Pakistan J. Zool., vol. 49(4), pp 1215-1221, 2017. DOI: http://dx.doi.org/10.17582/journal.pjz/2017.49.4.1215.1221

Substituting Bakery By-Products for Corn Grains and Wheat Bran in Growing Lambs Rations increases Growth Rate with no Adverse Effect

Adel Eid Mohamed Mahmoud*
Department of Animal Production, Faculty of Agriculture, Cairo University, 12613 Giza, Egypt

Article Information
Received 24 June 2016
Revised 07 January 2017
Accepted 27 January 2017
Available online 13 June 2017

Key words
Bakery by-products, Blood and ruminal parameter, Digestibility, Growth, Meat quality, Economic efficiency.

ABSTRACT

The objective of the study was to evaluate the effects of bakery by-products BBP inclusion (0; 30 and 60% DM basis) to replace yellow corn and wheat bran in the concentrate feed mixtures on digestibility, blood and ruminal parameters, growth performance, meat analysis and feed intake of growing lambs. Fifty one Barki lambs with body weight of 30±0.57 kg; in three groups (17 animals, each). Experimental rations were composed of concentrate and clover hay in a 60:40 concentrate: roughage ratio. There was no effect of bakery by-products inclusion on nutrients digestibility and nutritive values except digestion coefficients of crude protein and digestible crude protein. Ruminal pH values and ammonia nitrogen concentrations did not show any significant differences among groups. No significant differences were observed in meat chemical analysis of slaughtered animals among different groups. Animals fed BBP recorded insignificant increase in growth rate by 9 g daily with improvement in feeding cost by 10%. Bakery waste can replace corn grains and wheat bran in concentrate feed mixtures up to 60 % in growing lambs rations without any adverse effects on animal's performance with increasing growth rate.

INTRODUCTION

Increasing and instability of prices of animal feeds especially protein and energetic sources are substantial factors in livestock production in order to provide the competitiveness of production systems. In this respect, the objective of using low-cost alternative feeds can be a suitable way to enhance the sustainability of the livestock production system (França *et al.*, 2012). Among the alternative foods, bakery waste stands out for its high concentration of non-fibrous carbohydrates, which are characterized as energetic food (Arosemena *et al*., 1995). Bakery by-product (BBP) is any ingredient used in the bakery world, raw or cooked, which is discarded, or intended or required to be discarded. BBP generally consists of dough, flour, sugar and other edible ingredients, icing, burnt or broken product. In the baking business, product that does not meet specifications or is out of date is also considered a by-product. Dried bakery products are highly digestible because of their pre-cooked nature and can easily be incorporated in the diets and are free of anti-nutritional factor (Olomu, 1995).

* Corresponding author: akkb2010@agr.cu.edu.eg; akkb2010@gmail.com
0030-9923/2017/0004-1215 $ 9.00/0

Haddad and Ereifej (2004) observed that substituting BBP can substitute barley grain up to 30% of the ration. França *et al*. (2012) reported that bakery waste can be included in sheep diets without adverse effect on feed intake, digestion coefficients, ruminal pH and volatile fatty acids concentertion, as well as increasing ammonia nitrogen utilization by rumen microflora. The objective of the present study was to evaluate the effects of BBP (0, 30 and 60%, dry matter basis) to partially replace yellow corn and wheat bran in the concentrate feed mixtures on digestibility, blood and ruminal parameters, growth performance, meat analysis and feed intake of growing lambs.

MATERIALS AND METHODS

Experimental animals and rations

A growth trial was conducted for 90 days. Fifty one Barki lambs averaged (30±0.57kg) body weight; 5 months old were divided into 3 similar groups of 17 animals according to their live weight. The three groups were assigned at random to the three experimental rations. Control ration (R1): clover hay plus concentrate feed mixture (CFM), R2 and R3: clover hay plus CFM in which 30% or 60 % from yellow corn and wheat bran was replaced with BBP. The formulations of the experimental rations are presented in Table I.

Table I.- The formulations of the experimental rations (kg/100kg).

