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EFFECT OF DIFFERENT PLANES OF NUTRITION ON PERFORMANCE AND MEAT QUALITY OF NAJDI LAMBS EXPERIMENTALLY INFECTED WITH *HAEMONCHUS CONTORTUS*

(With 5 Tables)

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تأثير نظم مختلفة للتغذية على أداء النمو و صفات الذبيحة للحملان النجدية المصابة تجريبيا بديدان الهومنكس كونتورتس

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تمت عدوى ١٢ حمل نجدي بيرقات ديدان الهومنكس كونتورتس , وبعد ذلك قسمت الحملان إلى ثلاث مجموعات ,المجموعة الأولى غذيت عليقه تعطى حد الكفاية من البروتين والطاقة حسب الجداول القياسية لهذا النوع من الحيوانات والمجموعة الثانية على عليقه مرتفعة البروتين بمقدار ٥٠% عن المجموعة الأولى والمجموعة الثالثة على عليقه مرتفعة فى كل من البروتين والطاقة بمقدار ٥٥% ، ١١% عن المجموعة الأولى. وقد أظهرت النتائج تفوق المجموعة الثالثة على الأولى والثانية من حيث الوزن النهائي ووزن الذبيحة وكذلك في نسب تصافي الدهن و اللحم الأحمر. ولم توجد أي فروق معنوية في نتائج الاختبارات الكيميائية والحسية للحم.بينما كان هناك فروقات معنوية في هضم كل من المادة الجافة، البروتين والألياف الخام في المجموعتين الثانية والثالثة مقارنة بالأولى ,مما يثبت أن مكونات العليقة من البروتين والطاقة لها تأثير فاعل على إنتاجية و جودة لحم الخراف رغم أصابتها بديدان الهومنكس .

SUMMARY

In the present study, twelve Najdi lambs, experimentally infected with 10^4 third stage larvae of *Haemonchus contortus,* were divided into 3 groups, 4/ each, and fed on 3 different rations. The first group supplied just adequate energy and protein requirements, the second group fed on ration having 50%more protein, while the ration of the third group was higher in its protein and energy than the first one by 55% and 11% respectively.

Infected lambs given high protein and energy diet demonstrated high final body weights, carcass weight and dressing%, with higher meat and fat yield. In addition, better digestibilities of dry matter, crude protein and crude fibers were recorded in both supplemented groups. The chemical analysis and sensory evaluation of the lean meat revealed no statistical differences between the three groups. Conclusively, the plane of nutrition showed an upper hand over the parasitism.

Key words: Meat quality, Najdi lambs, Haemonchus contortus

INTRODUCTION

Parasitism can impair live weight gain, soft tissue deposition, skeletal growth, milk, and wool production (Holmes, 1993; Sykes, 1994). Resistance and resilience of ruminant host to gastrointestinal (GI) parasitic nematode infection are influenced by many factors including nutrition. Host nutrition has been considered to be an important factor influencing host-parasite relationship and impact of GI nematode infections. Under field conditions and especially in tropical zones, there is wide variation in dietary protein intake a matter that may have important influence on the metabolism and productivity of the host impacted with parasite infection (Abbott *et al.*, 1985).

The improved nutritional status of sheep reduces the production losses and mortality rates associated with nematode infection (Van Houtert and Sykes, 1996). Abbott *et al.* (1985; 1986) reported that Finn Dorset sheep given low protein diet and infected with single dose of about 3000 *H. contortus* showed more pronounced pathophysiological consequences-viz-high abomasal blood loss, albumin catabolism and plasma iron turnover and lower red cell volume than those on high protein diet. Abbott *et al.* (1988) used trickle infection with *H. contortus* and observed differences in faecal egg count (FEC) in sheep given low and high protein diets for 5 weeks of infection. Sheep given low protein diet carried almost 3 times as many as worms at the end of the experiment. Low dietary protein supply delays the development of capacity to expel worms in lambs subjected to continuous infection with *H. contortus* (Abbott *et al.*, 1985; 1986; Roberts and Adams, 1990). On the other hand, Wallace *et al.* (1995) observed similar worm burden after 10 weeks irrespective to dietary protein concentration. There is no doubt that the efficiency of using food energy for tissue deposition is reduced by infection (Van Houtert and Sykes, 1996), *however,* Bown *et al.* (1991) found that GI nematodes infection induce protein deficiency rather than energy and suggested that complete resilience may be achieved with higher protein level.

As the carcass of parasitized ruminants generally contains less protein, many authors studied influence of feeding lambs on the carcass parameters and meat quality in relation to parasitic infection. (Sykes, 1983). Walace *et al.* (1995) found that lambs infected with haemonchosis and supplemented with high protein diet have more muscle and less fat than the lambs fed only the basal diet. They also found that the animals have similar dry matter and fat, but higher protein and ash than those received the basal diet.

