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Research Article
Hydatid Cyst "*Echinococcus granulosus*" in Some Wildlife Herbivores at Tripoli Safari Park, Libya

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Abstract

Background: Hydatidosis is one of the world's major zoonotic diseases caused by larval stages of *Echinococcus granulosus*. In North Africa, the disease is moderately endemic and associated with economic losses and public health problems. **Methodology:** The present study was conducted at Tripoli Safari park through the period from 2001-2004 to determine the infection rate of hydatidosis in some wildlife herbivorous species. A total of 79 wild herbivores were examined for hydatid cyst infection. The overall infection rate with hydatid cyst of examined animals was 23/79 (29.2%), 3/7 (42.9%) in Addax, (*Addax nasomaculatus*), 4/17 (23.5%) dorcas gazelle (*Gazella dorcas*), 4/14 (28.6%) barbary sheep (*Ammortagus lervia*), 5/12 (41.7%) mouflon (*Ovis musimon*) and 7/29 (24.6%) fallow deer (*Dama dama*). The organs distribution of hydatid cyst in infected animals was 11 (47.8%) in lung, 5 (21.7%) in liver and 7 (30.4%) in both lung and liver. **Results:** Cyst fertility examination of a total of 249 hydatid cyst recovered from infected animals indicated that 168 (68.3%) was fertile cyst, 47 (19.1%) and 31 (12.6%) were sterile and calcified cysts, respectively. Out of 168 fertile cysts tested for viability 43 (25.6%) were viable. **Conclusion:** Conclusively, the present data represents the first large scale report on the occurrence of hydatidosis in wild herbivores at North Africa.

Key words: Hydatid cyst, *Echinococcus granulosus*, wildlife herbivores, addax, dorcas gazelle

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Hydatidos is caused by larval stage of *Echinococcus granulosus* is recognized as being one of the world's major zoonosis. Definitive hosts are carnivores such as dogs. The intermediate hosts are herbivores/omnivores, in which the development of the cysts occurs in liver, lung and other organs (Salem *et al*., 2010). The disease is associated with sever morbidity and disability. The pathogenesis of hydatidosis mainly depends on the extent/severity of infection and organs, on which the cyst is situated. The occasional rupture of hydatid cyst often leads to sudden death due to anaphylaxis, hemorrhage and metastasis. Previous studies have publicized that hydatidosis represented a considerable economic and public health significance in different countries (Kebede *et al*., 2009a). *Echinococcus granulosus* is the only species of the genus *Echinococcus* that found in Libya. The domestic dogs serve as the only known reservoir for the adult tapeworm, therefore they play a recognized role as the main source of infection causing both public health and veterinary problems (Aboudaya, 1985; Packer and Ali, 1986).

Based on the occurrence reports of *E. granulosus* in Libya, a high prevalence of *E. granulosus* infection in dogs has been frequently reported. In the eighties of the past century, necropsy of stray dogs indicated that they have the highest infection rates 40.3% followed by Sheppard dogs 34.8% (Gusbi, 1987). In another necropsy study conducted between 1985 and 1988, Awan *et al.* (1990) have reported that 36% of dogs in Tripoli area were confirmed to be positive for the presence *E. granulosus* infection. Retrospective analysis of hydatid cyst'prevalence in livestock depending on the slaughter house records between 2001 and 2005 revealed that the prevalence of hydatidos is in sheep, goats and cattle was 9.7, 1.8 and 4.8%, respectively (Buishi *et al*., 2012). In Libya, hydatidosis is one of the most prevalent zoonotic diseases due to easy movement of stray dogs across grazing area and livestock farms.

Records of surgery departmentat Tripoli Central Hospital from 1972-1979 revealed that 111 out of 22979 (0.48%) admission cases were surgically confirmed to have hydatidosis. A total of 73 (65.79%) and 38 (34.24%) of the infected persons were females and males, respectively. The highest incidence occurred among the 20-40 years age group, followed by 41-60 years group (Aboudaya, 1985).

Wildlife is currently recognized as an important source of emerging human pathogens, including parasites (Polley, 2005). Wild animals in Libya as in other regions of the world play an important role as reservoirs of diseases which can be transmitted to domestic animals as well as human (FAO., 1992). The current gap of information about the species, population and geographical distribution of wild animals in Libya necessitates the establishment of new epidemiological study trends to figure out the most prevalent zoonotic disease across the region. Thus, the present study aimed to determine the occurrence of hydatidosis in vital organs of some wild herbivores throughout Tripoli wildlife Safari park.

