



Sudan University of Science and Technology
College of Graduate Studies



**Prevalence And Risk Factors of Bovine Fasciolosis in
Slaughtered Cattle In Blue Nile State, Sudan**

نسبة الإصابة وعوامل الخطر لمرض الفاشيولا في ذبائح الأبقار بولاية

النيل الأزرق

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**A thesis Submitted to the College of Graduate Studies
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Dedication

To my Father , Mother , Brothers , my Wife and my
Lovely Babies

Acknowledgement

I wish to express my deepest sincere gratitude to my supervisor Prof. Siham Elias Suliman Department of Veterinary Medicine , College of Veterinary Medicine for her interest, encouragement, valuable, advice, suggestions and kind supervision. Also I wish to thank Dr. Nagla Abdel Hakeem Abbas for her support. Also my thanks are extended to my colleagues in Blue Nile State for their help and support.

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Abstract

A cross – sectional epidemiological study was conducted from november 2018 to december 2018 to estimate the prevalence and to investigate risk factors associated with the Fasciolosis in cattle slaughtered at two abattoirs in Eldmazin and Elreserries Localities – Blue Nile State. Among the total of 119 cattle livers examined at post mortem, 7 animals were positive and prevalence of bovine Fasciolosis was 5.9%.

Univariate analysis showed that there was statistically significant association between infection and age of animal ($X^2=57.891\%$, P.Value 0.000). There is was association between body condition of the animal and the disease ($X^2= 44.782\%$, P. Value 0.000) . Also the chi square test showed significant association between *Fasciola* infection and sex ($X^2=49.824$, P.value =0.000). Breed statistically significant with disease ($X^2= 79.067$, P. Value=0.000). Also using drug showed that prophylactic resistance there was statistically significant association with disease ($X^2 =99.840\%$, P.Value 0.000). Source of animals also statistically significant with disease ($X^2= 82.361\%$, P. Value 0.000), and localities statistically significant with disease ($X^2 =32.576\%$,P. Value 0.000). However type of grazing and present of snail were not found significant association with disease .

مستخلص البحث

أجريت دراسة مقطعية وبائية في الفترة ما بين نوفمبر 2018م حتى ديسمبر 2018م لتقدير الفاشيولا في الأبقار المذبوحة في محليتي الدمازين والرصيرص في ولاية النيل الأزرق لدراسة معدل انتشار وعوامل الخطر المرتبطة بمرض فاشيولا. من بين المجموعه 119 من الأبقار تم فحصها بعد الذبح في السلخانة وجد أن 7(5.9%) رأس من الأبقار مصابة بمرض الفاشيولا .

وأظهرت الدراسة أن نسبة انتشار الفاشيولا 5.9% من خلال الفحص الروتيني للحوم وجد أن هناك ارتباط ذو دلالة إحصائية بين العدوى وعمر الحيوان (مربع كاي 57.891، قيمة ف= 0.000) وارتباط بين الصحة الجسمية للحيوان والمرض (مربع كاي 44.782 ، قيمة ف 0.000) كما أظهر اختبار مربع كاي علاقة ذات دلالة إحصائية بين المرض والجنس (مربع كاي 49.824 ، وقيمة ف =0.000) وارتباط بين المرض والسلالة (مربع كاي 79.067 ، قيمة ف 0.000) واستخدام الأدوية (مربع كاي 99.840 ، وقيمة ف = 0.000)ارتباط ذو دلالة إحصائية بين مصدر الحيوانات والمرض (مرض كاي 82.361 ، وقيمة ف= 0.000) وارتباط ذو دلالة إحصائية بين المرض والمحليات (مربع كاي 32.576 ، قيمة ف = 0.000) ومع ذلك نظام الرعي ووجود القواقع ليس لهم علاقة معنوية مع حدوث الفاشيولا.

Table of Contents

Taitle	Page
Dedication	i
Acknowledgement	ii
English abstract	iii
Arabic abstract	iv
Table of Contents	v
List of Tables	vii
list of Figures	viii
Introduction	1
Objective of the study	2
Chapter One	
Literature Review	
1.1. Classification	3
1.2. Morphology of Fasciola	3
1.3. Host of fasciola	4
1.4. Intermediate Host	4
1.5. life cycle of the parasite	5
1.6. Clinical Signs	7
1.7. Immunity	10
1.8. Diagnosis	11
1.9. Control and prevention	12
1.10. Economic impact	15
1.10.1. Weight gain	15
1.10.2. Draught performance	16
1.10.3. Fertility	16
1.11. Bacteria associated with fasciolosis	16
1.12. The epidemiology of fasciolosis	17
1.13. Prevalence of fasciolosis in the world	18
Chapter Two	
Materials and Methods	
2.1. description of the study Area	26
2.2. Livestock Production	26
2.3. The Blue Nile Slaughter houses	27
2.4. Study design and sampling method	27
2.5. Questionnaire	28
2.6. Ante- Mortem Inspection	28
2.7. Post mortem Examination	28
2.8. Statistical Analysis	29

Chapter Three	
Results	
3.1. Over all Prevalence of disease	30
3.2. Age of animal	30
3.3. Sex of Animal	30
3.4. Breed of Animal	31
3.5. Source of Animal	31
3.6. Body Condition	31
3.7. Grazing	31
3.8. The effect of knowledge about present of snail on presences disease	32
3.9. The effect of treatment on present of disease	32
3.10. Localities	32
Chapter Four	
4.1. Discussion	35
4.2. Conclusion	38
4.3. Recommendations	39
Reference	40
Appendix (1)	47
Appendix (2)	57

List of Tables

No	Title	Page
1	Table 1 Over all Prevalence of disease	30
2	Table 2 Univariate analysis of risk factors associated with fasciolosis infection in cattle	33

list of Figures

No	Title	Page
1	Fig.1: Fasciola hepatica or gigantica	4
2	Fig.2: Fasciola gigantica or hepatica	4
3	Fig.3:Lymnaea Snail	5
4	Fig.4:Life cycle of Fasciola	7
5	Fig.5:Map of Blue Nile State	26

Introduction

Fasciolosis is an economically important disease, which is caused by Trematode of the genus *Fasciola* that migrates in the hepatic Parenchyma, and establishes and develops in the bile ducts (Troncy, 1989). *Fasciola* is commonly recognized as liver flukes and they are responsible for wide spread of morbidity and mortality in cattle characterized by weight loss, anemia and hypo proteinemia (Tsegay *et al.*, 2011). The parasite is transmitted by ingestion of metacercariae of *Fasciola* species on plants from contaminated fresh water. Fasciolosis is now recognized as an emerging animal disease (WHO, 1995).

The two most important species are *Fasciola hepatica* (found in temperate area and in cooler areas of high altitude in the tropics and subtropics) and *fasciola gigantica*, which predominates in tropical area . *Fasciola hepatica* is found in area above 1800 k.ms.In between these altitude limits, both species coexists where ecology is conducive for both snail hosts, and mixed infections prevailed. The snail of the genus *lymnae natalensis* and *lymnae truncatula* are known as intermediate host in life cycle of Fasciolosis. Infection with *Lymnaea truncatula* is usually associated with herds and flocks grazing wet marshy land . On the other hand, *fasciola gigantica* is a fresh water snail and infection with this species is associated with livestock drinking from snails infected watering places as well as with grazing wetland, which may be seasonally in undated (Tsegaye *et al.*,2011). Fasciolosis is an economically important disease of domestic livestock, in particular cattle and sheep and occasionally man. The disease is responsible for considerable economic losses in the cattle industry, mainly through mortality, liver

condemnation, reduced production of meat, milk, and wool, and expenditures for anthelmintics (Hillyer *et al.*,1997), also increased costs for replacement stockin cattle

Losses include reduced production and quality of milk, lower growth rates and lower feed conversion rates in fattening cattle (Boray, 2007).

The disease causes poor health, reduced growth rate, high mortalities especially in small ruminants and calves. For example Kithuka *et al.*, (2002) reported up to 0.26 million USD annual loss attributable to Fasciolosis associated liver condemnations in cattle slaughtered . Apart from its veterinary and economic importance throughout the world, Fasciolosis has recently been shown to be a re-emerging and widespread zoonosis affecting a number of Human populations (Mwabonimans *et al.*,2009).

Objective of the study :

1. To estimate the prevalence of bovine fasciolosis in Blue Nile State.
2. To investigate the risk factors associated with bovine fasciolosis in Blue Nile State.

Chapter One

Literature Review

1.1 Classification of Fasciola (David *et al.*,1969).

Class: Trematoda

Order : Monogenea

Family: Fasciolidae

Genus: *Fasciola*

Species: *F. hepatica*

F. gigantica

(David *et al.*,1969).

1.2. Morphology of Fasciola:

Fasciola gigantica is common liver fluke in African countries, it occurs in bile ducts and gall bladder, rarely under the peritoneum and in the lungs (Soulsby, 1982). The definitive hosts are sheep, cattle, and other ruminants rarely in rabbits and equines. Generally *Fasciola* is measuring from 2.0 to 3.0 cm in length by 0.08 to 1.3 cm in breadth. A cephalic cone, the integument is covered by scales, but the posterior surface may be smooth. Hemispheric oral and ventral suckers of equal size are present at the apex and base of the cephalic cone. The intestinal tract has a wall, developed pharynx, a short esophagus and two divergent intestinal caeca with numerous lateral diverticula, there is a posterior longate bladder with lateral branches. The highly dendritic *F.gigantica* (fig1) is larger than *F. Hepatica* (fig2), and eggs are larger in size, the body anterior cone is smaller than *F.hepatica*, the ventral sucker is larger than the *F.hepatica*. The inner intestinal branches take Y or T shape.

Fasciola hepatica is common liver fluke in Europe and other countries, it is flat, brownish, leaf shaped trematode.

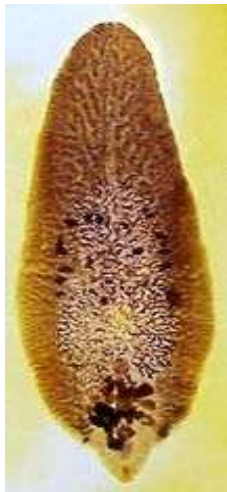


Figure (1) *F. gigantica*



Figure (2): *F. Hepatica*

(Mahrukh *et al.*, 2011)

1.3 Host of fasciola:

F. Hepatica

The adult fluke is a natural parasite of sheep and cattle but also may infect the horse, goat, camel, Lama, elephant, buffalo, dog, rabbit, guinea pig, monkey and man, (Mahrukh *et al.*, 2011).

