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STUDIEIS ON RUMEN METABOLISM
I- EFFECT OF DIFFERENT DIETARY NITROGEN SOURCES ON THE FATTENING PERFORMANCE OF FINN-OSSIMI CROSSBRED MALE LAMBS.

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ABSTRACT

Thirty-six Finn-Ossimi crossbred male lambs with an average live body weight of 22 kg and 4 months age were randomly assigned to 6 nutritional groups each of 6 animals. Six mixed rations based on bean straw were formulated to be isonitrogenoues and isocaloric so as to provide 14% CP and 64% TDN according to NRC (1985) recommendations. Soybean meal (SBM), corn gluten meal (CGM) and cotton seed meal (CSM) were used as the sole dietary protein source or it was partially substituted by urea (U) at 1% level. Experimental animals were allotted to one of the following rations in a fattening trial for 106 days; Tr1 SBM, Tr2 CGM, Tr3 CSM, Tr4 SBM + 1%U, Tr5 CGM + 1%U and Tr6 CSM + 1%U. A digestibility trial and nitrogen balance were conducted to evaluate the nutritive value of the experimental rations.

Results obtained showed that:

1- Dietary protein source (SBM, CGM and CSM) affected partially (p> 0.05) digestibility coefficient of nutrients, however urea supplementation caused an increase in EE,DM and OM digestibility but it decreased CF digestibility.
2- Higher (P<0.05) protein digestibility was obtained with diets contained SBM either with or without urea.
3- Urea supplementation resulted in a significant reduction of DMI for CGM (1353vs1159gm) and CSM groups (1319vs 1151gm) but it was not for SBM (1349 and 1341gm/h/d).
4- SBM diet had higher(P<0.05)TDN% value either it was supplemented with U or not.
5- DCP% value was increased (p<0.05) for CGM supplemented with U, but it was decreased with the other two protein sources (SBM and CSM).
6- Similar nitrogen intake was observed for all diets irrespective of source of protein or supplementation with U.
7- SBM group with or without U had higher (P<0.05) nitrogen retention (NR), however urea supplementation resulted in less NR for CGM and CSM groups.
8- Dietary nitrogen source had insignificant effect on live body weight gain of the experimental animals, however animals fed CGM with or without U had insignificant higher daily gain compared with the other treatments.
9- Incorporation of U in the diet improved insignificantly daily weight gain of SBM group (235 vs. 255 g/h/d), however it decreased daily weight gain of CGM and CSM groups.
10- Animal' s feed consumption was decreased insignificantly due to U supplem-entation, however it improved lamb's feed efficiency (as DM and DCP/kg gain).
11- The best feed utilization and the lowest feed cost/kg live body weight gain was achieved by (CGM+1%U) group; being 4.56kg DMI, 0.427 kg CPI/kg gain and 1.73LE.

It was concluded that to maintain maximum feed efficiency of a resistant dietary nitrogen source; inclusion of rapidly degradable N i.e. urea should be considered.

Keywords : lambs - protein sources - urea - performance .

INTRODUCTION

Improvements in performance have been suggested when feeding diets to ruminants formulated to be low in N solubility or to include protein sources slowly degraded in the rumen (Hvelplund 1991). By feeding protein sources that escape rumimal degradation, improvement in gain and feed efficiency of beef steers have been observed (Stock *et al.,* 1981 and Goedeken *et al.,* 1990). Soybean meal (SBM) is commonly utilized as a protein source in ruminant diets despite extensive degradation of its amino acids. Cotton seed cake has moderate amount of degradable protein in the rumen, while corn gluten meal (CGM) is naturally resistant to microbial degradation. However, the amount of a protein source that escapes microbial degradation is related to the rate of which the protein source is ruminally degraded (Zinn *et al.,* 1981 and Loerch *et al.,* 1983). On the other hand, urea (U) is completely degraded in the rumen, resulting in adequate amount of ammonia to be utilized by ruminal microorganisms, but not for maximum growth or lactation. In the mean time, it can reduce the cost of protein without deleterious effect on growth if such supplementation is considered to be part of an integrated approach that takes into account dietary protein and carbohydrate fraction and their ruminal availabilities. Therefore, the objective of the present study was to determine the impact of protein source (SBM, CGM or CSM) and urea supplementation on body weight gain and economic efficiency of Finn-Ossimi crossbred male lambs fattened on bean straw based diets.

MATERIALS AND METHODS

The present study was carried out in El-Azhar experimental station, Nasr city, Cairo, while the chemical analysis and laboratory studies were undertaken in the Animal Prod. Research Institute, Ministry of Agric. Dokki, Giza.

