



## Evaluation of carcass traits, non-carcass components and 12<sup>th</sup> rib analysis of hair sheep supplemented with phosphorus

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**ABSTRACT** - The aim of this study was to evaluate the performance of sheep supplemented with phosphorus (P) using carcass traits and analysis of 12<sup>th</sup> rib. Twenty male lambs weighing  $13.88 \pm 2.51$  kg and grazing *Andropogon gayanus* pasture were divided in two treatments of 10 animals each. In group P, animals were supplemented with 3 g phosphorus/animal/day, while in group NP no P supplementation was given. After 82 days the animals were slaughtered and carcass measurements were taken. The 12<sup>th</sup> rib was also removed for analysis. No significant differences in body weight, carcass yield, or commercial cut weights were found between both treatments, except for liver and kidneys that were heavier in the supplemented group ( $p=0.0954$ ). The 12<sup>th</sup> rib analysis showed that the group P had higher rib, bone, and muscle weights when compared to animals not supplemented with P. Other measurements such as carcass fatness and rib eye area were not significantly affected by treatments as well as contents of crude protein, ether extract, ash and P. It was shown that P supplementation improved performance in young sheep, including bone and muscle tissue and liver and kidney weights.

Key Words: lambs, deficiency, growth, mineral, Santa Inês

## Avaliação das características de carcaça, constituintes corporais e da 12<sup>a</sup> costela de ovinos deslançados suplementados com fósforo

**RESUMO** - Este trabalho foi realizado com a finalidade de avaliar o desempenho de ovinos suplementados com fósforo (P), utilizando-se as análises das características de carcaça e da 12<sup>a</sup> costela. Foram utilizados 20 ovinos com  $13,88 \pm 2,51$  kg de PV, mantidos em pastagem de *Andropogon gayanus*, distribuídos em dois tratamentos com dez animais: um com suplementação de 3g/fósforo/animal/dia e o outro sem suplementação. Após 82 dias, os animais foram abatidos, tomando-se as medidas da carcaça e da 12<sup>a</sup> costela, para posterior análise. Não foram encontradas diferenças significativas entre os valores de peso vivo, rendimento de carcaça, cobertura de gordura e cortes comerciais entre os dois tratamentos, exceto os pesos do fígado e dos rins, que foram superiores ( $p=0,0954$ ) no grupo suplementado. Na análise da 12<sup>a</sup> costela, o grupo com suplementação demonstrou maior peso da costela, do osso e do músculo em comparação aos animais que não receberam P suplementar. As demais medidas, como gordura e área de olho-de-lombo, não foram afetadas, assim como os níveis de PB, EE, CIN e P. A suplementação de fósforo melhorou o desempenho, a formação dos tecidos ósseo e muscular e os pesos de fígado e rins.

Palavras-chave: cordeiros, crescimento, deficiência, minerais, Santa Inês

### Introduction

Small ruminants, especially sheep, are growing in importance for animal production worldwide. In Brazil, meat sheep production increased considerably in recent years mainly using native hair breeds at pasture (Veloso et al. 2004).

Phosphorus (P) deficiency in tropical countries is more common in pasture-fed herds because most of the grasses are established on P deficient soils. For instance, 50% of the soils destined to animal production on these areas are

latosols with low levels of available P, despite their good physical properties. The deficiency of available P is aggravated by elevated levels of iron and aluminum oxides and hydroxides that react with P in the soil making it practically unavailable for more nutritionally demanding plants and plants with root systems unable to overcome aluminum toxicity (Carvalho et al., 2003).

Phosphorus is a key mineral for animal growth and energy metabolism. Moreover, it is an essential component in buffer systems in the blood and other organic fluids. Therefore, low intake of P by ruminants may cause a

reduction in voluntary consumption of feed, slow growth and weak bones (Underwood & Suttle, 1999).

Carcass is an important factor for evaluating the ability of an animal to transform feed into edible product (meat). With increasing consumer demand for lamb, the standardization of product quality is necessary (Macedo et al., 2000).

Generally, sheep carcasses may represent between 40 and 50% of the animal body weight depending on factors such as age, sex, birth weight, nutrition, management and others. Factors related to the carcass such as weight, length, fattening and conformation also influence dressing percentage (Pérez, 2002).