1.4 Intermediate Host:

Information from the studies indicates that the snail intermediate host, populations undergo marked seasonal variations in density with generally low densities during the rainy period and high densities in the post-rainy periods. The snail host (fig3) of *F. gigantica* in tropical Africa is *Lymnaea Natalensis* (Moayad *et al.*, 2011).

The numerical size of the population is dependent on several climatic factors, such as flooding, desiccation and temperature and on the natural rate of increase of the snail species following catastrophes. Information gained from the observations indicates that the transmission of trematodes by the intermediate hosts is high during the dry season. The increase in transmission during the dry season is attributed to decreased water volume observed in the habitats during the dry season leading to high focal concentration of the intermediate hosts. (Pfukenyia *et al.*, 2005).

This is accompanied by increased contact of the habitats by livestock due to scarcity of pasture and increased grazing around water bodies,

there by favoring accumulation of trematode eggs in close proximity to snail habitats . these factors result in increased frequency of contact between miracidia and snail intermediate hosts thereby increasing the prevalence of infection in the latter (Pfukenyiaet *al.*,2005).



Fig. (3) *Lymnaea* Snail

1.5 life cycle of the parasite :

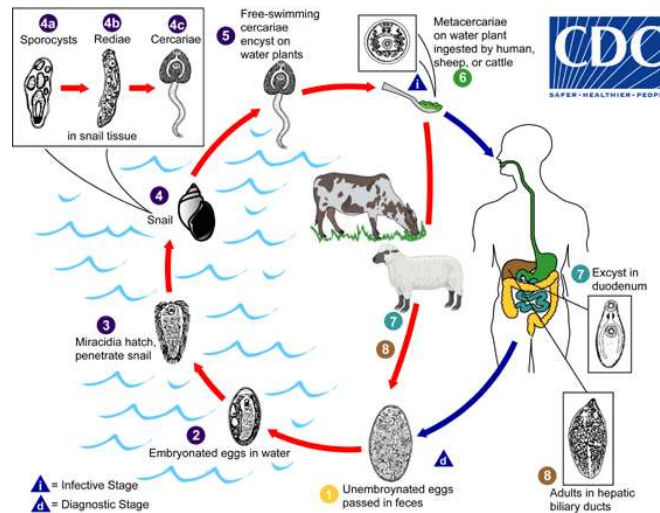
Eggs are passed in the faeces of the mammalian host, hatch and release motile miracidia. Hatching may take nine days and the optimal temperatures(22-26°C) , (Moayad *et al.*,2011).

Miracidia have a short life span and must locate a suitable snail within three hours. In infected snails sporocysts, reial stages and cercaria develop(fig4) (Moayad *et al.*,2011). Snails pass the motile cercaria which then attach themselves to plant material, where they encyst and become the infective metacercariae. A minimum of 6-7 weeks is required for Miracidia to form metacercaria,under unfavorable circumstances this may take several months. Following on infection of one snail with one miracidium over 600 metacercariae may be produced final host ingest the metacercaria and these excyst in the small intestine, followed by

migration through the intestinal wall crossing of the peritoneum and penetration of the liver capsule. The immature flukes migrate through the parenchyma (6-8 weeks period). Entering the small bile ducts and finally migrating to the larger bile ducts (and occasionally the gall bladder). Generally the life cycle of both fluke species is the same . The prepatent period of *F.hepatica* is 10 -12 weeks and one entire life cycle of *F.hepatica* may be completed in a minimum of 17- 18 weeks . *F.Hepatica* may live for years in untreated sheep but in cattle it is usually less than one year. For *F.hepatica* most phases of development take longer and the prepatent period is 13- 16 weeks. These parasites are hermatophrodytes, and one adult *F. hepatica* in a bile duct may produce 20.000 eggs per day establishing patent infestation (Robert *et al.*,2010)

The parasite lives in liver (*Fasciola* , liver fluke), The life cycle of flukes are always indirect, involving intermediate host before invasion of definitive host. The snails such as *lymnaea spp* for *Fasciola*; dependent of their close environment (nature of the soil), and of the climatic conditions for survival and multiplication of the intermediate hosts and also for the survival and evolution of larval stages (miracidium,sporocyst , redia, cercaria,and metacerceriae) (Dorchies,2006). Pathogenesis of Fasciolosis varies according to the phase of parasitic development in the liver and species of host involved, essentially the pathogenesis is twofold; the first phase occurs during migration in the liver parenchyma and is associated with liver damage and hemorrhage. Early infection , during fluke migration, there is hyper proteinemia, hyperglobulinemia, and hypo – alburinemia. The hypo – albuminemia is associated with plasma volume expansion caused by liver damage and reduced albumin synthesis. The second phase occurs when the parasite is in the bile ducts , and results from the hematophagic activity of the adult flukes and from

the damage to the mucosa, by their cuticles spines (Yeneneh *et al.*, 2012).



(Moayadet *al.*,2011)

Figure 4: life cycle of Fasciola

1.6 Clinical Signs:

Pathogenesis depends primarily on two different stages of development of the parasite in the liver of the host, the level of parasitaemia, and if it is an acute, sub acute or chronic infection . Acute and sub acute disease is seen in sheep, and occasionally occurs under conditions of heavy challenge in young calves. The chronic form of the disease is by far the most important in sheep, and specifically in cattle. The clinical signs of acute disease are characterized by sudden acute deaths, weakness, anaemia and dyspnoea. Sub acute and chronic fasciolosis is characterized by progressive loss of condition, anemia, hypoalbuminaemia, emaciation, pallor of the mucous membranes, submandibular oedema. Anemia is hypochromic and macrocytic and an accompanying eosinophilia is usually present . In milder infections clinical signs may or may not be readily observed, however, decreased appetite and interference with post

– absorptive metabolism of protein,, carbohydrates and minerals , may have a significant effect on production (Dechasa *et al.*, 2012). Acute disease is associated with mostly immature flukes, and usually seen in autumn and early winter, 2-6 weeks after ingestion of metacercariae in large numbers (> 2000) . Immature flukes migrate through the liver parenchyma and create migratory tracts, which results from direct trauma, coagulative necrosis and release of toxic excretions from the flukes. Lesions may vary from mild (low infestations) to severe in heavy, or repeat infestations. The liver may be large and hemorrhagic with fibrinous to fibrous exudates on the capsular surface (usually the ventral lobes). The migratory tracts may be visible as dark acute haemorrhagic streaks to , more yellowish white streaks typical of post necrotic scarring and granulation. Sometimes flukes may be seen in the migratory tunnels . If severe haemorrhages are present it may result in large subcapsular haemorrhages, which in turn may rupture with severe intra- abdominal hemorrhage and acute hemorrhagic anaemia as consequence. In some heavy and repeat infestations acute lesion of multi focal pinpoint serosal hemorrhages and fibrinous peritonitis to more chronic fibrous peritonitis may be present (Dechasa *et al.*,2012).Sub acute disease is usually seen during late autumn and winter, and 6-10 weeks after ingestion of smaller numbers 500-1500 of metacercaria . At this stage some parasites may have reached the bile ducts whilst others may still be migrating through the parenchyma. Sub capsular hemorrhages may be present but usually these do not rupture (Dechasa *et al.*, 2012).Chronic fasciolosis is associated with mature flukes, and seen mainly in late winter /early spring . It is usually 4- 5 months after ingestion of moderate number 200- 500 of metacercariae. Mature flukes, which are present in the bile ducts, cause necrosis and ulceration of the epithelium given rise to peribiliary inflammation and severe hyperplasia of the epithelial layer . Mechanical

irritation by their scales , and suckers, biliary retention and the production of toxic or irritant products by the flukes may contribute to production of toxic or irritant products by the flukes may contribute to lesions .Anemia and hypoalbuminaemia are the most important consequences contributing mostly to the pathogenesis. More than 0.5 ml blood per fluke can be lost per day. Plasma protein may be lost through the bile ducts into the intestine due to the increased permeability of the hyperplastic bile duct epithelium, and loss of plasma proteins through the flukes' digestive tract. Bile ductular distention in sheep, swine and horses may be more mechanical due to accumulation of parasites and bile, whereas in cattle the inflammatory lesion associated with erosions and granulation seems more prominent (Dechasa *et al .*, 2012).

Human fascioliosis was characterized by the following symptoms due to the migrating larvae causing localized or generalized toxic and allergic reactions lasting 2-4 months; the major symptoms of this phase are fever, abdominal pain, gastrointestinal disturbances, urticaria, and respiratory symptoms; the usual signs are hepatomegaly and splenomegaly, ascites, anemia, chest signs and jaundice. In human endemic areas, the infection is usually repetitive and the acute lesions are superimposed on chronic disease. Thus, the acute phase may be prolonged and overlap on to a latent or an obstructive phase, Fasciolosis chronicity and superimposed repetitive infections posing additional pathological complications (Coma, 2004).

On post mortem the liver may have an irregular outline, and be pale and firm. The ventral lobe is most commonly affected and reduced in size . The liver pathology of chronic disease is characterized by hepatic fibrosis and hyper plastic cholangitis. Several different types of fibrosis may be present and includes post–necrotic scarring (mainly in the ventral lobe and associated with healing of fluke tracts, is chaotic fibrosis

infarction as consequence of damage and thrombosis of large blood vessels, and peribiliary fibrosis damage by flukes in the small bile ducts). Fluke eggs may sometimes stimulate a granuloma – like reaction with obliteration of the affected bile ducts as consequence.

In bovines calcification of bile ducts, enlargement of the gallbladder and aberrant migration of the flukes is more common. Encapsulated parasites are often seen in the lungs. If adult cows are reinfected parasitic migration to the foetus and resultant prenatal infection has been reported (Dechasa *et al.*, 2012).

