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Analysis of added value in bovines sold for the angus meat program in the south of Brazil

Análise do valor agregado em bovinos certificados para o programa de carne angus no sul do Brasil

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Abstract
The objective of this work was to analyze price aggregation and disaggregation in commercialized animals searching for "Programa Carne Angus" benefits in the state of Rio Grande do Sul, Brazil. Data from 40,698 carcasses with Angus cattle racial pattern, slaughtered in a meat industry that performs the "Programa Carne Angus "certification, during the 2014 year were analyzed. The aggregated value was calculated by the difference between the negotiated base price for the lot and the final price obtained by animal after the certification process. The disaggregation was calculated based on the factors preventing the animals from being included in the certification program. The results show that the major disqualifying factor in males with the racial pattern was carcass fatness, and for females was the dentition, which disqualified 34.3 and 12.7% respectively. Value breakdown from 7,177 disqualified animals due to lack of finishing, or advanced dentition, reached R$ 1,213,528.00, or US$ 369,077.86 (US$ 51.43 per head), an amount that is no paid on from the industry to rural producers.
Keywords: Aberdeen Angus, beef cattle dentition, beef cattle meat chain, fatness carcass, quality meat.

Resumo
O objetivo deste trabalho foi analisar a agregação e a desagregação de valores dos animais comercializados em busca das bonificações do programa Carne Angus no estado do Rio Grande do Sul, Brasil. Foram analisados os dados de 40.698 carcaças de bovinos abatidos em uma indústria frigorífica que realiza a certificação para o programa Carne Angus, durante o ano de 2014. A agregação de valor foi calculada pela diferença entre o preço base negociado para o lote e o preço final obtido pelo animal depois do processo de certificação. A desagregação foi calculada em função dos fatores que impediram os animais de serem enquadrados no programa de certificação. Os resultados mostram que o maior

motivo para a desclassificação de animais com o padrão racial foi a dentição e o acabamento, os quais desclassificam, respectivamente, 34,3 e 12,7% dos animais com padrão racial. A desagregação de valor resultante de 7.177 animas que foram desclassificados por falta de acabamento ou por dentição avançada atingiu um valor de R$ 1.213.528,00, ou US$ 369.077,86 (US$ 51,43 por cabeça), quantia esta que deixou de ser repassada da indústria aos produtores rurais.
Palavras-chave: Aberdeen Angus, acabamento de carcaça, cadeia produtiva da carne bovina, carne de qualidade, dentição de bovinos.

Introduction

The increasing consumers demand quality meat, scientific research is looking for product differentiation options to meet this demand in the beef cattle production in the state of Rio Grande do Sul. As an alternative in improving the quality of beef, researchers have sought to reduce cattle slaughtering age without reducing the carcasses finishing, a result of higher weight gains from birth to animal slaughter[1]. Reduction in slaughter age is obtained by using early breeds, grown and finished with a proper diet, that improves carcass finishing and meat marbling, as is the case of Aberdeen Angus breed, which has in several countries represents a seal of quality meat differentiation obtained with the racial pattern certification[2].

Young animals from Britannic breeds Angus or Hereford, and adequate fatness, are fundamental for the meat quality, mainly on tenderness, but also on flavor and succulence. From the consumer's point of view, meat programs add value to the animal, due to the constant tenderness of young animals' meat, combined with the succulence of meat from a carcass with adequate fatness[2, 3].

Racial certification informs consumers about the supposed improvement in meat quality in the search for better product remuneration, benefiting the entire production chain, mainly the beef cattle producer[3]. Consumers consider beef meat racial certification to be important, though their knowledge and cited meat quality attributes do not confirm this concern[4]. In gourmet steakhouses, consumers consider certification important[5] however, there is a significant percentage of consumers who do not know what these attributes mean[4].

In Brazil, the domestic beef market is characterized by poor meat quality, since most of the noble cuts are exported. In the domestic market, certified meat programs, as the "Carne Angus" and "Carne Pampa" programs, guarantee specific characteristics of a quality product, produced from British breeds young animals and their crosses, and with a suitable carcass finish. In Brazil, the "Programa Carne Angus" began in 2003, seeking to benefit all stakeholders, favoring those producers who invested in reducing the slaughter age in search of this market niche[6].

Today, the greater acceptability of certified meat Angus products have an impact on bulls and semen markets, since breeders and terminators are looking for produce animals that fall under the Angus Meat Program, aiming to aggregate more value of the base

price paid to the common steers[7, 8]. Even so, most of the animals marketed in search of Angus meat quality certification do not reach the aggregate remuneration, because they do not have all carcass characteristics defined by the certification program. Therefore, the objective of this work was to study the indices, quantify aggregation values, and reasons for disqualification of Aberdeen Angus animals in the quality meat program of the state of Rio Grande do Sul, Brazil.

Materials and methods

This research evaluated data from 40,698 beef cattle slaughtered in a meat industry that performs carcasses certification for the "Programa Carne Angus". The slaughter information was collected from January to December 2014.

According to the Brazilian Association of Angus[9], animals classified for the Angus Beef program must have one of the following racial definitions: I) Aberdeen Angus defined, both black or red; II) crosses with a minimum of 1/2 Aberdeen Angus phenotype with European breeds and no more than 1/4 Zebu; III) Crosses with a minimum of 2/3 Aberdeen Angus with zebu and synthetic breeds.

