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Carcass characteristics of llamas (*Lama glama*) reared in Central Chile

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Abstract

Body and carcass composition were studied on 10 male and 10 female naturally reared llamas (*Lama glama).* Half the animals were young (9–12 months) and the other half adult (>3 year) . The average live weights for young and adult males were 104.4 and 100.6 kg, and for females 67.6 and 104.6 kg, respectively. Average carcass weights for the four groups were 58.9, 56.2, 36.8 and 56.7 kg, respectively. Carcass composition for males and females was similar, but males had slightly higher dressing percentages than females (56.1 and 55.8 vs. 54.1 and 54.2 for young and adult males and females, respectively). Carcass length and fat depth at the loin and proportions of cuts in the carcass were similar for both the sexes, except for leg and tail, which were proportionately heavier in young females compared to the other groups. The composition of meat on fresh basis was: moisture 70.2%, protein 20.5%, ether extract 8.23% and ash 3.4%. Age and sex seemed to have no effects on the body and carcass characteristics studied nor on the chemical composition of meat.

Keywords: Llama; Carcass; Meat

1. Introduction

Four species of camelids are found in South America: the guanaco (*Lama guanicoe*) and the vicuña (*Vicugna vicugna*) are wild, whereas the llama (*Lama glama*) and the alpaca (*Lama pacos*) are domesticated (Claverías, 1990; Jeri, 1990; Murray, 1989). Llamas are raised for wool, meat and hides, and sometimes used for carrying light loads. Recently, the importance of llama and alpaca has increased because their meat is an important source of protein for the Andean population (Vilca, 1991).

The population of llamas and alpacas in Chile is estimated at ≈89 500 (Bonacic, 1991). During the last two decades, both public and private organizations have been suggesting repopulating parts of Central and Southern Chile with domestic camelids, where these animals are at present almost extinct. If these efforts are successful, the number of camelids available for slaughter will increase. Animals to be slaughtered will include older culled breeding stock as well as young animals not suitable for breeding.

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Information on carcass and meat characteristics of llamas in Chile is scarce. The objective of this work was to evaluate body and carcass characteristics, and chemical composition of llamas in Chile.

2. Material and methods

Twenty llamas, forming a herd fed with natural pastures and located near Casablanca (33°15′S and 72°30′W), Central Chile, were involved in the study. The animals were grouped according to sex and age into four groups of 5 animals each: young males and females (9–12 months of age) and adult males and females (>3 years of age). These age groups represent culled old breeding stock and culled young animals. The animals were transported to a local commercial slaughterhouse and fasted (only water was available) for ≈12 hours prior to slaughter. After weighing, the llamas were electrically stunned and slaughtered according to standard procedures. The weight of carcass (including kidney and kidney fat), blood, feet (cut at tarsal–metatarsal and carpal–metacarpal articulations), hide, full and empty gastrointestinal tract, liver, heart, lungs including trachea, and head (cut at the occipital–atlantoidal articulation) were determined following the procedures described by Pérez et al. (1986). The gastrointestinal content was estimated as the difference between full and empty gastrointestinal tract and the empty body weight as live weight minus gastrointestinal content. Dressing percentage was calculated as carcass weight divided by live weight, and empty body weight percentage as carcass weight divided by empty body weight.

Three hours after slaughter, the carcasses were weighed again and then halved longitudinally with a band saw. The carcass length was measured from the front edge of the pubis simphysis to the upper part of the front edge of the first rib. Each carcass half was then cut in quarters between the 12th and 13th ribs. Fat depth and muscle area were measured at this level. Fat depth was measured at three-quarters the distance between the chine end and a line perpendicular to the axis running through the center of the longissimus dorsi muscle. A calliper was used to measure the muscle area of the longissimus dorsi muscle at the 12th rib. The carcass quarters were then cut into neck, shoulder, chops, thorax, and leg, according to the Chilean standard cutting procedure for lambs (Gallo et al., 1996). The cuts from the carcass right half were dissected, removing bones and tendons (Cuthbertson et al., 1972). The remaining muscles and fat were ground and thoroughly mixed. Samples were taken from these mixes to determine moisture, nitrogen content, ether extract and ash using standard methods (AOAC, 1995). Leg and shoulder from the carcass left half were packed in polyethylene bags, frozen at −20°C and dissected 2–5 months later (Cuthbertson et al., 1972).

