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Physical composition, primary cuts and meat cuts of carcasses from Zebu and Bos taurus × Bos indicus crossbred cattle

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ABSTRACT - Data on hot carcass weight, hot carcass yield, hindquarter weights and physical components, forequarter and spare ribs, and the weights of the main commercial cuts from the hindquarters of twenty young intact bulls were assessed. The animals, belonging to four genetic groups (Nellore, ½ Guzerath + ½ Nellore (½ G + ½ N), ½ Red Angus + ½ Nellore (½ R + ½ N) and ½ Marchigiana + ½ Nellore (½ M + ½ N)), were raised on pastures, finished in dry lot and slaughtered at live weights ranging from 445 to 517 kg, and at ages ranging from 679 to 863 days. During the dry lot period, which lasted 114 days, animals were fed sorghum silage offered *ad libitum*, and a concentrate (13.5 MJ of ME, 18% CP in the DM) at 1% live weight per day. Genetic group influenced hot carcass weight, forequarter weight, meat weight in the spare ribs, as well as meat and bone weights in the forequarter. Animals in the ½ M + ½ N group were superior both to those in the Nellore and in the ½ G + ½ N groups for hot carcass weight, forequarter weight and meat weight in the spare ribs. The ½ M + ½ N group also differed from the ½ R + ½ N and from the ½ G + ½ N groups in terms of forequarter weight and meat weight in the forequarter, respectively. Conversely, forequarter bone weight of ½ M + ½ N animals was higher than in animals from the Nellore and the ½ R + ½ N groups, respectively. There was no effect of genetic group on hindquarter cuts, except for higher shank and knuckle weights in the ½ M + ½ N group compared to the ½ G + ½ N and Nellore groups, respectively.

Key Words: feedlot, genetic group, meat production

Composição física, cortes primários e cortes cárneos da carcaça de bovinos Zebu e de mestiços *Bos taurus* × *Bos indicus*

RESUMO - Foram avaliados o peso e o rendimento de carcaça quente, os pesos dos cortes primários, os pesos dos componentes físicos dos cortes primários e os pesos dos principais cortes comerciais do traseiro especial de 20 bovinos machos não-castrados dos grupos genéticos Nelore, ½ Guzerá + ½ Nelore (½ G + ½ N), ½ Red Angus + ½ Nelore (½ R + ½ N) e ½ Marchigiana + ½ Nelore (½ M + ½ N) terminados em confinamento. O experimento durou em média 114 dias, período no qual os animais foram alimentados com silagem de sorgo à vontade e concentrado composto de 73,5% de grão de milho, 25% de caroço de algodão e 1,5% de ureia, perfazendo 13,5 MJ de EM e 18% de PB por kg de MS, fornecido à base de 1% do peso vivo do animal por dia. O grupo genético influenciou os pesos de carcaça quente, do dianteiro, da carne do costilhar e os pesos da carne e dos ossos do dianteiro. Animais do grupo ½ M + ½ N superaram os Nelore e os ½ G + ½ N em peso de carcaça quente e em peso do corte dianteiro e da porção de carne do costilhar. O grupo ½ M + ½ N distinguiu-se também do ½ R + ½ N quanto ao peso de dianteiro e do ½ G + ½ N quanto ao peso da carne do dianteiro. Por outro lado, a quantidade de ossos do dianteiro dos animais ½ M + ½ N foi superior à dos animais dos grupos Nelore e ½ R + ½ N. Não houve efeito de grupo genético sobre os cortes resultantes do desdobramento do traseiro especial, exceto pelo fato de os animais ½ M + ½ N apresentarem maior peso de músculo em comparação aos ½ G + ½ N e maior peso de patinho em comparação aos Nelore.

Palavras-chave: confinamento, grupo genético, produção de carne

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Introduction

Hot carcass weight is important in beef production because it influences the final value paid for the slaughtered animal. Studies assessing this trait in Zebu and ½ *Bos taurus* + ½ Zebu animals reported superiority for the crossbreds in comparisons on a constant age basis (Perotto et al., 2000).

