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Características de carne y de las canales de capibaras (*Hydrochoerus hydrochaeris*) en vida libre

Meat and carcass characteristics of free-living capybaras (*Hydrochoerus hydrochaeris*)

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Resumen

Ese estudio se realizó con finalidad de evaluar las características de la canal y carne de capibaras (*Hydrochoerus hydrochaeris*) en vida libre en los campos agrícolas de la región Grande Dourados, MS, Brasil. Cinco animales fueron utilizados (dos machos y tres hembras, peso entre 63.4-100 kg) para determinar el rendimiento, peso y medidas de la canal, así como el peso de los cortes comerciales. A los cortes (Lomo, costillas, *L. dorsi*, diezmillo, jamón and aguayón) fueron evaluados según los siguientes parámetros: humedad, proteína, grasa, cenizas, Ca, P y Fe, así como capacidad de retención del agua, pérdidas por cocción, fuerza de corte y color instrumental en coordenadas CIE-Lab. El rendimiento promedio de la canal caliente fue 62.47 % y el rendimiento de la canal fría fue 57.89 %. No hubo diferencia significativa (P>0.05) entre los sexos. El valor promedio de pérdida por enfriamiento fue de 4.10%. Para el rendimiento de los cortes, entre costilla (24.98%) y jamón (27.29%) no hubo diferencia significativa (P>0.05). No se encontró diferencia significativa (P>0.05) entre humedad, proteína y minerales de los cortes, pero el contenido de lípidos del lomo fue significativamente (P<0.05) menor. Los resultados indican que capibaras en vida libre tienen las características adecuados para comercialización de su carne, haciendo factible el desarrollo de proyectos sustentables con estos animales.

Palabras claves: Capibaras; rendimiento de canal; cortes de carne comerciales; composición química; color; sustentabilidad.

Abstract

This study aimed to evaluate carcass and meat characteristics of free-living capybaras (*Hydrochoerus hydrochaeris*) from agricultural areas of Grande Dourados, MS, Brazil. Carcass weight, yield and measures, as well as of commercial cuts weight of five animals (2 males and 3 females, body weight between 63.4-100 kg) were determined. The following parameters: moisture, protein, fat, ash, Ca, P and Fe, water holding capacity, cooking losses, shear force and color Instrumental color in CIE-Lab coordinates were determined to meat cuts (Loin, ribs, *L. dorsi*, chuck/brisket, ham and bottom sirloin). The dressing percentage average value was 62.47% of body weight and cold carcass yield was 57.89% of body weight, with no difference between sexes. The mean percentage of cold loss was 4.10%. Cuts yielding (ribs 24.98% and ham 27.29%) were not statistically different (P>0.05). There was no significantly (P> 0.05) difference between the moisture, protein and minerals content between the different cuts, but lipids content was significantly (P< 0.05) lower in loin. The results shown that free-living capybara have characteristics appropriate for commercialization, thus it is possible to development projects for the sustainable management of rural populations.

Key Words: Capybara*s*; carcass yield; commercial meat cuts; chemical composition; color; sustainability.

INTRODUCTION

Issues related to the co-existence of wild animals and men in farm areas are common in several regions of Brazil. The process of altering the original landscape may have direct or indirect influence on patterns of distribution and abundance of wild species (Wiens, 1996; Ferraz et al., 2003). These anthropogenic changes in the environment, especially those related to the crops cultivation, generate conflicts by reducing the areas to animals and by providing crops as an accessible and stable sources of food which allows the occurrence of great social groups and population as a whole (Ferraz et al., 2009, 2010). In Brazil, the control of pest populations and even noncommercial hunting in some cases are permitted. However, the products obtained with these activities are not allowed to be marketed, according to the Law No. 5197. (Piovezan and Moreira, 2012). Nevertheless, the permission for selling these products and the removal of animals by owners of areas where these animals are described as a problem would be viable alternatives for the conservation of populations of other rarer species, as the environments used by them may be kept (Piovezan and Moreira, 2012).

