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EFFECTS OF BROILER-MEAT MEAL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF CROSSBRED HAIR LAMBS

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ABSTRACT

The aim of this experiment was to evaluate the effect of different levels of broiler-meat meal (BM; by-products of meat and visceras coming from broiler processing plants) in finishing diets for feedlot crossbred hair lambs on their growth performance and carcass characteristics. Sixty-four intact male lambs (Pelibuey x Katadin x BlackBelly: 30.28 ± 1.8 kg) were fed for 56 d one of four dietary treatments: T1: control without BM, T2: 2.5% BM, T3: 5.0% BM, and T4: 7.5% BM. All diets contained 16.7% crude protein (CP) and 2.8 Mcal ME/kg DM; with ruminal undegradable protein (RUP) ranging between 25.5 and 27.2%.Dietary BM did not influence feed intake, feed efficiency, biological dressing percentage and gastrointestinal content. On the other hand, maximum average daily gain (ADG; 271 g/day) was observed in T2 lambs, while lambs receiving other levels of BM gained weight in the range of 182–245 g/ day.BM not only showed better growth performance and commercial dressing percentage in lambs fed low levels of BM (2.5%) than higher levels of this protein source. These results indicate that there is the potential for inclusion of 2.5% BM in finishing diets for hair lambs.

Keywords: Feed efficiency; feedlot, broiler-meat meal; commercial dressing.

INTRODUCTION

Protein quality is important for feedlot lambs; protein imbalance may reduce growth rate, increase feeding costs, and emission of gases**,** particularly methane, to theatmosphere(Atkinson *et al.*, 2007). Improving feed efficiency by formulating diets with the proper balance of ruminally degradable and undegradable proteins (RUP) and providing animal products to consumers that are safe for human consumption continue to be as great a challenge as ever, even though fermentable nitrogen and by-pass protein requirements have been quantified for years (Walli, 2005; NRC, 2007). Microbes in the rumen convert non-protein nitrogen into microbial amino acids (Bach *et al.*, 2005); however, when microbial protein synthesis is not adequate to satisfy the amino acids requirements of the host ruminant, it is necessary to supplement the diet with nitrogen sources that escape rumen degradation (Atkinson *et al.*, 2007). In low-producing ruminants, protein requirements can be satisfied mainly with microbial protein, which is produced from nitrogen sources and high fiber feeds (Bach *et al.*, 2005, Borgues *et al.*, 2011). On the other hand, in high-producing ruminants, like feedlot lambs, their high protein requirements for maximum growth rate and satisfactory carcass quality are not completely satisfied by the microbial protein produced in the rumen. Considering this, it is necessary to provide protein sources that escape rumen degradation. Traditionally, sources of dietary protein are seen as either being of animal or vegetable origin (Walli, 2005). Protein of animal origin has greater nutritional value compared to protein of plant origin; however their use in animal feeding is strictly regulated because feeding of infected protein supplements increases the risks for transmissible bovine spongiform encephalopathy (BSE, "mad cow disease"), scrapie, and other encephalopathies cases of an outbreak of BSE occurred in the United Kingdom in 1988, which resulted in the restriction of meat and bone meal in ruminant feeding. The actual Mexican laws, Official Mexican Norm: NOM-060-ZOO-1999 (SAGARPA, 1999), allow the use of meals of only non-ruminant animal origin for ruminant feeding and then only if they are produced in plants that adhere to production conditions stipulated by the mentioned norm, which requires that poultry by-product meal used for ruminant feeding must receive thermal processing. “True” protein must contribute at least two thirds of total nitrogen (CP) in ruminant diets (Kim and Patterson 2003). Therefore, feed formulations for ruminants must have a good balance between total and RUP (Bohnert *et al.*, 1999;NRC 2007). A study demonstrated that broiler-meat meal has 57.45% RUP. This level was related to the thermal treatment with steam which removed moisture, allowed lipids extraction, and increased RUP (Lapierre and Lobley, 2001, Bohnert *et al.*, 1999). We hypothesized that BM as a source of dietary RUP would enhance growth performance and carcass characteristics of feedlot crossbred hair lambs. The aim of this experiment was to evaluate the effect of different levels of BM in diets for feedlot, hair lambs on their growth performance and carcass characteristics.

MATERIALS AND METHODS

The experiment was carried out in central México (19° N, at an altitude of 2440 m). The weather was temperate and ambient temperature range from 4.7 to 23 °C. Broiler-meat meal with 69% of total protein was obtained from Poultry processing plants installed in this zone. BMwas the ground clean parts of the carcass of slaughtered poultry such as necks, heads, feet, undeveloped eggs, gizzards and intestines (content removed), exclusive of feathers.

