

Evolution of slaughter precocity in male beef cattle in the Carne Pampa programme

Evolução da precocidade de abate de bovinos de corte machos no programa Carne pampa

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Abstract

The aim of this study was to analyse precocity behaviour over nine years in Hereford steers and their crosses, slaughtered with from zero to six teeth. Approximately 144,000 certified carcasses in the Carne Pampa programme were analysed between 2010 and 2018. The increase in cold carcass weight per year was evaluated for three periods of the year: the hot season was defined as 26 December to 25 May, the autumn void was defined as 26 May to 25 July, and the cold season from 26 July to 25 December. To assess the behaviour of cold carcass weight over the years per season, the data were submitted to simple linear regression analysis. The average weights per season were compared by the mean value comparison test. The cold season had the highest mean carcass weight, with 239.1 kg, showing an annual increase of 6.45 kg. Analysing the behaviour of mean carcass weight by dentition, animals with zero teeth showed a greater weight increase over the years during the cold season as well as during the autumn void; during the hot season, animals slaughtered with two teeth showed the greater increase in weight. The category that showed the least increase in weight for all three seasons were animals slaughtered with six teeth. It was concluded that over the nine years, there was an increase in slaughter precocity in male cattle certified in the Carne Pampa programme.

Keywords: Quality meat. Certification. Maturity. Young steer.

Resumo

O objetivo deste estudo foi analisar o comportamento da precocidade ao longo de nove anos de novilhos da raça Hereford e suas cruzas abatidas com dentição de leite até seis dentes. Foram analisadas aproximadamente 144 mil carcaças certificadas no programa Carne Pampa, entre os anos 2010 e 2018. Avaliou-se o incremento no peso de carcaça fria por ano em três épocas do ano: a estação quente foi definida de 26 de dezembro a 25 de maio, o vazio de outono foi definido entre 26 de maio a 25 de julho e a estação fria de 26 de julho a 25 de dezembro. Para avaliar o comportamento dos pesos de carcaça fria ao longo dos anos por estação, os dados foram submetidos à análise de regressão linear simples. Os pesos

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médios por estação foram comparados por teste de comparação de médias. A época que apresentou maior peso médio de carcaça foi a estação fria, com 239,1 kg, que mostrou um incremento anual de 6,45 kg. Analisando o comportamento do peso médio de carcaça por dentição na estação fria, animais com dentição de leite apresentaram maior incremento de peso ao longo dos anos, na estação quente, animais abatidos com dois dentes apresentaram maior incremento de peso, assim como na estação vazia de outono. A categoria que apresentou menor incremento de peso nas três estações foram os animais abatidos com seis dentes. Concluiu-se que, ao longo dos nove anos, houve aumento na precocidade de abate em bovinos machos certificados no programa Carne Pampa.

Palavras-chave: Carne de qualidade. Certificação. Maturidade. Novilho jovem.

Introduction

The constant increase in world demand for meat in recent decades has challenged production systems to increase their economic indicators, maintaining the sustainability of their means of production and the quality of the final product. Among the demands of this expanding market, product quality becomes even more important, showing that it is also a niche market for adding value and improving economic results throughout the production chain.

According to the 2016 Agricultural Census, the Brazilian cattle herd has 172.7 million animals, 35.4% of which are in the Midwest region of the country. With a smaller herd, the South of the country has approximately 23.5 million head, with 48.6% of this herd in Rio Grande do Sul (RS)⁽¹⁾.

Although less significant in terms of quantity, RS plays an important role in the supply of quality meat. In 2017, there were around 7.8 million cattle raised for beef in the state⁽²⁾, predominantly breeds of European origin, which are preferred in gourmet markets. Research shows that 64.8% of the Gaucho herd comprises animals defined as from a European breed or crossbred. Among the breeds used, Aberdeen Angus and Hereford predominate, making up the largest portion (30%) of the crosses between European breeds⁽³⁾.