In many developing countries, the meat of wild animals has been a major source of protein for some rural and indigenous populations. In addition, the consumer market has been receptive to the consumption of wildlife meat and thus, these animals can be viable sources of highly profitable products, contributing to food production (Oda et al., 2004a). The production of capybara (*Hydrochoerus hydrochaeris* L. 1766) has been considered not only as an economic alternative to captive breeding, but also has been stood out in exotic meat market due to its biological and productive properties. In addition, has being indicated as a potential resource for implementing systems for sustainable development (Alvarez, 2011). This type of activity means new alternative for farmers, generating protein for human population, and contributes to the conservation of wildlife (Alvarez and Kravetz, 2006).

However, little is known about the nutritional quality, marketing and consumption of capybara meat. Studies are scarce in regards to the factors that affect the physical and chemical characteristics of this meat, as well as on the evaluation of carcass yield. Thus, the present study was carried out to determine carcass characteristics and meat quality of free-living capybaras.

MATERIAL AND METHODS

The experiment was conducted at the College of Agricultural Sciences from Federal University of Grande Dourados, located in Dourados, MS, Brazil. The animals used on the study were adults, two males and three females with average weight/standard deviation of 63.4±10.25 kg. The animals were free-living from agricultural areas of Dourados. Age classification was made according to the size of animals in which adult animals were considered those with body weight over 30 kg, as proposed by Verdade and Ferraz (2006). The free-living animals were in natural environments without any human handling and fed mainly crops cultivated on the farm properties (sugarcane, corn, rice, soybean, etc.). All procedures related to the capture, handling, transport and slaughter of these animals were conducted on approval and legal consent of the Federal Brazilian Agency (MMA/ICMBio/SISBIO), case number 23469-1, issued on the basis of Instruction No.154/2007 through the authentication code No. 52397954 and was approved by the Ethics Committee on the Use of Animals (protocol No. 001/2011) from UFGD. After capture, the animals were transported to the Laboratory of Meat Technology FCA/UFGD, where they were slaughtered to evaluate the weight and carcass yield, obtained by the ratio of hot carcass weight (eviscerated carcass without feet, head and leather) and slaughter weight, expressed as kg/100 kg body weight. After cooling for 24 hours in the refrigerator at 4 °C, the carcasses were reweighed to obtain the weight and cold carcass yield. PH readings were taken at 24 hours post-mortem with a portable stick-style pH meter (Testo®). Three measurements were made of pH in each carcass (ham, shoulder and loin) and the average values were used in the analysis.

The carcasses were split longitudinally and the right half was sectioned into retail cuts, which were then weighed and measured to estimate the yield of the carcass cold. The division of the cuts was based on the study of Santos et al. (2001), adapted by the Laboratory of Meat Technology (UFGD) in six anatomical regions: ham, chuck/brisket, flank (bottom sirloin), ribs, loin and neck, which are the commercial cuts. In the left half carcass, the muscle *Longissimus dorsi* was cut between the 10th and 12th rib and along with the other cuts was packed in polyethylene bags and kept at -18 °C for later analysis.

Capybaras and carcasses were weighed on a mechanical scale to 100kg and the cuts in digital electronic scales to 15 kg/0.1 g and 30 kg/0.1 g. The parameters used to evaluate the carcasses were determined as follows: Hot carcass yield (HCY) = hot carcass weight (HCW) / body weight at slaughter (BW) x 100; cold carcass yield (CCY) = cold carcass weight (CCW) / body weight at slaughter (PCA BW) x 100; the percentage of cooling losses (PCL) x 100; Loss by freezing PR (%) = (HCW-CCW) x 100/HCW; retail cuts yield (RCY) = weight of individual cuts / cold carcass weight x 100; carcass internal length (CIL) was measured in the region between the anterior border of the ischio-pubic symphysis and the anterior border of the first rib at its midpoint, and chest depth (CD), in a maximum distance between the top edge of scapula and sternum. The measurements were made with a tape measure according to the methodology described by Osorio and Osorio (2005).