The data were subjected to a 2×2 factorial analysis of variance, the factors being sex and age. Variables measured as percentages were transformed using arcsine (Sokal and Rohlf, 1981).

3. Results and discussion

The effects of sex and age on weight at slaughter, carcass variables, and proportions of the different commercial cuts are presented in Table 1. Within young animals, males had higher slaughter weight and carcass length than females, but in adult animals no significant differences between sexes were observed. The dressing percentages of llamas were higher than those for sheep (Pérez et al., 1986) and goats (Pérez et al., 1997) raised under similar environmental conditions. The empty body weight percentage was similar for the four groups. The hot carcass weight followed the same trend observed for live weight at slaughter.

Males and females showed differences in dressing percentage (56.0 and 54.2) and empty body weight percentage (63.7 and 62.0). Similarly, Pinto et al. (1984), Bravo et al. (1981), and Bustinza et al. (1986) noted that llama males showed higher dressing percentages. Fat depth was on average 2 mm, similar to those observed in sheep (Pérez et al., 1986) and greater than those reported for goats (Gallo et al., 1996; Pérez et al., 1997).

The proportion of commercial cuts was not affected by age or sex, except for the proportion of leg and tail in females in which case younger animals had higher proportions. Leg and shoulder represented between 53 and 60% of the carcass, proportions which are less than those observed in sheep (Pérez et al., 1986) and goats (Gallo et al., 1996; Pérez et al., 1997).

Table 1
Carcass characteristics and proportion of the commercial cuts of the llama's carcass according to sex and age (means and standard deviation)

Characteristic	Males				Females			
	young ($n = 5$)		adult ($n = 5$)		young ($n = 5$)		adult ($n = 5$)	
	mean	SD	mean	SD	mean	SD	mean	SD
Live weight at slaughter (kg)	104.4[a]	22.3	100.6[a]	19.4	67.6[b]	16.4	104.6[a]	22.6
Carcass length (cm)	101.8[a]	9.0	99.0[ab]	4.8	88.6[b]	6.5	104.0[a]	8.3
Dressing LW (%)	56.1	2.3	55.8	1.9	54.1	1.5	54.2	1.2
Empty body weight (%)	64.2	2.4	63.1	2.0	64.2	6.4	59.8	3.5
Hot carcass weight (kg)	58.9[a]	14.3	56.2[ab]	11.2	36.8[b]	9.9	56.7[ab]	12.2
Muscle area[c] (cm^2)	58.7	13.2	45.4	7.2	43.6	14.1	55.5	14.4
Fat depth over loin (mm)	1.8	0.8	2.2	0.8	1.6	0.6	2.6	0.6
Leg (%)	33.4[b]	2.4	33.1[b]	2.2	39.3[a]	4.0	32.9[b]	1.7
Shoulder (%)	21.8	2.8	20.9	1.0	20.6	1.7	19.9	1.1
Thorax (%)	19.5	2.9	17.1	1.5	18.3	2.3	20.2	2.7
Chops (%)	17.2	1.0	18.9	1.7	17.5	2.7	18.6	1.2
Neck (%)	8.0	1.8	8.7	2.3	7.6	3.7	8.8	3.0
Tail (%)	0.2[b]	0.1	0.3[b]	0.1	0.5[a]	0.2	0.3[b]	0.1

[a,b] Averages with different letters in the same row are different; $p < 0.05$.
[c] Of the longisimus dorsi muscle, measured at the 12th rib.

When the weights of organs, skin, blood and other corporal components were compared, only the weights of heart, kidney and liver showed differences between groups (Table 2). Nevertheless, no trend was seen from these differences. Full and empty digestive tract, followed by skin were the heaviest of the studied body components. Among the organs, liver and lungs, including trachea, were the heaviest.

No significant differences between groups in the chemical composition of llamas' meat were observed (Table 3), but adult animals tended to have less moisture and higher ether extract than younger animals (Table 4). The observed chemical composi-

Table 2
Weight of the principal components of llama's carcass according to sex and age (means and standard deviation)