Animals and experimental rations:

Thirty six healthy Finn-Ossimi crossbred male lambs with an average age of 4 months and 22.00 kg live body weight were randomly assigned to six nutritional treatments, each of 6 animals. Six mixed rations in a pellted form (1.2mm), based on bean straw were formulated to be isonitrogenous and isocaloric so as to provide 14% CP and 64% TDN according to the (NRC recommendations, 1985).

Experimental rations used (Tables 1 and 2) in the study differed mainly in the source of dietary protein. Soybean meal (SBM), corn gluten meal (CGM) and cottonseed meal (CSM) are three different protein sources varied in their rumen degradability, were utilized.

Urea (U) as a highly degradable NPN source was also incorporated to partially substitute 1% level of the crude protein sources used. Animals were fed diets ad lib. for 106 days and water was available all the time. Animals were weighed at biweekly intervals and feed consumption, live body weight gain, feed efficiency and feed cost per kg live body weight gain were estimated.

Table (1): Diets formulation.

Treatments	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
Ingredient%	SBM	CGM	CSM	SBM +1%U	CGM+1 %U	CSM+1 %U
Bean straw	40	45	26	40	41	31
Wheat bran	5	5	5	5	5	5
Yellow corn	28	28	23	35	36	34
Soybean meal (44% CP)	18.7	----	----	10.7	----	----
Gluten (60% CP)	-----	13.7	----	----	8.7	---
Cotton seed meal	----	----	37.7	----	-----	20.7
Urea	----	----	----	1	1	1
Limestone	2	2	2	2	2	2
Molasses	5	5	5	5	5	5
Sodium chloride	1	1	1	1	1	1
Mineral premix*	0.3	0.3	0.3	0.3	0.3	0.3
TOTAL	100	100	100	100	100	100
Price L. E / Ton	398	409	390	363	379	360

*** Each kg. contains: 100,000mg. Mn , 80,000mg. Zn , 20,000mg. Cu, 25,000 mg. I , 200mg. Se , 500mg.Co .**

Table (2) : Chemical composition of the mixed diets containing different protein sources (% DM basis) .

Item	Experimental diets					
	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
DM	93.06	92.15	92.03	92.41	90.84	91.10
OM	90.77	87.25	89.16	90.98	88.75	90.77
CP	14.22	14.04	14.57	14.00	14.56	14.29
CF	16.92	16.22	16.97	15.25	16.14	17.92
EE	1.89	2.24	2.66	2.89	3.06	3.15
NFE	57.74	54.75	54.96	58.84	54.99	55.41
Ash	9.23	12.75	10.84	9.02	11.25	9.23

Digestibility trial and N balance:

At the end of the fattening trial, three adult Finn-Ossimi rams per each treatment were used in a metabolic trial conducted as described by El-Shazly (1958). The digestibility trial lasted for three weeks as a preliminary period followed by one week as a collection period. Feed, feces and urine analyses were carried out according to the methods of A.O.A.C. (1970).

Statistical analysis:

Statistical analysis was carried out using SAS program (SAS 1988). ANOVA of SAS followed by Duncan (1955) multiple rang test were used to compare the effect of different treatments in the study.

RESULTS

Effect of protein source on feed intake and nutritive values:

No significant differences (P>0.05) were detected in dry mater intake (DMI) by sheep fed diets with different protein sources with no urea supplementation (Table3). Urea supplementation to soybean did not affect DMI (1349.37 vs. 1341.08g, respectively). In contrast, supplementation of gluten and cottonseed cake diet with urea reduced (P>0.05) feed intake (1353.73 vs. 1159.29 and 1319.10 vs.1151.77g, respectively). *Matras et al., (1991)* found no interactions (P<0.05) between intake level and protein source. Also, Lailer and Singh (1998) found that the N-source (groundnut-cake, CSM, mustard cake and U based concentrate) had no significant effect on daily DM intake of male crossbred calves.

Table (3) : Feed intake and nutritive value of mixed diets containing different protein sources fed to sheep (mean±SE).

