IJAS Iranian Journal of Applied Animal Science

The Effect of Replacing Barley Grain with Powerfeed® in Finishing Diets on the Performance, Serum Sodium and Potassium Concentration, and the Urine pH of Chall Lambs

Research Article

A. Pirzadeh Naeiny[1], A.A. Khadem[1], M. Rezaeian[2], A. Afzalzadeh[1] and M.A. Norouzian[1*]

[1] Department of Animal Science, College of Abouraihan, University of Tehran, Tehran, Iran
[2] Department of Animal Health and Nutrition, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran

Received on: 26 Feb 2012
Revised on: 2 Apr 2012
Accepted on: 1 May 2012
Online Published on: Jun 2013

*Correspondence E-mail: manorouzian@ut.ac.ir

Online version is available on: www.ijas.ir

ABSTRACT

Thirty six male Chall lambs (four-month old and 26 ± 1.5 kg body weight) were randomly assigned into four treatments (nine lambs per treatment) to study the effect of Powerfeed® (a commercial mixture made from wheat processing by-product and wheat bran) on weight gain, feed intake, feed conversion ratio, serum sodium and potassium concentration and urine pH. Lambs in control group were fed with a total mixed ration based of alfalfa and barley grain. Barley grain was replaced with Powerfeed® (PF) at levels of 4, 8 and 12 in treatments 2, 3 and 4, respectively. The experiment lasted for 105 days comprising 15 days of adaptation period and 90 days finishing period. No significant differences were observed in weight gain, feed intake, feed conversion ratio, serum sodium and potassium concentration and urine pH of lambs in control group when compared to other treatments. In conclusion, Powerfeed® can be used as partial replacement of barley grain in total mixed rations of finishing lambs.

KEY WORDS Chall lamb, Powerfeed®, urine pH, wheat processing by-product.

INTRODUCTION

In most parts of Iran, low rainfall and availability of water resources are the major limitations to the farmers. As many places in all over the world (Arosemena *et al.* 1995), feed shortage is a common feature of Iranian animal production industry.

Continuous grazing, especially with high stocking rates, has made rangelands bare, caused soil erosion and native pasture deterioration mainly through the loss of useful vegetation.

To offset part of this feed insufficiency, agricultural by-products have been commonly used in animal and poultry nutrition, and this situation seems to be continued in future (Tabeidian and Sadeghi, 2009).

However, some by-products from agricultural related industries are not yet being used properly.

Of these, the byproducts remain after starch and gluten separation from wheat flour in starch processing factories. A mixture of these valuable by-products plus wheat bran has been recently manufactured which is known by a trade name of "Powerfeed®" (Pirzadeh Naeiny *et al.* 2010a). The typical lamb finishing diets used in many parts of Iran are barley-based diets supplemented with sugar beet pulps and corn silage.

In this research, Powerfeed® was used in replacement of barley grain in rations to investigate its effects on the performance of Chall lambs.

MATERIALS AND METHODS

Animals and management

Thirty six male Chall lambs with 26 ± 1.5 kg body weights (BW) at four months of age were randomly divided into four treatments (nine lambs per treatment). Four diets with concentrate to forage proportions of 68:32 were used under a completely randomized design. Animals in group 1 (control) were fed on a total mixed ration (TMR) comprised of 26% alfalfa hay, 46% barley grain, 6% barley straw, 14% wheat bran, 7% rapeseed meal, 0.7% mineral-vitamin supplement and 0.3% sodium bicarbonate to meet their energy and protein requirements according to the NRC (1985) recommendations. Ground barley grain was replaced with Powerfeed® (PF) at levels of 4, 8 and 12% of diet for lambs in groups 2, 3 and 4, respectively. The ingredients and the chemical composition of the total mixed rations are presented in Table 1. Lambs had free access to fresh water during the experiment. The trial lasted 105 days comprising 15 days adaptation and 90 days finishing period. The experimental diets were given to lambs twice daily at 08:00 and 18:00. The BW of lambs was measured at 15-day intervals prior to their morning feedings and the initial and final weights were considered as the average of two consecutive weights. The feed conversion ratio was then calculated based on the relative feed consumption and weight gain of lambs.