The purpose of this study was to determine the link between different regimes of nutrition supplied to Najdi lambs experimentally infected with *H. contortus* and their growth rate and carcass characteristics.

MATERIAL and METHODS

Experimental design:

Three groups of helminthes-free lambs were used. They were fed on 3 different diets, group I, supplied the nutrient requirement just cover (NRC, 1985) recommendation, group II, fed on high protein diet, while group III, fed on high protein and high energy one. Lambs were artificially infected with *H. contortus.* The experiment extended for 4 months, to study the effect of nutrition on counteracting the impact of such parasitic infestation on animal performance and carcass quality.

Experimental animals:

Twelve, 5-6 months old Najdi lambs weighing 26.4 kg on average were divided into 3 groups each of 4 by stratified random sampling according to body weight.

Feeding and housing:

The animals were housed in groups and given 1.7 kg fresh matter per animal. Ingredients and composition of diets are given in tables 1. Group (I, BD) fed on a diet supplied just adequate energy and protein requirements for growing lambs (NRC, 1985), while group (II, HP) fed on diet supplied more protein (50%) than the requirement, and group (III, HPE) fed on diet supplied not only higher protein (55%) but also higher energy (11%) than the requirement, for 4 months experimental period. Body weight and feed intake were determined, every other week.

Table (1): Composition (kg) and mean proximate analysis of the experimental diet (g/kg DM^{-1}).

Components	BD	HP	HPE
Diet composition			
Barseem hay	0.7	1.7	1.0
Rhodes grass	1.0	-	-
Sheep pellets*	-	-	0.7
Chemical analysis			
Dry matter	861	852	872
Crude protein	127	192	197
Crude fiber	238.9	219.3	157
Ether extract	12.2	19.8	23.3
Ash	124.5	137.1	108.4
TDN**	0.55	0.63	0.9

*Commercial concentrate made up of grains, wheat bran, soybean meal, vegetable oil, molasses, minerals and vitamins. Proportions of ingredients were not stated.
BD: Basal diet HP: High protein diet HPE: High protein and energy
** TDN= Total digestible nutrients

Digestibility trials:

At the last of the experiment, digestibility trials were conducted using metabolic cages. During the collection period (7 days) faecal matter were collected daily, weighed, sampled and dried at 65^0C for 48 hours in hot air oven, re-weighed, ground, subsampled and stored for analysis according to standard procedures described in AOAC (1984).

Parasitological technique:

Each experimental lamb was infected orally with 10^4 third stage larvae (L3) of Haemonchus contortus, using a 20 ml syringe barrel for drenching the inoculums. The parasite isolate was obtained from naturally infected native lambs and the inoculums were prepared according to the method described by Hansen and Perry (1994).

Carcass analysis:

At the end of the experiment, all lambs were slaughtered. A day before slaughtering, the animals were fasting for overnight and weighed before slaughtering. The hot carcass and internal organs were weighed and the carcasses were chilled at 4 ± 1^0C for 24 hours. The cold carcass weight was determined then, half of the carcass was dissected (after removal of visible fat and connective tissues) for the determination of lean meat, fat and bone contents. While, the other half was minced after deboning and removing of excessive amounts of fat and connective tissue, to determine the chemical composition (AOAC, 1984). The sensory evaluation of meat was carried out on the thigh lean meat of the dissected half using trained panelists, recording the results in a format using 7 degrees system in which 7 degrees indicating excellent and one degree indicating unacceptable. The meat was prepared according to the method recommended by (AMSA, 1995).

Statistical analysis:

Obtained data were subjected to the proper analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Least significant difference (LSD) at 0.01% level of significance was used to compare the treatment means. Computation was done using SAS (2001).

RESULTS and DISCUSSION

Sheep performance:

The effect of nutrition on performance of sheep artificially infected with *H. contortus* is given in table (2). Infected lambs given high protein and energy diet (group III) showed the highest final live body weight (46. kg) which is significantly higher ($p<0.01$) than those given high protein diet and those fed on basal diet (38.1 and 35.6 kg respectively).

Table (2): Effect of plane of nutrition on sheep performance (Mean ±SD).

