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EVALUATION OF BARLEY INDUSTRIAL BY-PRODUCTS IN RATIONS OF GROWING LAMBS

El-Banna, H. M., A. M. Abdel Gawad and Wafaa, M.A.Ghoneem
Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

ABSTRACT

Thirty growing Ossimi lambs averaged 25 kg body weight, 9 months old were divided into 5 groups of 6 in each and allotted randomly to 5 tested rations. The animals in first group (control, R1) received concentrates mixture plus wheat straw. The second (R2) and the third (R3) rations contained discarded barley grains to cover 25 and 50%, respectively, of concentrates crude protein (CP) plus wheat straw. While, the fourth (R4) and the fifth (R5) rations contained radicel to cover 25 and 50%, respectively, of concentrates CP plus wheat straw.

EED and CFD were significantly increased and DMD was decreased when sheep fed R1. However, OMD, CPD and NFED did not change between the pervious ration and control. There were no significant differences between lambs fed control ration or those fed rations contained discarded barley grains in daily gain and growth rate. However, total DMI was the lowest for discarded barley grains rations. Lambs fed rations contained discarded barley grains and radicel had the highest rumen TVFA's. However, ruminal NH3-N and pH were not significantly changed. Creatinine and ALT (Alanine aminotransferase) were significantly increased for sheep fed rations contained radicel. However, there were no significant differences among control ration and the pervious rations in blood total protein, albumin, globulin and AST (Aspartate aminotransferase). The lowest feeding cost and the highest profit have been recorded for sheep fed rations contained discarded barley grains, especially for that fed R2. It was concluded that inclusion of discarded barley grains in sheep rations, to cover 25% of concentrates CP is recommended regarding nutrient digestibilities, performance and economic efficiency.

Keywords: discarded barley grains, radicel, Ossimi lambs, performance and digestion.

INTRODUCTION

In Egypt as well as developing countries, the gap between available and required animal feeds is wide. Moreover, the interference between human and livestock for feed is quite visible. Feed shortages are particularly acute with regard to protein. The sharp increases in the prices of the high quality protein sources such as soybean meal and fishmeal complexed economically the animal feeding. In order to correct the feeding balance in Egypt, all potentials must be directed to the utilization of agriculture residues and wastes as well as agro-industrial by-products either as it is or after treatment to be recycled in animal feeding. This is very important and the onely way to reduce feed shortages and decreases feeding cost. Consequently, the sale price of animal products could be decreased or maintained. Moreover, the use of such wastes and by-products may also diminish environmental pollution problems.

Barley radicel and discarded barley grains are characterized by high-energy values and also by relatively high protein contents (Pereira *et al.*, 1998). In Egypt, about 6550 tons of dried radicel are produced yearly (Al-Ahram for Manufacturing and Filling Co.). So, it is possible to use these by-products economically and successfully for formulating rations of farm animals. Also, these by-products are used as cheap ingredients to improve feed intake, digestibility and nutritive values of the ration and improve performance of growing animals (Hanafy, 1985, Ibrahim *et al.*, 1999, Zaki *et al.*, 1999 and El-Gendy *et al.*, 1999 and 2000).

Therefore, the present research was mainly outlined to study the effect of replacement of 25 and 50% from crude protein requirement of sheep ration by crude protein of radicel and discarded barley grains on the digestion, growth performance of lambs and economic efficiency.

MATERIALS AND METHODS

Growth trials

Experimental rations and animals

Thirty growing Ossimi lambs averaged (25-kg) body weight, 9 months old were divided randomly into 5 groups of 6 animals in each according to live body weight. The animals in first group (control, R1) received concentrates plus wheat straw without any replacement or addition. Rations of second (R2) and third (R3) groups contained discarded barley grains to cover 25 and 50%, respectively, of crude protein of R1. While, rations fed the fourth (R4) and the fifth (R5) groups contained radicel to cover 25 and 50%, respectively, of crude protein of R1.

