

RESPONSES IN BLOOD CONSTITUENTS, LACTATION PERFORMANCE AND LAMB GROWTH TO DIFFERENT LEVELS OF BARLEY RADICLE IN RATIONS OF RAHMANI EWES.

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ABSTRACT

Fifteen Rahmani ewes (38.9 ± 1.21 kg live body weight) belonging to the Agriculture Experimental and Research Station, Faculty of Agriculture, Cairo University were included in an experiment. The aim was to study the effect of inclusion of barley radicle (BR) as a partial substitution of the crude protein of the concentrate feed mixture at zero (control), 20 or 40 % levels on blood constituents, milk yield and composition. Changes in ewe weight and growth performance of lambs were also studied. The experiment started 4 weeks before expected lambing date and continued through lactation till the weaning of born lambs at the 90th day after lambing.

Plasma urea and creatinine in mg %, total protein, albumin and globulin concentrations in g % did not differ significantly among treatments. Plasma GOT activity increased ($P < 0.01$) with the 20% BR level compared to the other groups while GPT activity was almost similar for all treatments. Hematocrit % did not differ significantly among treatments while hemoglobin % was decreased by 2.8 and 6.4 % relative to the control due to inclusion of 20 and 40 % BR in ewes diets.

Daily milk yield increased by 12.3 and 21.6 % due to inclusion of BR at 20 and 40 %, respectively compared to the control ewes. Milk total solids %, fat % and gross energy per kg milk tended to increase with the increase in BR level in ewe's diets. Milk protein % was almost similar for the two BR groups with a tendency to be higher (7.8 %) than the control. Milk lactose % decreased ($P < 0.01$) with the high BR level.

Lamb birth weight tended to increase non-significantly with the increased level of BR. Average daily gain, weight gain till 90 days old and weaning weight of born lambs increased with the level of BR in ewe's diets but the increase was significant ($P < 0.05$) with the high level only compared to the control.

It could be concluded that barley radicle can be used up to 40 % of crude protein of the concentrate feed mixture in ewes rations to improve lactation performance and growth of born lambs with decreasing feed cost without any adverse effects in studied physiological functions.

Keywords: barley radicle, Rahmani ewes, lactation, growth and blood constituents.

INTRODUCTION

Untraditional protein sources such as agro-industrial by-products can be used in animal feeding to overcome the gap in traditional protein sources in Egypt. Fermentation of barely to produce beer beverages produces some of these by-products (malt culms, brewers' grains, spent hops and brewers' yeast, McDonald, *et al.* 1995).

Barley malt culms or also called barley rootlets, barley sprouts or barley radicle consist of the plumule and radicle of barley and are relatively rich in crude protein (about 280 g/ kg DM) but they are not a high energy food

and are of fibrous nature and when mixed with other foods, they are accepted readily by animals (McDonald, *et al.* 1995).

In the present study we chose barley radicle as an untraditional source of protein due to its high content of crude protein and also due to its estimated significant quantity produced in Egypt (500 ton / year, Al-Ahram Company for Beverages, Giza, Egypt).

The objectives of the present work were to investigate the effects of partial substitution of concentrate feed mixture crude protein by barley radicle crude protein in rations of Rahmani ewes on their performance in terms of blood constituents, milk yield and composition, changes in ewes weight and growth performance of suckling born lambs. The impact of such substitution on feed cost was also studied.

MATERIALS AND METHODS

Animals

Fifteen multiparous pregnant Rahmani ewes weighed 38.9 ± 1.21 Kg, at 4 weeks prior to expected lambing date belonging to the Agriculture Experimental and Research Station, Faculty of Agriculture, Cairo University were used in this trial. Ewes were divided into three equal symmetric groups according to live body weight and parity (3-5 parities). Ewes were housed in large pens, each group in a separated pen while born lambs (single lamb for each ewe) were left with their dams all time.