MATERIALS AND METHODS

Study area: The study was carried out at Tripoli wildlife Safari park, which is located approximately 25 km South Tripoli and comprises around 780 ha in range. The park climate is typically South Mediterranean. Winter is the main season for rainfall, the average annual rainfall (150-200 mm). The ambient temperature is temperate/cold in winter (4-24°C) and hot in late spring and summer (15-44°C).

The park is populated by hundreds of several species of wildlife herbivores Mountain zebra (*Hippotigris zebra*), impala (*Aepyceros melampus*), thomson's gazelle (*Eudorcas homsonii*), scimitar horned oryx (*Oryx dammah*), mouflon (*Ovis musimon*), the domestic herbivores (Camels, sheep and goats), carnivores (wild foxes, *Vulpes vulpes* and fennec fox, *Fennecus zerda*) and native dogs. Such carnivores live in the park and/or wandering at the surrounding areas.

Postmortem examination: A total of 79 freshly dead wildlife herbivores species Addax (*Addax nasomaculatus*), dorcas gazelle (*Gazella dorcas*), aoudad (*Ammotragus lervia*), mouflon (*Ovis musimon*) and fallow deer (*Dama dama*) were examined for hydatid cyst infection during a three years period (2001-2004) according to Georgi (1980). As a part of the routine reporting procedures adopted for dead wild animals in the park, Post Mortem (PM) examination was implemented. During the PM examination of the dead animals, systemic examination of the visceral organs particularly lung, liver, spleen, heart and kidney were employed by visual inspection, palpation and incision of the suspect organ to see the presence of hydatid cyst. The cysts were carefully removed and separately collected in clean containers and were transported to veterinary laboratory of Tripoli zoo for further cyst characterization according to the method described by Georgi (1980).

Cyst identification

Cyst size: All collected cysts were measured by vernier caliper. Cysts sizes were classified into small, medium and large cysts depending on their metric measures. A small cyst less than 2 cm, medium cyst measures 2-4 cm and large cyst is larger than 4 cm.

Cyst fertility: Using a sterile hypodermic needle, the pressure of the cyst was reduced and then the cyst wall was incised with sterile scalpel/scissors. The contents were poured into a glass petri dish and examined microscopically (10x) for presence of protoscoleces. Cysts that contained no protoscoleces, heavily suppurative or calcified were considered unfertile. The presence of protoscoleces either attached to the germinal layer in the form of blood capsule or its presence in the cyst fluid was considered as fertile (MacPherson *et al*., 1983). The viability of protoscoleces was determined by the principle that viable protoscoleces should completely or partially exclude the eosin dye, while the dead cysts keep it up. Moreover, calcified sterile cysts produced a gritty sound feeling upon incision (Soulsby, 1986).

RESULTS

Out of the total 79 wildlife herbivores species examined at the Tripoli Safari park, 23/79 (29.15) animals were found harboring hydatid cyst in various organs. Hydatid cyst was detected in 3/7 (42.9%) in Addax (*Addax nasomaculatus*), 4/17 (28.6%) dorcas gazelle (*Gazella dorcas*), 4/14 (28.6%) barbary sheep (*Ammortagus lervia*), 5/12 (41.7%) mouflon (*Ovis musimon*) and 7/29 (24.6%) fallow deer (*Dama dama*) were found positive for hydatid cyst infection (Table 1). Out of 23 hydatid infected animals, 11 (47.8%) harbored hydatid cysts in lung, 5 (21.7%) in liver and 7 (30.4%) were presenting concurrent infection in both lung and liver (Table 2 and Fig. 1). A total of the 246 hydatid cysts were collected from all positive animals, which has been categorized into 137 (55.7%) small size, 61 (24.8%) medium size and 48 (19.5%) large size (Table 3).

Out of 246 hydatid cysts tested for fertility, 168 (68.3%), 47 (19.1%) and 31 (12.6%) were identified as fertile, sterile and calcified, respectively. Table 3 exhibitedthe types of hydatid cyst detected in different species of wildlife herbivores. A total number of 168 fertile cysts recovered from lungs and livers were tested for viability. The test indicated that 32 (19%) cysts from lungs and 11 (6.5%) cysts from liver origin were viable. Also, the rate of all fertile cysts was higher in lung than liver.

