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Original Article

Economical Analysis and Commercial Cuts Yields of Buffaloes and Bovines of Both Sexes

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Abstract

The objective of this work was to study the effects of buffalo and bovine species and steers and heifers sexes, on the yields of commercial carcass cuts of animals with carcass average weight of 187.5 kg. A total of 72 animals were used, 30 Mediterranean crossbred buffaloes, 13 heifers and 17 steers, and 42 Aberdeen Angus crossbred bovines, 18 heifers and 24 steers. No significant interaction was observed between species and sex for the variables analyzed, indicating separate discussion of these effects. There was no statistical difference between species and sexes for hot carcass weight. Maturity was more advanced in bovines in relation to buffaloes, and in males in relation to females. Fat classifications did not differ between species, but females carcasses showed more fat cover than males. Buffalos and males showed forequarters with higher weight and percentage, and lower sawcut percentage than the bovines and females, respectively. Comparing the brake even point between buffalo and cattle was obtained the purchasing price of US$ 3.17 and US$ 3.13/ kg of carcass, respectively. Between sexes, the brake even point was US$ 3.18 for males and US$ 3.15 for females.

Key words: Aberdeen Angus, Brake even point, Heifers, Mediterranean, Slaughterhouse

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Introduction

Meat agribusiness complexes are involved in a considerable national income on gross domestic product and are considered some of the most important sectors of agribusiness products, concerning about world food security. Nevertheless, some sectors of the meat industrialization may be better exploited. One example is buffalo meat, which has no discrimination between the correct price and quality, which doesn't encourage the primary sector to develop and produce meat that reach the wanted characteristics by consumers (Jorge *et al*, 2005).

While the programs seek to young cattle beef quality, with better carcass traits and meat quality, much of the slaughter of buffaloes is still underutilized in the refrigerator. This assertion is based on the fact that most industries end up using the carcasses of these animals for sale in undifferentiated markets (Rodrigues and Andrade, 2004).

The longevity of female buffalo, and higher weaning rates, generate an exceeding of heifers, which reach slaughter weight at a young age. Nanda and Nakao (2003) comment about the research and the disinterestedness of the political world on these important species, although there are more than 5,000 years, the buffalo livestock are responsible for providing lean meat, milk with high protein and fat percentage, traction and skins for most countries of South Asia.

Spanghero *et al*. (2004) observed that buffalo meat was cooked softer than Simmental beef cattle, but was discriminated against by Italian consumers when fresh. Also Neath *et al*. (2007) reported that Carabao x Murrah meat has lower shear force compared to beef meat, the result of lower degradation of troponin T in crossbred Brahman cattle compared to buffalo, with differences in pH decline, which affected the muscle autolysis, resulting an increased in meat tenderness.

However, the meat industry has questioned about the carcass and commercial cuts of buffalo. Working with males castrated and no castrated, Rodrigues *et al*. (2003) found that the lower yield of the three commercial cuts of buffalo compared to cattle and crossbred zebu occurred only in relation to body weight, but sawcut income in relation to carcass weight was greater for buffaloes than cattle, which showed a higher yield than the buffalo forequarter.

The performance evaluation of primary cuts of carcass is of great importance, since they have considerable price variation, changing industry margins and, thus, resulting in lower income to producers (Pascoal *et al*, 2011). However, the duality between Brazilian researches studying the incomes of primary cuts of the carcass shows a possible high genetic variation of buffalo's herd in Brazil. Another possibility regarding the established concepts concerning buffalo's production can be derived from measurements made in slaughtering cull females buffalo, whose flesh has a lower quality (Kandeepan *et al*, 2009, Maeda *et al*, 2011). Jorge *et al*. (2005) believe that sawcut x ribcut relation undergoes variation with young buffalo slaughter weight, suggesting more studies about it.

The Aberdeen Angus British breed has worldwide recognition for meat quality and, their growing participation in the Brazilian herd, as the meatpacking plants have directed efforts to capture animals of that breed, based on the quality of meat from young bulls and heifers. The claim of these companies is that programs of quality meat give higher returns.