1.7 Diagnosis of fasciola:

A part from the presence of typical clinical signs, suggestive haematological and biochemistry findings, typical macroscopic and histological findings the laboratory confirmation may be depend mostly of faecal sedimentation tests, serology tests. (ELISA) and possibly in some regions of the world PCR test. An ELISA test, produced by the institute pourquier, employing “F2” antigen purified from *Fasciola* extracts, is currently available for routine diagnostic use in South Africa . It has been validated for the use on ovine and bovine serum, and bovine milk. Pooled and individual serum samples, and milk tank samples may be used, and the test results / values may be indicative of the level of infection in herds. (Qureshi *et al.* , 2012). In some studies of *F.hepatica* infection in cattle a significant correlation was observed between the intensity of the infection, and the ELISA values obtained, a very recent article published reports on the findings of their quantitative and qualitative evaluation of sediment flotation technique, a copro- antigen ELISA and two indirect serum ELISA’s. The sensitivities and specificities of these test; and the influence of the level of infection and season , on the result were evaluated which makes for very good reading .

Many other articles were published on the use of ELISA in other species such as humans, donkeys and water buffaloes (Qureshi *et al.* , 2012).

Many recent advances were made in the field of molecular diagnostics. Polymerase chain reaction (PCR) test were developed for the identification of the different snail species, which would be of great advantage in epidemiological investigations. PCR test, including multiplex PCR and real time PCR, were developed to diagnose/identify flukes and fluke antigens, and used to study many different aspects.

1.8 Immunity of fasciola:

It has been reported that sheep and cattle do not develop strong immunity to infection with *F. hepatica*, or to re- infections, and this lack of resistance in ruminants is believed to be associated with the inability of their macrophages to produce nitric oxide. (Phiri *et al.*, 2005). Several studies suggest liver flukes to elicit oxide. Immune responses typical of the Th2-type with eosinophilia, IgE and IgG1 antibody production . It is thought that helminths are able to withstand the effects of some components of the Th2 arm of the host immune response, and although these responses cause pathological damage to the host it can be tolerated over a long and sustained period. Migrating and adult *F. hepatica* seem to secrete substances that may include Th2 responses , and products such as cathepsin L proteases appear to actively lessen Th1 responses (Phiri *et al.*, 2005). Adult flukes in bile ducts are thought to be immunologically safe , and can survive for many years at these sites, although they still secrete antigens, which may be responsible for maintaining a Th2-immune response during chronic fasciolosis (Phiri *et al.*, 2005). From various vaccine trials with cathepsin L proteases a correlation between antibody responses and protection has been reported . Naturally – infected animals produce high IgG1 antibody titres controlled by the Th2 cytokine IL4, but little or no IgG2 at all. In contrast, both IgG1 and IgG2 are

produced in vaccinated animals. The titre of IgG2 antibodies seem to be , in general, directly correlated with the fluke burden of animals and it was found that in vaccinate groups animals with the lowest liver fluke numbers had the highest IgG2 levels. This may inactivate parasitic enzyme activation , block parasite migration and feeding. It may also be detrimental to the parasites as they may also activate complement and enhance phagocytosis by macrophages. Sheep macrophages do not produce nitric oxide following binding to sera from infected animals, but they may become activated in the presence of IgG2. Eosinophils and neutrophils may also contribute to killing already damaged flukes . It has been seen, however, that *F.hepatica* and *F. gigantica* have different immune modulation and strategies to evade the host immune responses and it seem that in practice *F.gigantica* homologues of antigens with protective properties against *F. hepatica* may not necessarily protect animals against *F. gigantica*. This may therefore require presentation of such antigens in different adjuvant formulations, or administration regimes, ELISA has also very successfully been employed to study the serum antibody type response (total,IgG,1Gg1 and IgG2,IgM) in *F. hepatica* and *F. gigantica* infected sheep and cattle . (Phiri *et al.*,2005).

1.9 Control and prevention:

The epidemiological information on trematode parasites of cattle can be used to design appropriate control measures. In principle, control should aim at the reduction of transmission rates. Several control methods, which include cultural, chemical, biological and immunological control. Cultural and husbandry control methods include practices such as controlling, stocking rates, rotational grazing, and the provision of clean grazing. The best way to prevent fasciolosis to keep cattle away from potentially dangerous water habitats. Drainage or fencing of wet areas pre-vents infection of pastures but is rarely cost effective on grazing land

in developed countries and neither is it feasible in developing countries, complete separation of stock from snail-infested areas is only practical in intensive farming husbandry systems. Hence cultural and husbandry control methods can be applicable in the commercial farming areas. In communal grazing areas animals are communally grazed and therefore practices such as rotational grazing and provision of clean pastures would not be feasible. (Pfukenyia *et al.*, 2005). Habitat management in the form of vegetation clearance is potentially effective both through reducing feed availability of snails and also by enhancing water flow rates during the rainy season. This method of control could probably be possible especially in commercial farming areas where snail habitats are not widespread. In widespread distribution of the snail habitats, cultural methods are difficult or perhaps impossible in the Highveld region and in communal grazing areas (Pfukenyia *et al.*, 2005). Long-term snail control can be achieved by drainage of the habitat, but permanent destruction of snail habitats may be expensive and ecologically sensitive, or controversial, especially in widespread habitats. When snail habitats are small and localized fencing of such areas, or annual treatment with a molluscicide, may be more feasible. The use of chemical molluscicides for the control of the snail hosts of bilharziasis and fascioliasis has been accepted for the present as the most promising and practical means of controlling these diseases, the application of copper sulfate to all water bodies and repeated sprayings of molluscicide at certain points where the human population had close and repeated contact with water bodies. In 1953, an experiment aiming for the total elimination of snails from an isolated river system was attempted in an African reserve in the Mtoko District, 90 miles (145 km) north of Salisbury. The whole river system was given two successive treatments at a six-week interval copper sulfate being applied to give a final concentration of 20-30 p.p.m. The

application was not repeated again but never the less it was found that snail reinfestation was slow (Clarke *et al.*, 1961). Treatment of infected animals will largely depend on the correct use of appropriate and registered anthelmintics. Fasciolosis may be controlled by reducing the populations of the intermediate snail host, or by appropriate anthelmintic treatment. Registered fluke anthelmintics may be used prophylactically (strategic treatment) to reduce contamination of pastures by fluke eggs at times most suitable for their development; or to remove fluke populations (tactical treatment) at a time of heavy fluke burdens, or at periods of nutritional and pregnancy stress to animal . The best anthelmintics are Oxyclozanide, Nitroxynil, Rafoxanide, Albendazole, Clorsulon and Triclabendazole. All these products are given by the oral route (Clarke *et al.*,1961) .

Control by means of vaccination has also been extensively investigated. In human, diseases is mostly associated with local endemic animal fasciolosis, and the spread of drug resistant liver flukes. In some parts there may be overlap, and concurrent *Shistosomaspp* infections may be seen, some efforts are therefore also directed at producing vaccines, which could produce cross reaction between, *Shistosomaspp* and *F.hepatica* (Clarke *et al.*,1961). During the past few years a number of proteins have been indentified and investigated as potential candidates for vaccine production. These were tested in various different combinations and trials were conducted in many suspects of animals including mice, rocks, rabbits, cattle and sheep. In some of these trails fairly high levels of protection was seen in sheep and cattle. These proteins are fatty acid hiding proteins (nFh12.,rFh15, Sm 14) cysteine peptidase (Cathepsin L1 and cathepsin L2), leucine amino peptidase, glutathione- S – transferase, More recent candidates are thioredoxin peroxidase, NK – Lysin like molecule, cathepsin L3, cathepsin B cystene

proteases, thioredoxin reductase and enolase, which are under investigation (Parr *et al.*,2000) It was found that many of these vaccines not only provided protection against the parasites but also resulted in reduction of the faecal egg counts, or production of non or poorly embryonating eggs. Egg production seems vulnerable to the immunological response induced by vaccination. It is not clearly established to what extent reduced egg production would have on the transmission of eggs and this still needs to be mathematically investigated. No articles on field studies of an effective vaccine have been reported so far (Parr *et al.*, 2000). The two drugs registered for use in lactating cows are oxcylozanide plus levamisole, and clorsulon plus, ivermectin only effective against adult fluke aged 12-14 weeks or older. Heavily contaminated pastures may have to treat lactating cows monthly during summer and autumn, using this product, which also controls gastroenteric nematode and long worm infections. Fasciolosis control with a triclabendazole treatment a month before calving, and immediately after drying off. Mixed grazing be careful if sheep and cattle are grazing on the same pasture, whether together or alternately. To reduce or eliminate contamination of pastures and thus infection, for best results using a drug highly effective against early immature fluke, i.e. Triclabendazole, or against advanced immature fluke, ivermectin (Joseph, 2007).

1.10 Economic impact :

1.10.1 Weight gain:

Monitoring weight gain of young animals is a useful way to assess the impacts of infection and interventions to prevent or control infection, improved nutrition or treatment with an anthelmintic. Younger growing animals are more susceptible to infection, less costly to maintain under experimental conditions and any results can be applied to production

system that are producing young growing animals for sale (Copeman *et al.*, 2012).

1.10.2 Draught performance:

Anemia resulting from fasciolosis has been shown to reduce work output by 7-15%, combined with a further indirect reduction of 20% in potential work capacity in animals whose growth has been restricted by fluke infection. It can be concluded that liver fluke can seriously lower the work potential of both cattle and buffalo. The economic significance of this may, however, be changing rapidly production systems where hand tractors are replacing animals as sources of draught power (Copeman *et al.*, 2012).

1.10.3 Fertility:

A link has also been observed between infection with *F.gigantica*, anaemia and fertility. There were significantly longer intercalving intervals and lower packed cell volume in Ongole cows in Indonesia infected with *F.gigantica* than in those treated with triclabendazole each July for two years. Also another study found that treated cows had a mean inter calving interval of 18.5 months whereas in untreated cows the interval was 31.5 months. It is thus reasonable to conclude that infection with *F.gigantica* is likely to adversely affect reproduction (Copeman *et al.*, 2012). Many studies confirmed that fasciolosis is an important disease entity causing considerable loss of revenue due to condemnation of affected liver and carcass weight reduction (Dechasa *et al.*, 2012).

1.11 Bacteria associated with fasciolosis:

Type of bacteria found in the carcasses may be of non specific groups which comprises that are non pathogenic or only potentially pathogens as Clostridia, Streptococci, Bacillus subtilis, Enterococci and E.coli in adult animals. These species are present naturally in the intestinal flora

pathogens including hemolytic Staphylococci, Pasteurella, Salmonella and Listeria monocytogenes (Ahmed, 2001); (Sohair *et al.*, 2009).

