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Gastro-intestinal parasitic infection and non carcass components

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ABSTRACT

Aim: The study was aimed to evaluate the effect of natural gastro-intestinal parasitic infection on the non carcass components of sheep, considering age and level of energy.

Method and materials: Forty-eight Sudan Desert lambs were selected to be divided into eight groups of six animals each and fattened for sixty days. A total of twenty four animals (3 from each group) were randomly selected for slaughter at the end of the fattening process. Non carcass components as fore and hind feet, genitals, blood, internal offal´s (stomach and intestine) full and empty, gut fill, heart, liver, spleen, lungs, trachea, omentum fat, mesenteric fat and pancreas were studied for their weights and postmortem changes.

Results: The study revealed that the weights of non carcass components were not significantly affected except for gut and rumen fills which were significantly ($P< 0.01$) affected. On the other hand, from a postmortem view, most of the internal organs were affected.

Conclusion: It was concluded that effect of natural gastro-intestinal parasitic infection on the non carcass components of sheep, considering age and level of energy can be detected, accordingly.

Keywords: Gastrointestinal parasites, Natural infection, Non carcass components, Sheep.

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Introduction

Sudan desert sheep is a crossbreeding between the Arab sheep with that of Fulani tribes (Muffarrih, 1991). Devendra and Mcleroy (1982) divided Sudan desert sheep into six famous ecotypes: Kababish, Hamari, Ashgar, Butana, Gezira and North riverian wooled. Sudan desert sheep play an important role in domestic meat supplyas long as their clear socio-economic importance in the Islamic countries (Tolera, 1998). Desert sheep represents about eighty percent of the slaughtered sheep in Sudan (FAO, 2015).Sheep are susceptible to endoparasitic nematodes, roundworms, tapeworms, and coccidia which are very pathogenic (Bassetto *et al*., 2009 and Onaga *et al*., 2009 and Jason *et al.,* 2008). Experts suggest that this is due to a combination of several factors such as climate, energy level of the diet, age, number of ingested larvae (Blackburn *et al*., 2011).

Some of gastrointestinal parasitic infection is characterized by the formation of necrotic nodules in the wall of the intestine (Emmanuel, 2013). According to Jason, *et al.,* (2008) the damage to organs is caused by migration of the parasite through the various tissues. Although tapeworms are often accused of causing weight loss and/or diarrhea, they rarely cause much damage (Jason, *et al.,* 2008). Coccidia species parasitize the intestinal epithelium of infected animals causing severe damage to the mucous membrane and sometimes sheep may suddenly die (Tafti and Mansourian, 2008). Infection could a predisposing factor for other pathogens (Love and Hutchinson, 2003). At least 11 species of *Eimeria* occur in Sudanese sheep (Abakar *et al.,* 2005). Love and Hutchinson (2003) stated that lesions in coccidiosis include catarrhal enteritis and multiple well-defined whitish lesions. Thus, parasites harmfully influence host life-history characteristics and *vice versa* (Cooper *et al.,* 2012). Non carcass components like rumen, intestine, liver and lungs are the main habitat of gastrointestinal parasitic infection which brings to consideration the importance of searching the relation between them.

Materials and Methods

Experimental animals

To study the effect of natural gastro-intestinal parasitic infection on the non carcass components of sheep, forty eight naturally infected Sudan Desert lambs were purchased. Infection was detected microscopically through the rectal samples that were taken from all lambs upon purchase. Treatment for internal parasites was done for half of the lambs to be used as the control while the rest were to be left naturally infected. Twenty-four of them were two years old while the rest were less than one year old. The average live weight of them was 24.13kg ± kg1.22.

Adaptation period

All animals were kept for an adaptation period of three weeks during which groundnut hay was given along with equal mixture of the high and low energy experimental rations. Animals were screened for internal and external parasites and ear tagged. After treatment for external parasites antibiotic injections (Oxytosin-10%) were given against respiratory diseases and coccidiobans against coccidiosis. Salt lick cubes plus vitamins were provided. Half of the animals were kept naturally infected with internal parasites while the rest were treated.