Recognised for producing quality meat, in recent years the main destinations for meat from RS have been Santa Catarina (14,392 tons) and São Paulo (9,196 tons). In these markets, particularly in the capital, restaurants and specialised meat shops look for products originating in breeds and crosses with European animals, and in meat programmes of the principal British breeds⁽²⁾, especially Hereford and Aberdeen Angus, brands that are also found in other countries.

Being the oldest breed with links to branded meat on the Brazilian market, Hereford cattle are currently of great importance in crossbreeding, especially in production systems that aim at the precocious slaughter of males and the mating of heifers when they are close to fourteen months of age⁽⁴⁾. According to a report from the Ministry of

Agriculture, Livestock and Supply, in 2018 in Brazil, 152,936 cattle of both sexes were registered in the Hereford herd, with 145,644 animals in RS, the equivalent to 95% of the Brazilian herd of Hereford cattle⁽⁵⁾.

Precocity is inversely correlated with one of the characteristics most appreciated by consumers, the tenderness of the meat. This fact influences the slaughterhouse industry and cattle breed associations to encourage producers to terminate animals when young, with awards and bonuses to breeders who produce precocious animals⁽⁶⁾. Precocious slaughter, therefore, coupled with other productive factors and the increase in consumer demand for quality food, results in industries investing in certification and traceability programmes⁽⁷⁾. This ensures the producer more adequate remuneration for carcass quality, also guaranteeing transparency and credibility between the various links of the beef production chain⁽⁸⁾. As such, the aim of this study was to understand and analyse precocity behaviour over nine years in Hereford steers and their crosses, slaughtered with from zero to six teeth.

Material and methods

The work was carried out at the Federal University of Santa Maria, and used as an analysis tool slaughter data from 2010 to 2018 of a slaughterhouse under the Federal Inspection Service (SIF), located in the Central Region of Rio Grande do Sul.

Information was collected on 1.22 million cattle slaughtered over the nine years with from zero to six teeth, from different districts in the state of Rio Grande do Sul. Both sexes were represented, but only female or castrated male cattle were considered. Uncastrated males, or those showing the characteristics of late castration, are disqualified from the Carne Pampa programme, and were not included in the analysis.

After filtering the data, approximately 144 thousand castrated males and 52 thousand females, certified in the Carne Pampa programme, were obtained, totalling approximately 197 thousand evaluated carcasses. For this study, only the data of the 144 thousand males were evaluated. The racial pattern of the animals was classified by technicians in the pre-slaughter pens, where the phenotypic characteristics required to include the animals in the program were visually identified: such as the coat, characterised as red with the face, belly, end of the tail and lower parts of the limbs completely white, as described by Severo *et al.*⁽⁹⁾

After slaughter, the degree of finish of the carcasses was checked by verifying the distribution and amount of fat cover at different places on the carcass (thoracic, lumbar region and over the thigh), where: lean (1) = no fat; little fat (2) = 1 to 3 mm of subcutaneous fat; medium fat (3) = between 3 and 6 mm of subcutaneous fat; uniform fat (4) = over 6 and up to 10 mm thick; and excessive fat (5) = over 10 mm thick.

Carcasses of animals with a racial pattern, whether from a female or castrated male animal, with a finish equal to or greater than 3.0 mm, and with up to six teeth, were certified as carcasses included in the Carne Pampa programme.

Seeing the variations in animal category on offer throughout the year due to forage

availability and the handling of the various bovine categories, the researchers understood the need to divide the year into three periods. The periods were grouped into three seasons with dates defined according to a report by the Frigorífico Silva slaughterhouse, prepared in 2016, in which information was collected regarding the nutritional basis at termination of the animals slaughtered that year. The data showed that during the year under study, in approximately 5 thousand lots, the 143 thousand slaughtered animals came from different production systems, in this case, natural pasture, summer or winter cultivated pasture, and confinement.