1.12 The epidemiology of fasciolosis :

The epidemiology of fasciolosis depends on the grazing habitat preference of the animal. Metacercariae can survive up to 3 months after harvesting in hay from endemic high land areas that are consumed by ruminants in arid and low land areas (Dechasa, 2012).

F.hepatic is mostly encountered in temperate areas, and in cooler areas of high altitude in the tropics and subtropics, whilst *F.Gigantica* predominates in tropical areas. Snails are their intermediate host. Amphibious snails of the genus *Lymnaea* species are widely distributed throughout the world and *L.Trunculata* is the most common of them all. In South Africa the most common intermediate hosts are *L.trunculata* (*F.hepatica*), *L. Natalensis* (*F.gigantica*) and *L.columella* (*F.hepatica* and *F.gigantica*). Other important *Lymnaea* vectors of *F.hepatica* are *L.tomentosa* in Australia, New Zealand, *L.columella* in North America, Australia, New Zealand, *L.bulimoides* in Southern USA and the Caribbean, *L.humilis* in North America, *L.vector* in South America, *L.diapheena* in South America. Other important *lymnaea* vectors of *F.gigantica* are *L.auricularis* in Europe, USA, Middle East, Pacific Islands, *L.rufescens* and *L.Acuminata* in India, Pakistan and *L.Rubiginosa* in Malaysia (Dechasa, 2012). Large numbers of metacercaria will usually be produced when there is optimal availability of suitable snail habitats, optimum temperatures and optimum moisture is present. This frequently results in seasonal patterns of emerging disease in certain parts of the world for e.g. in Britain metacercaria may appear on pastures from August to October and also in May to June (Dechasa, 2012). Suitable snail habitats will include all areas where snails may survive in clear water or mud such as the edges of streams, ponds, rivers and vleis (permanent

natural habitats) or temporary man – made depressions filled with water (tractor tracks etc) . A slightly acid environment may be more optimal. Temperature requirements are mean day/night temperatures of 10° C at which both the snails and the flukes will propagate of Below 5° C all activity will stop and above 15° C significant increase in both snails and fluke larval stages may be seen, with the optimum being 22- 26° C. Moisture level are described as optimal when rainfall exceeds transpiration and when field saturation is achieved (Robert, 2010).

1.13 Prevalence of fasciolosis in the world:

Epidemiological analysis of human and animal fascioliasis has been carried out in different parts of the world today fascioliasis is classified as tropical disorder. A low prevalence of Fasciolosis have been reported from Corsica (0.8%) and China (0.7%) but an intermediate prevalence from Porto(3.2%) followed by Egypt (7.3%), and Peru (8.7%) and a high prevalence from Montero Valley and Bolivia with prevalence of 34.2 and 66.7 percent respectively (Jahangir *et al.*, 2013). A cross sectional study was carried out from October 2010 to March 2011 with the objectives of determining the prevalence, risk factors and economic importance of bovine Fasciolosis in Desimunicipal abattoir, Ethiopia, over all prevalence of 25.2%(126 -500) was observed. Based on origins of animals, there was no statistically significant difference ($P.>0.05$) between the four study areas. Young animals were found with high prevalence (33.33%) followed by old animals (26.11%) and a adult animals (24.7%) .However, there was no statistically significant difference between the prevalence in the different age groups of animals. Prevalence's of 63.29% , 18.62% and 17.75% were observed in animals of poor body condition, good body condition and medium body condition, respectively. The difference between the prevalence of bovine fasciolosis in animal of different body

conditions was statistically significant ($P < 0.05$). Of 126 infected livers, 65.9%, 18.25%, 9.5% and 6.34% were infected with *F. hepatica*, *F. gigantica*, mixed and immature flukes, respectively (Ephrem *et al.*, 2012).

The prevalence of *Fasciola* species is different in different study areas and the highest prevalence of *F. Hepatica* was observed in Kutaber (20.34%) followed by Dessie Zuria (17.74%) and the highest prevalence of *F. gigantica* was observed in Worehimmenu (9.88%) followed by Kutaber (2.54%). The direct and indirect losses incurred due to fasciolosis in Dessie municipal abattoir were estimated about 2.495,346.13 Ethiopia animals. It is concluded that fasciolosis is prevalent in cattle in the study area. Hence, this disease deserves serious attention by the various stake holders in order to promote the beef industry in the study area (Ephrem *et al.*, 2012). Qualitative examination of *fasciola gigantica* eggs in faeces and bile were compared with the detection of precipitating antibodies in sera by Agar Gel Precipitation Test (AGPT) in 1000 cattle slaughtered at the Bodija Municipal abattoir in Ibadan, Nigeria. (Oyeduntan *et al.*, 2008). Faecal and bile examination methods detected (196 / 33.5%, 389 / 38.9%) of the animals as positive for fasciolosis, while (474 / 47.4%) were positive by AGPT. Both direct bile examination and faecal egg detection methods have high specificity and positive predictive value (100%) when compared with AGPT. However, lower values for sensitivity and negative predictive value were observed for both faecal egg examination (66.5% and 67.9% respectively) and bile examination (81.0% and 78.9% respectively). Faecal and bile examination failed to detect 33.5% and 19.0% of the cases detected by AGPT.

The results of the mentioned study revealed that the AGPT could become a better test for the herd diagnosis of bovine fasciolosis for veterinarians and other investigator in Nigeria (Oyeduntan *et al.*, 2008).

In Denmark, the prevalence of the liver fluke *Fasciola hepatica* in cattle has increased markedly during the last 3-5 years. Some studies were aimed to identify potentially high risk areas for fasciolosis in cattle in order to advise on appropriate control measures, to be taken. The risk factors evaluated for a high prevalence of *F. hepatica* in cattle were environmental, determinants and biotic factors including meteorology data and topography on municipality level (Ersbqll *et al.*, 2006).

The prevalence of *F.hepatica* in municipalities was based on condemned *F.hepatica* infected livers of a total of approximately 1.4 million heads of cattle at slaughter during the period 2000- 2003 as recorded in the Danish cattle database (Ersbqll *et al.*, 2006). The median prevalence of cattle infected with *F.hepatica* in the municipalities was 2.8% (range:0-27%) for beef cattle and 0.7% (0- 14%) for dairy cattle. Significant risk factors affecting the prevalence of *F.hepatica* in cattle were the cattle density in the municipality, precipitation adjusted by the potential vapotranspiration (mm) and % coverage with wet areas and soil composition (Ersbqoq *et al.*, 2006). Across sectional study was conducted to determine the prevalence of *Fasciola hepatica* and to investigate the related risk factors in cattle from Kayseri, Turkey (Yildirimet *al.*, 2007). Faecal and blood samples were collected from 282 cattle from May 2004 to April 2005 and were examined by modified McMaster sedimentation and ELISA techniques to detect *Fasciola spp.* Eggs and anti-*F.hepatica* antibodies, respectively . A total of 282 cattle, 184 were seropositive for *F.hepatica* with a prevalence of 65.2%. In addition 24.5% seropositive cattle had fluke eggs in the faecal examination. The mean number of EPG in infected cattle was 42.8 . The highest prevalence was observed in ≥ 6 age group (87.2%) followed by 3-5 (79.5%) and ≤ 2 age groups (51.6%). The differences between ≤ 2 age and other age groups were found significant ($P < 0.001$), whereas no statistical significant difference ($P > 0.05$) was

observed between 3-5 and >6 age groups. The infection was more prevalent in female (70.7%) than males (47.8%), and in cattle from the traditional farms (76.5%) than the small-scale dairy farms (37.2%). No statistically significant difference ($P>0.05$) was observed related to breed. This results highlight the importance of initiating a control program for fasciolosis based on regular treatment and prophylaxis in Kayseri Province. (Yildirim *et al.*, 2007). Another study in Pakistan to estimate the point prevalence of fascioliasis and its economic impact in terms of increased milk yield after chemotherapy of a bovine population from the district of Toba Tek Singh, Punjab, Pakistan (Khan *et al.*, 2011). A total of 2400 cattle and buffaloes were examined quantitatively using the McMaster egg counting technique. Infected cattle and buffaloes (50 of each) were randomly selected and each divided into two groups of 25 animals. Groups A (Buffaloes) and C (cattle) were treated with oxcyclozanide (orally, 16.6mg/21kg body weight) Groups B and D served as negative controls for buffaloes and cattle, respectively. Pre- and post-treatment milk yield was recorded to determine if there were any changes in milk yield after treatment of 2400 faecal samples analyzed, 654 (27.25%) were positive for *Fasciola spp.* With a mean number of eggs per gram (EPG) of 503.2 (Khan *et al.* , 2011). The point prevalence and worm burden of fascioliasis was significantly higher (OR $\frac{1}{4}$ 2.13; P. value, 0.05) in buffaloes (34.58%; 415/1200, mean EPG maximum likelihood $\frac{1}{4}$ 521.4%) as compared to that of cattle (19.9% ;39/1200: mean EPG maximum likelihood $\frac{1}{4}$ 415.8). Among the parasite species, *F.gigantica* (19.88%; 477/2400 was predominant OR $\frac{1}{4}$ 3.12, P. value, 0.05) as compared to *F. Hepatica* (7.38%; 177/2400). An average daily increase of 0.67 and 0.87 litres of milk with 0.41% and 0.37% more fat per-animals was observed in Oxcyclozanide - treated buffaloes and cattle, respectively. The economic value of reduced production of infected

animals was estimated as US Dollar(0.33 and 0.32) per animal per day for cattle and buffaloes, respectively(Khan *et al.* , 2011) .

Fasciolosis is usually observed in the southern and south eastern regions of Brazil, where it has an endemic nature (Sandra and Maria,2003). In these regions, the infection rate of dairy cattle ranges between 10 and 100%. The actions taken by the State Program for the control of bovinefasciolosis were based upon the information provided by the Brazilain,meat inspection System. In Rio Grande do Sul, the infection caused by *F.hepatica* is endemic, with condemnation of 52.14% (between 1982and 1988) and 27.4% (between 1989 and 1992) of the livers. Although the study was conducted in a smaller meat packing plant, the liver condemnation rate (10.34%) was similar to the rate reported by another for different regions of the country, showing poor reduction of fasciolosis (Sandra and Mari,2003). The landscape of Punjab is amongst the most heavily irrigated on earth and canals can be found throughout the province. Besides that Punjab receives abundant rainfall. Temperature and humidity are favorable for the growth and multiplication of fasciola and snail so incidence is high during autumn followed by spring and lowest during summer . Infection was the highest at Gujranwala followed byLahorc, Sargodha, Sheikhpura, Jhang while the lowest was at Faisalabad .This may be due to the fact that high level of infection was thought to be associated with the extension of the canal system providing additional areas of swamp and marsh where the cattle were exposed to infective larvae and metacercariae of helminthes (Walker *et al.*, 2008).