Racial certification occurs after animal bleeding and before leather removal when racial characteristics can be visualized and the carcass sequences can be recorded on the slaughter line. Soon after, the classification of gender and sexual condition is made, eliminating uncastrated males' carcasses.

After leather removal, the Brazilian Angus Association typifier performs the fat classification, according to Brazil rules, in a five classes scale: 1 = absent fat, 2 = scarce fat, 3 = median fat; 4 = uniform fat; 5 = excessive fat.

The animal's dentition is analyzed before the head is separated from the carcass, being accepted animals from zero to four teeth. Animals, male castrated or female, with one of the racial patterns mentioned and fat classification 3, 4, or 5, are approved. Certified carcasses are stamped before weighed, but may also be disqualified from the program in case of any sanitary problem, as determined by the Brazilian federal inspection service at the meat industry.

To calculate the bonus, the slaughterhouse carries out the 2% discount from hot carcass weight to estimate the cold carcass weight. It is on cold carcass weight that the bonus is calculated, within each dentition range, as shown in Figure 1.

The added value paid by the meat industry to producers is calculated by the difference between the negotiated base price for the corresponding lot and the final price obtained, by animals, after the certification process. The bonus considers the dentition and carcass weight of slaughtered animals (Figure 1). Although they are traded for a lower base price, females that meet the certification requirements, receive the bonus from castrated steers price.

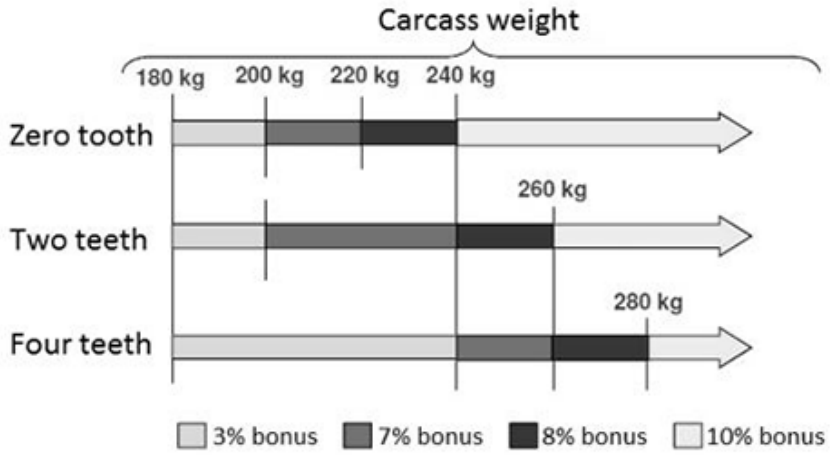

Figure 1. Animal bonification acording to angus meat certification program"
Source: Associação Brasileira de Angus[9]

The carcass value loss considered in this work was calculated by the potential bonus value that animals failed to earn once they did not meet one or more of the program's requirements. The value breakdown analyzed each unattended factor separately, or in combination when an animal with a racial pattern did not meet more than one quality required by the certification program.

The independent variables analyzed were sex, dentition, finishing, and reason for animals' disqualification of the "Programa Carne Angus". The mean, absolute frequency, and relative frequency for these variables were calculated. For finishing degree and sex, the analysis of variance was performed and, when necessary, test of comparison of means, both analyzes at the 5% level of probability. Analyses were performed according to the following model: $Y_{ij} = \mu + \alpha_i + e_{ij}$, where Y_{ij} is the dependent variable certifications number; μ is the general mean of analyzed characteristic; α_i is the independent variable *i*, being gender, fatness or tooth; and *eij* is the residual effect associated to measures. Also, linear regression for cold carcass weight as a function of fatness classes for both genders was performed. The software Microsoft Excel®, and SAS System®, was used as an aid to analyzes.

Results and discussion

In the 40,698 animals sampled with racial characteristics accepted by the "Programa Carne Angus", 18,250 carcasses were certified, representing a percentage of 44.8% of animals receiving the Angus Beef registration (Table 1). The other 22,448 animals were disqualified for failing to meet one or more characteristics required by the Brazilian Association of Angus[9].

Table 1. List of certified or non-certified animals according to sex and their respective cold carcass weights

Gender	Animals with racial pattern	Certified animals	Cold carcass weight (kg)		Certified
			Not certified	Certified	
Females	18,068	4,971	215.9	198.2	27.5%
Steers	22,630	13,279	232.9	226.6	58.7%
Mean[1]			225.4	218.9	
Total	40,698	18,250			44.8%

[1] For the mean cold carcass weight of animals with racial patterns and certified, the total number of animals was considered independent of gender.

Table 1 shows that males certification occurs on a larger scale than in females, representing 58.7 and 27.5%, respectively, of certified animals compared to the total animals with the racial pattern of the "Programa Carne Angus" (Table 1). It is also noticed that the cold carcass weight of certified cattle is lower (218.9 kg on average) compared to the average of animals with the racial pattern that was disqualified, probably because the disqualified animals were represented, in good part, by animals with high age, typified with six or eight teeth.

Regarding the cold carcass weight of cows and heifers, these have a lower weight than castrated steers, both in non-certified and in certificates animals (Table 1). Although, among the certificates, the difference in favor of males was more representative (14,3%) than the difference between genres within the noncertified ones (7.9%), probably due to the high representativeness of adult cows within the noncertified animals. Another interesting result of this research is showed in Figure 2, which shows the increase in carcass weight of males with racial patterns and fatness 2, 3, or 4, as the dentition increases, regardless of whether or not they have been certified.

