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Full Length Research Paper

Carcass yield and characteristics of Karadi lambs as affected by dietary supplement of rumen undegradable nitrogen fed with *Nigella sativa*

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The objective of this work was to investigate the effect of two levels of rumen undegradable nitrogen (7 and 10 g UDN/kg DM) fed with two levels of *Nigella sativa* (0 and 7.5 g NS/ kg DM) supplementation to rations of karadi lambs on carcass characteristics, using 2 x 2 factorial experiment. Sixteen individual Karadi male lambs were used (four lambs for each treatment). They were weighing approximately 34 kg live weight and 7 months old. The diets were formulated to be given a 40% NaOH-treated barley straw DM to 60% concentrates DM. At the end of feeding trial the lambs were slaughtered after over night with feeding draw. Differences in daily nutrients intake among treatments were not statistically significantly. The UDN and total N intake were followed the intended treatments composition (P < 0.01). Live weight gain was not significantly affected by levels of UDN and NS supplementation. Slaughter body weight, hot and cold carcass weights and killing out proportion were not significantly affected by both NS supplementation and levels of UDN. Moreover, no differences in leg cut tissue (lean, subcutaneous fat: intramuscular fat and bone) among treatments. The main wholesale cuts weights were not significantly different among treatments. The differences in fat-tail weights between the NS and UDN treatments were not statistically significant.

Key words: Lambs, rumen undegredable nitrogen, *Nigella sativa*, carcass characteristic.

INTRODUCTION

It is well understood that the requirement for protein by ruminant animals is a combination of the need of the rumen micro-organisms and that of the host animal. The host animal's requirement for amino acids (AAs) is met from the microbial protein synthesized in the rumen, together with dietary protein which escapes degradation in the rumen and is digested in the small intestine (ARC 1984; NRC, 2001). In the specific case of lambs weighing in excess of 30 kg, ARC (1984) has proposed that the nitrogen requirement may, in most instances, be met by microbial protein only, and thus, that only rumen degradable nitrogen (RDN) is required in the diet. However, many studies (Hassan and Bryant, 1986; Al-Jassim et al., 1991; Hassan and Hassan, 2009d) showed that rumen undegradable nitrogen (UDN) supplementation of lambs weighing more than 30 kg and fed alkali treated straw diet resulted in a significant improvement in live weight gain. These responses were independent of energy intake and associated with differences in carcass characteristics (Al-Jassim et al., 1991; Hassan et al., 1991). In contrast, medicinal plants are very important material that can improve growth rate, feed efficiency utilization and carcass characteristics of growing lambs (Saarela et al., 2000; Mohamed et al., 2005; Hassan and Hassan 2009a, b, c, d). Hassan (2009) and Hassan et al. (2010) found that *Nigella sativa* (NS) supplementation clearly improved live weight gain, killing–out proportions and lean to fat ratio in Awassi and Karadi lambs, respectively. However, no information is available on responses

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Abbreviations: AAs, Amino acids; **RDN,** rumen degradable nitrogen; **UDN,** undegradable nitrogen; **NS,** Nigella sativa; **SBM,** soybean meal; **FTSBM,** formaldehyde- treated soybean meal; **OM,** organic matter; **SBW,** slaughter body weight; **HCW,** hot carcass weight; **CCW,** cold carcass weight.

Table 1. Formulation and chemical composition of experimental diets.

Level of UDN (g/kg DM)	7 g UDN/kg DM		10 g UDN/kg DM	
Level of *Nigella sativa* (NS)	0	7.5	0	7.5
Diet no.	1	2	3	4
Ingredients (g/kg DM)				
NaOH-treated straw *	400	400	400	400
Yellow corn	400	392.5	360	352.5
Soybean meal(SBM)	175	175	130	130
Formaldehyde-treated SBM	-	-	85	85
Nigella sativa (NS)**	-	7.5	-	7.5
Urea	5	5	5	5
Min. and vit. Mixture	20	20	20	20
Chemical composition (g/kg DM)				
DM g/kg fresh	920	919	918	918
Total nitrogen (TN)	23.9	23.8	26.0	26.0
RDN g / MJ of ME	1.4	1.4	1.4	1.4
UDN	7.17	7.12	9.78	9.84
Metabolizable energy (MJ)***	11.76	11.66	11.78	11.68
Neutral detergent fiber (NDF)	311	310	312	312
Acid detergent fiber (ADF)	216	216	219	219
Hemicellulose	95	94	93	93
Cellulose	154	154	155	155
Lignin	62	62	64	64