Traits such as the forequarter, spare ribs, and hindquarter proportions are frequently assessed in carcass evaluation studies. Jaeger et al. (2004) reported that F1 Aberdeen × Nellore presented higher proportions of spare ribs and lower proportions of hindquarter than F1 Canchim × Nellore, F1 Limousin × Nellore and purebred Nellore animals.

The physical composition of the carcass (bone, muscle and fat percentages) estimated according to Hankins & Howe (1946) has also been evaluated in many studies. Perotto et al. (2000) did not observe differences in the physical composition of carcasses among Nellore and ½ Guzerath + ½ Nellore, ½ Red Angus + ½ Nellore and ½ Marchigiana + ½ Nellore crossbreds, except for the proportions of bones between Nellore and ½ Red Angus + ½ Nellore. The same authors reported that the proportions of muscle were higher in the ¾ *Bos taurus* + ¼ Nellore than in the Nellore group, and that for slaughter weights below 500 kg, the percentage of fat in Nellore animals was higher than in the crossbreds.

Luchiari Filho et al. (1981) reported that ½ Marchigiana + ½ Nellore and ½ Chianina + ½ Nellore crossbreds produced more excess fat trimmed beef of the hindquarter than pure Nellore animals, but highlighted the need for more research on the influence of the degree of finishing on the yield of high priced trimmed cuts from the hindquarter as well as on meat quality. Bonilha et al. (2007) evaluated carcass characteristics and trimmed cut yield of Nellore and Caracu cattle. The latter breed needed a longer time in feedlot to reach the same degree of finishing achieved by the Nellore animals. Nevertheless, there were no differences between these two breeds for most of the studied traits, except for spare rib yield and for tenderloin and knuckle weights.

This experiment assessed the hot carcass weight and yield, the weight and the physical composition of the forequarter, spare ribs and hindquarter and the weight of the commercial cuts of the carcasses of intact Nellore, ½ Guzerath + ½ Nellore (½ G + ½ N), ½ Red Angus + ½ Nellore (½ R + ½ N) and ½ Marchigiana + ½ Nellore (½ M + ½ N) males, finished in feedlot.

Materials and Methods

Data on hot carcass weight, hot carcass yield, weights and physical components (bone, muscle and fat) of hindquarter, forequarter and spare ribs and the weights of the main commercial cuts from the hindquarters of twenty young bulls were evaluated. The animals, generated by a planned crossbreeding experiment that included mating between Nellore cows and Nellore, Guzerath, Red Angus and Marchigiana bulls, were born from February 1986 through February 1987, at IAPAR's Paranavaí Experimental Station, in Paranavaí, North-Western Paraná, Brazil. Local climate is classified as the Cfa type according to the Köeppen system (IAPAR, 1974), and the predominant soil groups of the region are Yellow-Red Latosoils (Ministério da Agricultura, 1970).

The dams of the experimental animals were fed tropical pastures supplemented with chopped sugar cane (*Saccharum officinarum* L.) and Nappier grass (*Pennisetum purpureum* Schum.), direct grazing on protein banks of Leucaena (*Leucaena leucocephala* lem. witt) and Pigeon Pea (*Cajanus cajan* (L.) Millsp.), as well as urea added to the mineral mix during the dry season (April to September). The herd was kept under a strict health management scheme that included internal and external parasite control and vaccination against the main cattle diseases.