However, if buffalo meat has also good quality (Jorge *et al*, 2006; Tateo *et al*, 2007; Kandeepan *et al*, 2010), it is necessary to study whether the meatpacking industry has lower economic returns to foster programs buffalo meat quality, of both sexes. A Japanese research has studied cattle and buffaloes of both sexes showed that changes in buffalo meat quality between the sexes are smaller in relation to cattle (Ban-Tokuda *et al*, 2007). In the same study, it was evident that the total deposition of fat in the longissimus and total cholesterol in blood plasma was significantly higher in the lost.

The aim of this study was to analyze the economic effects of bovine and buffalo species and sex castrated males and females, on revenue from commercial carcasses cuts of animals slaughtered at 12.5 kilos, suitable for quality meat programs.

Materials and Methods

Seventy-two animals were used, 30 crossbred buffaloes Mediterranean, where 13 were females and 17 bulls, 42 Angus crossbred cattle, including 18 females and 24 castrated males, completed during the hot season in Rio Grande do Sul.

This study was designed so that the animals reached 187.5 kg of carcass, in both species. For this purpose was calculated that the buffalo, regardless of sex, reach carcass yield of 46% and the cattle, 49%. The animals of both sexes were completed in a similar food system, but with variation in diet between cattle and buffalo seeking to obtain the same carcass weight.

Animals were slaughtered in the slaughterhouse business, which includes the Federal Inspection Service. Slaughter followed the establishment flow and the line industrialization was made weighing the carcass is still hot, dentition evaluation and classification of the fat degree following the Brazilian System of Bovine Carcass Classification, where the fat class 1 = fat away, 2 = low fat, 3 = fat average, 4 uniform fat, 5 = excessive fat.

After slaughter, carcasses were identified, cleaned and cooled to -2° C for a period of 24 hours. After this, the carcasses were reweighed and the commercial cuts were weighed to calculate their percentage related to the weight of cold carcass.

The primary cuts were obtained by the division of the forequarter, separating completely from the hindquarter between the fifth and sixth ribs. The forequarter is formed by chuck and shoulder. The hindquarter was divided in ribcut and sawcut, the last including the round, rump and loin. The ribcut was obtained by dividing the hindquarter to approximately 30 cm from the back line. Such as the study was conducted from the industrialization perspective of viability of carcasses, cuts were made following the slaughterhouse standard procedure.

Statistical Analysis

The completely randomized experimental design was used, with effect from bovine and buffalo species, and castrated male and female sexes. The statistical model tested by Statistical Analysis System software (version 9.2) GLM procedure, at the significance level of 5% was: $Y_{ij} = \mu + SP_i + SE_j + e_{ij}$, where Y_{ij} is the observation made at the n-th animal belonging to the i-th species and j-th sex; μ, the overall feature, SP_i the i-th species; SE_j is the j-th sex, and e_{ij}, the random effect associated with each observation, assuming NID (0, σ^2). The interaction between sex and genetic group state ($E_i * S_j$) was initially tested and removed from the final model because it is not significant.

Results and discussion

The interaction was not significant ($p > .05$) between sex and species effects, for the studied variables. Rodrigues *et al*. (2003) also found no interaction between cattle and buffalo species, and castrated and no castrated sex conditions for weights and yields of carcass or primary cuts variables.

Table 1: Carcass characteristics of buffalo and bovine of both sexes

	Hot carcass weight, kg		Tooth[1]		Fat classification[2]	
Buffalo	192.9	± 4.1	0.85	± .08	2.98	± .08
Bovine	186.1	± 3.4	1.01	± .07	2.78	± .07
Probability	0.19		0.03		0.06	
Male	190.9	± 3.5	1.04	± .07	2.77	± .07
Female	188.0	± 4.0	0.83	± .08	2.98	± .08
Probability	0.58		0.01		0.05	

[1] 0 tooth = milk dentition, 2 = eruption of at least one or two incisors;
[2] ratings according to Brazilian National Cattle Carcass Grading, being class 1 = thin or absent and class 5 = very fat or excess fat.

