CARCASS CHARACTERISTICS AND MEAT QUALITY OF BARKI LAMBS FED RATIONS CONTAINING DRIED SUGAR BEET PULP WITH OR WITHOUT FIBROLYTIC ENZYMES

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SUMMARY

Twenty-five Barki lambs with an average body weight of 25 ±0.5Kg, at 8-months of age, were divided into 5-groups of 5-animals each, according to their live body weight in growth trial lasted for 90 days to study effect of replacing yellow corn by beet pulp in lambs diets with or without fibrolytic enzymes on carcass characteristics and meat quality. First group (G1) was fed the control ration, which consisted of concentrate feed mixture (CFM) and Alfalfa hay; second group (G2) was fed a ration where 50 % of the corn was replaced with sugar beet pulp (SBP); third group (G3) was fed a ration where 75 % of corn was replaced with SBP; fourth group (G4) was fed the same ration as G2 but supplemented with 4 g/head/day of fibrolytic enzymes and fifth group (G5) was fed the same ration as G3 but supplemented with 4 g/head/day of fibrolytic enzymes, like G4. Result showed that final slaughtered body weight (FSBW) was higher in G5 and G4 compared to other groups. However, the difference was significant (P<0.05) for G5 (45.2Kg) compared with the other groups. Significant main effects for enzyme supplementation, and SBP substitution at 50% and 75%, were noted on FSBW. Dressing percentage was similar for all groups, but the amount of protein in meat was higher in animals fed rations without enzymes compared to the control group. Eye muscle (longesmus dorsi) was significantly different for G5 compared with the control group. The colour of meat was the same for all groups, but protein content in meat was significantly higher for G5 compared to the other groups. It may be concluded that SBP may substitute yellow corn at 50 and 75 % in Barki lambs ration with enzyme positively effecting FSBW, as well as protein content in meat.

Keywords: *lambs, beet pulp, enzyme, meat, carcass.*

INTRODUCTION

One of the crucial aims in livestock feeding is to promote the use of local feeds and by-products in order to decrease feed cost (Guessous *et al.,* 1989 and Lanza *et al.,* 2001). Change in production system, aiming for increasing animal productivity and profitability is desirable, if meat quality and consumer acceptance is maintained (Arsenos *et al.*, 2002 and Santos-silva *et al.,* 2002). Nutritional factors have significant effects on the biochemical, structural and metabolic characteristics of muscles and on the dietetic value and sensory qualities of meat from ruminants (Geay *et al.,* 2001). Changing traditional production systems may enhance the eating quality of sheep meat (Arsenos *et al.,* 2002).

Sugar beet pulp (SBP) is a common by-product results from sugar industry and is widely used in animal nutrition as a source of energy (Fadel, 1999). Dried sugar beet pulp is characterized by high content of soluble fiber 19% (pectins, glucans), which is fermented primarily to acetate (Hall et al., 2000). Therefore, SBP is a candidate for partially substituting cereals in ruminant diets (Richardson et al., 2003; Norman et al., 2005).

Diets rich in wheat or barley decrease the firmness of subcutaneous adipose tissue owing to the high propionate concentration in the rumen. While dried beet pulp produces more acetate and less propionate in rumen and hence limits this problem. (Matray et al. 1994). The partial or total substitution of cereals by sugar beet pulp was investigated in several experiments with positive or negative effects (Normand et al., 1999 and Berthelot et al. 2001).

Exogenous fibrolytic enzymes have been used to improve the nutritive value of fiber-rich diets and subsequently the performance of cattle (El-wakeel *et al.,* 2007) sheep (Cruywagan and Vanzyl, 2008) and goats (Stella et al., 2007).Meanwhile this can be achieved by direct feeding of these enzymes which increased DMI, passage rate and digestibility of DM, NDF and ADF (Stakes, 1992). Beauchemin et al.

(2003) found that applying exogenous fibrolytic enzyme in ruminant rations improved feed digestibility. It had been shown that interaction between a pre-feeding enzyme and feed enhanced the beneficial effects of enzymes on ruminal fermentation (Giraldo *et al.,* 2004). However, the addition of enzyme to diet immediately before feeding or direct addition of enzymes to ruminants has received considerably less attention.

Therefore, the aim of this study was to investigate the effect of partial substitution of yellow corn by dried sugar beet pulp at levels of 50 and 75 % supplemented or not with oral fibrolytic enzymes on some Carcass parameters and chemical composition of meat in growing Barki lambs.