Treatments and diets

Experimental treatments were zero (control), 20 or 40 % of the concentrate feed mixture crude protein of the daily rations was replaced by barley radicle (BR) protein. The three experimental rations were iso-caloric and iso-nitrogenous. Ewes were fed as a group with their daily requirements of ME and crude protein according to NRC allowances (1985). The daily rations included two portions, the concentrate and roughage (Table 1). Chemical analysis of ingredients and experimental rations were determined according to AOAC (1996) and is given in (Table 2).

Table 1. Ingredients of the experimental rations on dry matter basis

Ingredients, %	Treatments		
	Control	20% BR	40% BR
CFM*	50	40	30
Barley	15	14	17
Barley radicle	--	5	10
Egyptian clover	18	17	15
Rice straw	17	28	28

*Concentrate feed mixture consisted of (as fed): 36 % yellow corn, 12 % cotton seed meal, 5 % soybean meal, 6 % sunflower meal, 23 % wheat bran, 13 % rice bran, 3 % molasses, 1 % limestone, 0.5 % sodium chloride and 0.5 % mineral mixture.

Table 2. Chemical composition and nutritive value of ingredients and experimental rations

Item	DM	Nutrients, % of DM						ME, Kcal/Kg DM
		OM	Ash	CP	CF	EE	NFE	
CFM	90.56	92.60	7.40	16.33	9.90	3.42	62.95	2.54 ^a
Barley	91.67	96.60	3.40	9.60	8.51	1.96	76.52	3.15 ^a
Barley Radicle	94.02	91.82	8.18	31.95	13.28	1.23	45.35	2.68 ^b
Egyptian clover	16.50	87.70	12.30	15.15	25.55	2.10	44.9	1.95 ^a
Rice straw	92.71	81.61	18.39	3.73	36.60	1.52	39.76	1.56 ^a
Ration 1 (control)	100	90.45	9.55	12.97	17.05	2.64	57.79	2.36
Ration 2 (20% BR)	100	92.92	11.09	13.09	20.41	2.49	56.93	2.36
Ration 3 (40% BR)	100	89.39	10.61	13.09	19.83	2.22	54.30	2.30

^a Using TDN values of Abou Raya (1967) and using a value of 3.608 Mcal ME / Kg TDN (NRC, 1985). ^b According to McDonald, *et al.* (1995)

Management

Ewes were introduced to treatments four weeks prior to the expected lambing date. Egyptian clover (*Trifolium alexandrinum*) was offered once daily at 8 a.m. while the concentrate was offered at 10 a.m. Rice straw was offered at 2 p.m. meanwhile fresh water was available all time. Ewe live body weights were recorded at the beginning of the experiment, at lambing and in biweekly intervals thereafter till weaning of their lambs. Born lambs were weighed at birth and at biweekly intervals thereafter till weaning at 90 days old.

Estimation of milk yield and composition

Milk yield was determined weekly for each ewe till weaning of the born lambs using lamb suckling technique described by Owen and Ingleton (1963)). Milk samples were collected weekly from each ewe after separating the offspring for 8 hours and were frozen immediately (-20°C) till analyzed for total solids, fat, solids not fat, protein and lactose in g/100ml, using Milkoscan®, 133 B, N. Foss Electric, Denmark. Gross energy of milk was calculated according to energy values of fat, protein and lactose (McDonald *et al.*, 1995).

Blood sampling

Blood samples were withdrawal at four weeks prepartum, at delivery of lambs and biweekly thereafter till lamb weaning using EDTA as anticoagulant. Values of Blood heamatocrit (Frankel and Reitman, 1963), and hemoglobin (Benjamin, 1985) were determined immediately using the whole blood, while the rest of blood samples were centrifuged at 3000 rpm for 20 minutes to separate plasma which was frozen (20°C) till analysis. Plasma was analyzed colorimetrically for total protein (Henry, *et al.*1974), albumin (Doumas *et al.*, 1971), globulin and A/G ratio by calculation, urea (Fawcett and Scott, 1960), creatinine (Bartles, *et al.* 1972) and glutamic oxalacetate transaminase (GOT) and glutamic pyruvate transaminase (GPT) (Reitman and Frankel, 1957).

