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Growth Performance and Carcass Characteristics of Feedlot Lambs Fed Diets with Pig Manure and Rumen Contents

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Abstract: The effects of diets containing Dried Pig Manure (DPM) and Dried Rumen Contents (DRC) on growth performance and carcass characteristics were examined in lambs. Sixteen intact male Pelibuey×Dorper lambs weighing 23.8±1.9 kg were housed in individual pens for a 60-day feeding trial and were assigned randomly into four treatment diets in a 2×2 factorial design, based on the addition of 15% DPM and/or 4% DRC: T1 no addition (control); T2 DPM only; T3 DRC only; and T4 both DPM and DRC. All diets were formulated to contain 14% CP and 2.6 Mcal ME kg^{-1} DM. At the end of the trial, carcass images were recorded in the last intercostal space (12-13th ribs) using ultrasound to measure the *Longissimus dorsi* area muscle and subcutaneous fat. Daily dry matter intake was lower ($p<0.05$) in animals consuming DPM plus DRC, compared to animals consuming only DPM or DRC, but similar to the control group; DMI was 941, 1077, 1015 and 952 g, for T1 to T4, respectively. Average daily gain (227, 209, 214 and 188 g, respectively) and feed efficiency (5.37, 5.54, 5.44 and 6.02, respectively) were similar ($p>0.05$) between groups. Moreover, subcutaneous fat (0.31, 0.29, 0.29 and 0.24 cm, respectively) and *Longissimus dorsi* area (15.37, 15.32, 15.66 and 14.47 cm^2, respectively) showed no significant difference ($p>0.05$) between lambs fed the four diets. In conclusion, feed consumption was depressed in the diet with pig manure plus rumen contents, however, weight gain or carcass characteristics were not influenced by the inclusion of pig manure and/or rumen contents in their diets.

Key words: Pig manure, rumen contents, growth performance, carcass characteristics, lambs

INTRODUCTION

Pig production could be limited by ammonia emission, because nitrogen excretion is implicated in environmental pollution while large volumes of manure increase the cost of handling and disposal (Boer *et al*., 1997). Pig manure is composed of feces, urine and small quantities of feed particles. The nutritive value of pig manure is well recognized; it is a good source of protein and minerals (Duarte *et al*., 2000). Another advantage of pig manure is its availability throughout the year. It was concluded in a digestion and metabolism trial that fresh swine excreta is a valuable source of nitrogen for sheep that can be fed up to 600 g d^{-1} as dry matter (Gcanton *et al*., 2005). Pig manure is a suitable and safe ingredient in sheep diets; high levels of pig manure fed to finishing sheep did not affect weight gain or carcass characteristics and copper levels in the liver were normal (Padilla *et al*., 2000).

When ruminants are slaughtered, the contents of their rumen can become a viable feed resource. Rumen contents can serve as a good source of soluble vitamins, crude protein and dietary energy for herbivores. The manipulation of dietary factors alters bacterial colonization of rumen particles that flow to the duodenum (Yana *et al*., 2001). Rumen contents are a yellow-to-green semi-liquid mixture with a very intense, characteristic odor, composed of non-digested feed, rumen micro-organisms and end products of rumen fermentation. If rumen contents accumulate after land disposal, they can contribute to environmental pollution.

Lamb production is regulated by two factors: First, the efficiency of transforming feed into meat and second, the market. Carcass quality provides the first measure of the finished product and is used as a key selection criterion in genetic improvement (Kempster, 1989). Ultrasono-graphy has been identified as a technology with potential for evaluating carcass characteristics before slaughter, because it allows a non-invasive observation of muscle and fat in the live animal (Allison, 1989).

Feedlot production of lambs in Mexico has been increasing in importance; however, information on the use of pig manure and rumen contents in fattening diets for

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lambs is limited. Thus, objectives of the present study were to evaluate growth performance and measure *Longissimus dorsi* muscle area and subcutaneous fat in fattening lambs fed diets containing dried pig manure and/or rumen contents.

MATERIALS AND METHODS

Fresh pig manure of growing and finishing pigs was collected from the farm, spread on a concrete floor in layers of about 5 cm and exposed to dry in the sun, turning the layers twice daily until it contained about 90% dry matter.

Rumen contents were obtained from cattle slaughtered at the local abattoir. The process of drying rumen contents was similar to that for pig manure.