Samples of 100 grams of each cut were separated, homogenized, identified and frozen at -18 °C. The assessment of the meat chemical composition was performed in the Laboratory of Animal Nutrition at UFGD and Laboratory of, Plant and Soil Correction at Embrapa Agropecuária Oeste. The moisture, crude protein, lipid and ash were determined according to the methodology described by Silva and Queiroz (2002). The mineral phosphorus (P), calcium (Ca), and iron (Fe) were also determined according to the methodology proposed by Silva and Queiroz (2002) through via wet chemical methods with adjustments made by the Laboratory of Soil, Plant and Correction of Embrapa Agropecuária Oeste. The reading of minerals (Ca and Fe) was held in atomic absorption spectrophotometer and P through a spectrophotometer for molecular absorption with 420 nm wavelength, according to the metavanadate-yellow color method.

Meat quality characteristics were assessed through analysis of *Longissimus dorsi* muscle of each animal. In order to evaluate the water holding capacity (WHC), samples with approximately 2 grams were subjected to a pressure of 10 kg for 5 minutes and then, the difference between the before and after weights was calculated following the methodology described by (Hamm, 1986). The meat color was analyzed using a portable colorimeter (Minolta CR 410) with the CIE-Lab coordinates: L* (brightness), a* (redness) and b* (yellowness), with a D65 light source and 10° angle. The measurements were performed on the sample surface, according to the methodology described by Houben et al. (2000).

The cooking weight losses were determined as described by Abularach et al. (1998). The samples were thawed out for 24 hours under refrigeration (4 °C), sliced into steaks, 2.5 cm thick, and baked in a preheated electric furnace at a temperature of 300 °C, up to reach 70 °C in the geometric center. After cooking steaks were cooled at room temperature for one hour and the surface moisture was removed with absorbent paper, and then steaks were reweighed. The percentage of cooking weight loss (PCWL) was determined by the difference between the final weight and the initial weight of the sample according to the equation: PCWL = (IW-FW/IW× 100), wherein: Cooking Weight Loss = PCWL by cooking; FW = sample weight after cooking; IW = initial sample weight.

The determination of the shear force (SF) was performed according to the methodology described by Wheeler et al. (2005). For that, the samples were baked as described in the previous paragraph, and then six samples were cut with 13 mm diameter cylinders in the longitudinal direction of the muscle fibers. SF was assessed using a texturometer (TA.XT2i, Stable 27 Micro Systems) with Warner-Bratzler blade, moving with 500 mm/min descent speed (AMSA, 1995).

For statistical analysis of RCY a completely randomized design (CRD) was used considering the cuts as treatments, animals as repetition and RCY as response variable. The chemical composition of the male and female meat was compared using Student's t test in which the sex of animals was considered as a treatment and commercial meat cuts were as repetition.

The parameters of the nutritional composition were analyzed according to methodology by Bressan et al. (2002) and Oda et al. (2004a), using a completely randomized design, considering the cuts as treatments, animals as repetition and nutritional parameters as response variables.

The qualitative characteristics of meat were held through descriptive analysis to assess the WHC as well as color and SF, regardless of capybaras sexes. Average values for these variables were described and discussed in comparison with studies performed with capybara meat produced in captivity and other species used in animal production.

Analyses were performed as the statistical model described below:

$$Y_{ij} = \mu + t_i + e_{ij}$$

wherein:

Y_{ij} is observed variable, μ, general constant; t_i, treatment effect and e_{ij}, random error associated with each observation. When the analysis of variance identified significant differences between the cuts for each variable, the means were compared by Tukey test adopting $\alpha = 0.05$. Statistical analyses were performed with the software Sigma Plot 11.0 (2008).

RESULTS AND DISCUSSION

The values for weight, hot and cold carcass yields, cooling losses, carcass length and depth of the chest are shown in Table 1. Hot carcass yield (HCY) had an average value of 62.47 kg/100kg, within the range, 49.89 to 64.7 kg/100kg obtained by Assaf et al. (1976a, b). In an experiment conducted by Bressan et al. (2002) the average value of HCY was 51.33 kg/100kg. However, on research conducted with capybaras in a semi-extensive system and fed different diets, Andrade et al. (1998) found 63.96 kg/100kg as a mean value for

HCY. Nogueira Filho (1996) reported that animals weighing between 35-40 kg in intensive system will have a carcass weight between 18-22 kg. According to this statement, for an overall average of 20 kg carcass for animals slaughtered at 37.5 kg body weight, the average carcass yield remains between 53.33 kg/100kg, ranging from 51.42 kg/100kg (for animals with 35kg body weight and 18 kg of carcass) to 55 kg/100kg carcass yield (simulating 22 kg carcass for an animal with 40 kg body weight).