Sixty-four intact male lambs (30.28 ± 1.8 kg) of the hair lambs breed (Pelibuey x Katadinx x BlackBelly), about 6 months old were received at the unit research of Tlaxcala University. Upon arrival, lambs were vaccinated against clostridial diseases (Ultrabac 8®, SmithKlineBeechman) and treated for parasites (Ivomec Plus® Merck, Rahawy, NJ). Lambs were adapted to the basal grain diet for 14 d before the initiation of the trial. Afterwords, lambs were selected according to the body weight and randomly assigned within weight groupings, to 16 pens, 16 lambs per treatment and 4 treatments (4 pens per treatment distributed in four lambs per pen). Pens were 4 m^2 with bed wood chip and automatic waters resources. The care of animals was in accordance with the guidelines of the Mexican Council of Animal Care (SAGARPA, 1999). The treatments used were: T1, control with 0% BM and 25.53% RUP; T2, 2.5% BM and 26.08% RUP; T3, 5% BM and 26.63% RUP; and T4, 7.5% BM and 27.18% of RUP. The composition of experimental diets is shown in Table 1. Diets were prepared at approximately weekly intervals and stored in plywood boxes. Lambs were allowed free access to feed. Approximately 40% of daily feed consumption was provided in the morning feeding and 60% in the afternoon feeding. Experimental feeding was done for a period of 56 days, during this process animals were weighed at the begining of the study and then regularly after every 14 days, before feeding and watering them, from 7 to 9 a.m., on an electronic weighing balance with a precision of ± 10 g (Torrey®, Mexico). The amount of feed offered to each animal was revised at 14 day intervals as per the change in the average daily gain (ADG) and dry matter intake (DMI). Feed conversion ratios (DMI/ADG) were estimated for the 7 weeks that lambs remained in the experiment.

Carcass measurements: At the end of the feeding trial all lambs were slaughtered according to commercial practice consisting of stunning with a captive bolt followed by exsanguinations. Carcasses were dressed and hot carcass weights (HCW) recorded included kidney and testicle weights according to the Mexican norm for carcass evaluation (SAGARPA, 2006).After slaughtering, gastrointestinal digesta content was weighed and classified in terms of their respective percentages with respect to slaughter live weight (SLW). Empty body weight (EBW) was calculated by subtracting the weight of gastrointestinal content from live weight at slaughter. Warm carcasses were chilled in a cold room maintained at 4 ºC. On the next day, the cold carcass weight (CCW) was registered. Commercial and biological dressing percentages were calculated according to the following formulae:

Commercial dressing percentage = HCW/SLW x 100

Biological dressing percentage = CCW/EBW x 100

Representative samples of feed offered were ground to pass through a 1mm sieve screen size using a laboratory mill and analyzed based on index no. 934.01 for DM, index no. 984.13 for nitrogen, index ` 942.05 for ash (AOAC, 1990). The neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed following the procedure of Van Soest *et al.* (1991). *In vitro* digestion of dry matter was estimated according to Helrich (1990).

Analyses of variance using a randomized complete block designapplying the PROC GLM procedure of the statistical Analysis Systems Institute (SAS System, 2000) were used. The model including treatment as main effect with pens of 4 lambs each designated as an experimental unit. Linear and quadratic polynomials were used to detect the response to inclusion level of BM in the diet. Differences detected at the 0.05 level or less were considered statistically significant.

RESULTS AND DISCUSSION

Average daily gain varied quadratically (Table 2, $P< 0.05$) with T2 presenting the highest ADG. ADG for T3 and T4 were lower than T2, but did not differ with T1. Nitrogenous compounds (CP, NPN, and total protein) were slightly lower in BM diets (Table 1). These small reductions were not, however, great enough to explain the reduction in growth performance of lambs in groups T3 and T4. The *in vitro* digestibilities of diets varied little (Table 1) and these differences does not seems to explain the variation in ADG of lambs fed different levels of BM. It could be that increasing the amount of RUP reduced ruminal fermentation which negatively affected growth performance of lambs offered the diet with the highest BM level. Freeman *et al.* (2008) observed the same ADG reductions in beef steers fed high levels of RUP in the form of secondary protein nutrients and attributed this response to rumen fermentation changes.

In the present trial lambs weighed less than 45 kg and weight gains agreed with those reported in other trials where hair lambs have achieved ADG of about 250 g/d (Can *et al.,* 2005), as did hair lambs consuming a similar bypass protein to the one used in the present trial (Haddad *et al.,* 2005). Heavier lambs (60 kg) fed by-pass

Table 1 Experimental diets, with different levels of broiler-meat meal (DM basis)

	Percentage ofbroiler-meat meal			
	T1	T2	T3	T4
	0.0	2.5	5.0	7.5
Ingredient composition, g/kg (DM basis)				
Wheat grain	33.5	33.6	33.7	33.8
Barley grain	30.0	30.0	30.0	30.0
Soybean meal	8.0	5.5	3.0	0.5
Wheat bran	15.0	15.0	15.0	15.0
Broiler-meat meal	0.0	2.5	5.0	7.5
Urea	1.2	1.1	1.0	0.9
Vegetal oil	3.0	3.0	3.0	3.0
Mineral premix	2.3	2.3	2.3	2.3
Molasses, sugar cane	7.0	7.0	7.0	7.0
Nutrient composition, g/kg (DM basis)				
ME (Mcal/kg DM)[a]	2.8	2.8	2.8	2.8
Dry Matter	90.4	91.6	93.1	93.5
Ash	5.5	5.4	5.7	6.1
Crude protein	16.8	16.7	16.5	16.4
RUP, DM	25.5	26.1	26.6	27.2
Neutral Detergent Fiber	23.8	24.6	23.3	23.9
Non Protein Nitrogen	1.2	1.1	0.9	1.1
True protein	92.9	93.3	94.5	93.2
In vitro digestibility	80.8	81.7	81.6	78.2

aME - metabolizable energy, calculated according to NRC (2007) from diet component.

