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EFFECT OF REPLACING CORN BY BARLEY GRAINS IN CONCENTRATE FEED MIXTURE ON THE PERFORMANCE OF SHEEP

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ABSTRACT

A feeding trial was conducted using twenty Ossimi lambs. Animals were divided into two equal groups (26.05±0.008 Kg). The objectives of the study were to compare the efficiency of animal performance during summer season using two types of concentrate feed mixtures (CFM) containing yellow corn grains (CFM1) or barley grains (CFM2) along with berseem hay. Digestibilities of DM, OM, CP, EE, NFE and energy and serum total protein, albumin and globulin were better for lambs fed CFM1 than those fed CFM2. No differences were detected between CFM1 and CFM2 in respect with average daily gain and feed conversion. Feed cost/Kg live body weight gain was lower for barley included ration than that included yellow corn. It is concluded that barley grains could replace corn grains in manufacturing concentrate feed mixtures to decrease the cost of production of one kilogram of growth without any adverse effect on the productivity of lambs.

Keywords: corn, barley, concentrate feed mix, sheep, growth performance

INTRODUCTION

The production of green forage decreases in the period between the winter and summer seasons. So, the dependency on concentrate feed mixture (CFM) and roughage increases to satisfy animal needs. The main source of energy in CFM is corn grains, which is not produced in this period. Besides, the amount of corn grains available for livestock is shrinking because of using corn for human consumption. Thus, it was thought to utilize another source of energy, which is available in this period. Barley grains is a good source to satisfy the energy needs of ruminants. (Mould *et al.*, 1984). It was used as a substitute to corn in manufacturing of CFM to be experimented in animal nutrition. The present study was, therefore, conducted to study the comparative digestive efficiency and utilization of nutrients by Ossimi lambs fed CFM containing either corn or barley grains.

MATERIALS AND METHODS

Twenty Ossimi lambs were randomly selected and were used during summer and autumn seasons (June to November). Lambs were divided into two similar groups according to body weight (26.0 and 26.0 ±0.008 Kg for groups 1 and 2, respectively). Lambs of each group were assigned at random to receive one of the following dietary treatments (Table 1).

1- CFM1 containing yellow corn grains at 2% of live body weight (control)
2- CFM2 containing barley grains at 2% of live body weight

Berseem hay was given ad lib for both groups.

Table 1. Ingredients of concentrate feed mixture as fed to growing sheep

Ingredient	CFM1	CFM2
Yellow corn	50	--
Barley grains	--	50
Wheat bran	10	10
Undecorticated cotton seed cake	9	9
Linseed meal	22	20
Molasses	5	7
Limestone	3	3
Mineral salt	1	1
Total	100	100

Chemical composition of ingredients and rations are shown in Table (2). Rations were offered twice daily at 7 am and 4 pm. Drinking water was available all times. Initial, final and biweekly body weights were measured prior to offering the morning meal. The experimental period lasted for 183 days. Two digestibility trials were conducted during the feeding trial (after 13 weeks of the beginning of the feeding trial) using three lambs from each group.

Table 2. Chemical composition of ingredients and rations as fed to growing lambs

Item	DM	OM	CP	EE	CF	NFE	Ash	GE, Kcal/Kg
					DM basis, %			
Yellow corn	84.97	98.07	8.39	3.63	1.92	84.13	1.93	--

Barley grain	88.29	96.61	9.63	1.71	6.31	78.96	3.39	--
CFM1	89.01	92.75	14.05	3.31	7.11	68.28	7.25	4235
CFM2	88.38	92.35	14.15	2.82	9.35	66.03	7.65	4194
Berseem hay	83.36	83.36	12.01	2.81	30.81	45.04	9.33	4101
Calculated chemical composition of rations used in the experiments (DM basis, %)								
Control ration		92.11	13.42	3.16	15.08	60.45	7.89	4194
Tested ration		91.76	13.40	2.82	17.55	57.99	8.24	4161

Proximate analysis for composite samples of feedstuffs, feces, and urine was conducted according to A.O.A.C. (1990). Energy contents of feedstuffs were determined using a bomb calorimeter. Rumen liquor samples were withdrawn at the end of the digestion trial before the morning feeding and at 3 and 6 hrs postfeeding. Total volatile fatty acids (TVFA's) was determined according to Erwin *et al.* (1961). Blood samples were withdrawn from the Jugular vein before morning meal. Plasma total protein, albumin and glucose were determined according to Armstrong and Carr, (1964), Doumas *et al.* (1971) and Hyvarinen and Nikklia, (1962), respectively. Data were statistically analyzed using the GLM procedures of SAS, (1988).