According to the report, between 26 December and 25 May, the animals were predominantly finished on summer, natural or cultivated pasture. This period was therefore classified as the hot season. From 26 May to 25 July the animals came predominantly from confinement, with a small percentage from winter pasture at the start of the cycle, but these latter were animals that already had some deposition of fat accumulated during the hot season. This period was classified as the autumn void. From 26 July to 25 December, the animals came from finishing systems on cultivated winter pasture, with few animals from confinement lots, this period being classified as the cold season.

To assess the behaviour of the cold carcass weight of the steers over the nine years by season and by dentition, the data were submitted to simple linear regression analysis, with the cold carcass weight as dependent variable, and the year and dentition as regressor variables.

The mathematical model used was:

$$\hat{y} = b_0 + b_1 x_i$$

In the linear regression analysis, the years 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018 were replaced by the numbers 1, 2, 3, 4, 5, 6, 7, 8, and 9 respectively.

The analysis was carried out using the SAS University Edition statistical software.

Results and discussion

Figure 1 shows a variation in the percentage representation of steer dentitions over the years. The percentage of animals slaughtered with four teeth gradually decreased from 2011 to 2016 and then increased from 2017 to 2018.

From 2014 to 2018, the percentage of animals slaughtered with zero teeth was higher than that of animals with six teeth, which implies an increase in early slaughter over the last four years; in addition, from 2010 to 2018, the percentage of animals slaughtered with two teeth was greater than that of animals slaughtered with four and six teeth, indicating the slaughter of younger animals.

Although Figure 2, shows some fluctuation during the period under analysis, the increase in cold carcass weight from 2010 to 2018 is evident for all categories.

The mean cold carcass weight of animals slaughtered with zero and two teeth showed a gradual increase from 2010 to 2012, a period when the weight difference in these

categories was 28 kg and 16 kg respectively.

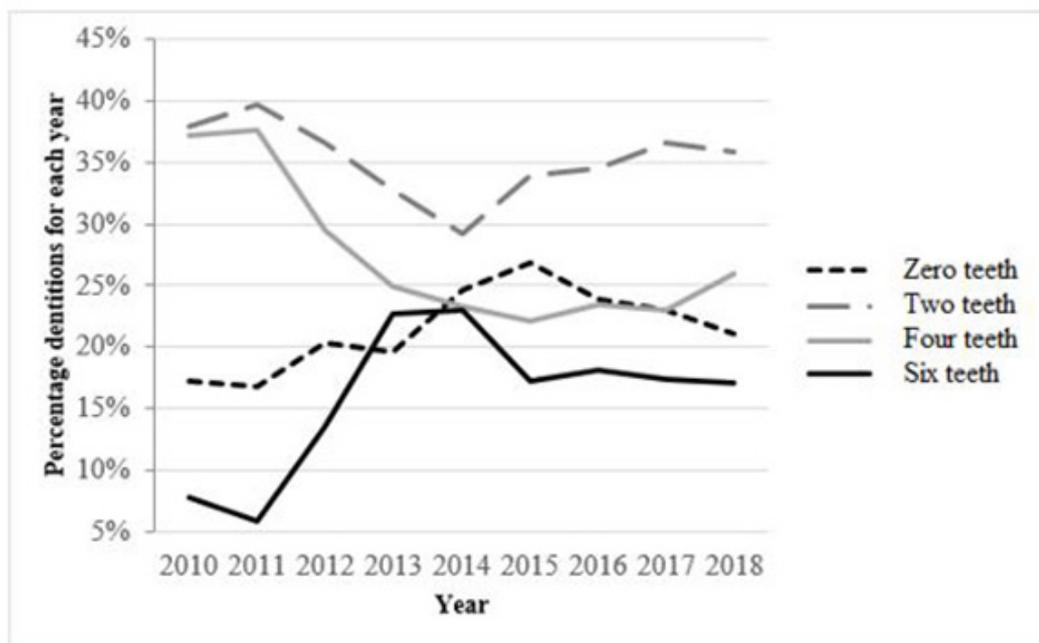


Figure 1. Percentage representation of the dentitions for each year.
Source: prepared by the authors.