Item	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
Feed intake (g DM/h/d)	1349.37[a] ±23.34	1353.73[a] ±14.39	1319.10[a] ±48.80	1341.08[a] ±7.76	1159.29[b] ±1.77	1151.77[b] ±19.7
TDN(g/h/d)	865.67[a] ±21.02	841.69[a] ±14.20	838.21[a] ±31.89	864.83[a] ±5.89	725.74[b] ±11.18	720.68[b] ±19.82
DCP(g/h/d)	127.79[a] ±2.27	117.91[c] ±2.22	118.15[c] ±2.27	123.15[b] ±1.02	108.56[d] ±5.15	100.38[d] ±11.12
TDN (%)	64.14[a] ±0.57	62.17[b] ±0.53	63.54[ab] ±0.17	64.49[a] ±0.16	62.64[b] ±0.13	62.49[b] ±0.43
DCP (%)	9.48[a] ±0.30	8.71[b] ±0.22	8.97[ab] ±0.19	9.18[ab] ±0.08	9.41[a] ±0.16	8.70[b] ±0.24

a, b, c and d: Means in the same row with different superscripts are significantly different (P<0.05).

No significant change in TDN% was observed when urea was added to the basal diet except with cotton seed cake where a slight insignificant reduction in TDN was noticed (63.54 vs. 62.49%).

Digestible crude protein (DCP%) was increased (P<0.05) by urea supplementation only in gluten meal containing diet (8.71 vs. 9.41%, respectively), while it was decreased for the other two protein sources (soybean and cottonseed cake). No significant differences (P<0.05) were obtained in DCP% for soybean and cottonseed cake containing diets without urea and soybean and gluten diet with urea (Table 3).

The present results are in accordance with those reported by *Colovos et al. (1967)* using high-quality concentrate mixture containing 0, 1.25, 2.0 or 2.5% U replacing an equivalent amount of plant protein nitrogen. They found that TDN was not altered by U concentration in the diet.

Similar results were also obtained by *Etman et al., (1995)* who used concentrate feed mixture with or without 25% protein concentrate containing U. They found that the latter slightly improved the feeding values (TDN and DCP), but without any significant difference. While, *Matter et al., (1995)* indicated that using U as a substitution for 25% of CP of the concentrate feed mixture in the ration significantly (P<0.05) improved the TDN and DCP values.

When DMI was expressed as TDNI, no significant differences (P<0.05) were observed between TDN values of different protein sources in diets without urea supplementation and soybean diet with urea. Lower (P<0.05) TDN intake was noticed for the diets which contained gluten and cottonseed cake with urea (725.74 and 720.68g, respectively).

When the intake was expressed as DCP, higher DCPI was found for soybean diet without urea, followed by the same diet with urea (127.79 and 123.15g, respectively). Lowest (P<0.05) values were obtained with gluten and cottonseed cake diets with urea (108.56 and100.38g), respectively. Intermediate values were obtained by the same diets without urea supplementation (117.91 and118.15g, respectively). It was noticeable that urea supplementation decreased (P<0.05) DCPI.

Nitrogen utilization:

Nitrogen utilization of the diets fed to sheep are presented in Table (4). Nitrogen intake (NI) was almost similar for diets which contained different protein sources, either unsupplemented or supplemented with urea. The values were 30.70, 30.41, 30.75, 30.04, 27.00 and 26.33(g/h/d) for the diets which contained soybean, gluten meal and cottonseed cake without urea and with urea, respectively. Although, supplementation with urea resulted in lower NI in gluten meal and cottonseed cake containing diets, but without significant differences.

The same trend was observed regarding the nitrogen excreted in feces or in urine. Similar results were obtained by Lailer and Singh (1998) who reported that nitrogen intake and excretion in feces were not significantly differed due to difference in dietary N sources (groundnut-cake, CSM, mustard cake and U based concentrate rations and wheat straw). As for (ND), soybean diet with and without urea had the higher digested nitrogen (20.44 and 19.70g/h/d, respectively) compared with the other dietary protein sources and without significant differences. Cottonseed meal supplemented with urea had the lowest (P<0.05) value, i.e. 16.06 g/h/d. Urea supplementation resulted in reducing (ND) insignificantly.

Higher (P<0.05) nitrogen retention (NR) was recorded by soybean containing diet with or without urea (12.52 and 11.79g/h/d, respectively). Lower (P<0.05) NR was showed by sheep fed diets contained gluten meal and cottonseed cake supplemented with urea (8.45 and 9.05g/h/d, respectively). These results are in accordance with those of *Nikolic et al.,* (1983) who found that replacing SBM protein with U (1.5%) did not significantly affected NR, while Oroskov (1972) illustrated that supplementing basal diet with urea (0.7, 1.4 or 2.1%) significantly improved the NR in young lambs. When the nitrogen utilization of the experimental diets was expressed as either NR/NI or NR/ND, no significant differences (P<0.05) were detected. However, soybean meal-containing diet was well utilized by urea supplementation (38.38 vs. 41.67 and 57.86 vs. 63.55%, respectively).

