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# Prevalence and risk factors of Sheep Hydatidosis in East Nile locality, Khartoum State, Sudan.

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## Abstract

A cross-sectional study was conducted on 332 sheep slaughtered at El-hag yousif abattoir, East Nile Khartoum State, Sudan, during the period extended from December 2016 to February 2017. The objective was to estimate the prevalence of hydatid cysts in sheep and to investigate risk factors associated with the disease.

Routine meat inspection procedure was employed to detect the presence of hydatid cysts in visceral organs (liver, lung, heart and spleen).Examined sheep originated from three areas: Buttana, East Nileand White Nile. The overall prevalence was 3%. The prevalence of hydatid cysts infection according to age of sheep was 3.7% in animals equal and more than one year and 2.11% in animals less than one year. The distribution of the hydatid cysts according to the area (source) of sheep was 2.4% in Buttana, 2.19% in East Nile, and 5.6% in White Nile. As for body condition the prevalence was 3.3% in good body condition and 0.0% in poor body condition. The prevalence of Hydatidosis in ecotype of animals was 2.3% in Baldy ecotype,5.7% in Hamary ecotype, 2.4% in Dubasy ecotype and 5% in Kabashy ecotype. The results of the univariate analysis by using the Chi-square for the following potential risk factors were: ecotype (P-value= 0.578), age of animal (p-value= 0.407), origin of animal (P-value = 0.359), body condition (p-value = 0.321), grazing (p-value =0.100),and present of dog (p-value =0.343). The grazing of animal was found to be significantly associated with Hydatidosis (p-value =0.1). Using multivariate analysis to determine possible significant association betweenHydatidosis and potential risk factors, the result showed that there was no significant association with any of the investigated risk factors.Our study showed that the liver was the most infected organ (6 cysts), while two cysts were found in the lung and liver. No cyst was found in heart and spleen. Microscopic examination of the 12 cysts (found in 10 affected animals) revealed that, eight cysts was sterile, two cysts were fertile.

The present research work that is to alert policy makers to design governmental control programs against hydatid cyst infection to minimize the prevalence in Sudan and ensure effective protection not only for animal population but also for humans at risk of contracting the infection.

**Keywords:** Hydatid cysts, Abattoir, prevalence, risk factors, microscopic examination.

## Introduction

Hydatid disease is caused by cestoda Echinococcus granulosus of 5.7 mm length with a scolex bearing four suckers and with body containing 2-6 proglottids (terminal segments), this worm lives in dog intestine. The adult worm in dog intestine was discovered by Hartmann (1695) and distributed throughout temperate and subtropical regions of world. The proglottids (terminal segments) release eggs that are passed in feces, after infection by an intermediate host such as sheep, goat, swine, cattle, horse, and man, the eggs hatch in the small bowel and release an oncosphere (hexacanth embryo) that penetrate the intestinal wall and migrates thought the circulatory system into various organs, especially the liver and lung, in these organs the oncosphere develops into cysts that gradually enlarges. Sheep are more sensitive to the disease; its distribution is normally associated with under developed countries, especially in rural communities, where man maintains close contact with dog, the definitive host which may act as intermediate host. Hydatidosis occurs in all breeds, sex, and ages of sheep but animals of 5 years of age and older have higher infection rates and greater of cysts, animals heavily infested sheep are undernourished, their wool is strangely and a characteristic cough is noted with signs of weakness, anorexia, dyspnea, loss of weight, and finally death. The sheep strain is the main cause of infection in human. In the endemic Mediterranean area sheep and dromedaries are intermediate host. Hydatidosis is wide spread parasitosis and causes a great health problem in many countries (Waleed et al.,2013).

Hydatidosisis a chronic cyst-forming parasitichelminthic disease of human beings as well as domestic and wild ungulates. It is caused by infection with the larval (metacestode) stages of dog tapeworms belonging to the genus Echinococcus (family Taeniidae) and is also referred to as echinococcosis. Three broad morphological forms of echinococcosis are recognized clinically: Cystic echinococcosis caused by E. granulosus, alveolar echinococcosis caused by E. multilocularis, and polycystic echinococcosis caused by Echinococcus vogeli or Echinococcus oligarthrus. Human cystic echinococcosis is the most common presentation and probably accounts for more than 95% of the estimated 2–3 million global cases, with human alveolar echinococcosis causing around 0.3–0.5 million cases (all in the northern hemisphere); fewer than 150 cases of polycystic echinococcosis have been described, all in Central and South America. The global burden (disability-adjusted life years) for human cystic echinococcosis was recently estimated to be more than that for onchocerciasis and almost the same as that for African trypanosomiasis. (Craig et al.,2007).