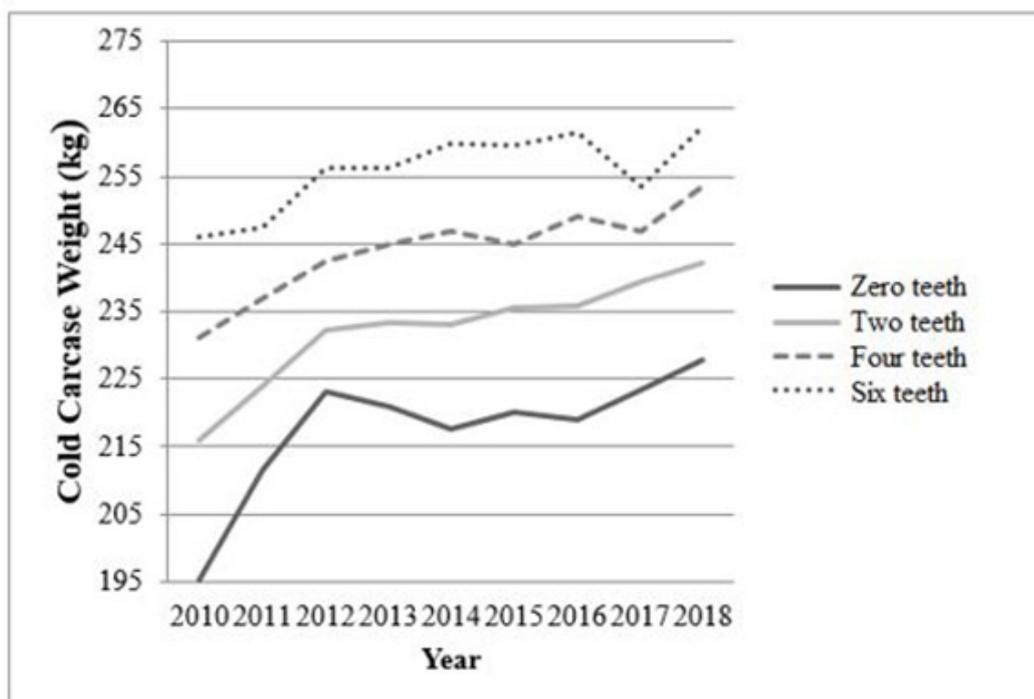


Figure 2. Evolution of mean cold carcass weight for each year.
Source: prepared by the authors.

Table 1 shows the mean value and increase in cold carcass weight of the steers, separated for production period. Steers finished during the autumn void show an annual increase of 4.76 kg in cold carcass weight ($P < 0.01$). During both the cold and hot seasons this increase is greater than 6.0 kg, with values of 6.45 and 6.38 kg respectively. These results show an improvement in the precocity of the slaughtered animals, a fact not reported in the domestic literature where there are few studies on precocity, most of the research being related to reproduction^(10, 11, 12).

Table 1. Mean cold carcass weight of the steers each year by season

Year	Autumn Void	Cold Season	Hot Season
2010	205.5	216.5	230.4
2011	228.3	229.7	225.7
2012	237.9	237.9	233.1
2013	237.9	239.5	238.3
2014	237.7	238.2	237.3
2015	237.4	234.9	238.2
2016	241.3	236.2	242.5
2017	233.3	240.6	238.5
2018	246.1	251.3	238.9
Mean	236.7	239.1	237.5
Standard deviation	30.2	31.7	31.1
Probability	$P < 0.01$	$P < 0.01$	$P < 0.01$
Equation*	$\hat{y} = 225.0 + 4.76x$	$\hat{y} = 222.7 + 6.45x$	$\hat{y} = 219.0 + 6.38x$

* \hat{y} =cold carcass weight and x =year

Source: prepared by the authors.

Figure 3 shows that the highest number of animals with zero teeth were slaughtered during the autumn void season, with the lowest percentage during the hot season, indicating a greater use of this category in more-intensive feeding systems, such as confinement, which is used mainly during the off-season between the hot and cold-season pastures. Terminating cattle during the hot season is the result of termination systems using native pasture, with or without the use of supplements.