*NaOH-treated barley straw containing (DM basis): 87% OM, 0.59% N, 8%; NDF, 5% ADF and 45% organic matter digestibility, OMD; **NS containing (DM basis): 91.3% OM , 4.1 % N, 6.7% CF,11.5%EE,43.3% NFE ***ME (MJ/ kg DM) = 0.012 CP +0.031 EE+0.005 CF +0.014 NFE (MAFF, 1975).

of growing lambs to supplementary of UDN fed with NS and its effects on carcass characteristics and other slaughter parameters. Thus, the first part of this study was conducted to study the effects of increasing levels of UDN by providing NS on daily weight gain and some blood parameters of karadi lambs (Hassan and Hassan 2009d). While the objective of this part was to study the effect of increasing level of UDN supplemented with NS on carcass characteristics and other slaughter parameters of Karadi lambs.

MATERIALS AND METHODS

Experimental design and diets

The effect of two levels of UDN and two levels of NS on carcass characteristics were investigated in a 2x2 factorial experiment using a randomized block design with 4 replicates per cell of the design. Diets were formulated to provide two levels of UDN (7 and 10 g UDN / kg DM) and two levels of NS (0 and 7.5 g NS/ kg DM) with a constant level of RDN (1.4 g RDN/MJ of ME) and metabolizable energy across treatments. This was achieved by using both untreated soybean meal (SBM) and formaldehyde- treated soybean meal (FTSBM) in the diets and substituting FTSBM for untreated SBM as level of UDN increased. Barley and yellow corn were chosen as the basal ingredients for the diets because they have low N concentration. SBM was chosen as the source of RDN because the N content is reputed to be largely rumen degradable. FTSBM was used as the source of UDN, because the N content is reputed to be largely undegradable N. The disappearance of N from the feedstuffs in the rumen was estimated by using the values reported by Hassan and Al-sultan (1995ab). The concentrate diets fed separately from the treated barley straw. The diets were formulated to be given 40:60 roughage to concentrate ratio. Formulation and chemical composition of experimental diets are shown in Table 1.

Treated soybean meal and barley straw

Formaldehyde treatment of SBM was prepared as described by Hassan et al. (1991). The barley straw used in this experiment was ground and treated with NaOH at rate of approximately 40 g/kg DM. The sprayed straw was mixed well to bring NaOH solution into contact with straw as completely as possible. The freshly- made material was covered with polyethylene nylon for approximately 2 - 3 weeks to absorb moisture that formed during the heating process.

Animals and management

Sixteen individual Karadi male lambs were used. They weighed approximately 34 kg live weight and 7 months old at the start of the experiment. Four lambs were randomly allocated from live weight block to each treatment. The lambs were individually housed in pens (1 x 1.3 m). Water was available at all times. The diets were gradually introduced to the lambs over a period of 3 weeks before the start of the experiment. The diets were offered once daily in quantities calculated to support maintenance and daily gain of 200 g (Al-Jassim et al., 1996). Allowance was recalculated each 2

Table 2. Performance of karadi lambs as affected by supplementation with rumen undegradable nitrogen (UDN) and *Nigell sativa* (NS).

Level of UDN (LUDN)	Low UDN		High UDN		SE of means and significance of effects			
Level of NS (LNS)	No NS	With NS	No NS	With NS	SEM	LUDN	LNS	LUDN x LNS
Diet no.	1	2	3	4				
Daily intake								
Dry matter (DM,g)	1164	1203	1166	1225	21.02	NS	NS	NS
Metabolizable energy (MJ)	13.93	13.9	13.6	14.3	0.127	NS	NS	NS
RDN (g / MJ of ME)	1.5	1.5	1.5	1.5	0.009	NS	NS	NS
UDN (g)	9.14	9.27	13.09	13.5	0.334	**	NS	NS
Total nitrogen (g)	30.04	30.12	33.49	34.95	0.447	**	NS	NS
Initial live weight (LW,Kg)	35.33	34.05	34.00	33.95	0.641	NS	NS	NS
Final LW (Kg)	48.42^{a}	45.95^{b}	47.30^{ab}	48.45^{a}	0.559	NS	NS	*
Daily LW gain (LWG/g)	208^{ab}	189^{b}	211^{ab}	230^{a}	9.263	NS	NS	*
Feed conversion ratio (g DM intake /g LWG)	5.06	6.37	5.52	5.32	0.616	NS	NS	NS

