International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS
International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2016; 3(2): 121-125
Received: 26-01-2016
Accepted: 27-02-2016

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Relative effect of feeding strategies and parasitism on nutrient utilization and immunity in lambs

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Abstract
To evaluate the effect of concentrate ration and grazing on feed utilization and faecal egg count in lambs and to assess the immune suppressive effect of gastrointestinal parasites in lambs. Nine Balkhi lambs of same breed, age (2-2.5 months) and body weight (21 ±2 Kg) were purchased from local market and randomly divided into three groups named A, B and C, under completely randomized design. All the animals were allowed to graze on natural pasture twice a day while concentrate diet was offered to group B and C at evening. Group 'A' lambs were on conventional grazing. Whereas group B and C lambs were grazed and also supplemented with a concentrate diet having 17% crude protein as per NRC recommendations (1985). The latter group was drenched with an anthelmintic (Albandazole @75mg/kg). Statistically significant difference $p<0.05$ recorded for overall body weight gain for group C (12.63^{a}±0.336) kg/lamb followed by group B (11.16^{b}±0.665) and Group A (5.80^{c}±0.100) respectively. Reduction in the faecal egg count was observed in Group C (770^{a}.0±34.64) as compared to group B (131.67^{b}±10.40) and A (115.00^{c}±6.100).whereas the immunity status of group C in which the amount of total protein in blood plasma was high (2.30^{a}±34.64) as compared to group B (0.96^{b}±10.40) and C (0.86^{b}±6.100) respectively. It was concluded from the study that group C showed higher body weight gain, improved immunity and lowest faecal egg count in comparison with the other two groups.

Keywords: Concentrate diet, blood plasma, total protein

Introduction
In Pakistan about 30 to 35 million people are engaged in livestock, raising two to three cattle/buffalo and five to six sheep/goat per family, which helps them to derive 30 to 40 percent of their income (Bachaya *et al*., 2006) [3]. Gastrointestinal parasitic infection is one of the main limiting factors for developing sheep production systems based on grazing. Gastrointestinal parasites decrease voluntary feed intake and the efficiency of nutrients utilization (Coop et al., 1977; Dakkak, 1990) [6, 8]. The interactions between status of nutrition and pathophysiology of host induced by gastrointestinal parasites have been reviewed by Coop and Kyriazakis (1999) [7] and it offers interesting possibilities as a means of reducing anthelmintic usage for the control of nematode infections in sustainable production systems.

Most of the experimental work concerning nutrients/expression of immunity has been focused on the effect of protein nutrition on the resilience (Albers et al., 1987) [2] and resistance of the host to parasitic infection. As best of the effector devices of the immune system are proteinaceous in nature, it is possible that infection would increase protein demand for intestinal tissue (Bown et al., 1991) [5]. In this respect, information available suggests that protein supply may improve resilience, providing the animals are fed an adequate plane of nutrition (Jackson, 2000) [10, 11].

Heavy dependence on anthelmintics to control the gastrointestinal parasites that has created resistance against parasite (Kaminsky, 2003) [13]. Particularly for gastrointestinal parasites of sheep and goats, in some animals this resistance include all current classes of anthelmintic drugs (Jackson and Coop, 2000; Bartley et al. 2006) [10, 11, 4]. Which has provoke an idea to develop the alternatives to anthelmintics these alternatives include protein feed supplementation and grazing of anti-parasitic forages which includes chicory and lotus to produce mutton which is free of the drug residue. The ability of the parasite population to quickly develop resistance to a wide range of drugs, besides increasing consumer demand for a more organic product, provoke the need to control parasites with alternative methods.

Thus the current study is aimed to investigate effect of parasitism in relation to nutrition on sheep performance in terms of body weight, which will enable us to know that how much nutrients are changed into valuable products (like mutton and meat) in the presence/absence of parasites and its effect on health status in term of general immunity and resistance against parasites which is directly related to efficient utilization and quality products.

Objectives

1. To determine the effect of parasitism on nutrient utilization in terms of weight gain in sheep.
2. To investigate the immune suppressive effect of parasitism in relation to feeding regime in sheep.
3. To explore the role of nutrition in resistance against parasitic infestation.