There was no statistical difference for carcass weight (Table 1) between buffalo (192.9 + 4.1 kg) and cattle (186.1 + 3.4 kg). In his work, Spanghero *et al*. (2004) commented that although the buffalo show less weight gain during the feedlot finishing that Simmental bulls, found no difference in carcass weight of cattle and buffaloes. The difference in this feature may be related to the nutritional level of

animals during the ending, because it could be obtained the highest carcass weight for cattle at higher levels of food during growing and finishing phases, because the buffalo stand on diets of lower quality, since that consumption is not limited (Nanda and Nakao 2003; Vaz *et al*, 2003).

Already Lapitan *et al*. (2007) observed slaughter weight of 468.7 kg in buffaloes against 398.9 kg in bovines, resulting in hot carcass weight of 257.3 and 234.4 kg, and cold carcass 251.0 and 227.2 kg, respectively. For the authors, the largest hot carcass yield in cattle (58.8 against 55.0%) was due, in part, to a lesser extent byproducts of the carcass in relation to body weight, these (16.1%) compared the buffalo (18.1%).

By analyzing the levels of leptin, insulin, triglycerides, glucose and total cholesterol in the plasma of animals of 22 months, Ban-Tokuda *et al*. (2007) found that concentrations of insulin, leptin and cholesterol levels increased during the fattening and were higher in bovine than in buffaloes, but did not result in weight differences between species.

Regarding the comparison between the sexes is observed that the hot carcass weights were similar between castrated males and females (Table 1). This shows the proper performance of females compared to castrated males, indicating their viability for systems of short-cycle (Prado *et al*, 2005). Studying descriptive statistics for development, Malhado *et al*. (2008) observed similar growth between buffalo's males and females from birth to 1.460 days old.

By studying animals, Coutinho Filho *et al*. (2006) found hot carcass weight increased in males (257.0 kg) than females (202.4 kg), as a result of the higher final weight (462 vs 384 kg) and better carcass yield of the first ones (55.6 against 52.8%). Similarly, Vaz *et al*. (2010a) found that bovine castrated males had hot carcass weight (203.4 kg) than the weight observed in cows (168.6 kg). Higher slaughter weight and carcass of males would result in greater growth momentum caused by androgenic hormones, especially testosterone.

Boggs and Merkel (1993) comment that the lower carcass weight for females may be the result of fat deposition that occurs early in heifers compared to steers, slowing growth, with increased deposition of fat in the carcass and meat (Ban-Tokuda *et al*, 2007).

However, Ban-Tokuda *et al*. (2007) found that most significant weight differences are found between sexes of bovine than between the sexes of buffalo, indicating less sexual dimorphism of the latter species. Costa *et al*. (2010) observed that castration did not promote accumulation of abdominal fat in buffalo as happened in bovine, indicating a later maturity of the first ones. This could be associated to the later maturity of buffalo species, as seen in Table 1, which shows an average of .85 $\pm$ .8 incisors in buffaloes and 1.01 $\pm$ .7 incisor in bovine, indicating that buffalo exacerbate sexual dimorphism in older age, resulting in differences in carcass characteristics (Kandeepan *et al*, 2009).

The similarity in carcass weight between the sexes shows that carcass yield was similar between heifers and steers, regardless of species. Carcass yield of buffaloes of different breeds is under direct influence of the components of the gastrointestinal tract. This fact has been observed by other authors, according to Jorge *et al*. (1997), the low income housing seen in these animals is a result mainly of higher rawhide heads and presented by the buffalo, which reaches a 5% difference in carcass yield in favor of bovine.

Rodrigues *et al*. (2003) reported that the differences between bovine and buffaloes are independent of sexual state, but found a higher yield of buffalo's viscera in relation to bovine, 2.8% more than Nellore and 3.3% more than animals from crossing Nellore x Sindi. Vaz *et al*. (2010a) observed that castrated animals had higher carcass weight in relation to farm than the heifers, which showed a greater weight of leather and udder in relation to the inguinal fat of males.