Table 2 Influence of different levels of broiler-meat meal on growth performance of feedlot crossbred hair lambs (means ± standard error)

	Percentage of broiler-meat meal			
	T1	T2	T3	T4
	0	2.5	5.0	7.5
Lambs, number	16	16	16	16
Initial live weight, kg	30.05 ± 1.8	30.40 ± 2.0	30.21 ± 1.7	30.45 ± 1.6
Weight gain, kg/d				
1-14 daysa	0.207 ± 0.08	0.211 ± 0.04	0.220 ± 0.05	0.206 ± 0.09
14-28 daysa	0.229 ± 0.05	0.253 ± 0.03	0.182 ± 0.04	0.151 ± 0.07
28-56 daysa	0.245 ± 0.07	0.271 ± 0.06	0.237 ± 0.06	0.182 ± 0.08
1-56 days a	0.219 ± 0.06	0.249 ± 0.05	0.180 ± 0.05	0.178 ± 0.07
DM intake, kg/d				
1-14 days	0.865 ± 0.05	0.889 ± 0.03	0.865 ± 0.05	0.872 ± 0.04
14-28 days	1.027 ± 0.07	0.980 ± 0.04	0.955 ± 0.06	0.922 ± 0.04
28-56 days	1.101 ± 0.10	1.026 ± 0.09	1.033 ± 0.08	0.968 ± 0.06
1-56 days	0.997 ± 0.07	0.964 ± 0.05	0.941 ± 0.06	0.921 ± 0.05
Feed efficiency (DM intake/weight gain)				
1-14 days	4.19 ± 1.6	4.33 ± 1.2	4.01 ± 1.3	4.87 ± 1.3
14-28 days	4.82 ± 1.1	4.42 ± 1.12	5.43 ± 1.3	6.25 ± 1.0
28-56 days	4.85 ± 1.3	4.68 ± 1.2	5.81 ± 1.4	5.64 ± .09
1-56 days	4.74 ± 1.4	4.18 ± 1.11	5.47 ± 1.3	5.6 8 ± 1.2

Initial and final live weight reduced the gastrointestinal digesta percentage.aQuadratic effect, $P< 0.05$.

protein gained 350 g/d (Loe *et al.*, 2000). No effect (Table 2, *P* >0.50) of level of BM on DMI was detected, which is in line with data of Dabiri (2004), who reported DMI of 1.08 and 1.09 kg/d in lambs consuming diets containing soybean meal or fishmeal, respectively. Martínez *et al.* (2002) reported DMI of 972 g/d for lambs. Over the entire feeding trial, FE did not differ among treatments, which agrees with , Haddad *et al.* (2005) using similar bypass protein. These authors obtained similar feed efficiency in lambs fed RUP; however, Lewis *et al.* (2000), obtained 200 g/d less ADG when poultry by-product meal replaced soybean meal in finish diets for lambs. Lambs in the T2 group presented the highest slaughter weight, empty body weight and commercial dressing (quadratic effect *P* <0.05) compared to all other groups. Both the gastrointestinal content and biological dressing were not influenced by dietary treatment (Table 3, *P* >0.50). Lewis *et al.* (2000) using BM and soybean meal in their diets, obtained carcass yields of 46%, which is lower than values obtained in the present trial.

Table 3 Influence of different levels of broiler-meat meal on tissues and dressing percentage of feedlot hair lambs during and after of slaughter (means ± standard error)

	Percentage of broiler-meat meal			
	T1	T2	T3	T4
	0	2.5	5.0	7.5
Slaughter live weighta	41.53 ± 2.2	43.15 ± 2.3	40.4 ± 2.5	40.01 ± 1.9
Slaughter, empty body weighta	37.69 ± 3.1	39.21 ± 2.9	36.72 ± 3.2	36.18 ± 3.1
Gastrointestinal content, %	10.21 ± 1.1	10.32 ± 0.09	10.01 ± 1.03	10.42 ± 1.08
Commercial dressing, %a	52.95 ± 2.7	53.44 ± 2.9	52.12 ± 3.0	53.84 ± 3.1
Biological dressing, %	58.84 ±3.2	59.27 ± 3.3	57.91 ± 3.1	59.82 ± 3.4

aQuadratic effect, *P*< 0.05. Commercial dressing percentage = Hot carcass weight/live weight x 100. Biological dressing percentage = cold carcass weight/empty bodyweight x 100.

Conclusion: The results showed that the inclusion of 2.5% of BM in the finishing ration based on cereal grains for feedlot hair lambs improved growth performance and some carcass characteristics over rations with higher BM levels. Thus, low levels of BM could be used as a promising source of protein in lamb feed.

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