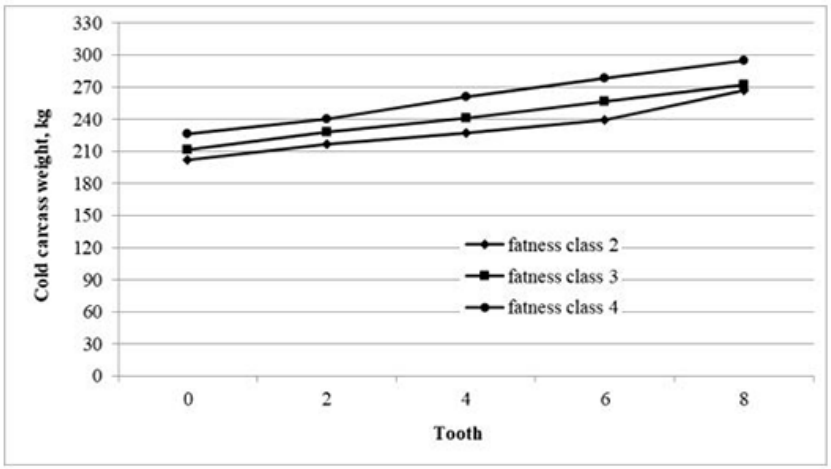

Figure 2. Cold carcass weight of males with racial pattern required by the "Programa Carne Angus"

Figure 2 does not show data from animals with class 1 fatness, not representative in the sample, with 16 observations for dentition 0, 8 observations for 2 teeth, 3 observations for 4 teeth, 2 observations for 6 teeth, and 3 observations for animals with 8 Teeth. Figure 2 shows a relatively parallel growth between lines representing the males' carcass finishes, but in the same analysis of cows and heifers, cold carcass weight increase according to age advance was not as clear (Figure 3). In this case, with no racial pattern in this sample, these results can indicate a variation of breeds in the Rio Grande do Sul livestock, reflected by differences in frame and mature weight among breeds.

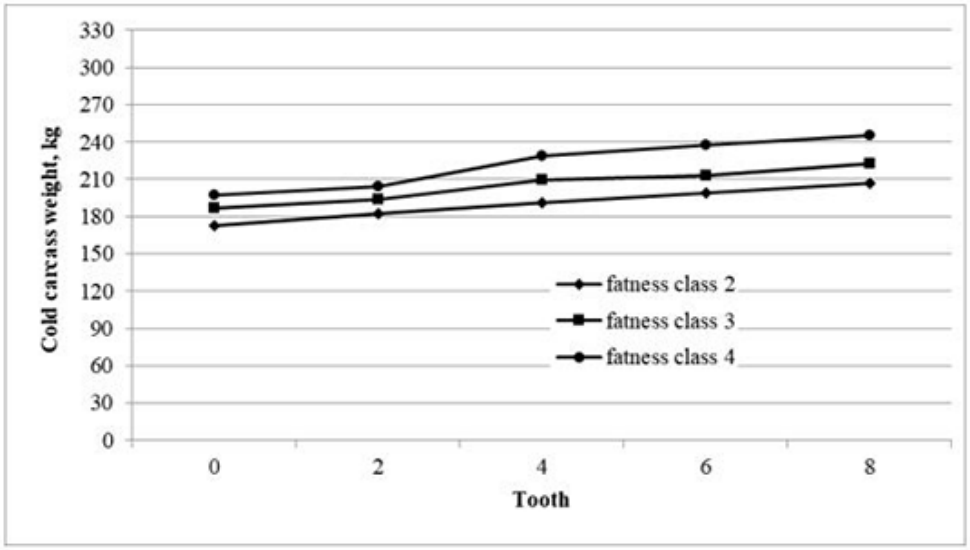

Figure 3. Cold carcass weight of females with the racial pattern required by the "Programa Carne Angus"

Also, by the low representativeness, with 18 observations, females with class 5 fatness were not analyzed in Figure 3. The more pronounced increase in carcass weight in females, with advanced dentition (Figure 3), than in males (Figure 2), indicates that females may deposit fat more easily than castrated males, or even reaching adult size sooner than males. Vaz et al.[10] attributed the difference in carcass between females and castrated males as the result of the sexual dimorphism of genera, resulting in a lower adult weight of females, which begin to deposit fat earlier than castrated males[11].

The statistical analysis showed that males were always significantly heavier than the cows or heifers within the same fatness degree (Table 2). Besides, increased finish, regardless of gender, resulted in a significant increase ($P < 0.05$) in animals carcass weight.

The linear regression equation shown in Figure 4, despite the low R, indicates that, with each increase in the finishing degree of females, the carcass weight increases 20.352 kg, while in males this increase is 11.249 kg (Figure 5).

Table 2. Carcass weight averages for males and females with the racial pattern.

Fatness	Females		Males	
	Cold carcass weight (kg)	Racial pattern (heads)	Cold carcass weight (kg)	Racial pattern (heads)
Class 1	173 d[2]	14		
Class 2	195 cA[1]	1.819	222 cB	4.681
Class 3	213 bA	11.667	232 bB	13.759
Class 4	236 aA	1.811	249 aB	651
VC[3]	14,28		15,44	
Probability	<0,0001		<0,0001	

[1] A, B in the line indicates differences between gender (P < .05); [2] a, b, c in the column, indicates differences among fatness (P< .05), analyzed by Tukey's test; [3] Variation coefficient.