Statistical analysis

Data were analyzed using general linear model of SAS (1998) for personal computers, while differences among treatment means were tested using Duncan (1955).

RESULTS AND DISCUSSION

Responses in blood constituents

Results of measured blood parameters are given in Table 3. Heamatocrit values did not differ significantly among treatments while those of hemoglobin were marginally decreased due to inclusion of 20 or 40 % BR levels (2.67 and 5.98 %, respectively). This might be due to the relatively low iron content of barley rootlets (0.10 g/ Kg DM) as reported by Salama *et al.* (1997). Moreover, Frandson and Spurgeon (1992) stated that most of the iron that absorbed from the diet by epithelial cells of the duodenal mucosa after the food leaves the stomach goes to the bone marrow to become part of the heme molecule for developing erythrocytes. They also showed that, the female gives up iron to the developing fetus during pregnancy and during nursing of the new born.

Table 3. Responses in blood constituents of ewes fed barley radicle in different levels

Items	Treatments		
	Control (0 %)	20 % BR	40 % BR
Heamatocrit, %	35.1 ± 1.34 ^a	36.2 ± 1.19 ^a	33.1 ± 1.09 ^a
Hemoglobin, g%	14.21 ± 0.30 ^a	13.83 ± 0.27 ^{ab}	13.36 ± 0.25 ^b
Total protein, g%	6.95 ± 0.29 ^{ab}	6.47 ± 0.26 ^b	7.28 ± 0.23 ^a
Albumin, g%	2.59 ± 0.06 ^a	2.71 ± 0.06 ^a	2.60 ± 0.05 ^a
Glubulin, g%	4.22 ± 0.24 ^a	3.80 ± 0.21 ^a	4.36 ± 0.19 ^a
A/G ratio	0.72 ± 0.07 ^{ab}	0.86 ± 0.06 ^a	0.65 ± 0.05 ^b
Urea, mg%	42.0 ± 1.8 ^a	41.9 ± 1.7 ^a	42.4 ± 1.5 ^a
Creatinine, mg%	0.70 ± 0.06 ^a	0.77 ± 0.05 ^a	0.70 ± 0.05 ^a
GOT, U/L	81.9 ± 4.0 ^b	102.8 ± 3.6 ^a	78.5 ± 3.3 ^b
GPT, U/L	15.3 ± 1.3 ^a	18.6 ± 1.2 ^a	18.4 ± 1.1 ^a

Means in the same raw with different superscript differ (P<0.05).

The response in plasma proteins concentrations due to BR feeding (40%, level) was in term of slight increase while values of plasma albumin and globulin were not affected by treatment. Meanwhile values of A/G ratio decreased (P<0.05) with the high level of BR. Yousef and Zaki (2001) found a significant (P<0.05) increase in plasma total protein and albumin when barley radicle was included in diets of Friesian cross bred calves at 15 and 30 % levels of concentrate feed mixture. In contrary, El Hussein, *et al.* (1997) and El Ghamry *et al.* (1999) reported a decline in plasma proteins of rabbits fed diets containing BR.

The activity of plasma GPT was increased insignificantly with BR inclusion, while the lowest GOT activity was recorded for ewes fed 40 % BR. No significant differences were observed among treatments in plasma urea and creatinine concentrations related to BR feeding. The present results are in accordance with those reported by Yousef and Zaki (2001), who found a slight increase in GPT of blood and no changes in both GOT activity and creatinine without exceeding their normal physiological levels in Friesian calves fed BR.

The present results concerning blood metabolites in ewes fed untraditional source of protein (BR) indicated no adverse effects on ewes due to inclusion of BR since these values are within the normal physiological ranges reported for normal healthy sheep. These normal ranges of blood constituents in sheep were 6- 8 g / dl (total protein), 8- 20 mg/ dl (urea nitrogen), 1- 2 mg/ dl (creatinine) and 11.5 g/ dl (hemoglobin) (Reece, 1992).