All animals were offered concentrate feed mixture to cover 100% of their daily total requirements of protein as recommended by NRC, 1985,and wheat straw was offered *ad. lib*. The composition of experimental concentrate mixtures are shown in Table (1).

Table (1): Composition of experimental concentrate mixtures (kg/ton).

Ingredient	Experimental concentrate mixtures				
	R1	R2	R3	R4	R5
Yellow corn	650	445	260	552	544
Wheat bran	150	115	50	155	45
Soybean meal	75	80	44	55	5
Undecortecated cottonseed meal	75	52	80	40	60
Discarded barley grains	-	258	516	-	-
Radicel	-	-	-	148	296
Limestone	30	30	30	30	30
Minerals mixture	10	10	10	10	10
NaCL	10	10	10	10	10

During the period of growth trial (90 days) each group was fed once daily and water was allowed freely all the times. Orts were collected just before offering the next day's feed. Lambs were weighted biweekly before morning feeding after 17h fasting. Feed intake was recorded, and daily weight gain and feed efficiency were calculated.

Rumen liquor parameters: -

Rumen liquor samples were taken from 3 animals of each group randomly through stomach tube. The samples were taken just before morning feeding and then at 2, 4 and 6 h Post feeding. Rumen samples were filtered through two layers of cheesecloth to get clear liquid. The samples were taken immediately for pH determination then for NH_3-N and total valatile fatty acids (TVFA's).

Blood constituents: -

Blood samples were taken at the end of growth trial from the Jugular vein of each animal. Plasma samples were obtained by using Cal-Heparin anticoagulant and then samples were centrifuged at 3500 rpm for 10 minutes and frozen till analysis. Plasma samples were used to determine total protein (Henry *et al.*, 1974), albumin (Doumas *et al.*, 1971), and kidney and liver function via determination of creatinine (Folin, 1934), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) activities (Reitman and Frankel, 1957).

Metabolism trials: -

At the end of the growth trials, three animals of each group were used to evaluate the experimental rations through metabolism trials for 7 days collection period. The animals were fed individually in metabolic cages. During this trial the experimental rations were fed 90% of the voluntary feed intake measured previously in growth trials. Feces and urine were collected daily, then one tenth of daily feces weighed and excreted urine were taken. Urine samples were stored in tight bottles containing sulfuric acid 1:1 to capture NH_3 . N. Feces samples were weighed and dried at 60-70 °C in a hot air oven. The orts were weighed daily, meanwhile feed intake was calculated. Also, water consumption for each animal was recorded daily to estimate water balance. The dried samples of feces and feeds were grinded, and stored for chemical analysis. Consequently, the digestion coefficient and nutritive values of the experimental rations were calculated (Ghoniem, 1964).

Analytical methods: -

Triplicates samples were used for analysis . The proximate analysis of feeds and feces were carried out following the conventional methods of the A.O.A.C., 1990. The pH value of rumen liquor samples was determined by using pH meter (digital pH meter). Ammonia nitrogen in rumen liquor was determined according to Conway, 1957, and the TVFA's concentration was determined according to Warner, 1964.Plasma was analyzed coloimetrically for total protein (Henry *et al.*, 1974), albumin (Doumas *et al.*, 1971), globulin by difference, creatinine (Folin, 1934) , and AST and ALT according to Reitman and Frankel, 1957.

Statistical analysis: -

Data were analyzed statistically using the general linear model procedure of SAS, 1986, significant differences between means were separated by multiple range test Duncan, 1955.

RESULTS AND DISCUSION

Evaluation of the experimental rations

The chemical composition of ingredients, concentrate mixtures and the experimental rations are shown in Tables (2) and (3). The chemical composition of the experimental rations showed approximate values except R1, which had the lowest CF and highest NFE contents compared with the other rations. These results may be attributed to that discarded barley grains and radicel had high CF and low NFE contents compared with the control ration.

Table (2): Chemical composition of experimental concentrate mixtures ingredients (on DM basis).