In research that has studied bovine barrows and gilts, slaughtered at 14 or 24 months, Santos *et al*. (2008) reported similarity in dressing percentage between the sexes, regardless of age at slaughter, commenting that this effect was directly related to the accumulation of fat in females occurred in the final period of fattening. In the present study, females had better ratings fat ($p < .05$) than males (Table 1), an effect also found by Vaz *et al*. (2010b) in bovine crossbred Hereford steers, whose carcass fat percentages were 23.9 and 19.1% respectively

for males and females, although the former were lighter at slaughter.

The values of subcutaneous fat thickness compared between bovine (2.78 ± .07 points) and buffalo (2.98 ± .08 points) were similar (Table 1). Jorge *et al*. (1997) worked bovine with different genetic groups, finding on average 2.51 mm for bovine, while the Mediterranean buffalo breed, reached 5.90 mm.

Regarding the analysis of the dentition (Table 1), we found that males showed more advanced maturity than females. If the collagen stability advances with maturity, reducing the tenderness, as the females were less mature and better finish, this is also a positive factor for meat tenderness, it can be inferred that they have better meat quality than the bulls regardless of species.

In the study of the weight of commercial cuts (Table 2), it appears that the buffalo and the males showed heavier forequarters ($p< .05$). Due to the sexual dimorphism of the males, even if neutered, the forequarter grows more expressive in relation to females. Sawcut weights were similar ($p> .05$) between the sexes, a characteristic that has dual opinion in literature, with works mentioning that castration reflected in an increase in the percentage of sawcut (Rodrigues *et al*, 2003).

Table 2: Weight of commercial cuts of buffaloes and bovines of both sexes

	Forequarter, kg		Sawcut, kg		Ribcut, kg	
Buffalo	71.2	± 1,7	89.0	± 1,9	29.3	± .9
Bovine	65.7	± 1,5	86.8	± 1,7	28.7	± .8
Probability	0.02		0.40		0.57	
Male	70.8	± 1,4	88.2	± 1,7	29.1	± .7
Female	66.0	± 1,7	87.6	± 2,0	28.9	± .9
Probability	0.04		0.83		0.83	

In this study the ribcut weight was similar between sexes and species (Table 1). Comparing species, Roberts *et al*. (2003) found that the Mediterranean buffalo showed higher cutting back (ribcut + sawcut) and a lower proportion of forequarter to Nellore and Nellore x Red Sindi.

In working with young Angus bulls, Costa *et al*. (2002) found the forequarter weights (66.5 kg) for animals slaughtered at 340 kg, similar to the current work, however, sawcut higher weights (91.7 kg) and ribcut (23.4 kg) checked the results for bovine of this study.

In relation to the percentage of the cuts (Table 3), it was observed that buffaloes showed a higher percentage of forequarter and lower sawcut percentage being observed for the same males compared to females. Rodrigues *et al*. (2003) reported that Mediterranean buffalo had a lower forequarter proportion than bovine.

Table 3: Percentage of commercial cuts of buffaloes and bovines of both sexes

	Forequarter, kg		Sawcut, kg		Ribcut, kg	
Buffalo	37.5	± .2	47.0	± .3	15.4	± .3
Bovine	36.2	± .2	47.9	± .2	15.8	± .3
Probability	0.01		0.01		0.34	
Male	37.6	± .2	46.9	± .2	15.5	± .3
Female	36.2	± .2	48.0	± .3	15.8	± .3
Probability	0.01		0.01		0.44	

Rodrigues *et al*. (2003) calculated the cuts yield in relation to body weight, mentioning a higher sawcut percentage for zebu than buffaloes of the Mediterranean breed, in this case influenced by carcass yield. Very similar sawcut values in relation to cold carcass weight between the species are cited by Lapitan *et al*. (2007), who reported for cattle and buffalo, respectively, 46.4 and 46.9%. Even without significant difference, Lapitan *et al*. (2007) found lower values in percentage of fat in cattle carcass

(30.2 against 33.2%), offset by a greater percentage of lean meat (59.9 against 55.5%).