Table 1. Quantitative analysis of carcass of free-living capybaras in agriculture areas in Grande Dourados region (means and coefficient of variation)

Parameters	Mean	CV (%)
BW (kg)	63.40	16.18
HCW (kg)	40.30	27.08
CCW (kg)	37.21	26.46
HCY (%)	62.47	15.44
CCY (%)	57.89	15.85
PCL (%)	4.13	40.43
CIL (cm)	63.00	15.02
CD (cm)	22.00	3.21

BW = Body Weight, HCW = Hot Carcass Weight (carcass without pawns, head and skin), CCW = Cold Carcass Weight, PCL = Percentage of cooling losses (HCW – CCW x 100/HCW), HCY = Hot Carcass Yield (HCW/BW) x 100, CCY = Cold Carcass Yield (CCW / BW) x 100, CIL = Carcass Internal Length, CD = Chest Depth.

Ojasti (1973) obtained lower values (51 to kg/100kg) for capybaras from extensive systems in Venezuela. When compared with other types of production, Capybaras presented a HCY greater than that found by Menezes et al. (2008) for carcasses of “Santa Ines” lambs, finished on pasture with three types of grasses (47.3 kg/100kg) and cattle, selected and unselected Nellore breed (57.83 and 56.82 kg/100kg) respectively (Vittori et al., 2006). Greater carcass yields are most often associated with fatter animals, whose carcasses will have a reduced percentage of edible portions (Oliveira, 2005). In this paper, the average weight at slaughter (BW) was 63.40 kg. The ideal slaughter weight for capybaras, according to Pinheiro (2008), is about 40 kg of live weight. After that weight, the animal has the muscle tissue almost completely developed, and then, fat deposition occurs, which causes deterioration in feed conversion (Pinheiro, 2008). It's noteworthy that the differences in the method of skinning can influence carcass yield, since, when animals are slaughtered in commercial slaughter houses through current method, that causes a retaining of significant amounts of fat that is adhered to the skin of the animal, and hence, causes reduction in yield. Nonetheless, excessive fat on the carcass adversely affect the quality of the final product and also affects the economic viability of the production system, once most of the nutrients were transformed into undesirable tissue according to the consumer's point of view (Fernandes and Barros, 2009). Capybara meat has lower saturated fat content which turns it more suitable for human nutrition. However, when compared to other types of red meat, it has higher content of unsaturated fat which can lead to faster rancidity of the product.

The cold carcass yield (CCY) obtained (57.89 kg/100kg) is consistent with that described by Pinheiro et al. (2007) who found similar values, including data from males and females (58.26 kg/100kg) with approximately 40 kg of body weight. According to these authors, these values are considered adequate if compared to other experiments with capybaras. The cooling loss indicates the percentage of weight that is lost during the carcass cooling, due to factors such as loss of moisture and chemical reactions that occur in the muscle (Brochier and Carvalho, 2009). Thus, the smaller this value, the higher the probability of the carcass has been handled and stored appropriately. In this experiment, the percentage of cooling losses (PCL, 4.13) was lower when compared to Andrade et al. (1998) who found 5.36 and 4.50% as average values of cooling losses for capybaras confined in stalls and paddocks, respectively. In this study, the measures for internal length (CIL) were higher than that described by Pinheiro et al. (2007) who found 57.63 cm to 55.41 cm for females and males. PT was similar to that described by these authors (23.62 cm for females and 22.68 for males). There was no significant difference (P <0.05) on the hot carcass weight for the yield of these cuts (Table 2), ribs (27.29 kg/100kg) and ham (24.98 kg/100kg), which accounted for the highest percentage compared to other cuts.

Table 2. Yield of commercial cuts of free-living capybaras.