Echinococcosis is an important disease but it is a neglectedpublic health problem in Africa, especially in rural communities. In East Nile locality (Khartoum), hydatidosis may be one of the major infectious zoonotic diseases because most abattoirs in East Nile locality (Khartoum) is not well qualified, where sheep, cattle and goats are still slaughtered traditionally and carcass wastes are easily accessible to scavenging dogs and other wild carnivores, which are roaming freely and in large groups everywhere, due to absence of control programs for killing stray dogs by veterinary services. This study is therefore undertaken to determine the extent of spread of animal hydatidosis among slaughtered animals. It is clear that hydatidosis is considered a major public health problem in Sudan. Many animals are infected with hydatid cyst disease. Since the animals share the same life cycle as man, therefore determination of the prevalence of the disease in East Nile locality (Khartoum) is very important in order to explore the size of the problem which helps to control the disease.

The objectives of this study were: to estimate the prevalence of Ovine hydatidosisin Khartoum state, East Nile locality and to investigate the risk factors associated with the disease.

## Materials and Methods

### Study area:

The study was carried out in Khartoum state East Nile locality in El Hag Yousif abattoir. Khartoum State lies at the junction of the two rivers, the White and the Blue Niles in the North Eastern part of centralSudan. It lies between latitude 15-16 N and longitude 21-24 East with a length of 250 k and a total area of 20,736 km2 the surface elevation ranges between 380 to 400 m a.s.l.

Khartoum State is divided into three clusters (cities), built at the convergence of the Blue and White Niles: Omdurman to the northwest across the White Nile, North Khartoum, and Khartoum itself on the southern bank of the Blue Nile(Adel and Omer, 1999).

East Nile locality locates at the eastern north of Khartoum state, it's bounded by Nile from west, Nahar Nile state at north, Kassala state on east and both Gadarif and Eljazera states from south (www.eastnile.gov.sd).

### El-Hag Yousif abattoir:

El-Hag Yousif slaughter house is located near a residential area. Thus, constitutes nuisance and endangers the health of the community in the immediate surrounding environment. It is a small low-walled open-air slaughterhouse with an impermeable sloped floor. Its iron-bar doors permit the entrance of dogs especially at night thus, may contaminate the floor where dressing and evisceration of sheep, camels and cattle take place. Carcasses are cut into parts and hanged on fixed hooks for inspection. Sewage disposal is by collection into pits and then carried away in tanks to be disposed of in remote areas of town on open places where dogs can get access to it. Because of the water problem in the town, water supply is insufficient especially during summer for cleaning.

### Study design:

A cross-sectional study was conducted at abattoir on three randomly selected days. The animals in these days selected by systematic random sampling method. From each five animals one animal was selected for examination. The study was performed in the period betweenDecember2014 to February2015 to determine the prevalence and risk factors associated with the disease at a particular point of time.

### Examination:

### Ante –mortem examination:

Regular visits were made by the investigator to conduct ante -mortem examination of animals for slaughtering. During the ante mortem inspection, the age, sex, breed, origin and body condition of each animal most be determined.

### Post -mortem examination:

During the post mortem examination, visual inspection, palpation and systemic incision of each visceral organs was performed particularly the liver, lungs, kidneys, heart and spleen. Infected organs were collected in polyethene pags and taken to laboratory to conduct cyst count, cyst size, cyst fertility and viability of protoscoleces.

### Laboratory examination:

### Examination of cysts:

The fertility of cysts was examined microscopically. Each cyst was cut-open with scissor and the content of the cyst was poured into a clean petri dish. A drop of cyst fluid was put in a clean slide and then examined under the microscope (40×) for the presence of protoscolices.The

viability of protoscolices was determined by flame cell motility. The cyst which contained no protoscolices as well as suppurative, calcified, or degenerated was considered as unfertile cyst.

**Size measurement:**

Hydatid fluid was aspired from the cysts by syringe and the volume of cysts was estimated by measuring this fluid. Measurementof this fluid was done by using syringe.

**Sample Size:**

The expected prevalence of sheep hydatidosis for calculation of sample size was taken from the study in Sudan(SheepHydatidosis in Khartoum State, Sudan) in which the prevalence of hydatidosis in sheep was 10.7% (Abdalraswal, 2011).