Materials and Methods

The study was conducted at "The University of Agriculture Peshawar" dairy farm and was comprised of nine lambs which were purchased from the local market of same breed (Balkhi) and of same body weight 21±2 kg. Lambs were randomly divided into three groups (3 animals/group) named as group A, B and C. Animals were tagged with the alphabets hanged on their neck collars for their identification. Lambs in the first group were grazed conventionally; lambs in group B were grazed and given concentrate also. In group C, animals were grazed, offered concentrate and were treated with an anthelmintic (Albandazole at the standard dose rate of 75mg/kg). Dewormer was given at the start of the experiment and then on 14th day of trial. Lambs in the 2nd and 3rd group were kept in separate pens because of their feeding. The body weight, faecal egg count and total protein within the blood plasma of lambs were estimated on weekly basis. The study was continued for 63 days with 10 days of adaptation period.

Feeding : Lambs of each group were subjected to graze on the area twice a day and apart from group A concentrate was given to the lambs of groups B and C which was formulated according to the NRC recommendations.

Proximate analysis: Proximate analysis of ingredients available in the market was done before formulating concentrate diet for lambs (Table.1)

Table 1: Proximate analysis and nutritive value of each feed ingredient of ration (dry matter basis)

Ration / Ingredients	% DM	%moisture	%CP	% CF	% ash	% EE	% NFE	% TDN
Cotton seed cake	91.8	8.2	24	27.4	6.9	8.7	33.6	63
Mustard seed cake	91.6	8.4	31	19.8	11	9.7	26.2	84
Maize oil cake	94.7	5.3	17	9.3	1.7	12.2	60.5	78
Maize gluten 20%	87.8	12.2	21	12.7	1	10.7	63.2	54
Maize grain	91.3	8.9	8	2.8	1.8	3.4	82.4	81
Wheat bran	89.6	10.4	12	8.8	4.2	3.6	68.7	71

Ration formulation: Ration for group B and C was formulated according to the NRC recommendations (1985) for the growth and maintenance of lambs. According to NRC recommendations 17% CP and 81%.TDN were required by lambs. Fresh and clean drinking water was available for 24 hours for all lambs (Table. 2).

Table 2: Ration formulations for lambs

Ingredients	17% CP 81% TDN
Cotton seed cake	13
Maize oil cake	20
Maize gluten 20%	10
Mustard seed cake	7
Molasses	5
Maize grain	13
Wheat bran	25
Salt	1
DCP	1
Maize bran	5
Total	100

The parameters which were studied during trial included body weight gain which was recorded on weekly basis through a digital balance, parasitic load was analysed through McMaster's faecal egg count techniquein which faecal samples were taken per rectum and transported to lab in transparent plastic bags on weekly basis. The eggs of different worms were seen under the microscope including eggs of *Haemonchus contortus*, Trichostrongylus species, Namatodirus species incase of group A and B. However in case of group C egg count was almost negligible and immunity status of lambs was measured through blood samples taken on each week and tested for the presence of total protein through Haematological Analyser**.** The data was arranged on excel sheet and analysed through analysis of variance technique (ANOVA) by using completely randomized design (CRD) as described by The data was analysed through SPSS 16.0 and means of three treatments and three replications were compared by using Post hoc test (L.S.D).

Results

The study showed significant difference $p<0.05$ in overall weight gain, faecal egg count and immunity in lambs, weight gain for treatment C (12.63^{a}±0.336) kg followed by treatment B (11.16^{b}±0.665) and treatment A (5.80^{c}±0.100) throughout the experiment. Lambs of group C showed an ideal weight gain because of the anthelmintic treatment given to them through which their immunity boosted up and had showed good performance as compared to other two groups (Table 3).

The lambs in group C showed reduction in faecal egg count (770^{a}.0±34.64) no. of eggs because of the anthelmintic given to them, while in case of treatment B (131.67^{b}±10.40) number of worm eggs were reduced followed by treatment A (115.00^{c}±6.100) in which the decline in faecal egg count was very less as compared to other two groups because these lambs were neither receiving the anthelmintic nor the concentrate diet to get their immune system stronger against the parasites. So results clearly showed that in order to control the gastro intestinal parasites dewormer should be given to animals because alone protein supplementation cannot help to reduce worm burden (Table 4).

