PHYSICAL PARAMETER TRENDS OF CULL COW MEAT ACCORDING TO AGE, FINISHING AND ELECTROSTIMULATION

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SUMMARY

The aim of the trial was to find some equations that fit the trend of physical parameters of cull cow meat during first week after hot carcass dissection.
The trial was carried out on 120 Friesian cows, which were located in 4 groups, fed on different finishing diets, and also a control group. After slaughtering, 50% of the caws were electrically stimulated (ES) and all the left sides were immediately dissected. At different times 4 muscles were tested for pH, water losses, colour and hardness on raw meat. The ES carcass muscles showed a more rapid pH drop, particularly the LD. Significant differences for the water losses and hardness curves among finishing diets were found, while the ES treatment had limited effects.

Introduction

Each year, in Europe, a great number of cows are slaughtered due to sterility, low production and as a consequence of the European Economic Commission resolution on the milk quota system. Therefore, it would be interesting to investigate the possibility to improving meat characteristics by acting both before and after slaughter. In a 5 year programme that was performed on cull cows, some factors were studied that can contribute to this goal. Like the finishing technique, and the electrical stimulation linked with hot boning dissection of carcasses, to prevent the meat deterioration during aging (cold shortening), as reported by some authors which were reviewed by Dutson et al. (1980), in our previous works (Borghese et al., 1990; Romita et al., 1987) and recently in Van Laack and Smulders (1990), Kastner et al. (1993).

The aim of this study was to evaluate the physical parameter trends of cull cow meat during the first week after hot carcass dissection and to estimate the effects of several finishing tecniques, of electrical stimulation and of animal age on quality meat.

Materials and methods

The trial was carried out on 120 Friesian cull cows both under and over 5 years old, located in 5 groups: C (control group), slaughtered without a finishing period and the other groups (A, B, D, E) fed with several finishing diets, as reported in tab. 1. Half of the cows were electrically stimulated (ES) with low voltage (20V - 50Hz) using Mitab apparatus, while the others were not stimulated (NES). The left sides were hot dissected, and on 4 muscles (semitendinosus (St), gluteobiceps (Gb), semimembranosus (Sm) and longissimus dorsi (LD)) the pH at 1, 2, 3, 4, 5, 6, 8, 10, 12, 24, 48 hours and 7 days after dissection, was determined. The water losses (for dripping WHC), the hardness (using Instron 1140 with the Warner Bratzler Shear dispositive WBS) and only on LD the colour (lightness (L), chroma (C) and hue (H) with C illuminant, cloudy daylight with 6770°K) at 2, 24, 48, 96 hours and 7 days, were determined.

The qualitative parameter trends were studied to find some equations that fit well the experimental data and to estimate the equation coefficient variations which were due to the finishing diets, the electrical stimulation, the age and the different muscles of the animals. Logarithmic functions to estimate the trends of ph, water losses ($Y = a + bx * \lg(cx)$), and exponential functions for hardness ($Y = a + xb * \exp(-cx)$), lightness, croma and hue ($Y=a+b(1-\exp(-cx))$) were used. After the minimum coordinates for water losses and pH, the maximum coordinates for hardness and asimptotic value for colour were calculated. The variance analysis of coefficients

(a, b, c) was made using two polifactorial models with the first order interactions: one used to estimate the colour coefficient variations without muscle effect, the other to estimate the pH, WHC and WBS coefficient variations, considering muscle effect. For every statistical analysis, SAS procedures (NLIN and GLM), were used.

Results and discussion

The equations employed to evaluate qualitative parameters fit well the experimental data. The LD muscle showed little differences in colour (L, C, H) trend during the first week after slaughtering. The lightness (tab. 2) showed significant differences for intercept (a) due to the finishing treatments; D and E groups (fed on high energetic diets), showed higher values (+8%) in comparison with the other groups, but "b" had an opposite trend from "a", obtaining similar asimptotic values (a+b) in all groups (38.7), therefore the C, the A and the B groups had the highest speeds, while in our previous works the finishing tecniques did not bring out any effect (Borghese et al., 1990; Romita et al., 1987). The chroma showed similar significant differences for "a" in comparison with "L", but had different asimptotic values, particularly between B and D groups (both finished for 8 weeks) (37.77 vs 40.07). The hue showed significantly different trend only between C and D groups (-9% for "a" and +6% for "b" coefficients). The multiplicative coefficients of time "c" were not modified by the diets. The electrical stimulation produced limited effects on "L", "C" and "H", generally higher values were found in all colour parameters in ES group in comparison with the NES group as reported by Moore and Young (1991) on lambs and Van Laack and Smulders (1990) on cows over 5 years old. They noticed a decrease of colour stability in ES animals.

The pH trend (tab. 3) was modified by the finishing treatment, the control and A groups (fed on low energetic diets) showed a rapid pH drop with significant differences for "a", "b" and "c" coefficients as compared to the other groups (6.11, 0.0264, 0.011 vs 5.76, 0.0031, 0.0047), with the minimum value (pH = 5.23) at about 33 hours after dissection for C and A, and at 78 hours for B, D and E groups. The ES group showed a rapid drop, with different minimum times than NES (44 vs 60 hours after dissection). Similar trends were found by Jeremiah et al. (1985), Kastner et al. (1993). The pH trend was affected also by the age of animals. LD muscle showed lower coefficient values in comparison with others (-3% for "a" -92% for "b" and -52% for "c") as reported by Jeremiah et al., (1985). The WHC showed similar pH trends with higher differences between the control and the other groups (+30%, +52%, +18% respectively for "a", "b" and "c"). The influence of pH on WHC was well known, in fact with falling pH, due to change in protein charges, the distance between fibrils and filaments lessen and WHC is reduced.

The ES treatment and the age of the animals did not show significant differences in trend. While in muscles the ST had the maximum intercept (a) and "b" value followed by SM and lastly by GB and LD according to the characteristics of the muscles. While "c",that produces the minimum time value (1/c*e), is higher in LD and lower in GB (with 54 vs 84 h). The WBS trend (tab 4) changed with different finishing diets. The importance of the fattening degree on meat tenderness was pointed out by Lochner et al. (1989) in fact the same WBS value (2.21 Kg/cm2 maximum point) was obtained at different times (12 hours for E, 5 for B and 6 for the other groups): ES group had few inportant differences, showing a higher "a" value +6.5% and a lower "b" value -16% in comparison with the NES group. The tenderness due to ES was evident only in cooked meat (Romita et al., 1987 and Jeremiah et al., 1985). The higest WBS value on the time was found in ST muscle (3.23 vs 1.84 Kg/cm2 for the intercept) in comparison with the others muscles. The LD on the contrary had the lowest "a".

Conclusions

In this study we have again noticed the good quality characteristics of the meat due to electrical stimulation and finishing tecnique.

Furthemore, the use of mathematic equations has allowed us to find some differences not evident in our previous works. Further equation improvements could bring out some specific trends.

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