**Sample size was calculated according to the formula by Martin et al, (1987):-**

$$n=\frac{4\times P\times Q}{L2}$$

**Where:**

n≡ Required Sample Size
P≡ Expected prevalence = 10.7
Q ≡ 1- P = 1-10.7
L≡ Allowable error = (0.05)

$$n=\frac{4\times 10.7\times(1-10.7)}{0.0025}=\mathbf{166}$$

The small sample size calculated (166) was multiplied by 2 to increase precision of the results (Thursfield, 2007).

**Statistical analysis:**

Frequency tables of the distribution according to the potential risk factors were constructed. Univariate analysis for risk factors associated with sheep Hydatidosis in Khartoum state, Sudan were analyzed by the Chi-square test by using statistical packets for Social Sciences (SPSS). Multivariate analysis by Logistic Regression models was performed for risk factors significant at level ≤ 0.25 in the Univariate model. The significant level in the Multivariate analysis was ≤ 0.05.

**Results:**

Out of the total 332 sheep inspected, only 10 (3%) animals were positive, and the rest were negative for hydatidosis (table 1).

**Table (1): Distribution of hydatidosis infection among 332 sheep examined in El-Hag Yousif slaughter house:**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 322 | 97.0 | 97.0 | 97.0 |
| | 1 | 10 | 3.0 | 3.0 | 100.0 |
| | Total | 332 | 100.0 | 100.0 | |

**Location of cysts:**

The location of cysts in different organs was investigated. The results showed that liver was most infected organ with hydatidosis where in 6 cases, the cysts were found in the livers, and 2

cases was found in the lung. Also 2 cases were found on lungs and liver in same animal. (Table 2)

Chi- square test showed significant association between the infection and location of cyst (p-value=0.00). (Table 3).

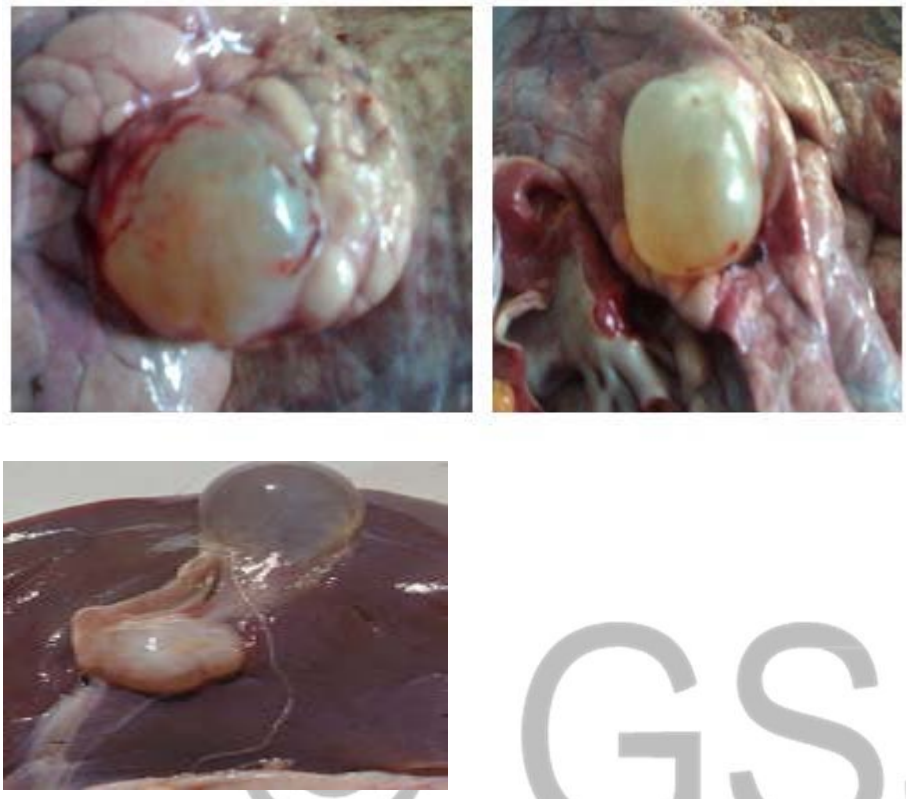

**Figure (1): Hydatid cyst in lung and liver of sheep.**

**Size of cysts (volume):**

Distribution of small cyst than 4 ml, equal or more than 4 ml in organs was listed in (Table2). Equal or more than 4 ml size cysts was found in six cases and small than 4 ml cysts was found in four cases, (Table 2).