RESULTS

Metabolism trial

Data concerning the nutrient digestibility and nutritive values (Table 3) showed that digestion coefficient of DM, OM, EE, NFE and energy of the control ration (CFM1) were higher, while CF digestibility was lower than those of tested ration.

Table 3. Digestibility and feeding values of experimental rations (DM basis, %)

Item	Control	Tested ration	±SE
Digestibility coefficients, %			
DM	73.42[a]	71.42[b]	0.02
OM	75.07[a]	73.79[b]	0.11
CP	66.13	66.08	2.02
CF	51.77	52.53	0.80
EE	75.47	74.65	0.61
NFE	82.87[a]	81.96[b]	0.62
Energy	74.59	73.36	0.18
Feeding values, %			
TDN	72.14[a]	70.35[b]	0.11
DCP	8.87	8.86	0.30
DE intake, Mcal/Kg	3.13	3.05	0.01

Means with different superscripts in the same row differ significantly (P<0.05)

Regarding the nutritive values (Table 3), higher TDN value was observed for the control ration, while DCP values of the tested and the control rations were comparable. Digestible energy of the tested ration was lower than that of the control.

Nitrogen balance of lambs fed on the two experimental rations are shown in Table (4). The nitrogen balance of animals was positive for the two rations. Also, results in Table (4) indicated that nitrogen balance as percent of N intake or digested N were not significantly affected by type of grains.Water balance and utilization (Table 4) by experimental animals was studied as an indicator of animal performance. Absolute water intake, total water intake and water intakes relative to DM intake were similar between animals of the two groups. Animals of the group fed the control ration excreted less water in urine, while insensible water loss was higher than animals of the group fed the tested ration.Table (5) shows the average values of rumen liquor parameters at different times (0, 3, and 6 hrs postfeeding). The rumen liquor pH values and the TVFA's concentrations were similar for the two rations with little variability.

Effect of experimental rations on some plasma blood parameters is shown in Table (6). Total protein, albumin, globulin concentrations and Al/Gl ratios were similar for lambs fed the two rations. On the other hand, plasma glucose concentration was significantly (P<0.05) higher in control group than tested group.

Table 4. Nitrogen utilization and water metabolism of lambs fed the experimental rations

Item	Control	Tested ration	±SE	Sig.

Nitrogen balance, g/h/d				
N intake	28.78	28.03		NS
Fecal N	9.73	9.51		NS
Digested N	19.05	18.52		NS
Urinary N	11.85	11.52		NS
N balance	7.20	7.00	0.05	NS
NB/NI	25.02	24.97	0.78	NS
NB/Digested N	37.80	37.80	0.07	NS
Water utilization, ml/h/d				
Free water intake	4024[a]	4055[a]		NS
Feed moisture	228	241		NS
Total water intake	4252	4296		NS
Fecal moisture	953	949		NS
Urine volume	803[b]	1047[a]		P<0.05
Total water output	1756[b]	1996[a]		P<0.05
Insensible water loss	2496[a]	2300[b]		P<0.05
Water intake/Kg DMI (L)	2.97	2.86	0.38	NS

Means with different superscripts in the same row differ significantly (P<0.05)
NS = non significant

Table 5. Effect of experimental rations on pH and TVFA's concentrations in rumen liquor

Item	Time after feeding (hr)	control	Tested ration	±SE
pH	0	6.94	6.98	0.09
	3	6.06	6.12	0.07
	6	6.29	6.34	0.06
	Ave.	6.43	6.48	0.01
TVFA's,	0	4.62	4.58	0.03
meq%	3	8.47[a]	8.09[b]	0.36
	6	7.53[a]	7.32[b]	0.26
	Ave.	6.87	6.66	0.22

Means with different superscripts in the same row differ significantly (P<0.05)

Table 6. Effect of experimental rations on blood parameters

Item	Control	Tested ration	±SE
TP, gm%	7.19	7.13	0.07
Albumin, gm%	4.08	4.11	0.07
Globulin, gm%	3.11	3.02	0.12
A/L ratio	1.31	1.36	0.07
Glucose, mg%	66.97[a]	65.25[b]	0.19

Means with different superscripts in the same row differ significantly (P<0.05)

Growth trial

Table (7) provides information on the productive performance of lambs. The berseem hay intake, total DM consumption, daily TDN and DCP intake, feed conversion expressed as Kg DM, TDN, or DCP/Kg gain and average daily gain (g/h/d) were comparable between animal group fed the control ration and fed the tested ration.

