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INFLUENCE OF PROTEIN SUPPLEMENTATION ON INTAKE, DIGESTIBILITY AND NUTRITIVE VALUE OF BERSEEM HAY AND ITS STRAW DIETS FED TO SHEEP AND GAOTS

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SUMMARY

Twelve metabolism trials were conducted on sheep and goats, six trials each to study the effect of addition of soybean meal (SBM) either treated with formaldehyde (HCHO-SBM) or untreated SBM to either berseem hay (BH) and its straw (BS) as good or poor quality roughages, respectively on feed intake, digestibility, feeding value and N balance with both species. Formaldehyde treated-SBM or untreated SBM was given to cover about 50% of the maintenance requirement of CP for sheep and goats, while the tested roughage was given *ad libitum*.

The results showed that there was a benefical effect on total DM intake as g/Kg $W^{0.75}$ by sheep and goats as a result of addition of treated or untreated SBM. The addition of HCHO-SBM to BH diet caused a significant ($P < 0.05$) increase in DM intake from roughage as g/Kg $W^{0.75}$, while such addition caused a significant ($P<0.05$) decrease in DM intake from BS as g/Kg $W^{0.75}$. Goats consumed more DM intake from BS diets than sheep. The addition of either untreated or treated SBM to tested roughages caused significant ($P<0.05$) increases in most nutrient digestibilities. All tested diets resulted in positive N balance and goats tended to utilize and retain N more efficiently than sheep.

Keywords: Sheep, goat, roughage, intake, digestibility

INTRODUCTION

When low quality roughages such as straws, stalks or low quality hay are used as the basal feeds for ruminant animals their values may be improved by offering supplements to correct their nutrient deficiences and to increase the availability of nutrients (Silva *et al.*, 1989). Supplementation of NPN substances to rations containing undegradable protein has been recommended to improve nutrient digestibilities and dietary N utilization by ruminants (Soliman *et al.*, 1985). Although, soybean meal is a rich source of protein of high quality yet it is degraded to large extent in the rumen (Mehrez, 1981) and is considered a wasteful process for high producing animals. However, differences among types of different farm animals in

utilizing such agricultural by-products were recorded by Playne (1978); El-Badawi *et al.* (1990) and Soliman *et al.* (1994), when offered at the same level.

The objectives of the present study were to investigate and compare the effect of some protein supplementation on the utilization of berseem hay "as a high quality" and its straw "as low quality" roughages in comparative study with sheep and goats.

MATERIALS AND METHODS

The experimental work of the present study was conducted at the Agricultural Experimental Station, Faculty of Agriculture, Mansoura University.

Experimental animals and their management :

Twelve digestibility trials were carried out on two groups of sheep and goats. Three mature healthy Rahmany rams with an average live body weight of 47 Kg and three healthy males of the "Zaraiby" goats with an average live body weight of 37 Kg were used.

The classical metabolism trial procedures were carried out as described by (Schneider and Flatt, 1975). Each experimental period consisted of 28 days, the first 21 days were considered as a preliminary period, followed by 7 days for quantitative collection and separation of feces and urine. During the preliminary period, the animals were housed individually in pens and given the experimental diets for two weeks. The animals were then kept in metabolic cages for 2 weeks during which they were offered 90% of the recorded *ad libitum* intake of berseem hay (BH) and berseem straw (BS) recorded for each animal during the first 2 weeks of the preliminary period to avoid any feed refusals. All animals were given their daily feed allowance in two equal meals at 8.00 am and 15.00 pm. Drinking water was available at all times.

Feed ingredients and experimental rations :

Four main ingredients were used to formulate six experimental diets. Good quality roughage (berseem hay), poor quality roughage (BS) were used as sole source of roughage. Both BH and BS were chopped to approximately 1 - 3 cm length and were fed *ad libitum*.

The soybean meal was used either without treatment (U-SBM) or after being treated with 1% formaldehyde (HCHO-treated SBM). The treated soybean meal was prepared by spraying ground SBM with 1 gm formaldehyde (commercial 40% formaline) / 100 gm crude protein of SBM. The treated SBM was stored for 2 weeks in well tight plastic container at room temperature before being used. Fresh amount of HCHO-SBM was prepared for each experiment. The level of 1 g HCHO per 100 gm CP was suggested for maximum protection of plant proteins by Fergueson (1975).

