management, husbandry, feeding and veterinary services in different areas of Dhamar are recommended. The findings of this study could be valuable in formulating preventive strategies against these common diseases.

Keywords: Common diseases, retrospective study, animal, Yemen

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Original Article

دراسة مقارنة لبعض خصائص الجودة لخمسة انواع من القمح المستورد الي اليمن

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الملخص

تعتبر حبوب القمح من الاغذية الكاملة، نظراً لاحتوائها على البروتينات والكربوهيدرات والدهون والمعادن والفيتامينات، وتعتمد اليمن على القمح المستورد لتغطية احتياجاتها التغذوية ولذا فقد هدف هذا البحث الى دراسة مقارنة بعض خصائص الجودة لخمسة انواع من القمح المستورد الى اليمن (الامريكي، الروسي، الهندي، الاوكراني، الاسترالي) والمستخدم في انتاج الدقيق في المطاحن اليمنية من اجل معرفة تأثير الانواع على تلك الخصائص. حيث أجري تقييم كلاً من الشوائب الكلية في الشحنة ووزن الالف حبة والوزن النوعي فيما تم تقدير كلاً من الرطوبة والرماد ورقم السقوط والجلوتين الرطب والبروتين وتقييم محتواها من الافلاتوكسين بالإضافة الى الكشف عن الخمائر والاعفان وبكتيريا السالمونيلا. اظهرت النتائج وجود فروقات معنوية) (P<0.05) في نسبة الشوائب الكلية ووزن الالف حبة والوزن النوعي في عينات القمح المستورد، حيث احتوى القمح الهندي على اعلى نسبة شوائب (5.37%) متجاوزاً على المواصفة القياسية اليمنية الخاصة بالقمح رقم 2006/72 (بان لا تزيد نسبة الشوائب الكلية عن 5%). فيما اظهر القمح الاسترالي اعلى متوسط لوزن الالف حبة (42.9 جم) فيما حصل القمح الامريكي على اعلى وزن نوعي (81.8 كغم/هكتوليتر). كما اظهرت نتائج التحليل الكيميائي ان القمح الامريكي كان الاقل في المحتوى الرطوبي (10.20%) فيما كانت نسبة الرماد في القمح الهندي هي الاعلى (1.65%) وحصل القمح الروسي على اعلى قيمة في رقم السقوط(465 ثانية) فيما كان القمح الامريكي الاعلى في نسبة الجلوتين الرطب(33.57%) وفي نسبة البروتين كان القمح الاسترالي هو الاعلى(12.78%) وفي محتوى الافلاتوكسين اظهرت النتائج خلو القمح الروسي والاوكراني من الافلاتوكسين بينما حصل القمح الهندي على اعلى قيمة (4.9ppb) وفي نتيجة التحليل الميكروبي أظهرت النتائج خلو القمح الامريكي والروسي والاوكراني من الاعفان فيما حصل القمح الهندي على اعلى قيمة (90cfu/g) فيما كانت جميع العينات خالية من بكتيريا السالمونيلا. اظهرت نتائج الدراسة تفوق القمح الامريكي على بقية انواع القمح في كثير من صفات الجودة، ولذا ننصح باستخدامه في المطاحن لإنتاج انواع الدقيق المختلفة.

الكلمات المفتاحية:
خصائص الجودة، فيزيائية، كيميائية، ميكروبية، قمح مستورد

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المقدمة Introduction

يعد القمح (*Triticum aestivum*) من المحاصيل الزراعية الهامة باعتبارها الغذاء الاساسي للشعوب، وتتوزع زراعة القمح في اغلب دول العالم فهو من المحاصيل الوفيرة وحبوبه الناضجة تمثل مخزون ذو قيمة غذائية عالية. يعتبر القمح الغذاء اليومي للمجتمعات ومصدراً للدقيق المستخدم في صناعة الخبز، إذ يستهلك 80% من القمح المنتج لغذاء الانسان و11% كبذور للعام التالي و7% كعلف وكما تستخدم نسبة بسيطة منه في انتاج البرغل والسميد (الفين، 2013).