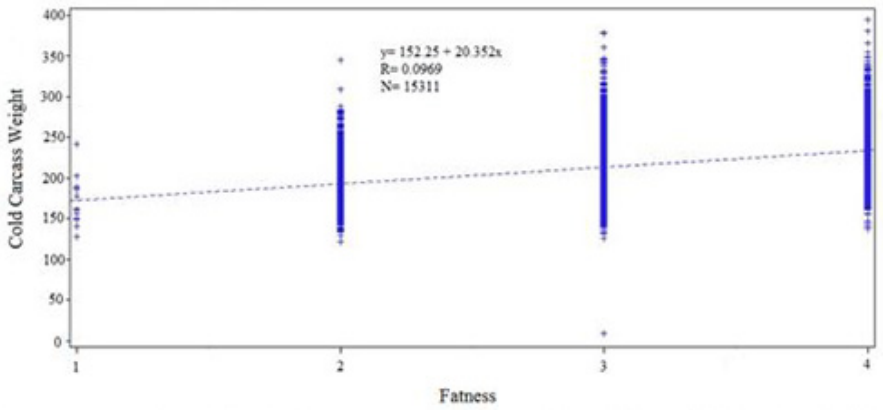

Figure 4. Linear regression of cold carcass weight as a function of finishing in females.

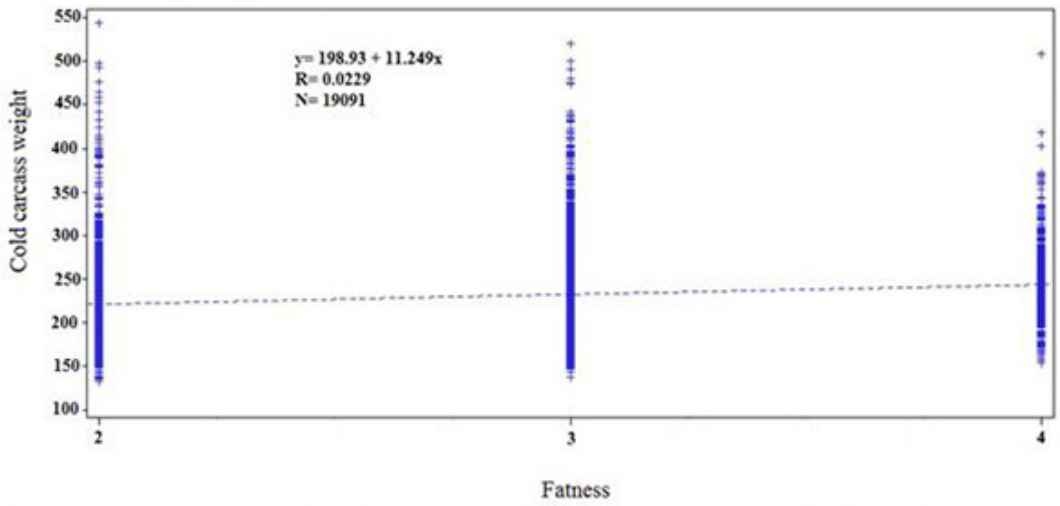

Figure 5. Linear regression of cold carcass weight as a function of finishing in males

Collecting slaughter data from a slaughterhouse in the United States, Lawrence et al.[12] observed weights of 334.2, 352.7, 349.7, 342.1, and 328.1 kg, respectively for animals with zero, two, four, six, and eight teeth, showing an increase of 18.5 kg when animals dentition passed from milk teeth to two teeth. However, the same authors cite a decrease in the average carcass weight of adult animals, reaching a 14.0 kg decrease in carcass weight, when dentition increases from six to eight teeth.

In the present study, the evaluation of disqualification reasons (Table 3) shows that dentition is the characteristic that most disqualifies females from the Angus Beef Program, while in males, fatness is the primordial reason of value loss.

Table 3. Certification and disqualification of animals from both genders in the "Programa Carne Angus"

Gender	Certified	Not certified					Total
		Fatness (F)	Dentition (D)	F and D	Sexual condition	Sanity	
	Absolute values (heads)						
Females	4,971	934	10,451	1,149	-	563	18,068
Males	13,279	4,217	3,562	1,160	60	352	22,630
Total	18,250	5,151	14,013	2,309	60	915	40,698
	Relative values (%)						
Females	27.5	5.2	57.8	6.4	0.0	3.1	100
Males	58.7	18.6	15.7	5.1	0.3	1.6	100
Total	44.8	12.7	34.4	5.7	0.1	2.2	100

From a sample of 40,698 animals with a required racial pattern, 14,013 were not certified due to advanced dentition. Among these, females are more representative, since 10,451 females were disqualified for having 6 or 8 teeth, compared to the 3,562 castrated males slaughtered with these dentitions. However, if it is considered that a good part of females is slaughtered as a discard of reproductive herds, the most representative number is the males' disqualification, once 15.7% of the steers are old for meat certification. These results indicate the existence of production systems with low weight gains that do not confer finishing on steers when they are still young[12, 13].

In males, the main reason for disqualification was the animals' lack of finishing, which disqualified 4,217 castrated male bovines, representing 18.6% of male animals with racial patterns accepted by the "Programa Carne Angus". The data show another deficiency of beef cattle finishing systems in the state, representing a value loss of young animals that could be subsidized if they were better finished.

In the same way, Table 3 shows that 2.2% of animals with a racial pattern are no bonified due to sanitary problems, a relatively high value if the young animals are considered. A comparison between genders shows that 563 heifers (3.1%) and 352 steers (1.6%) were disqualified by sanitary alterations.