Item	Experimental rations		
	R1	**R2**	**R3**
Clover hay	40	40	40
Yellow corn	33	23.1	13.2
Wheat bran	13.2	9.24	5.28
Bakery by-products (BBP)	0.0	13.86	27.72
Soybean meal	3	3	3
Sunflower meal	9	9	9
Common salt	0.6	0.6	0.6
Limestone	0.9	0.9	0.9
Mineral mixture	0.3	0.3	0.3

R1, ration 1; R2, ration 2; R3, Ration 3.

Feeding procedures

The growing lambs were fed CFM and clover hay twice daily to cover their total requirements of sheep according to NRC (1985) and animals were fed in groups. Water was allowed freely all the day round. Orts were collected just before offering the next day feed. Lambs were weighed every two weeks before morning feeding after 15 h of fasting. Rations were adjusted every two weeks according to body weight changes (Khattab *et al*., 2011). Body weight gain was recorded and daily feed intake was calculated. Dry matter (DM), total digestible nutrients (TDN) and digestible crude protein (DCP) intake were calculated. Feed conversion ratio was calculated as follow (intake g/daily gain g) for DM, TDN and DCP.

Digestion trials

Nutrients digestibility were determined by the acid insoluble ash (AIA) technique as described by Van Keulen and Young (1977) to determine the nutrients digestibility and the nutritive values of the experimental rations. In these trials the experimental rations consisted of 60 % CFM and 40% clover hay.

Chemical analyses

Dried feed, orts, feces samples were ground through a Wiley mill (Arthur H. Thomas, Philadelphia, PA, USA) using a 1 mm screen. Samples were analyzed for DM (#930.15), N (#954.01), ash (#942.05) and ether extract (EE; #920.39), according to AOAC (1997), while fiber fractionations (*i.e.* NDF and acid detergent fiber, ADF) were completed according to Van Soest *et al*. (1991). Nitrogen free extract was calculated by difference.

Rumen liquor sampling

Rumen liquor samples were taken just before morning feeding, and four hours post feeding. Samples of rumen liquor were strained through two layers of cheesecloth and its pH was immediately measured after collection. The pH value of rumen liquor samples was determined using pH meter. Quantitative analysis of ammonia concentration was carried out by a modified Nessler's method modified by Szumacher-Strabel *et al*. (2002).

Blood parameters

At the end of the digestion trials blood samples were taken from 5 animals. Blood plasma parameters were analyzed using specific kits obtained from Stanbio Laboratory, Boerne, Texas, USA; for total protein and creatinine as described by Tietz (1986) and Tietz *et al*. (1990), albumin was determined according to Doumas *et al*. (1971), blood plasma urea was determined according to Patton and Grouch (1977). Alanine aminotransferase (ALT) and aspartate aminotransfearse (AST) activities were colorimetrically determined according to AST and ALT kits (Quimica Clinica Aplicada S.A., Spain) based on reaction of Young (1997). Glucose was executed by using kits of Stanbio Laboratory Inc, procedure No. 1070. (San Antonio, Texas, USA). Total lipids, triglycerides and total cholesterol were quantified by using a calorimetric method by using kits of the Bio diagnostic company.

Meat sampling

After the end of the growth trial, four animals from each group were slaughtered in a slaughter. 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.

Statistical analysis

Data were analyzed using the general linear model procedure of SAS (2001, Ver.8.02, SAS Institute Inc., Cary, NC, USA). One way ANOVA procedure used to analyze data according to the next model; $Y_{ij}=\mu+T_{ij}+e_{ij}$, were: μ is overall mean of Y_{ij}; T_{ij} is treatment effect; the e_{ij} is experimental error. Differences among means were separated according to Duncan New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Data of chemical composition and fiber fractions of the experimental ingredients and the experimental rations are shown in Table II. Analysis of yellow corn and wheat bran were used in this study were much closed to their standard reported by CLFF (2001) for feedstuffs used in animal nutrition in Egypt. Chemical analysis of BBP revealed that crude protein content was close to that of wheat bran but was more than that of yellow corn by 5.57% units. Ether extract of BBP (13.19%) was greater than yellow corn and wheat bran, being 5.74 and 3.64 %, respectively. However, nitrogen free extract content of corn was the highest (81.65%) followed by BBP (68.34%) and wheat bran (55.93%). Fiber fractions of the experimental feed ingredients cleared that wheat bran had higher values of NDF, ADF, ADL, cellulose and hemi-cellulose compared to corn and BBP. No differences were observed among the experimental rations in chemical composition except EE, CF and CP with R3. Previous studies showed that BBP had a wide variation in its chemical composition especially in ether extract. Such variation makes it difficult to compare these values to those obtained by other researchers. The differences in bread by-product or bakery waste could be related to the bread source, origin, components, and processing method. Therefore, it is recommended to analyze the nutrient content of bread byproduct before inclusion in the ruminant diets (França *et al*., 2012; Guiroy *et al*., 2000). Champe and Church (1980), studied the use of bakery waste in sheep diet and noticed the following values of 8.5 and 10.4% for CP and EE contents, respectively.