Experimental design

The design depended on three parameters which were health, age and dietary energy level. Forty-eight naturally infected lambs were used in this experiment. They were divided into two groups of twenty four lambs each. One of which was treated for internal parasites while the other was left naturally infected. According to age, each group was then divided into two groups (Old and young). The old was two years old and young which were milk teeth. Another division according to the dietary energy level (high and low). Accordingly eight groups of six individuals each which were resulted. They were, old infected high energy (OIHE), old treated high energy (OTHE), old infected low energy (OILE), old treated low energy (OTLE), young infected high energy (YIHE), young treated high energy (YTHE), young infected low energy (YILE) and young treated low energy (YTLE). They were then fattened for sixty days during which feed intake and live body weights were calculated and at the end twenty four animals (3 individuals from each group) were randomly selected for slaughter to study the changes of the non carcass components.

Screening and sorting of animals according to natural infection with gastrointestinal parasites

Animals were screened for parasites, upon arrival. External parasites were searched manually and animal that were manifested with parasites were recorded. For internal parasites, rectal fecal samples were taken gently and taken weekly for gastrointestinal parasites detection. After laboratory diagnosis of samples the animals were sorted according to the presence or absence of internal parasites to naturally infected or treated.

Parasites occurrence in the lambs

The prevalence of both internal and external parasites in the experimental lambs was recorded. All animals were bring to being infected with either internal parasites (IP), external parasites (EP) or both of them. Ninety-six percentage of them were infected with internal parasites (Trichostrongyles, Monieza and coccidia), while those infected with external parasites were 52%. Trichostrongyles was the most main parasite (80%), followed by Monieza, Coccidia, mixed infection of Trichostrongyles and Monieza, Trichostrongyles and coccidia, Monieza and coccidia and Trichostrongyles, while the least was the mixture of Monieza and coccidia which is 15%.

Anthelmintic application

At the beginning of the experiment Ectothrin dipping solution was used to treat all animals for external parasites. Half of the animals were treated for Internal parasites using Anthelmintics. Anthelmintics given were Albendazole drug for internal parasites as a broad spectrum anthelmintic. Ivermectin was provided for both external and internal parasites. These were given twice a month as a protection. To treat and control coccidian infection Coccidiobans were given for all experimental animals for throughout the experimental time. Respiratory tract infections were treated using Oxytetracyclin and Gentamycine.

Experimental rations

Two iso-nitrogenous diets of high and low energy were formulated. The ingredients of the experimental diets were given (Fig 1 and 2). Ingredients proportions of the experimental diets were calculated according to MAFF (1979).

Chemical analysis

The chemical composition of low and high energy diets. Samples of high and low energy diets were analyzed for proximate composition of dry matter (DM), crude protein (CP) using Kieldahl method of analysis, ether extract (EE) using soxhlet apparatus, crude fiber (CF) and Ash according to AOAC (2000). All samples were analyzed in replicates and the means were then taken. The protein percentage in both high and low energy diet was 16.11%.