The calves were generated via artificial insemination during the fall of 1985 (April 4th to June 30th), spring of 1985/86 (October 5th 1985 to February 2nd 1986) and fall of 1986 (April 15th to June 30th), with semen from 16 bulls (four Nellore, four Guzerath, four Red Angus and four Marchigiana), randomly purchased from the available stocks of each of these four breeds from commercial AI companies. These calves were weaned at approximately seven months of age, irrespective of the month the calf was born. During the first winter after weaning, the calves were maintained on tropical pastures, but with access to oat pastures for two hours every day. In the other seasons of the year, the animals were maintained exclusively on tropical pastures at a stocking rate of two animal units (450 kg live weight) per hectare, under rotational grazing. Pasture grazing and resting periods averaged 28 days, during which animals were offered mineral formulas *ad libitum*. On the 28th June 1988, after a 14-day adaptation period to feedlot conditions, the animals were treated against internal and external parasites, weighed and grouped in pairs according to live weight. Subsequently, each group of two animals was penned in 28 m^2 stalls with concrete floors, and provided with wells and 3 m long and 60 cm deep sheltered masonry troughs. Prior to the beginning of the feedlot period, the

animals received an injection of an A-D-E vitamin supplement. Slaughter took place on three dates (October 4th, 1988, October 25th, 1988 and November 10th, 1988) in order to allow each animal to reach the minimum slaughter weight of 420 kg. Thus, the average age per genetic group at the beginning of the feedlot period varied from 565 to 749 days (minimum of 489 days and maximum of 856 days); the average age per genetic group at slaughter ranged from 679 to 863 days (minimum of 589 days and maximum of 960 days), and the length of the confinement period spanned from 98 to 134 days, with averages per group varying from 106 to 124 days. At baseline confinement, animals weighed on average 334 kg, with genetic group means varying from 306 to 379 kg. At slaughter, the average weight was 471 kg, with genetic group means ranging from 445 to 517 kg.

The feed fed to the animals during confinement was made up of sorghum silage, offered *ad libitum*, plus a concentrate formulated with ground corn grain (73.5%), cotton seed (25%) and urea (1.5%) (Table 1), fed at the proportion of 1% live weight per day, based on dry matter. During the confinement, samples of the concentrate and silage were taken every week for laboratory analyses of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE), non nitrogenous extract (NNE), mineral matter (MN), neutral detergent fiber (NDF) and acid detergent fiber (ADF), according to methodology described by Silva (1981).

The study protocol for the confined animals included weighing at the beginning and at the end of the experiment and at 28-day intervals. The initial and the final weights were assessed 12 hours after withdrawal of water and feed, whereas the intermediate weights were assessed 12 hours after withdrawal of feed only. These intermediate weights were used to make the adjustments of the feed based on animal weights.

At the end of the feedlot period, the animals were weighed and slaughtered, always on the morning following the day of their arrival at the slaughter house, after a 15 to 16-hour fasting period. Hot carcass weight was assessed in the slaughter line, after removing the head, hide, viscera, diaphragm muscle and surplus fat. The hot carcass yield was calculated as the ratio of hot carcass weight to slaughter weight. After weighing, the half-carcasses were washed with flushed water and carried to the cooling chamber. Twenty-four hours later, the half-carcasses were withdrawn from the cooling chamber for evaluation of the quantitative characteristics described by Perotto et al. (2000). The left half-carcass was initially separated into forequarter, spare ribs and hindquarter. The weight of each of these primary cuts was then assessed. Subsequently, the forequarter and the spare ribs were thoroughly boned to compute their bone, muscle and fat weights . The hindquarter was separated into commercial cuts (tenderloin, beef loin, top sirloin butt, top sirloin cap, inside round, outside round, knuckle, eye round and shank), which were also weighed to assess the bone, muscles and fat components of the beef loin, the complete loin and the top sirloin butt. The beef loin is the portion of the hindquarter between the sixth rib, from the section where the forequarter was cut, up to the section where the ribs begin (i.e. the frontal end of the tenderloin), whereas the complete loin is the portion of the hindquarter between the beginning of the insertion of the ribs (i.e. the frontal end of the tenderloin), and the section that separates the top sirloin butt from the loin.