Parameters	*BD*	*HP*	*HPE*
Initial weight (Kg)	$27.5^{a} \pm 1.19$	$25.4^{a} \pm 1.8$	$26.3^{a} \pm 1.7$
Final weight (Kg)	$35.6^{a} \pm 1.30$	$38.1^{b} \pm 1.4$	$46.0^{c} \pm 2.1$
Body gain (kg)	$8.13^{a} \pm 1.10$	$12.25^{b} \pm 0.8$	$19.23^{c} \pm 2.3$
Average daily gain (ADG) g	$67.6^{a} \pm 8.8$	$102.21^{b} \pm 6.5$	$160.4^{c} \pm 18.5$

a , b and c: Means in the same raw with no common superscript are significantly different ($p<0.01$)
BD: Basal diet HP: High protein diet HPE: High protein and energy

A clear similar trend was seen in data concerning body weight gain and average daily weight gain. Infected lambs given HPE diet recorded 19.23 kg and 160.4 g respectively. These data are significantly higher ($p<0.01$) than those of both HP and BD groups. Abbott *et al.* (1985) reported that lambs given high protein diet have a higher mean body weight and weight gain than those given low protein diet over the whole 20 weeks period. Moreover, Wallace *et al.* (1995) found that supplementation with soybean meal showed a significant increase in gain than the lambs on basal diet. To our knowledge there have been no studies to evaluate the influence of high protein and energy diet on performance of lambs infected with *H. contortus.* There is no doubt that gross efficiency of using food energy for tissue deposition is reduced by infection (Van Houter and Sykes, 1996). A major cause is the reduction of total energy intake, which reduces the amount of energy available above maintenance. The efficiency of use of metabolizable energy (ME) in sheep infected with *T. colubriformis* was reduced from 0.26 to 0.13 Mca/Kg and with *O. circumcincta* from 0.19 to 0.14 (Sykes and Coop, 1976).

Nutritional study:

The effect of plane of nutrition on digestibility in sheep infected with *H. contortus* is given in table (3). The digestibility % of dry matter in lambs of groups III and II (HPE and HP) showed significant ($p<0.01$) higher values, 71.9% and 68.24%, respectively than those given BD (60.91%). Concerning crude protein and crude fiber digestibilities, a similar trend was found as crude protein digestibility values were 80.69 and 80.3% for groups HPE and HP that were significantly higher ($p<0.01$) than those given basal diet (70.1%). Moreover, both groups of HPE and HP, showed nearly similar crude fiber digestibility of 58.96% and 59.53% respectively, which was also significantly higher ($p<0.01$) than those fed on basal diet (40.34%). These results were agreed with those reported by Abbott *et al.* (1985). They reported no significant differences in digestibilities of feed fractions except the crude protein digestibility in infected Finn Dorset lambs given low protein diet. Higher crude protein digestibility was attributed to the lower contributions of endogenous nitrogen in total faecal nitrogen output. Rumen functions can be dramatically changes by optimizing the rumen environment with mineral and/or non-protein nitrogen supplement (Leng, 1991). Optimizing rumen functions increased microbial protein production and thereby provides increased protein for digestion and absorption in the small intestine (Kanjanapruthiporg and Leng, 1995).

Table 3: Effect of plane of nutrition on feed digestibility (%) in sheep infected with Haemonchus contortus (Mean ±SE)

Parameters	*BD*	*HP*	*HPE*
Dry matter	$60.92^{a} \pm 0.88$	$68.24^{b} \pm 1.60$	$71.9^{b} \pm 5.32$
Crude protein	$70.10^{a} \pm 1.65$	$80.30^{b} \pm 0.85$	$80.69^{b} \pm 4.40$
Crude fiber	$40.34^{a} \pm 0.24$	$59.53^{b} \pm 2.77$	$58.96^{b} \pm 7.10$

a , b and c: Means in the same raw with no common superscript are significantly different ($p<0.01$)
BD: Basal diet HP: High protein diet HPE: High protein and energy

Studies with *H. contortus* (Preston and Allonby, 1987; Abbott *et al.*, 1988) showed that sheep given a diet high in protein content had less severe clinical signs such as weight loss, anemia and less severe clinical signs than animals on low protein diet, despite similar levels of gastroenteric blood loss. Similar results have shown that during infection with *H. contortus*, young goats offered high protein diet had better live weight than those fed low protein diet (Blachburn *et al.*, 1991). High protein effect may be due to improving feed intake so counteracting the effect of parasites on appetite and also increase microbial protein availability (Kaujanapruthipong and Leng, 1995). Moreover, Wallace *et al.* (1995) reported that dietary supplementation with soybean meal had a beneficial effect on the development of immunity at least as far as controlling faecal egg count in lambs infected with *H. contortus.*

Carcass characteristics and meat quality:

The obtained results (Tables 2&4) revealed that, at slaughter the BD group was lesser in weight and had less fat and lean meat. Weight itself is a major determinant of composition, as has been shown by Lister *et al* (1983). Sheep given HPE diet had better performance, considering the final body weight, dressing value, lean meat and fat yield, whereas the HP group had results approximately in the midway between the BD&HPE groups. Studies with *H. contourtus* (Preston & Allonby, 1978; Abbott *et al* 1988) confirmed the obtained results. Knox & Steel (1996) stated that the supplementation of sheep with high protein can enhance the efficiency of animal performance and assist the animal to withstand infection and decrease the need for medicaments, consequently reduces chemical residues in animal products and environment.