Table (4): Nitrogen utilization by sheep fed mixed diets containing different protein sources (mean±SE).

Item	Diets					
	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
Nitrogen intake (NI) (g/h/d)	30.70 ±0.53	30.41 ±0.32	30.75 ±1.14	30.04 ±0.17	27.00 ±4.15	26.33 ±2.73
Feces-N (FN) (g/h/d)	10.26 ±0.82	11.54 ±0.58	11.85 ±0.82	10.33 ±0.21	9.63 ±1.72	10.27 ±1.09
Nitrogen digested (ND) (g / h / d)	20.44^{a} ±0.36	18.87^{ab} ±0.39	18.90^{ab} ±0.36	19.70^{ab} ±0.17	17.37^{ab} ±2.42	16.06^{b} ±1.78
Urinary nitrogen (g / h / d)	8.65 ±1.09	7.82 ±0.16	7.47 ±0.17	7.18 ±0.76	8.92 ±2.98	7.01 ±1.92
Nitrogen Retention (NR) (g / h / d)	11.79^{ab} ±0.73	11.06^{b} ±0.25	11.45^{ab} ±0.39	12.52^{a} ±0.76	8.45^{c} ±0.75	9.05^{bc} ±1.32
NR / NI, %	38.38 ±1.94	36.36 ±0.94	37.29 ±1.16	41.67 ±2.29	33.84 ±8.55	34.99 ±5.65
NR / ND , %	57.86 ±4.57	58.58 ±0.53	60.55 ±1.17	63.55 ±3.81	51.96 ±12.21	57.18 ±8.11

a, b and c: Means in the same row with different superscripts are significantly different (P<0.05).

While other protein sources were lowly utilized due to urea supplementation; the values were 36.36 vs. 33.84 and 58.58 vs. 51.96% for gluten meal diet and 37.29 vs. 34.99 and 60.55 vs. 57.18% for cottonseed cake diet. The same trend was also obtained by Lailer and Singh (1998) who reported that NR as a percent of N-intake and absorbed-N did not differ significantly in animals fed different N sources.

While Oltjen and Putnam (1966) showed that N-retention was significantly greater when steers were fed purified diets containing isolated soybean protein as the sole source of dietary nitrogen compared with that of steers fed U. Moreover, *Poos et al.* (1979) using diets supplemented with U or SBM, found that U resulted in the greatest amount of urinary-N, while SBM showed the greatest N-retention.

Effect of protein source on digestibility coefficient:

No significant differences were noticed for DM digestibility coefficients of protein sources for diets containing soybean, corn gluten and cottonseed cake. The values were 66.80, 66.17 and 65.64%, respectively (Table5). The supplementation with urea resulted in a significant (P<0.05) decrease of DM digestibility coefficients of all diets. The values were 64.23, 63.44 and 61.78%, respectively. However, no significant difference was found between soybean and gluten meal supplemented with urea, while lower digestibility coefficient of DM was noticed with cottonseed cake + urea diet. The present results are in accordance with the results of *Garrett et al.* (1987), who noticed little effect of urea on DM digestibility as a nitrogen supplement. The same trend was also observed for OM digestibility coefficient (Table 5).

In the same manner, Urbaniak (1995) found no significant differences (P>0.05) between groups of animals regarding DM and OM digestibility when they fed diets containing SBM or fish meal since the later is considered to be less degradable in the rumen, as the same as corn gluten used in this study.

Concerning CP digestibility coefficient, only gluten-containing diet was improved after urea supplementation, but without significant difference from the same diet without urea (64.66 vs. 62.07%, respectively). In this respect, CP digestibility coefficient was not significantly (P>0.05) affected within each protein source by the addition of urea. Sharma and Mudgal (1981) found that addition of urea resulted in decreasing CP digestibility coefficients of diets.

Crude fiber digestibility coefficients were significantly (P<0.05) reduced by the addition of urea (Table5). This was especially evident with gluten meal (35.45%). However, CSM and CGM had significantly (P<0.05) higher CF digestibility compared with the other dietary protein sources (46.72 and 45.08%, respectively).

Thombson et al. (1982) showed that when lambs were fed diets supplemented with urea, CF digestibility coefficient was lower compared with those unsupplemented. In contrast, Abdel-Hafiz and El-Hommosi (1982) indicated that CF digestibility coefficient increased as urea increased in the diet of lambs. Animals on the non-urea ration digested more crude fiber than those on urea supplemented ration (Table 5).