Items	Chemical Composition, (%)					
	OM	CP	CF	EE	NFE	Ash
Concentrate mixtures						
R1	91.19	14.76	4.93	2.85	68.65	8.81
R2	90.95	14.24	7.80	2.84	66.07	9.05
R3	86.25	14.30	6.61	2.60	67.14	9.35
R4	90.60	15.06	5.81	2.55	67.18	9.40
R5	89.78	14.92	7.05	2.33	65.48	10.22
Wheat straw	88.90	2.16	40.64	0.50	45.60	11.10
Discarded barley grains	93.99	14.44	15.97	6.74	56.84	6.01
Radicel	95.24	24.66	16.51	7.43	46.64	4.76

Table (3): Chemical composition of experimental rations (concentrate mixtures + wheat straw) on DM basis.

Rations	Chemical Composition, (%)						
	OM	CP	CF	EE	NFE	Ash	GE* Mcal/kg
R1	90.93	13.34	8.96	2.58	66.05	9.07	4.15
R2	90.69	12.71	11.97	2.54	63.47	9.31	4.13
R3	86.52	13.05	10.12	2.38	64.86	9.59	4.11
R4	90.37	13.34	10.45	2.28	64.30	9.63	4.11
R5	89.66	13.17	11.65	2.08	6 2.76	10.34	4.07

***Determined as: 1 g protein = 5.65 kcal GE, 1 g carbohydrates = 4.20 kcal GE and 1 g lipids = 9.45 kcal GE (ADCP, 1983)**

Data concerning nutrients digestibilities and nutritive values are presented in Table (4). The inclusion of discarded barley grains or radicel in sheep rations were found to decrease DMD. However, OMD, CPD and NFED did not differ significantly with R2 compared with the control ration. In this respect, lambs fed R2 were found to have higher EED and CFD compared with those fed the control ration. No significant differences were detected in

TDN between R2 and the control ration. On the other hand, using either discarded barley grains (R2 and R3) or radicel (R4 and R5) in sheep rations were found to decrease the DCP values compared with the control.

Table (4): Digestion coefficients and nutritive values of the experimental rations (DM basis).

Item	Experimental rations				
	R1	R2	R3	R4	R5
Apparent digestibility,%					
Dry matter (DMD)	72.23^{a}	68.78^{b}	64.36^{c}	67.71^{bc}	67.05^{bc}
Organic matter (OMD)	75.69^{a}	74.00^{ab}	72.23^{bc}	70.84^{bc}	70.61^{c}
Crude protein (CPD)	73.05^{a}	73.48^{a}	68.97^{b}	66.67^{c}	63.35^{d}
Ether extract (EED)	78.68^{b}	85.75^{a}	60.67^{d}	63.45^{d}	71.86^{c}
Crude fiber (CFD)	38.25^{c}	50.27^{a}	25.21^{d}	48.75^{ab}	44.57^{b}
N-free extract (NFED)	80.61^{a}	79.11^{ab}	78.13^{bc}	75.98^{c}	76.84^{c}
Nutritive value, %					
Total digestible nutrients (TDN)	70.99^{a}	70.48^{a}	62.44^{c}	66.10^{b}	65.12^{b}
Digestible crude protein (DCP)	9.74^{a}	9.34^{b}	9.00^{c}	8.89^{c}	8.34^{d}

a,b,.... means on the same row with different super script are significantly ($p < 0.05$) different.

Growth performance

Data in Table (5) indicated that lambs fed either rations contained discarded barley grains or radicel were found to have lower total DMI compared with the control group. This decrease may be due to the high CF content in these rations. On the other hand, the decrease in total DMI in rations contained radicel (R4 and R5) may be due to the bitter flavor owing to the presence of the amino acid asparagine, which forms about one-third of the radicel crude protein (McDonald *et al.*, 1995).

The inclusion of both levels of discarded barley grains (R2 and R3) or the low level of radicel (R4) in sheep rations had no significant effect on daily gain. While it was lower with R5 compared with the control group.

Table (5): Effect of the experimental rations on growth performance of sheep.