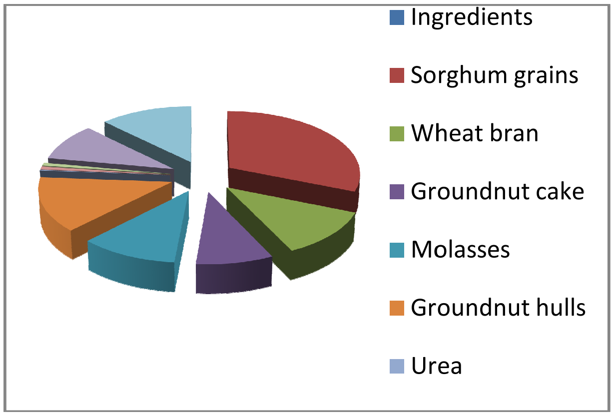

Fig 1: Ingredient proportions of the high energy diet

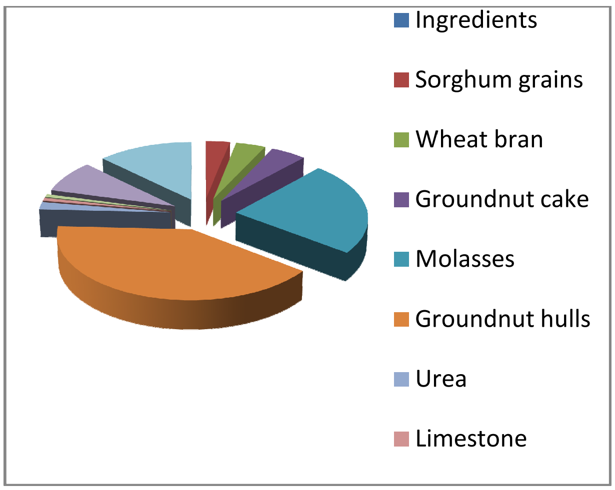

Fig 2: Ingredient proportions of the low energy diet

Feeding programand Feed intake

Feed was offered *ad lib* in the early morning (8.00 am). Feed refusals were collected and weighed every day in the morning before feeding throughout the data collection period. Samples of feed offered and refused were taken weekly for analyzing DM, then pooled to monthly samples for further analysis.Feed intake of each group was recorded daily and calculated as the difference between the weight of the quantity offered and refusal on the next morning. The average dry matter of the experimental diet and the refusal were obtained to calculate dry matter intake.

Live body weight gain

Initial live body weight was recorded for each animal on the first day of the experiment. Through the experimental period animals were weighed weekly in the morning after an overnight fast except for water using Weigh Bridge balance of 150kg maximum capacity load with 0.1 kg division.

Slaughter procedure and samples preparation

At the end of the experiment a total of twenty four animals (three from each treatment) were randomly selected for slaughter. They represented all different sub groups. Slaughter weight for each animal was taken just before slaughtering after an overnight fast except for water. The slaughtering process was performed according to the international Muslim practice, where the jugular vein and carotid artery were severed as well as the oesophagus and trachea, using a sharp knife without stunning.

Non-carcass components

On complete bleeding the head was removed at the atlanto-occipital joint (between the occipital bone, Oss occipital and the first cervical vertebra, Atlas). After skinning, the tail was removed at the first inter coccygeal articulation. Fore and hind feet were then removed at the carpo-metacarpal and tarso-metatarsal joints respectively. The genitals were removed from their base. All these parts and the blood were weighed. Blood was collected directly after slaughter until the slaughtered animal stopped bleeding. The carcass was then opened through for ventral median line and eviscerated. Internal offal´s, stomach and intestine were removed and weighed full and empty. The gut fill weight was obtained by the difference of full and empty gut. Empty body weight was obtained by subtracting gut fill from the slaughter weight. Other internal organs including heart, liver, spleen, lungs and trachea, omentum fat, mesenteric fat and pancreas were individually removed, weighed hot and registered. All the internal and the external non carcass components were expressed as percentage of empty body weight. The pelvic fat, the kidneys were left attached to the carcass.

Postmortem examination

Postmortem examination of internal organs was performed immediately after slaughter. The findings were recorded and the grossly affected organs were examined for the presence of internal parasites, lesions and other changes. Organs examined were rumen, small and large intestine, liver, heart, lungs, spleen, kidneys, heart, pancreas, prescapular lymph nodes as well as mesenteric fat were detected.

Results and Discussion

Data related to feedlot performance of the Sudan desert sheep of the two age groups (young and old), fed different dietary energy levels (low and high) and treated for internal parasites or left naturally infected was presented (Table 1). The average final live weight of old lambs treated for internal parasites and given high energy diet was (39.5 kg) which was the highest of all the treatments followed by that of young lambs treated for internal parasites and fed high energy diet too (35.8 kg). All infected lamb groups performed lesser average final live weights than their counterpart treated groups. The average final live weight of the group of infected young lambs given low energy diet was 45% lesser than old treated lambs given high energy diet. Average final live weight of infected old lambs raised on low diet was 23.5 kg which was 32% lesser treated young lambs given low energy diet. Total live weight gain (TLG) of old lambs treated for internal parasites and given high energy diet was 5.08 kg higher than that of infected old lambs (Table 2). The effect of treatment was clear, since the low energy diet given to old lambs that were treated for internal parasites resulted in significantly ($P< 0.001$) high (TLG) which was 7.9 kg higher than that of infected old lambs, in fact the later had lost 0.5 kg of their initial weight. Young lambs treated for internal parasites and fed high energy diet resulted in 2.5kg higher (TLG) than that of infected young lambs. Young lambs fed low energy diet and treated for internal parasites had gained only 5.17 kg while infected young and lambs fed low energy diet lost (0.25 kg) and (0.5 kg) respectively. Average daily live weight gain showed the same pattern as total live weight gain. The effects of internal parasites on live weights of experimental lambs were shown (Fig 3). The initial weights were almost the same. Differences in final weights and weight gain were very clear. Old lambs which were treated for internal parasites and given high energy diet reached the highest final body weight of all experimental groups as well as achieving the highest weight gain, followed by the young lambs which were treated for internal parasites on the same energy level. Infected groups on high energy diet gained more weight than treated groups on low energy diet. On the other hand, infected groups on low energy diet lost weight (Table 3).