Comparing genders, there was a greater percentage ($p < .05$) of sawcut in females and lower percentage of forequarter related to males. Vaz *et al*. (2010b) also mentioned a higher percentage of males in forequarter of castrated animals compared to females, which showed higher ribcut, which in the present study was similar between sexes ($p > .05$).

The highest percentage of females in the sawcut may be related to their carcass finish (Table 1), as compared to the forequarter, the sawcut has greater accumulation of fat at a young age. In buffaloes fed energy levels Franzolin and Silva (2001) found 13.4, 13.8 and 15.1% for ribcut, respectively, for low levels, and high energy required, showing fat accumulation in this cut, this break with an increased level of energy, which was already quoted in working with bovine (Vaz *et al*, 2010a).

In the analysis of correlation between buffaloes (Table 4), ignoring the correlations between carcass weight and cuts weights, the highest positive correlation was between the teeth and weight ($r = .90$), indicating that the increased maturity of buffalo's maturity resulted in the development of this cut, which can be ratified by a somewhat higher correlation between carcass weight and forequarter weight ($r = .95$) compared to first one with sawcut weight ($r = .91$). In Murrah buffaloes, Menegucci *et al*. (2006) found the opposite, citing correlation values of $r = 0.98$ between cold carcass weight and sawcut weight, while between forequarter weight and carcass weight was $r = .88$.

Table 4: Correlations between variables sawcut, forequarter and ribcut for buffaloes males and females

	Sawcut,		**Forequarter,**		**Ribcut**	
	kg	**%**	**kg**	**%**	**kg**	**%**
Hot carcass weight	0.91**	-0.39*	0.95**		0.65**	
Teeth			0.90**			
Fat class				-0.47**		
Sawcut weight			0.86**			
Sawcut percentage			- 0.38*		- 0.81**	-0.79**
Forequarter weight				0.56**	0.49**	
Forequarter percentage						- 0.49**
Ribcut weight						0.85**

* $p < .05$; ** $p < .01$.

Table 5: Correlations between variables sawcut, forequarter and ribcut for bovines males and females

	Sawcut, kg	**Sawcut, %**	**Forequarter, kg**	**Forequarter, %**	**Ribcut, kg**	**Ribcut, %**
Hot carcass weight	0.98**		0.97**		0.84**	
Teeth		- 0.39**				
Sawcut weight			0.93**		0.77**	
Sawcut percentage				- 0.51**	- 0.31*	- 0.48**
Forequarter weight				0.43**	0.76**	
Forequarter percentage						- 0.51**
Ribcut weight						0.36*

* $p < .05$; ** $p < .01$.

The correlation was lower and negative, although significant ($p < .05$) between carcass weight and sawcut percentage ($r = - .39$), a result of increased ribcut yield due to fat accumulation, as previously mentioned, although in this study this correlation was not significant ($p > .05$). However, it was observed a negative correlation ($p < .05$) between fat and percentage of forequarter ($r = - .47$), a fact which shows that this cut has less fat deposition than the ribcut and sawcut.

Jorge *et al*. (2005) comment that the higher yield of ribcut animals to slaughter buffalo related that weighed about 500 kg related to those with 400 kg shows that the ribs maintain its growth in later stages of animal's life.

In Murrah buffaloes, Menegucci *et al*. (2006) observed that the increase in feedlot finishing linearly increased the percentage of diapers and tallow, reducing the percentage of beef and knuckle + rump roll. Ban-Tokuda *et al*. (2007) observed that differences in body fat deposition seem to have an influence of insulin, leptin and cholesterol in plasma the behave of those concentrations is different among bovine and buffalo.

Among the bovines (Table 5) the correlations between fat and other characteristics were not significant ($p > .05$). The teeth of the animals only had a significant correlation with the sawcut percentage ($r = - .39$). Among the cuts weights, the sawcut weight and the forequarter weight showed nearly perfect correlation with carcass weight, while the ribcut weight resulted in $r = .84$ ($p < .05$) with carcass weight.