Chi- square test showed significant association between the infection and size of cyst(p-value=0.00). (Table 3).

**Fertility of cysts:**

Macroscopic examination of the cysts revealed a total of 10 cysts, 2 cysts in two cases were fertile viable and eight cysts were sterile (table 2).

Chi- square test showed significant association between the infection and fertility of cyst (p-value=0.00). (Table3).

**Table (2): Summary of frequency tables for potential risk factors of Hydatidosis in 332 sheep examined at El-HagYousif slaughterhouse:**

| Risk Factors | Frequency | Relative Frequency % | Cumulative Frequency % |
|---|---|---|---|
| Age | | | |
| < 1 years | 142 | 42.8 | 42.8 |
| ≥ 1 years | 190 | 57.2 | 100 |
| Source | | | |
| Buttana | 123 | 37 | 37 |
| East Nile | 137 | 41.3 | 78.3 |
| White Nile | 72 | 21.7 | 100 |
| Breed | | | |
| Baldy | 132 | 39.8 | 39.8 |
| Dubasy | 127 | 38.3 | 78 |
| Hamary | 53 | 16 | 94 |
| Kabashy | 20 | 6 | 100 |
| Grazing | | | |
| Close | 114 | 34.3 | 34.3 |
| Open | 218 | 65.7 | 100 |
| Body condition | | | |
| Poor | 29 | 8.7 | 8.7 |
| Good | 303 | 91.3 | 100 |
| Present of dog | | | |
| No | 213 | 64.2 | 64.2 |
| Yes | 119 | 35.8 | 100 |
| Location | | | |
| No cyst | 322 | 97 | 97 |
| Liver | 6 | 1.8 | 98.8 |
| Lung | 2 | 0.6 | 99.4 |
| Liver& Lung | 2 | 0.6 | 100 |
| Volume | | | |
| No cyst | 322 | 97 | 97 |
| <4 ml | 4 | 1.2 | 98.2 |
| ≥4 ml | 6 | 1.8 | 100 |
| Fertility | | | |
| No cyst | 322 | 97 | 97 |
| Fertile | 2 | 0.6 | 97.6 |
| Sterile | 8 | 2.4 | 100 |

**Table (3):Summary of univariate analysis for potential risk factors of hydatidosis in 332 sheep examined at El-Hag Yousif slaughterhouse using the Chi- square test:**

| Risk factors | No.inspected | No. affected (%) | Df | X2 | p- value |
|---|---|---|---|---|---|
| **Origin** | | | 2 | 2.05 | 0.359 |
| Buttana | 123 | 3 (2.4) | | | |
| East Nile | 137 | 3 (2.19) | | | |
| White Nile | 72 | 4 (5.56) | | | |
| **Age** | | | 1 | .687 | 0.407 |
| <years | 142 | 3 (2.11) | | | |
| ≥years | 190 | 7 (3.68) | | | |
| **Body condition** | | | 1 | 0.987 | 0.321 |
| Poor | 29 | 0(0) | | | |
| Good | 303 | 10(3.3) | | | |
| **Presence of dog** | | | 1 | 0.899 | 0.343 |
| Yes | 119 | 5 (4.2) | | | |
| No | 213 | 5 (2.34) | | | |
| **Breed** | | | 3 | 1.974 | 0.578 |
| Baldy | 132 | 3 (2.27) | | | |
| Dubasy | 127 | 3 (2.36) | | | |
| Hamary | 53 | 3 (5.66) | | | |
| Kabashy | 20 | 1 (5) | | | |
| **Grazing** | | | 1 | 2.709 | .100* |
| Open | 218 | 9 (4.12) | | | |
| Close | 114 | 1 (0.87) | | | |

*Is mean significant value



**Origin (Area (state)):**

Out of the total 332 sheep inspected, 10 (3%) animals were positive for sheep hydatidosis. Table (3) summarizes the number of infected animals with hydatidosis in various states. The highest rate of infection was in White Nile (5.56%). Buttana had infection rate (2.4%) and the less rate of infection was in East Nile (2.19%).

The Result of study showed that there is no significant association between hydatid infection and origin of animal (p-value 0.359) (Table 3).

**Age of animals:**

Three hundred thirty-two sheep of various ages were examined in this study. The presence of hydatid cyst in various organs was investigated. Table (2) shows the age distribution of sheep, 142 of sheep were less than year and 190 of sheep were equal and more than year. Infection was high in animals which were equal or more than one year (3.68%) but in animals less than one year the infection rate was (2.11%).