Table 1 - Composition of feed ingredients

Item	Ingredient		
	Sorghum silage	Ground corn	Cottonseed
Crude protein	5.00	10.59	24.04
Crude fiber	29.44	2.18	2.95
Ether extract	2.05	4.82	21.19
Mineral matter	4.19	1.49	4.66
Non nitrogenous extracts	59.32	80.92	27.16
Neutral detergent fiber	58.41	16.33	33.88
Acid detergent fiber	36.46	3.78	30.59
Calcium	0.17	0.30	0.10
Phosphorus	0.12	0.26	0.48
Metabolizable energy (MJ/kg)	8.80	13.60	14.35

All characteristics under study were tested for normality. Those that showed normal distribution were analyzed by the least squares methodology fitting a linear statistical model that included the fixed effects of genetic group and the age of the animal at slaughter as a co-variable through SAS Proc GLM (SAS, 2004). Those characteristics that did not show normal distribution where analyzed by the generalized linear models method (Nelder e Wedderburn, 1972), using the GENMOD Procedure (SAS, 2004), and assuming a model with effects of genetic group and age of the animal at slaughter for the systematic part of the distribution. In these cases, the gamma distribution and the reciprocal link function were used.

Results and Discussion

The ½ M + ½ N group produced heavier carcasses than the two Zebu groups (Table 2). The hot carcass weight of the ½ R + ½ N group was intermediate and did not differ from the Zebu nor from the ½ M + ½ N groups. Studies that compared the hot carcass weights of Zebu with those of ½ *Bos taurus* + ½ Zebu report superiority of the crossbreds

when comparisons were made on a constant age basis (Perotto et al., 2000). In general, these differences are due to differences in mature weight, which varies considerably among these groups, since there is a positive correlation between weight at any age during the growth period and mature weight (Taylor, 1965). The hot carcass weights and the yields found in this study for the Nellore and ½ Marchigiana + ½ Nellore groups are in accordance with those observed by Luchiari Filho et al. (1981) for animals of the same groups which were finished in a feedlot receiving feed containing high levels of total digestible nutrients. Similarly, there is total agreement between both studies in respect to the weights of the forequarter, hindquarter and spare ribs, which, in this study refer to a half carcass, whereas in the cited study the values were obtained from the whole carcass.

Contrary to reports by Perotto et al. (2000) and Luchiari Filho et al. (1981), in this study, the weight of the hindquarter did not differ among the groups. Likewise, Euclides Filho et al. (1997) found no differences among genetic groups for the weight of the primary cuts in a study where quantitative carcass characteristics of intact Nellore, ¾ Nellore-Charolais, ¾ Nellore-Fleckvieh and ¾ Nellore-Chianina males, fed on diets with different forage to concentrate ratios, were evaluated. Galvão et al. (1991) evaluated the yield of the primary cuts and the physical composition of carcasses from intact Nellore, F1 Nellore-Marchigiana and F1 Nellore-Limousin males, fed *ad libitum* on a diet with 50% concentrate in the DM and slaughtered at different degrees of maturity. No differences were found among groups with respect to the forequarter and hindquarter proportions. Similarly, Peron et al. (1993) studied castrated males from five genetic groups, including Nellore and ½ Nellore-Chianina, kept under restricted or *ad libitum* feeding, and reported no effect of genetic group on the primary cuts of the carcass.