Table 4 shows that, from 40,698 animals sampled with a pattern appropriate to the Angus Meat program, 20,419 were slaughtered in the four summer months in the South

of Brazil (September, October, November, and December) representing 50.12% of total Angus animals and their crosses. According to Viana and Silveira[14], in Rio Grande do Sul it is in October/November that the animals are removed from winter pasture areas for soybean and corn crop implantation, in the case of integrated crop-livestock production systems. Thus, there is an increase in animal supply for slaughter with adequate fatness in these same months.

Table 4. Certification and disqualification of animals in the Angus Meat Program during the months of the year.

Months	Certified	Not certified					Total
		Fatness (F)	Dentition (D)	F and D	Sexual condition	Sanity	
	Absolute values (heads)						
January	945	302	752	204	3	61	2,267
February	1,059	170	713	91	2	38	2,073
March	1,258	322	1,087	182	7	38	2,894
April	931	480	1,040	305	0	44	2,800
May	436	243	807	278	0	24	1,788
June	445	82	318	65	1	27	938
July	2,137	329	1,022	92	7	65	3,652
August	1,664	560	1,362	185	3	93	3,867
September	2,303	515	1,879	137	10	171	5,015
October	2,507	788	1,951	191	15	159	5,611
November	2,104	755	1,825	310	8	145	5,147
December	2,461	605	1,257	269	4	50	4,646
Sum	18,250	5,151	14,013	2,309	60	915	40,698
	Relative values (%)						
January	41.7	13.3	33.2	9.0	0.1	2.7	100
February	51.1	8.2	34.4	4.4	0.1	1.8	100
March	43.5	11.1	37.6	6.3	0.2	1.3	100
April	33.3	17.1	37.1	10.9	0.0	1.6	100
May	24.4	13.6	45.1	15.5	0.0	1.3	100
June	47.4	8.7	33.9	6.9	0.1	2.9	100
July	58.5	9.0	28.0	2.5	0.2	1.8	100
August	43.0	14.5	35.2	4.8	0.1	2.4	100
September	45.9	10.3	37.5	2.7	0.2	3.4	100
October	44.7	14.0	34.8	3.4	0.3	2.8	100
November	40.9	14.7	35.5	6.0	0.2	2.8	100
December	53.0	13.0	27.1	5.8	0.1	1.1	100
Sum	44.8	12.7	34.4	5.7	0.1	2.2	100

July was the month in which the highest number of animals was certified, from 3,652 cattle with a standard accepted by the program, 58.5% were certified (Table 4). In April, May, and June, the animal supply with Angus pattern and their crosses decreased considerably, since it is a period where there is a fodder void for cattle in the state of Rio Grande do Sul, resulting in loss of condition score until spring[3].

In April and May, less animal certification occurred, with percentages of 33.3 and 24.4%, respectively. It is observed that the major reason for animal disapproval in this period was their age. In these months, a good part of the weaning and gestation diagnosis occurs in the bovine matrices, carrying out the discarding of females that did not conceive. Being these animals in a state of adequate finishing occurs the commercialization of these cows for the abattoirs. Table 4 shows that, throughout the year, the 14,013 animals cited in Table 3, represent 34.4% of animals with the racial pattern, fatness, but with advanced dentition. The 3,562 old steers (Tables 3 and 4) indicate production systems that kill animals suffering from nutritional deficiencies delaying the young steers finishing or by breeders' intention to commercialize older cattle to obtain a greater carcass weight, a fact that is not limiting for bovine commercialization in South of Brazil.

The lack of finishing disqualified 5,511 heads, representing 12.7% of animals, being the months of April and August the ones with higher relative indexes of disapproval. These results reflect the discussed previously regarding forage production in the studied state. In April, native pasture paralyzes its growth[15] and the winter pastures are not yet ready for grazing, resulting in poorly finished animals being sent to slaughter. This fodder deficiency lasts until August[3], however, in May, June, and July it is representative the animals finishing in confinement with silage from summer crops when animals that were in the native pasture are closed to be fed at a feedlot.

In August and September, it was observed that the number of declassification cases of animals by sanity increased, since in these months the temperature is increasing, probably providing conditions more prone to diseases that lead to animal non-certification of the meat program. Also, in this season, the slaughter percentage of adult females who had longer exposure to contagious diseases grows[16]. These diseases render carcasses unfit for the Angus Meat program, such as Actinobacillose, Cysticercosis, Fasciolosis, and Hydatidosis.

When analyzing the number of certified and not certified steers in each month of the studied year, separated by disqualification attribute, Table 5 shows that July was the month in which more animals were certified, in percentage. From 2,249 steers, a total of 1,619 were certified, comprising 72%. This high approval of animals is because most of the animals at this time are finished in cultivated winter pastures, with high nutritional quality.

Only in April and May, the proportion of certified animals was less than 50% of the animals with a racial pattern, due to a high disqualification by fatness or dentition, 23.8 and 21.9%, respectively.

Considering only the steers (Table 5), declassification rates by fatness and dentition were 18.6 and 15.7% respectively, which represents 4,217 oxen declassified by finishing and 3,562 disqualified by dentition.