Furthermore, Figure 3 makes it clear that, just as in the hot season, during the winter, the highest percentage of slaughtered animals had four teeth. This may indicate that cold-season pasture continued to be used in cattle that did not reach the desired finish in native summer pastures.

Regardless of the period under study, animals slaughtered with six teeth had the smallest percentage participation in the different seasons, demonstrating an attempt by producers to determine the precocity of the animals. This can be explained by the use of pastures grown during the hot and cold seasons, aiming at the termination of younger animals that might be included in quality meat programmes. Some authors report that in addition to the importance of slaughter age, cattle finished immediately

after weaning are more efficient during termination compared to those not fully grown after weaning⁽⁵⁾.

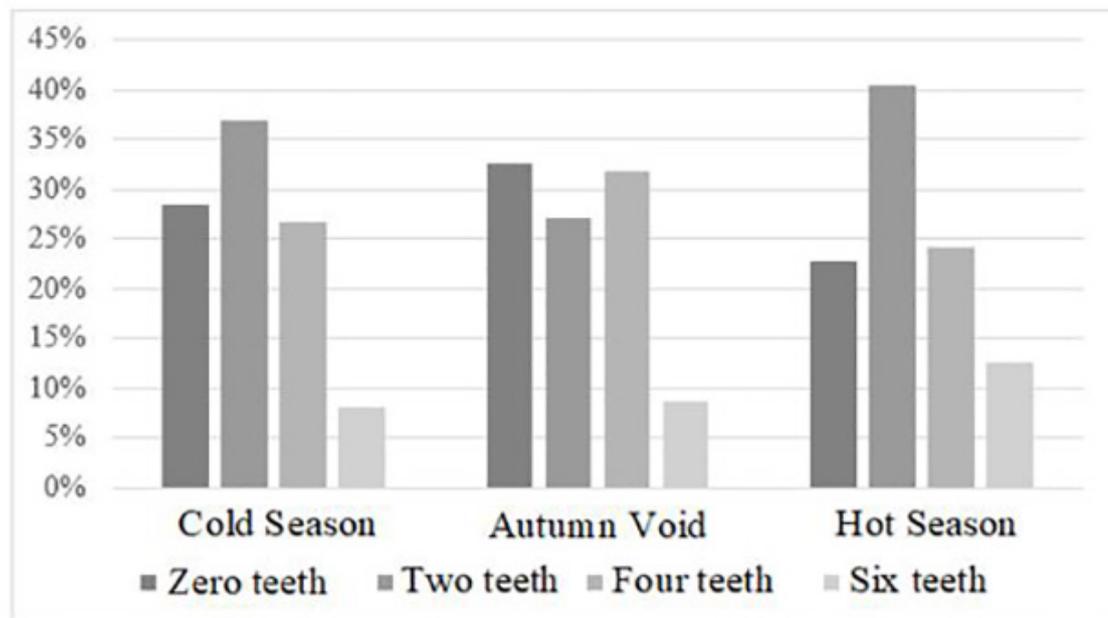


Figure 3. Percentage participation of the different dentitions in each season
Source: prepared by the authors.

Despite an increase in costs, producers select and finish animals that show the racial pattern, weight and age required by the regulations of the certification programme. This happens due to the carcass bonus offered by the industry for carcass certification^(5,8). Due to the speedy acceptance by consumers of certified meat in recent years, slaughterhouses have increased the bonuses to guarantee supply of the product⁽¹³⁾.

The important increase in the use of animals with zero and two teeth, may indicate a probable advance in the use of feeding technology which accelerates and intensifies the production process and reduces the slaughter age of the animals. Animals with six teeth are also influenced by the use of this technology, but at the time of writing, the slaughterhouses in this research no longer offered a bonus for animals with this dentition, providing certification for up to four teeth only.

According to Vaz *et al.*⁽¹⁴⁾, the evolution of the slaughter of young cattle is a result of the use of more-intensive production systems, with a growth in birth rate and weaning rate greater than 80%, contributing to increase the number of calves produced.