Milk yield and composition

Results of milk yield, milk composition and gross energy of milk are given in Table 4. Inclusion of 20 or 40 % BR as a partial substitution of concentrate feed mixture crude protein increased milk yield of ewes by 12.3 and 21.6 % over the control, respectively. However, these differences were non-significant, which may be attributed to the high variability among individual ewes within treatments in milk yield. Also, this variability might be due to the different genetic ability of the individuals to the biosynthesis of milk. But these increases in milk yield may suggest the increase in the available nutrients to the mammary gland. The nutritive value of BR was studied exclusively by Salama *et al.* (1997), who reported that barley rootlets is rich in calcium (19.9 g/ Kg DM) and in protein (31.9 %) which had essential amino acids of about one- third of the total amino acids and it is considered to have a good nutritive value (low phytic acid and polyphenols content).

Table 4. Milk yield, constituents and gross energy of ewes fed barley radicle in different levels

Items	Treatments		
	Control (0% BR)	20% BR	40% BR
Milk yield, g/d	587.3 ^a ± 57	659.7 ^a ± 51	714.2 ^a ± 46
Total solids, %	13.89 ^a ± 0.4	14.51 ^a ± 0.4	14.72 ^a ± 0.3
Fat, %	5.24 ^b ± 0.3	5.85 ^{ab} ± 0.3	6.23 ^a ± 0.3
SNF, %	8.65 ^a ± 0.3	8.66 ^a ± 0.3	8.49 ^a ± 0.2
Protein, %	4.08 ^a ± 0.2	4.40 ^a ± 0.2	4.39 ^a ± 0.2
Lactose, %	3.62 ^{ab} ± 0.1	3.96 ^a ± 0.1	3.29 ^b ± 0.1
Gross energy, Kcal/ Kg milk	879 ^a ± 31	929 ^a ± 28	954 ^a ± 25

Means in the same raw with different superscript differ (P<0.05).

Percentages of milk constituents were improved with BR feeding except for Solids not fat which was not affected by the treatment. Gross energy per Kg milk increased by 5.68 % and 8.53 % over the control due to BR inclusion at 20 and 40 %, respectively. Milk gross energy is a good measure of the nutritive value of milk, which reflects the increase in milk components particularly fat percent, which in turn reflects the superiority of diets containing BR.

Ewe weight and lamb growth performance

Changes in ewe weight during late pregnancy and lactation period are illustrated in Figure 1. The initial body weight of pregnant ewes was similar for all groups, while the final body weight at the 90th day after lambing was increased by 3 % and 7 % due to BR inclusion at 20 and 40 % levels, respectively. The overall mean of different recorded ewe weights throughout the experiment as a result of BR inclusion in the diets were 31.5, 33.5 and 35.9 Kg for control (zero %), 20 % and 40 % BR diets, respectively.

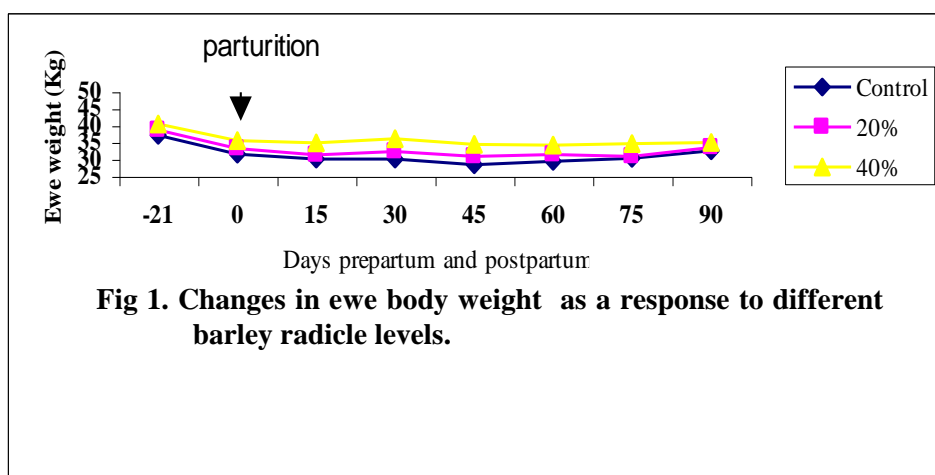


Fig 1. Changes in ewe body weight as a response to different barley radicle levels.

