Substituting Bread By-product for Barley Grain in Fattening Diets for Baladi Kids

S. G. Haddad* and K. I. Ereifej[1]

Dept. of Animal Production, Faculty of Agriculture, Jordan University of Science and Technology

P O Box 3030, Irbid 22110, Jordan

ABSTRACT : The objectives of this study were to determine the effects of substituting bread by-product (BBP) for barley grain in high concentrate fattening diets for kids on nutrient intake, growth performance, and nutrient digestibility. Twenty-eight Baladi kids (body weight=17.1±1.0 kg) were assigned randomly to 4 experimental finishing diets (7 kids/treatment) in a completely randomized design for 70 days. The control (CON) diet contained 20, 60, 11, 7 and 2% (DM basis) alfalfa hay, barley grain, soybean meal, corn grain, and mineral and vitamin mix, respectively. Bread by-product substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP, and HBBP diets, respectively. Dry matter intakes for the CON, LBBP and MBBP diets were similar ($p>0.05$; avg.=592 g/day), however, kids fed the HBBP diet had a lower ($p<0.05$) DM intake (451 g/day). Organic matter and CP intakes showed similar patterns to that observed for DM. Dietary treatments did not affect ($p>0.05$) average daily gain for kids fed the CON, LBBP and MBBP diets (avg.=150 g/day). Final body weights for kids fed the CON, LBBP and MBBP diets (avg. 27.1 kg) were greater ($p<0.05$) than for kids fed the HBBP diet (23.7 kg). Feed to gain ratio was greater for the CON, LBBP and MBBP diets (avg. 3.9) compared with the HBBP diet (5.0). No significant ($p>0.05$) effect of the dietary treatment was observed for DM, OM and NDF digestibility. Substituting BBP for barley grain up to 20% of the diet DM did not affect nutrient intake, growth performance and nutrient digestibility of kids and resulted in a decrease in feed cost. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 5 : 629-632)***

Key Words : Bread By-products, Barley Grain, Fattening, Kids

INTRODUCTION

The study conducted by Nör and Ströbel (1996) concluded that the small ruminants sector in Jordan is not competitive with the world market. This sector does not cover the economic cost, which is primarily the result of the shortages in locally produced feedstuffs. In Jordan, 70 to 80% of the production cost of red meat is attributed to feed cost (Nasr et al., 2001). If the production efficiency of meat animals is defined as the return of salable product per unit of feed input (Beermann et al., 1986), any reduction in feed cost will have a large impact on the production profitability.

Farmers need feeds that are economical and easily managed. Grain-based commercial supplements and diets for fattening small ruminants are not economical in most cases. Bread by-product (BBP) consists of the surplus and leftover materials of the restaurants and bakeries. It is sold to farmers at reasonable prices (20 to 40% of barley grain price).

Barley grain is the predominant grain source for fattening lambs and kids throughout the Middle East area (Haddad et al., 2000). It usually represents 50 to 75% of the diet DM. Bread by-product has similar composition to barley grain and is much cheaper. Therefore, substituting BBP for barley grain in fattening diets would be of economical importance.

Very limited data are available for the use of BBP in diets for fattening kids. The objectives of this study were to determine the effects of substituting BBP for barley grain in high concentrate fattening diets for kids on nutrient intake, growth performance, and nutrient digestibility.

MATERIALS AND METHODS

This experiment was conducted at the Agriculture Center for Research and Production at the Jordan University of Science and Technology. Bread by-product obtained from local restaurants (surplus and leftovers) in the required quantities was air-dried for 4 weeks, and ground through a 3-mm screen before the start of the experiment. The BBP contained 89, 98, 2.5, 15 and 16% DM, OM, ether extract (EE), CP and NDF, respectively.