Commercial cuts	Yield of commercial cuts (kg/100kg)		
	Mean	SD	CV (%)
Loin	13.28b	±2.33	17.54
Ribs	24.98a	±4.62	18.49
Chuck/Brisket	14.76b	±2.25	15.24
Ham	27.29a	±2.62	9.60
Bottom sirloin	9.55b	±2.23	23.35
Neck	7.64bc	±1.58	20.68

Means with same letters on the column are not statistically different by Tukey test with $\alpha = 0.05$.

According to Andrade et al. (1998), animals reared in larger areas have higher ham percentage that animals reared in confinement, which tend to have higher yield of chuck/brisket, loin and ribs as capybaras tend to have higher development when have better conditions for movement and other activities due to stress reduction and increased physical activity. The average values for ham and ribs in this study contradict the statements reported by Andrade et al. (1998). The average overall value for yield of loin for males and females was higher than those found by Pinheiro et al. (2007) and Andrade et al. (1998) for males and females (kg/100kg 10.83 and 8.47), respectively. The cut, chuck/brisket (14.76 kg/100kg) showed similar values to those described by Andrade et al. (1998), for capybaras in semi-extensive systems and fed with dry feed + grass (16.66%). Capybaras tend to have higher development when they have greater areas available due to stress reduction and increased physical activity (Andrade et al., 1998), which was confirmed by this study. All parameters for analysis of the chemical composition of capybara meat were no statistically significant (P> 0.05) between the sexes (Table 3). There were no differences among the commercial cuts in regards to the percentage of moisture, protein and ash (Table 4). However, the levels of lipids were statistically significant (P <0.05).

In comparison with capybaras in captivity, Oda et al. (2004a) found values of 75.80 g/100g moisture when comparing these same commercial cuts. In a study conducted with the objective of evaluating the effect of management on young capybaras in confinement Girardi et al. (2004) found average values of moisture 74.47 and 74.42 g/100g for loin of capybaras with or without access to lagoons, respectively. When comparing the levels of moisture and lipids with other species, the values found confirm the statements made by Sales (1995); According to Kadim et al. (2008), water content differs slightly between species, but fat content differences are greater. The total lipid content was low, ranging from 0.7 to 1.85 g/100g, similar to those found by Saldanha et al. (2002), for the ham and brisket cuts (average 1.60 g/100g). The findings were also similar to those described by Oda et al. (2004a) for the same cuts. In this current study, the variation on lipid content was lower among the cuts. Although, the loin presented the lowest lipid content (0.70 g/100g), there was no difference (P> 0.05) when compared with the brisket which was also similar to the results found by Oda et al. (2004a). While Jardim et al. (2003) found for the same cuts 0.83 g/100g and 0.76 g/100g respectively. These findings are contradictory with the assertions of Madruga et al. (2005) who state the loin muscles have more fat, once are less used by the animal, especially when compared to muscles for support such as ham. Capybaras have similarities with the pigs in relation to fat deposition, especially for showing abundant subcutaneous fat and not having fat marbling in the muscle L. dorsi, as occurs with cattle and sheep. In this context, comparing the results of this study to the research conducted by Bragagnolo and Rodriguez-Amaya (2002) with pigs, it was found that the lipid content of the loin (3 g/100g) was also the lowest, if compared to the ham and brisket cuts (5 g/100g respectively for each cut) which was different from the shank, but not from the brisket. The average for protein content was no difference (P> 0.05) among the cuts. This result was below the average values presented by Oda et al. (2004a), for the same cuts (21.98 g/100 g), but was similar to those found by Girardi et al. (2005)

for ham and loin of young capybaras (20.80 g/100g). Therefore, the protein content of capybara meat is akin to that of different feedlot species (16 to 22 g/100 g) as cited by Ordonez et al. (2005).

Table 3. Chemical composition of meat (female and males) of free-living capybaras.

Sex	Moisture (g/100g)	Lipids (g/100g)	Protein (g/100g)	Mineral (g/100g)	Ca (mg/100g)	P (mg/100g)	Fe (mg/100g)
Male	74.23±4.92	1.53±0.69	20.98±1.99	1.26±0.20	28.69±10.54	202.90±23.7	0.39±0.38
Female	75.28±3.36	1.44±0.46	20.33±2.31	1.15±0.20	32.92±13.03	205.48±22.4	0.60±0.14
Mean	74.75	1.48	20.65	1.20	30.80	204.19	0.49

Table 4. Chemical composition of commercial meat cuts of free-living capybaras.