Item	Experimental rations				
	R1	R2	R3	R4	R5
Feed intake/day					
Concentrate (DMI), g	996.8^{a}	942.8^{c}	938.2^{c}	952.1^{b}	944.6^{c}
Roughage (DMI), g	123.9^{c}	140.4^{a}	105.1^{e}	132.9^{b}	112.4^{d}
Total DMI, g	1120.7^{a}	1083.2^{b}	1043.3^{c}	1085^{b}	1057^{c}
Total digestible nutrients (TDN), g	795.6^{a}	763.4^{b}	651.4^{e}	717.2^{c}	688.3^{d}
Total digestible nutrients (TDN), g/ kg $W^{0.75}$	55.79^{a}	54.45^{a}	47.76^{c}	51.60^{b}	51.99^{b}
Crude protein, g	149.5^{a}	137.7^{b}	136.1^{b}	144.7^{ab}	139.2^{b}
Crude protein, g/kg $W^{0.75}$	10.48	9.82	9.98	10.41	10.51
Initial live body weight (I.B.W),kg	25.42	25.23	25.05	25.45	25.05
Final live body weight (F.B.W),kg	43.75^{a}	42.37^{b}	40.12^{d}	41.38^{c}	37.57^{e}
Total body gain, kg	18.33^{a}	17.13^{a}	15.10^{ab}	15.93^{ab}	12.52^{b}
Daily gain, g[1]	203.7^{a}	190.4^{a}	167.8^{ab}	177.0^{ab}	139.1^{b}
Growth rate[2], %	72.11^{a}	67.89^{b}	60.28^{d}	62.59^{c}	49.98^{e}
Feed conversion, Kg /Kg					
DMI / daily gain	5.50^{c}	5.69^{c}	6.22^{b}	6.13^{b}	7.60^{a}
TDN intake / daily gain	3.90	4.01	3.88	4.05	4.95

[1] Daily gain: total gain, g / 90 days. [2] Growth rate: total gain, kg / I.B.W., kg

No significant differences were observed in feed conversion when lambs fed on R2 compared with the control group. However, the groups R3, R4 and R5 showed less feed conversion.

Rumen liquor parameters

Lambs fed the tested rations were found to have higher ruminal NH_3-N concentrations compared to the control group (Table, 6). The increase in ruminal NH_3-N in radicel rations may be due to the rapid degradation of CP in radicel due to the soaking process of barley for 2 or 3 days in warm water to germinate and obtain radicel, the endosperm of the grain is partly degraded by enzymes of several types such as enzymes dealing with nitrogen (proteases, peptidases, nucleases and phosphatases)(El-Boushy and Vander poel, 2000). Also, the soaking process may be due to break the bonds between protein and phytic acid, which cause increase in CP degradability.

Lambs fed the tested rations had higher TVFA's concentration than the control group. On the other hand, no significant differences were detected in TVFA's concentrations between R3, R4, R5 and the control group. Using 25% either discarded barley grains or radicel were found to have a significant effect on ruminal pH compared to the control group at 0 and 6 hrs time.

Table (6): Effect of the experimental rations and sampling time on rumen liquor parameters