In Pakistan, majority of the slaughtered animals were harboring mature flukes in their livers while in clinical ill animals the incidence of infection was based on identification of eggs in the faeces. Therefore , the recorded incidence of the infection was mainly due to mature parasites. It was also noticed that during the year 1999 rains started during June changing

environmental temperature and humidity, thus favouring the emergence of cercariae from snails. Due to this, metacercariae may show their existence in July after ingestion which produces fasciolosis with advancing age. In the present study, higher infection rate was recorded in older animals as in other laboratories (Pfukenyi *et al.*, 2005). Through the explicit cause of the high incidence of the disease in adult animals can not be explained fully, it seems to be related to faulty management. It is also possible that the higher infection rate in older animals might have resulted due to relaxation of resistance because of environmental factors at parturition or during lactation. A slightly higher incidence was observed in males than females. The reason for which seems to be related more to be social practice of keeping females under better management and feeding conditions in comparison to males which are generally being let loose to graze freely in pastures (Umbreen and Azhar, 2012). Across sectional study of fasciolosis was conducted on serum samples from 296 autochthonous Rubia Gallega cattle of 36 farms by using an enzyme - linked immunosorbent assay (ELISA) test with a 2.9-KD recombinant protein. Results were examined on the basis of the age. Of the cattle 0-2, 3-8 and >8 years), farm characteristics (Number of cattle, slope, altitude, rainfall) and fasciola- control measures. The cattle -level prevalence was 71% and the highest values were observed in the oldest animals. Ninety percent (86%, 100%) of the farms had cattle positive to the ELISA test, and by estimating the odds ratio values, they observed the highest risk for fasciolosis in the biggest farms (more than 25 cattle), where cattle received treatment against this trematode, located above 1000 m altitude and where rainfall did not achieve more than 1000mm (Umbreen and Azhar, 2012). The present study revealed the effect of temperature, meracidia dose, and snails age on some parameters like prevalence(%), prepatent period, the number of metacercaria produced,

and the percentage of floating metacercaria. The study revealed that the prevalence (%) was significantly increased with temperature decreasing and the increase of meracidia dose. The prepatent period was significantly decreased with the increase of temperature and the decrease of meracidia dose. Also, the prepatent period was significantly longest in small snails (Moayad *et al.*, 2011). Concerning the number of metacercariae production, a study reveals that the production of metacercariae from snail increased of (25+1) while decreased significantly (19+1C and 30+1C) and it also increased significantly with the increase of meracidia dose and the snails size. The floating metacercaria percentage significantly increased with the increase of temperature but there was no significant and an effect for meracidia dose and the size of snails (Moayad *et al.*, 2011). In another study period, 9880 male cattle were slaughtered in the Ismailia abattoir. Based on seasons, 2502 (25.2%), 1737 (17.5%), 1950 (19.7%) and 3691 (37.6%) male cattle were slaughtered in autumn, winter, spring and summer, respectively. Autumn and summer seasons were the highest season in number of slaughtered animals in Ismailia abattoir. According to the results of the statistical analysis, significant difference ($P < 0.05$) was observed in number slaughter cattle between summer season and other seasons. This may be due to the site of Ismailia as a tourist city that attracts many people during summer season, subsequently increased in their population and meat demand (Ahmed *et al.*, 2013). There was no animal condemned as result of antemortem inspection all over the study period. As a result of postmortem inspections, 8 (0.10%) carcasses were condemned and 1456 (14.7%) organs had pathological lesions. Feeding, breed and management of cattle may be associated with the presence or absence of pathological lesions and could cause carcass condemnation during the inspection process. It was shown that the proportion of cattle showing pathological lesions differ between countries (Raji *et al.*, 2010).

The slaughterhouse and its regulations, represents a key control point of livestock production chain. Results of meat inspection of slaughter animal is too importance for animal health control system (Ahmed *et al.*,2013). Two hundreds animal fecal samples were collected from endemic areas in Kalubia province (Egypt) in order to determine *Fasciola* infectious rate and to identify associated risk factors. The overall prevalence of fascioliasis in animal was 14% . Species isolated was *F. hepatica* (Abdel Razek, 2007).

Chapter Two

Materials and Methods

1.2. description of the study Area

Blue Nile state(BNS), is one of the states of the Sudan . It called in the period 1991-1994 in the name of the Medium state. It has an areas of 45.844 square kilometers and a population of 1.193.293.Its capital is El damazin,butEl roserires town is the main source of energy in Sudan until the completion of the establishment of Merowe Dam in 2010.

The study area is situated between longitude 32-36° East latitude 12-14° north and have borders with Jazeeera. White Nile, Gedarif state and Ethiopia . The studied area involves Sinnar and the Blue Nile states . The area is under the umbrella is the first site where the Blue Nile will be connected with White Nile to form the River Nile at Khartoum city (FAO, 2014)



Figure (5) Map of Bule Nile State (Map data @ 2019 Google)

2.2.Livestock Production:

Blue Nile state is known for its huge livestock with a total estimated livestock Population of 15.28 million (FAO, 2014).

Pastoralism and agro- pastoralism is among the key farming systems in BN where majority of rural households rely for their subsistence. BN

state is also endowed with huge area of rain fed agriculture with significant amount of crop residues that is essential to promote stall feeding and encourage investment in animal fattening for small holder and medium scale enterprises. It is also very clear that there are both positive and negative environmental impacts related to the livestock production in the state. Hence, it is important for stakeholders to make due consideration of the environment in designing the different early recovery and developmental projects in the state.

2.3.The Blue Nile Slaughter houses :

The blue Nile slaughterhouses located near a residential area. Thus it constitutes nuisance and dangers the health of the community in the immediate surrounding environment . The area of small low- walled open – air for slaughtering with an impermeable sloped killing floor. Carcasses cut into parts and hange on fixed hooks for inspection. Sewage disposed by collection into pits and then carried away by sewage tank in remote areas of town on open places, water supply is sufficient. Meat inspection at Admazin and Al- Roseires abattoirs carried out by officers of Ministry of Livestock . They are veterinarian and official meat inspectors.

2.4.Study design and sampling method:

A cross–sectionalstudy was concluded in November to Decmber 2018 to determine the prevalence bovine fascioliasis and to investigate potential risk factors associated with their occurrence.The sample size was calculated according to Thrustfield formula (2007) based on last previous study (8.5%)for fasciolaisis in Khartoum state conducted by Adam(2015). With 95%confidence interval and 5% desired absolute precision to carryout this survey.

Multi stage random sample was used to select localities then systematic random samples were collectedby substinintuting the last previous prevalence (Adam, 2015) and sample size was cattle119 cattle.

$$n = 1.96 *^2 Pexp \frac{(1 - P.exp)}{D2} n = 1.96 *^2 (8.5) * (1 - 8.5)$$

2.5.Questionnaire:

The individual risk factors (age, sex, breed , source of Animal, body condition, grazing , appearance of signs of disease). Also the questionire included information about 3 farms as: size of the herd, hygiene, health practiced , the type of grazing used treatments and presence of the snail.

2.6.Ante- Mortem Inspection:

The ante mortem examination of animal covered the external abnormalities like emaciation, submandibular edema. Animals were examined before slaughtering and tagged with identification numbers.The same animals were subjected for post-mortem examination. Attention was given to the factors such as age, body condition and source of the animals to determine the impact of these factors on the disease picture.

2.7.Post mortem Examination:

The slaughtered houses were visited every day for three weeks from November to December 2018 . The cattle were slaughtered between 5:00 am and 9:00 am . Before the animals were slaughtered, the breed , sex and other risk factors of the disease were recorded.Post–Mortem inspection was carried out according to the method described by Thornton’s and Gracey (1981). The inspection of the meat was made possible through the cooperation of the veterinary staff of duty at the abattoir. For each cattle slaughtered, the abattoir workers assisted in bringing out the liver. The liver was thoroughly examined alongside the bile duct for adult of *Fasciola* species.

2.8 Statistical Analysis:

Data collected from the active abattoir survey about the risk factors and the results was entered into Excel spread sheet, cases were categorized as either positive or Negative and analyzed using Statistical Package of Social Science (SPSS) version (16) were used. Frequency table of the distribution according to the potential risk factors were constructed. Cross tabulation of bovine fasciolosis infection per according to potential risk factors was made. Univariate analysis: chi-square test was used to describe the variables, number of tested animals and degree of freedoms, chi-square P. value.

Chapter Three

Results

3.1. overall prevalence rate of fasciolosis in slaughtered cattle in Blue Nile State.

A total of 119 liver samples were collected from cattle in Eldamazim and Elroseriries abattoirs, among these samples 7 (5.9%) were positive and 112(94.1%) samples were negative.

Table 1: The prevalence of fasciolosis in slaughtered cattle in Blue Nile State .

Valid	No. Of liver samples	+ ve (%)	- ve (%)	Cumulatide Percent
Positive	7	5.9	5.9	5.9
Negative	112	94.1	94.1	100.0
Total	119	100	100.0	

3.2.Age of animal:

The presences of *Fasciola* in cattle were investigated. In cattle of different ages, 18(15.1%) of cattle were young (animal age less or equal two years) and 101(84.9%) of cattle were old animal age more than two years (Table2). Infection was higher in animal which were old (84.9%) and their age more than two years. The chi-square test showed significant association between infection and age of animal (P. value = 0.000).

3.3.Sex of Animal:

Ninety eight of males cattle were examined in this study for fasciolosis. As shown In (Table2), 98 (82.4%) of cattle were males and 21(17.6%) were femaels. The highinfection rate infemales (85.7%) than males (14.3%). The Chi-Square test showed significant between infection and sex of animals (P. value =0.000).