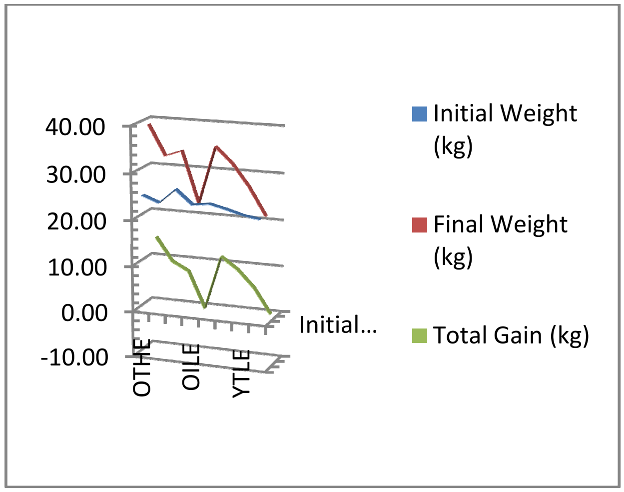

Fig 3: Effect of internal parasites on weight gain of treated old and young Sudan desert sheep
Here: OTHE: Old Treated High Energy, YTHE: Young Treated High Energy, OTLE: Old Treated Low Energy, YTLE: Young Treated Low Energy.

Internal parasites and non carcass components of Sudan desert sheep

It was showed data related to non-carcass components of Sudan desert sheep of two age groups (young and old), fed different dietary energy levels (high and low) and treated for internal parasites or left naturally infected. Data related to the blood, head and skin of all groups under study showed no significant differences. Fore gut contents of old lambs given high energy diet and left naturally infected was not significantly higher than the same lamb group fed the same energy level and treated for internal parasites. On the other hand, old lambs treated for internal parasites and given low energy diet had significantly ($P<0.01$) higher foregut contents percentage than old lambs given low energy diet and left naturally infected. Young lambs given high energy diet and left naturally infected had higher but not significantly so foregut contents than young lambs of the same age treated for internal parasites. Young lambs, given low energy diet and treated for internal parasites had significantly ($P< 0.01$) high foregut contents than young lambs left naturally infected and given low energy diet. Data related to the empty rumen, full intestine, empty intestine, liver, heart, lung & trachea, kidneys, four feet, reproductive organs, and spleen of all groups of animals under study showed no significant differences between lamb group of young and old age fed high or low energy diets and treated for internal parasites or left naturally infected.

Table 1: Effect of internal parasites infection on non-carcass components of Sudan desert sheep

	Old				Young					
	High energy		Low energy		High energy		Low energy			
Trait % of Slaughter weight	Treated	Infected	Treated	Infected	Treated	Infected	Treated	Infected	SE	P -Level
Blood	3.83	4.17	3.54	4.77	4.07	5.42	5.65	6.15	0.65	NS
Head	6.75	6.92	8.42	8.25	6.68	7.34	8.37	7.55	0.6	NS
Skin	9.26	7.75	10.36	10.20	9.51	8.96	9.62	8.24	0.97	NS
Empty Foregut	3.49	3.57	4.57	4.37	3.69	4.22	4.61	3.73	0.39	NS
Full Intestine	7.57	8.69	8.63	7.68	8.17	8.87	12.08	10.26	1.28	NS
Empty Intestine	2.98	3.63	3.07	3.6	3.84	4.34	4.28	4.07	0.34	NS
Liver	1.96	2.22	1.67	1.87	2.2	2.52	2.33	2.06	0.20	NS
Heart	0.48	0.48	0.42	0.51	0.46	0.48	0.51	0.52	0.06	NS
Spleen	0.52	0.99	0.19	0.22	0.3	0.34	0.32	0.31	0.13	NS
Lungs& Trachea	2.01	2.24	2.02	2.21	2.00	2.44	1.93	2.18	0.16	NS
Kidneys	0.32	0.35	1.42	0.36	0.36	0.35	0.41	1.10	0.47	NS
Four Feet	4.50	2.7	3.17	2.77	2.63	2.75	3.00	2.81	0.25	NS
Reproductive Org.	0.86	1.01	1.02	1.56	0.71	1.38	1.20	1.08	0.31	NS
Omentum Fat	1.21	1.09	1.09	1.01	1.17	1.20	0.96	0.75	0.25	NS
Kidneys Fat (KCCF)	1.85	1.22	1.84	0.54	1.01	1.27	0.73	0.59	0.44	NS