Blood and urine measurements

At the middle and at the end of the experiment, jugular blood samples of lambs were taken into an evacuated glass tubes and allowed to coagulate. Samples were then transported to the laboratory within two hours of collection. The serum was separated by centrifuge at 3000 × g for 15 minutes. Samples were then frozen and stored at -20 ˚C for further analysis. A flame photometer was used to determine sodium and potassium in serum. Urine samples were collected manually in plain glass tubes and their pH was measured by electrical digital pH-meter within 2 hours.

Chemical analysis

Dry matter content of feed samples was measured drying them in oven at 110 ˚C for 24 hours (AOAC, 1990). The proximate compositions of feeds were then measured according to the AOAC (1990) method. The neutral detergent fiber (NDF) and the acid detergent fiber (ADF) contents of feed samples were also measured using the Van Soest *et al.* (1991) procedure. In addition, the crude protein (CP) content was determined using Kjeldahl method (AOAC, 1990).

Statistical analysis

Data were analyzed using the GLM procedure of SAS (2001). The lambs' initial live weight was considered as a co-variable and a covariance analysis was conducted on the body weight and live weight gain.

Table 1 The ingredients and the chemical composition of Powerfeed® contained total mixed rations

Items	Treatments*			
	Control	4% PF	8% PF	12% PF
Ingredients (%)				
Alfalfa hay	26	26	26	26
Barley straw	6	6	6	6
Ground barley grain	46	42	38	34
Rapeseed meal	7	7	7	7
Wheat bran	14	14	14	14
Powerfeed®	-	4	8	12
Mineral-vitamin mixture	0.7	0.7	0.7	0.7
Sodium bicarbonate	0.3	0.3	0.3	0.3
Chemical composition (%)				
Crude protein	14.70	14.87	15.04	15.21
Neutral detergent fiber	28.21	29.05	29.88	30.71
Acid detergent fiber	15.65	15.93	16.22	16.51
Ash	5.48	5.87	6.26	6.64
Sodium	0.18	0.30	0.42	0.54
Potassium	1.08	1.11	1.14	1.16
Calcium	0.48	0.52	0.56	0.61
Phosphorous	0.51	0.54	0.57	0.60

* Barley grain was replaced with Powerfeed® (PF) at amounts of 4, 8 and 12 percentages for the total mixed rations of lambs in group 2 (4% PF), group 3 (8% PF) and group 4 (12% PF), respectively.

The differences between the means were compared using Duncan's multiple range tests. The significance of differences between the treatment groups were then stated at $P<0.05$ values.

RESULTS AND DISCUSSION

Chemical compositions

The chemical compositions of diets are shown in Table 1. The crude protein contents were 14.70%, 14.87%, 15.04% and 15.21 in control, 4% PF, 8% PF and 12% PF mixtures, respectively; indicating that four diets used in this experiment were almost isonitrogenous.

The neutral detergent fiber and the acid detergent fiber contents were increased with the increasing of Powerfeed® levels in diets so that the highest percentage of NDF was observed in 12% PF diet followed decreasingly by 8% PF and 4% PF diets, and the lowest percentage of NDF was observed in control diet.

The ash content of diets was also increased with the increasing of Powerfeed® proportions in total mixed rations. The sodium levels were also measured and it was found to be 0.18%, 0.30%, 0.42% and 0.54% for the control, 4% PF, 8% PF and 12% PF treatments, respectively (Table 1). From these, it can be concluded that by the increasing of Powerfeed® percentages in rations, the ash and the fiber

contents of rations were concurrently increased due to the relatively high content of fiber in wheat bran and the sodium contents of starch wastages. In agreement with these results, Singh *et al.* (1999), Dhakad *et al.* (2002) and Tabeidian and Sadeghi (2009) reported higher ash and fiber contents with the replacement of grains with wheat bran or de-oiled rice bran in diets.