The untreated or treated SBM was offered in all diets to provide 50% of maintenance requirements for both species which was calculated according to the (NRC, 1975) for sheep and the (NRC, 1981) for goats which were in average 4 gm CP / Kg $W^{0.75}$. The experimental rations were as follows :

Diet 1: Berseem hay (BH) as a sole feed.
Diet 2: BH + Untreated SBM (U-SBM).
Diet 3: BH + Treated SBM (T-SBM).
Diet 4 : Berseem straw (BS) as a sole feed.
Diet 5 : BS + U-SBM.
Diet 6 : BS + T-SBM.

Chemical analysis

The chemical analysis of tested materials, feces and urinary nitrogen were determined according to the standard methods outlined by A.O.A.C. (1980). Digestible energy (DE) and metabolizable energy (ME) of tested diets were calculated according to M.A.F.F. (1975) using the following equations :

DE (MJ / Kg DM) = DOM × 0.91.

ME (MJ / Kg DM) = DE MJ / Kg × 0.82.

Where : DOM = digestible organic matter (g / Kg DM).

Statistical analysis

Statistical analysis of the obtained data was carried out according to Steel and Torrie (1980) utilizing MSTATC package of computer. The differences between means were tested using L.S.D. test.

RESULTS AND DISCUSSION

I. Chemical composition

The results in Table (1) show that crude protein content of berseem hay was almost two times as that of berseem straw (13.6 *vs.* 7.2). The highest CF content was observed with BS which was higher by about 39% than that of BH. In contrast, NFE content of BH was about 18% higher than that of BS. The higher value of OM content was found with BH compared with BS which was associated with the lower ash content in BH.

In general, the summative analysis of both two tested roughages fall within the normal ranges reported in Egypt by several workers (Abou-Raya, 1967; Soliman, 1994 and Gabr *et al.*, 1995).

Concerning the chemical composition of SBM, there was no marked change between the HCHO-SBM and the untreated SBM, except in DM content, since it was lower by about 2.3% units in HCHO-SBM than that for untreated SBM. The summative analysis of SBM obtained herein was within the normal ranges given by Spears *et al.* (1985), Waltez and Stern (1989) and Abd El-Maksoud (1990). Regarding the chemical composition of tested diets, the results in Table (1) indicated that diets which contained BH plus both kinds of supplementation of SBM were practically similar in most nutrient contents. Similar nutrient contents were also observed with those contained BS plus the same supplementation.

II. Feed and energy intakes

The average of voluntary intakes from the experimental diets are presented in Table (2). The results indicated that DM intake from either BH or BS were lowest when offered alone by sheep and goats. The supplementation of both kinds of SBM caused significant increases in DM intake from BH and BS by about 16.6; 7.3; 9.0 and 4.5% in average for sheep and goats compared with those contained unsupplemented SBM. It is clear that the supplementation of both kinds of SBM with BH and BS diets caused significant ($P<0.05$) increase in total DM intake (g/Kg $W^{0.75}$) than that the unsupplemented diets 1 & 4. It is noticeable that, the intakes (g/Kg $W^{0.75}$) from the diets contained high quality roughage (BH) with untreated SBM were higher ($P< 0.05$) for sheep than goats. In contrast, the intake from diets which contained low quality

roughage (BS) with either SBM were significantly ($P<0.05$) higher for goat than sheep.

Table 1. The chemical composition of the different ingredients and the calculated composition of the experimental diets.

Items	DM %	Chemical composition on DM basis (%) OM	CP	EE	CF	NFE	Ash	DE MJ/K g DM	ME MJ/K g DM
Chemical composition of the ingredients:									
Berseem hay (BH)	91.0	89.4	13.6	1.5	26.6	47.7	10.6	11.2	9.1
Berseem straw (BS)	92.5	86.3	7.2	1.9	36.9	40.3	13.7	10.4	8.4
Untreated soybean meal (U-SBM)	91.3	92.8	42.5	3.8	6.0	40.5	7.2	11.2	9.1
Treated soybean meal (T-SBM)	89.0	92.9	42.4	4.0	6.2	39.6	7.8	15.2	12.3
Calculated chemical composition of tested rations :									
BH + U-SBM	91.2	89.5	15.5	1.60	25.2	47.2	10.5	15.2	12.3
BH + T-SBM	91.3	89.7	15.5	1.70	25.3	47.2	10.3	15.3	12.4
BS + U-SBM	92.4	86.7	10.0	2.05	37.3	40.3	13.3	11.8	8.5
BS + T-SBM	92.0	86.8	10.0	2.07	37.5	40.2	13.2	10.5	8.5