Table II.- Chemical composition and fiber fractions of the experimental ingredients and the experimental rations (% DM basis).

Item	Experimental ingredients			Experimental rations		
	YC	WB	BBP	R1	R2	R3
Chemical composition %						
DM	90.97	89.23	85.64	92.14	92.45	92.80
OM	98.37	91.70	98.52	93.48	93.09	93.01
Ash	1.63	8.30	1.48	6.52	6.91	6.99
CP	8.28	16.07	13.85	16.66	16.11	15.41
EE	5.74	3.64	13.19	3.29	4.40	6.04
CF	2.70	16.06	3.14	22.12	22.00	19.51
NFE	81.65	55.93	68.34	51.41	50.58	52.05
Fiber fractions %						
NDF	8.69	37.78	7.81	37.99	37.54	37.67
ADF	3.79	11.80	5.77	25.84	27.23	23.70
ADL	1.44	3.89	1.57	6.88	6.33	6.93
Cellulose	2.34	7.91	4.20	18.96	18.93	16.78
Hemi-cellulose	4.90	25.98	2.03	12.15	12.28	13.96

ADF, acid detergent fiber; ADL, acid detergent lignin; BBP, bakery by-products; CF, crude fiber; CP, crude protein; DM, dry matter; EE, ether extract; NDF, neutral detergent fiber; NFE, nitrogen free extract; OM, organic matter; WB, wheat bran; YC, yellow corn.

Dale (1990), Saleh *et al*. (1996), Guiroy *et al*. (2000), Al-Tulaihan *et al*. (2004), Carneiro *et al*. (2006) and Kwak and Kang (2006) reported different values of EE (11.10, 11, 1.32 and 17.70 %), and CP (10.6, 12.5, 12.2, 9.9%). Arosemena *et al*. (1995) evaluated the chemical composition of bakery waste from different areas and showed variations of 4.46 to 11.70% in EE contents, and from 11.9 to 13.3% in CP contents.

Table III.- Effect of the experimental rations on nutrients digestibility and nutritive values of the experimental rations (%).

Item	Experimental rations			±SEM
	R1	R2	R3	
Nutrients digestibility %				
DM	72.12	73.30	70.33	0.96
OM	74.52	75.75	73.29	0.92
CP	72.18[a]	70.24[ab]	64.97[b]	1.37
EE	73.17	75.40	71.73	1.49
CF	69.70	62.56	66.14	2.23
NFE	67.37	66.32	61.39	1.57
NDF	57.79	61.60	58.08	1.74
ADF	60.81	66.64	57.11	2.45
Cellulose	71.57	74.44	76.13	1.68
Hemi-cellulose	51.37	56.58	59.70	2.63
Nutritive values %				
TDN	67.71	67.65	64.63	1.40
DCP	12.02[a]	11.32[a]	10.01[b]	0.32

Means in the same row with different superscript are significantly different ($P<0.05$). For abbreviations, see Table II.

Results of nutrients digestibility and nutritive values of the experimental rations are shown in Table III. No significant differences were recorded among the experimental rations except digestion coefficient of crude protein and digestible crude protein. These results may be partly due to the similarity of chemical analysis of the experimental rations except crude protein content. The same trend was observed by França *et al*. (2012) when they fed sheep bakery waste and corn meal at varying proportions (0, 25, 50, 75, and 100%). The nutritive values as total digestible nutrients in the current study were higher than those obtained by Waller (2010) and França *et al*. (2012). In the same context, Champe and Church (1980) determined nutrients digestibility of diets with 0, 30 and 60% of corn replacement by bakery by-products, and observed an improvement in DM digestibility being; 68.3, 73.5 and 78.3% for the three replacement levels, respectively. Also, Carneiro *et al*. (2006) found no effect of substituting up to 80% of the corn by bakery waste on DM digestibility by sheep. As well as, Haddad and Ereifej (2004) showed that digestibility coefficients of DM, OM, and NDF were not affected with increasing bakery by-products levels of 10, 20, and 30 % DM, in goat kids ration.