Lamb performance

Data on the performance of lambs are presented in Table 2. Although the initial BW of lambs was not significantly different among the treatment groups, a covariance analysis was applied for more precise interpretation of observations. The BW of lambs was not significantly affected by the replacement of barley grain with Powerfeed® up to 12% (Figure 1).

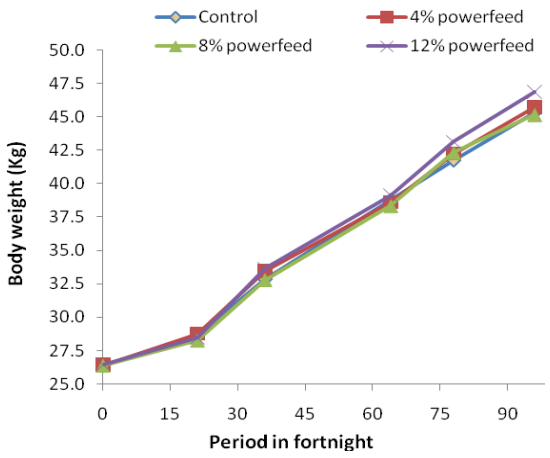

Figure 1 The effect of replacing barley grain with Powerfeed® on the body weight of finishing Chall lambs

Our results agree well with the findings of Abii *et al.* (1993) who observed no depression in daily gain of growing lambs when wheat bran was used up to 30% of their diets, but it was significantly depressed when the level of wheat bran of diet was increased to 60% and above. Table 2 indicates that the replacement of barley grain with Powerfeed® had no adverse effect on the feed conversion ratio of finishing lambs.

Lambs in control, 4% PF, 8% PF and 12% PF groups had average feed intake of 1.26, 1.30, 1.22 and 1.30 kg/d, respectively, indicating that the partial replacement of ground barley grain with Powerfeed® had no adverse effect on the feed intake of lambs. Our results are in agreement with findings of Singh *et al.* (1999) who reported no adverse effect on feed intake when grains were replaced with wheat bran or de-oiled rice bran.

However, Abii *et al.* (1993) found a significant reduction in dry matter intake of sheep with the increasing of wheat bran levels in their diets.

Serum sodium and potassium concentration, and urine pH

There were no significant differences in the serum sodium and potassium concentrations of lambs fed control diet compared to those fed 4%, 8% and 12% Powerfeed® diets (Table 3).

No differences in blood sodium and potassium concentration have been found using high levels of sodium in lambs' diets (Meyer and Weir, 1954; Devlin and Roberts, 1963; Moseley and Jones, 1974). Furthermore, normal concentrations of sodium and potassium in sheep blood serum reported 142-160 mmol/L and 4.5-5.9 mmol/L, respectively which are similar to those found for the lambs in different treatments of our study.

Table 2 The effect of Powerfeed® containing total mixed rations on the performance of Chall lambs

Item	Treatments*				
	Control	4% PF	8% PF	12% PF	SEM
Initial live weight (kg)	26.38	26.40	26.39	26.44	0.76
Final live weight (kg)	45.34	45.77	46.46	46.91	0.93
Weight gain (g/d)	193.54	197.62	200.51	208.84	4.05
Feed intake (kg/d)	1.26	1.30	1.22	1.30	0.08
Feed conversion ratio	6.52	6.58	6.31	6.22	0.13

* Barley grain was replaced with Powerfeed® (PF) at amounts of 4, 8 and 12 percentages for the total mixed rations of lambs in group 2 (4% PF), group 3 (8% PF) and group 4 (12% PF), respectively.

Table 3 The effect of Powerfeed® containing total mixed rations on the serum sodium (mmol/L) and potassium (mmol/L) concentrations, and the urine pH of Chall lambs

Item	Treatments*				
	Control	4% PF	8% PF	12% PF	SEM
Serum sodium	160.90	159.70	162.91	163.71	1.84
Serum potassium	4.12	3.91	4.21	4.02	0.07
Urine pH	8.16	8.17	8.18	8.19	0.04

* Barley grain was replaced with Powerfeed® (PF) at amounts of 4, 8 and 12 percentages for the total mixed rations of lambs in group 2 (4% PF), group 3 (8% PF) and group 4 (12% PF), respectively.