MATERIALS AND METHODS

Animals, diets and enzyme

Twenty-five growing male Barki lambs (25±0.5 Kg of BW) were used in this experiment. The animals were housed in groups (5 groups of 5 lambs each). The animals had continuous access to fresh water and vitamin-mineral block. The experiment lasted for 90 days. The animals were weighed biweekly to record the body weight and to calculate the average daily body gain and feed efficiency.

Ingredients and chemical composition of the diets are shown in (Table 1). The diets were formulated according to NRC (1985) guidelines. The diets were offered to the animals twice daily (9am and 4pm) to cover the total requirements according to NRC (1985). The experimental diets were formulated to test the effect of yellow corn grain substitution by dried sugar beet pulp (DSBP) (50 and 75 % by weight) on performance of lambs. The control diet (G1) consisted of a concentrate feed mixture (70 %) along with alfalfa hay (30%). The experimental diets G2, G3, G4, G5, contained the yellow corn in concentrate feed mixture substituted by DSBP at 50% with and without oral fibrolytic enzyme or substituted at 75% with and without oral fibrolytic enzyme respectively. Oarts were collected just before the next morning feeding. Alfalfa hay was the main source of roughage.

Enzyme mixture

An exogenous fibrolytic enzyme mixture, Miami, Fl 33145, recommended by AGRANCO CORP. (USA) was used to indicate its effects on performance of lambs. The mixture was orally given to each animal in G4 and G5 (4 g/d) just before second meal.

Chemical analysis.

Feeds were analyzed for proximate analyses according to (A.O.A.C., 1995) and nitrogen free extract was calculated by difference. Chemical composition of the experimental rations is shown in Table (1).

Table (1). Chemical composition of the ingredients, experimental concentrates feed mixture and ration (on DM basis).

Item	DM	Chemical composition % (DM)					
		OM	CP	CF	EE	NFE	Ash
Ingredients							
Clover Hay	90.76	88.68	16,80	19,42	4,25	48,21	11.32
Sugar beet pulp	90.84	96.46	8.97	18.91	1.29	67.29	3.54
Experimental CFM							
(G1)	90.84	90.02	12.99	5.88	2.64	68.51	9.98
CFM, G2&4	91.42	88.91	12.91	8.11	2.21	65.68	11.09
CFM, G3&5	91.53	89.5	12.46	9.18	1.98	65.88	10.5
Experimental rations							
G1-ration	90.87	90.33	14.35	10.69	3.21	62.08	9.67
G2&G4	91.26	89.57	14.21	11.91	2.89	60.56	10.43
G3&G5	91.13	89.76	13.88	12.59	2.73	60.56	10.24

Group (G1) control,G2 beet pulp with50%replacement of yellow corn, G3 beet pulp with 75%replacement of yellow corn, G4 beet pulp with 50%replacement of yellow corn with enzyme, G5 beet pulp with 75%replacement of yellow corn with enzyme.

Experimental procedures and sampling

After 90 days of the experiment, three animals from each group were slaughtered in a slaughterhouse to measure the different carcass traits.

The lambs were slaughtered by exsanguination using conventional Islamic procedure after 16 h feed deprivation. Before slaughter, the live body weight was recorded. After complete bleeding, the animals were skinned and external organs (head, feet and skin) were weighed. Stripping, legging, dressing and evisceration were performed by adopting the standard procedures described by Gerrand (1964).The weight of hot carcasses and organs were recorded. The dressing percentage was obtained as percent of hot carcass weight to pre-slaughter weight.

Determination of chemical analysis of L. dorsi muscle (moisture, protein, fat and collagen) and physical characteristics were carried out in the Research Park, Faculty of Agriculture, Cairo University.

Meat chemical analysis was performed using Food Scan™ Pro meat analyzer (Foss Analytical A/S, Model 78810, Denmark).

According to the manufacturer's instructions about 50 - 100 gm of raw meat (obtained from the 9th rib) were minced and put in the meat analyzer cup. The cup was inserted into the meat analyzer for scanning sample with infra-red to determine the chemical components.

Meat color was measured using Chroma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer. Color was expressed using the color instrumental parameters (CIE) L*, a*, and b* color system (Yuksel et al. 2011). A total of three spectral readings were taken for each sample on different locations of the muscle. L* (lightness) values measure (higher L* value indicates a white color, while lower L*value indicates a black color); a* values measure redness (positive a* value indicates a reddish color, while negative value measures greenish); and b* values measure yellowness (positive b* value indicates a more yellowish color, while negative value measures blueish). It is well known that higher values of lightness and positive one of redness and yellowness indicate that the meat is better than lower values of lightness and negative values of redness and yellowness (Honikel, 1998).