The chi square test showed no significant association between infection and age of animal (p-value= 0.4) (Table 3).

**Body condition:**

The body condition of animals and the presence of hydatid cyst had been investigated. 302 of sheep were found to be in good condition and rate of infection was (2.98%) followed by 30 of sheep were found to be in poor condition and rate of infection was (3.3 %), (Table 3).

The Chi square test showed no significant association between the infection and body condition (p-value 0.9) (Table 3).

**Presence of dogs:**

The presence of dogs and presence of hydatid cyst infection had been investigated. The total number of infections was higher in presence of dogs (4.2%), the infection was low in area where dogs were absent (2.34%), (Table 3).

The chi-square test showed no significant association between infection and presence of dogs (p-value 0.523), (Table 3).

**Breed of animals:**

The results of study showed distribution of hydatid cyst infection in El-hag Yousif slaughter house by breeds. Total number of Baldy breed was 132 animals among these 132 animals 3 were found infected and the rate of infection was (2.27%). Total number of Dubasy breed examined were 127, among these there were 3 infections with rate (2.36%). Total number of Hamary breed examined were 53, among these 3 cases was infection with rate of infection (5.66%). Total number of Kabashy breed was 20 animals, among this one case was infected, with rate of infection (5%), (Table 3).

The chi square test showed there is significant association between the hydatid cyst infection and breeds (p-value=0.578), (Table 3).

**Grazing:**

The grazing and presence of hydatid cyst infection had been investigated. The total number of infections was higher in open grazing (4.1%) more than infection was the grazing closed (0%).

The chi square test showed there is significant association between the hydatid cyst infection and grazing (p value-0.100) (Table 3).

**Table (4): Summary of multivariate analysis for potential risk factors of hydatidosis in 332 sheep examined at El-Hag Yousif slaughterhouse using the Exp(P)**

| Risk factors | No.inspected | No. affected % | Df | Exp (P) | p- value | 95%CI For Exp(P) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| **Origin** | | | 2 | | 0.548 | | |
| Buttana | 123 | 3 (2.4) | | Ref | | | |
| East Nile | 137 | 3 (2.19) | | 0.00 | | 0.00 | - |
| White Nile | 72 | 4 (5.56) | | 1.41 | | 0.00 | - |
| **Age** | | | 1 | | 0.261 | | |
| <years | 142 | 3 (2.11) | | Ref | | - | - |
| ≥years | 190 | 7 (3.68) | | 2.1 | | 0.512 | 8.876 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Body condition** | | | 1 | | 0.784 | | |
| Poor | 29 | 0(0) | | Ref | | - | - |
| Good | 302 | 10(3.3) | | 3.92 | | 0.00 | 7.47 |
| **Presence of dog** | | | 1 | | 0.742 | | |
| Yes | 119 | 5 (4.2) | | Ref | | - | - |
| No | 213 | 5 (2.34 | | 1.222 | | 0.327 | 4.562 |
| **Breed** | | | 3 | | 0.837 | | |
| Baldy | 132 | 3 (2.27) | | Ref | | - | - |
| Dubasy | 127 | 3 (2.36) | | 1.4 | | 0.00 | 2.02 |
| Hamary | 53 | 3 (5.66) | | 0.00 | | 0.00 | 0.00 |
| Kabashy | 20 | 1 (5) | | 0.00 | | 0.00 | - |
| **Grazing** | | | 1 | | .157 | | |
| Open | 218 | 9 (4.12) | | Ref | | - | - |
| Close | 114 | 1 (0.87) | | 6.085 | | 0.507 | 73.05 |

*Using multivariate analysis to determine possible significant association between hydatidosis and potential risk factors, the result showed that there was no significant association with any of the investigated risk factors.

**Discussion:**

The prevalence of Hydatid cyst in this study (3%), was higher than the prevalence in other studies in Sudan, which was 1.6% in north kordofan (Khalid,2014), 1.4% in Khartoum state (Mohamadin and Abdelgadir, 2011).

The present result is in agreement with the result of another studies in different countries which was 3.61% in Kenya (Njoroge et al., 2002) , and 2.7% in northwest Iran (Tappe et al., 2010).