Differences among means showed a significant ($P<0.05$) increase in ewe weight with the level of BR. Better ewe live body weight changes, which accompanied BR inclusion, may reflect a high feed efficiency and a superiority of BR protein relative to the control diet.

Results of lamb growth performance as a response to feeding their dams on BR are represented in Table 5. Lamb birth weight was linearly increased with the increase in BR levels in their dam's diet. The magnitude of the increase in lamb birth weight was 17.57 % and 21.41 % for 20 and 40 % BR level, respectively over the control. However, these differences were non-significant, which may attributed to the short feeding period of their dams prior to lambing. Average daily gain, Weight gain and weaning weight of born lambs were higher significantly ($P<0.05$) in both BR treatments compared to the control.

Table 5. Responses in lamb growth due to inclusion of barley radicle at different levels in daily rations of their dams

Items	Treatments		
	Control (0% BR)	20% BR	40% BR
Birth weight, Kg	3.13 ^a ± 0.25	3.68 ^a ± 0.22	3.80 ^a ± 0.20
Weaning weight, Kg	14.11 ^b ± 0.78	16.07 ^{ab} ± 0.70	17.12 ^a ± 0.64
Weight gain, Kg	10.98 ^b ± 0.66	12.36 ^{ab} ± 0.59	13.32 ^a ± 0.54
Average daily gain, g	122 ^a ± 7.10	138 ^{ab} ± 6.30	148 ^a ± 5.80

Means in the same raw with different superscript differ ($P<0.05$).

Actually, responses in lamb growth is a good indicator to the enhancement of efficiency of the ewe mammary gland to produce more milk with higher gross energy which may reflect a higher feed utilization and better protein quality in BR diets. Yousef and Zaki (2001) estimated nutrient digestibility and nutritive values of diets containing 15 and 30 % BR using Rahmani sheep. They reported non-significant increase in DM, OM and CP digestibility with BR feeding with a significant increase in crude fiber digestibility. Better digestibility of BR containing diets may explain the better performance of ewes and their suckling lambs.

Economic evaluation

Data on the economics of barley radicle inclusion in Rahmani ewe's diets are given in table 6. Lamb yield as Kg weaned per group for the 20 and 40% groups were higher than the control by 13.9 and 21.3 %, respectively (Table 5). In addition, feed consumed was the same for all ewe groups throughout the experiment being the cheapest with 40 % BR followed by 20 % BR as compared to the control. So, feed cost either per Kg weaned or per Kg lamb growth was the lowest with 40 % BR followed by 20 % BR compared to the control. Ibrahim, *et al.* (1999) reported that replacing up to 10 % of barley in rabbit diets by barley radicle decreased feed cost. Also, Yousef and Zaki (2001) found that, the net return was increased by 24 % due to replacing concentrate feed mixture in diets of Friesian crossbred calves by BR at 15 % level. Better lamb yield and low cost ration resulted in more efficient management.

Table 6. Economics of inclusion of barley radicle in Rahmani ewes rations

Item	Treatments		
	Control	20% BR	40% BR
No. of ewes	5	5	5
Weaning weight, Kg	14.11	16.07	17.12
Kg weaned/ group	70.55	80.35	85.60
Feed consumed/ group ¹ , g	1028	1028	1028
Feed consumed/ Kg weaned	14.57	12.79	12.01
Feed cost / Kg weaned ² , L.E.	7.62	6.05	5.17
Feed cost/ Kg growth, L.E.	9.79	7.86	6.66
Relative feed cost ³	100	79.40	67.85

¹For each group, each ewe was fed 1.475 Kg DM/d during the 4 weeks prior lambing, 2 Kg DM/d during the first 60 day of lactation and 1.475 Kg DM/d during the final 30 d of lactation.

²On the basis of prices of rations ingredients (as fed basis) of 0.60 L.E. for Kg CFM, 0.45 L.E. for Kg barley, 0.40 L.E. for Kg Barley Radicle, 0.10 L.E. for Kg Egyptian clover and 0.05 L.E. for Kg rice straw.