Statistical analysis

Collected data were subjected to statistical analysis using two way analysis SAS (1996) according to the following model: $Y_{ij} = \mu + B_i + E_j + BE_{ij} + E_{ijk}$; where: μ is the overall mean of Y_{ij}; B_i is the beet pulp level i= 1 and 2; E_j is the enzyme level where j= 1 and 2;$BE_{ij}$is the interaction between beet pulp and enzyme level; E_{ijk} the experimental random error. The differences among means were separate according to Ducan´s New Multiple Range test (Duncan´s, 1955).

RESULTS AND DISCUSSION

Effect of the experimental rations on carcass characteristics

Dressing percentage and eye muscle

Carcass characteristics of the slaughtered lambs are given in Tables (2) and (3). Slaughter weights and hot carcass weights were slightly higher for lambs fed the 75% SBP ration with Hydroenzime (G5). However, its dressing percentage was the lowest. There were no significant differences in the yields of edible offal's of lambs fed the different rations.

There are no significant differences were observed in the dressing percentages of all rations (Table 2). However, El-Badawi and El-Kady (2006) reported that the dressing percentage was much better for lambs fed 50% SBP than those fed a commercial diet. McAllister et al. (2000) reported that enzyme supplementation, to concentrate rations, resulted in slight decrease in the dressing percentage than lambs fed concentrate rations without adding enzymes.The eye muscle weights are shown in Tables(2, 3). The G4 group (50 % SBP with Hydroenzime) had the highest eye muscle weight (200 g). This weight was significantly higher than the control group (152.5) and G3 group (127.5 g). The weight of the bone of the eye muscle weight was significantly higher in G2 and G5 than the other groups.

Table (2). Carcass characteristics of lambs fed the experimental rations.

Item	Experimental ration group						
	G1	G2	G3	G4	G5	P value	SE
Fastingbodyweight,kg	42.5	42.3	41.9	46	46.9	0.088	9.41
After -slaughterweight, kg	40.7	40.2	40.2	42.6	45.2	0.109	1.02
Hot carcassweight, kg	20.8	20.9	20.6	21.7	22.6	0.134	4.15
Dressingpercentage, %	48.9	49.4	49.16	49.13	48.18	------	-----
Edibleoffalsweights, g							
Liver	665	610	627	595	585	0.210	1.818
Heart	145	127	137	145	135	0.061	0.89
De-fattedkidneys	105	105	105	100	120	0.306	1.558
Spleen	55	52.5	55	45	47	0.102	0.22
Dissectedcarcasstraits							
Eye muscle weight,g (longesmus dorsi)	152.5^{bc}	170^{ab}	127.5^{c}	200^{a}	167.75^{ab}	0.019	0.83
Bone of eye muscle weight,g	107.5^{b}	125^{a}	85^{c}	97^{b}	122.25^{a}	0.0001	0.37

$^{a, b, ...}$means in the same column for each main effect or interaction followed by different superscripts are significantly different (P<0.05).G1: control ration, G2: sugarbeet pulp replacing 50% of the corn, G3: sugarbeet pulp replacing 75% of the corn, G4: sugarbeet pulp replacing 50% of the corn plus Hydroenzime, G5: sugarbeet pulp replacing 75% of the corn plus Hydroenzime.

Table (3). Carcass characteristics of lambs due to main effect of sugar beet pulp and hydroenzime.

Item	SBP main effect				Hydroenzime main effect			
	SBP 50%	SBP 75%	P value	SE	Without	With	P value	SE
Fasting body weight, g	44.13	44.4	0.860	1.28	42.1^{b}	46.5^{a}	0.02	8.35
After-slaughter weight, g	41.4	42.7	0.388	1.16	40.2^{b}	43.9^{a}	0.038	8.79
Hot carcass weight, g	21.3	21.6	0.553	3.86	20.7^{b}	22.2^{a}	0.026	3.02
Dressing percentage, %	49.26	48.67			49.28	48.65		
Edible offals, g								
Liver	602.5	606.25	0.889	1.57	618.75	590	0.3101	1.355
Heart	136.25	136.5	0.951	0.37	132.5	140.25	0.092	0.3912
De-fatted kidneys	102.5	112.5	0.215	0.45	105	110	0.514	0.485
Spleen	48.75	51	0.265	0.203	53.75^{a}	46^{b}	0.005	0.115
Dissected carcass traits								
Eye muscle (longesmus dorsi) wt, g	185^{a}	147.625^{b}	0.0007	0.947	148.75^{b}	183.88^{a}	0.001	0.98
Bone of eye muscle, wt, g	111.25^{a}	103.63^{b}	0.021	0.747	105	109.88	0.094	0.750