بحسب تقرير منظمة الاغذية والزراعة (FAO, 2021) فان اليمن تعتمد على القمح المستورد بنسبة 97% حيث بلغ المعدل السنوي لاستيراد القمح 2.8 مليون طن في العام من إجمالي الاستهلاك المحلي البالغ زهاء ثلاثة ملايين طن فقد استوردت اليمن حوالي 710 آلاف طن قمح من أوكرانيا و800 ألف طن من روسيا، ووفقا لتقرير المعهد الدولي لبحوث السياسات الغذائية(2020) يبلغ الاعتماد على استيراد الحبوب في اليمن 97%، حيث توفر روسيا وأوكرانيا الحصة الأكبر من واردات القمح ومنتجاته بحوالي 42%" فيما تأتي امريكا والهند في المرتبة الثانية بنسبة 37% وفي المرتبة الثالثة حلت استراليا بنسبة 21%.

ان معرفة خصائص الجودة للقمح المستورد المستخدم في انتاج الدقيق في اليمن يساهم في تحديد مواصفات الجودة المطلوبة عند شراء القمح كما انها تعد مؤشراً على معدل انتاج الدقيق عند الطحن والاستخلاص بالإضافة الى معرفة الظروف التي مرت بها الحبوب ابتداء من الحقل واثناء الحصاد والنقل كما انها تعد مؤشراً على قابلية الحبوب للخزن ومدى صلاحيتها.

تعرف الشوائب الكلية في القمح بانها كل المواد الغريبة غير الحبوب السليمة والتي تشمل على الحبوب المصابة والضامرة والمكسورة والغريبة والقش، حيث يجب ان لا تزيد هذه الشوائب عن 5% بحسب المواصفة القياسية اليمنية رقم 2006/72. فيما يشير وزن الالف حبة الى درجة امتلاء الحبوب وهو ما يعطي صورة مبدئية عن نسبة الدقيق المستخلص من هذه الحبوب عند الطحن، حيث ان العلاقة طردية بين وزن الالف حبة وبين نسبة الدقيق المستخلص فكلما زاد وزن الالف حبة للحبوب زادت نسبة الدقيق المتوقع استخلاصها من تلك الحبوب (فضل واخرون، 2005) فيما يعتبر الوزن النوعي مقياساً لكثافة الحبوب ومعياراً لجودة الطحن وكمية الدقيق المتوقع انتاجها ويعتبر من اهم العوامل المؤثرة في انظمة تدريج الحبوب في الاسواق العالمية (العاتي واخرون،2017).

تعتبر رطوبة القمح من العوامل المساعدة في تخزين الحبوب لفترات طويلة كما ان رطوبة القمح المرتفعة تدل على تعرض الحبوب للأمطار قبل الحصاد وهو ما يمكن ان ينتج عنة زيادة نشاط انزيم الالفا اميلز وبالتالي انخفاض رقم السقوط والعمل على تلف الحبوب وبالتالي التأثير على خصائص جودة المنتجات المصنعة من هذه الحبوب وانتاج منتجات غير مرغوبة (Ktenioudaki et al., 2010). فيما يعد الرماد مؤشراً على جودة الطحن اذ تحدد من خلاله كفاءة عملية الطحن لارتباطها بكمية النخالة في حبة القمح (Boz et al., 2012).

تعتبر نسبة الجلوتين من الخصائص الهامة للدقيق والتي تعطي مؤشراً لنوعية وجودة الدقيق وكما انها تعكس النسبة العامة لبروتين القمح بالإضافة الى انه تعكس بشكل ايجابي خصائص العجين (الهبيل، 1992). تنتج السموم الفطرية عن نمو انواع مختلفة من الاعفان على الحبوب نتيجة الاصابة في الحقل او ارتفاع رطوبة الحبوب اثناء التخزين، حيث تسبب العديد من المخاطر الصحية للإنسان (السلوقي واخرون، 2021).