These results agreed with those obtained by Murdoch, 1962; De Simian *et al.*, 1981; El-Badawi *et al.*, 1990 and El-Ayek and Gabr, 1994, who found higher intake from roughage by goats than sheep. In addition, De Simian *et al.* (1981) noted that DM intake was generally higher in goats than sheep and differences were more pronounced for low protein roughage. Also, El-Badawi *et al.* (1990) found that the intake from roughages by sheep and goats was positively affected by its quality, since goats consumed high DM (g/Kg $W^{0.75}$) by about 25% and 39% than sheep from berseem hay and rice straw, respectively.

There was no benifical effect on total DM intake as g/Kg $W^{0.75}$ by sheep as a result of HCHO treatment of SBM when supplemented to either BH and BS diets. While, the addition HCHO treated SBM to BH diet with goats caused no significant increase in total DM intake (g/Kg $W^{0.75}$) compared with untreated SBM. In contrast, the addition of treated SBM to BS diet in goats caused a significant ($P < 0.05$) decrease in total DM intake (g/Kg $W^{0.75}$) than untreated ones. This could be explained by the fact that CP of low quality roughages (e.g. straw) is characterized by its unavailability to rumen microorganisms and accordingly, undigested (Van Soest, 1982) therefore, treated SBM caused more lack in available N for cellulolytic bacteria in the rumrn of animals (Ørskov, 1982). Comparing the total CP intake as g/Kg $W^{0.75}$/day, the results showed that the higher value was obtained with BH diets compared with the other tested diets. This could be related to higher CP content of BH than that of BS (Table 1). Also, the mean intake of CP in diet 1 for sheep and goats was 8.5 g/Kg $W^{0.75}$/day in average, which is twice the maintenance CP requirements recorded by NRC (1975 & 1981) for sheep and goats. The corresponding value in diet 4 was 4.5 g/Kg $W^{0.75}$/day in average, this amount was sufficient to cover the maintenance requirements for Egyptain mature sheep reported by Abou-Raya *et al.* (1971).

Table (2) : Average daily dry matter (DM), TDN, SV and DCP intakes from the experimental diets by sheep and goats.

Items	Berseem hay diets						Berseem straw diets						L.S.D. (P < 0.05)	
	1		2		3		4		5		6			
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Treat.	Spec.
DM intake (g/day):														
from roghage	1110.0	953.3	1290.0	999.3	1298.0	1046.6	976.7	1086.7	1072.2	1173.6	1064.7	1097.0	50.5	71.48
from SBM	-	-	84.7	70.6	84.4	70.8	-	-	84.7	70.6	84.4	70.8		
Total DM intake: g/day	1110.0	953.3	1382.4	1116.4	1382.4	1116.4	976.7	1086.7	1154.9	1244.2	1149.1	1167.8		
g/Kg $W^{0.75}$	61.8	63.5	76.6	71.3	77.0	74.4	54.4	72.4	64.3	82.9	64.0	77.8	3.23	6.20
DM intake from roughage, g/Kg $W^{0.75}$	61.8	63.5	71.9	66.6	72.3	69.7	54.4	72.4	59.6	78.2	59.3	73.1	3.21	4.56
CP intake :g/day	151.3	129.4	200.0	165.6	201.3	172.0	70.6	78.1	106.9	114.4	106.2	108.7		
g/Kg $W^{0.75}$	8.4	8.6	11.1	11.0	11.2	11.5	3.9	5.2	5.9	7.6	5.9	7.3	0.33	0.47
TDN intake :g/day	664.9	578.5	819.2	622.4	807.3	703.3	546.0	648.8	649.6	777.2	602.6	722.1		
g/Kg $W^{0.75}$	37.0	38.6	45.6	41.5	45.0	47.0	30.4	43.3	36.2	51.8	33.6	48.1	0.81	1.15
SV intake :g/day	570.5	495.6	712.1	539.5	704.8	611.7	436.6	461.0	524.4	410.5	486.6	595.2		
g/Kg $W^{0.75}$	31.7	33.0	39.7	36.0	39.3	40.8	24.3	30.7	29.2	27.4	27.1	29.7	0.83	1.17
DCP intake :g/day	105.4	91.5	136.7	108.0	135.0	119.4	40.0	49.0	66.4	73.6	66.0	70.4		
g/Kg $W^{0.75}$	5.9	6.1	7.6	7.2	7.5	8.0	2.2	3.3	3.7	4.9	3.7	4.7	0.49	0.70