DISCUSSION

Wildlife reservoirs can be established through parasitic infections transmitted through domestic animals as a result of

Table 1: Infection rate of hydatid cyst in different examined species of wildlife herbivores in Tripoli Safari park

			Infected organs		
Animal species	No. of animals examined	Infected animals	Lung	Liver	Lung and liver
Addax	7	3 (42.8%)	1	-	2
Dorcas gazzal	17	4 (23.5%)	2	2	-
Barbary sheep	14	4 (28.6%)	2	1	1
Mouflon	12	5 (41.6%)	2	-	3
Fallow deer	29	7 (24.1%)	4	2	1
Total	79	23 (29.15)	11	5	7

Table 2: Intensity of hydatid cyst infection in different organs of examined wildlife herbivores species in Tripoli Safari park

	Lung		Liver		Lung and liver	
Animal species	Infected animals (%)	No. of cysts	Infected animals (%)	No. of cysts	Infected animals (%)	No. of cysts
Addax	1/3 (33.3)	8	-	-	2/3 (66.6)	30
Dorcas gazzal	2/4 (50)	16	2/4 (50)	20	-	-
Barbary sheep	2/4 (50)	12	1/4 (25)	10	1/4 (25)	15
Mouflon	2/5 (40)	10	-	-	3/5 (60)	46
Fallow deer	4/7 (57.1)	36	2/7 (28.6)	19	1/7 (14.3)	24

Table 3: Calibrated hydatid cyst distribution in different infected organs

Organ	No. of cyst	Small size (<2 cm)	Medium size (2-4 cm)	Large size (>4 cm)
Lung	82	48	22	12
Liver	49	21	13	15
Lung and liver	115	68	26	21
Total	246	137 (55.7%)	61 (24.8%)	48 (19.5%)

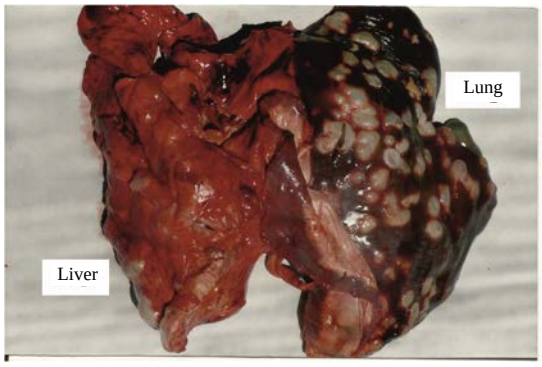

Fig. 1: Heavy hydatid cyst infection in the liver and lung of a wild herbivore (Addax) from Tripoli Safari park

human activity such as offering offal of infected dead wild herbivores to dogs and other carnivores. The emerging issues with the pathogenic parasite *Echinococcus* obviously emphasize how anthropogenic impacts overshadow the potential sequels that an infectious disease may have on a wildlife population. Hydatidosis is a systemic infection caused by the larval stage of the genus *Echinococcus*. The parasite is retained in a two-host life cycle including carnivorous final hosts in which the adult fertile cestode develop in the small intestine (Soulsby, 1986). Intermediate host, which may include human and domestic/wild herbivores, acquire infection by accidental ingestion of embryonated eggs that have been released into the environment in the feces of infected final hosts (Soulsby, 1986). This process results in development of the cystic stage, most commonly in lung and/or liver of the intermediate host.

Numerous primitive/traditional abattoirs of domestic herbivores are randomly scattered through the urban area (Qasr Ben Ghashier) located at the close vicinity of the Tripoli Safari park. The faulty anthropogenic activities of farmers/butchers at this area might have played a key role in the emergence of hydatidosis through the entire area and its surroundings including the Safari park. The random uncontrolled dumping of dead farm animals carcasses, offal and other wastes of the domestic herbivores have attracted a very wide array of stray dogs who dominated the area for decades. *Echinococcus granulosus* tend to establish sylvatic cycle when predator-prey relationships exist in the wildlife population of a region. Thus, *E. granulosus* cycle is maintained among wild ruminants (Georgi, 1980).

Despite the fact that hydatidosis has been profoundly studied in human and domestic animals, yet, their occurrence, sylvatic cycle and distribution in wildlife is puzzling and in real need for further epidemiological investigations. This gap in knowledge about the disease in wildlife has triggered us to utilize the available reports of the disease in their taxonomically close relatives of domestic herbivores (Sheep and cattle) to better discuss our obtained results.