Supplementation of soybean and gluten meals with urea improved (P<0.05) EE digestibility coefficient (70.87 vs. 85.76 and 74.49 vs. 82.07%, respectively). However EE digestibility coefficient of cottonseed cake containing diet was significantly decreased (81.19 vs. 75.93%, respectively). No significant differences (P>0.05) were noticed between soybean and gluten meal diets without urea and cottonseed cake with urea. These results are in partial agreement with the results obtained by Kakkar and Mudgal (1979) who reported higher EE digestibility coefficient values for diets containing urea.

Table (5) : Digestibility coefficients (% DM basis) of diets containing different protein sources (mean±SE).

Item	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
DM	66.80^{a} ±0.57	66.17^{a} ±1.2	65.64^{ab} ±0.58	64.23^{bc} ±0.31	63.44^{c} ±0.71	61.78^{d} ±0.51
OM	68.82^{a} ±0.73	68.87^{a} ±0.55	68.23^{ab} ±0.12	67.47^{b} ±0.17	67.04^{b} ±0.13	65.55^{c} ±0.46
CP	66.66^{a} ±2.11	62.07^{bc} ±1.57	61.57^{bc} ±1.34	65.61^{ab} ±0.59	64.66^{abc} ±1.12	60.91^{c} ±1.67
CF	40.10^{b} ±1.90	45.08^{a} ±1.15	46.72^{a} ±0.99	36.87^{bc} ±2.05	35.45^{c} ±1.48	36.30^{bc} ±0.79
EE	70.87^{c} ±3.70	74.49^{c} ±2.26	81.19^{ab} ±1.87	85.76^{a} ±0.46	82.07^{ab} ±1.24	75.93^{c} ±0.50
NFE	77.70 ±1.18	77.42 ±1.45	76.02 ±0.62	74.94 ±0.35	76.11 ±0.62	75.61 ±0.72

a, b, c and d: Means in the same row with different superscripts are significantly different (P<0.05).

NFE digestibility coefficient showed no significant differences among the experimental diets (Table5). Urea supplementation had no effect on NFE digestibility coefficient, although the values were slightly less than those for unsupplemented diets.

Feeding trial:

Results obtained in Table (6) showed the performance of Finn-Ossimi crossbred male lambs fed mixed rations containing different protein sources. It shows that lambs fed on gluten meal (60%CP) as the sole protein source (Tr_2) had the heaviest total gain (27.32 kg) and the faster daily weight gain (258 g) compared with other protein sources. However, the difference was not statistically significant. On the other hand, lambs fed a combination of cottonseed meal as true protein with 1% urea had the lowest total weight gain (23.88 kg). Other protein sources used in feeding male lambs gave intermediate values without significant differences among various groups. It was also evident that the partially substitution of dietary natural proteins with 1% urea led generally to decrease, lambs total gain. As shown, the effect was more pronounced with CSM groups, (Tr_3 and Tr_6, respectively). On contrast, the partially substitution of SBM with a highly degradable nitrogen compound (1%U) resulted in accelerating lambs daily gain, i.e 0.235 vs. 0.255 kg (Tr_1 and Tr_4 , respectively). Similar results were obtained by Krause and Klopfenstein (1978) who attained higher body weight gain with cattle fed diets containing corn gluten meal than with soybean meal.

Table (6) : Performance of Finn-Ossimi corssbred lambs fed diets containing different protein sources (mean±SE) for 106 days.

Item	Diets					
	Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6
Initial body weight (Kg)	22.72 ±2.01	22.58 ±2.04	22.68 ±2.00	22.63 ±2.01	22.55 ±1.93	22.60 ±1.89
Final body weight (Kg)	47.62 ±3.35	49.90 ±2.62	49.68 ±1.78	49.70 ±2.46	49.43 ±2.25	46.48 ±1.56
Total body gain (Kg)	24.90 ±2.00	27.32 ±1.62	27.00 ±1.35	27.07 ±1.34	26.88 ±1.05	23.88 ±1.59
Daily gain (Kg/h/d)	0.235 ±0.02	0.258 ±0.02	0.255 ±0.01	0.255 ±0.01	0.254 ±0.01	0.225 ±1.01
Feed consumption (Kg DMI/h/d)	1.349 ±0.02	1.354 ±0.01	1.319 ±0.05	1.341 ±0.08	1.159 ±0.01	1.152 ±0.18
Feed efficiency:						
(Kg DM/Kg gain)	5.74^{a} ±0.10	5.25^{ab} ±0.06	5.17^{ab} ±0.19	5.26^{ab} ±0.03	4.56^{b} ±0.70	5.12^{ab} ±0.53
(Kg DCP/Kg gain)	0.544^{a} ±0.01	0.457^{ab} ±0.01	0.463^{ab} ±0.01	0.483^{ab} ±0.01	0.427^{b} ±0.06	0.446^{b} ±0.05
(Kg TDN/Kg gain)	2.74^{a} ±0.03	2.41^{c} ±0.03	2.48^{b} ±0.01	2.54^{b} ±0.01	2.48^{b} ±0.00	2.77^{a} ±0.01
Cost of Kg DM feed (L.E)	0.398	0.409	0.390	0.363	0.379	0.360
Economic efficiency (Cost of DM/Kg gain)	2.28	2.17	2.02	1.91	1.73	1.84