³Assuming that feed cost per Kg weaned of the control equals 100.

CONCLUSION

It can be concluded that partial substitution of concentrate feed mixture crude protein by barley radicle crude protein up to 40 % in the daily rations of Rahmani ewes had a positive effects on ewes weight during late pregnancy and lactation, lactation performance, birth and weaning weight of the born lambs without any harmful or adverse effects on their normal physiological parameters, including liver and kidney functions. The BR diets were well palatable and ewes were accustomed to it just from the first day of feeding. Finally, the BR diets were more economically feasible.

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الاستجابات المختلفة في مكونات الدم و إدرار اللبن و تركيبه و نمو الحملان الرضيعة نتيجة استخدام مستويات مختلفة من راديسيل الشعير في علائق النعاج الرحماني.

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أستخدم في هذه التجربة عدد ١٥ نعجة رحماني (٣٨,٩ ± ١,٢١ كجم وزن حي) من مزرعة محطة التجارب و البحوث الزراعية التابعة لكلية الزراعة جامعة القاهرة لدراسة تأثير الاستبدال الجزئي لبروتين مخلوط العلف المركز في العليقة اليومية ببروتين راديسيل الشعير بمستويات صفر (المقارنة) و ٢٠ أو ٤٠ % علي بعض القيم الفسيولوجية ببلازما الدم و محصول اللبن و تركيبه و التغيرات في وزن النعاج و كذلك نمو الحملان. وقد بدأت التجربة قبل ميعاد الولادة المتوقع بمدة أربعة أسابيع و استمرت حتى فطام الحملان المولودة (حمل لكل أم) علي عمر ٩٠ يوما.

و قد أوضحت النتائج أن تركيز اليوريا و الكرياتينين (ملجم %) و البروتين الكلي و الألبومين و الجلوبيولين (جم %) ببلازما الدم لم يختلف معنويا بين المعاملات بينما ازداد نشاط أنزيم GOT معنويا ببلازما الدم مع استخدام مستوي ٢٠ % من راديسيل الشعير مقارنة بباقي المجموع و لكن لم يتأثر نشاط أنزيم GPT بالمعاملات المختلفة.

لم تختلف قيمة هيماتوكريت الدم بين المعاملات معنويا بينما انخفض تركيز هيموجلوبين الدم بمقدار ٢,٨ و ٦,٤ % عند استخدام الراديسيل بمستوي ٢٠ و ٤٠ % علي التوالي.

تزايد محصول اللبن اليومي بمقدار ١٢,٣ و ٢١,٦ % نتيجة استخدام راديسيل الشعير بنسبة ٢٠ أو ٤٠ % علي التوالي مقارنة بمجموعة المقارنة أما النسب المئوية لمكونات اللبن المختلفة ماعدا اللاكتوز و كذلك محتوى اللبن من الطاقة الكلية اتجهت إلى الزيادة في لبن النعاج المغذاة علي العلائق المحتوية علي راديسيل الشعير. أنخفض محتوى اللبن من اللاكتوز مع المستوي العالي من راديسيل الشعير.

ازداد وزن ميلاد الحملان بزيادة مستوي الراديسيل بعليقه الأمهات و كذلك ازداد كل من معدل النمو اليومي و الزيادة الكلية في الوزن الحي حتى الفطام ووزن الفطام للحملان نتيجة استخدام الراديسيل في علائق الأمهات حيث كانت الزيادة معنوية مع المستوي العالي من الراديسيل.

من هذه الدراسة يمكن استخلاص أنه يمكن استخدام راديسيل الشعير كمصدر للبروتين الخام في علائق النعاج الرحماني بمستويات تصل إلى ٤٠ % من بروتين مخلوط العلف المركز حيث ينعكس ذلك علي تحسين إدرار النعاج اللبن مما ينعكس علي تحسين نمو الحملان الرضيعة ووزن الفطام وفي نفس الوقت يؤدي إلى انخفاض تكلفة الغذاء.