EFFECT OF FRESH PORK QUALITY ON THE PRODUCTION OF POLYPHOSPHATE-FREE COOKED HAM

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SUMMARY

The aim of the present work has been to evaluate the possibility of using electrical conductivity measurements in fresh pork hams upon arrival at a meat plant as an early quality screening in order to improve the production of high-quality cooked ham labeled 'Meesterlyck'. Hams were selected according to their conductivity value measured in the semimembranosus muscle (sm) with a Tecpro Pork Quality Meter (QM). Hams with a QMsm value < 9.0 were assigned to a low-QM ('high-quality') group (n=47), whilst hams with a QMsm value > 13.0 made up the high-QM ('low-quality') group (n=46). After selection of the hams, conductivity was also measured in the gluteus muscle and pH and internal light scattering (FOP) in the semimembranosus and gluteus muscle. Hams were then individually marked, deboned, injected with a polyphosphate-free curing solution, tumbled and cooked according to the normal plant procedure.

After overnight cooling at room temperature, cooking losses were determined by weighing the cooked hams with and without jelly. Half of the hams were sliced and evaluated by a panel of three staff members for the presence/absence of a hole on the cut surfaces. Sliced hams were also given an overall panel score involving an appreciation of colour, texture and general appearance. Finally, instrumental colour parameters, shear force value and dry matter content were determined on samples of the hams.

Significant differences were found between the high-QM and the low-QM group for all parameters measured on the fresh legs in both the semimembranosus and the gluteus muscle. Mean pH and FOP values were higher and lower respectively in the low-QM group compared to the high-QM group. Mean cooking losses were also significantly lower in the low-QM group. In the high-QM group, 66% of the cooked hams had a hole in the middle of the cut surfaces, whilst only 13% of the cooked hams in the low-QM group showed this quality defect. Mean panel score did also significantly differ between the two groups. On the other hand, no significant differences were found for colour co-ordinates, shear force and dry matter content.

Although more research is needed on the relationship between conductivity values of fresh hams and quality parameters of cooked end-products, these limited data suggest that differentiating hams upon arrival at a processing plant according to electrical conductivity measurements might be useful in order to reduce the frequency of quality defects in the manufacture of polyphosphate-free cooked ham.

Introduction

Polyphosphate-free cooked ham is gaining an increasing popularity among consumers. Since mai 1992 a quality label of ham ('Meesterlyck') has been installed in Belgium, guaranteeing among other things that no phosphates or polyphosphates are added during manufacturing. The consumption of this labeled ham has seen an increase from 80 to almost 250 tonnes per month over the period may 1992 - october 1993 (Anonymous, 1993). Polyphosphates are normally added to brine solutions in order to increase the water holding capacity of the meat. Hence, they are able to mask partly certain fresh meat quality defects like poor water holding capacity of PSE meat. In the manufacture of polyphosphate-free cooked ham the initial quality of the raw material will thus become more important. Monitoring the meat quality of the hams upon arrival at the processing plant will then receive more attention, especially in Belgium where the proportion of PSE carcasses is still very high (De Smet et al., 1994). An early prediction of meat quality defects will provide the industry with a powerful tool for a better allocation of raw material among different production lines.

Quality control of the raw hams upon arrival at the processing plant nowadays mainly consists of a measurement of pH and a rapid visual jugdment of the colour, in addition to first constraints of optimal weight and fat grade of the ham. Although meat with low ultimate pH is clearly unwanted for cooked ham manufacture (Cariou et al., 1988), the use of PSE meat may be as detrimental (Honkavaara, 1988). Since ultimate pH readings are unable to differentiate between normal and PSE meat, other instrumental measurements such as internal light scattering and conductivity offer perhaps more opportunities (Eikelenboom and Nanni Costa, 1988; Warriss et al., 1991). In addition, these instruments may be easier to operate compared to a pH meter. Therefore, we conducted a trial in order to evaluate the use of conductivity measurements in hams upon arrival in a meat processing plant. Two groups of different quality were selected and processed to polyphosphate-free cooked ham. The final product was then evaluated. A specific problem in this plant was the appearance of large holes in the center of the final product at the connection of the main muscles, rendering the cooked ham slices unattractive.

Materials and methods

On three runs a total of 93 fresh pork hind legs were selected upon arrival at a meat processing plant according to the conductivity value measured in the semimembranosus muscle (sm) with a Tecpro Pork Quality Meter (QM). Legs with a QMsm value < 9.0 were assigned to the 'high-quality' (low-QM) group (n=47), whilst legs with a QMsm value > 13.0 made up the 'low-quality' (high-QM) group (n=46). These lower and upper QM limits approximately corresponded to the 20 and 80 percentile of the frequency distribution of a small screening previously carried out in the plant. Casteels and Bosschaerts (1992) proposed a threshold QM value of 15 at 24 hours post mortem for PSE carcasses.