a, b and c: Means in the same row with different superscripts are significantly different (P<0.05).

Data of daily feed consumption (kg DM/head) pointed out insignificant differences among groups; however lambs fed on gluten meal diet (60%CP) consumed more feed (1.354kg) compared with cottonseed meal + 1%urea (Tr_6), which had the lowest daily feed intake (1.152 kg) and body gain.

Inclusion of urea to the experimental rations, Tr_4 ,Tr_5 and Tr_6, respectively decreased lambs feed consumption, however it led to improve their feed efficiency.

Feed efficiency on dry matter basis showed significant difference ($P<0.05$) among groups, however lambs fed on soybean meal as the sole protein source (Tr_1) had the lowest feed efficiency (5.74kg DMI/kg gain) compared with those fed on a combination of gluten meal+1%urea which had the best feed efficiency value (4.56kgDMI/kg gain). Feed efficiency of other treatments pointed out to insignificant differences among groups.

Results of economic efficiency took the same trend, since lambs fed on the combination of gluten meal and urea had the cheapest cost of feed to produce one kg gain, being 1.73 LE/kg gain.

Results of feed efficiency on either DCPI or TDNI basis had the same trend, since lambs fed on gluten meal alone or in combination with urea had higher ($P<0.05$) feed utilization compared with the other treatments.

In the light of the present results, it could be concluded that rations containing lower degradable proteins i.e. CGM must be supported with highly degradable nitrogen sources like urea to maintain maximum efficiency of dietary nitrogen utilization.

Results of economic efficiency showed also that substitution of true protein in the diet with urea led in general to minimize, cost of production. *Shain et al.* (1994) observed improvement in ADG andG/F by supplementing steers consuming dry-rolled corn finishing diets with 0.88% urea, but no improvement in performance was noted when dietary urea was increased to 1.94%. Performance responses in the present study and responses reported by *Shain et al., (1994)* also agreed with those obtained for diets based on extensively processed corn. Reverse results were obtained by Aregheore (1992) who reported that the differences in feed conversion efficiency for growing sheep fed diets with 7.5% palm kernel meal or 1.65% U as the protein source, were not significant.

Lavezzo et al. (1996) demonstrated that with sheep fed diets without or with U, partly replacing SBM, U supplementation had no significant effect on feed conversion value.

DISCUSSION

Using crop residues (as roughage) complemented with any industrial by-products of high protein content will give a complete and an economical diet. There are many by-products used in formulation of feed concentrate. Those from feed meals with characteristics that make them desirable feeds for ruminants. They are relatively high in crude protein content and over 50% of the protein of most of these feed by-products have been estimated to escape from rumen fermentation (Poos, 1981). However, the protein chosen for the present study represented a wide range in ruminal degradability. Dry matter, organic matter and NFE digestibility were not affected (P>0.05) by protein source. Urea supplementation resulted in less DM and OM digestibility, which could be related to the lower DM intake, where the reduction was 14 and 13% for corn gluten meal and cottonseed cake, respectively. While the reduction was negligible for SBM diet supplemented with urea.

Animals on urea diet digested lower crude fiber than those on non urea-diet. These could be related to the higher content of corn of such diets compared to the natural protein containing diets. *Joanning et al., (1981),* showed that moderate to high level of concentrates (corn) in the diet can cause a reduction in the degree and extent of fiber digestion. In the same manner, as level of corn grain in cereal crop residue diet increased, ruminal activity increased and cellulose and hemicellulose digested were reduced (Abou-Akkada and El-Shazly,1958 and *Henning et al.,* 1980).

Higher (P<0.05) protein digestibility (CPD) was noticed with diet containing SBM either with or without urea supplementation. The greater CPD was likely due to increased ammonia absorption in the rumen and dilution of metabolic feed-N from SBM *(Tritschler II et al.,* 1984), which resulted in higher (P<0.05) TDN and DCP values of such diet.