High prevalences of human hydatidosis have been frequently reported across the Southern Mediterranean basin, particularly at North African region including Libya (Shambesh, 1997; Ibrahem and Craig, 1998; Ecca *et al*., 2002; Lamar *et al*., 2001; Sabry, 2007). Previous necropsy surveys in the 1980s indicated that the *E. granulosus* prevalences in stray dogs have ranged from 27.8-40.3% at Tripoli area (Gusbi, 1987; Awan *et al*., 1990). However, the prevalence was much higher in owned dogs through rural areas of Tripoli, which have vastly approached 60% in average (Packer and Ali, 1986). After two decades, another necropsy survey revealed that the overall prevalence of stray dogs in/around Tripoli area has reached 25.8% (Buishi *et al*., 2005).

According to Buishi *et al*. (2012), the results of a retrospective analysis study of *E. granulosus* infection in livestock based on Tripoli abattoir slaughter data from 1997 through 2001 have revealed that the prevalences of infection were 9.7% in sheep (7.3-11.6% of 269,649 animal), 1.8% in goat (1.6-2.4% of 694 animal) and 4.8% in cattle (3.1-6% of 177,663 animal).

In the present study, the overall prevalence of HC among 79 wild herbivores was 29.14%. The prevalence of HC in 4 ovine species was 27.8%, which is divided into 4/17 (23.5%) in dorcas gazzal, 4/14 (28.6%) in aoudad, 5/12 (41.6%) in mouflon and 7/29 (24.1%) in fallow deer. On the other side, the prevalence among one bovine species was 3/7 (42.6%). In a previous screening study at Tripoli slaughterhouse, Buishi *et al*. (2012) have reported comparably lower prevalences of hydatidosis in sheep (9.7%), goat (1.8%) and cattle (4.8%). Similarly, very lower prevalence of hydatidosis (7.7%) was reported among sheep from Ethiopia (Kebede *et al*., 2009b). Regionally, a comparable lower prevalence (22.9%) among Moroccan cattle was reported by Azlaf and Dakkak (2006). In Ethiopia, a comparably lower prevalence has been reported at different locations e.g., 7.5% in Shire (Kebede *et al*., 2009b) and Debre Birhan (Tsehay, 1995), while higher prevalences were also reported in other Ethiopian locations such as Asella (72.4%) Bahir Dar (59.9%) (Nebiyou, 1990), Bale Robe (62.96%) (Woubet, 1987) and Hawassa (52.69%) (Regassa *et al*., 2010).

Globally, a wide scope of prevalences beginning from 10.6-75% has been reported in many countries including those with endemic situation at the African continent (Dalimi *et al*., 2002). In the present study, the overall

prevalence of hydatidois among wild herbivores at Tripoli Safari park is 29.14%, which relatively lower than the average global prevalence of hydatidosis among the same animal species. This could be attributed to that condition that animals were grazing over a vast range of open grazing areas, which could be heavily populated with the definitive host (dogs and wild carnivores). Moreover, these animals could be feeding on green pasture, where infective stage is settled down within the grasses till accidental host (sheep and goat) apprehend them while grazing. Further, the erratic disposal dead infected sheep and goat carcasses at the open grazing areas could have maximized the chances to dogs and wild carnivores to prey them with consequent maintenance of hydatidosis cycle in unstoppable manner. In Tripoli Safari park, the endemic existence of infected definitive hosts (dogs, foxes and jackals) that share the same grazing area could be the primary motive for emergence of hydatidosis in wild herbivores with the different ranges of prevealences reported through the present study.

Taxonomically, the recorded morphometric measures of the detected cysts perfectly coincide with the standard morphometric criteria of hydatid cyst reported by Soulsby (1986). Also, the average sizes of the retrieved hydtid cysts from infected organs were consistent with those reported in different morphometric studies in the past few decades.

In respect to levels of infection in different organs of wild *Ovis* spp., results have indicated that lung was the highest infected organ (10/20 (50%)) followed by liver (6/15 (33%)). However, ovines with concomitant liver/lung infections presented 25% from the total infected animals. In Addax (*Bovine* spp.), this findings revealed that 80% (12/15) of lungs of the examined animals were infected, while no infection was recorded in liver of infected animals. However, 66.6% (2/3) of the examined animals were liver/lung concomitantly infected.