Treat : (L.S.D. at P < 0.05) between treated diets. Spec.: (L.S.D. at P < 0.05) between sheep and goats..

The addition of untreated or treated SBM to the BH and BS diets the CP intake (g/Kg $W^{0.75}$) caused increases by about 32% and 60%, respectively, compared with unsupplemented roughages. The improvements in voluntary feed intake in cases of supplementation with either SBM or protected SBM could be mainly due to the increased amounts of protein reaching the duodenum and hence enzymatically digested (Cecava and Parker, 1993). Two possible sources of protein could be involved namely: more microbial protein synthesis in the rumen specially with untreated SBM and or undegradable SBM protein escaping rumen degradation particularly with HCOH-SBM.

The results in Table (2) indicated that TDN, SV and DCP intakes from tested diets contained BS were significantly ($P < 0.05$) lower than those contained BH. The SV intakes from all tested diets obtained herein were considerably higher than the end range of maintenance requirements for sheep reported by Abou-Raya *et al.* (1971) being 17.5 - 19.2 g/Kg $W^{0.75}$. The TDN intakes from the tested diets ranged from 30.4 - 45.6 g/Kg $W^{0.75}$ with sheep and from 38.6 - 51.8 g/Kg $W^{0.75}$ with goats being higher than the values 31.2 and 27.2 g/Kg $W^{0.75}$ for sheep and goats, respectively, recommended by NRC (1975 & 1981). The values of DCP intakes from tested diets were higher than the range 1.75 to 2.75 g/Kg $W^{0.75}$ for sheep reported by Abou-Raya (1967). The supplementation of treated SBM in BH diet caused an increase in TDN, SV and DCP intakes as g/Kg $W^{0.75}$ than that untreated SBM especially with goats. On the other hand, the addition of treated SBM in BS diet caused negative effect on the TDN and SV intakes compared with untreated SBM supplementation in both sheep and goats diets. This might be due to in part to the lower nutrient digestibility in BS when supplemented with treated SBM (Table 2).

III. Digestibility coefficients:

The results concerning digestibility and feeding values for tested diets are presented in Table (3). The addition of both types of SBM to BH diets resulted in significant ($P < 0.05$) increases in most of nutrient digestibilities, compared with unsupplemented ones for sheep and goats, except the CP and CF digestibilities which were decreased by about 3.4 and 2.0% for diet 2 and diet 3, respectively compared with diet 1. However, the addition of untreated and HCHO-treated SBM in BS diets resulted in significant ($P < 0.05$) increase in CP digestibility compared with unsupplemented one with sheep. This could be explained by the changes in rumen pH values which in turn influences protein solubility and shifts in rumen microflora (Ganev *et al.*, 1979). Cellulolytic bacteria activity is known to be depressed when concentrate diets are fed with roughages especially when rumen pH values falls below 6.0 (El-Shazly *et al.*, 1961).

The digestibilities of most nutrients in diet 1 were almost similar by sheep and goats, in contrast the corresponding digestibility values for diet 4 were higher by goats than that with sheep. The addition of both types of SBM to BS diets caused significantly higher ($P < 0.05$) nutrients digestibility compared with unsupplemented one (diet 4) with sheep and goats. The addition of treated SBM to BS (diet 6) resulted in a slight decrease in most nutrient digestibilities.

IV- Feeding values

There were significant differences ($P < 0.05$) between the sole feed in diets 1, 4 and other tested ones in their feeding values expressed as TDN, SV and DCP% (Table 3). The lowest values were obtained for diet 4, which had the lowest energy content as

Table 3. Digestibility coefficients and feeding values of the experimental diets by sheep and goats.