Nitrogen digested was not affected by dietary protein source, although digestible-N slightly decreased with urea supplementation indicating balanced situation between the amount of N intake and fecal-N. Nitrogen retention (NR) decreased (P<0.05) as corn gluten meal diet was supplemented with urea which could be related to the less N-intake and the higher urinary- N excretion. However, no significant effect of protein source or urea supplementation on NR (as percentage of intake or digested) was noticed.

Although, no significant differences were noticed among diets in dry matter intake (DMI) but those which contained urea had less DMI compared to the diets with no urea. This was confirmed by *Leng et al.* (1977) and *Hennessy et al.* (1981) where DMI increased when by-pass protein was fed, which was related to the less degradability of the unsupplemented diets as observed in this study.

In contrast, *Santos et al.* (1998) found no difference in DMI when SBM was compared by the ruminal less degradable protein sources, as well as nitrogen intake was generally not affected.

There was an improvement in average daily gain (ADG) of 8.5% with SBM+U than the unsupplemented diet, while it was slightly decreased for the other two protein sources (CGM and CSM).

However, a protein source that escapes ruminal degradation and that complements the amino acids (AA) profile of microbial protein (MP) synthesis should increase animal performance or decrease the amount of protein required for production (Owens and Bergen, 1983). These proteins must, however provide a ruminal level of NH_3 for the rumen microbes to prevent inefficient utilization of other dietary nutrients (*Klopfenstein et al.,* 1982).

These results could be due to the biological value of such diets, where it had more NR/NI and NR/NA (%) by about 8.6 and 9.8%, respectively. These results were in contrast to those reported by Ludden and Cecava (1995), where replacing urea with true protein in their study linearly increased

ADG regardless of true protein source. Several researches have shown that certain species of ruminal microbes tend to use soluble AA and peptides as N source when NH_3-N concentrations are limited (*Williams et al.,* 1991).

The feed efficiency (kg DM/kg gain) was much better for CGM+U diet than CGM (by about 13%), while other diets showed either similar efficiency (SBM) or 8% better (CSM), with no impact (P<0.05) on efficiency among diets. These results suggest that differences in the efficiency of gain among lambs apart from genetical, are mainly due to differences in pathways for the disposal of energy that are not specifically concerned with protein synthesis. MacRae and Lobley (1982) have suggested that differences in the efficiency of gain among animals on roughage- based diets could be due to a shortage of glucose or glucogenic substances (primarily propionate). Glucose is the main substrate of the production of the $NADPH_2$ required for utilization of acetate for lipogenesis in adipose tissue. A deficiency in $NADH_2$ could lead to the oxidation of the excess acetate in a substrate cycle. The potential to make improvements in gain or efficiency by feeding ruminal escape protein in roughage-based diets may be limited. On the other hand, increasing degradable N is of little benefit for animals fed high-grain diets unless it is utilized for microbial protein synthesis (Rofflen and Satter, 1975). The quantity of metabolizable protein supplied by ruminal microbes and the basal feedstuffs in diet may be sufficient to meet the needs of growing lambs fed roughage-based diets. When formulating the diets, the primary consideration should be to supply sufficient protein for optimal microbial synthesis.

CONCLUSION

Results of this study indicated that source of supplemental N has little effect on digestion of DM or OM in the rumen. Nitrogen digestibility in the rumen was influenced by supplemental N source; SBM-CP was degraded at relatively rapid rates compared with CGM-CP. Data presented here indicated limited ruminal digestibility of dietary N, when proteins resistant to microbial degradation were fed which may have reduced microbial growth. Therefore, feeding CGM would result in a greater escape of dietary N, but may not increase total N reaching the small intestine due to limited microbial growth. When a portion of the protein supplement of the diet is resistant to microbial degradation, then inclusion of rapidly degradable protein sources (urea) should be considered to maintain maximum efficiency of microbial conversion of N and organic matter.

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دراسات على التمثيل الغذائى فى الكرش
١- تأثير مصادر نيتروجين الغذاء علي كفاءة تسمين ذكور الحملان الخليط فلندي-أوسيمي.

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استخدم في هذه الدراسة ست وثلاثون من ذكور الحملان الخليطة (فلندي-أوسيمي) بمتوسط وزن ٢٢كجم وعمر أربعة أشهر- قسمت عشوائيا إلى ستة مجاميع غذائية- متساوية في محتواها من البروتين والطاقة (١٤% بروتين خام و ٦٤% مركبات مهضومة كلية) طبقا لمقررات NRC ١٩٨٥.