Based on the data in Table 2, it can be seen that younger animals slaughtered during the cold season showed a greater annual weight increase; steers slaughtered with zero, two and four teeth, showed an increase greater than 2.0 kg in cold carcass weight per year, while steers slaughtered with six teeth showed a lower weight increase during the cold season, of only 1.2 kg/year.

The greater increase in cold carcass weight per year seen during the cold season is due to animals from finishing systems that use pasture grown in winter. As such, Azevedo

Junior⁽¹⁵⁾ concluded that the use of winter pasture, together with supplementation, is an alternative that helps to increase the rate of growth of the animals and reduces the age of slaughter.

Table 2. Cold carcass weight in steers with different dentitions slaughtered during the cold season, over nine years

Year	Zero Teeth		Two Teeth		Four Teeth		Six Teeth	
	N	Weight	N	Weight	N	Weight	N	Weight
2010	617	195.9	951	211.1	924	231.4	153	212.8
2011	948	212.8	1,604	228.9	1,432	240.6	79	245.6
2012	1,321	223.3	1,950	232.9	1,665	244.3	1,049	255.5
2013	2,275	220.8	2,567	238.2	1,978	250.3	1,038	262.5
2014	2,394	220.7	2,789	234.7	2,035	248.7	1,240	262.2
2015	2,540	220.3	3,478	234.5	1,886	244.0	875	259.5
2016	3,101	219.4	4,113	233.8	2,423	248.8	1,220	262.1
2017	2,933	224.6	4,757	240.0	2,864	249.1	1,617	255.7
2018	2,452	235.0	4,831	246.6	3,685	258.4	2,323	266.8
Mean	2,065	221.9	3,004	236.6	2,099	248.5	1,066	260.8
Probability	P<0.01		P<0.01		P<0.01		P<0.01	
Standard deviation	26.8		28.3		30.3		33.1	
Equation*	$\hat{y}=207.45+2.43x$		$\hat{y}=221.76+2.42x$		$\hat{y}=235.9+2.12x$		$\hat{y}=252.9+1.21x$	

* \hat{y} =cold carcass weight and x =year

Source: prepared by the authors.

When observing the number of animals slaughtered per year for each dentition, it should be noted that during the cold season, the slaughter of younger animals, such as steers with two teeth, predominates and represents 36.5% of the total slaughtered over the nine years. Animals with six teeth made up 12.2% of the total number of slaughtered Hereford animals.

Table 3 shows that steers finished with zero teeth during the hot season presented an annual increase in cold carcass weight of 1.87 kg ($P<0.01$), and animals slaughtered with two teeth had an increase of 2.12 kg ($P<0.01$). The annual increase in cold carcass weight of animals slaughtered with four and six teeth was lower, 1.79 kg and 0.60 kg respectively. There is an increase in slaughter precocity due to the greater increase in cold carcass weight found in the categories of animals slaughtered with zero and two teeth.

Therefore, with the increase in precocity, the offer of quality meat in the slaughterhouse industry is greater, since Kuss *et al.*⁽¹⁶⁾, researching the slaughter of castrated and non-castrated males slaughtered at 16 and 26 months, found that in the super-young category (16 months) the characteristics of tenderness, juiciness and palatability were similar between the castrated and non-castrated animals, whereas in the young category (26 months), the meat of the non-castrated animals was less tender compared

to that of the castrated animals. These results show that reducing the age of slaughter affords higher quality meat.