3.4. Breed of Animal:

The results of distribution of Fasciolosis infection in Blue Nile Slaughter houses according to breed (table 2). Showed that Botana breed cattle were 108(90.8%) and Nilotic breed were 11 (9.2%). So that the infection was higher in nilotic breed (100%) than Botana breed (Zero).The chi square test showed that there was significant association between infection and breed. P. value =0.000.

3.5. Source of Animal:

After examination of 109(91.6%) indigenous cattle and 10 (8.4%) exotic cattle (table 2) the infection was highest from exotic cattle (100%).

The chi-square test showed there was significant association between infection and source of animal (P.Value = 0.000).

3.6.Body Condition:

The body condition of animals and the presence of fasciolosis had been investigated. 96 (80.7%) of cattle were found to be in good condition (table 2) and rate of infection was zero followed by 23(19.3%) of cattle were found to be in poor condition and rate of infection was (100%).

Chi square test showed there was significant association between the infection and body condition(P. value =0.000).

3.7.Grazing :

The relation between grazing and fasciolosis had been investigated (table 2). The total number of infection was higher in open grazing (119) (100%) and no infection were noted in close grazing. The Chi square test showed there was no significant association between the infection and grazing.

3.8.The effect presence of snail on presence of the disease.

The relationship between presence of snail and presence of fasciolasis in 119 (100%) cattle were investigated (table2). The chi square test showed there was no significant association between infection and presence of snail .

3.9.The effect of treatment on presence of disease :

Total of the 119 cattle inspected,5(4.2%) animals were treated and 114 (95.8%) of cattle were not treated. The highest rate of infection was in animal which were not treated (71.4%) and treated animal had low infection rate (28.6%). The Chi Square test showed there was significant association between infection and absence of treatment .

3.10. Localities:

Cattle inspected were (119)animals ,90 animals from ELDmazin locality (75.6%), and 29 animals from ELreserires locality (24.4%).The highest rate of infection in animals from ELdamazin locality 100%.

The chi square test showed there was significant association between infection and localities (P. Value = 0.000).

Table 2: Univariate analysis of risk factors associated with fasciolosis infection in cattle (n=119) in Blue Nile State .

Risk factors	Frequency	Relative Frequency %	Cumulative Frequency	Number of Positive	percentage
Age					
Young ≤ 2 years	18	15.1	15.1	0	Zero
Old ≥ 2 years	101	84.9	100.0	7	100%
Sex					
Male	98	82.4	82.4	1	14.3%
Female	21	17.6	100.0	6	85.7%
Breed					
Botana	108	90.8	90.8	0	Zero
Nilotic	11	9.2	100.0	7	100%
Source of Animal					
Indeginous	109	91.6	91.6	0	Zero
Exotic	10	8.4	100.0	7	100%
Body Condition					
Poor	23	19.3	19.3	7	100%
Good	96	80.7	100.0	0	Zero
Type of grazing					
Open	119	100	100.0	7	100%
Close	0	0	0	0	Zero
Present Snail					
Yes	0	0	0	0	Zero
No	119	100.0	100.0	7	100%
Treatment					
Yes	5	4.2	4.2	2	28.6%
No	114	95.8	100.0	5	71.4%
Disease					
Positive	7	5.9	5.9	7	5.9%
Negative	112	94.1	100.0	112	91.1%
Localities					
ELdamazin	90	75.6	75.6	7	100%
ELroserires	29	24.4	100.0	0	Zero

Univariate analysis revealed that all risk factors were all associated with disease except type of grazing and snail presence. In multivariate analysis using of the logistic regression showed that there were no potential risk factor associated with the disease .

Chapter Four

4.1.Discussion

The result of this study revealed that bovine fasciolosis occurred in cattle slaughtered in ELdamazin and ELroserires (Blue Nile state) slaughterhouses. The prevalence of disease was 5.9% which is lower than many other studies from different abattoirs in Sudan according to that Salam *et al.*, (2009). The prevalence of disease is lower than the rate reported by Abdul (1992) and Adam(1994) which is 47%. Mohammed (2012) reported prevalence rate of 91% in Alkadroo slaughter house, north Khartoum. Also the prevalence is lower than that reported by Adam (2015) in Khartoum state which is 8.5% and that reported by Ali, A.H (2018). in El-duiem abattoirs, white Nile state which is 43.4%.

On the other hand the prevalence of bovine fasciolosis recorded during this study is lower than others in neighbouring countries 28.63% prevalence rate was recorded in Ethiopia Rahmeto *et al.*, (2010), 21% also in Ethiopia by Yemisrach and Mekonnen, (2012), 16% reported in Tanzania by Mellan *et al.*, (2010), 21% in Brazil recorded by Alves *et al.*, (2011), 50% in Nigeria recorded by Ozung *et al.*, (2011) ,51% in Egypt by Kuchai *et al.*, (2011) and 65% in Turkey by Yildirim *et al.*, (2007).

However, the prevalence of bovine fasciolosis recorded during this study is higher than other studies conducted by Gad Alkareem *et al.* (2012) who recorded 5% and Zeinab(2014) reported 1.4% prevalence rate in Elobied abattoir. Differences in prevalence among geographical locations could be attributed mainly to the variation in the climate and ecological conditions such as altitude, rain fall and temperature. Fasciolosis prevalence has been reported to vary over the years mainly due to variation in amount and pattern of rain fall (Mungube *et al.*,2006).

In univariate analysis in our study the total number of old animals was 101 animals and young animals was 18 animals. The prevalence of bovine

fasciolosis was higher in old animals (age >2 years) 100% and chi-square test showed significant association between age and bovine fasciolosis (P. value 0.000). This result agreed with Abdul Hakim and Addis (2012), and disagreed with Abie *et al.*, (2012) who reported that the prevalence of higher in young than adult animals.

The results of the present study revealed that sex has significant effect on the prevalence of bovine fasciolosis, where prevalence in females was 85.7% compared with males which was 14.3%, and chi-square test showed significant association between sex and bovine fasciolosis (P. value 0.000). This result is in agreement with Kuchai *et al.* (2011) in Ladakh.

The results of this study showed that Nilotic breed cattle have higher rate of infection than Botana breed, The rate of infection in Nilotic cattle was 100%, chi square test showed significant association between bovine fasciolosis and breed (P. value 0.000). This is in agreement with other studies carried out in Sudan showed significant association between bovine Fasciolosis and breed of cattle, in this study exotic breed cattle came from south sudan which rate of infection was 100% (P. value 0.000) than indigenous cattle was 0.0%. This result is in agreement with Ammar (2013).

In Japan where the prevalence was higher in native cattle than Friesian or Jersey cattle (Kato *et al.*, 2005) and in Spain where the prevalence was higher in cross breed cattle than that in autochthonous Rubia Gallega Friesian or brown Swiss cattle (Sanchez *et al.*, 2002).

Infection rate of bovine fasciolosis was statistically analyzed on the base of body condition to study the impact of the disease in debilitating (Emaciating) in infected animals, the prevalence of bovine fasciolosis in poor body condition animals was found to be 100% compared with good body condition 0% and chi square showed highly significant association

between bovine fasciolosis and body condition (P. value 0.000). This finding suggests the importance of bovine fasciolosis in causing weight loss and emaciation as characteristic signs of the disease. Also *Fasciola* worms are known to suck blood and tissue fluid and even damage the parenchyma of the liver due to the migrating immature worms, (Dechasa, *et al.*, 2012). This result agrees with Ephreem *et al.*, (2012), Yemisrach *et al.*, (2012). Mihreteab *et al.*, (2010) and Dchasa *et al.*, (2012) in Ethiopia. However, our result disagrees with Shiferaw (2011) in Ethiopia. According to this study, the presence of snails and type of grazing were found not significantly associated with the disease, this disagrees with Tesfay *et al.* (2012).

A total number of animals using drugs were 5 animals, 2 animals were found infected (28.6%), while the total of animals not using drugs was 114 animals, 5 animals were found infected (71.4%). This result attributes the effectiveness of the drug used. Joseph (2007) reported that drugs play an important role in the control of bovine fasciolosis. The chi-square test showed significant association between bovine fasciolosis and disease. According to the result of localities, the chi-square test showed there was significant association between localities and disease, and the prevalence was higher in ELDmazin locality (100%) (P. value 0.000) than ELresires 0%.

4.2. Conclusion

Fasciolosis is a serious health problem of cattle which causes liver condemnation in the abattoir, reduction in the production of the animal.

This study indicated that the prevalence of bovine fasciolosis in Blue Nile Stat during the study period was 5.9%. The assessed risk factors, age, sex, breed, body condition..etc, were found to be associated with the occurrence of disease. There was paucity of information and prevention options of the disease .

4.3. Recommendations :

1. Standard regulations and functional meat inspection policies should be formulated for organs and carcass approval /rejection.
2. Farmers should be aware of and informed about the importance of the disease control programs.
3. Treatment of animal with anti- parasite medicine and prophylactic anti- helmentic dosage for all animals.
4. Regular dowering animals before and after the rainy season is important .