اعتمدت العلائق في تركيبها على تبن الفول كمادة أساسية - وان اختلفت فيما بينها في مصدر البروتين الغذائي - حيث اشتملت على ثلاثة مصادر للبروتين الحقيقي تتباين فيما بينها في

درجة تحللها في الكرش – ألا وهي كسب فول الصويا- كسب جنين الذرة- كسب القطن غير المقشور- ثم استبدل البروتين الحقيقي جزئياً بمصدر نيتروجيني سريع التحلل وهو اليوريا بنسبة ١%- وقدمت العلائق الست المراد اختبارها للحيوانات لتتغذى عليها تغذية حرة في صورة مكعبات في تجربة تسمين استمرت لمدة ١٠٦ يوماً - وذلك لاختبار تاثير مصادر نتروجين الغذاء على كفاءة تسمين الحملان الخليط فلندي-أوسيمي.

كما اجريت تجربة هضم وميزان ازوت لتقييم العلائق المختبرة.

وقد أظهرت النتائج ما يلي :-

١- لم يكن لمصدر نتروجين الغذاء (كسب فول الصويا- كسب جنين الذرة- كسب القطن الغير مقشور) تأثيرا معنويا على معاملات هضم المادة الغذائية عموما- وان أدي استبدال جزء من البروتين الحقيقي بنسبة ١% يوريا إلى زيادة معامل هضم الدهون وخفض معامل هضم الألياف – ومع ذلك فقد سجلت المعاملة المحتوية على كسب فول الصويا سواء بمفردة أو مع اليوريا أعلى معدل لهضم البروتين عند مستوى معنوية ٥%.

٢- سجلت العلائق المحتوية على كسب فول الصويا أعلى نسبة للمركبات المهضومة الكلية سواء بمفردها أو عند تدعيمها باليوريا - بينما سجلت العليقة المحتوية على كسب جنين الذرة مع اليوريا أفضل نسبة بروتين خام مهضومة مقارنة بالصويا – وكسب القطن .

٣- أدت إضافة اليوريا للعلائق الى خفض كمية المادة الجافة المأكولة يوميا- وكان هذا التأثير معنويا مع كل من كسب جنين الذرة وكسب القطن غير المقشور (١١٥٩ ، ١١٥١جم/رأس/يوم) وبصوره غير معنوية مع كسب فول الصويا.

٤- لم يكن لمصدر نتروجين العليقة أي تأثير معنوي على كمية النتروجين اليومي المأكول وان سجلت العليقة المحتوية على كسب فول الصويا (سواء مع اليوريا أو بدونها) أعلى معدل نتروجين محتجز ، وعلى النقيض فقد أدت إضافة اليوريا إلى خفض معدل النتروجين المحتجز مع باقي المصادر البروتينية.

٥- لم يكن لمصدر نيتروجين الغذاء تأثيراً معنوياً على معدل الزيادة اليومية لحملان التسمين – وان سجلت العلائق المحتوية على كسب جنين الذرة زيادة غير معنوية في أوزان الحملان.

٦- أدت إضافة اليوريا للعلائق إلى تحسين معدل النمو اليومي للحملان المغذاة على كسب فول الصويا (من ٢٣٥جم إلى ٢٥٥جم للرأس /يوم) في نفس الوقت الذي انخفضت فيه هذه المعدلات مع كسب جنين الذرة وكسب القطن غير المقشور نتيجة لهذه الإضافة.

٧- أدت إضافة اليوريا للعلائق إلى خفض غير معنوي في كمية المادة الجافة المأكولة يوميا وان حسنت الكفاءة التحويلية للحملان – وكانت أفضل معدلات تحويل غذائي وأقل العلائق تكلفة في عملية التسمين العليقة المحتوية على كسب جنين الذرة مع اليوريا ٤,٥٦ كجم مادة جافة مأكولة – ٠,٤٢٧ كجم بروتين مهضوم و ٧٣.١ جنيه/ كجم زيادة يومية.

وقد أستخلص من هذه الدراسة أنه عند استخدام مصادر بروتينية في علائق الحملان المسمنة تتميز بانخفاض معدل تكسرها في الكرش (كما هو الحال في كسب جنين الذرة) فانه يجب تدعيم هذه العلائق بمصدر نيتروجيني سريع التحلل وهو اليوريا وذلك للوصول إلى أفضل استخدام لهذه البروتينات وللمحافظة على كفاءة تحويل غذائية مرتفعة .