Hamburgers from Holstein Fresian cull cow finishing with different silages (corn *vs.* "pastone")

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Abstract-Meat quality of hamburger patty from Holstein-Friesian cull cows feeding with two different finishing feeding (commercial concentrate *vs.* "pastone" silage) was investigated. Meat quality traits studied were chemical composition, colour parameters, water holding capacity and texture profile analysis. Feeding finishing treatment affected intramuscular fat content, moisture percentage, water holding capacity, and textural parameters. The results show that a feeding finishing based on "pastone" silage was more effective, due to the increase in intramuscular fat and improved overall textural parameters.

Key word: **Cull dairy cows; Finishing feeding, Textural profile analysis, Hamburger patty**

I. INTRODUCTION

The finishing of cull cows in the dairy herds can be an important activity to raise the profits of a cattle farm. The productive life of these cows is about five years. Then over 50% are culled for various reasons, none of which prevent them from being used for butchering. Finishing these animals increases their weight and improves their condition score and fatty state (Cranwell, Unruh, Brethour, & Simms, 1996), with a subsequent rise in price. The economic interest of finishing cull cows has been studied primarily in beef breeds (Cranwell et al., 1996; Sawyer, Mathis, & Davis, 2004). In Galicia (NW of Spain), there is a census of around 500,000 dairy cows (AEG, 2003), that mainly belong to the Holstein-Fresian breed. Therefore, we can estimate that about 50,000 cull cows from dairy and suckler herds are eligible to enter the beef supply chain. These animals can not be finished off pasture during spring and summer due to a low body condition score. For this reason, the prolongation of finishing should be considered using conserved forages and concentrates.

Product quality attributes is a wider term comprising of physicochemical, microbiological and sensory characteristics of a product. The colour and odour of meat are the most important quality attributes for the consumers by which meat quality is readily assessed (Mancini, & Hunt, 2005). Consumers expect a uniform appearance within a group of similar ground beef product (burger and patties with the same fat percentage). Texture is the most important factor deciding overall acceptance of patty products (Saricoban, Yilmaz, & Karakaya, 2009) For this reason the companies manufacturing hamburger patties for the fast food sector have to pay considerable attention to this attributes, avoiding process that negatively affects the colour and texture of fresh ground beef can lead to lower consumer appeal and marketability.

Therefore, the aim of this study was to investigate how the type of feeding finishing in Holstein-Friesian culls cows affects to the meat quality of hamburgers.

II. MATERIALS AND METHODS

II.1. Animals and hamburger elaboration

Fourteen cows of the Holstein-Friesian breed, culled for age and different reproductive reasons, from the experimental herd of Agricultural Research Centre of Mabegondo, were used for this study. Animals were not finished indoors; they were finished in an area without pasture during three months. One group was finishing with commercial concentrate and corn silage while the second group was

finishing with “pastone” silage (composed only by corncob). Immediately after slaughter, carcasses were weighed and chilled at 4°C in a cold chamber for 24 h.

Hamburgers of 100 g (n=14 per feeding group) were manufactured using the primal cut of neck. Meat was ground using a 6 mm plate in a refrigerator grinder machine (La Minerva, Bologna, Italy). The meat was missed and compressed by hand; a 12.5 g of NaCl per kg of meat was added and then maintained under refrigeration for 20 hours. The hamburgers were produced in moulds with a diameter of 10 cm and a height of 1 cm in a burger-maker (Gaser, A-2000, Girona, Spain).

II.2. Analytical methods

In all burger patties, pH, colour, proximate composition, cooking losses and texture profile analyses were determined. The pH was measured using a pH-meter equipped with a glass probe for penetration. A portable colorimeter (Minolta CR-400) was used to measure meat colour in the CIELAB space (Lightness, L*; redness, a*; yellowness, b*, CIE, 1978). Samples were allowed to bloom for 1 h before measuring directly in contact with air (Insausti et al., 1999). All measurements were made in triplicate.

Moisture, fat and protein (Kjeldahl N x 6.25) were quantified according to the ISO recommended standards 1442:1997 (ISO, 1997), 1443:1973 (ISO, 1973) and 937:1978 (ISO, 1978), respectively. Collagen content was expressed as a concentration of hydroxyl-proline, multiplying the content of hydroxyl-proline by 8 constant. The determination of the hydroxyl-proline was carried out in duplicate according to AOAC (2000).

Hamburgers were cooked placing vacuum package bags in a water bath with automatic temperature control (JPSelecta Model Tectron Bio) until reached internal temperature of 70 ºC, controlled by thermocouples type K (Comark, PK23M, UK), connected to a data logger (Comark Dilligence EVG, N3014, UK). After cooking, hamburgers were cooled at room temperature, during a period of 45 minutes and percentage cooking loss was calculated by measuring the difference in weight between the cooked and raw samples. Hamburger were cut into seven pieces of 1 x 1 cm and compressed at a crosshead speed of 3.33 mm/s. TPA test was realized according methodology proposed by Bourne (1978) in a texture analyser (Stable Micro Systems TA-XT2, UK). Textural parameters were measured by compressing to 80 % with a compression probe of 19.85 cm^2 of surface contact. Between the first and second compression, the probe waited for 2 seconds. Hardness cohesiveness, springiness, gumminess and chewiness were obtained.