Table IV.- Effect of the experimental rations on rumen pH and ammonia concentration

Item	Experimental rations			±SEM
	R1	R2	R3	
pH				
Zero time	6.73[a]	6.70[ab]	6.53[b]	0.04
4 h	5.46	5.56	5.63	0.03
Ammonia NH_3-N (mg/100ml)				
Zero time	15.35	18.76	15.73	1.16
4 h	20.93	21.49	18.87	1.66

Means in the same row with different superscript are significantly different (P<0.05).

Data in Table IV shows the inclusion of BBP at both levels in concentrate portion had no effect (P>0.05) on pH values or ruminal ammonia concentration either before or after 4 hours of feeding. Smith *et al*. (1972) found that ruminal pH value ranged from 6.0 to 6.8 and that provide maximum activity of cellulolytic organisms and that the inclusion of bakery waste in diet did not negatively affect the rate of microbial growth. Numerically lower value of ruminal ammonia concentration (18.87) was recorded for R3 compared with other rations. This reduction in ruminal NH_3-N concentration may be related to the increase in energy availability for microbial protein synthesis, provided by the bakery waste inclusion in the diet (França *et al*., 2012). Carvalho *et al*. (1997) reported that the reduction in ruminal NH_3-N concentration can be explained by the increase in energy availability in the rumen, allowing higher use of ammonia for microbial growth, with consequent reduction in ammonia loss due to synchronization in the carbohydrates and protein degradation. Similarly, Mehrez *et al*. (1977) found that the maximum rate of fermentation in the rumen is obtained when the NH_3-N concentration reaches values between 19 and 23 mg/dl rumen fluid. On contrary, Van Soest (1994) reported the optimal level of 10 mg NH_3/dl, a value lower than the concentration of NH_3-N obtained with the proportion of 100% of bakery waste. However, this should not be considered a fixed number, considering that the ability of bacteria to use ammonia and to synthesize protein depends on the roughage: concentrate ratio of the diet.

Table V.- Effect of the experimental rations on some blood parameters.

Item	Experimental rations			±SEM
	R1	**R2**	**R3**	
Total proteins (g/dl)	6.82[b]	5.85[b]	7.05[a]	0.02
Albumin (g/dl)	3.6[a]	3.45[b]	3.5[ab]	0.03
Globulin (g/dl)	3.22[b]	2.4[a]	3.55[a]	0.20
Glucose (g/dl)	51[a]	46.5[b]	46.5[b]	0.90
Cholesterol (g/dl)	78.75	77.5	76.25	0.75
Triglycerides (g/dl)	95	91.25	90	1.99
Urea (mg/dl)	36.22	36.67	35.55	0.61
Creatinine (mg/dl)	1.19	1.15	1.2	0.06
ALT (IU/L)	15.87	15.37	15.75	0.13
AST (IU/L)	26.12	26.12	27.07	0.33

Means in the same row with different superscript are significantly different (P<0.05). ALT, alanine aminotransferase; AST, aspartate aminotransferase.

Data of blood parameters in Table V showed significant effects of the experimental rations on total proteins, albumin, globulin and blood glucose. Total protein recorded the highest value (7.05g/dl) with R3 compared with R1 and R2. This may be due to crude protein content, digestion coefficients and digestible crude protein in R3 (15.41, 64.97, and 10.01%, respectively). Blood glucose concentration was higher in R1 (51) compared with R2 and R3 (46.5 for both). No significant differences were observed among the different groups in cholesterol, triglycerides, urea, creatinin, ALT and AST. Generally, all blood parameters were in normal range of healthy sheep. These results agreed Ghoneem and Mahmoud (2014).