$^{a, b, ...}$means in the same column for each main effect or interaction followed by different superscripts are significantly different (P<0.05).G1: control ration, G2: sugarbeet pulp replacing 50% of the corn, G3: sugarbeet pulp replacing 75% of the corn, G4: sugarbeet pulp replacing 50% of the corn plus Hydroenzime, G5: sugarbeet pulp replacing 75% of the corn plus Hydroenzime.

Colour of meat

One of the carcass characteristics is colour of the slaughtered lamb's meat. The meat colour parameters are presented in Table (4). No significant differences were observed among groups in lightness (L) and redness (a) of the meat. However, the group that received 75 % SBP (G3) had significantly ($P \leq 0.05$) more yellowish (b) meat than all other groups. In same context, Yuksel *et al.,* (2011) where they reported non-significant differences in redness of meat among a control group and groups receiving 4 or 8 % sugar beet pulp. They also stated that the yellowness of meat was significantly ($P<0.01$) higher in sugar beet pulp than the control diet.

Table (4). Colour of lambs meat fed on the experimental rations.

Item	Colour		
	Lightness(L)	Redness(a)	Yellowness(b)
SBP main effect			
50%	40.85	16.59	3.4850[b]
75%	42.22	16.79	4.7300[a]
P value	0.3828	0.6304	0.0251
SE	1.0244	0.2706	0.2822
Hydroenzime main effect			
Without	42.67	16.71	4.55
With	40.41	16.67	3.67
P value	0.1703	0.9185	0.0809
SE	1.0453	0.2317	0.3505
Interaction between SBP and Hydroenzime			
G1	41.41	15.94	3.22[b]
G2	43.00	16.42	3.685[b]
G3	42.34	17.01	5.41[a]
G4	38.71	16.78	3.285[b]
G5	42.11	16.57	4.05[b]
P value	0.4172	0.2802	0.0159
SE	1.158	0.28809	0.2408

[a, b, …]means in the same column for each main effect or interaction followed by different superscripts are significantly different (P<0.05).G1: control ration, G2: sugar beet pulp replacing 50% of the corn, G3: sugar beet pulp replacing 75% of the corn, G4: sugar beet pulp replacing 50% of the corn plus Hydroenzime, G5: sugar beet pulp replacing 75% of the corn plus Hydroenzime.

Chemical composition of meat

The chemical composition of the meat is presented in Table(5). The collagen level of the group fed 50 % SBP (G2) was significantly higher than the other four groups. Also the groups fed 50 % SBP had significantly higher collagen percentage than those fed 75% SBP. The groups fed Hydroenzime had significantly lower collagen than the groups that were not fed the Hydroenzime.

The fat percentage of the meat of the group fed 50 % SBP (G2) was significantly higher than all other groups. Similar results were reported by El-Badawi and El-Kady (2006) when using 50 % SBP. However, the groups fed 75 % SBP had significantly lower fat level than those fed 50 % SBP (Table 5).

The protein percentage of the meat of the group fed 75 % SBP with Hydroenzime (G5) was significantly higher than the control group and G2 and G3 groups. This contradicts the results of Bodas *et al.,* (2007) who reported no significant differences in the protein percentages among groups of lambs fed on different sugar beet pulp levels. No significant differences were observed between the groups fed Hydroenzime and the groups that were not fed Hydroenzime.

CONCLUSION

The different finishing diets used for Barki lambs had acceptable performance in terms of dressing percent, eye muscle, chemical and color of the meat. Supplying fibrolytic enzymes (Hydroenzime) to the rations improved lamb performance. It was concluded that the best results were obtained when 50 or 75 %of the corn was substituted with dried sugar beet pulp and adding Hydroenzime (4gm/h/d). It may be recommended, for sheep producers, to add Hydroenzime to improve their animal performance significantly.

Table (5). Chemical composition of lambs meat fed on the experimental rations.