Depot fat as omentum, kidney and channel fat were reduced but not significantly so, by infection irrespective of age or dietary energy. It was revealed the effect of interactions of age, health and level of dietary energy on foregut and alimentary canal fills as percentage of slaughtered weight. The significance of the effect of the level of dietary energy was clear, since the lambs which were fed high energy diet 13.94% foregut fill and 14.83 alimentary canal fill while those lambs which were fed low energy diet had an average foregut fill of 20.47% and alimentary tract fill of 22.09%. Regarding the foregut fill there was an interaction between age and health status and between age and energy while for the alimentary canal fill an interaction was observed between health and energy.

Interactions of the statistical factors

Effect of interactions of dietary energy level, age and health status on full foregut were observed. Dietary energy level × health interaction was significant for both alimentary canal fill and foregut contents. However age × health × dietary energy interaction was significant for the foregut fill, where both age, energy and internal parasites affected foregut fill. This is applied for alimentary canal fill, too (Table 4). A huge differences in the percentage of foregut fill between the lambs which were treated and given low energy diet (24.97%) and those which were left naturally infected and given the same energy diet (15.97%). These values were higher than of those lambs which were given high energy diet whether treated or left naturally infected.

Table 2: Status of Foregut and alimentary canal fills interactions of energy in treated and naturally infected lambs.

Health Status	Energy level	Foregut %*	Alimentary Canal%*
Treated	High	13.10	13.97
	Low	24.97	27.07
Infected	High	14.78	15.68
	Low	15.97	17.11

*Percentages of slaughter weight

Post morteminternal organs

Postmortem examinations of internal organs of slaughtered lambs which were left naturally infected (Fig 4-10).

The blood percentages were significantly different but they were slightly higher in the untreated lamb groups. The skin was heavier in the treated groups whether old or young and or kept on high or low energy dietary level. In lambs kept naturally infected skin hair was noticed to peal easily. Loss of hair might have contributed to the reduction in skin weight. In this study foregut fill and alimentary canal fill seemed to be affected by internal parasites infection and level of energy of the diet. Both old and young lambs treated for internal parasites and given low energy diet had lower foregut fill and alimentary canal fill percentages than old and young lambs given low energy diet and left naturally infected. This brings fact that eating low energy diet causes impaired or lessen digestion which lead to increase rumen contents. This in fact comes along with the finding of Holmes (1987) who stated that low energy level feed lead to lessen feed intake which slowed down gut motility. In addition, infestation with internal parasites causes lower digestibility according to Anna (2009). This explains the increase of the rumen contents and gut fill in infected lambs. Fox *et al.* (1989) indicated that intestinal tract of lambs infected with Monieza had a slower gut motility and passage of ingesta than of those treated for internal parasites due to the physical presence of the parasite and reduced feed intake.

Table 3: Interaction effects of age (old and young), health status (treated and naturally infected) and energy (high and low energy diet) on foregut fill.

Age	Health status	Energy	Foregut fill (%)*
Old	Treated	High	13.10
		Low	24.97
	Infected	High	14.78
		Low	15.97
Young	Treated	High	13.06
		Low	24.92
	Infected	High	14.83
		Low	16.02

*Percentages of slaughtered weights

Table 4: Effect of interactions of age, health and level of dietary energy on dressing percentage, full alimentary Canal and foregut fills.