The costs to produce one Kg gain were 6.98 and 6.86 LE for control and tested rations, respectively. The corresponding economic efficiencies were 1.84, and 1.87.

Table 7. Performance of lambs fed different experimental rations

Item	Control	Tested	±SE	Sig.
No of lambs	10	10		
Initial weight (Kg	26.0	26.1		
Final weight (Kg)	58.35	58.17		
Total gain (Kg)	32.35	32.07		
Daily gain, g/h/d	176.78	175.26	0.79	NS
Daily feed intake, g/h/d				
CFM	910.88	904.98		
Berseem hay	560.30	563.99		
TDMI	1471.18	1468.97	0.97	NS
TDN intake	1061.31	1032.72	0.24	NS
DCPI	130.49	130.06	0.59	NS
Feed conversion				
Kg DM/Kg gain	8.32	8.38	0.77	NS
Kg TDN/Kg gain	6.00	5.89	0.56	NS

Kg DCP/Kg gain	0.74	0.74	0.07	NS
Feed cost*	6.98	6.86		
Economical efficiency**	1.84	1.87		

*** Based on the basis that the price of one ton of CFM1, CFM2 and berseem hay are: 628, 612, and 300 LE, respectively. The price of live body weight Kg is 9.00 LE which were the prevailing prices during the experiment.**
**** Calculated as the ratio between price of the weight gain and cost of feed consumed.**
NS= non significant

DISCUSSION

Ration containing corn grains had higher digestibility coefficients for all nutrients, except for CF, and higher feeding values than tested ration containing barley grains (Table 3). These results are in agreement with those reported by Singh (1984) and Hanafy *et al*. (1998). They found that DM, EE, and NFE digestibilities were higher for corn than for barley diets. Furthermore, Hill and West (1991) reported that DM, OM, and NFE digestibilities were higher ($P<0.05$) for corn ration than for barley rations. The higher digestibilities observed with the control ration in comparison with the tested ration may be due to the higher solubility of starch in the corn grains (Galloway *et al.,* 1991).

Low crude fiber digestibility in control ration containing corn grains might refer to a negative effect of the high content of NFE (Table 2). McCarthy *et al*. (1989) found that the passage of starch to the duodenum was greater for corn than for barley diets. Low CF digestibility might be explained by the changes in rumen pH values resulting from higher starch fermentability of corn grains. (Horton *et al.,* 1980).

The higher TDN value of corn ration is related to the higher digestibility of corn contents (EE, NFE and OM) compared with barley. Reddy and Reddy (1999) drew the same conclusion on corn diets.

Water requirements vary and are regulated by many factors such as intake of DM, environmental temperature and water losses from the body (Shafie, 1999). In Table (4), the same relationship between water intake and DM intake was valid within thermal conditions. Lambs under hot conditions (32 – 38 ^{o}C) consumed 2.97 and 2.86 liters of water per Kg DM intake at animal group fed control ration and tested ration orderly. This result agree with many authors (Forbes, 1969, El-Nouty *et al.,* 1988 and El-Bedawy *et al.,* 1994). Generally, sheep consumed about 2 liters of water per Kg DM intake at temperate zone (Owen, 1981). Water consumption in various species increases with increasing environmental temperature, consequently, the ratio increases to 3:1 above 20 ^{o}C (NRC, 1981).

