INCREASING THE FUNCTIONALITY AND USE OF PALE, SOFT AND EXUDATIVE (PSE) PORK IN CANADIAN-STYLE BACON

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SUMMARY

The present study was conducted to determine the effect of injection of dark, firm and dry (DFD) and PSE pork loin suspensions (9% of the meat weight) into PSE and normal pork loins, respectively, on processing yields and product quality of Canadian-style bacon. Fine suspensions, consisting of meat, water, ice and curing ingredients were made by the Suspentec system[1]. These prepared cold suspensions (-6 to -6.5° C) were injected into whole loins and processed into Canadian-style bacon.

Objective tests and sensory analysis showed that 100% PSE meat products had lower processing yields, poorer binding and sliceability, and were paler in color, less firm and less acceptable compared to 100% normal meat products. Substitution of 9% PSE meat with 9% DFD meat (91% PSE + 9% DFD product) significantly increased the processing yields and improved the texture and juiciness but the overall product quality was still not acceptable. Substitution of 9% normal meat with 9% PSE meat (91% normal + 9% PSE product) did not significantly affect the processing yields, texture, color, sliceability or overall acceptability. This study showed that it was possible to add approximately 9% PSE meat, as a fine suspension into normal meat without affecting the finished product quality. However, it was not possible to enhance the finished product quality by adding 9% DFD meat suspension to PSE meat.

Introduction

PSE meat, as result of myofibrillar protein denaturation, has a poor water-holding capacity (Penny, 1969) which results in higher cooking losses (Wirth, 1986) and undesirable texture (Townsend et al., 1980) in processed meat products. Considerable research has been conducted on processing methods and non-meat ingredients to improve the functionalities of PSE meat. Wirth (1986) found that small amounts of PSE pork could be incorporated into finely chopped sausages if the PSE pork was mixed with higher pH pork or beef. Knipe et al. (1990) found a significant improvement in cooking yields and sensory characteristics of Canadian-style bacon made from PSE pork when it was injected in the pre-rigor state with brine containing a sodium tripoly- and hexameta- phosphate mixture. Dolatowski (1986) reported that the incorporation of 5-10% blood plasma improved the quality of smoked PSE hams. In contrast, Goto et al. (1994) found no improvement with blood plasma but reported that a combination of sodium tripolyphosphate, sodium hydroxide and potato starch improved the yields and quality of cooked ham-type product made from PSE pork.

A recent patent (US patent 4,960,599) claims that injection of cold particle suspension made from meat trimmings and brine solutions into whole meat cuts resulted in higher cooking yields without affecting the product quality. The present study was conducted to determine the effect of injection of PSE and DFD pork loin suspensions into normal and PSE pork loins, respectively, on processing yields and product quality of Canadian-style bacon.

Materials and Methods

Normal (pH 5.5 - 5.8), PSE (pH 5.3 and below) and DFD (pH 5.8 and above) pork loins were collected from a local packing plant by visual observation and pH measurements. All loins were trimmed of external fat and connective tissue. The loins (PSE and DFD) used for suspensions were frozen and flaked before being mixed with brine. Control brine contained 9.49% salt, 2.17% dextrose, 1.08% phosphate, 0.13% erythorbate, 0.052% nitrite and 87.09% water (75.09% water + 12% ice) whereas suspensions had 7.28% salt, 1.66%

dextrose, 0.83% phosphate, 0.10% erythorbate, 0.040% nitrite and 66.81% water (44.54% water + 22.27% ice). Suspensions were made with Suspentec 701 system (manufactured by Cozzini Inc., Chicago) by passing the ingredients through the reduction mill 3 times in order to produce fine suspensions. Final temperature was -6.0 to 6.5° C. Controls (100% PSE or 100% normal) were injected to 30% of the green weight, whereas suspension extended products (91% PSE + 9% DFD or 91% normal + 9% PSE) were injected to 43% so that both controls and trreated products had similar levels of salt, dextrose, phosphate, erythorbate and water.

Injected loins were cut into small pieces, vacuum tumbled (Inject Star tumblers) for 4 h continuously, rested overnight at 2° C and tumbled for 1 h in the morning before being stuffed into fibrous casings (10 cm diameter), using a Risco vacuum stuffer. Cooking and smoking was done in a Maurer and Sohne oven to an internal temperature of 68° C and the products were chilled overnight before being peeled and vacuum packed. Weights were taken before and after cooking, after chilling and after peeling to obtain different processing yields. This experiment was replicated 3 times.

PSE and DFD suspensions were analysed for water-holding capacity (WHC) and protein solubility. For WHC, 40 g of suspension was heated in 50 ml centrifuge tubes in a water bath at 80° C for 30 min, centrifuged at 5000 G for 30 min. Supernatant (released water) was weighed and bound water was calculated from the total moisture of the suspension and expressed as percent WHC. For protein solubility, 200g suspension was weighed into 250 ml centrifuge bottles and centrifuged at 5000 G for 30 min at 0° C. Supernatant was weighed, measured for protein conent and expressed as percent protein solubilised based on the total protein content of the suspension.