Items	Berseem hay diets						Berseem straw diets						L.S.D P < 0.05	
	1		2		3		4		5		6			
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Treat.	Spec.
Nutrients digest (%)														
DM	64.4	65.6	68.4	66.7	67.7	67.6	61.9	66.9	64.0	70.1	62.8	69.2	1.07	1.51
OM	66.1	66.7	69.4	67.8	68.8	68.9	63.5	67.7	64.8	70.3	63.3	69.8	1.04	1.47
CP	69.9	70.8	67.9	69.5	67.1	69.2	57.2	62.8	61.9	65.0	62.3	63.7	2.00	2.80
EE	54.8	54.1	61.8	59.7	64.4	59.6	46.0	51.8	64.9	59.4	63.4	58.1	N.S.	N.S.
CF	57.2	61.8	56.4	59.5	56.9	58.8	59.2	64.6	63.4	65.9	60.6	64.0	N.S.	2.42
NFE	70.0	68.8	77.1	72.8	72.1	74.6	69.5	72.3	69.1	76.2	69.9	77.0	1.43	2.02
Feeding values (%)														
TDN	59.9	60.7	63.5	62.3	62.2	63.0	55.9	59.7	60.7	62.3	56.6	61.5	0.99	1.40
SV	51.4	52.1	55.2	54.0	54.3	54.8	44.7	48.4	49.0	52.9	45.7	50.7	0.81	1.50
DCP	9.5	9.6	10.6	10.8	10.4	10.7	4.1	4.5	6.2	5.9	6.2	6.0	N.S.	0.82

Table 4. Utilization of dietary nitrogen by sheep and goats given the experimental diets .

Items	Berseem hay diets						Berseem straw diets						L.S.D P < 0.05	
	1		2		3		4		5		6			
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Treat.	Spec.
N-intake (NI, g/day)	24.2	20.7	32.0	26.5	32.2	27.5	11.3	12.5	17.1	18.3	17.0	17.4	0.85	0.85
Fecal-N (g/day)	7.3	6.1	10.3	8.1	9.6	8.5	4.8	4.5	6.5	6.4	6.4	6.3	0.45	0.64
Urinary-N (g/day)	10.5	7.7	12.3	8.3	11.5	8.6	5.6	6.8	5.5	6.9	5.2	6.0	0.56	0.80
Digested-N(DN, g/day)	16.9	14.6	21.7	18.4	22.5	19.0	6.5	8.0	10.6	11.9	10.6	11.4	0.67	0.95
TotalN Excreted(g/day)	17.8	13.8	22.6	14.6	21.1	17.1	10.4	11.3	12.0	13.3	11.6	12.3		
N-retained (NR, g/day)	6.4	6.9	9.4	10.1	11.5	10.4	0.8	1.2	5.1	5.0	5.4	5.1	0.88	N.S.
NR, % of NI	26.6	33.3	29.2	38.1	35.6	37.8	7.5	10.0	30.0	27.3	31.9	29.3	3.22	4.50
NR, % of DN	38.1	47.3	43.1	55.0	50.9	55.0	13.2	15.6	48.3	42.2	51.2	45.7	4.95	7.00
NR / 100 gm DOM	0.11	0.12	0.12	0.16	0.14	0.17	0.01	0.02	0.08	0.08	0.11	0.09	N.S.	0.017

Treat : (L.S.D. at P < 0.05) between treated diets. Spec.: (L.S.D. at P < 0.05) between sheep and goats.

DE and ME (MJ/Kg DM) "Table 1". The TDN, SV and DCP values for BH and BS as sole feeds were within the range given by EL-Badawi *et. al.*, 1990 and Gabr *et. al.*, 1995 for the same roughages, determined by sheep. However, the TDN and SV values obtained herein were considerably higher than the values recorded by Abou-Raya (1967).

The addition of treated SBM to BH diet with goats caused slight increases in TDN and SV values compared with untreated SBM, but this effect was not noticeable in sheep diets. While the addition of treated SBM to BS diet had significantly ($P<0.05$) negative effect on the feeding values as TDN and SV in both sheep and goat diets when compared with untreated SBM.