The negative correlations between hindquarter percentage and forequarter percentage ($r = - .51$) are explained by Rodrigues *et al*. (2003) who reported that castrated animals regress or paralyze the development of secondary sexual characteristics, greater quarters muscle, neck and chest, and we observed an increase in height and further hindquarters development in relation to the whole.

Table 6 shows that the forequarters sales represented US$ 14.12 and sawcuts US$ 8.66 more for buffaloes, due to the weight of these cuts, as discussed above. Although the cuts are heavier to carry out a study of the bones in pieces cut side because Spanghero *et al*. (2004) reported that the buffaloes' rear shows a higher proportion of fat cuts (13.4%) than cattle (8.9%).

Table 6: Sale balance of commercial cuts of buffaloes and bovines

	Buffaloes	Bovines	Sale, US$ / kg
Forequarters sale, US$	182.81	168.69	2.57
Sawcuts sale, US$	350.23	341.57	3.94
Ribcuts sale, US$	78.40	76.79	2.68
Total carcass sale, US$ (a)	611.44	587.05	
Hot carcass weight, kg (b)	104.27	100.59	
Brake even point, US$ / kg (a / b)	3.17	3.16	

The assessments of hindquarter proportions and its components and ribcut are useful as they are products that are marketed largely by slaughterhouses and butchers (Jorge *et al*, 2005). However, the data in Table 6 indicate a better viability in the cattle acquisition, with a carcass balance of US$ 3.16 / kg, versus R$ 3.17 / kg buffaloes' carcass. Table 7 shows the purchase balance point in the comparison between the sexes, which was favorable to females (US$ 3.15 from US$ 3.18 / kg).

Table 7: Balance the sale of commercial cuts of males and females

	Males	Females	Sale, US$ / kg
Forequarters sale, US$	181.78	169.46	2.57
Sawcuts sale, US$	347.08	344.72	3.94
Ribcuts sale, US$	77.86	77.33	2.68
Total carcass sale, US$ (a)	606.72	591.50	
Hot carcass weight, kg (b)	103.19	101.62	
Brake even point, US$ / kg (a / b)	3.18	3.15	

By estimating purchase's balance's price of animals in carcass weight due to the cuts sale, it can get the best economic result for industrial companies that make the cuts sale with bones, as in most Brazilian slaughterhouses. Based on the market selling prices, it's observed that the

calculated equilibrium cut point suffers major effect with higher income, in this case, the sawcut showed an income of 53.3% per kilogram higher than the forequarter and 47.1% higher than the ribcut.

Sale price of beef cuts cited by the market were used, based on information that the buffaloes' carcasses, when programs are not aimed to a quality production of meat and are sold in conjunction with the primary beef cuts. This is so true that there is no information of commodity market for buffalo meat.

Based on this, and because the selling price is a signal of the price paid by the final consumer, accounting for the capital's flow in production chain, the work of genetic improvement in bovines and buffaloes should cherish the animal hindquarter developments, sometimes letting go the racial characteristics, often prioritized by breeders. This work was developed in the chicken chain, whose income from breast and thighs were extended. In pigs, the researchers seek to improve genotypes for best leg and shoulder conformations, cuts that have become more valued than the sidecut.

The work also shows the females potential for quality meat production, because at a young age, that sex has good performance over the sawcut to the forequarter, more developed in males, resulting in favorable balance point of the first.

Conclusion

The equilibrium price that industry can afford the housing buffalo is only R$ 0.02 / kg lower than bovine, but the comparison between the sexes, this parameter is R$ 0.06 / kg favorable to females compared to males.

Males and buffaloes have a higher income than female's forequarter and bovine, and the latter have greater sawcut development when slaughtered at a young age. Buffaloes showed, through the teeth, maturity younger than bovine, which can infer more tender meat for the first one. Females, in addition to mature later, have a higher fat classification than males and mature, factors that may result in more tender meat and tasty than the males.

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