II.3. Statistical analysis

For the statistical analysis of the results, data were analyzed using the SPSS (version 15.0, USA). One-way analysis of variance (ANOVA) was used to analyze the effect of finishing feeding type on hamburger quality traits. Correlations between variables ($P<0.05$) were determined by correlation analysis using the Pearson´s linear correlation coefficient (SPSS 15.0).

III. RESULTS AND DISCUSSION

Table 1 presents the results of meat quality characteristics (chemical composition, colour parameters, WHC and hardness, springiness, chewiness, gumminess and cohesiveness of hamburgers from culled cows with different feeding finishing concentrate and corn silage vs. “pastone” silage.

There were no significant differences in pH. Average values for pH measured in the hamburger varied between 5.78 and 5.85. Regarding, the parameters of chemical composition studied, the percentage of protein and collagen was not affected ($P>0.05$) by feeding treatment. On the contrary, significant variations ($P<0.01$) between feeding treatments in the water and intramuscular fat (IMF) content were found. IMF mean values (8.5%) were lesser than to that showed in beef hamburgers manufactured without any fat source than IMF (García, Calvo, & Selgas, 2009). The percentage of IMF was increased by the feeding finishing treatment, therefore the hamburger from cows feeding with “pastone” had 18.6 %

more IMF than those feeding with corn silage. Feeding rations between groups were isoenergetic, so differences on IMF content might be due to different net energy assimilation on cow groups, produced by the different size particle of the silages.

Table 1. *Meat quality characteristics (pH, chemical composition, colour parameters, water holding capacity and textural profile analysis of hamburgers from culled cows with different feeding finishing (concentrate and corn silage vs. "pastone" silage*

	Corn silage	Pastone	SEM	Sig
pH	5.85±0.17	5.78±0.10	0.03	n.s.
Chemical Composition (%)				
Water	67.10±1.57	65.79±1.02	0.28	*
Intramuscular Fat	7.62±2.05	9.37±1.38	0.37	*
Protein	18.75±0.95	18.26±0.35	0.14	n.s.
Collagen	1.73±0.20	1.74±0.18	0.03	n.s.
Water-holding capacity (%)				
Cooking Losses (%)	18.40±5.13	14.89±6.13	1.11	n.s.
Colour parameters				
Luminosity (L*)	32.46±1.63	33.88±2.46	0.41	n.s.
Index of red (a*)	27.55±2.72	27.62±2.88	0.53	n.s.
Index of yellow (b*)	5.52±1.25	6.22±1.30	0.25	n.s.
Textural properties-TPA test				
Hardness (kg/cm^2)	4.72±1.56	3.23±1.05	0.29	**
Springiness	0.63±0.06	0.61±0.08	0.01	n.s.
Chewiness (kg)	1.63±0.60	1.05±0.41	0.11	**
Gumminess (kg/cm^2)	2.52±0.84	1.66±0.54	0.16	**
Cohesiveness	0.53±0.02	0.51±0.03	0.01	*

Significance: ** ($p<0.01$), * ($p<0.05$), n.s (not significant)

On the other hand, water content decreased in hamburgers with higher IMF content, this result was expected since it is accepted that the increase in IMF content in the meat means a decrease in water content (Varela, 2002, Franco, Bispo, González, Vázquez, & Moreno, 2009). In this study, the correlation between moisture content and IMF ($r= -0.886$) was highly significant ($P<0.001$).

The chromatic characteristics of the hamburger (L*, a* and b*) was not significant affected ($P>0.05$) by feeding finishing treatment. However, in general hamburger from cows with higher IMF content provided a meat with higher luminosity and yellowness. Luminosity of these hamburgers fall in the same range that noted by Garcia et al. (2009).

Water holding capacity, measured by cooking loss was larger in hamburgers with higher content in moisture. There is an inverse relationship between moisture content and CL, and this result has been widely reported in beef steaks (Jeremiah, Dugan, Aalhus, & Gibson, 2003).

The hardness of the hamburgers showed significant differences ($P<0.01$) between feeding treatments. Chewiness, gumminess and cohesiveness, also showed significant differences ($P<0.01$) between "corn silage "hamburgers and "pastone" hamburgers. These values were in the same range to that showed in beef hamburgers (Garcia et al., 2009). Hamburgers with higher IMF content had lower values in all texture traits (Table 1) which is probably related to the higher percentage of fat. It has been established, that IMF provides a higher degree of tenderness to the muscle, so hardness, chewiness, and gumminess was slightly negative correlated with IMF content ($r=-0.41$, $r=-0.42$, $r=-0.38$, $P<0.05$, respectively).

IV. CONCLUSIONS

Increase the fatness level and marbling score is one of the main objectives of finishing in culled cows, hence the finishing with "pastone" silage can be advantageous, because intramuscular fat content increase. In addition, hamburger from this fed-group showed better overall good tenderness and provided a meat with higher luminosity and yellowness although there were no significant differences between the feeding treatments.

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