Scientific Paper

Carcass yield of different cattle genotypes raised under grazing conditions

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Abstract

Objective: To compare the carcass yields of three cattle genotypes, *Zebu*, crossbred *Holstein* x *Zebu* and *Mambí*, reared together in a system of rotational grazing and moderate energy-protein supplementation.

Materials and Methods: Thirty 29-month old bulls were used. The animals were randomly distributed, at a rate of 10 per genotype. The research was conducted in a slaughterhouse of Matanzas province, Cuba. After slaughtering, the carcass of the hot carcass, between three and five hours, the carcass yield percentage with regards to post-shrink live weight and deboned meat yield (bones and fat) against the final live weight of the cold carcass in percentage, were determined.

Results: The hot carcass weight significantly differed ($p < 0,05$) among the three genotypes (220,5; 210,0 and 188,0 kg for *Zebu*, *Holstein* x *Zebu* and *Mambí*, respectively). In the carcass yield percentage there were no significant differences, with values between 47,5 % and 48,7 %. In total beef production there were significant differences ($p < 0,05$) among the genotypes (128,4 kg for *Zebu* vs. 119,2 and 111,0 kg for *Holstein* x *Zebu* and *Mambí*, respectively). The deboned beef yield was higher ($p < 0,05$) for *Mambí* (60,3 %); while for *Holstein* x *Zebu* and *Zebu* it was 57,9 and 59,3 %, respectively. The fat and bone percentages of the three genotypes were high.

Conclusions: The carcass weight of the three genotypes (Zebu, Holstein x Zebu and Mambí), reared under grazing conditions with moderate supplementation, was directly proportional to the final live weight. However, there were no differences in yield.

Keywords: fattening, beef yield, bull

Introduction

In Cuba, currently, beef production is based mainly on grazing systems in pasturelands with cover of native or naturalized grasses, and both (García, 2013). Pasture and forage availability in the country is reduced by more than 50 % during the dry season, which prevents the animals from fulfilling their nutritional requirements and even, often, maintenance requirements, necessary to achieve an adequate beef production. This causes that they do not exceed 380 kg of live weight at slaughter, with more than 35 months of age (Iraola *et al*., 2016; ONEI, 2018).

This is in addition to the wide heterogeneity of the bulls that are fattened, because the cattle stock in the growth category, for fattening as well as for replacement, is predominantly crossbred, with a great diversity of genotypes (Anon, 2014).

Díaz (2009) reported that when animals are reared under grazing conditions, with moderate supplementation, there are no differences in carcass yield, although the final live weight is different. This author obtained yields in carcass of 49 %, in *Zebu* animals, as well as in *Zebu* with *Holstein* crosses (*Siboney* genotype), under grass and legume grazing conditions. Aguirre *et al*. (2014), also under grazing conditions, determined that the beef cattle *Bos taurus* had better carcass yield (52 %) than *Bos indicus* and *Creole* (50 %); while in crossbred *Holstein*, the yields were 49 % of live weight.

As can be appreciated, the carcass characteristics and yield in marketable beef are important criteria for most of the different links of the beef chain in Cuba. The breed or genotype is one of the factors that have the highest impact on the above-mentioned traits. Thus, the objective of this work was to compare the carcass yields of three cattle genotypes, *Zebu*, crossbred *Holstein* x *Zebu* and *Mambí*, reared together in a rotational grazing system and moderate energy-protein supplementation.

Materials and Methods

Location of the experimental area. The field experiments were carried out in an Agricultural Enterprise of Matanzas province, Cuba; while the

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stage of the carcass tests was conducted in the slaughterhouse of this same company, in the Junco locality, Jovellanos. This unit is located in the geographic point determined by 22°30'4'' north latitude and 81°3' west longitude, at 19,01 masl.

Treatment and experimental design. The treatments were the genotypes *Zebu*, crossbred *Holstein* x *Zebu* and *Mambí*, arranged according to a complete randomized design, at a rate of 10 animals per treatment.

Experimental procedure. For the evaluation of the slaughter and carcass indicators, 30 29-month old animals were selected, which came from a grazing area of 26 ha, divided into 12 paddocks (Iglesias *et al*., 2015). From them, 15 were sown with the pasture Guinea grass [*Megathyrsus maximus* (Jacqs.) B.K. Simon & S.W.L] cv. Likoni, and 5 with CT-115 [*Cenchrus purpureus* (Schumach.) Morrone clone]. Guinea grass and CT-115 represented 40 and 20 % of the floristic composition of the area, respectively. The animals grazed together in the system and received similar supplementation in feeding trough (Northgold and wheat bran) and mineral salts in the afternoon, after returning from grazing. The prefixed live weight (LW) for delivery to the slaughterhouse was 420 kg, although the *Mambí* genotype did not reach that weight at the end of the grazing evaluation.