ولمعرفة الخصائص الفيزيائية والكيميائية والميكروبية للقمح المستورد الى اليمن والمستخدم في المطاحن اليمنية وتأثير تلك الخصائص على جودة الدقيق الناتج وصفاته التصنيعية وقابلية التخزين ومدى صلاحيتها وظروف زراعة وانتاج القمح صممت هذه الدراسة.

المواد وطرائق العمل Materials & Methods

المواد المستخدمة في البحث

تمت الدراسة على خمسة انواع من القمح المستورد (الامريكي، الروسي، الهندي، الاوكراني، الاسترالي).

مكان وتاريخ اخذ العينات

تم الحصول على عينات القمح المستورد من بواخر القمح التي تصل الي مينائي الحديدة والصليف. خلال الفترة من ابريل 2020 – ابريل 2023 م حيث تم اخذ العينات وفقاً لما جاء في المواصفة (YSMO GSO ISO 950/2012).

المحاليل والكيماويات المستخدمة

كانت الكيماويات والمحاليل المستخدمة في الدراسة ذات نقاوة عالية ومن انتاج شركة BDH Chemical Ltd.

تقدير الخصائص الفيزيائية

تم تقدير الخواص الفيزيائية للقمح والمتمثلة بنسبة الشوائب الكلية، وزن الالف حبة والوزن النوعي وفقاً لما جاء ذكره (Zeleny,1971).

تقدير الخصائص الكيميائية

اجرى تقدير كلاً من المحتوى الرطوبي للحبوب باستخدام الطريقة القياسية (AACC, 2000, 44-16)، الرماد الكلي باستخدام الطريقة القياسية (AACC, 2000, 08-01)، رقم السقوط باستخدام الطريقة القياسية (ICC, 107-01 ,2006)، الجلوتين الرطب باستخدام الطريقة القياسية (ICC, 2006, 106-01)، المحتوى البروتيني باستخدام الطريقة القياسية (AACC, 2000, 46-12).

تقدير الخصائص الميكروبية والسمية

تم تقدير العدد الكلي للأعفان وبكتيريا السالمونيلا في الحبوب قيد الدراسة بحسب الطريقة الموصوفة من قبل Harrigan وMcCance (1976). فيما جرى الكشف عن سم الأفلاتوكسين باستخدام طريقة الممتز المناعي المرتبط بالإنزيم Enzyme- Linked Immuno Sorbant Assay (ELISA) باستخدام طاقم قياس الأفلاتوكسين والذي تم الحصول عليه من شركة Veratox Neogenالامريكية (Crowther, 2002).

التحليل الإحصائي

حللت البيانات للاختبارات المختلفة بطريقة تحليل التباين analysis of variance (ANOVA) واستعمل اختبار دنكن متعدد الحدود عند مستوى احتمال 5% لمعرفة الفروق المعنوية بين المتوسطات، باستعمال برنامج التحليل الإحصائي STAT SAS,1995.

النتائج والمناقشة Results& Discussion

الخواص الفيزيائية

الشوائب الكلية (%)

تشير النتائج في الجدول رقم (1) الى وجود فروقات معنوية($P<0.05$) بين انواع القمح في نسبة الشوائب الكلية إذ احتوى القمح الهندي على النسبة الأعلى من الشوائب الكلية (5.37%)، فيما احتوى القمح الاسترالي على النسبة الاقل (1.24%). كانت نسبة الشوائب في العينات قيد الدراسة ضمن حدود المواصفة القياسية اليمنية رقم (2006/72) (بان لا تزيد نسبة الشوائب الكلية عن 5%). ما عدا القمح الهندي (5.37%). تعتبر الشوائب الكلية وكميتها من

المقاييس الهامة في الحكم على جودة القمح كما ان زيادتها في شحنة القمح يؤدي الى زيادة الفاقد في قسم التنظيف وبالتالي خسارة مادية اكبر (العاتي واخرون,2017). كما أن وجود الشوائب والمواد الغريبة في القمح يعيق من عملية نقله وتخزينه لفترة طويلة كما أن مرور بعضها لمرحلة الطحن يسيء لجودة المنتج النهائي (محمد، 2000)، وبالرغم من ان اغلب هذه المواد يتم فصلها في مرحلة تنظيف القمح قبل الطحن، إلا ان تسريبها الى داخل القمح المطحون يؤدي الى الإضرار بخواص الدقيق الناتج ومنها رفع نسبة الرماد الكلي وظهور لون غير مرغوب في الدقيق (الفين، 2013).