Item	Time of sampling (hrs)	Experimental rations				
		R1	R2	R3	R4	R5
NH_3-N (mg/100ml rumen liquor)	0	7.52^{b}	10.99^{a}	7.65^{b}	9.49^{ab}	11.95^{a}
	2	10.93^{c}	18.99^{a}	15.59^{b}	11.29^{c}	17.02^{ab}
	4	7.53^{c}	13.97^{b}	9.14^{c}	7.76^{c}	18.62^{a}
	6	4.48^{b}	5.19^{b}	9.10^{a}	5.38^{b}	5.91^{b}
	Mean	7.61^{e}	12.29^{b}	10.37^{c}	8.48^{d}	13.39^{a}
	0	4.83^{ab}	5.91^{a}	5.25^{ab}	5.25^{ab}	4.25^{b}
	2	6.57	8.72	6.89	6.74	7.01
	4	6.19	8.05	7.66	7.70	7.73
TVFA's (meq/100ml rumen liquor)	6	5.22^{b}	7.35^{a}	5.89^{ab}	6.61^{ab}	6.72^{ab}
	Mean	5.70^{b}	7.51^{a}	6.42^{ab}	6.57^{ab}	6.43^{ab}
	0	7.77^{a}	7.36^{b}	7.54^{ab}	7.40^{b}	7.76^{a}
	2	6.74	6.62	7.11	6.97	6.48
	4	6.89	6.43	6.93	6.60	6.62
Rumen pH	6	7.17^{ab}	6.53^{c}	7.56^{a}	6.89^{bc}	7.20^{ab}
	Mean	7.14	6.73	7.29	6.96	7.02

Nitrogen balance

Data concerning nitrogen balance in Table (7) showed that using either discarded barley grains or radicel in sheep rations were found to decrease nitrogen intake compared to the control. Lambs fed on R3, R4 or R5 were found to have higher total nitrogen excreted, however, R2 was lower compared with the control group.

Table (7) : Effect of the experimental rations on nitrogen balance.

Item	Experimental rations				
	R1	R2	R3	R4	R5
Live body weight, kg	48.00^{a}	46.00^{b}	44.83^{c}	45.00^{c}	44.50^{c}
Metabolic body weight, kg	18.24	17.66	17.32	17.37	17.23
N-intake,					
g/head	25.55^{a}	22.99^{d}	24.88^{b}	24.87^{b}	23.43^{c}
g/ kg	0.53	0.50	0.55	0.55	0.53
g/ kg $W^{0.75}$	1.40	1.30	1.44	1.43	1.36
N-excreted, g/ day/ head					
1- In feces	6.57^{b}	6.48^{b}	7.28^{ab}	8.28^{a}	8.59^{a}
2- In urine	12.01^{ab}	10.28^{b}	12.55^{a}	11.70^{ab}	10.91^{ab}
3- urine / feces ratio	1.83^{a}	1.59^{ab}	1.72^{a}	1.41^{bc}	1.27^{c}
Total N-excreted,					
g/head	18.58^{b}	16.76^{c}	19.83^{a}	19.98^{a}	19.50^{ab}
g/ kg	0.39	0.36	0.44	0.44	0.44
g/ kg $W^{0.75}$	1.02^{b}	0.95^{b}	1.14^{a}	1.15^{a}	1.13^{a}
Nitrogen balance,					
g/head	6.97^{a}	6.23^{ab}	5.05^{bc}	4.89^{bc}	3.93^{c}
g/ kg	0.14	0.14	0.11	0.11	0.09
g/ kg $W^{0.75}$	0.38^{a}	0.35^{ab}	0.29^{bc}	0.28^{bc}	0.23^{c}

The obtained results of nitrogen balance were found to be positive and were decreased by using either the high level of discarded barley grains (R3) or both levels of radicel (R4 and R5) compared with the control ration. Such result was reflected on growth rate.

Blood parameters

It was observed from Table (8) that there were no significant differences in blood total protein and albumin values among all the experimental groups. Blood globulin and AST concentrations did not differ significantly between R2, R5 and the control group. On the other hand, R3 had the lowest values of globulin and AST. Lambs fed on R5 had the highest blood creatinine and ALT concentrations compared to the control group.

Table (8): Effect of the experimental rations on blood parameters.

Item	Experimental rations				
	R1	R2	R3	R4	R5
Total protein (g/dl)	6.76	6.24	5.96	6.37	6.59
2.55	2.57	2.43		2.90	2.54
Globulin (g/dl)	4.19^{a}	3.81^{ab}	3.41^{b}	3.47^{b}	4.05^{a}
Creatinine (mg%)	1.26^{b}	1.19^{b}	1.11^{b}	1.18^{b}	2.00^{a}
AST (U/l)	63.40^{a}	61.34^{ab}	60.00^{b}	64.53^{a}	63.67^{a}
ALT (U/l)	15.83^{d}	16.05^{d}	18.95^{b}	17.52^{c}	20.62^{a}

The present results concerning blood metabolites in lambs fed untraditional source of protein indicated no adverse effects on tested blood parameters of lambs due to inclusion of discarded barley grains or radicel since these values of blood parameters of sheep are within the normal physiological ranges which reported by Kaneko *et al.*, 1997.