Table 5. Certification and reasons for non-certification of steers according to the months of the year

Months	Certified	Not certified					Total
		Fatness (F)	Dentition (D)	F and D	Sexual condition	Sanity	
				Absolute values (heads)			
January	682	235	123	89	3	9	1,141
February	747	131	191	53	2	18	1,142
March	1,033	236	308	92	7	17	1,693
April	718	413	379	199	0	24	1,733
May	286	168	297	154	0	15	920
June	343	61	86	18	1	9	518
July	1,619	276	274	42	7	31	2,249
August	1,134	461	280	97	3	36	2,011
September	1,609	429	359	74	10	61	2,542
October	1,597	674	371	95	15	61	2,813
November	1,615	633	495	123	8	49	2,923
December	1,896	500	399	124	4	22	2,945
Sum	13,279	4,217	3,562	1,160	60	352	22,630
				Relative values (%)			
January	59.8	20.6	10.8	7.8	0.3	0.8	100
February	65.4	11.5	16.7	4.6	0.2	1.6	100
March	61.0	13.9	18.2	5.4	0.4	1.0	100
April	41.4	23.8	21.9	11.5	0.0	1.4	100
May	31.1	18.3	32.3	16.7	0.0	1.6	100
June	66.2	11.8	16.6	3.5	0.2	1.7	100
July	72.0	12.3	12.2	1.9	0.3	1.4	100
August	56.4	22.9	13.9	4.8	0.1	1.8	100
September	63.3	16.9	14.1	2.9	0.4	2.4	100
October	56.8	24.0	13.2	3.4	0.5	2.2	100
November	55.3	21.7	16.9	4.2	0.3	1.7	100
December	64.4	17.0	13.5	4.2	0.1	0.7	100
Sum	58.7	18.6	15.7	5.1	0.3	1.6	100

Regarding sexual status, September, October, and November were the months with more animals disqualified for that reason, with 33 animals not certified during this period, more than half of the annual total disapproved for this trait. The possible explanation is that at this time of the year, the andrological tests are carried out on

adult bulls to be used in the field and young bulls that will be taken to the auctions. The animals that are disapproved in these tests are destined to slaughter.

Table 6. Certification and reasons for non-certification of cows and heifers according to the months of the year

Months	Certified	Not certified				Total
		Fatness (F)	Dentition (D)	F and D	Sanity	
			Absolute values (heads)			
January	263	67	629	115	52	1,126
February	312	39	522	38	20	931
March	225	86	779	90	21	1,201
April	213	67	661	106	20	1,067
May	150	75	510	124	9	868
June	102	21	232	47	18	420
July	518	53	748	50	34	1,403
August	530	99	1,082	88	57	1,856
September	694	86	1,520	63	110	2,473
October	910	114	1,580	96	98	2,798
November	489	122	1,330	187	96	2,224
December	565	105	858	145	28	1,701
Sum	4,971	934	10,451	1,149	563	18,068
			Relative values (%)			
January	23.4	6.0	55.9	10.2	4.6	100
February	33.5	4.2	56.1	4.1	2.1	100
March	18.7	7.2	64.9	7.5	1.7	100
April	20.0	6.3	61.9	9.9	1.9	100
May	17.3	8.6	58.8	14.3	1.0	100
June	24.3	5.0	55.2	11.2	4.3	100
July	36.9	3.8	53.3	3.6	2.4	100
August	28.6	5.3	58.3	4.7	3.1	100
September	28.1	3.5	61.5	2.5	4.4	100
October	32.5	4.1	56.5	3.4	3.5	100
November	22.0	5.5	59.8	8.4	4.3	100
December	33.2	6.2	50.4	8.5	1.6	100
Sum	27.5	5.2	57.8	6.4	3.1	100

When the females were analyzed in Table 6, it is verified that only 27.5% are certified by the program, being August, September, October and, November the months with the highest certification numbers. As already discussed, among females, dentition was the major reason for disqualification, as every month studied, more than 50% of females

slaughtered with the racial pattern had six or eight teeth. Taken together, disqualification per tooth and fatness plus tooth, a total of 11,600 females with the racial pattern were disqualified, indicating that much of slaughtered females were cull cows. However, on the other hand, it can also be inferred that 934 heads were young females but had no finishing, and another 563 were young and fat but presented health problems. This represents that 8.3% of all females slaughtered with the racial pattern were young, probably discarded by excess females in their herds of origin[17].

The high percentage of cull cows, old or young, shows a similar price between steers and cows practiced in the South of Brazil was is already 5%[3]. In this region, breeders adjust their schedule according to natural forage production, which is regulated by climate conditions. Mating occurs from December to February, pregnancy diagnosis in April or May, and cull sold right after this management or, if using cultivated winter forages, three or four months after.

Along the months of the year, this data shows that for males (Table 5) or females (Table 6) July is the month with the higher percentage of certified animals the program. In that month 36.95%, or 518, females were certified in the studied abattoir, but in absolute numbers, in October, certification reached 910 females.

Table 7. Relative and absolute value aggregation on females and males certified by Meat Angus Program in South of Brazil

Gender	Aggregation (R$)	Aggregation (US$[1])	Aggregation (%)
Female	99.98	30.41	5.82
Male	109.80	33.39	5.30
Mean	107.12	32.58	5.44

[1] Dollar exchange (R$ 3.288/1.00 US$) in June, 19th, 2017.

Regarding values paid to producers, a new analysis was constructed (Table 7) showing that, in percentage, females added more value compared to males. The explanation for this is that, when it is certified, the female starts to be remunerated on the base price of males, which is always higher than the female base price. Therefore, females added value is a result of male price plus the bonus for the carcass weight class depending on the animal's dentition, as shown in Figure 1.