وزن الالف حبة (جرام)

اشارت النتائج في الجدول رقم (1) الى وجود فروقات معنوية (P<0.05) بين متوسط وزن الالف حبة للعينات القمح المدروسة. حيث ان متوسط وزن الألف حبة للعينات قيد الدراسة كانت 39.94، 37.80، 38.50، 38.40، 42.9 جم للقمح الامريكي، الروسي، الهندي، الاوكراني، الاسترالي على التوالي. حيث ان اعلى متوسط لوزن الالف حبة كان في القمح الاسترالي (42.9جم) فيما كان اقل متوسط في القمح ال روسي37.80 جم. الا ان جميع العينات كانت ضمن حدود المواصفة اليمنية للقمح (2006/72) (لايقل عن 30 جم). اتفقت نتائج الدراسة مع ما ذكره كلاً من (العاتي واخرون,2017، فضل واخرون 2005) من ان وزن الالف حبة في اصناف القمح المختلفة تتراوح بين 30- 45 جرام. يعتبر وزن الالف حبة للقمح من الخصائص الهامة والتي تشير الى امتلاء الحبوب وبالتالي زيادة الوزن وزيادة نسبة الاندوسبيرم مقارنة ببقية مكونات الحبة، كما انها تعتبر مؤشراً جيدا لنوعية القمح والى كمية الدقيق الذي سيتم استخلاصه من تلك الحبوب (حواس،1994).

الوزن النوعي (كغم/هكتوليتر)

اظهرت النتائج في الجدول رقم (1) من ان متوسط الوزن النوعي لعينات الحبوب كانت 81.81، 77.60، 77.50، 80.30، 80.73 كجم / هكتوليتر للقمح الامريكي، الروسي، الهندي، الاوكراني، الاسترالي على التوالي. وجاءت جميع القيم مطابقة لماء جاء في المواصفة القياسية اليمنية للقمح (2006/72). حيث أظهرت النتائج أن القمح الامريكي أعطى اعلى متوسط للوزن النوعي 81.81 كجم / هكتوليتر فيما كان اقل وزن نوعي في القمح الهندي 77.50 كجم / هكتوليتر. اتفقت نتائج الدراسة مع ما وجدة (فضل واخرون،2010) من ان القمح الامريكي كان الاعلى بين انواع القمح المدروسة يليه القمح الاسترالي بمتوسط 81.09 و80.84 كجم/هكتوليتر للقمح الامريكي والاسترالي على التوالي. اشار كلاً من (فضل واخرون، 2010) و(الهبيل وابوراس، 2021) من ان هناك علاقة طردية بين الوزن النوعي وبين حاصل الدقيق، لذا فان هذا الاختبار يعتبر مقياساً مهما للوقوف على درجة امتلاء الحبوب ومعرفة كمية الدقيق الناتج الذي يمكن الحصول علية من طحن الحبوب (نسبة الاستخلاص). يتأثر الوزن النوعي للقمح بمحتوى ونوع الشوائب وشكل وملاسة وحجم الحبة والمحتوى الرطوبي، حيث انه كلما كان شكل الحبة أقرب الى الشكل الكروي كلما كان الوزن النوعي أكبر، كما ان حبات القمح الكبيرة والناضجة في الجو الرطب تزداد فيها كمية النشاء والبروتين خلال مراحل النضج المختلفة مما يعني زيادة في الوزن النوعي مقارنة بالقمح ذو الحبات الصغيرة الناضجة في جو جاف (Manjunatha et al., 2021).