Characteristic	Males				Females			
	young ($n =$)		adult ($n =$)		young ($n = 5$)		adult ($n = 5$)	
	mean[a]	SD	mean[a]	SD	mean[a]	SD	mean[a]	SD
Blood (kg)	2.8	1.0	2.7	0.9	2.5	0.2	3.0	0.7
Head (kg)	2.8	0.5	2.8	0.5	1.9	0.3	2.7	0.5
Feet (kg)	2.4	0.3	2.2	0.2	1.7	0.2	2.2	0.5
Ski (kg)	10.9	2.3	10.4	2.0	7.3	1.0	10.3	2.9
Full digestive tract (kg)	20.0	5.8	17.9	5.3	13.8	3.3	17.1	8.4
Empty digestive tract (kg)	6.8	1.9	6.1	2.1	3.9	0.6	7.4	2.6
Digestive content (kg)	13.2	4.2	11.8	3.5	9.9	2.9	9.7	7.0
Heart (kg)	0.6[a]	0.2	0.5[ab]	0.1	0.3[b]	0.1	0.3[a]	0.1
Kidney (kg)	0.2[ab]	0.1	0.2[ab]	0.0	0.2[b]	0.0	0.3[a]	0.1
Lung and trachea (kg)	1.9	0.4	1.9	0.4	1.1	0.2	1.6	0.4
Spleen (kg)	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0
Liver (kg)	1.8[a]	0.4	1.6[b]	0.2	1.4[b]	0.5	2.0[a]	0.5

[a] Averages with different letters in the same row are different; $p < 0.05$.

Table 3
Chemical composition of llama's meat according to sex and age (means and standard deviation)

Characteristic	Males				Females			
	young ($n = 5$)		adult ($n = 5$)		young ($n = 5$)		adult ($n = 5$)	
	mean	SD	mean	SD	mean	SD	mean	SD
Moisture	71.9	3.7	67.2	3.4	72.2	3.2	69.7	5.8
Protein	19.2	2.0	21.8	3.1	21.4	2.2	19.9	1.7
Ether extract	8.0	2.2	10.1	3.0	5.5	1.3	9.3	4.9
Ash	1.0	0.1	1.0	0.3	1.0	0.2	1.0	0.2

Table 4
Proportions of muscle, dissectable fat (intermuscular plus subcutaneous) and bone of shoulder and leg in llama's carcass according to sex and age (means and standard deviation)

Characteristic	Males				Females			
	young ($n = 5$)		adult ($n = 5$)		young ($n = 5$)		adult ($n = 5$)	
	mean	SD	mean	SD	mean	SD	mean	SD
Shoulder								
Muscle	61.8	4.6	63.4	3.4	64.8	2.1	61.8	3.2
Bone	19.9	3.1	19.2	2.9	23.0	2.4	19.6	0.9
Fat	12.5	7.9	11.2	6.2	5.7	3.7	13.7	4.1
Losses[a]	5.8	1.1	6.3	2.6	6.6	1.8	5.0	1.1
Leg								
Muscle	69.7	4.4	70.4	3.9	70.8	1.4	70.5	1.9
Bone	18.2	0.8	19.8	3.2	20.4	2.4	18.4	1.1
Fat	6.6	4.9	5.5	2.7	3.3	0.8	6.5	2.4
Losses[a]	5.5	1.5	4.3	1.3	5.5	1.3	4.6	1.0

[a] Represents weight loss during dissection, and tissues considered as residues, such as nerves, tendons, etc..

tion was within the ranges reported for this species (Vilca, 1991; Henriquez and Waissbluth, 1984; Bonacic, 1991). The protein content in llama's meat was higher than those reported for cattle, pig, chicken, and alpaca (Waissbluth and Henriquez, 1984), indicating a potential for this species as a source of animal protein.

No significant differences were observed between groups in the proportion of muscle, bone and fat in shoulder and leg cuts (Table 4). The proportion of edible parts (muscle and fat) of both cuts is higher than those reported for sheep (Pérez et al., 1986) and goats (Gallo et al., 1996; Pérez et al., 1997). The area of the longisimus dorsi muscle of the llama was comparable to those of steers weighing 250 kg; however, fat cover was 50% thinner than in steers (Klee et al., 1997).

4. Conclusions

The main characteristics and components of llama's carcass were not affected significantly by the animal's age or sex, except for dressing percentage where males showed a higher value than females. Chemical composition of meat was also not affected by age or sex. The most relevant commercial cuts, shoulder and leg, showed a high proportion of muscle and fat and a lower proportion of bone compared to goats and sheep. The high meat and fat proportion of llama's carcass, coupled with its high protein content, high muscle area and thin fat cover, indicate that this animal has a great potential as a source of meat in Chile. However, the results of this study are based on a relatively small sample of five animals per sub-group, which contributed to relatively high variations in the

traits studied. More studies on larger numbers are needed before conclusive recommendations can be given.

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