Although the minor relative value, in absolute values the price aggregation in males is higher, resulting from the higher carcass weight compared to females, as already discussed in Table 1. In absolute values, value aggregation on steers carcass was almost US$ 3.00 higher than for young females' carcass.

From another perspective, Table 8 shows a simulation of females that were not certified due to low carcass fat, not reaching the "median" fat class, minimum finish required for certification to occur. It is observed that these animals that had a first dentition

(zero tooth) did not receive an average of US$ 63.87, due to the low carcass fat. These values were estimated based on the 3% bonus that young animals, with zero tooth and 186.3 kg of cold carcass weight, receive added to the male purchase price, as explained previously.

Table 8. Simulation of value aggregation for non-certified females due to insufficient fatness, if they were slaughtered with class 3 fatness

Tooth	0	2	4
Price paid (R$/kg)	8.11	8.22	8.34
(US$/kg[1])	2.47	2.50	2.54
Base price (R$/kg)	8.42	8.40	8.45
(US$/kg)	2.56	2.55	2.57
Carcass weight (kg)	173.4	183.6	191.9
Number of heads	244	318	364
Price paid (R$/head)	1,406.00	1,510.00	1,601.00
(US$/head)	427.62	459.25	486.92
Carcass weight (kg[2])	186.3	194.1	209.2
Bonus (%[3])	3	3	3
Final price (R$/kg)	8.67	8.65	8.70
(US$/kg)	2.64	2.63	2.65
Price paid, (R$/head)	1,616.00	1,679.00	1,820.00
(US$/head)	491.48	510.64	553.53
Loss of value (R$/head)	210.00	169.30	219.40
(US$/head)	63.87	51.49	66.73

[1] Dollar exchange (R$ 3.288/1.00 US$) on June, 19th, 2017. [2] Considering that animals with its dentition had the cold carcass weight of an animal with class 3 fatness, as showed in Figure 2. [3] Source: Figure 1.

For animals with two teeth, that were not certified for reasons of class 1 fatness, values are not presented in Table 8, such as the penalty imposed by the studied slaughterhouse. It's largely representative (actually 60% of negotiated value), which would result, in a final remuneration of R$ 1,748.75, a difference of R$ 1,184.86 per carcass, since animals with 2 teeth, class 1 fat, received an average of R$ 563.89. It should be noted that the number of carcasses during the year 2014 with these characteristics was low, few females presented dentition 2 and finish 1 (absent). It is also important to note that animals with Aberdeen Angus pattern, and their crosses, with adequate dentition and non-existent finishing, were not many, meaning some care of producers in not killing animals with lack of finishing, with the risk of being penalized for these carcasses in the refrigeration industry.

The depreciation of carcasses with finish 1 is a severe rule of the researched industry,

in order to inhibit the slaughter as an end to animals easily identified as lean. However, some producers end up selling animals for slaughter by not being able to fatten them with their contemporary groups. The females already with dentition 4, but finish 2, no longer add R$ 219.40 when compared if they obtained the remuneration of finished carcasses 3.

Table 9. Simulation of value aggregation for uncertified males due to insufficient finishing, if they were sold with class 3 fatness

Tooth	0	2	4
Price paid (R$/kg)	8.70	8.74	8.65
(US$/kg[1])	2.65	2.66	2.63
Base price (R$/kg)	8.74	8.79	8.68
(US$/kg)	2.66	2.67	2.64
Carcass weight (kg)	201.6	216.4	227.3
Number of heads	1.306	1.367	1.113
Price paid (R$/head)	1,753.00	1,891.00	1,966.00
(US$/head)	533.15	575.12	597.93
Carcass weight (kg[2])	211.8	227.8	241.2
Bonus (%[3])	7	8	7
Final price (R$/kg)	9.36	9.49	9.28
(US$/kg)	2.85	2.89	2.82
Price paid (R$/head)	1,983.00	2,162.00	2,239.00
(US$/head)	603.10	657.54	680.96
Loss of value (R$/head)	230.1	270.9	272.9
(US$/head)	69.98	82.39	83.00

[1] Dollar exchange (R$ 3.288/1.00 US$) on June, 19th, 2017. [2] Considering that animals with its dentition had the cold carcass weight of an animal with class 3 fatness, as showed in Figure 2. [3] Source: Figure 1.

Table 9 shows that males disqualified due to finishing 2, which theoretically could be finished with a few more days of feeding, the mean value compared to the base price was R$ 0.03 lower, probably a result of a less bargained between producer and industry when animals are less finished. These animals also showed lower carcass weight than animals with finishing 3, as a result of the higher fat deposition in the latte. It should be noted that, for animals with a low finish (2) to reach the median degree (3), the producer would have a higher cost, and this value should be lower than the value that was not added to the fact that the animals were not certified.

Sometimes, due to seasonality of fattening pastures, producers prefer to keep animals for another year in the production system, with lower weight gains than investing in improving the food level to carry out the termination of the younger animals. The next results presented estimate values of value aggregation that could be achieved if some non-ideal certification questions were improved.

Another discussion that may be made is about the possibility for producers to finish animals that will be disqualified by advanced dentition, before the planned season, yet with dentition accepted by the Angus Meat certification. In the case of females with a racial standard and finishing required by the "Programa Carne Angus", but with 6 teeth, if they were marketed when they still had 4 teeth, logically with a lower weight, they could receive a 3% bonus above the base price, adding only R$ 23,40 (Table 10) in function of their low carcass weight.