Sixteen intact male Dorper×Pelibuey lambs were assigned randomly into four treatment diets (4 lambs per diet). They were housed in individual pens (2 m^2) located in a shaded area and received water at free access. The feeding trial lasted 60 days, preceded by a 10-day adaptation period, during which lambs were tagged for identification and were treated for intestinal parasites. The diets contained 14% CP and 2.6 Mcal ME kg^{-1} DM and were formulated based on nutrient requirements for growing lambs (NRC, 1985). Composition and chemical analysis of diets are shown in Table 1. The experimental groups were based on the addition of 15% Dried Pig Manure (DPM) and/or 4% Dried Rumen Contents (DRC) to the group feed as follows: T1 with no feed addition (control); T2 DPM only; T3 DRC only and T4 DPM and DRC. Respective diets were individually offered to each lamb twice daily (09:00 and 16:00) in quantities sufficient to allow *ad libitum* consumption. The amounts given and left over were weighed to calculate Daily Feed Intake (DFI).

Weight of each lamb was registered at the beginning of adaptation and feeding periods and every 20 days throughout the feeding trial. Average Daily Gain (ADG) and Feed Efficiency (FE) were calculated.

At the end of the feeding trial, carcass images were recorded using an Aloka SSD-500 ultrasound equipment and a 7.5-MHz linear transducer. The images were taken from the last intercostal space (12-13th ribs) on both sides, after shaving approximately 25 cm^2 to provide proper contact. Subcutaneous fat (mm) and *Longissimus dorsi* muscle area (cm^2) were estimated using the measuring accessories in the equipment.

Data on ADG, DFI, FE as well as measurements of subcutaneous fat and *Longissimus dorsi* muscle area were subjected to analysis of variance using a 2×2 factorial analysis: factor A, with 0 or 15% of pig manure and factor B, 0 or 4% of rumen contents (Steel and Torrie, 1988).

Table 1: Diets used in the lamb feeding trial (% DM basis)

	Treatments (diets)			
Ingredients	0% DPM 0% DRC	15% DPM 0% DRC	0% DPM 4% DRC	15% DPM 4% DRC
Urea	0.3	0.3	0.2	0.2
Sorghum grain	55.2	52.5	55.0	48.0
Soybean meal	18.5	10.8	17.0	11.0
Sugar cane molasses	7.0	4.0	5.3	7.3
Minerals[a]	1.0	1.0	1.0	1.0
Sorghum straw	10.0	10.0	6.0	6.0
Wheat bran	7.0	4.0	5.3	7.3
Calcium soaps of tallow	3.0	3.0	2.0	3.5
Dried pig manure	0.0	15.0	0.0	15.0
Dried rumen contents	0.0	0.0	4.0	4.0
Total	100.0	100.0	100.0	100.0
Nutrients				
CP (%)	14	14	14	14
ME, Mcal kg^{-1}	2.6	2.6	2.6	2.6

DPM = Dried Pig Manure; DRC = Dried Rumen Contents, [a]Contains: Ca 100 g, P 80 g, Mg 30 g, Zn 4 g, Mn 3 ppm, Fe 3 ppm, Cu .0025 g, I .04 g, Se .04 g, Co .02 g, Vit. A 150 000 UI, Vit. D 25 000 UI, Vit. E 150 UI (qs. 1 kg)

Table 2: Performance and carcass characteristics of lambs in the feeding trial

	Treatments (diets)				
Item	0% DPM 0% DRC	15% DPM 0% DRC	0%DPM 4% DRC	15% DPM 4% DRC	SEM
Animals per treatment	4	4	4	4	
Initial weight (kg.)	18.5	17.8	19.0	20.6	
Final weight (kg.)	31.7	34.0	33.7	33.4	
Daily feed intake d^{-1} (g)[a]	941	1076	1015	952	45.41
Average daily gain (g)[b]	227	209	214	187	19.27
Feed efficiency[b]	5.37	5.53	5.44	6.01	0.85
Carcass characteristics					
Longissimus dorsi					
area (cm^2)[b]	15.37	15.32	15.65	14.46	0.84
Subcutaneous fat (cm)[b]	0.30	0.29	0.29	0.23	0.03

DPM = Dried Pig Manure; DRC = Dried Rumen Contents; SEM = Standard Error of the Mean, [a]Interaction A×B treatment effect($p<0.05$), [b]No treatment effect ($p>0.05$)

RESULTS AND DISCUSSION

Lambs were similar ($p>0.05$) in ADG and FE. There was an effect ($p<0.05$) for interaction A×B treatment for DFI (Table 2).

In the present experiment lambs fed the diet with only pig manure showed weight gains similar to other groups. In agreement with this, it was reported in sheep feeding that diets with pig manure produced weight gains of 155 g d^{-1}, similar to diets without pig manure (Padilla *et al*., 2000). In growing bulls, a researcher found no significant differences on average daily gain or intake of feed; their results suggest that sun-dried swine excreta previously mixed with ground dried corn plant might be included in ruminant diets (Garcia *et al*., 2002).