Water retention

Data in Table (9) illustrated that no significant differences were observed in total water intake between lambs fed on R2, R3, R4 and the control. However, R5 had the lowest total water intake. Total water excreted was found to the control group. Lambs fed on R2 had the highest water retention compared to the control group. While, those fed on R5 had the lowest value.

The economical evaluation

There was no significant difference in profit when lambs fed either R2, R3, R4 or the control ration. On the other hand, lambs fed R5 were found to have the lowest profit (Table, 10).

Feed cost per 1 kg gain did not affected by adding radicel in sheep rations (R4 and R5) compared with the control group. However, rations contained discarded barley grains (R2 and R3) were found to be lower in feed cost per 1 kg gain compared with the control.

Table (9): Effect of the experimental rations on water retention.

Item	Experimental rations				
	R1	R2	R3	R4	R5
Dry matter intake, g	1198^{a}	1130^{d}	1191^{b}	1165^{c}	1111^{e}
B.W$^{0.82}$, kg	23.91	23.09	22.60	22.67	22.47
water intake,					
• In feed concentrate	118	103	117	108	104
• In feed roughage	13	14	12	15	15
• Drinking water	2918	2488	2796	2565	1897
Total,					
ml/day	3049^{a}	2605^{ab}	2925^{a}	2688^{ab}	2016^{b}
ml/ w $^{0.82}$ kg	127.52^{a}	112.82^{ab}	129.42^{a}	118.57^{ab}	89.72^{b}
ml/g DMI	2.55	2.31	2.46	2.31	1.81
water excreted,					
• in urine	969	514	947	954	624
• in feces	570	413	602	766	694
Total,					
ml/day	1539^{c}	927^{e}	1549^{b}	1720^{a}	1318^{d}
ml/ w $^{0.82}$ kg	64.37^{c}	40.15^{e}	68.54^{b}	75.87^{a}	58.65^{d}
ml/g DMI	1.28^{ab}	0.82^{b}	1.30^{ab}	1.48^{a}	1.19^{ab}
[1]Water retention, ml/day	1510^{b}	1678^{a}	1376^{c}	968^{d}	698^{e}

[1]Water retention = total water intake – total water excreted

Ingredients price per Ton at 2002 were : 650 yellow corn, 480 wheat bran, 1200 soybean meal, 760 cotton seed meal, 180 discarded barley grains, 450 radicel, 50 limestone. 2000 minerals, 150 Nacl and 300 wheat straw.

[1] Price of kg live body weight = 12 LE.

[2] Profit = price of daily weight gain – total feed cost/day.

Table (10): Feed cost and economic evaluation of feeding the experimental rations to sheep.

Item	Experimental rations				
	R1	R2	R3	R4	R5
Feed intake, kg/h/day					
Concentrate mixture	1.108	1.052	1.048	1.044	1.040
Roughage	0.136	0.146	0.124	0.154	0.116
Feed cost, LE/h/day					
Concentrate mixture	0.74	0.58	0.44	0.65	0.61
Roughage	0.04	0.04	0.04	0.05	0.03
Total	0.78^{a}	0.62^{b}	0.48^{c}	0.70^{ab}	0.64^{b}
Initial live body weight, kg	25.42	25.23	25.05	25.45	25.05
Final live body weight, kg	43.75	42.37	40.12	41.38	37.57
Total body gain, kg	18.33^{a}	17.13^{a}	15.10^{ab}	15.93^{ab}	12.52^{b}
Daily gain, kg	0.204^{a}	0.190^{a}	0.168^{ab}	0.177^{ab}	0.139^{b}
[1]Price of daily gain, LE/kg	2.45^{a}	2.28^{a}	2.02^{ab}	2.12^{ab}	1.67^{b}
[2] Profit, LE/h/day	1.67^{a}	1.66^{a}	1.54^{ab}	1.42^{ab}	1.03^{b}
Feed cost/gain, LE/kg	3.82^{ab}	3.26^{b}	2.86^{b}	3.95^{ab}	4.60^{a}