Commercial cuts	Moisture (g/100 g)	Lipids (g/100 g)	Protein (g/100 g)	Minerals (g/100 g)
Loin	74.90±1.67 a	0.70±0.42 b	21.50±1.22 a	1.16±0.09 a
Ribs	78.05±1.67 a	1.51±0.42 a	19.46±1.22 a	1.18±0.09 a
L. dorsi	73.33±1.67 a	1.48±0.42 a	20.67±1.22 a	1.29±0.09 a
Chuck/brisket	73.94±1.67 a	1.43±0.42 ab	22.25±1.22 a	1.31±0.09 a
Ham	74.35±1.67 a	1.83±0.42 a	20.66±1.22 a	1.26±0.09 a
Bottom sirloin	74.60±1.67 a	1.85±0.42 a	18.98±1.22 a	1.05±0.09 a
Mean	74.86	1.46	20.58	1.21
CV (%)	2.23	28.76	5.93	7.44

Means with same letters on the column are not statistically different by Tukey test with $\alpha = 0.05$.

The ash content ranged from 1.05 to 1.29 mg/100 g, with no significant difference ($P > 0.05$) among the cuts and was equivalent to the values reported for other food animals (Ramos et al., 2009; Juárez et al., 2009; Leon et al., 2011; Faria et al., 2009). The micro-element iron (Fe) had an average concentration of 0.51 mg/100g. The content of this mineral showed differences ($P < 0.05$) in relation to the different cuts and the rib cut presented the highest level, although was not statistically different ($P > 0.05$) from the brisket, loin and bottom sirloin (Table 5).

Table 5. Mineral composition (macro and micro-elements) of different meat cuts of free-living capybaras.

Commercial cuts	Fe (g/100 g)	Ca (g/100 g)	P (g/100 g)
Ham	0.44±0.10 b	29.01±7.09 a	215.29±10.78 a
Chuck/Brisket	0.64±0.10 abc	28.11±7.09 a	212.34±10.78 a
Ribs	0.65±0.10 a	39.65±7.09 a	190.68±10.78 a
Longissimus dorsi	0.40±0.10 bc	37.22±7.09 a	213.38±10.78 a
Loin	0.49±0.10 ab	33.37±7.09 a	201.70±10.78 a
Bottom sirloin	0.47±0.10 ab	20.02±7.09 a	193.29±10.78 a
Mean	0.51	31.23	204.44
CV (%)	19.60	22.70	5.27

Means with same letters on the column are not statistically different by Tukey test with $\alpha = 0.05$.

The average final pH (24 hours post-mortem) found is considered optimal according to Luchiari Filho (2006), that stated pH value below 5.8 is optimal for export trades (Luchiari Filho, 2000). When compared with pork meat, RFN/Normal (red, firm and non-exudative) reported by Santos et al. (2012) capybara meat is also within the normal range for pH_{45} (above 5.7). In studies conducted by Bressan et al. (2004) with captive adult capybara the average final pH value was 6.01 in the muscle *L. dorsi.* Oda et al. (2004b) reported an average final pH of 5.96. This value is above the range considered adequate for acidification in red meat, which according to the authors, indicates that glycogen reserves on the muscle was consumed during the pre-slaughter period, which resulted in less acidic meat at 24 hours post mortem. In some countries, such as Australia pH values above 5.7 are unacceptable (Delgado and Soria, 2006). The pH values between 5.40 and 5.60 are considered normal for beef and 6.0 is considered as a divider between the normal and dark-cutting (Fernandes et al., 2008).

In this study, the capybara meat showed WHC of 67.21%. Results obtained by Bressan et al. (2004) were approximately 76.50% to the capybara meat. This finding is consistent with the assertions of Abularach et al. (1998), mentioned previously, since the pH values presented by Bressan et al. (2004) was greater than 5.8, resulting in greater WHC. For water losses by cooking (PCWL), the mean values were lower than those described by Bressan et al. (2004) for the same species (31.28 to 33.60%) and similar to those described by Oda et al. (2004b), who found values ranging from 24.93 to 33.84 %. The water released during the application of any external force or along a particular process drags soluble protein, vitamins and minerals with a consequent reduction in the nutritional value (Ordóñes et al., 2005).