The most important component in valorization of the carcass or cut is muscle. Therefore, the greater proportion of muscle, the higher commercial value of the animal (Fernandes, 1994). Fat offers protection to frozen meat, reducing loss and it also affects palatability (Deambrosis, 1972).

Measurements that can be correlated with composition are very useful in avoiding costly total dissection of the carcass. The rib has been used for predicting the proportions of muscle, fat and bone in the carcass (Silva & Pires, 2000). In this study carcass, non-carcass components and 12<sup>th</sup> rib were analysed to evaluate the effect of P supplementation in young sheep.

## Material and Methods

This trial was conducted in the sheep section of the Água Limpa farm of the Brasília University (UnB), located at 15° 47' latitude south and 47° 56' longitude west. The regional climate is classified as AW by Köppen with mean annual temperature of 21.1°C varying from 16.0°C (minimum) to 34.0°C (maximum). Mean annual precipitation is 1578.5 mm and mean relative air humidity is 68%.

Twenty Santa Inês male sheep averaging 13.8 ± 2.5 Kg of initial body weight and three months of age were maintained in a single group on *Andropogon gayanus* grass pasture. Pastures were not fertilized the 12 months before the experiment. The lambs were randomly allocated to two dietary treatments as follows: 16.66 g/animal/day of bicalcium phosphate providing 3.0 g phosphorus/animal/day (group P) or no phosphorus supplementation (group NP).

At the end of each day, the groups were separated in closed stables and received a concentrate containing 200 g cassava flour, 10 g urea and 9.57 g a mineral mixture (0.009 KI; 0.0008 CoSO<sub>4</sub>; 0.03 CuSO<sub>4</sub>; 1.61 MgO; 3.0 NaCl; 0.32 ZnSO<sub>4</sub>; 0.148 MnSO<sub>4</sub>; 0.457 FeSO<sub>4</sub>; 4.0 S).

Pasture samples were collected on days 6, 42 and 69 of the experiment, and chemical analysis carried out according to the Association of Official Agricultural Chemists (AOAC, 1995) recommendations (Table 1).

Animals were weighed on days 1, 8, 29, 43, 57 and 82 of the experiment. Parasites were counted (eggs per gram of faeces – EGF) weekly using modified Mc Master technique (Whitlock, 1948). Animals were treated as necessary using febendazole (Panacur oral®).

After 82 days on experiment, lambs were weighed (slaughter body weight – SBW) and slaughtered after a 24 hour fast. Soon after bleeding, skin was removed and weighed. Viscera were also removed and thoracic (TCO – lung, heart and trachea) and abdominal cavity organs (ACO – liver and kidneys) weighed followed by measurement of hot carcass weight (HCW). Carcass traits were evaluated using the system proposed by Müller (1987) and Osório et al. (1998). Fat was measured subjectively on a 0.25 point increasing scale varying from score 1 (no visible subcutaneous fat on the carcass) to score 5 (high fatness – obese – carcass surface covered with subcutaneous fat). Carcass length (distance between base of the tail and base of the neck) was measured with a metric tape.

Half-carcasses were obtained by a longitudinal cut on the vertebral column and the left half weighed (LHCW). A fraction of the rib cage was taken by transverse cuts at the 12<sup>th</sup> and 13<sup>th</sup> ribs to obtain the 12<sup>th</sup> rib cutting close to the posterior faces of the 11<sup>th</sup> rib and 12<sup>th</sup>, with ventral separation at the end of the 12<sup>th</sup> rib followed by weigh and composition (muscle, bone and fat – adapted from Hankins & Howe, 1946). The component rib tissues were minced together for freeze drying. Afterwards, samples were chopped before chemical analysis according to AOAC (1995).

Eye muscle area was determined by drawing around the longissimus muscle exposed by the transverse cut of the 12<sup>th</sup> intercostal space using a standard transparent checked base (1cm<sup>2</sup>/cell). The halfcarcass was divided into six commercial cuts: leg, shoulder, back, rib, belly and neck (adapted from Santos, 1999) and then individually weighed. Dressing percentage of the hot carcass (DHC) was calculated using the formula suggested by Osório et al. (1998):  $DHC = (HCW/SBW) \times 100$

The experiment was analyzed as a completely randomized design with two treatments (dietary levels of P) with 10 replications and five repeated measures in time for body weight only. The program Statistical Analysis System (SAS, 1996) was used for data analysis.