Table 3. Cold carcass weight in steers slaughtered during the hot season, over nine years

Year	Zero Teeth		Two Teeth		Four Teeth		Six Teeth	
	N	Mean	N	Mean	N	Mean	N	Mean
2010	52	216.2	839	224.1	573	234.9	149	253.0
2011	314	207.8	1,676	218.7	1,149	232.3	425	248.0
2012	519	214.3	2,231	231.2	1,392	239.1	166	263.0
2013	574	219.3	3,101	229.8	1,824	239.6	2,253	253.6
2014	997	202.3	1,710	229.9	1,158	246.5	1,719	258.9
2015	1,489	215.9	2,009	236.6	1,196	245.9	1,255	259.6
2016	1,111	213.0	2,630	238.1	1,546	249.7	1,657	262.3
2017	1,808	220.0	3,020	239.9	1,442	245.9	1,318	252.3
2018	2,761	221.5	5,297	238.1	2,529	246.3	1,810	257.7
Mean	1,069	214.5	2,501	231.8	1,423	242.2	1,194	256.5
Probability	P<0.01		P<0.01		P<0.01		P<0.01	
Standard deviation	25.3		28.1		29.2		30.9	
Equation*	$\hat{y} = 203.64 + 1.87x$		$\hat{y} = 221.14 + 2.12x$		$\hat{y} = 233.34 + 1.79x$		$\hat{y} = 253.31 + 0.60x$	

* \hat{y} =cold carcass weight and x =year

Source: prepared by the authors.

Table 4 shows that during the autumn void season, over the nine years there are more steers slaughtered with zero teeth, and the lowest number of animals slaughtered with six teeth, with an average of 223 head per year. The zero-tooth classification reached an average of 562 animals per year.

In relation to weight increase over the nine years, animals with six teeth had the lowest annual increase, with 0.94 kg, while the category of animals with two teeth showed the greatest weight increase during the autumn void, where carcass weight went up by 2.63 kg per year. Steers with two teeth show better performance during confinement compared to younger animals⁽¹⁷⁾, which explains the increase, as this is the most-employed category in the intensive finishing systems characteristic of this season, with the result that producers seek to improve these nutritional systems, each year prioritising an improvement in efficiency and, consequently, carcass weight.

In general, there has been an improvement in genetic quality or breeding and fattening technology, which has increased the cold carcass weight of Hereford animals and their crosses, regardless of the finishing system used during the fattening phase, characterised in this study by the seasons. In addition, new studies that investigate the evolution of slaughter precocity in animals from different breeds are important

to identify the direction of livestock farming in different regions of the country, and improvements in the rearing and finishing technology of animals destined for quality meat programmes. Market data show that in other countries, adding value to certified meat cuts often means the viability of beef production chains.

Table 4. Cold carcass weight in steers slaughtered during the autumn void, over nine years

Year	Zero Teeth		Two Teeth		Four Teeth		Six Teeth	
	N	Mean	N	Mean	N	Mean	N	Mean
2010	255	188.8	189	202.9	234	220.2	41	235.0
2011	265	211.2	359	227.1	573	236.1	34	240.1
2012	512	231.4	273	237.3	347	246.1	47	250.3
2013	350	225.1	272	229.1	412	244.5	233	255.7
2014	760	227.9	412	235.8	641	241.7	313	255.5
2015	799	227.8	374	238.5	358	247.5	169	259.1
2016	484	228.8	341	241.4	408	247.9	289	252.6
2017	827	227.2	475	231.8	533	236.7	296	246.6
2018	810	227.9	598	243.9	987	254.4	584	258.9
Mean	562	225.2	366	234.3	499	243.7	223	254.3
Probability	P<0.01		P<0.01		P<0.01		P<0.01	
Standard deviation	26.8		29.5		30.9		29.5	
Equation*	$\hat{y} = 212.56 + 2.16x$		$\hat{y} = 219.40 + 2.63x$		$\hat{y} = 231.20 + 2.20x$		$\hat{y} = 258.01 + 0.94x$	

* \hat{y} =cold carcass weight and x =year

Source: prepared by the authors.

Conclusions

From 2010 to 2018, there was an evolution in slaughter precocity and an increase in the cold carcass weight of Hereford steers.

The greatest increase in cold carcass weight occurred during the cold season. In this season, zero-tooth steers showed the greatest increase.

Steers with two teeth showed a greater increase in cold carcass weight during the hot and autumn void seasons each year.

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