Table 4: effect of regimes of nutrition on sheep carcass characteristics and relative weight of visceral organs (Mean ± SE)

Parameters	BD	HP	HPE
Hot carcass weight kg	16.48^{a} ± 0.98	17.43^{b} ± 0.72	24.08^{c} ± 1.73
Cold carcass weight kg	15.28^{a} ± 0.85	16.4^{b} ± 0.72	23.08^{c} ± 1.16
Dressing* %	44.03^{a} ± 0.31	46.85^{a} ± 0.39	52.53^{b} ± 0.38
Lean meat yield kg	10.47^{a} ± 0.23	10.30^{a} ± 0.44	15.54^{b} ±1.64
Lean meat yield ** %	68.58^{a} ± 1.27	62.85^{a} ± 1.23	67.34^{a} ± 0.77
Fat yield kg	1.48^{a} ± 0.34	2.21^{b} ± 1.22	3.54^{c} ± 0.68
Fat yield**%	9.73^{a} ± 1.50	13.50^{a} ± 2.66	15.33^{a} ± 1.22
Bone kg	3.27^{a} ± 0.44	3.63^{a} ± 0.83	3.81^{a} ± 0.72
Bone **%	21.38^{a} ± 1.22	22.18^{a} ± 1.88	16.5^{a} ± 0.85
Liver *%	2.60^{a} ± 0.14	2.61^{a} ± 0.22	2.34^{a} ± 0.09
Heart *%	0.68^{a} ± 0.04	0.76^{a} ± 0.01	0.68^{a} ± 0.02
Lung *%	2.28^{b} ± 0.09	2.20^{b} ± 0.20	1.6^{a} ± 0.83
Kidney *%	0.61^{b} ± 0.04	0.57^{b} ± 0.02	0.45^{a} ± 0.15
Tail fat* %	7.00^{a} ± 0.07	8.85^{a} ± 1.26	8.08^{a} ± 1.33

a , b and c: Means in the same raw with no common superscript are significantly different ($p<0.01$)

* % In relation to live body weight

** % In relation to cold carcass weight

BD: Basal diet HP: High protein diet HPE: High protein and energy

The variations in the final body weight, carcass weight and dressing %, could be attributed to the increased lean meat and fat deposition in the group of sheep fed HPE ration in comparison to other animals fed BD and HP rations (Tables2&4). Similar results were reported by Wallace *et al* (1995) in sheep infected by *H.contortus* third stage larvae and supplemented with soybean meal. The weight of internal organs in relation to live body weight (Table 4) showed no significant variations except in case of lungs and kidneys, such variations were apparently connected to the variations in live weight.

Table 5: Effect of regimes of nutrition on lean meat composition (%) and sensory parameters* (Mean± SE).

Parameters	BD	HP	HPE
Chemical composition			
Moisture	75.48 ± 0.61	74.30 ± 0.87	74.33 ± 0.58
Protein	18.8 ± 0.29	18.23 ± 0.09	17.62 ± 0.44
Fat	4.85 ± 0.44	6.03 ± 1.5	6.85 ± 0.32
Ash	0.98 ± 0.04	0.99 ± 0.03	1.00 ± 0.03
Sensory parameters			
Color	5.14 ± 0.19	5.86 ± 0.34	5.72 ± 0.19
Taste	5.13 ± 0.35	5.31 ± 0.16	5.19 ± 0.24
Odor	5.05 ± 0.21	5.23 ± 0.16	5.36 ± 0.01
Tenderness	5.28 ± 0.36	5.42 ± 0.15	5.66 ± 0.07
Overall acceptability	5.22 ± 0.26	5.48 ± 0.23	5.44 ± 0.17

BD: Basal diet HP: High protein diet HPE: High protein and energy

*Number of each sensory parameter recorded were from 7 degrees, where 7 for excellent and 1 for unacceptable

The data of chemical analysis (Table 5) showed that, fat% in the lean meat of BD group is lower than the two other groups by 1% at least. The last decade measuring of meat quality is highly influenced by consumer health concern, which inturn affected by fat content. The incidence of deaths due to chronic coronary heart disease has a relationship to high fat consumption NRC (1989), DH (1994) and Jequier (1995). Considering the consumer health concern, it could be concluded that the sheep have BD ration, which had the lowest fat content, produced better meat than those given the HP or HPE rations. Actually the variation in chemical composition proved to be non-significant. The sensory analysis of lean meat revealed no significant differences between the 3 groups of experimental animals (Table, 5). This may be attributed to the little variation in the chemical composition of the tested meat.

It could be concluded that the plane of nutrition has the main influence on the growth of sheep, dressing value and meat yield of Najdi lambs despite of *Haemonchus contortus* infection.

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