Before slaughter, which was carried out by the captive piston method, the bulls were fasted for 24 hours, with access only to water. The gun cut of both carcasses was made, by separating the chest, between the fifth and sixth rib by 1/4 of its length, then making a right angle through the ribs, parallel to the spine and leaving the thigh (Salazar, 2009), to utilize fully the long dorsal muscle, of high economic value.

Measurements. The live weight before slaughter and the weight of the hot carcass between three and five hours after slaughter were determined, in addition to the percentage of carcass yield with regards to post-shrink LW, after removing the head and viscera of the slaughtered animals The boneless meat yield was also calculated, as well as the bone and fat percentage.

Statistical differences. The mathematical analysis for comparing the indicators was carried out through a simple classification linear model. The means were compared by Duncan's test. For the data analysis the statistical package SPSS® on Windows, version 17, was used.

Results and Discussion

Table 1 shows the final live weight of the animals before slaughter, as well as carcass weight and yield.

The carcass weight significantly differed among the three genotypes ($p < 0,05$), which is related to the final live weight of the bulls obtained in the farm (452,6; 439,0 and 397,0 kg for *Zebu*, *Holstein* x *Zebu* and *Mambí*, respectively) and coincides with the report by Iraola *et al.* (2016). The carcasses of the *Zebu* animals weighed, as average, 220,5 kg; while those of the *Mambí* genotype had a weight of 188 kg, that is, 32,5 kg less.

Regarding the carcass yield, no significant differences were observed among the treatments, with values that varied between 47,5 for the *Mambí* genotype and 48,7 for *Zebu*.

These carcass yields are lower than those reported by Quintana and Díaz (2005) in a compilation about the yields of different breeds in Cuba, which varied between 53,0 and 58,0 %. However, they are similar to those reported by Aguayo-Ulloa *et al.* (2018) in commercial *Zebu* animals under grazing conditions, supplemented with palm kernel cake and rice bran.

They are also lower than those obtained by Huerta-Leidenz *et al.* (2013) in Venezuela, in a study that comprised more than 500 animals of different genetic composition and sex. In this study, the carcass yields were close to 60,0 %. This difference could be ascribed to the fact that the animals of this experiment received concentrate feed in moderate amounts, up to 13 % of the diet, which represented

Table 1. Carcass yield of the different genotypes.

Treatment	Final live weight, kg	Carcass weight, kg	Yield, %
Zebu	452,6[a]	220,5[a]	48,7
Crossbred *Holstein* x *Zebu*	439,0[a]	210,0[b]	47,8
Mambí	397,0[b]	188,0[c]	47,5
SE ±	6,10[*]	2,60[*]	0,35

a, b, c: Values with different superscripts in the vertical differ at $p<0,05$; [*]$p<0,05$

0,3 % of the LW (Iglesias, 2015). It is known that the animals that consume a high fiber proportion in the ration have a lower carcass proportion, if compared with the live weight of those whose ration is based on concentrate feeds (Hernández–Bautista *et al*., 2009). This is due to the fact that the amount of concentrate feed and feedstuff is directly related to the weight of the digestive content and the rumen size.

In diets based on forage or grazing, the weight, volume and thickness of the rumen walls increase, due to the effort of this organ to digest fiber. There is a negative correlation between the animal yield and the weight of the gastrointestinal tract content, for which reducing the intake of fibrous feedstuffs in the final stage of fattening, and increasing the concentrate feed is suggested (Simeone and Beretta, 2009).

Rodríguez *et al.* (2014) and Chizzotti *et al.* (2015) found values in carcass yield similar to those in this study with *B. indicus* animals and *B. taurus* x *B. indicus* crosses, under grazing and supplementation conditions, which they ascribe to such factors as fat deposition, intestinal filling and genotypic composition. In spite of the above-stated fact, the obtained yields are similar to those achieved by Iraola (2017), who reported carcass yields between 51,70 and 51,9 % of the final LW, and the ones reported by Rodríguez (2009), when feeding *Holstein* x *Zebu* bulls with a diet based on *Saccharum officinarum* L. forage and molasses-urea with 17 % of concentrate feed.

Regarding the comparison among genotypes, a better response in the carcass yield of European animals has been reported compared with *Zebu* in energy supplementation systems (Rodas-González *et al*., 2006). However, this work showed that, when animals are reared under grazing conditions, with moderate supplementation, there are no differences in yield, although the final live weight is different. Díaz (2009) obtained 49 % carcass yields, in *Zebu* animals as well as in *Zebu* and *Holstei*n crosses (*Siboney* genotype), under grazing conditions on grasses and legumes.