Twenty-eight Baladi kids (BW=17.1±1.0 kg) were adapted to their experimental diets for 2 weeks. During the adaptation period, kids were fed at maintenance level. Kids were then assigned randomly to 4 experimental fattening diets (7 kids/treatment) in a complete randomized design for 70 days. The control (CON) diet contained 20, 60, 11, 7 and 2% (DM basis) alfalfa hay, barley grain, soybean meal, corn grain, and mineral and vitamin mix, respectively. Bread by-product substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP and HBBP diets, respectively (Table 1).

* Corresponding Author: S. G. Haddad. Tel: +962-2-7201000 (22220), Fax: +962-2-7095069, E-mail: shaddad@just.edu.jo

[1] Department of Nutrition and Food Technology, Jordan University of Science and Technology, P.O. Box 3030, Irbid 22110, Jordan.

Received March 14, 2003; Accepted January 8, 2004

Table 1. Formulation of the experimental diets fed to fattening Baladi kids (% DM)

Item	Experimental diet*			
	CON	LBBP	MBBP	HBBP
Alfalfa hay	20	20	20	20
Barley grain	60	50	40	30
Bread	0	10	20	30
Corn	11	11	11	11
Soybean meal	7	7	7	7
Salt and limestone	2	2	2	2
Mineral and vitamin mix*	+	+	+	+

* CON=control. Bread by-product (BBP) substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP, and HBBP diets, respectively.

Table 2. Chemical composition of the experimental diets fed to fattening Baladi kids

Item	Experimental diet*			
	CON	LBBP	MBBP	HBBP
DM (%)	92.8	93.1	93.5	93.8
OM (% of DM)	93.3	93.5	93.6	93.8
CP (% of DM)	16.0	16.1	16.1	16.2
NDF (% of DM)	22.6	22.3	21.9	21.6
ADF (% of DM)	11.9	11.8	11.6	11.5
Ether extract (% of DM)	2.1	2.0	1.9	1.9
Metabolizable energy (Mcal/kg)	2.84	2.83	2.81	2.79
Cost, ($/ton)	135	128	121	114

* The control (CON) diet contained 20, 60, 11, 7 and 2% (DM basis) alfalfa hay, barley grain, soybean meal, corn grain and mineral and vitamin mix, respectively. Bread by-product substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP, and HBBP diets, respectively.

Kids were housed in individual pens (1.5×0.75 m) with constant illumination and fed the experimental diets as total mixed diets twice daily at 09:00 and 17:00 h in amounts to ensure 10% orts. Feed offered and refused was recorded daily. Clean drinking water was available in plastic buckets. Animal pens were cleaned weekly. Kids weights were recorded weekly before the 09:00 h feeding. Experimental diets were mixed biweekly and were sampled upon mixing to ensure proper mixing. All vitamins and minerals were added to the experimental diets to meet or exceed the requirements.

At day 40 of the experiment, 20 kids (5 kids/treatment) were selected randomly for the digestibility determination. Total fecal collection was carried out for 5 days. Samples of individual ingredients, diets, and feces were analyzed for EE and CP (AOAC, 1990), DM by oven drying for 48 h at 96°C, ash by combustion at 550°C for 6 h, ADF by the procedure of Goering and Van Soest (1970) and α-modified NDF by the procedure of Van Soest et al. (1991).

Data were subjected to ANOVA for a complete randomized design using the general linear procedure of SAS (1991). Differences among treatment means for significant dietary effect were detected using the LSD procedure of SAS. Initial kid weight was used as a covariant (SAS, 1991).

RESULTS AND DISCUSSION

In this study, BBP replaced barley grain by 0, 10, 20 and 30% of the diet DM as shown in Table 1. The similar chemical composition of BBP and barley grain resulted in similar OM, CP and NDF contents among all the experimental diets and averaged 93.5, 16.1 and 21.8%, receptively (Table 2). As a result of barley grain substitution, feed cost decreased $7 /ton for each 10% increase in BBP in the experimental diet as shown in Table 2.