Several past surveys have supported our findings. For example, Debas and Ibrahim (2013) have reported that lungs of cattle were found to be the most affected organ followed by liver with infection intensities 75 and 59.8%, respectively. Previous studies at the same slaughterhouse during 1999 indicated that hydatid cycts infection rate was 14.7% in sheep, 2.7% in goats and 6.3% in cattle (Shareif, 2000). Simillar studies in the Western parts of Iran showed that hydatid cysts infection rate was 11.1% in sheep, 6.3% in goats and 16.4% in cattleand 12.4% in buffaloes (Daryani *et al*., 2007). Several previous studies at slaughterhouses from different parts of the middle East have revealed that sheep was the most affetced herbivores followed by goats then cattle (Arslan and Umur, 2008; Akhlaghi *et al*., 2005; Lotfi *et al*., 2010).

Possible explanations for the puzzling story of high infection intensities in lung compared to liver were all hypothetical and rational. One of the possible explanations could be the animal age, where the majority of wild herbivores were older in age with wider hepatic capillaries allowing swift passage of different stages of hydatid cyst to lungs. Moreover, having a larger thoracic duct could have allowed easy and intense passage of the cycts directly to lung and heart (Gracey, 1986). Hypothetically, the compact histological nature of hepatic tissue could be considered as a limiting factor to the entrance, lodging and establishment of the cysts. Further, the spongy vacuolar nature of lung together with the rich alveolar spaces could have allowed maximal lodgment expansion and division of cysts.

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REFERENCES

Aboudaya, M.A., 1985. Prevalence of human hydatidosis in Tripoli region of Libya. Int. J. Zoonoses, 12: 304-307.

Akhlaghi, L., J. Masoud and A. Hosseini, 2005. Observation on hydatid cyst infection in Kordestan Province (West of Iran) using epidemiological and seroepidemiological criteria. Iran. J. Pub. Health, 34: 73-75.

Arslan, M.O. and S. Umur, 2008. Erzurum mezbahalarinda kesilen koyun ve sigirlanda hidatozur yayilisi ve ekonomik onemi. Kafkas Universitesi Veteriner Fakultesi Dergisi, 3: 161-171.

Awan, M.A., A.M. Gusbi and W.N. Beesley, 1990. Echinococcosis in Libya. III. Further studies on the prevalence of *Echinococcus granulosus* in dogs. Ann. Trop. Med. Parasitol., 84: 473-475.

Azlaf, R. and A. Dakkak, 2006. Epidemiological study of the cystic echinococcosis in Morocco. Vet. Parasitol., 137: 83-93.

Buishi, I.E., E.M. Njoroge, O. Bouamra and P.S. Craig, 2005. Canine echinococcosis in Northwest Libya: Assessment of coproantigen ELISA, and a survey of infection with analysis of risk-factors. Vet. Parasitol., 130: 223-232.

Buishi, I.E., M. Fares and R. Elzlitni, 2012. A retrospective analysis of abattoir data for Cystic Echinicoccosis (CE) in livestock in Tripoli. Libyan Vet. Med. J., 3: 137-145.

Dalimi, A., G. Motamedi, M. Hosseini, B. Mohammadian, H. Malaki, Z. Ghamari and F.G. Far, 2002. Echinococcosis/hydatidosis in Western Iran. Vet. Parasitol., 105: 161-171.

Daryani, A., R. Alaei, R. Arab, M. Sharif, M.H. Dehghan and H. Ziaei, 2007. The prevalence, intensity and viability of hydatid cysts in slaughtered animals in the Ardabil province of Northwest Iran. J. Helminthol., 81: 13-17.

Debas, E. and N. Ibrahim, 2013. Prevalence and economic importance of hydatidosis in cattle slaughtered at North Gonder Elfora abattoir. Eur. J. Applied Sci., 5: 29-35.

Ecca, A.R., M. Conchedda, F. Gabriele, G. Bortoletti, C. Palmas, P. Craig and Z. Pawlowski, 2002. Cystic echinococcosis in the Mediterranean basin. Proceedings of the NATO Advanced Research Workshop on Cestode Zoonoses: Echinococcosis and Cysticercosis: An Emergent and Global Problem, September 10-13, 2000, Poznan, Poland, pp: 41-55.

FAO., 1992. The potential of the New World screw worm *Coclionmyia hominivorax* (Coqeral) on wild life in Africa, the Mediterranean Basin, the near East and Asia. Technical Report No. 27, Food and Agriculture Organization, Rome, Italy.