		Rumen full (% of S. Wt.)	Alimentary Canal fill (% of S. Wt.)
Age	LS	NS	NS
	Old	18.99	19.81
	Young	15.43	17.10
Health Status	LS	NS	NS
	Clean	19.04	20.52
	Infected	15.37	16.40
ENERGY	LS	**	**
	HIGH	13.94	14.83
	LOW	20.47	22.09
AGE×HEALTH		NS	NS
AGE×ENERGY		**	NS
HEALTH×ENERGY		**	*
AGE×HEALTH×ENERGY		NS	NS
OVERALL		17.2±1.12	18.47±1.11

(% of S. Wt.): Percentage of slaughter weight
LS: Level of significance *: ($P \leq 0.05$) **: ($P \leq 0.01$)

Accordingly, feed remained longer inside the rumen (full rumen). A significant interaction between dietary energy level and internal parasites infection was recorded for both gut fill and rumen fill. However, an interaction for all three factors (age, health and dietary level of energy) was recorded for rumen fill only. In this study foregut fill was influenced by diet quality and quantity. Thus higher quality diet fed ad-libitum allowed treated lambs to attain a better condition which agrees with Philips (2000), both factors automatically affected foregut contents. On other hand, empty foregut, intestine (full), intestine empty, liver, heart, lung and trachea, kidneys, four feet, reproductive organs and spleen of all groups of animals under study showed no big differences between lamb groups of young and old age fed high or low energy diets and treated for internal parasites or left naturally infected. Depot fat as omentum, kidney and channel fat were slightly reduced by gastrointestinal parasitic infection irrespective of age or dietary energy. This was quite reasonable because treated lambs had a better feed intake, consumption and absorption, a finding which coincided with Wallace (2000).

In this study, no big variations were found in wholesale cuts yield for all groups of different ages, dietary energy levels and treated for internal parasites or left naturally infected.