No statistically significant differences were observed for the urine pH of samples taken from individual lambs of four treatment groups in the present study (Table 3). Scientific resources reported a normal urine pH of 7.90-8.11 for healthy lambs (Scott *et al.* 1993; Brown *et al.* 1999; Vinodh Kumar *et al.* 2010) which are similar to those found for lambs in the current study.

CONCLUSION

The results of the present study indicate that barley grain could be replaced by Powerfeed® up to a level of 12% in total mixed rations of finishing lambs without any adverse effect on their productive traits.

REFERENCES

Abii J.U., Iji P.A., Umunna N.N. and Dim N.I. (1993). The replacement value of wheat bran for cotton seed cake and maize in diets for sheep. *Bulletin. Anim. Health. Prod. Africa*. **41,** 65-69.

AOAC. (1990). Official Methods of Analysis. Vol. I. 15th Ed. Association of Official Analytical Chemists, Arlington, VA.

Arosemena E.J., Peters D. and Fadel G.J. (1995). Extent of variability in nutrient composition within selected by-product feedstuffs. Anim. *Feed Sci. Technol*. **54,** 103-120.

Brown M.S., Hallford D.M., Galyean M.L., Krehbiel C.R. and Duff G. (1999). Effect of ruminal glucose infusion on dry matter intake, urinary nitrogen composition, and serum metabolite and hormone profiles in ewes. *J. Anim. Sci*. **77,** 3068-3076.

Devlin T.J. and Roberts W.K. (1963). Dietary maintenance requirement of sodium for whether lambs. *J. Anim. Sci.* **22,** 648-653.

Dhakad A., Garg A.K., Singh P. and Agrawal D.K. (2002). Effect of replacement of maize grain with wheat bran on the performance of growing lambs. *Small Rumin. Res*. **43,** 227-234.

Meyer J.H. and Weir H.C. (1954). The tolerance of sheep to high intakes of sodium chloride. *J. Anim. Sci.* **13,** 443-449.

Moseley G. and Jones D.I.H. (1974). The effect of sodium chloride supplementation of a sodium adequate hay on digestion, production and mineral nutrition in sheep. *J. Agric. Sci. Camb.* **83,** 37-42.

NRC. (1985). National Research Council, Nutrient Requirements of Sheep. The 6th Revised Ed. Natl. Acad. Sci., Washington, DC.

Pirzadeh Naeiny A., Khadem A.A., Rezaeian M. and Afzalzadeh A. (2010a). Starch processing wastage as a feed for Holstein bulls. *Proc. British Soci. Anim. Sci.* 373.

SAS Institute. (2001). SAS®/STAT Software, Release 8.2 SAS Institute, Inc., Cary, NC.

Scott D., Loveridge N., Abudamir H., Buchan W. and Milne J. (1993). Effects of acute acid loading on parathyroid hormone secretion and on urinary calcium and cAMP excretion in the growing lambs. *Exper. Physiol.* **78,** 57-163.

Singh P., Garg A.K., Malik R. and Agrawal D.K. (1999). Effect of replacing barley grain with wheat bran on intake and utilization of nutrients in adult sheep. *Small Rumin. Res.* **31,** 215-219.

Tabeidian S.A. and Sadeghi G.H. (2009). Effect of replacing barley with rice bran in finishing diet on productive performance and carcass characteristics of Afshari lambs. *Trop. Anim. Health. Prod.* **41,** 791-796.

Van-Soest P.J., Robertson J.B. and Lewis B.A. (1991). Methods of dietary fiber, neutral detergent fiber and non-starch polysaccharide measurements in relation to animal nutrition. *J. Dairy Sci.* **74,** 3583-3597.

Vinodh Kumar O.R., Swarnkar C.P., Shinde A.K. and Singh D. (2010). Clinical, mineral and haemato biochemical studies of urolithiasis in weaner lambs. *Afric. J. Agric. Res.* **5,** 2045-2050.