On the other hand the prevalence of Hydatid cyst recorded during this study is lower than the results in other studies which was 4.9% in Ethiopia (Formsa and Jobre.,2011), 8.4% in Libya (Al-Kalidi, 1998), 11.1% in Iran (Dalimi et al,2002) , 11.1% in Iraq (Saida and Nouraddin, 2011), 12.61% in Saudi Arabia (Ibrahim,2010) , 12.9% in Jordan (Kamhawi et al.,2012) and 45.5% in Iran (Khanjari et al,2012). This might be due to the variation in environmental condition because; as it is known that the eggs survive for only short periods of time if they are exposed to direct sunlight and dry conditions (OIE, 2005), and under ideal conditions, E. granulosus eggs remain viable for several months in pastures or gardens and on household fomites. Also, the eggs survive best under moist conditions and in moderate temperatures (OIE, 2005). In addition, the difference in hydatidosis prevalence rate between countries could be associated with different factors like control measures applied in place, the level of community awareness created about the disease, education and economic status of the population, variation in the temperature, environmental conditions, the nature of the pasture and the way of raising these animal, levels of exposure and the maturity and viability of eggs (Njoroge et al., 2002).

This difference in the prevalence of hydatid cyst infection could be also attributed, perhaps, to the variability of the following: origin of animal, mode of grazing, presence of definitive host (carnivore) degree of contamination with parasite and other carnivores, improved standards of meat inspection, overall improvement in socio-economic condition, hygienic status of sheep herds, variation in the temperature, environmental conditions, the nature of the pasture, and the way of raising of these animals.

The prevalence of hydatid cyst infection by origin has been investigated in this study. The rate of infection in Buttana was (2.4%), in East Nile was (2.19%), and in White Nile was (5.56%). There is no significant association between hydatid cyst infection and origin of animal ( p-value =0.359).

With regards to rate of infection of hydatidosis in different age groups of sheep, no significant association (p-value = 0.407) was observed. Animals of one year and more than one year of age were more affected (3.68%) compared with animals less than one year (2.11%). The difference in infection rate could be attributed mainly to the fact that aged animals have longer exposure time to E. granulosus (Khanjari et al., 2012),and also due to the fact that hydatid cyst infection is a chronic disease, the older age reflects a much longer period of exposure to infection, the chances of detecting cysts at meat inspection are higher in aged animals due to the larger size of cysts. Also the older animal cysts have more time to enlarge. Beside that an Echinococcus egg, in general, requires at least 6-12 months before the hydatid cyst stage grows sufficiently to produce protoscolices capable of infecting the carnivore host (Omer, 2013). The result are in agreement with the result of investigations carried out in Sinnar area, Blue Nile State, Sudan (Ibrahim et al,2011), in Jordan (Kamhawi et al., 1995), and in Northern Iran (Daryani et al, 2009).

The results of the current study showed that the prevalence of hydatid cyst infection within 2 categories of body condition of the animals was: 3.3% in good body condition and 0.0% in poor body condition. However, there was no significant association between hydatid cyst infection and body condition of animals (p-value = 0.321). This could be attributed to the fact that, the hydatid cyst infection is a mild disease which may not affect the general health of the affected animals. Also lack of variability in relation to body condition might be due to the little tendency of excluding emaciated animals form being slaughtered. This result is in agreement with the result of another study carried out in Sudan (Abdalraswal, 2011).

The prevalence of hydatid cyst infection as related to breed of animals was 2.27% in Baldy, 2.36% in Dubasy, 5.66% in Hamary, and 5% in Kabashy. There was no significant association between breed and hydatid cyst infection (p-value = 0.578).

The occurrence of hydatid cyst infection in relation to the location of cyst in animals was high in liver. There was a significant association between hydatid cyst infection and location of cysts (p-value =0.00). The liver in this study was the most affected organs. These findings are consistent with the observations reported in Libya (Ibrahem and Craig, 1998), Iran (Tappe et al, 2010) and (Khanjari et al, 2012), Ethiopia (Fikireet al, 2012), Nigeria (Abdullahi et al, 2011), Mauritania (Salem et al, 2011), Sudan (Mohamadin and Abdelgadir, 2011) and (Ibrahim et al,2011), Saudi Arabia ( Ibrahim, 2010), Sudan and Kenya(Njoroge et al,2002). The liver was the most common site of infection in sheep, this could be due to the fact that the liver is the first organ the blood flows through after leaving the intestine and filtered in it. The ova that are not trapped in the liver passed to the lungs then to other organs (Soulsby, 1982).

Fertility of cyst is an important factor that can affect stability of E.granulosus cycle depending on geographical situation, kind of infected host and size of cyst. In our study there was significant association between hydatidosis and fertility of cyst (p-value=0.00). Most cysts in this study were sterile (8 cases), and two cysts was fertile (two case).

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