V- N-Utilization

Regarding the results in Table (4) of N-balance by sheep and goats given the experimental diets, it was clear that total N-intake (g/day) was lower by about 53 and 39.6% for diet 4 than from diet 1 for sheep and goats, respectively. While in the supplemented SBM diets the N-intake (g/day) was very similar in supplemented diets. Also, it was clear that N-intake from BH diets by sheep and goats were significantly ($P<0.05$) higher than from BS diets as a result of roughage quality and its CP content (13.6 *vs.* 7.2).

Total N excreted (g/day) was significantly ($P < 0.05$) higher in group given the BH diets than those fed on BS diets.

Nitrogen retained (g/day) was significantly ($P < 0.05$) higher in BH diets resulted in positive N balance. It was noticeable that when BH and BS were given as sole feeds, goats tended to retaine more N than sheep, but there was no significant difference.

Likewise, N-retained (NR) as % of N-intake and digested N were significantly ($P<0.05$) higher with goats than sheep when they were fed on BH diets. However, when NR was related to energy intake since they are metabolically interrelated (Ørskov, 1982) daily retained N/100 g digestible OM intake (DOM) was nearly similar for both diets.

From the foregoing results, it could be concluded that the addition of protected SBM to berseem hay diet improved efficiency of feed utilization in terms of nutrient digestibilities, intake, feeding values and N-retained by sheep and goats. It appears also with berseem straw diet that protecting dietary protein supplements is not required and more dietary degradable protein is recommended to sustain maximum microbial activity consequently better animal performance.

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تأثير البروتين المضاف لعلائق دريس البرسيم وتبن البرسيم على المأكول والمهضوم والقيمة الغذائية مع الأغنام والماعز.

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أجريت ١٢ تجربة تمثيل غذائى مع مجموعتين من ذكور الأغنام والماعز وإستخدم ٣ ذكور كباش رحمانى وثلاث تيوس ماعز زرايبى (ستة تجارب لكل منهم) لدراسة تأثير إضافة كسب فول الصويا غير المعامل أو المعامل بالفورمالدهيد إلى نوعين من الأعلاف الخشنة (عالى الجودة ومنخفض الجودة) وهما دريس وتبن البرسيم على كمية المأكول اليومى والقيم الهضمية والغذائية وميزان الأزوت مع كلا النوعين. تم تغذية جميع الحيوانات على كمية محدودة من كسب فول الصويا تم حسابها بحيث تكفى لتغطية ٥٠٪ من الإحتياجات الحافظة من البروتين ، أما مواد العلف الخشنة فكانت تغذى بحرية.

وأوضحت النتائج مايلى :

– أدت إضافة كسب فول الصويا المعامل أو غير المعامل للمادة الخشنة إلى زيادة كمية المادة المأكولة الكلية فى صورة جرام/كجم حيز جسم تمثيلى.

– أدت إضافة كسب فول الصويا المعامل بالفورمالدهيد لدريس البرسيم إلى زيادة معنوية فى كمية المأكول من المادة الخشنة جرام / كجم حيز جسم تمثيلى ، كما تفوقت الأغنام على الماعز عند التغذية على كل من كسب الصويا المعاملة أو غير المعاملة.

– أدت إضافة كسب الصويا المعاملة بالفورمالدهيد إلى علائق تبن البرسيم إلى خفض كمية المادة الخشنة المأكولة جم / كجم حيز جسم تمثيلى ، وأظهرت الماعز كفاءة أعلى فى كمية المأكول من تبن البرسيم مقارنة بالأغنام.

– أدت إضافة كسب فول الصويا بكلا نوعيه إلى علائق دريس البرسيم لرفع أغلب معاملات الهضم فيما عدا البروتين الخام والألياف الخام ، بينما أدت إضافة الكسب بكلا نوعيه إلى علائق تبن البرسيم إلى رفع معاملات الهضم لجميع المكونات مع الأغنام والماعز.

– أظهرت الماعز تفوقاً فى قيم معاملات الهضم لأغلب مكونات علائق التبن مقارنة بالأغنام ، بينما أظهرت الأغنام تفوقاً فى قيم معاملات الهضم لمكونات علائق دريس البرسيم.

– لوحظ تفوق الماعز على الأغنام فى كمية النتروجين المحتجز فى علائق الدريس ، بينما لم يلاحظ ذلك فى علائق التبن ، وكان ميزان الآزوت موجباً فى جميع الحالات.