Table 10. Simulation of value aggregation for uncertified females due to advanced dentition, if they were sold with 4 teeth

Fatness	**Class 3**		**Class 4**	
Tooth	**6**	**8**	**6**	**8**
Price paid (R$/kg)	8.46	8.38	8.60	8.35
(US$/kg[1])	2.57	2.55	2.62	2.54
Base price (R$/kg)	8.48	8.39	8.61	8.35
(US$/kg)	2.58	2.55	2.62	2.54
Carcass weight (kg)	213.3	222.9	237.6	245.6
Number of heads	1,042	659	97	1,279
Price paid (R$/head)	1,805.00	1,868.00	2,045.00	2,050.00
(US$/head)	548.97	568.13	621.96	623.48
Carcass weight (kg[2])	209.2	209.2	228.7	228.7
Bonus (%[3])	3	3	3	3
Final price (R$/kg)	8.74	8.64	8.86	8.6
(US$/kg)	2.66	2.63	2.69	2.62
Price paid (R$/head)	1,829.00	1,808.00	2,027.00	1,967.00
(US$/head)	556.27	549.88	616.48	598.24
Loss of value (R$/head)	23.40	-59.90	-18.70	-82.80
(US$/head)	7.12	-18.22	-5.69	-25.18

[1] Dollar exchange (R$ 3.288/1.00 US$) on June, 19th, 2017. [2] Considering that animals with its dentition had the cold carcass weight of an animal with class 3 fatness, as showed in Figure 2. [3] Source: Figure 1.

When the value for females with 8 teeth was estimated, slaughtered yet with 4 teeth, there is no added value due to reduced cold carcass weight, reducing the value paid per head. In cows with 8 teeth, the average cold carcass weight was 222.9 kg, or 4.5% higher than the weight of animals with 6 teeth, and 6.5% greater than the weight of heifers with 4 teeth. This higher percentage in carcass weight supplants the bonus that these animals would achieve if they were included in the "Programa Carne Angus". The same reasoning can be done for cows with uniform fat finishing (fat 4), in which carcass weight was even higher, further supplanting the bonus that would be obtained if these females were slaughtered with 4 teeth.

Table 11. Simulation of value aggregation for uncertified steers due to advanced dentition, if they were sold with 4 teeth

Fatness	Class 3		Class 4	
Tooth	6	8	6	8
Price paid (R$/kg)	8.81	8.54	9.08	8.68
(US$/kg[1])	2.68	2.60	2.76	2.64
Base price (R$/kg)	8.84	8.59	9.09	8.69
US$/kg	2.69	2.61	2.76	2.64
Carcass weight (kg)	256.6	271.8	278.4	295.2
Number of heads	1,375	1,533	48	84
Price paid (R$/head)	2,261.00	2,322.00	2,529.00	2,562.00
(US$/head)	687.65	706.20	769.16	779.20
Carcass weight (kg[2])	241.2	241.2	261.2	261.2
Bonus, (%[3])	7	7	8	8
Final price (R$/kg)	9.46	9.19	9.81	9.37
(US$/kg)	2.88	2.80	2.98	2.85
Price paid (R$/head)	2,282.00	2,217.00	2,563.00	2,448.00
(US$/head)	694.04	674.27	779.50	744.53
Loss of value (R$/head)	20.40	-105.40	33.10	-114.00
(US$/head)	6.20	-32.06	10.07	-34.67

[1] Dollar exchange (R$ 3.288/1.00 US$) on June, 19th, 2017. [2] Considering that animals with its dentition had the cold carcass weight of an animal with class 3 fatness, as showed in Figure 2. [3] Source: Figure 1.

The results estimated in Table 11 for steers with dentition 6 and finishing class 3 or 4, show that the advanced dentition prevented an additional revenue of R$ 20.43 and R$ 33.10, respectively, simulating a slaughter of the same animal with dentition 4. Moreover, animals with 8 teeth would not add value if slaughtered with 4 teeth, due to high carcass weight when their dentition is 8 teeth, corresponding to 271.78 kg and 295.17 kg, respectively, for animals with finishes 3 and 4. Such as with females, these animals no longer earn the subsidy offered by the Brazilian Association of Angus, but add value with carcass weight, even though the producer has a high cost with these products because they stay a longer time remain on the farm until they reach these slaughter age.

Conclusions

The percentage of certification is higher in steers compared to females, since males are slaughtered with lower age than females.

The steers are heavier than females in all ages, being your bonus, in absolute values, higher than the heifers. However, in relative values, revenue aggregation is higher in

cows and heifers, as certification increases the base price value of negotiation, as a rule of the Carne Angus Program.

In steers, declassification occurs mainly due to carcasses' lack of finishing, while in females the most expressive declassification is due to advanced dentition.

July is the month with the highest animal certification compared to the total number of animals with racial pattern slaughtered, while in May there is the highest animal declassification in the Angus Meat Program. When analyzing only females, the greatest declassification month was March.

Considering only the final revenue, it is not an advantage to the producer to slaughter animals with a racial pattern of the Angus Beef Program at a younger age, since the carcass weight reduction does not compensate for bonuses that could be obtained. However, other work should look at the cost increase that farmers have by keeping the animals longer on the farm.

Regarding the lack of finishing in animals with the racial pattern, a value disaggregation occurs when animals are slaughtered before reaching the standard finish required by the Meat Angus certification, representing US$ 66.73 per head in females, and US$ 88.00 per head in steers, simulating both 4 teeth.

Conflict of interest

The authors declare no conflict of interest.

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