While in case of total protein in lambs of group C (2.30^{a}±34.64) followed by group B (0.96^{b}±10.40) and group

A (0.86^{b}±6.100). Group C showed a normal value of total protein because they had recovered from the gastro intestinal parasitic infection by using anthelmintic while other 2 groups showed low total protein value because lambs were suffering from parasitic infection that causes hypoproteinemia (Table 5).

Table 3: Effect of different feeding regimes on live body weight gain of lambs from week 01 to week 09

Week		Groups	
	A	B	C
	Mean ±SE	Mean ±SE	Mean ±SE
1	0.466^{b}±0.033	1.200^{a}±0.033	1.200^{a}±0.050
2	0.733^{b}±0.033	1.333^{a}±0.033	1.266^{a}±0.018
3	0.66^{c}±0.033	1.16^{b}±0.050	1.40^{a}±0.030
4	0.633^{c}±0.033	1.300^{b}±0.033	1.433^{a}±0.048
5	0.66^{c}±0.032	1.23^{b}±0.060	1.466^{a}±0.028
6	0.66^{c}±0.039	1.36^{b}±0.050	1.53^{a}±0.317
7	0.63^{c}±0.038	1.23^{b}±0.043	1.46^{a}±0.032
8	0.66^{c}±0.035	1.16^{b}±0.040	1.46^{a}±0.035
9	0.66^{c}±0.031	1.16^{b}±0.045	1.40^{a}±0.034
Over mean	5.80^{c}±0.100	11.16^{b}±0.665	12.63^{a}±0.336

Table 4: Decline in faecal egg count (no. of eggs in faeces) of lambs through different feeding regimes

Week		Groups	
	A	B	C
	Mean ±SE	Mean ±SE	Mean ±SE
1	0.13^{b}±0.233	0.03^{b}±2.88	0.26^{a}±5.77
2	0.10^{b}±0.233	0.10^{b}±2.88	0.23^{a}±5.77
3	0.00^{b}±0.268	0.10^{b}±2.88	0.26^{a}±5.77
4	0.10^{b}±0.233	0.10^{b}±2.88	0.23^{a}±0.048
5	0.10^{b}±0.232	0.13^{ab}±2.88	0.23^{a}±0.028
6	0.13^{b}±0.239	0.10^{b}±2.88	0.26^{a}±0.317
7	0.03^{b}±0.138	0.13^{ab}±2.88	0.26^{a}±5.77
8	0.10^{b}±0.135	0.13^{b}±2.88	0.26^{a}±5.77
9	0.16^{a}±0.231	0.13^{a}±2.88	0.26^{a}±5.77
Over mean	0.86^{b}±6.100	0.96^{b}±10.40	2.30^{a}±34.64

Table 5: Effect of different feeding regimes on immunity (total protein g/dl) of lambs

Week		Groups	
	A	B	C
	Mean ±SE	Mean ±SE	Mean ±SE
1	0.13^{b}±0.233	0.03^{b}±2.88	0.26^{a}±5.77
2	0.10^{b}±0.233	0.10^{b}±2.88	0.23^{a}±5.77
3	0.00^{b}±0.268	0.10^{b}±2.88	0.26^{a}±5.77
4	0.10^{b}±0.233	0.10^{b}±2.88	0.23^{a}±0.048
5	0.10^{b}±0.232	0.13^{ab}±2.88	0.23^{a}±0.028
6	0.13^{b}±0.239	0.10^{b}±2.88	0.26^{a}±0.317
7	0.03^{b}±0.138	0.13^{ab}±2.88	0.26^{a}±5.77
8	0.10^{b}±0.135	0.13^{b}±2.88	0.26^{a}±5.77
9	0.16^{a}±0.231	0.13^{a}±2.88	0.26^{a}±5.77
Over mean	0.86^{b}±6.100	0.96^{b}±10.40	2.30^{a}±34.64

Discussion

The results showed significant difference $p<0.05$ in overall weight gain for treatment C (12.63^{a}±0.336) kg followed by treatment B (11.16^{b}±0.665) and treatment A (5.80^{c}±0.100) throughout the experiment as given in the table 3. There is a high weight gain in the lambs of group C that were treated with the anthelmintic and given concentrate as compared to other two groups. Same results were recorded by Sykes and Coop. (1976) [16] they reported that gastro intestinal parasitism cause decrease in the intake of food and weight gain of lambs over the whole experiment, but had no effect on the digestibility. At the first trial the weight gain of the sheep in first group was only 50% of that of the sheep in 2nd group with the same digestible energy and protein intakes. The protein content of the gain in empty body weight of the sheep in 1st group was low as compared to second and third group.