### Results and Discussion

Chemical composition of the feeds used in the experiment are presented in Table 1.

No significant differences were observed in the body weight of the animals comparing both treatments throughout the experimental period (Figure 1). Winks (1990) observed that P deficiency was more severe in grazing ruminants on pastures with P level lower than 0.15%. In the present study, P content of the pasture was approximately 0.21%, which may be considered as a marginal deficiency for the NP sheep. Moreover, it can be seen that the 82-day period was not enough to significantly reduce weight gain of animals not supplemented with P.

Working with 215 kg Nellore calves, Nicodemo et al. (2000) found reduction in both intake and weight gain on animals receiving 5g P/day. However, some studies showed that body weight alone is not a good indicator for early diagnosis of P deficiency (Vitti et al., 1988; Villarroel et al., 1991).

Table 1 - Chemical composition of feeds offered to sheep

Chemical composition (g/kg DM)	Grass	Concentrate	
		Phosphorus	No phosphorus
DM	322.6	888.5	880.1
CP	61.7	238.0	232.0
EE	28.0	14.8	11.1
NDF	733.6	143.5	142.7
ADF	380.8	31.5	32.6
Ash	63.4	84.1	28.6
Phosphorus	2.1	16.4	0.9

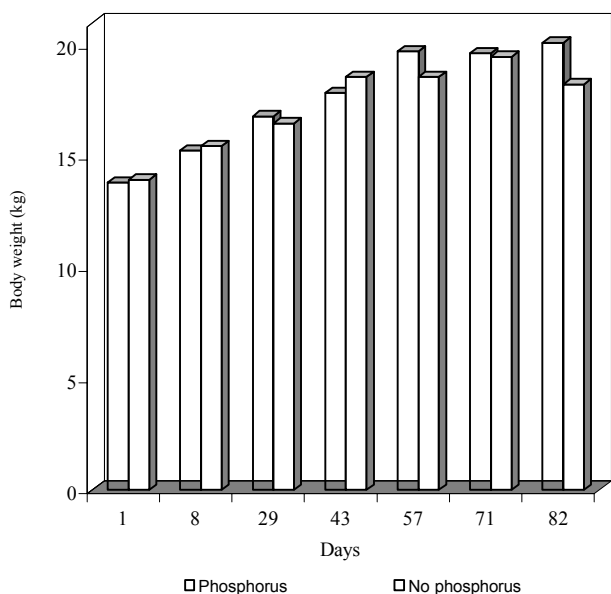


Figure 1 - Body weight change in sheep with or without P supplementation.

No significant differences were observed between treatments for carcass component weights (Table 2), except for liver and kidneys that were heavier in the supplemented group (p=0.0954). Although liver and kidneys are not carcass components, they have an aggregated economic interest for sale because can be consumed by lower income families in developing countries such as Brazil (Tonetto et al., 2004).

Carcass dressing percentage averaged 40% across treatments and was lower than those reported by Alves et al. (2003), which varied from 45 to 50%. However, these authors used heavier animals (14.5–16.5 kg carcass weight). Comparison of carcass traits should taking into account breed, sex, age, weight and nutrition of the animals in order to avoid inadequate conclusions. Sousa (2003) used Santa Inês sheep similar in weight and age to those in the present trial but a different feeding system (confined animals fed corn and sunflower silage). Carcass fatness (fat and ether extract of the 12<sup>th</sup> rib) was higher in Souza (2003) study, due to the greater energy density of the diet, but few differences were found when other carcass traits were compared between both experiments.

Studying the effect of four different forage types (hay of water-grass, hay of bagasse of pineapple, forage palm and corn silage) on the quality of meat in Santa Inês sheep, Madruga et al. (2002) apud Madruga (2003), found in the meat higher concentrations of lipids for animals fed water-grass hay, bagasse of pineapple hay, and corn silage. This was also due to higher energy levels in the diet. In the meat, levels of water content, protein, phosphorus, calcium and cholesterol were significantly greater for sheep fed with forage palm compared to the other treatments.

Fat in the carcass has beneficial effects in terms of flavour, and reduces dehydration which occurs during the cooling process. This dehydration makes the meat dark and dry, undesirable to the customer (Sainz, 1996). Higher fat levels found in adult sheep are not desirable for sale purposes, because of poor texture and consistency, due to a high degree of saturated fatty acids which adhere to the palate when not served hot (Osório & Osório, 2003).