*P < 0.05; ** P < 0.01; NS, not significant. abc Means within rows with different superscripts are significantly different (P < 0.05).

weeks according to live weight. The lambs were weighed each two weeks to nearest 0.5 kg, at the same time each day. Recording of daily intake and live weight gain was maintained for 9 weeks.

Determination of carcass characteristics

At the end of feeding trial, the lambs were slaughtered after over night with feeding draw. Slaughter was performed according to local Muslim practice by severing the jugular vessels, the esophagus and the trachea without stunning. Carcasses were weighed and chilled for 24 h at 4°C weighted again and cut into left and right sides, after removing the fat tail from the carcasses. The left side was cut into standardized wholesale cuts (Forrest et al., 1975). The cuts were weighed separately; while leg cut was dissected into lean, fat and bone tissue. Hassan et al. (1990) reported that the leg was the best cuts representative for lean, fat and bone carcass tissue.

Chemical analysis

Feedstuffs, offered and refusals were chemically analyzed accor-ding to AOAC (1995) and Goering and Van soest (1970). *In vitro* organic matter (OM) digestibility of barley straw was deter-mined by the method of Telley and Terry (1963).

Statistical analysis

Data was statistically analyzed using Completely Randomized Design Model (CRD) procedure by SAS (2001). Duncan's multiple range test was used to determine the significance of differences between treatments means (Duncan, 1955). Analysis of variance was carried out on all data. The treatment was partitioned into main effects and their interaction.

RESULTS AND DISCUSSION

The lambs consumed all the concentrate diets offered. The effects of increasing levels of UDN and NS supple-mentation on daily nutrients intake, live weight gain and feed conversion ratio are presented in Table 2. Since the diets were offered in quantities calculated to support maintenance and daily gain of 200 g, differences in daily nutrients intake among treatments were not statistically significantly. The UDN and total N intake followed the intended treatments composition (P < 0.01). Live weight gain was not significantly affected by the main effect of levels of UDN and NS supplementation. However, lambs fed high levels of UDN showed higher live weight gain as compared with those fed low levels of UDN. But there was a level of UDN x NS interactions (P < 0.05), mainly because improvement in live weight gain being propor-tionately greater in lambs fed higher level of UDN supplemented with NS (Diet 4). The response to UDN supplementation by lambs indicates that the UDN supply from the control diet (low UDN) was insufficient for ade-quate growth. Lambs fed diet 4 received the high UDN and consumed slightly more dietary energy (about 0.25 MJ/day), insufficient to achieve the additional measured LW gain (32 g/day) compared with low UDN diet. Therefore the response observed should be related to differences in UDN rather than dietary energy. Similar explanation applied to lambs received the high UDN diet (Al-Jassim et al., 1991). Slaughter body weight (SBW), hot carcass weight (HCW), cold carcass weight (CCW), killing out proportion and tissue in leg cut are presented in Table 3. SBW, HCW, CCW and killing out proportion were not significantly affected by both NS supplemen-tation and levels of UDN. However, slightly differences in killing out proportion were shown between treatments, but these differences were disappeared when killing out proportion were expressed as CCW/ EBW. Moreover, no differences in leg cut tissue (lean, subcutaneous fat, intramuscular fat and bone) among treatments. Similarly,

Table 3. Carcass yield and characteristics of karadi lambs as affected by supplementation with rumen undegradable nitrogen (UDN) and *Nigell sativa* (NS)