The forequarter of ½ M + ½ N animals was heavier than those of the remaining groups, which did not differ with respect to this trait. Euclides Filho et al. (1997) also observed heavier forequarter weights for Chianina-Nellore crossbreds in comparison to Nellore animals when both groups were fed diet with a higher concentrate to roughage ratio. Perotto et al. (2000) did not find differences in forequarter weights between Nellore and ½ Marchigiana + ½ Nellore crossbred animals. Luchiari Filho et al. (1981), however, found heavier forequarter weights in Nellore animals than in ½ Marchigiana + ½ Nellore crossbreds. Jaeger et al. (2004) compared the weights of primary cuts of carcasses from intact Nellore, F1 Canchim × Nellore, F1 Limousin × Nellore and F1 Angus × Nellore, slaughtered at an average weight of 558 kg. F1 Aberdeen × Nellore crossbreds were found to have a higher percentage of spare ribs and lower percentage of hindquarter than animals from the other three groups. Despite the fact that the weights of the primary cuts of the half-carcasses in this study did not differ between the Nellore and the ½ R + ½ N groups, if expressed in percentages, our results are very similar to those of Jaeger et al. (2004). In another study where the forequarter, spare ribs, hindquarter and meat cut weights were evaluated, Suguisawa et al. (2002) did not detect differences between Nellore and Angus × Nellore crossbreds for the mentioned traits. Heavier forequarter and hindquarter weights of intact Nellore were reported by Vittori et al. (2006) in comparison to non-castrated Guzerath males. The authors attributed the results to differences in hot carcass weights (287 vs 259 kg).

The differences herein observed for the weight of the forequarter can be attributed to the growth rate of the primary cuts and their chemical composition, which differ among genetic groups, since, theoretically, the Zebu groups should be closer to maturity than the ½ Marchigiana + ½ Nellore group. This was confirmed by the differences observed among groups for the lean meat and bone weights in the forequarter as well as by the weight of lean meat in the spare ribs (Table 2), that did not happen for the fat component. Luchiari Filho et al. (1981) also found a greater amount of bones in the forequarter of ½ Chianina + ½

Table 2 - Hot carcass weight, hot carcass yield and weight of primary cuts of carcasses of Zebu and of crossbred *Bos taurus* × *Bos indicus* cattle

Characteristic	Genetic group				Pr>F
	Nellore	½ G + ½ N	½ R + ½ N	½ M + ½ N	
Hot carcass weight (kg) [1]	255 ± 7b	267 ± 7b	271 ± 7ab	290 ± 7a	P<0.05
Hot carcass yield (%)[1]	57 ± 1.5	58 ± 1.5	60 ± 1.4	56 ± 1.4	P>0.10
Hindquarter (kg)[2]	59 ± 0.0005	57 ± 0.0005	57 ± 0.0005	62 ± 0.0005	P>0.10
Spare ribs (kg)[1]	16 ± 0.6	17 ± 0.6	17 ± 0.6	18 ± 0.6	P>0.10
Forequarter (kg)[1]	53 ± 3b	52 ± 3b	53 ± 3b	60 ± 3a	P<0.05

Means on the same row followed by different letters are statistically different by the t test at the specified level of probability.
[1] Characteristics that showed normal distribution and were analyzed by the least squares methodology.
[2] Characteristic that did not show normal distribution and was analyzed by generalized least squares methodology.

Nellore and in ½ Marchigiana + ½ Nellore compared to Nellore animals. In the analysis of the physical composition of the spare ribs, a greater amount of lean meat was observed in this primary cut of ½ Marchigiana + ½ Nellore compared to Nellore and to ½ Guzerath + ½ Nellore animals (Table 3). This finding can be associated with the heavier hot carcass weight of this group compared to the Zebu group and to the transmission of greater muscular development from Marchigiana bulls to their progeny. The lack of statistical significance for the contrast between the physical components of the forequarter and spare ribs of the Nellore and ½ Red Angus + ½ Nellore groups confirmed findings reported by Túllio et al. (2005), who compared the yield of different meat cuts of Nellore and crossbred Canchim × Nellore, Angus × Nellore and Simental × Nellore animals, slaughtered at 20 months of age. No statistical significant differences were found between the Nellore and the Angus × Nellore groups for the percentages of eatable meat and forequarter bone content. Suguisawa et al. (2002) also observed no differences in the bone, muscle and fat percentages when comparing the carcasses of Nellore and crossbred ½ Angus + ½ Nellore animals finished in a feedlot. Comparisons between the physical components of the carcasses of Nellore and Guzerath animals, selected to increase weight at 378 days of age, were performed by Vittori et al. (2006). No differences were found between these two breeds for the bone, lean meat and fat percentages in the carcasses of intact males slaughtered at live weights of 496 and 469 kg, respectively. Likewise, in the present study, no differences between Nellore and ½ Guzerath + ½ Nellore were detected for any of the physical components of the forequarter or spare ribs.