الخواص الكيميائية

الرطوبة (%)

تشير النتائج في الجدول رقم (2) الى عدم وجود فروقات معنوية (P<0.05) بين رطوبة القمح الامريكي والهندي والاوكراني، وبين القمح الروسي والاسترالي، حيث كان متوسط نسبة الرطوبة في عينات القمح المستورد الامريكي والروسي والهندي والاوكراني والاسترالي كانت 10.20 ، 11.12، 10.3، 10.90، 11.16 % على التوالي. حيث حصل القمح الامريكي على اقل متوسط لقيم الرطوبة 10.20% فيما كان القمح الاسترالي الاعلى في المحتوى الرطوبي 11.16%. الا ان جميع النتائج كانت ضمن حدود المواصفة القياسية اليمنية للقمح (2006/72). اتفقت نتائج الدراسة مع ما ذكره (الهبيل وابوراس، 2021) من ان رطوبة القمح لا تزيد عن 14%. فيما اختلفت نتائج الرطوبة عما وجدة (فضل واخرون،2010) وخاصة في القمح الامريكي والاسترالي وقد يعود السبب الى اختلاف الشحنات باختلاف المواسم الزراعية وطرق التجفيف. تعتبر رطوبة القمح من المعايير اللازم معرفتها للحكم على جودة القمح وتحديد درجته وبالتالي تحديد سعرة عند الشراء. كما انها تعتبر من الصفات الهامة وتؤثر تأثيرا مباشراً على عملية تخزين القمح، فكلما ارتفعت رطوبة القمح قصرت فترة التخزين وزيادة احتمالية اصابته بالحشرات والفطريات وبالتي تضررها، وبالمقابل فان انخفاض الرطوبة بشكل كبير يؤدي الى فقدان الحبوب ليونتها ويجعلها عرضة للتكسر اثناء النقل والتداول مما يتسبب في خسائر نتيجة ان الحبوب المكسرة تخرج اثناء عملية التنظيف قبل الطحن (العرموش، 2015).

نسبة الرماد (%)

بينت النتائج في الجدول (2) الي عدم وجود فروقات معنوية(P<0.05) في نسبة الرماد بين القمح الروسي والهندي وبين القمح الامريكي والاوكراني فيما اختلف القمح الاسترالي معنوياً على بقية الانواع، حيث كان متوسط نسبة الرماد في عينات الاقماح قيد الدراسة 1.49، 1.64، 1.65، 1.50، 1.43 % للقمح الامريكي، الروسي، الهندي، الاوكراني، الاسترالي على التوالي. حيث كان اعلى متوسط لنسبة الرماد في عينات القمح الهندي 1.65% بينما كانت النسبة الاقل في عينات القمح الاسترالي 1.43%. تقاربت النتائج مع ما وجده العديد من الباحثين من ان نسبة الرماد في القمح تتراوح بين 1.30 – 2 % (فضل واخرون,2005 ، Iqbal, 2015). تختلف نسبة الرماد في القمح باختلاف معادن التربة وكميتها وكذا نوع الاسمدة المستخدمة اثناء الزراعة، وعادة ما تنخفض نسبة الرماد في القمح من القشرة باتجاه الاندوسبيرم حيث محتواه من الرماد تبلغ نسبة 0.5% بينما تبلغ نسبة الرماد في القشرة بحدود 8% (الهبيل وابوراس، 2021).

رقم السقوط

اوضحت نتائج الجدول رقم (2) وجود فروقات معنوية(P<0.05) في رقم السقوط حيث كان رقم السقوط