Results of growth performance in Table VI showed insignificant effect of including bakery by-products at both levels in rations on final, total and average daily gain of the experimental animals. Although, R3 recorded insignificant increase in growth rate by 9 g daily compared to the control which will affect on the total weight especially in the case of feeding in large scale. Results of meat analysis revealed that no significant differences were observed among experimental groups. Ash content in animal meat fed R3 (1.96%) was lower compared to other animals. These results may be a reflection of the nutritive values of the experimental rations. These results were compatible with Guiroy *et al*. (2000) when bakery by-products substituted up to 75% of whole shelled corn in a growing finishing beef feedlot ration without reducing meat quality or feedlot performance. Similar results were reported by Haddad and

Ereifej (2004) when barley grain were replaced by bakery by-products in fattening kid's diets and observed that replacement of barley grain up to 20% of the diet DM had no effect on animal performance.

Table VI.- Effect of the experimental rations on growth performance and chemical composition of meat.

Item	Experimental rations			±SEM
	R1	R2	R3	
Live body weight				
Initial body weight (kg)	30.08	30.00	30.00	0.57
Final body weight (kg)	46.86	47.15	47.55	0.76
Total weight gain (kg)	16.78	17.15	17.55	0.42
Average daily gain (g)	186.44	190.55	195.00	4.68
Meat analysis %				
Moisture	71.77	72.72	72.68	0.31
Ash	2.34	2.38	1.96	0.18
Lipid	4.06	3.73	4.31	0.71
Protein	21.83	21.17	21.05	1.65

Means in the same row with different superscript are significantly different (P<0.05).

Results in Table VII showed that both levels of replacement of corn grain and wheat bran by BBP had no significant (p>0.05) on dry matter and total digestible nutrients intake among the experiment rations. This finding was matched the results of Obeidat *et al.* (2012). Also, Afzalzadeh *et al.* (2007) observed no significant differences in DM intake when fattening Zandi lambs fed diets containing bakery waste at levels of 6, 12.5, and 25% DM compared to control. While, digestible crude protein recorded lower value (97 g) with R3 compared with other rations. This data was in agreement with Hindiyeh *et al.* (2011) noticed protein intake decreased in Awassi lambs fed diets contained various levels of bakery waste. Also, Champe and Church (1980) stated that feed intake was lower in sheep fed dry bakery product at level of 40% DM than sheep fed control diet. Similarly, Haddad and Ereifej (2004) found that DM and CP intakes decreased in goat kids fed BBP at level of 30% DM versus kids fed lower levels of BBP (0, 10, or 20% DM). It was expected that feeding highly fermentable carbohydrates such as BBP may reduce the feed intake and cause acidosis (Morgante, 2002). However, herein there was no reduction in feed intake was observed in all diets. In the current study, no signs of clinical acidosis were observed among lambs. Also, subclinical cases are also unexpected as no differences in intake were identified.

Feed conversion recorded the best values with R3 especially with DCP (0.51) compared with R2 and R1. There was an improvement in economic efficiency by 5% and 10% with R2 and R3 compared with control ration R1 (Table VII). These results are in consistencies with Hindiyeh *et al.* (2011) and Obeidat *et al.* (2012).

Table VII.- Effect of the experimental rations on feed intake, feed conversion and economic efficiency of growing lambs.

Item	Experimental rations			±SEM
	R1	R2	R3	
Feed intake/day				
Concentrate (g)	622	626	636	10
Roughage (g)	410	413	419	7
Total DMI (g)	955	961	976	17
TDN intake (g)	646	651	631	11
DCP intake (g)	115[a]	110[a]	97[b]	2
Feed conversion (g/g)				
DMI/ daily gain	5.12	5.12	5.08	0.07
TDN intake / daily gain	3.53	3.46	3.29	0.05
DCP intake / daily gain	0.63[a]	0.58[b]	0.51[c]	0.10
Economic efficiency				
Feeding cost (LE/h/d)	2.06	2.02	2.00	-
Gain price (LE/h/d)	7.83	8.00	8.19	-
Profit (LE/h/d)	5.77	5.98	6.19	-
Relative (profit/feeding cost %)	2.80	2.96	3.09	-
Comparative economic improvement	100	105.7	110.35	-

Means in the same row with different superscript are significantly different (P<0.05). Prices are in Egyptian Pounds, (LE); R1, 2 LE/kg; R2, 1.95 LE/kg; R3, 1.90 LE/kg; live weight for Barki lambs, 42 LE/kg.