Finished products were analysed for pH, salt, fat, protein and moisture levels. Color analysis was done with Hunter-Lab spectrocolorimeter (L, a and b values). Sliceability of the product was assessed by slicing the product into 2 mm slices using an automatic slicer. For drip loss measurements, 2 mm thick slices were vacuum packed and stored at 4° C for 21 days. Drip loss was measured after 21 days and expressed as percent weight of the initial product. Texture (compression test) was analysed with Instron Universal Testing Machine equipped with a 500 kg load cell and set at a cross head speed of 100 mm / min. Whole slices (25 mm thick) were compressed (with a 30 mm diameter plunger) to 50% of their thickness, and results are expressed as kg of force. Sensory analysis was performed by an untrained panel comprising 21 panelists. Color, texture, juiciness and overall acceptability of cold Canadian-style bacon slices were scored using a 5-point scale in which '1' signifies red, very firm, juicy and acceptable product, whereas '5' signifies pale, very soft, dry and unacceptable product.

Statistical analysis was performed by using the Statistical Analysis System (SAS, 1986) to determine means, standard errors and analysis of variance. Least significant difference was used to seperate the means.

Results and Discussion

Moisture, fat, protein, and salt levels were not significantly different in control or treated products and therefore results are not presented. However, all the processing yields measured were significantly lower in 100% PSE meat product compared to 100% normal meat product (Table 1). These results agree with Honkavaara (1989) who reported that hams from PSE meat had lower smokehouse yields than hams from normal meat, and also with Knipe et al. (1990) who showed that Canadian-style bacon from PSE meat had lower cooking yields than that made from normal meat. Substitution of 9% PSE meat with 9% DFD meat (91% PSE + 9% DFD) significantly improved all processing yields. These higher yields are due to the higher WHC and protein solubility of the DFD suspension compared to that of the PSE meat (Table 2). Penny (1969) also reported that extractability of salt soluble proteins from PSE pork was reduced 50% compared to normal pork. Substitution of 9% normal quality meat with 9% PSE meat (91% normal + 9% PSE) had no significant negative effect on processing yields. Wirth (1986) also reported that small amount of PSE pork could be incorporated into sausage batters of higher quality (high pH) pork without affecting the cooking yields. Drip loss measurements (Table 1) showed no differences between PSE or normal meat products. Also, substitution with DFD or PSE meat did not have any influence on the drip loss.

As expected, pH of the final product was significantly lower in 100% PSE meat product than in 100% normal meat product (Table 3). Substitution with 9% DFD meat or 9% PSE meat did not influence the pH of the final product. Color analysis showed that 100% PSE meat product was significantly lighter, as seen from the higher L values, than 100% normal product (Table 3). Honikel (1984) reported that the pale color of PSE meat was due to the denaturation of sarcoplasmic proteins. Substitution of 9% PSE meat with 9% DFD meat (91% PSE + 9% DFD) did not affect the L value compared to the 100% PSE product. However, substitution of 9% normal quality meat with 9% PSE meat (91% normal + 9% PSE) significantly lowered the L value compared to 100% normal product. Also, 100% PSE product had significantly lower a values and higher b values than 100% normal products. However, a and b values were not affected by the substitution of 9% PSE meat and 9% normal meat with 9% DFD meat and 9% PSE meat respectively.

Instron texture analysis showed that 100% PSE meat product was significantly softer, as seen by the lower compression peak force and energy values, than 100% normal meat product (Table 4). Knipe et al. (1990) also found that Canadian-style bacon made from PSE meat was softer as shown by the lower WB shear values compared to that of normal meat. Compression peak force or energy values were not affected by the substitution with DFD or PSE meat. PSE product also had poor sliceability compared to that of normal meat. Substitution of 9% PSE meat with 9% DFD meat (91% PSE + 9% DFD) slightly improved the sliceability but still not acceptable compared to the normal product. Substitution of 9% normal meat with 9% PSE meat (91% normal + 9% PSE) did not effect the sliceability of the product.

Sensory analysis showed that 100% PSE meat product was significantly softer and less acceptable compared to 100% normal product (Table 5). However, there were no significant differences in juiciness and color, although L values (Table 3) indicated that PSE product was paler than normal product. Panelists found that the 91% PSE + 9% DFD meat product was significanly firmer and juicier than 100% PSE meat product although Instron measurements showed no differences. Substitution of 9% PSE meat with 9% DFD meat (91% PSE + 9% DFD) did not enhance the overall acceptability. Substitution of 9% normal meat with 9% PSE meat (91% normal + 9% PSE) did not negatively influence the texture, juiciness, color and overall acceptability of the product compared to the 100% normal meat product.

The results of this study suggest that limited amounts (9%) of PSE meat could be added into normal meat as a fine suspension without significantly affecting the cooking yields and product quality of Canadian-style bacon. However, subtitution of small amounts of PSE meat with DFD meat (9%) did not improve the poor functionalities of the PSE meat.

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