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Appendix (1)

Table (1) The distribution of fasciolosis according to age: Young \leq years (18:(15.1%). Old \geq 2 years 101(84.9%)

Age	Frequency	Percent %
Young \leq years	18	15.1%
Old \geq2 years	101	84.9%
Total	119	100%

Fig. (1) The distribution of fasciolosis according to age

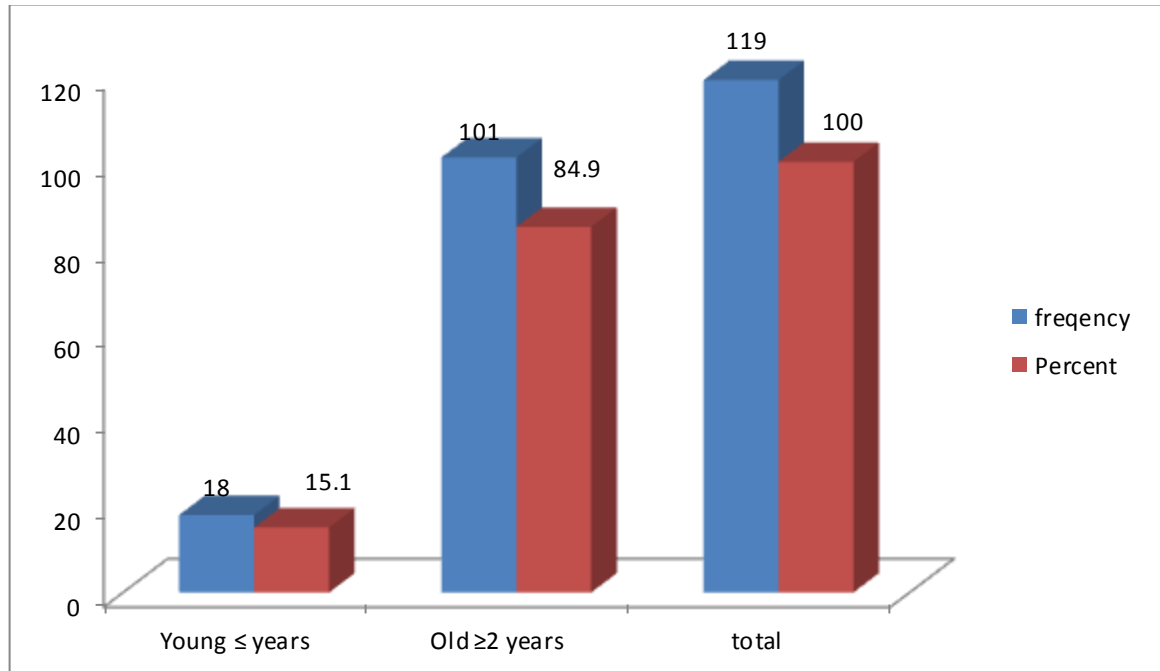


Table (2) The distribution of fasciolosis according to Sex

Sex	Frequency	Percent %
Male	98	82.4
Female	21	17.6
Total	70	100

Fig. (2) The distribution of fasciolosis according to sex

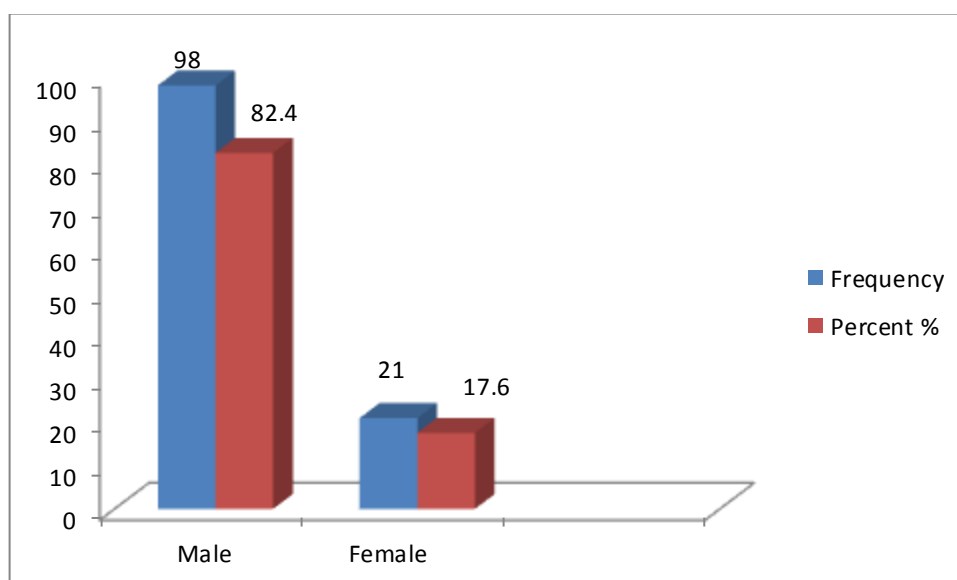


Table (3) The distribution of fasciolosis according Breed

Breed	Frequency	Percent %
Botana	108	90.8
Mitotic	11	9.2
Total	119	100

Fig. (3) The distribution of fasciolosis according Breed

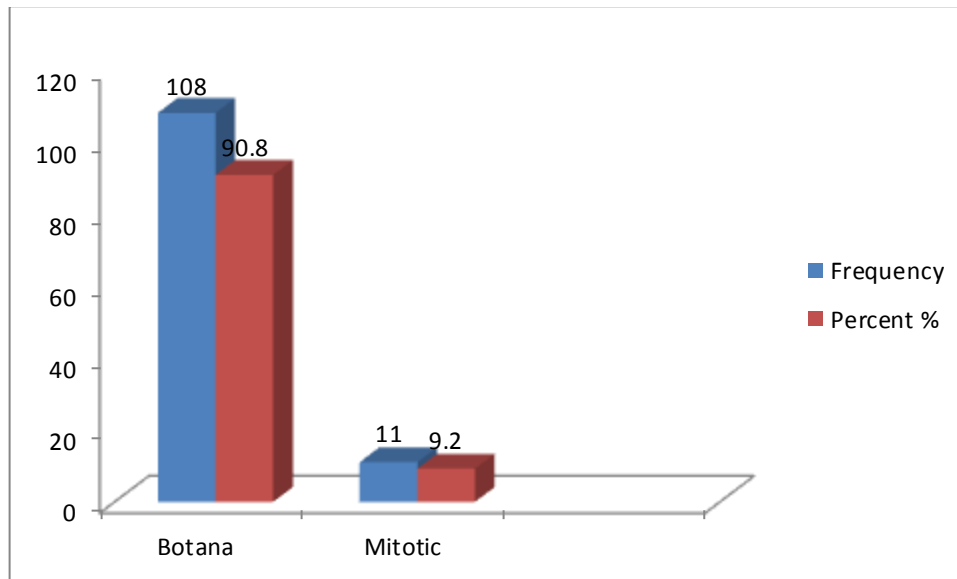


Table (4) The distribution of fasciolosis according Source of Animal

Source of Animal	Frequency	Percent %
Botana	109	91.6
Nilotic	10	8.4
Total	119	100