It was clear that ruminal liquor pH values recorded before feeding (Table 5) were higher in contrast to the values recorded post feeding for the two diets. Generally, the pattern of VFA's concentrations followed the reverse trend of pH values. Ruminal TVFA's concentrations were lower with the tested ration containing barley grains than control ration. This may be due to increased NFE content in corn grains and resulting in higher NFE for control ration (Table 2). Barake *et al.* (1989) and Fredrickson *et al.* (1993) found that ruminal pH was nearly the same for animals fed diets containing corn or barley grains. Hill and West, (1991) reported that corn diet had lower pH than corn plus barley diet. On the other hand, Casper *et al.* (1990) found that TVFA's concentrations were similar when animals were fed barley or corn diets.

Circulating plasma total protein and its fractions measurements have been used as predictors of nitrogen status of ruminants. On the other hand, metabolic profile of glucose in farm animals may be considered useful for determining whether energy requirements are satisfied or not during growth and sexual maturity (Montemurro *et al.,* 1995).

Generally, the means of some plasma parameters are within the range of normal values. This might indicate the normal health status of lambs. Soliman, (1994) found that values of serum total protein were 7.0 to 7.6 g/100 ml for rams fed a diet containing yellow corn and berseem hay. Hanafy *et al.* (1998) observed that the differences in grain source (corn or barley) did not affect plasma total protein. On the other hand, Yousef *et al*. (1998) found that values of plasma glucose were 59 to 61 mg/100 ml for sheep. The increase in plasma glucose with lambs fed control or tested rations (Table 6) may be attributed to the enhanced carbohydrate metabolism (El-Barody *et al.,* 1998).

Daily weight gains between 109 to 172 gram/h/d had been recorded for local breeds of lambs (Ossimi, Rahmani, and Barki) fed under confinement conditions (Soliman *et al.,* 1975, El-Sherbini and El-Ashry, 1976, Abdel-Hafez and El-Homisi, 1976 and El-Bedawy *et al.*, 1993)

Values of average daily gain for lambs (Ossimi) in the present study were higher than those reported by other investigators. Taie, (1996) reported (165 g/h/d); Taie *et al.* 1998 (139 g/h/d); Aboul-Fotouh, 1999 (127 to 151 g/h/d) and Deraz and Mohamed, 1999 (97 g/h/d) for Ossimi lambs. This improvement in daily gain may be due to increased grain proportion in diets and the use of berseem hay as highly palatable roughage. Many investigators found that the average daily gain increased ($P<0.05$) with increasing corn grains (Karnezos *et al.,* 1994), barley grains (Leventini *et al.,* 1990) and berseem hay (Fouad *et al.,* 1997 and Mehrez *et al.*, 1997) in rations.

The average cost of one Kg gain obtained in tested ration containing barley grains was lower, and the economical efficiency was better than in control ration containing corn grains. This may be attributed to the lower price of barley than corn grains.

It is concluded that barley grains could replace corn grains in manufacturing concentrate feed mixtures to decrease the cost of production of one kilogram of growth without any adverse effect on the productivity of lambs.

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تأثير إحلال حبوب الشعير بدلا من حبوب الذرة فى العلف المصنع على أداء الأغنام

رأفت طه فؤاد
قسم بحوث تغذية الحيوان - معهد بحوث الإنتاج الحيوانى - مركز البحوث الزراعية – الدقى – الجيزة

تم إجراء تجربة تغذية باستخدام عشرين حمل اوسيمى قسمت الى مجموعتين متساويتين غذيتا على نوعين من العلف المصنع بمعدل ٢% من وزن الجسم أحدهما يحتوى على حبوب الذرة الصفراء والثانى على حبوب الشعير مع استخدام دريس البرسيم مع كليهما لحد الشبع.

كانت معاملات الهضم للمادة الجافة والمادة العضوية والبروتين والدهن والكربوهيدرات الذائبة والبروتين الكلى للدم والالبيومين والجلوبيولين لصالح مجموعة العلف المركز المحتوى على ذرة.

معدلات النمو والكفاءة التحويلية ككيلوجرام مادة جافة لكل كيلو نمو كان فى صالح مجموعة الذرة.

تكلفة إنتاج كيلو النمو كانت منخفضة فى حالة التغذية على العلف المحتوى على حبوب شعير.

ويستنتج من ذلك انه يمكن استبدال حبوب الذرة بحبوب الشعير فى تصنيع الأعلاف المركزة لتقليل تكلفة إنتاج كيلوجرام نمو وذلك بدون أى تأثير سلبى على الحيوانات.