The shear force (SF) measured in this study was lower than found in literature. For capybaras in captivity, Bressan et al. (2004) found values of 5.2 kgf while Saldanha (2000) reported values of 4.55 and 4.68 kgf for brisket and ham cuts. In comparison with these values, the meat of free-living capybara was extremely soft. A soft meat is considered when the maximum physical strength is about 5.0 kg (Judge et al., 1988), however, is variable according to the particularities of each species and type of muscle (Table 6).

Table 6. pH, water holding capacity, cooking losses and shear force of *L. dorsi* muscle of free-living capybaras.

Parameters	Mean	SD	CV (%)
pH (final)	5.60	0.02	0.35
Water holding capacity (%)	67.21	3.02	4.49
Cooking looses (%)	27.86	9.92	35.60
Shear force (kgf/cm^{-2})	2.84	0.79	27.81

Color is one of the most relevant factors in the consumer's perception of the quality of the meat. It is a characteristic that influences both the initial choice of the product by the consumer and the acceptance at the time of consumption (Fletcher, 1999; Gaya and Ferraz, 2006, Tapp III et al., 2011). The brightness (L*) value (Table 7) found in this study (34.28) was higher than that described by Bressan et al. (2004) for the same species. In a study to evaluate two methods of slaughter of capybaras, the humane method (MH) and the shooting method (MT), Oda et al. (2004b) found darker meat (29.58) in the first method than in the second one (32.40). Besides the difference of slaughter method, another factor that may be related to this variation is the age of the animals, as it is stated that older capybaras have darker meat. In this current experiment, the age classification adopted was based on that proposed by Verdade and Ferraz (2006), since it is difficult to determine precisely the age of free-living animals. The L* value found in this work is similar to that presented by Fernandes et al. (2008) for cattle (37.69) and lower for pork. According to the "Meat and Livestock Commission", an associated agency to the American Meat Science Association (AMSA), L* values between 49 and 60, are within the appropriate standards of pork quality (Warris and Brown, 1995). In this context, the brightness of capybara meat is similar to that observed in red meat. The red content (+a*) found in this study, is in accordance to that proposed by Ribeiro (2002), which reports that this parameter should be between 18 and 22 for red meats. The +a* value found in the present study is higher than the values presented by Bressan et al. (2004) and Oda et al. (2004b) for capybara meat (10.74) and (13.43-14.74), respectively. The values for yellow content +b * differ from those reported by Bressan et al. (2004) and Oda et al. (2004b): 1.74 and ranging between 0.65 and 0.73 respectively. The yellowing of fat usually is associated with grass-fed animals and so, at an older slaughter age. A less pigmented (white) fat is related to animals finished in confinement with a forage diet that is poor in carotenoids pigments (Fernandes et al., 2008). Such statement may be taken into account to this current study, since these animals were adults fed natural grass and had body weighting above that described in the literature for commercial slaughter of this species (Pinheiro, 2008).

Table 7. Instrumental color for *L. dorsi* muscle of free-living de capybaras.

Parameters	Mean	SD	CV (%)
Brightness (L*)	39.94	3.65	9.14
Redness (+a*)	22.10	3.01	13.62
Yellowness (+b*)	11.12	1.85	16.64

CONCLUSIONS

Free living capybaras exhibit characteristics of meat and carcass similar to captive capybaras and other species for food production. The results demonstrate the feasibility of developing projects in regards to sustainable management, once the meat is in accordance with commercial standards. Sustainable extensive systems would be an appropriate alternative, since have the advantage of providing ecosystem conservation through its enhancement associated to income generation from a resource hitherto has not been used rationally. However, legal restrictions prevent the development of systems for management of free-living population in Brazil, differently from other countries, as Venezuela where a controlled harvesting of wild populations is permitted. However, further research is need on the evaluation of health status and sensory analysis, once there are few published studies and these issues must be evaluated within programs for wildlife production.

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