After selection of the legs, the conductivity value was also measured in the gluteus muscle (gl) and the pH and internal light scattering were measured in both the semimembranosus and gluteus muscle. pH was measured with a Knick Portamess 654 pH meter equipped with an Ingold xerolyt electrode. Internal light scattering was measured with a Fibre Optic Probe instrument (FOP). The hams were then individually marked, deboned, injected with a polyphosphate-free curing solution, tumbled for 19 hours and cooked in an industrial oven for 24 hours. Within each run hams were treated in the same tumbler but they did not necessarily pass the same cooking chamber. By weighing the hams after cooking with and without jelly, cooking losses were determined.

After overnight cooling at room temperature, visual evaluation of the cooked hams was performed by a panel of three staff members of the meat processing plant. Within each run and quality group one half of the cooked hams were sliced several times and evaluated for the presence or absence of a hole on the cut surfaces. The hams were also given an overall score on a six-point scale (1 = very bad and 6 = very good) for colour, texture and general appearance. Finally, samples were taken from the semimembranosus muscle of the cooked hams for instrumental colour measurement (Hunterlab Miniscan apparatus) and determination of dry matter content (4 hours at 105°C) and shear force (Instron 1140 apparatus, Warner-Bratzler shear).

Results and discussion

In table 1 mean values are given of the measurements on the fresh legs for the low-QM and the high-QM group. Mean QM values were much higher than those found by Warriss et al. (1991), indicating a large proportion of hams with PSE-like properties. However, it has to be stressed that the lower and upper QM limits were based on a limited screening. After completion of the trial, the frequency distribution of a larger sample of QM values in the same plant was found to be quite different (data not shown). Two groups of hams were selected according to QMsm values, so the corresponding mean values are of course significantly different. Mean pH and FOP values were also significantly different between the two groups. Higher mean conductivity values coincided with lower mean pH and higher mean FOP values. Comparing the two muscles, mean pH values did almost not differ. Mean FOP values were lower in the gluteus muscle than in the semimembranosus muscle and a higher mean QM value was found in the gluteus muscle compared to the semimembranosus muscle only in the low-QM group.

From table 2 it can be seen that mean cooking losses were 1.3% higher in the high-QM group than in the low-QM group, which corresponds to a difference in mean weight loss of about 90 g per ham. No significant differences were noted between the mean values of shear force and of colour co-ordinates, except a tendency for a higher b* value in the high-QM group. The higher cooking losses in this group were partly reflected in a non-significantly higher dry matter content. On the other hand, the low-QM group had a clear advantage compared to the high-QM group regarding the absence of holes and overall panel scores (table 3 and 4). In the low-QM group, a hole was found in only 13% of the cooked hams, whilst in the high-QM group 66% of the hams showed a hole in the middle. The overall frequency of hams with this defect was rather large, indicating this was a real problem in this plant. The plant staff defined panel scores 4 and 5 as acceptable end-product quality, i.e. cooked hams with a normal texture, without colour defects and lacking holes. In the low-QM group, 78% of the cooked hams met this criterium, whilst this was true for only 29% of the cooked hams of the high-QM group.

Our results are in agreement with those of Honkavaara (1988), who reported that PSE meat negatively affects technological yield and organoleptic quality of cooked hams and fermented dry sausages. Pizza and Pedrielli (1992) also reported a marked influence of raw material characteristics on cooking losses, depending also on the cooking method.
De Smet et al. (1992) compared the value of hams from halothane-positive and halothane-negative pigs for manufacturing cooked ham. In their study, pH values measured early post mortem in the semimembranosus muscle were better related to the technological yield than ultimate pH values. Ultimate pH values are not differentiating between normal and PSE meat in contrast to pH values taken early post mortem. Hence, when a large proportion of PSE meat and a relatively low variability in ultimate pH is encountered, conductivity or light scattering measurements that are differentiating between normal and PSE meat to a certain extent may be more suitable than ultimate pH measurements in order to improve technological yield. The relative influence of variability in pH early post mortem and variability in ultimate pH on water holding capacity of meat and consequently cooked ham manufacturing properties needs more research.

Conclusion

Polyphosphate-free cooked hams prepared from legs with QM values < 9.0 had lower mean cooking losses and higher panel scores than hams prepared from legs having high QM values > 13.0. Moreover, 87% of the cooked hams from the low-QM group did not present a hole, whilst 66% of the hams from the high-QM group did. Although more research is needed on the relationship between conductivity values of the fresh hams and quality parameters of the cooked end-product, our data suggest that differentiating hams upon arrival at a processing plant according to electrical conductivity measurements might be useful in order to reduce the frequency of quality defects in the manufacture of polyphosphate-free cooked ham.

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