Additional data analyses found that the animals were slaughtered at degrees of finishing varying from 0.32 mm to 0.59 mm, as measured by the thickness of the subcutaneous fat layer above the 12th rib. This is far below the minimum of 3.00 mm required by the industry. Nevertheless, these results indicated that the carcasses evaluated in this study met the objective proposed by Galvão et al. (1991) for the Brazilian beef cattle industry, which is the production of meat with a higher proportion of muscle tissue and minimum percentage of trimmer fat.

Table 3 - Components of forequarter, spare ribs and hindquarter of Zebu and of *Bos taurus* × *Bos indicus* crossbred cattle

Component (kg)	Genetic group				Pr>F
	Nellore	½ G + ½ N	½ R + ½ N	½ M + ½ N	
Forequarter					
Meat cuts[1]	41.6 ± 2ab	40.7 ± 2b	41.4 ± 2ab	48.0 ± 2a	P<0.05
Fat[1]	2.9 ± 0.2	3.1 ± 0.2	3.1 ± 0.2	3.3 ± 0.2	P>0.10
Bones[1]	8.0 ± 0.3b	8.5 ± 0.3ab	8.1 ± 0.3b	9.1 ± 0.3a	P<0.05
Spare ribs					
Meat cuts[1]	13 ± 0.4b	13 ± 0.4b	14 ± 0.4ab	15 ± 0.4a	P<0.01
Fat[1]	1.2 ± 0.1	1.4 ± 0.1	1.2 ± 0.1	1.3 ± 0.1	P>0.10
Bones[1]	1.8 ± 0.1	1.9 ± 0.1	1.8 ± 0.1	1.6 ± 0.1	P>0.10
Beef loin					
Meat[1]	5.7 ± 0.4	5.4 ± 0.4	5.8 ± 0.4	6.2 ± 0.4	P>0.10
Fat[1]	0.487 ± 0.095	0.400 ± 0.095	0.280 ± 0.095	0.312 ± 0.095	P>0.10
Bones[1]	1.2 ± 0.11	1.5 ± 0.11	1.4 ± 0.11	1.4 ± 0.11	P>0.10
Tender loin[1]	2.0 ± 0.1	2.1 ± 0.1	2.1 ± 0.1	2.3 ± 0.1	P>0.05
Complete loin					
Meat of beef loin	5.1 ± 0.3a	4.8 ± 0.3ab	4.5 ± 0.3ab	5.3 ± 0.3b	P<0.05
Fat[1]	0.580 ± 0.056	0.515 ± 0.053	0.462 ± 0.055	0.462 ± 0.052	P>0.05
Bones[1]	1.4 ± 0.9b	1.4 ± 0.9b	1.2 ± 0.9b	1.5 ± 0.9a	P<0.05
Top sirloin with cap					
Meat[1]	6.8 ± 0.5	6.8 ± 0.5	7.0 ± 0.5	6.8 ± 0.5	P>0.10
Fat[2]	0.482 ± 0.13	0.588 ± 0.13	0.462 ± 0.13	0.260 ± 0.12	P>0.10
Bones[1]	2.04 ± 0.1	2.06 ± 0.10	1.94 ± 0.10	2.11± 0.10	P>0.10
Top sirloin without cap					
Meat[1]	5.3 ± 0.5	5.3 ± 0.5	5.7 ± 0.5	5.3 ± 0.5	P>0.10
Fat[2]	0.469 ± 0.14	0.613 ± 0.12	0.470 ± 0.13	0.287 ± 0.14	P>0.10
Top sirloin cap[1]	1.56 ± 0.15	1.56 ± 0.14	1.34 ± 0.14	1.37 ± 0.14	P>0.10
Inside round[1]	8.9 ± 0.4	9.0 ± 0.4	9.1 ± 0.4	9.7 ± 0.4	P>0.10
Outside round[2]	5.6 ± 0.0067	5.2 ± 0.0072	5.2 ± 0.0072	5.7 ± 0.0066	P>0.10
Knuckle[1]	5.2 ± 0.3	5.0 ± 0.3	4.9 ± 0.3	5.6 ± 0.3	P<0.10
Eye round[2]	2.6 ± 0.1	2.6 ± 0.1	2.6 ± 0.1	2.8 ± 0.1	P>0.10
Shank[2]	3.9 ± 0.1a	3.7 ± 0.1b	4.1 ± 0.1a	4.3 ± 0.1a	P<0.05