Dry matter intake was not affected ($p>0.05$) by the substitution of BBP for barley grain up to the 20% level and averaged 592 g/day (Table 3). However, DM intake decreased ($p<0.05$) by the 30% substitution level (451 g/day). Crude protein and NDF intakes were similar ($p>0.05$) for kids fed the CON, LBBP and MBBP diets and averaged 95 and 130 g/day, respectively (Table 3). Kids fed

Table 3. Effect of partial replacement of barley grain with bakery waste on production responses of fattening Baladi kids

Item	Experimental diet *				SE**
	CON	LBBP	MBBP	HBBP	
No. of kids	7	7	7	7	
DM intake (g/day)	602[a]	595[a]	580[a]	451[b]	24
CP intake (g/day)	98[a]	95[a]	91[a]	73[b]	4.1
NDF intake (g/day)	133[a]	130[a]	127[a]	94[b]	10
MEI[1] (Mcal/day)	1.71[a]	1.68[a]	1.63[a]	1.26[b]	0.1
Feed to gain	3.8[b]	3.8[b]	4.2[b]	5.0[a]	0.4
Initial body weight (kg)	17.0	17.1	17.1	17.3	24
Final body weight (kg)	28.5[a]	27.6[a]	26.1[a]	23.7[b]	0.9
Weight gain (kg)	11.2[a]	10.5[a]	9.3[a]	6.4[b]	0.5
Average daily gain (g/day)	160[a]	155[a]	136[a]	91[b]	12
Cost ($/kg weight gain)	0.53	0.48	0.50	0.57	

* The control (CON) diet contained 20, 60, 11, 7 and 2% (DM basis) alfalfa hay, barley grain, soybean meal, corn grain, and mineral and vitamin mix, respectively. Bread by-product substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP and HBBP diets, respectively.

[1] MEI = metabolizable energy intake.

** SE = Standard error. [a, b, c] Means within a row with different on-line letters differ ($p<0.05$).

Table 4. Effect of substituting bread by-product for barley grain in fattening diets for Baladi kids on nutrient digestibility

Digestibility (%)	Experimental diet *				SE**
	CON	LBBP	MBBP	HBBP	
DM	60.2	61.4	58.9	57.2	2.5
OM	62.3	62.5	60.2	58.3	2.3
CP	64.1[a]	63.8[a]	62.2[a]	57.9[b]	2.1
NDF	63.0	60.1	58.3	57.9	4.0

* The control (CON) diet contained 20, 60, 11, 7 and 2% (DM basis) alfalfa hay, barley grain, soybean meal, corn grain, and mineral and vitamin mix, respectively. Bread by-product substituted barley grain by 10, 20 and 30% of the diet DM in the LBBP, MBBP and HBBP diets, respectively.

** SE=Standard error. [a,b] Means within a row with different on-line letters differ ($p<0.05$).

the HBBP diet (30% substitution level) consumed less ($p<0.05$) protein (73 g/day) and less ($p<0.05$) NDF (94 g/day). Metabolizable energy intake was greater ($p<0.05$) for kids fed the CON, LBBP and MBBP diets (avg. 1.67 Mcal/day) compared with kids fed the HBBP diet (1.26 Mcal/day; Table 3).

The decrease in feed intake observe for kids fed the HBBP diet resulted in lower ($p<0.05$) average daily gain (91 g/day), final weight (23.7 kg) and total weight gain (6.4 kg) as compared with kids fed the CON, LBBP and MBBP diets which averaged 150 g/day, 27.4 kg and 10.3 kg, respectively, as shown in Table 3. The greatest ($p<0.05$) reduction in production cost was for the LBBP diet (10% substitution level). The reduced growth rate for kids fed the HBBP diet (30% substitution level) resulted in the greatest cost for production compared with the rest of the experimental diets (Table 3).

Nelson et al. (2000) substituted barley grain with potato by-product, which is similar in its chemical composition to BBP and observed a reduction in DM intake of steers when the potato by-product was above 10% of the diet DM. This reduction in DM intake was accompanied by a reduction in steer performance above that level. In contrast, Guiroy et al. (2000) conducted an experiment to study the effects of substituting whole corn with BBP and concluded that BBP can substitute for corn up to 75% of the diet DM for growing finishing steers without any reduction in performance.