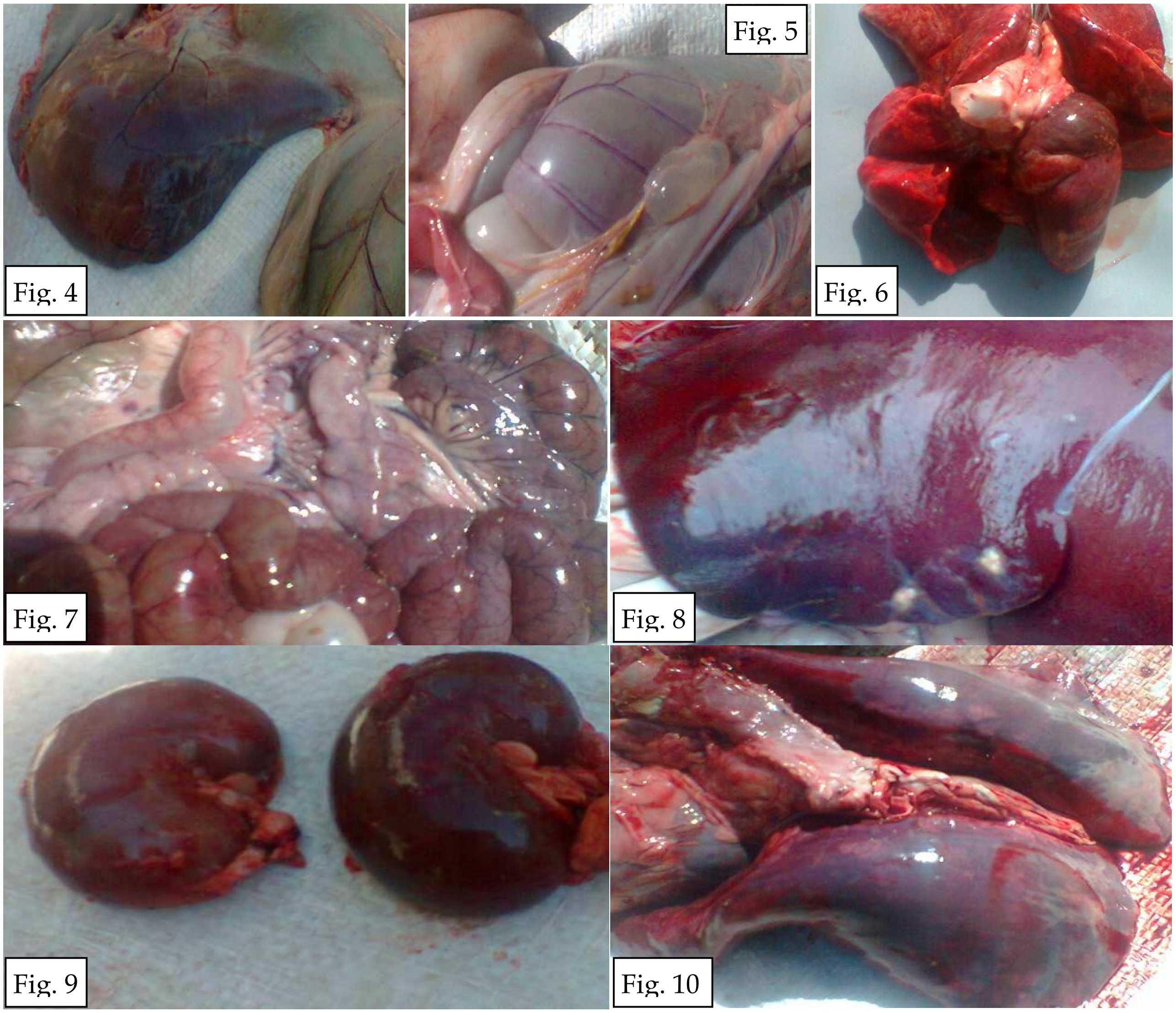

Fig 4: Abomasum hyperemia and congestion of rumen blood vessels of an infected dead lamb. Fig 5: Hydated cysts all around internal organs and blood vessels congestion. Fig 6: Enlarged and congested heart. Fig 7: Congestion and hyperemia of small and large intestines of infected dead lamb. Fig 8: Liver necrosis of infected dead lambs. Fig 9: Congestion and enlargement of kidney of dead lambs, Fig 10: Bilateral lungs congestion of infected dead lamb.

Neck cuts of infected lamb groups were slightly higher than that of treated groups that might be due to manual cutting. Single short fore quarters of untreated groups were slightly higher except young lambs treated for internal parasites and given low energy diet. It might be due to good performance observed in last three weeks of the experiment. Leg and chump, Loin, tail, best end of neck and breast cuts showed no big differences among all groups. The tail was heavier in treated lambs of the two age groups and fed either high or low energy diets. This could possibly be due to the effect of treatment allowing better utilization of diet and increased deposition of fat in the tail.

Although, Zanton *et al.* (2005) stated that change in body weight did not usually took account of alterations in body composition which might be of considerable importance in determining carcass quality. Yet this study proved the opposite regarding muscle percentage. Loin cut composition, in terms of weight or percentage of the cut for all treatments, showed no differences between treatments except for muscle percentage data. A higher muscle percentage was obtained by the groups of old and young lambs which were given high energy diet and treated for internal parasites compared to the same age groups of lambs left naturally infected and given high energy diet. This agreed with Bishop (2012) who stated that anthelmintic treatment reduced production loss. Low energy diet given to untreated old lambs resulted in higher muscle percentage than the same age group treated for internal parasites and given low energy diet. On the other hand, young lambs left naturally infected and given low energy diet had less muscle percent than their counterparts treated for internal parasites. Hence age effect could be the explanation, as old animals tend to develop immunity against internal parasites which comes in line with Perry *et al.* (2002). This finding also came along with Anindo *et al.* (1998) who claimed that molasses-urea-blocks could be as effective as administering anthelmintic in mitigating the effects of gastrointestinal parasite in grazing sheep. In spite of this, treated young lambs on low energy diet, acted the opposite way. They had more muscle percentage than the same age group left naturally infected and given low energy diet. Internal organ examination of infected lambs revealed severe damage due to gastrointestinal parasites. Abomasum hyperemia and congestion of blood vessels were of the main findings that were in line with Fox (1997). Signs of generalized enteritis, including hemorrhage and oedema which agreed with Florian *et al.* (2013). Liver necrosis of infected dead lambs could be due to the infection of internal parasites which acts as a predisposing factor for any bacterial infection. Jason (2008) stated that the damage to organs was caused by migration of the parasite through the various tissues.

Conclusion

It was concluded that effect of natural gastro-intestinal parasitic infection on non carcass components of sheep, considering age and level of energy can be noticed, accordingly as most of internal organs were not affected while most of internal organs were affected in postmortem view.

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