Item	Chemical composition %		
	Collagen	Fat	Protein
<u>SBP main effect</u>			
50%	1.37[a]	5.93[a]	20.95[b]
75%	1.17[b]	4.55[b]	21.65[a]
P value	0.0385	0.0393	0.0202
SE	0.088	0.559	0.1359
<u>Hydroenzime main effect</u>			
Without	1.39[a]	5.57	21.29
With	1.14[b]	4.91	21.3
P value	0.0126	0.2562	0.9846
SE	0.0717	0.595	0.2027
<u>Interaction between SBP and Hydroenzime</u>			
G1	1.15[b]	4.79[b]	20.67[c]
G2	1.58[a]	7.31[a]	21.12[bc]
G3	1.15[b]	4.54[b]	20.77[bc]
G4	1.22[b]	3.83[b]	21.47[ab]
G5	1.13[b]	5.28[b]	21.83[a]
P value	0.0065	0.014	0.0199
SE	0.0725	0.4099	0.1507

[a, b, …] means in the same column for each main effect or interaction followed by different superscripts are significantly different (p <0.05).G1: control ration, G2: sugar beet pulp replacing 50% of the corn, G3: sugar beet pulp replacing 75% of the corn, G4: sugar beet pulp replacing 50% of the corn plus Hydroenzime, G5: sugar beet pulp replacing 75% of the corn plus Hydroenzime.

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مواصفات الذبحية وجودة اللحم لحملان البرقى المغذاة علي علائق محتوية علي تفل بنجر السكر الجاف, مع أو بدون إنزيم تحليل الألياف

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قسم الإنتاج الحيوانى، كلية الزراعة، جامعة القاهرة

استخدم عدد 25 حمل برقي بمتوسط وزن 26 كجم ومتوسط عمر 8 شهور، قسمت إلي خمس مجموعات (خمس حيوانات في كل مجموعة) حسب وزن الجسم واستمرت التجربة لمدة 90 يوما. وذلك لدراسة تأثير استبد الذرة الصفراءبتفل بنجر السكر في العليقةمع أوبدون إضافة إنزيمات تحليل الألياف علي مواصفات الذبيحة وجودة اللحم.تكونت عليقة المقارنة (العليقة الأولي) من مخلوط علف مركز مع دريس البرسيم الحجازي، العليقة الثانية هي عليقة المقارنة مع استبدال 50 % من الذرة الصفراء بتفل بنجر السكر الجاف ، العليقة الثالثة: عليقة المقارنة مع استبدال 75% من الذرة الصفراء بتفل البنجر، العليقة الرابعة: عليقة المقارنة مع استبدال 50 % من الذرة الصفراء بتفل البنجر مع إضافة هيدروإنزيم(4 جرام/ رأس / يوم)، العليقة الخامسة: عليقة المقارنة مع استبدال 75% من الذرة الصفراء بتفل البنجر مع إضافة هيدروإنزيم(4جرام / رأس / يوم).

أوضحت النتائج أن وزن الجسم النهائي كان أعالي في المجموعة 4 و المجموعة 3 مقارنة مع المجموعات الأخري وكان الوزن بعدالذبح أعلي معنويا (P<0.05) في المجموعة 4 مقارنة مع المجموعات الأخرى،وكذلك في حالة إضافة هيدروإنزيم كان أختلافا كبيرا مقارنة مع عدم وجود هيدروإنزيم،أيضا العضلة العينية (longesmus) سجلت فروق معنوية بين المجموعة 4 و عليقة المقارنة كونها 167.75 جم و 152.5 جم على التوالي . ولوحظ كذلك ان أحلال تفل بنجر السكر الجاف سجل فروق معنوية للعضلة العينية بين مستويين 50 %و 75 % (185 جم و 147.63 جم علي التوالي)،بينما سجل إضافة الانزيم فروقا معنوية عالية (183.89 جم)مقارنة بعدم إضافة انزيم (148.75 جم) .لوحظ أنة لأ يوجد فروق معنوية في لون اللحم بين المجموعات. وبينما سجلت نسبة البروتين في اللحم فروقا معنوية في المجموعة 4 مقارنة بالمجموعات الأخرى.

ومن هذة النتائج يتضح ان استبدال الذرة الصفراء مع تفل بنجر السكر الجاف في علائق الأغنام البرقي بنسبة 50، 75 % مع اضافة انزيم fibrolytic لها تاثير ايجابي علي نسبة التصافي ونسبة البروتين في اللحوم.