Level of UDN (LUDN)	Low UDN		High UDN		Se of means and significance of effects			
Level of NS (LNS)	No NS	With NS	No NS	With NS	SEM	LUDN	LNS	LUDN x LNS
Diet no.	1	2	3	4				
Slaughter Body weight (SBW, kg)	49.0	46.20	47.67	48.87	0.974	NS	NS	NS
empty body weight (EBW,kg)	45.8	41.87	43.43	43.93	1.131	NS	NS	NS
Gut contents (kg)	3.2	4.33	4.24	3.93	0.157	NS	NS	NS
HOT carcass weight (HCW,kg)	24.63	22.40	23.33	23.27	0.385	NS	NS	NS
Cold carcass weight (CCW,kg)	24.43	22.30	23.20	23.16	0.353	NS	NS	NS
Killing – out proportions (g/kg)								
HCW/SBW	502^{a}	484^{ab}	498^{a}	476^{b}	5.42	NS	NS	NS
CCW/SWB	$^{a}498$	482^{ab}	486^{ab}	473^{b}	5.36	NS	NS	NS
CCW/EBW	533	532	534	527	6.03	NS	NS	NS
Tissue in leg cut (kg)								
Meat	2.206	2.040	2.124	2.184	0.048	NS	NS	NS
Subcutaneouse fat	0.452	0.383	0.441	0.342	0.074	NS	NS	NS
Intermuscular fat	0.078	0.081	0.085	0.087	0.003	NS	NS	NS
Bone	0.722	0.654	0.662	0.743	0.017	NS	NS	NS

Table 4. Wholesale cuts of half cold carcass weight and fat tail weight (kg)of karadi lambs as affected by supplementation with rumen undegradable nitrogen (UDN) and *Nigell sativa* (NS).

Level of UDN (LUDN)	Low UDN		High UDN		Se of means and significance of effects			
Level of NS (LNS)	With NS	No NS	With NS	No NS	SEM	LUDN	LNS	LUDN x LNS
Diet no.	1	2	3	4				
Leg	3.638	3.258	3.396	3.511	0.068	NS	NS	NS
Loin	0.662	0.598	0.701	0.635	0.023	NS	NS	NS
Rack	0.761	0.721	0.763	0780	0.028	NS	NS	NS
Shoulder	2.065	1.908	1.904	1.946	0.051	NS	NS	NS
Neck	0.700	0.608	0.642	0.650	0.030	NS	NS	NS
Foreshank	0.626	0.541	0.578	0.578	0.017	NS	NS	NS
Breast	0.928	0.872	0.967	0.966	0.039	NS	NS	NS
Flank	0.187	0.183	0.198	0.196	0.011	NS	NS	NS
Fat tail weight (kg)	4.69	4.46	3.36	4.65	0.165	NS	NS	NS
% of CCW	19.23	20.02	18.81	20.11	0719	NS	NS	NS

*P < 0.05; NS, not significant.

Hassan and Hassan (2009b) obtained no improvement in live weight gain and feed conversion ratio related to NS supplementation when lambs were with fed concentrate diets and alkaline treated or untreated barley straw. While anther studies (Abul-Fotouh et al., 1999; Allam et al., 1999; El-Saadany et al., 2001; Mohamed et al., 2005; Hassan, 2009; Hassan and Hassan, 2009a) reported a clear improvement in live weight gain when lambs fed restricted concentrate diets supplemented with medicinal plants such NS or Rosemary. Moreover, these improvements in LWG were associated with significantly changes in carcass characteristic and leg cuts tissue. Al- Jassim et al (1991) obtained that responses to UDN and Al-Rubeii et al. (2009) and Hassan (2009) responses to NS in term of LWG were associated with significantly changes in carcass characteristic and produce leaner gain. However, the mechanisms of the NS effect still unknown (Huck et al., 2000) and more details are required in order to clarify the effect of medicinal plants on LWG, carcass characteristic and physical changes in tissue to explain the nature of these improvements.

The effects of increasing levels of UDN and NS supplementation on main wholesale cuts and fat tail weights are presented in Table 4. The main wholesale cuts weights expressed as g/kg CCW were not significantly different among treatments, with no interaction between level of UDN and NS supplementation. The differences in fat-tail expressed as weights (kg) or as a percentage of CCW between the NS and UDN treatments were not statistically significant. However, Huck et al. (2000) and Afaf (2001) reported that such additives increased the total volatile fatty acid produce in the rumen which caused differences in lipids thickness and its deposition in animal body.

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