لكلاً من القمح الامريكي، الروسي، الهندي، الاوكراني، الاسترالي 381، 465، 417،345، 389 على التوالي حيث اعطى القمح الروسي اعلى متوسط لرقم السقوط 465، فيما كان القمح الهندي الاقل في رقم السقوط 345. جاءت جميع النتائج ضمن حدود المواصفة القياسية اليمنية (2006/72) والتي نصت على انه يجب ان لا يقل رقم السقوط في القمح المستخدم للمخبوزات عن 250. يعتبر رقم السقوط مؤشراً على درجة نشاط لنزيم الالفا- اميلز في الدقيق ويمكن ربطها بجودة القمح خاصة مع الانواع التي تتعرض للرطوبة مثل الامطار قبل وبعد الحصاد، حيث يلاحظ ان ارتفاع درجة نشاط الانزيم بدرجة عالية وهو ما يؤدي الى خفض رقم السقوط (العاتي واخرون،2017). كما ذكر (فضل واخرون، 2010) من ان ارتفاع رقم السقوط للأصناف من القمح المحلية ربما يعود الى ظروف النمو في الطقس الحار وعدم تعرض القمح للرطوبة والامطار قبل وبعد الحصاد. فيما اشار (Posner et al.,2006) الى ان اختلاف رقم السقوط بين اصناف القمح يعود الى صفاتها الوراثية.

نسبة الجلوتين الرطب (%)

اظهرت النتائج في الجدول رقم (2) وجود فروقات معنوية (P<0.05) في نسبة الجلوتين الرطب بين اصناف القمح المستوردة، حيث كانت النسب كالتالي: 33.57، 33.02، 26.45، 26.40، 30.29% لكلاً من القمح الامريكي، الروسي، الهندي، الاوكراني والاسترالي على التوالي. حيث حصل القمح الامريكي على اعلى متوسط لنسبة الجلوتين الرطب (% 33.57) فيما كان القمح الاوكراني الاقل في نسبة الجلوتين الرطب (26.40 %). اختلفت النتائج عما وجده (فضل واخرون، 2010) في القمح الامريكي والاسترالي. يعتبر الجلوتين مؤشراً هاماً على جودة ونوعية دقيق القمح وتعد انعكاساً لمحتوى القمح من البروتين باعتبار ان الجلوتين يمثل 85% منها، كما انه يلعب دوراً حيوياً في سلوك العجين (الهبيل وابوراس,2021).

نسبة البروتين (%)

أظهرت النتائج في الجدول رقم (2) عدم وجود فروقات معنوية(P<0.05) بين القمح الامريكي والاوكراني والاسترالي من جهة ومن جهة اخرى بين القمح الهندي والروسي، إذ بلغ متوسط نسبة البروتينات في العينات المدروسة 12.50، 11.80، 11.90، 12.30، 12.78 % لكلاً من القمح الامريكي، الروسي، الهندي، الاوكراني والاسترالي على التوالي. حيث سجل اعلى متوسط لنسبة البروتين (12.78%) في القمح الاسترالي فيما سجل القمح الروسي اقل متوسط لنسبة البروتين (11.80%)، إلا ان جميع النتائج كانت ضمن حدود المواصفة القياسية اليمنية للقمح (2006/72). اتفقت نتائج الدراسة مع ما وجدة العديد من الباحثين من ان نسبة البروتين في القمح تتراوح بين 10-13.5% (الهبيل واخرون. 2020، فضل واخرون،2010) إذ تعتبر نسبة البروتين من الخصائص الهامة والتي بموجبها يتم تحديد سعر طن القمح في الاسواق العالمية، وقد يعود التباين في نسبة البروتين بين انواع القمح الى اسباب وراثية او ظروف التربة ونوع وطريقة التسميد(Kweon et al.,2011).