CONCLUSION

it could be concluded that discarded barley grains or radicel could be used to cover 25% from crude protein of concentrate feed mixture in sheep rations to decrease the feed cost and to increase the feed ingredients resources for sheep feeding.

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تقييم بعض مخلفات تصنيع الشعير في علائق الحملان النامية

هشام محمد عبد الجواد البنا،عبد الرحمن محمود عبد الجواد ،وفاء مصطفى على غنيم.
قسم الانتاج الحيوانى – كلية الزراعة – جامعة القاهرة – الجيزة – مصر.

أجريت هذه الدراسة على ٣٠ حمل أوسيمي بمتوسط وزن ٢٥ كجم ، عمر ٩ شهور. تم تقسيمهم إلي ٥ مجموعات (٦ حيوانات في كل مجموعة) ، تم توزيع هذه المجاميع عشوائيا على العلائق المختبرة. الحيوانات في المجموعة الأولى تم إعطاءها مخلوط العلف المركز بالإضافة لتبن القمح (العليقة المقارنة). الحيوانات في المجموعة الثانية والثالثة تم إعطاءها علائق احتوت على فرز الشعير ليغطى ٢٥ و ٥٠ % ، بالترتيب من البروتين الخام بالعلف المركز بالإضافة لتبن القمح. الحيوانات في المجموعة الرابعة و الخامسة تم إعطاءها علائق احتوت على الراديسيل ليغطى ٢٥ و ٥٠ % ، بالترتيب من البروتين الخام بالعلف المركز بالإضافة لتبن القمح. الهدف من هذه الدراسة هو اختبار تأثيرات الإحلال ٢٥ و ٥٠ % من البروتين الخام الموجود بالراديسيل و فرز الشعير على الهضم، نمو الحملان و الكفاءة الاقتصادية.
ارتفع معامل هضم مستخلص الأثير و الألياف الخام بينما انخفض معامل هضم المادة الجافة في الحيوانات التي تغذت على العليقة الثانية مقارنة بالعليقة المقارنة. بينما لم يكن هناك اختلاف في معامل هضم المادة العضوية، البروتين الخام و المستخلص الخالي من الازوت. لم تختلف معنويا الحملان التي تغذت على العليقة المقارنة أو العلائق المحتوية على فرز الشعير في الزيادة اليومية في وزن الجسم و معدل النمو. في حين أن الحملان المغذاة على علائق فرز الشعير أعطت أقل قيمة للمادة الجافة الكلية المأكولة. الحملان التي تم تغذيتها على علائق فرز الشعير و الراديسيل أعطت أعلى قيمة للأحماض الدهنية الطيارة الكلية بالكرش. بينما لم يختلف نيتروجين الامونيا و pH الكرش معنويا بين هذه المجاميع. ارتفع الكرياتينين و ALT معنويا في دم الأغنام التي غذيت على علائق الراديسيل. في حين أنه لم يكن هناك اختلاف معنوي بين العلائق السابقة و العليقة المقارنة في البروتين الكلى، الالبيومين، الجلوبيولين و AST بالدم. تم تسجيل أقل قيمة لتكاليف التغذية و أعلى قيمة للفائدة للأغنام التي تم تغذيتها على علائق احتوت على فرز الشعير خاصة تلك التي تم تغذيتها على العليقة الثانية. و بهذا يمكن التوصية باستخدام فرز الشعير في علائق الأغنام خاصة لتغطى ٢٥ % من البروتين الخام بالعلف المركز.