Weights of the 12<sup>th</sup> rib, bone and muscle (p=0.0618) were higher for animals supplemented with P but no significant differences were observed for the remaining variables (P>0.10; Table 3).

Animals that received P supplementation had higher degree of development of the 12<sup>th</sup> rib, reflected by the greater amount of muscle and bone tissue. Muscle is edible and adds more economic value to the carcass.

Nutrition is a key point in the standardization of lamb carcasses that is required to improve market value of the

Table 2 - Slaughter and carcass weights and weights and proportions of commercial cuts of half carcasses and non-carcass components in sheep with or without P supplementation

Item	Carcass components		Standard Error
	Phosphorus	No phosphorus	
Body weight at slaughter (kg)	20.10	18.24	1.12
Carcass weight (kg)	8.08	7.51	0.52
Half carcass weight (kg)	4.09	3.90	0.27
Carcass dressing (%)	40.2	41.2	0.78
Carcass length (cm)	60.2	62.4	1.34
Carcass fatness (score 1 to 5)	2.3	2.2	0.1
Leg (kg)	1.33	1.21	0.08
% <sup>1</sup>	32.7	31.2	1.1
Shoulder (kg)	0.89	0.81	0.06
% <sup>1</sup>	21.8	20.9	1.0
Back (kg)	0.44	0.50	0.06
% <sup>1</sup>	10.7	12.7	1.1
Rib (kg)	0.44	0.41	0.01
% <sup>1</sup>	10.9	10.5	0.5
Belly (kg)	0.68	0.64	0.06
% <sup>1</sup>	16.5	16.3	0.5
Neck (kg)	0.39	0.34	0.0
% <sup>1</sup>	9.5	8.9	20.4
Non-carcass components			
Skin (kg)	1.17	1.19	0.07
% <sup>2</sup>	14.5	15.4	2.1
Lung, trachea and heart (kg)	0.46	0.42	0.03
% <sup>2</sup>	5.8	5.8	0.3
Liver and kidney (kg)	0.57 <sup>b</sup>	0.49 <sup>a</sup>	0.03
% <sup>2</sup>	7.2	6.7	0.3
Scrotum weight (kg)	0.21	0.20	0.04
% <sup>2</sup>	2.3	2.7	0.4
Scrotal circumference (cm)	19.5	19.0	1.65

a, b Means followed by different letters in the same row are significantly different (p<0.10)

<sup>1</sup> Half carcass weight as reference and <sup>2</sup> Carcass weight as reference.

Table 3 - Weight, proportion and chemical composition of 12<sup>th</sup> rib and rib eye muscle area for sheep with or without P supplementation

Treatments	Phosphorus	No phosphorus	Standard error
Rib weight (g)	55.72 <sup>b</sup>	43.37 <sup>a</sup>	3.77
Muscle weight (g)	35.94 <sup>b</sup>	29.23 <sup>a</sup>	2.43
%	65.0	67.4	2.3
Bone weight (g)	12.57 <sup>b</sup>	8.53 <sup>a</sup>	1.30
%	22.3	19.5	1.3
Fat weight (g)	5.16	4.17	0.67
%	9.2	9.9	1.2
Eye muscle area (cm <sup>2</sup> )	8.1	8.3	0.6
12 <sup>th</sup> rib chemical composition			
Dry matter % (DM)	32.9	33.6	0.88
Crude protein (%DM)	61.9	59.2	2.46
Ether extract (%DM)	17.2	19.3	1.60
Ash (%DM)	15.2	14.2	0.65
Phosphorus (%DM)	2.7	2.5	0.12

a, b Means followed by different letters in the same row are significantly different (p<0.10).

product and to attract consumers. Carcass must have a high percentage of muscle, uniform subcutaneous fat deposit and adequate fat levels to fulfill market requirements. All these traits are influenced by the degree of maturity of the genotype. Conformation and fattening

score of carcasses are criteria that define quality and carcass finished with good conformation tends to have better prices at sale, especially in countries with tradition in lamb and mutton production (Silva Sobrinho et al., 2003).

## Conclusion

Phosphorus supplementation can improve bone tissue and muscle deposition, as well as, kidney and liver weights in young sheep reared at pasture in the savannah region of Brazil. Therefore, it is important to feed mineral supplementation to animals, particularly P, in cases of P deficiency in pasture and soil.

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