Georgi, J.R., 1980. Parasitology for Veterinarians. 3rd Edn., WB Saunders, Philadelphia, PA., ISBN: 1455740063, pp: 208-210.

Gracey, J.F., 1986. Meat Hygiene. 8th Edn., Baillier Tindall, London, UK., Pages: 517.

Gusbi, A.M., 1987. Echinococcosis in Libya. I. Prevalence of *Echinococcus granulosus* in dogs with particular reference to the role of the dog in Libyan society. Trop. Med. Parasitol., 81: 29-34.

Ibrahem, M.M. and P.S. Craig, 1998. Prevalence of cystic echinococcosis in camels (*Camelus dromedarius*) in Libya. J. Helminthol., 72: 27-31.

Kebede, N., H. Mekonnen, A. Wossene and G. Tilahun, 2009a. Hydatidosis of slaughtered cattle in Wolaita Sodo Abattoir, Southern Ethiopia. Trop. Anim. Health Prod., 41: 629-633.

Kebede, W., A. Hagos, Z. Girma and F. Lobago, 2009b. Echinococcosis/hydatidosis: Its prevalence, economic and public health significance in Tigray region, North Ethiopia. Trop. Anim. Health Prod., 41: 865-871.

Lamar, S., M. Kilani and P. Torgerson, 2001. Frequency distributions of *Echinococcus granulosus* and other helminths in stray dogs in Tunisia. Ann. Trop. Med. Parasitol., 95: 69-76.

Lotfi, A., M. Yusefkhani, A. Samavatian, H. Yilmaz, Z.T. Cengiz and M. Valilou, 2010. Prevalence of cystic echinococcosis in slaughtered sheep and goats in Ahar abattoir, northwest part of Iran. Kafkas Univ. Vet. Fak Derg., 16: 515-518.

MacPherson, C.N., L. Karstad, P. Stevenson and J.H. Arundel, 1983. Hydatid disease in the Turkana District of Kenya. III. The significance of wild animals in the transmission of *Echinococcus granulosus*, with particular reference to Turkana and Masailand in Kenya. Ann. Trop. Med. Parasitol., 77: 61-73.

Nebiyou, G., 1990. Study of hydatidosis/echinococcosis in cattle slaughtered at Bahr Dar municipality abattoir. D.V.M. Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Packer, D.E. and T.M. Ali, 1986. *Echinococcus granulosus* in dogs in Libya. Ann. Trop. Med. Parasitol., 81: 137-139.

Polley, L., 2005. Navigating parasite webs and parasite flow: Emerging and re-emerging parasitic zoonoses of wildlife origin. Int. J. Parasitol., 35: 1279-1294.

Regassa, F., A. Molla and J. Bekele, 2010. Study on the prevalence of cystic hydatidosis and its economic significance in cattle slaughtered at Hawassa Municipal Abattoir, Ethiopia. Trop. Anim. Health Prod., 42: 977-984.

Sabry, M.A., 2007. Advanced concepts in diagnosis of hydatidosis in human and living animals. J. Biol. Sci., 7: 720-728.

Salem, C.B.O.A., F. Schneegans, J.Y. Chollet and M.H. Jemli, 2010. Prevalence and aspects of lesions of hydatidosis in camel in Northern Mauritania. Revue D'elevage Medecine Veterinaire Pays Tropicaux, 63: 23-28.

Shambesh, M.K.A., 1997. Human Cystic Echinococcosis in North Africa (Excluding Morocco). In: Compendium on Cystic Echinococcosis in Africa and in Middle Eastern Countries with Special Reference to Morocco, Andersen, F.L., H. Ouhelli and M. Kachani (Eds.). Brigham Young University, Provo, Utah, pp: 223-244.

Shareif, M., 2000. The prevalence of hydatid cyst infection in slaughtered animals. J. Shahid Sadoughi Univ. Med. Sci. Health Serv., 4: 80-84.

Soulsby, E.J.L., 1986. Helminths, Arthropods and Protozoa of Domesticated Animals. 7th Edn., Bailleir Tindall, London, UK., Pages: 809.

Tsehay, T., 1995. Epidemiology of bovine fasciolosis and hydatidosis in Debre-Brahan region. D.V.M. Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Woubet, M., 1987. A preliminary study on echinococcosis/hydatidosis in Harrargie region and the efficacy of *Glinus lotoides* seeds against *Echinococcus granulosusin* pups infected experimentally with hydatid materials. D.V.M. Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.