It is possible that in the present experiment, the diet with only pig manure had similar nitrogen usage than the control diet; in agreement with this, it was showed that diets for sheep with 0, 200, 400 or 600 g of fresh swine excreta had similar ($p>0.05$) N balance

(Gcanton *et al*., 2005). In a trail, it was used 20, 25, 30 and 35% Dehydrated Pig Feces (DPF) in rations based on sorghum and cane molasses in steers; they concluded that DPF can be included up to 35% of DM in the ration of beef cattle, without negatively affecting rumen fermentation (Salcedo *et al*., 2004a). This way, it was found that the incorporation of DPF in the ration improves rumen environment and efficiency of microbial growth in the rumen and consequently increases the availability of microbial nitrogen in the small intestine (Salcedo *et al*., 2004b).

In the present experiment lambs fed the diet with only rumen contents had weight gains similar to those fed other diets; in agreement with this, other authors reported in sheep feeding that diets with rumen contents in levels of 0, 20 and 40% in substitution of corn straw and Sudan hay exhibited similar ($p>0.05$) weight gains, (156, 159 and 144 g d^{-1}, respectively (Dominguez *et al*., 1994). Similar results reported no effect on weight gain in lambs fed diets with different levels of rumen contents. These findings show that rumen contents can replace the forage source in lamb feedlot diets (Lerma and Salinas, 1990).

In a research it was evaluated the effect of dietary inclusion of rumen contents and barley (RCB; at 0, 25 and 50%) on growth performance and carcass traits in lambs. Daily DM intake and final body weight were not different among treatments, although average weight gain was higher ($p<0.05$) in lambs fed control diet than those fed RCB diets (Abouheif *et al*., 1999). These findings contrast with the results of the present experiment; this could be attributable to the high levels of rumen contents used by authors (Abouheif *et al*., 1999) compared to 4% used in the present experiment; feedlot diets should contain a high concentrate proportion. In agreement with the present research, in a report it was concluded that non-silage rumen content as a sole roughage diet can be used efficiently in goats (Gosh *et al*., 1997).

In the present experiment, the interaction of pig manure plus rumen contents (T4) had a significant ($p<0.05$) effect in feed consumption. It is possible that the offensive odor of both, rumen contents and pig manure in same diet caused a reduction in feed consumption. Nevertheless, DFI in group T4 was similar to that in the control group.

In this study, subcutaneous fat did not exhibit significant differences ($p>0.05$) related to the addition of pig manure and/or rumen contents in the diets of the experimental groups of lambs. These findings agree to those of others who fed high levels of pig manure to Pelibuey lambs; they reported a smaller amount of perineal fat compared to lambs fed without pig manure (Padilla *et al*., 2000). In contrast, it was observed a decrease in perineal fat with increasing amounts of pig manure in the ration (Verdin *et al*., 2001).

In the present experiment, one of the reasons why lambs, which received diets with pig manure and/or rumen contents, did not show differences in fat deposition, could be because the amount of fat deposited in all lambs was very low at this age. It has been established that fat accumulation is age dependent and subcutaneous fat is the last to be accumulated during growth. This finding was corroborated by others, who evaluated body fat accumulation in Pelibuey lambs at different ages and diets. In 12 and 16-months-old lambs dietary lipids affected body fat reserves ($p<0.05$) compared to 8-month-old lambs. These authors found that an 8-month lamb weighing 29.8 kg at slaughter showed 3.3 mm of back fat, whereas animals weighing 42.3 kg showed 6.2 mm of back fat (Leon *et al*., 1999). Thus, it seems that at a higher finishing body weight there is an apparent effect on the amount of subcutaneous fat (Salinas *et al*., 2004).

The *Longissimus dorsi* area measured by using ultrasound in the present study did not show significant differences between groups ($p>0.05$). These findings are also in agreement with others who observed that the proportion of each part of the left carcass and the ratio of soft-to-bone tissue were found to be normal in comparison to others (Padilla *et al*., 2000). Similarly, it was concluded that pig manure inclusion in hair sheep rations did not affect carcass characteristics. In other trial, when evaluated dietary inclusion of rumen contents and barley (0, 25 and 50%) for lambs; the carcass weight and dressing percentage were not different among treatments (Abouheif *et al*., 1999).

CONCLUSION

It is concluded that under the conditions of this experiment, diets with only pig manure or rumen contents did not affect daily weight gain, daily feed intake, feed efficiency, *Longissimus dorsi* area, or subcutaneous fat in lambs. However, the diet with rumen contents plus pig manure reduced feed consumption of lambs; they may have diminished their feed intake because of the offensive odor of both ingredients, which could have a negative associative effect in feed intake. It is possible that processing one ingredient in a different way, like silage, could improve feed consumption of both ingredients in the same diet, because of this, additional studies are suggested to use these ingredients, which will help reduce environmental pollution, decreasing at the same time high-cost protein-rich ingredients like soybean meal in feedlot sheep rations.

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