Means on the same line followed by different letters are statistically different at the specified levels of probability.
[1] Characteristics that showed normal distribution had the standard error computed from the mean.
[2] Characteristics that did not show normal distribution had the standard error computed from the estimates of the parameters of the function.

Values found for the hindquarter main cuts in the Nellore group (Table 3) are in complete agreement with a study that assessed the same characteristics in two Nellore populations (selected and control) and one selected Caracu population (a Brazilian breed derived from cattle brought by the first Portuguese and Spanish settlers) (Bonilha et al., 2007). These authors evaluated carcass and meat cut yield traits and detected no differences between the Nellore and Caracu populations selected for highest weight at 378 days of age for most traits, except for the spare rib weight and yield and the tenderloin and knuckle weight. The Caracu group was superior to the Nellore group for all these traits except for the knuckle weight. Similarly, Jaeger et al. (2004) did not find differences for the weights of the main meat cuts in the hindquarter among Nellore, ½ Canchim + ½ Nellore, ½ Limousin + ½ Nellore and ½ Angus + ½ Nellore animals. The exceptions were the knuckle weights, for which the ½ Angus + ½ Nellore group was inferior to the other groups, and the outside round weight, for which the first three groups were inferior to the last one. Tullio et al. (2005) reported superiority of Nellore animals compared to Angus × Nellore crossbred castrated animals finished on cultivated pastures and slaughtered at 20 months of age for the main hindquarter meat cuts, except for the shank. However, when the results were expressed as a proportion of carcass weight, differences disappeared. This confirmed that the crossbreds were slaughtered at lower weights.

In the present study, there were practically no differences between groups for the studied characteristics, except for the knuckle ($P<0.10$) and shank ($P<0.05$) weights, with a slight superiority of the ½ Marchigiana + ½ Nellore group in relation to the others. This finding disagrees – in statistical significance but not in the magnitude of the numerical values – with the results reported by Luchiari Filho et al. (1981), who found higher weights of tenderloin, beef loin, inside round, knuckle and shank in ½ Marchigiana + ½ Nellore crossbreds compared to Nellore animals. Similarly, in this study, higher bone content in the complete loin and higher meat content of beef loin in the complete loin were found in the ½ Marchigiana + ½ Nellore crossbreds in comparison to the remaining groups.

Conclusions

The hot carcass weights of Zebu Nellore and ½ Guzerath + ½ Nellore were lighter than those of ½ Marchigiana + ½ Nellore animals, which produced heavier forequarters compared to animals from the other groups, including the ½ Red Angus + ½ Nellore group. Crossing Marchigiana bulls with Nellore cows produced animals with a greater amount of meat in the spare ribs compared to Nellore and ½ Guzerath + ½ Nellore cattle. The meat weight in the forequarter of ½ Guzerath + ½ Nellore animals was lower than that of ½ Marchigiana + ½ Nellore animals. Nellore and ½ Red Angus + ½ Nellore animals had a lower proportion of bones in the forequarter than ½ Marchigiana + ½ Nellore animals. Higher proportions of bones in the complete loin and heavier beef loin, knuckle, and hindquarter shank weights were found in crossbred ½ Marchigiana + ½ Nellore animals compared to the other groups.

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