CONCLUSION

Similarity in the performance of growing lambs (nutrient intakes and digestibility, body weight changes and meat analysis), leads to the conclusion that bakery by-product could be replace up to 60% (DM basis) of the corn grain and wheat bran in growing lambs concentrate feed mixtures.

Conflict of interest statement

The authors have declared no conflict of interest.

REFERENCES

Afzalzadeh, A., Boorboor, A., Fazaeli, H., Kashan, N. and Ghandi, D., 2007. Effect of feeding bakery waste on sheep performance and the carcass fat quality. *J. Anim. Vet. Adv.,* **6**: 559-562.

Al-Tulaihan, A.A., Najib, H. and Al-Eid, S.M., 2004. The nutritional evaluation of locally produced dried bakery waste (DBW) in the broiler diets. *Pakistan J. Nutr.,* **3**: 294-299. https://doi.org/10.3923/pjn.2004.294.299

AOAC, 1997. *Official methods of analysis*, 16th ed. Association of Official Analytical Chemists, AOAC, Arlington, VA, USA.

Arosemena, A., Depeters, E.J. and Fadel, J.G., 1995. Extent of variability in nutrient composition within selected byproduct feedstuffs. *Anim. Feed Sci. Technol.,* **54**: 103-120. https://doi.org/10.1016/0377-8401(95)00766-G

Carneiro, M.S.S., Oliveira, A.H. and Sales, R.O., 2006. Valor nutritivo de rações para ovinos com quatro níveis do resíduo de panificação. In: *Reunião anual da sociedade Brasileira de zootecnia*, 43, João Pessoa. Anais. Soci. Bras. Zootec., João Pessoa, pp. 1-3.

Carvalho, A.U., Valadares Filho, S.C. and Coelho Da Silva, J.F., 1997. Níveis de concentrados em dietas de zebuínos. 4. Concentrações ruminais de amônia e pH, taxa de passage de digesta ruminal e degradação in situ dos alimentos. *R. Bras. Zootec.,* **26**: 1016-1024.

Champe, K.A. and Church, D.C., 1980. Digestibility of dried bakery product by sheep. *J. Anim. Sci.,* **51**: 25-27. https://doi.org/10.2527/jas1980.51125x

CLFF (Central Lab for Food and Feed, Ministry of Agriculture, Agriculture Research Center), 2001. Feed composition tables for Animals and Poultry feedstuffs used in Egypt. *Tech. Bull.,* **1**: 4-17.

Dale, N.M., 1990. Energy and nutrient content of dried bakery product and crab meal. *Poult. Sci.,* **65**(Suppl. 1): 163.

Doumas, B.T., Watson W.A. and Biggs, H.G., 1971. Albumin standards and measurements of serum with bromochresol green. *Clin. Chim. Acta,* **31**: 87-96. https://doi.org/10.1016/0009-8981(71)90365-2

Duncan, D.B., 1955. Multiple range and multiple F-Test. *Biometrics,* **11**: 1-42. https://doi.org/10.2307/3001478

França, A.B., Mirton, J.F.M., Fernando, C.F.L., Afranio, S.M., Danilo, A.M., Bruna M.F., Luciano, S.C. and Carlos, E.M.F., 2012. Bakery waste in sheep diets: intake, digestibility, nitrogen balance and ruminal parameters. *R. Bras. Zootec.,* **41**: 147-153. https://doi.org/10.1590/S1516-35982012000100022

Ghoneem Wafaa M.A. and Mahmoud A.E.M., 2014. Effect of in-activated and dried yeast on productive performance of Barki lambs. *Asian J. Anim. Vet. Adv.,* **9**: 664-673. https://doi.org/10.3923/ajava.2014.664.673

Guiroy, P.J., Fox, D.G., Beermann D.H. and Ketchen, D.J., 2000. Performance and meat quality of beef steers fed corn-based or bread by-product-based diets. *J. Anim. Sci.,* **78**: 784-790. https://doi.org/10.2527/2000.783784x

Haddad, S.G. and Ereifej, K.I., 2004. Substituting bread byproduct for barley grain in fattening diets for Baladi kids. *Asian-Aust. J. Anim. Sci.,* **17**: 629-632.