Ramírez-Barboza *et al.* (2016) reported that there were no differences in the carcass yield of F1 animals (B. *indicus* x *B.taurus*) compared to *Zebu* (between 57 and 59 %) under finishing, grazing and energy supplementation conditions. This is ascribed to the fact that carcass yield is influenced more strongly by the animal genotype than by the environmental component (Albertí *et al*., 2008)

Yield upon boning is determinant in the commercial value of beef cattle. As the carcass is the current commercialization unit, its weight and that of its main components (bone, fat and muscle) serves to measure biologically tissue yield (Montero *et al*., 2014).

With regards to total beef production (table 2), there were significant differences among genotypes ($p < 0,05$) in favor of *Zebu*, which produced 128,38 kg, which was due to the higher weight of the carcass of this genotype. On the other hand, *Holstein* x Zebu and *Mambí* did not differ among them, with 119,18 and 110,95 kg, respectively.

When analyzing the beef yield upon boning, the *Mambí* type showed the best results (60,3 %), which differed significantly from the others, showing no differences among them.

The total value of the *Mambí* genotype was similar to that reported by Rodríguez *et al.* (2011), who obtained a percentage of carcass beef of 62,1 in crossbred *Holstein* x *Zebu* bulls, fed with *S. officinarum* forage. These results were higher than those found by Orellana *et al.* (2009) in animals of the

Table 2. Carcass, bone and fat yield, according to the genotypes.

Indicator	Treatment			SE ±
	Zebu	Crossbred *Holstein* x *Zebu*	*Mambí*	
Hot carcass yield, %	48,7	47,8	47,5	0,35
Cold carcass yield, %	47,8	46,9	46,3	5,02
Beef yield, kg	128,4^{a}	119,2^{b}	111,0^{c}	1,32*
Total beef, %	59,3^{b}	57,9^{b}	60,3^{a}	0,22*
Bone yield, kg	59,8^{a}	57,2^{a}	51,7^{b}	0,32*
Bone, %	27,6	27,8	28,1	1,74
Fat yield, kg	28,4^{a}	29,5^{a}	21,4^{b}	0,12*
Fat, %	13,1^{a}	14,3^{a}	11,6^{b}	1,52*

a, b, c: Values with different superscripts in the vertical differ for $p < 0,05$; $^{*}p < 0,05$

Argentinean Creole and Bradford breeds, fattened with pastures of cultivated grasses and slaughtered at a similar age to that of this experiment.

In this study, the lower yield of the other genotypes could be related to the fat deposition in the carcass (table 2), since they had a higher growth rate and finished the fattening with higher body weight than those of the *Mambí* type (Orellana *et al*., 2009). It is known that *Zebu* cattle and its close crosses are genotypes of early maturity, very prone to fat accumulation. Fat values with regards to the carcass were higher than those reported by Iraola (2017), who found that the percentages did not exceed 10,0 %.

In general, in the three genotypes the beef yields upon boning were low and lower than those reported by Torrescano *et al*. (2010) in Mexico (73,4-75,6 %) and by Díaz *et al*. (2009) in Cuba. These last authors obtained total beef yields higher than 67 % in *Siboney* bulls, and 69 % in *Zebu* animals which grazed in silvopastoral systems with *L. leucocephala* and star grass.

The age at slaughter at 29 months (due to the moderate daily gains) could have been determinant in the low beef yield of the studied genotypes. In this regard, it is known that, the lower the gains are, the lowest protein percentage is deposited in the form of muscle in the animal, for which the nutrient deposition is prioritized in the skeletal system and the beef/bone ratio decreases (Rodas-González *et al*., 2013).

In this research, the estimated bone percentages were over 27 %, for which they were higher than the report by Lemus (2009), who argued that the bone weight varies, generally, between 16 and 21 % under the conditions of Cuba. Di Marco (2012) stated that, in order to obtain higher productivity in beef yield, the bone percentages with regards to the carcass should be, as average, between 14 and 17 % according to the biotype or breed and the weight at slaughter of the animals. Nevertheless, Díaz *et al*. (2013) reported bone percentages in the carcass similar to the ones in this work, when studying animals fattened in a silvopastoral system with *L. leucocephala*. Likewise, Rodríguez *et al*. (2012) referred similar values under confinement conditions.

Conclusions

- The carcass weight of the three genotypes (Zebu, Holstein x Zebu and Mambí), reared under grazing conditions with moderate supplementation, was directly proportional to the final live weight. However, there were no differences in yield.
- The carcass yields upon boning were low in the three genotypes, caused by the age at slaughter (29 months and the high bone and fat proportion in the carcass.

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Authors' contribution

- Jesús Manuel Iglesias-Gómez. Contributed to the conception and design; to data acquisition, analysis and interpretation; wrote and revised the paper.
- Odalys Caridad Toral-Pérez. Contributed to the conception and design; to data analysis and interpretation; wrote and revised the paper.
- Luis García-Pérez. Contributed to the conception and design; to data acquisition, analysis and interpretation.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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