EARLY DETECTION OF ULTIMATE pH IN LONGISSIMUS DORSI (L.D.) OF BEFF CARCASSES : COMPARISON OF THREE METHODS

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SUMMARY

The possibilities of three methods to predict the ultimate pH in LD of beef carcasses on the slaughterline were compared.

After having tested very precisely the experimental conditions of the three methods, the first part of this experiment consisted in determining their accuracy.
In a second part, the relationship between the pH values obtained with the method and the ultimate pH of 100 carcasses were studied.

The three methods obtained correct repeatabilities (s1 = 0.057, s2 = 0.086, s3 = 0.094 (when pH was measured 10 minutes after the begining of the operations). The method 1 appeared as accurate as the classical measure of pH 48 h.p.m. (s = 0.055). Experimental values were closely related to ultimate pH (r2 = 0.85 ; 0.88 ; and 0.95 respectively).

It was concluded that the three methods were technicaly able to predict ultimate pH. The pH value was disponible as the scale with 2 methods. The third one was longer to realise so that the pH could be measured only 40 or 45 minutes after the begining of the treatment.

INTRODUCTION

Even if number of DFD carcasses has decreased in the last recent years, this problem continues to be of great importance for industrials. Nowadays, DFD carcasses are selected by measuring ultimate pH in the L.D. 24 to 48 hours after slaughter.

In same slaughterhouses, low volage electrical stimulation of the whole carcass is practised. This technic accelerates the anset of rigor mortis, so pH may be measured 6 to 10 hours after slaughter. Nevertheless, detection of a DFD carcass on the slaughterline, prior to entry in the chilling room, would present many advantages : quality grading, most reasonable utilisation of beef carcasses.

Recently, Braathen (1990) has proposed a local electrical stimulation in the lain in order to accelerate rigor mortis process within the localy stimulated area. Hald (1993) has shown that, with this concept, 80% of carcasses could be segregated as normal (pH < 5.8) by pH measuring on the slaughterline.

Three laboratory methods were known in the litterature to accelerate decrease of pH in meat after slaughter. The aim of this experiment was to compare their possibilities to detect, in an industrial concept, DFD carcasses as the last operation of the slaughterline : the scale.

MATERIALS AND METHODS

Preliminary work to determine experimental conditions of the methods

The three methods needed to take a sample of pre-rigor muscle (1 to 3 g) and consisted in :

- additionning solution of Ca 2x and Mg 2x ions with strong homogeneisation : method 1.
- additionning surfactant triton X-100 with strong homogeneisation : method 2.
- liquid nitrogen freezing and thawing : method 3.

More details are given by Vada-Kovacs (1981, 1985) and Davey and al. (1980). In order to precise them, same additionnal factors were studied :
- 2 post mortem times when methods started were compared [30 mn p.m. / 50 mn p.m. for methods 1 and 2 ; 30 mn p.m. / 1 h p.m. for method 3],
- for methods 1 and 2, two conditions of temperature were applied ($15 < T < 20°C$ and $T = 37°C$), and pH decreased registrated by measurements at 4, 8, 12, 16 and 20 mn after additionning solution.
- for method 3, freezing times (5 mn / 15 mn / 24 hr) and thawing times (10 mn / 20 mn / 1 hr) were studied.

The results of this preliminary work were :

For the three methods : 1) no incidence of the post mortem time when methods started
For the methods 1 and 2 : 1) an effect of temperature. pH decreased faster when treatments were applied at 37°C. 2) A stable pH value reached about 10 mn after additionning the solution.
For method 3 : 1) no incidence of freezing time. 2) A 30 mn minimal thawing time to obtain a stable pH value.

According to these results, experimental conditions used in the course of experiment are described figure 1.

Accuracy of the methods :

10 animals were used. For each of them, two slices of 100 cm^2 and 2 cm thick were taken from L.D. at first lumbar. From one slice, the 3 methods were repeated 20 times. The other one was stored for 48 hours at 0-2°C and pH measured at 20 adjoining sites.

Relationship between experimental pH values and ultimate pH

100 carcasses were used. In order to have enough DFD carcasses, 40% were chosen among stressed animals. For each of them, the 3 methods were applied and ultimate pH was measured 48 h.p.m. in L.D. at first lumbar.

Measurements were carried out twice, and the mean was calculated.

RESULTS

Accuracy of the methods

Factors affecting accuracy include 1) efficiency of the method, 2) accuracy of pH measurement equipment and 3) variation of pH within the muscle.

With a classical measure of ultimate pH 48 h.p.m., just the 2 last factors occured.

The three methods obtained correct results. Standard deviations of repeated measurements were respectively s1 = 0.057, s2 = 0.086 and s3 = 0.094. The method 1 appeared as accurate as classical measure of pH 48 h.p.m., whose standard deviation was 0.055.

Relationship between experimental pH and ultimate pH values

Ultimate pH values distribution is presented figure 2. 29% of carcasses were DFD (pH ≥ 5.8).

Experimental pH values were closely related to ultimate pH over the extreme range of ultimate pH (5.4 - 7.2). As shown figure 3, the best prediction was obtained with parabolic models : r2 = 0.85 ; 0.88 and 0.95 respectively. A linear relationship could be accepted too. In such a case, r2 obtained were 0.81 ; 0.84 and 0.89 respectively.

The parts of well classified carcasses were 93, 97 and 99% for methods 1, 2 and 3 respectively, among the wrong classified carcasses presented table 1. Two cases had to be separated :
- normal carcasses wrongly classified DFD. This case concerned only 2 carcasses with method 1.
- DFD carcasses wrongly classified normal. With method 1, 5 carcasses were concerned.

It could be explained by an additional pH reduction occured in the presence of Ca2+ due to its interaction with protein (Vado-Kovacs, 1985).
With methods 2 and 3, 3 and 1 carcasses were concerned. In these cases, it could be due to pH variation within muscle.

CONCLUSION

The three methods were technically able to predict ultimate pH.
With methods 1 and 2, 93 and 97% of carcasses could be well classified (normal or DFD) as the last operation of the slaughterline : the scale.
The third one appeared more performent (99% of carcasses were well classified) but it was longer to realise so that the pH could be measured only 40 to 45 minutes after the beginning of the treatment, when carcasses were in chilling room.

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