الخواص الميكروبية والسمية

أظهرت نتائج التحليل الميكروبي للعينات قيد الدراسة بان القمح الامريكي والروسي والأوكراني كانت جميعها خالية من الفطريات فيما احتوى القمح الهندي على اعلى محتوى (90cfu/g) فيما احتوى القمح الاسترالي على اعداد منخفضة من الفطريات (10cfu/g). اكدت نتيجة الحمل الميكروبي (الاعفان) العالي في القمح الهندي ما جاء في نتيجة محتوى القمح من السموم الفطرية ونسبة الشوائب العالية. اتفقت نتائج الدراسة مع ما ذكره على ويازجي (2006) من ان المحتوى العالي للفطريات في الاغذية غالبا ما يصاحبه مستويات معنوية من الافلاتوكسين باعتبار ان العديد من انواع الفطريات التي تنمو على الاغذية تقوم بإفراز سم الافلاتوكسين. ان احتوى الحبوب وخاصة القمح على الفطريات يعود في الغالب الى تلوث القمح بالفطريات اثناء الزراعة او اثناء الحصاد او التخزين وكلها مراحل اثبتت الابحاث ان له علاقة مباشرة بمحتوى القمح من الفطريات والسموم التي تفرزها (السلوقي واخرون.2021). كما ذكر الشرجبي (2015) من ان التخزين السيئ للحبوب ومنتجاتها يؤدي الى نمو الاحياء المجهرية والتي قد يتسبب بعضها في افراز السموم الميكروبية ومنها السموم الفطرية والتي هي عبارة عن نواتج ايض ثانوي للفطريات الخيطية على الحبوب المخزنة. من جهة اخرى اظهرت نتائج التحليل الميكروبي ان جميع العينات كانت خالية من بكتيريا السالمونيلا. بالرغم عدم ملائمة الحبوب لنمو البكتيريا بسبب فعاليتها المائية المنخفضة الا ان وجود البكتيريا في الحبوب يمكن ان يكون ذو دلاله على عمليات النقل والتخزين السيئة التي يمكن ان تتعرض لها الحبوب وهو ما يؤدي الى ارتفاع محتواها البكتيري.

محتوى الافلاتوكسين(ppb)

اوضحت النتائج في الجدول رقم (3) ان هناك فروق معنوية في محتوى الافلاتوكسينات في العينات إذ كانت عينات القمح الروسي والاوكراني خاليتان من الافلاتوكسين بينما سجلت اعلى النتائج في القمح الهندي(ppb4.9) يلاحظ بان هناك علاقة بين محتوى الشوائب الكلية ووجود الاعفان في القمح وبين محتواها من الافلاتوكسين إذ اظهرت النتائج ان القمح الهندي كان الاعلى في نسبة الشوائب وفي اعداد الاعفان وايضا الاعلى في محتوى الافلاتوكسين الا ان جميع مستويات الافلاتوكسينات المتحصل عليها كانت ضمن الحدود الأمنه بحسب المواصفة القياسية اليمنية (2001/156). تنتشر انواع متعددة من الفطريات في الحقول الزراعية وخاصة الفطريات المنتجة للسموم (الافلاتوكسينات) وتصيب محاصيل الحبوب ومنها القمح، إذ تتعرض الحبوب لمهاجمة الفطريات سواء في الحقل او اثناء الخزن كما ان ظروف الحصاد يمكن ان يساهم في تلوث الحبوب بأنواع من الفطريات نظراً لتداخل العديد من انواع الاعشاب مع الحبوب والتي في الغالب تكون مصابة بالفطريات المنتجة للسموم (العامري.2015، الزوي والفيتوري 2016). كما ان خزن الحبوب في مخازن رطبة او تعرضها للرطوبة اثناء الحصاد او النقل يمكن ان يؤدي الى نمو الاعفان وبالتالي ارتفاع محتواها من الافلاتوكسينات (Kumar.2008, Asadie et al., 2002).

الاستنتاجات

تشير النتائج الى تفوق القمح الامريكي في كثير من صفات الجودة الفيزيائية او الكيمائية او الميكروبية فيما كان القمح الهندي هو الاقل في درجات الجودة المدروسة ولذا ننصح باستخدام القمح الأمريكي في انتاج الدقيق في المطاحن اليمنية وذلك لتفوقه في الخصائص التصنيعية او القابلية الخزينة.