Hindiyeh, M.Y., Haddad, S.G. and Haddad, S.K., 2011. Substituting bakery waste for barley grains in fattening diets for Awassi lambs. *Asian-Aust. J. Anim. Sci.,* **24**: 1547-1551.

Khattab, H.M., Gado, H.M., Kholif, A.E., Mansour A.M. and Kholif A.M., 2011. The potential of feeding goats sun dried rumen contents with or without bacterial inoculums as replacement for berseem clover and the effects on milk production and animal health. *Int. J. Dairy Sci.,* **6**: 267-277. https://doi.org/10.3923/ijds.2011.267.277

Kwak, W.S. and Kang, J.S., 2006. Effect of feeding food waste-broiler litter and bakery by-product mixture to pigs. *Bioresou. Technol.,* **97**: 243-249. https://doi.org/10.1016/j.biortech.2005.02.008

Mehrez, A.Z., Ørskov, E.R. and Mcdonald, I., 1977. Rates of rumen fermentation in relation to ammonia concentration. *Br. J. Nutri.,* **38**: 437-443. https://doi.org/10.1079/BJN19770108

Morgante, M., 2002. Digestive disturbances and metabolic nutritional disorders. In: *Dairy sheep feeding and nutrition* (ed. G. Pulina). Avenue Media, Bologna.

NRC, 1985. *Nutrient requirements of sheep*. 6th Ed., National Academy of Sciences, Washington, D.C., pp. 45.

Obeidat, S., Haddad, S.G., Titi, H.H., Abu Ishmais, M.A. and Telfah, B.T., 2012. Performance of nursing awassi ewes fed different levels of bread by-product. *Asian-Aust. J. Anim. Sci.,* **25**: 1132-1137.

Olomu, J.M., 1995. *Monogastric animal nutrition: Principles and practices*, Jachen Publication, pp. 68-125.

Patton, F.G. and Grouch, S.R., 1977. Colorimetric determination of urea. *Anal. Chem.,* **49**: 464-468. https://doi.org/10.1021/ac50011a034

Saleh, E.A., Watkins, S.E. and Waldroup, P.W., 1996. High level usage of dried bakery product in broiler diets. *J. appl. Poult. Sci.,* **5**: 33-38.

SAS, 2001. *User's guide*. Statistic. Ver.8.02, SAS

Institute Inc., Cary, NC, USA.

Smith, L.W., Goering, M.K. and Gordon, C.H., 1972. Relationship of forage compositions with rates of cell wall digestion and indigestibility of cell walls. *J. Dairy Sci.,* **55**: 1140-1148. https://doi.org/10.3168/jds.S0022-0302(72)85636-4

Szumacher-Strabel, M., Potkański, A., Kowalczyk, J., Cieślak, A., Czauderna, M., Gubała, A. and Jędroszkowiak, P., 2002. The influence of supplement fat on rumen volatile fatty acid profile, ammonia and pH levels in sheep fed a standard diet. *J. Anim. Feed Sci.,* **11**: 577-587.

Tietz, N.W., Finley, P.R., Pruden, E. and Amerson, A.B., 1990. *Clinical guide to laboratory tests*, 2nd Ed., W.B. Sunders Co., Philadelphia, ISBN: 9780721624860, pp. 931.

Tietz, N.W., 1986. *Text book of clinical chemistry,* W.B. Saunders, Philadelphia, pp. 1271.

Van Keulen, J. and B.A. Young, 1977. Evaluation of acid insoluble ash as a neutral marker in ruminant digestibility studies. *J. Anim. Sci.,* **44**: 282-287. https://doi.org/10.2527/jas1977.442282x

Van Soest, P.J., 1994. *Nutrition ecology of the ruminant*. Comstock Publishing Associates, Ithaca, pp. 476.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A., 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci.,* **74**: 3583-3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2

Waller, J.C., 2010. Byproducts and unusual feedstuffs. *Feedstuffs,* **82**: 18-23.

Young, D.S., 1997. *Effects of preanalytical variables on clinical laboratory tests*. 2nd Ed., AACC Press, Washington, D.C., USA, ISBN-13: 9780915274888, pp. 1285.