In another study Niezen *et al*. (1995) [15] compared the body weight gains of lambs that were treated with anthelmintic with the lambs that were kept untreated. The body weights of treated lambs were higher than the untreated ones. The weight gain was not decreased by genetic resistance to gastro intestinal parasites. Lambs those were grazed on lucerne also had a much lower average daily gain than those grazing sulla. Another experiment was carried out Hordigen *et al*. (2003) [9] in which they had compared the effect of protein levels in different rations on the weight gain in lambs so they recorded that during grazing, animals that had received the ration with high protein content had higher body weight gain, higher antibody responses and lower faecal egg counts than did the lambs offered the lower protein concentrates.

The results for reduction in faecal egg count for treatment C (770^{a}.0±34.64) no. of eggs were decreased because of the anthelmintic given to lambs and in case of treatment B (131.67^{b}±10.40) number of worm eggs were reduced followed by treatment A (115.00^{c}±6.100) as given in the table 4. The results of the current study were similar to the work of Niezen *et al*. (1995) [14] in which they estimated higher faecal egg count in lambs that were untreated while grazing lucerne as compared to those who were grazing other fodder. As in this study the faecal egg counts were lower in case of lambs consuming concentrate diet as compared to lambs that were on grazing. Athanasiadoua *et al*. (2001) [1] worked on the anthelmintic effects of tannins they showed that the lambs infected with the gastro intestinal parasites and drenched with Quebracho had lower faecal egg count as compared to other sheep.

Similar results to our current study was carried out by Neizen *et al.* (1998) [15] showed that, when sulla is fed to sheep, there occur a reduction in gastro intestinal worm burdens and faecal egg count when the lambs were grazed on sulla but lotus also holds condensed tannins which results in high worm burdens and faecal egg counts. Similarly in the present study concentrate diet was used to reduce the faecal egg count in order to get drug free mutton and to overcome the resistance which is developing against the anthelmintic.

While in case of total protein in lambs of group C (2.30^{a}±34.64) followed by group B (0.96^{b}±10.40) and group C (0.86^{b}±6.100).the group C showed a normal value of total protein as given in the table 5. The total protein level was increased in the group of lambs that were treated with the albandazole because it boosted up the immunity of lambs against parasitism so that the body weight gain was also ideal in these lambs of about 1.2 kg per week. The results of Coop and Kyriazakis (1999) [7] were in lined with this study that the improved nutrition will always lead to enhanced resistance, it was suggested that the function of growth, lactation and pregnancy have priority over the expression of immunity. They observed the improved immunity and reduction in worm egg count in small ruminants supplemented with protein. The experiment of Valderrabano *et al.* (2002) [17] also concluded that extra protein supplementation and provision of more energy in ration cannot only boost up the immunity but also increases the carcass characteristic of animal. Kahn *et al.* (2000) [12] concluded that the protein supply delivered by the moderate protein feed was sufficient to produce immunity against gastro intestinal parasites. It is possible that the potential for protein supply to boost resistance against nematode infection.

Conclusion

The study evaluated the relative effect of different dietary regimes and anthelmintic on live body weight gain of lambs, the effect of concentrate ration containing crude protein and total digestible nutrients according to the NRC recommendations on faecal egg count in lambs. The research study concluded that the lambs that were grazed conventionally on grasses showed very less weight gain. The lambs that were fed the concentrate diet according to the NRC recommendations along with grazing showed ideal weight gain. The negative effects of parasitism can be controlled by feeding the protein diet to the lambs because parasites causes decrease in protein level of body. The lambs can attain high body weights through concentrate feeding even if they are not given the anthelmintic.

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