Fig. (4) The distribution of fasciolosis accordingto Source of Animal

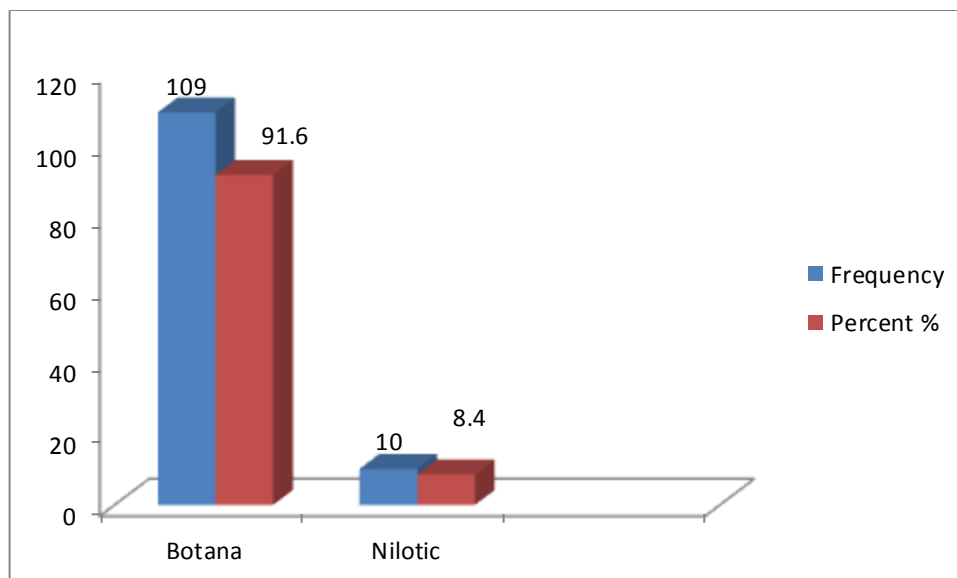


Table (5) The distribution of fasciolosis according to body condition

Body condition	Frequency	Percent %
Poor	23	19.3
Good	96	80.7
Total	119	100

Fig. (5) The distribution of fasciolosis according to body condition

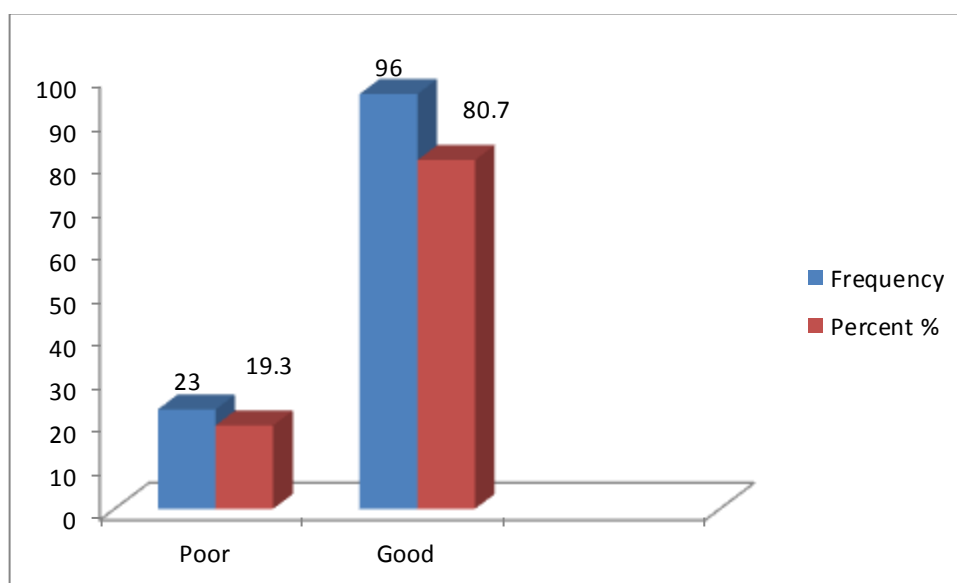


Table (6 The distribution of fasciolosis according to type of grazing

Type of grazing	Frequency	Percent %
Open	119	100
Closed	0	0%
Total	119	100

Fig. (6) The distribution of fasciolosis according to type of grazing

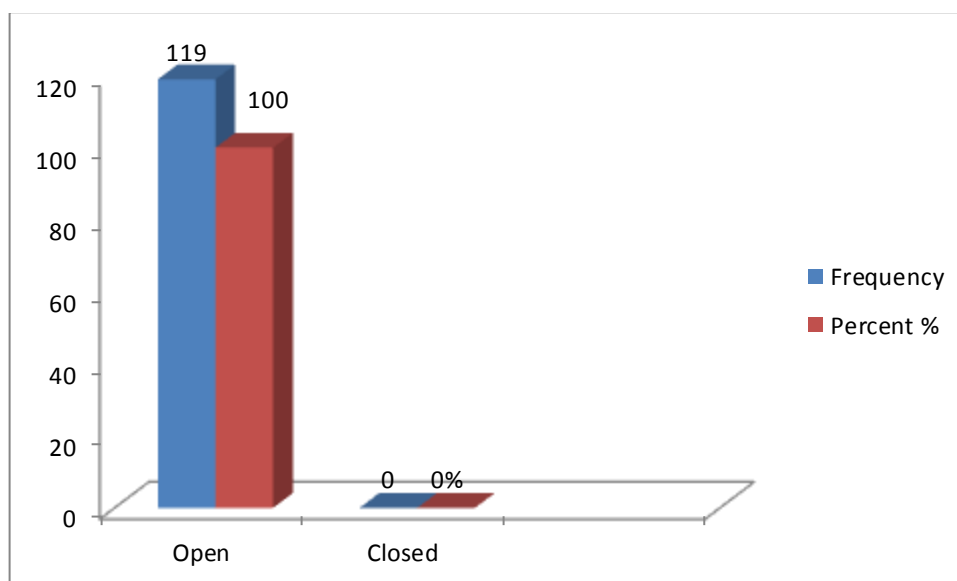


Table (7) The distribution of fasciolosis according to present snail

Present of Snail	Frequency	Percent %
Yes	0	0%
No	119	100%
Total	119	100

Fig. (7) The distribution of fasciolosis according to present of Snail

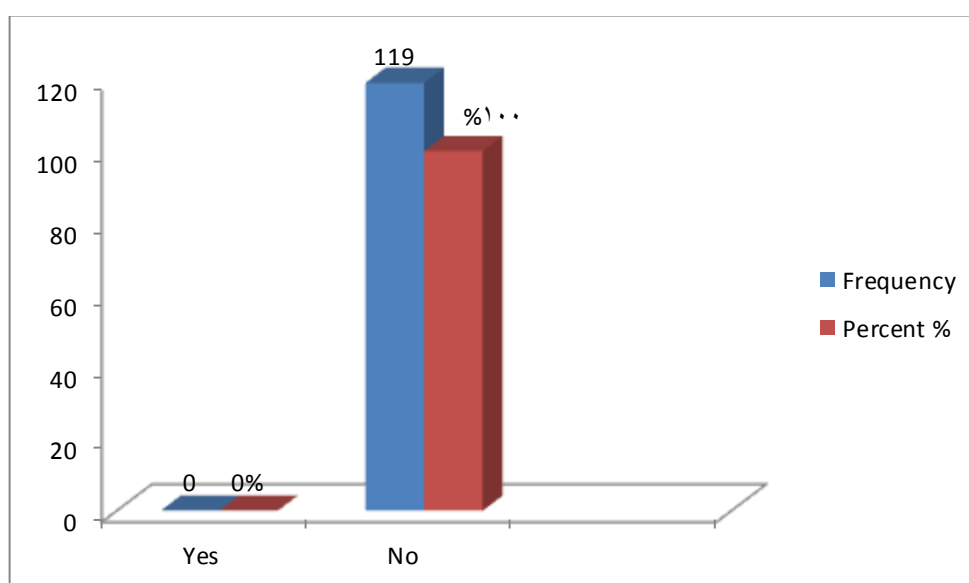


Table (8) The distribution of fasciolosis according to treatment

Treatment	Frequency	Percent %
Yes	5	4.2
No	114	95.8
Total	119	100

Fig. (8) The distribution of fasciolosis according treatment

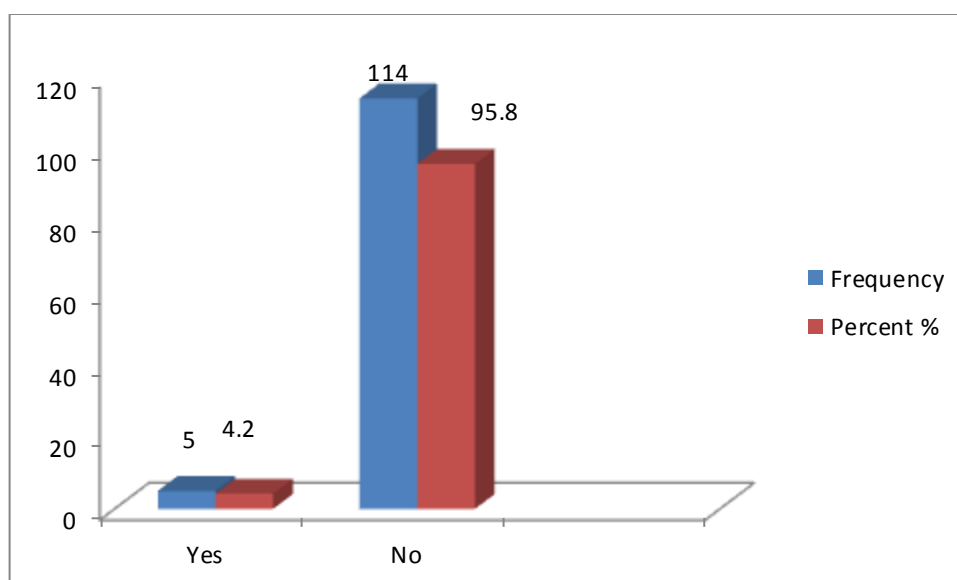


Table (9) The distribution of fasciolosis according to disease

Disease	Frequency	Percent %
Positive	7	5.9
Negative	112	94.1
Total	119	100

Fig. (9) The distribution of fasciolosis according to disease

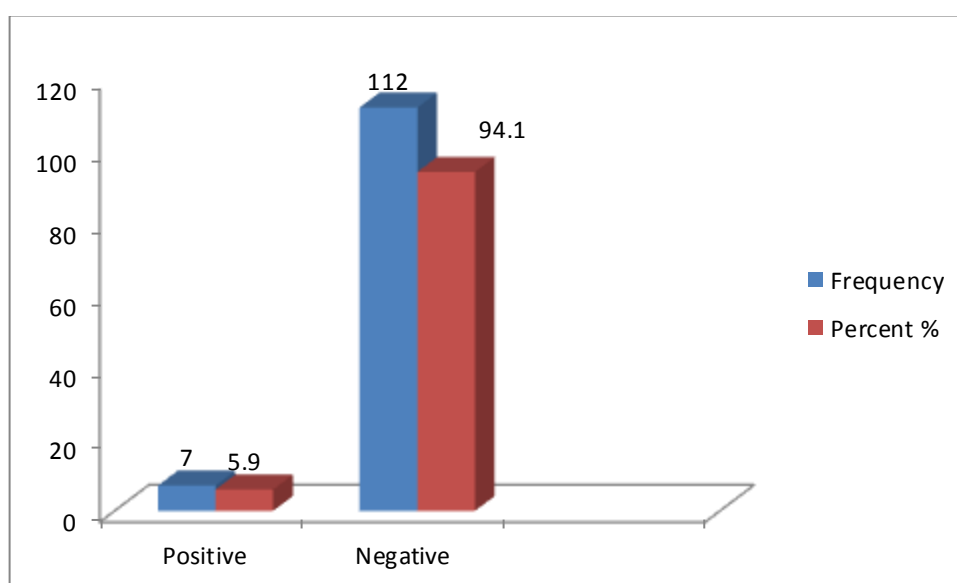
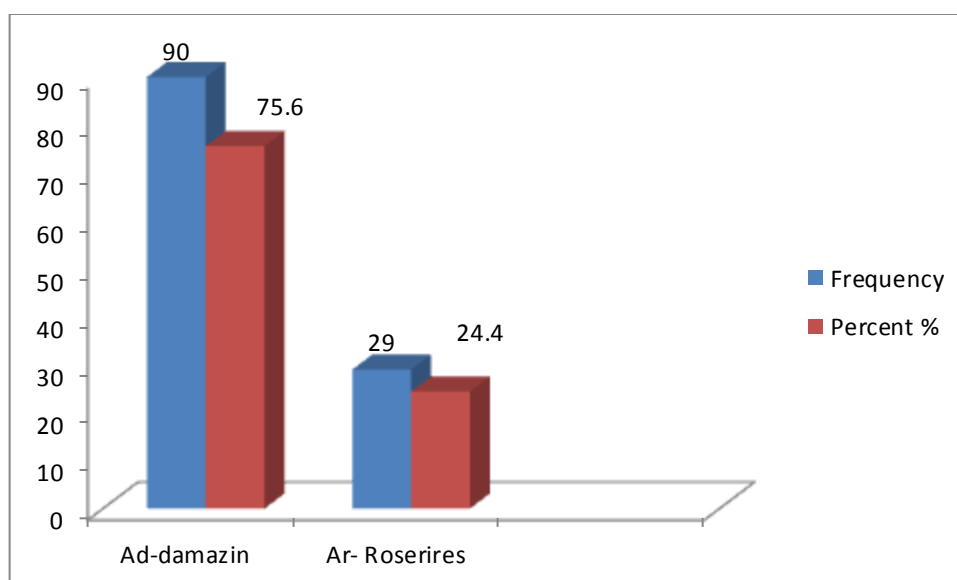


Table (10) The distribution of fasciolosis according localities

Localities	Frequency	Percent %
Ad-damazin	90	75.6
Ar- Roserires	29	24.4
Total	119	100

Fig. (10) The distribution of fasciolosis according to the Localities



Appendix (2)

Questionnaire

To obtain information about fasciolosis in cattle and information regarding geographical localization and risk factors influencing the presence of the disease.

General information :

1.Name :

Gender :

Level of education:.....

Information about the fasciolosis risk factors:

1.Age:

Young ≤ 2 years ()

Old ≥ 2 years ()

2. Sex:

Male ()

Female ()

3. Breed :

Botana ()

Nilotic ()

4.Source of animals

Indeginous ()

Exotic ()

5. Body condition:

Good ()

Poor ()

6. Grazing

Open ()

Close ()

7. Present of snail

Yes ()

No ()

8. Using Drug

Yes ()

No ()

9. Present of disease

Positive ()

Negative ()

10. Localities

Eldamazin ()

Elroserires ()