A large portion of the variation observed with the very limited published data could be attributed to the considerable variation in composition of the various bread by-products studied. Arosemena et al. (1995) reported considerable differences in bakery waste composition from the corresponding values previously reported in the literature (NRC, 1989). Furthermore, Milton and Brandt (1994) suggested an optimal level of inclusion of bakery waste below 30% of the diet DM, while Huber (1981) recommended no more than 10% in the feedlot diets.

Bread by-product substitution for barley grain did not affect DM, OM and NDF digestibility as shown in Table 4. However, CP digestibility for kids fed diet 4 (30% substitution level) decreased as compared with diets 1, 2 and 3 (Table 4).

In summary, BBP substitution for barley grain in high concentrate fattening diets for kids did not affect nutrient intake or growth performance up to the 20% substitution level and resulted in a lower production cost. However, further substitution above 20% of the diet DM resulted in a decreased performance and a lower efficiency.

ACKNOWLEDGEMENTS

The authors would like to thank M. Al-Mansee for data collection and H. Talafha and M. Abu-Shmais for their help in the lab analysis. The assistance of the farm staff led by I. Tahat at the Center for Agriculture and Production at JUST is greatly appreciated.

REFERENCES

AOAC. 1990. Official Methods of Analysis. 15th edn. Association of Official Analytical Chemists. Arlington, Virginia.

Arosemena, A., E. J. Depeters and J. G. Fadel. 1995. Extent of variability in nutrient composition within selected by-products feedstuffs. Anim. Feed Sci. Technol. 54:103-120.

Beermann, D. H., D. E. Hogue, V. K. Fishell, R. H. Dalrymple and C. A. Ricks. 1986. Effects of cimaterol and fishmeal on performance, carcass characteristics and skeletal muscle growth in lambs. J. Anim. Sci. 62:370-380.

Goering, H. K. and P. J. Van Soest. 1970. Forage fiber analyses (apparatus, reagents, procedures and some applications). Agric. Handbook No. 379. ARS, USDA, Washington, DC.

Guiroy, P. J., D. G. Fox, D. H. Beermann and D. J. Ketchen. 2000. Performance and meat quality of beef steers fed corn-based or bread by-product-based diets. J. Anim. Sci. 78:784-790.

Haddad, S. G., R. E. Nasr and M. M. Muwalla. 2000. Optimum dietary crude protein level for finishing Awassi lambs. Small Ruminant Res. 39:41-46.

Huber, J. T. 1981. Upgrading Residues and By-Products for Animals. CRC Press, Boca Raton, Florida.

Milton, C. T. and R. T. Brandt. 1994. Effect of dried bakery product on nutrient digestibility and nitrogen metabolism in finishing steers. J. Anim. Sci. 72(Suppl. 2):80 (Abstr.).

Nasr, R. E., S. G. Haddad and E. K. Al-Karablieh. 2002. Economic assessments of hormonal and nutritional treatments for improvement of Awassi sheep production in Jordan. Asian-Aust. J. Anim. Sci. 15:1110-1114.

Nelson, M. L., J. R. Busboom, J. D. Cronrath, L. Falen and A. Blankenbaker. 2000. Effects of graded levels of potato by-product in barley- and corn-based beef feedlot diets: I. Feedlot performance, carcass traits, meat composition and appearance. J. Anim. Sci. 78:1829-1836.

Nör, B. and H. Ströbel. 1996. Application of a regional sector model for the evaluation of livestock sector production system in Jordan. Seminar on Livestock Policy Analysis in Jordan. 24-

26 March 1996. Amman, Jordan.

National Research Council. 1989. Nutrient Requirement of Dairy Cattle. (6th edn) National Academy Press, Washington, DC.

SAS Institute Inc. 1991. SAS for windows, Version 6.0, 4th edn. SAS Institute Inc., Cary, North Carolina.

Van Soest, P. J., J. B. Robertson and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3592.