الشكر والعرفان

يود الباحثون التقدم بجزيل الشكر والعرفان الى القائمين في مينائي الحديدة والصليف لتزويدهم بعينات القمح المستورد المطلوبة خلال اجراء هذه الدراسة

جدول (1) الخواص الفيزيائية لأنواع القمح قيد الدراسة

الخواص	امريكي	روسي	هندي	اوكراني	استرالي	المواصفة
الشوائب الكلية (%)	1.44a	2.79b	5.37c	2.8b	1.24a	لا تزيد عن 5%
وزن الالف حبة (جرام)	39.94 b	37.80d	38.50c	38.40d	42.9a	لا تقل عن 30
الوزن النوعي (كغم/هكتوليتر)	81.81 a	77.60b	77.50b	80.30a	80.73a	لا يقل عن 74

الأحرف المختلفة ضمن الصف الواحد تشير الى وجود فروق معنوية (P<0.05)بين متوسطات المعاملات.

جدول (2) الخواص الكيميائية لأنواع القمح قيد الدراسة

الخواص	امريكي	روسي	هندي	اوكراني	استرالي	المواصفة
الرطوبة (%)	10.20a	11.12b	10.30a	10.38a	11.16b	لا تزيد عن 13%
الرماد (%)	1.49b	1.64a	1.65a	1.50b	1.43c	-
رقم السقوط	381c	465a	345d	417b	389c	لا يقل عن 250
الجلوتين الرطب (%)	33.57a	33.02a	26.45c	26.40c	30.29b	-
البروتين (%)	12.50a	11.80 b	11.90b	12.30a	12.78a	لا تقل عن 9%

الأحرف المختلفة ضمن الصف الواحد تشير الى وجود فروق معنوية (P<0.05)بين متوسطات المعاملات.

جدول (3) الخواص الميكروبية لأنواع القمح قيد الدراسة

الخواص	امريكي	روسي	هندي	اوكراني	استرالي	المواصفة
الاعفان (CFU)	0a	0a	90b	0a	10c	لا تزيد عن 10^4
السالمونيلا (CFU)	Nil	Nil	Nil	Nil	Nil	Nil
الافلاتوكسين (ppb)	0.28b	0a	4.9d	0a	1.24c	لاتزيد عن 20 ppb

الأحرف المختلفة ضمن الصف الواحد تشير الى وجود فروق معنوية (P<0.05)بين متوسطات المعاملات.

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Comparative study on some quality characteristics of imported wheat in Yemen

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ABSTRACT

Wheat grains are considered a complete food, as they contain proteins, carbohydrates, fats, minerals and vitamins. Yemen depends on imported wheat to cover its nutritional needs. Therefore, this study aimed to compare some quality characteristics of five types of wheat imported to Yemen (American, Russian, Indian, Ukrainian, Australian) which is used in the production of flour in Yemeni mills in order to know the effect of types on these characteristics. The total impurities in the shipment, the weight of one thousand grains, and the specific gravity were evaluated, while the moisture, ash, falling number, wet gluten, and protein were estimated, and their aflatoxin content was evaluated, in addition to the detection of yeasts and molds and salmonella. The results showed significant differences($P<0.05$) in the percentage of total impurities, weight per thousand grains, and specific gravity in samples of imported wheat, as Indian wheat contained the highest percentage of impurities (5.37%), exceeding the Yemeni standard specification for wheat. While Australian wheat showed the highest average weight of one thousand grains (42.9 g) while American wheat had the highest specific weight (81.8 kg/hectol). The results of the chemical analysis also showed that the American wheat had the lowest moisture content (10.20%), while the ash percentage in Indian wheat was the highest (1.65%)· Russian wheat had the highest value in the fall number (465 seconds), while American wheat was the highest in wet gluten percentage (33.57%), and in protein percentage, Australian wheat was the highest (12.78%), and in aflatoxin content, the results showed that Russian and Ukrainian wheat were free of aflatoxin, while Indian wheat obtained the highest value (4.9ppb), and as a result of the microbial analysis, the results showed that American, Russian, and Ukrainian wheat were free of mold, while Indian wheat obtained the highest value (90cfu/g), while all samples were free of salmonella bacteria. The results of the study showed that American wheat is superior to other types of wheat in many quality characteristics. The results of the study showed that American wheat is superior to other types of wheat in many quality characteristics. Therefore, we recommend to use it in mills for producing different types of flour.

Keywords*:* Quality characteristics, physical, Chemical, Microbial, imported wheat

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