Effect of smoking on the texture of different casing-types of frankfurters

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I. INTRODUCTION

Natural casings are considered the best because of their unique properties such as bite, kink, curvature and snap. Not all of these properties such as flexibility, compressive strength, smoke absorption and permeability can be replicated by synthetic casings. This is the reason why natural casings are often considered the best option for sausage casings and are expected to remain the preferred choice for a lot of sausages (Suurs et al. [1]). Alternatively, synthetically produced collagen is used, which accounts for 80% of all edible casings, and has these advantages of uniformity in size, strength and flexibility under different processing conditions, as well as better consistency of net product weight, casing's elasticity, higher hygiene status, and therefore longer shelf life. Another alternative is cellulose casings, which have advantages in terms of strength, ease of processing and shelf life. As cooked sausages, such as frankfurters, form a stable, self-supporting gel when heated and filled in casings, casings do not always have to act as mold holders. These casings allow small molecules such as water and small organic molecules found in wood smoke to pass through. Larger molecules, such as fat and protein, are largely retained and can withstand the conditions in a smokehouse with high relative humidity (Barbut [2]).

II. MATERIALS AND METHODS

For the production of the Frankfurter Sausages, following materials were used: 30 % RIII beef meat, 30 % SIII pork meat, 18 % SIX pork fat, 22 % ice, 1.8% nitrite curing salt, 0.2% phosphate, 0.05% ascorbic acid, 0.5% spice mixture, 0.2% dextrose, 1% fresh onion, 0.1% garlic paste. Once the sausage batter has been produced, it is filled into sheep casings (22 mm), collagen casings (21 mm) or cellulose casings (19 mm). For the smoking of the Frankfurters, five different smoke generator temperatures and smoking times were conducted per casing type. Those were: 300 °C for 10 min, 450 °C for 7 min, 600 °C for 6 min, 750 °C for 4 min and 900 °C for 3 min. During the smoking process, beech (diameter of 6 – 12 mm) were used to produce the smoke. The followed cooking step was at 75 °C for 20 min which led to an internal temperature of 72 °C.

To assess the tenderness of the Frankfurters, the Warner Bratzler shear force measurement was performed. 12 measurements for each sausage type were conducted using four sausages per type in total, all at 7 °C. To perform the shear force measurement, the sausage sample was positioned in the center, directly beneath a V-shaped blade. Once the measurement started, the blade steadily moved towards the sample with a speed of 1.5 mm/s and applying pressure until the sausage reached its breaking point. Throughout this process, the force applied by the blade was continuously measured.

The tensile strength was determined as the maximum stress until the casing broke (Suurs et al. [1]). Only the sausages with natural casing or collagen casing were used for this test. A total of 12 samples per sausage type were prepared by removing all residues from the sausage meat with a razor blade and roughly removing it from the casing. This led to thickness of about 0,5 mm. The casings were cut into 7 cm x 4 cm pieces and packed in plastic bags under a controlled atmosphere and stored overnight at 5 °C. To perform the measurement, the sample was clamped between the fixtures at a distance of 4.2 cm. The clamps were moved in the opposite direction at a speed of 0.2 mm/s until the break was reached and the force was measured continuously

III. RESULTS AND DISCUSSION

The findings in Figure 1 (left) indicate that the peeled cellulose casing samples exhibited the lowest maximum force with a range of 23.3 ± 0.8 N to 27.5 ± 1.0 N at 300 °C and 750 °C, respectively. These results are statistically significant and demonstrate that the peeled cellulose casing samples differ

significantly from the other casing type samples and are, thus, more tender. The removal of the casing, which is responsible for the hardness of the other samples, is the main reason for this difference. This is, on the one hand, due to the drying out of the surface. On the other hand, the reduction of myofibrillar and sarcoplasmic protein nitrogen and increase in stromal protein nitrogen leads to cross-linking of surface proteins and therefore a firmer outside of the smoked product (Maga [3]). Overall, the collagen and natural casings yielded similar results with notable deviations at 450 °C and 900 °C. These findings confirm that frankfurters in peeled cellulose casing exhibit greater tenderness despite the smoking temperature. In contrast, frankfurters smoked in ESC and NC at 300 °C, 600 °C or 750 °C display insignificant differences in tenderness.

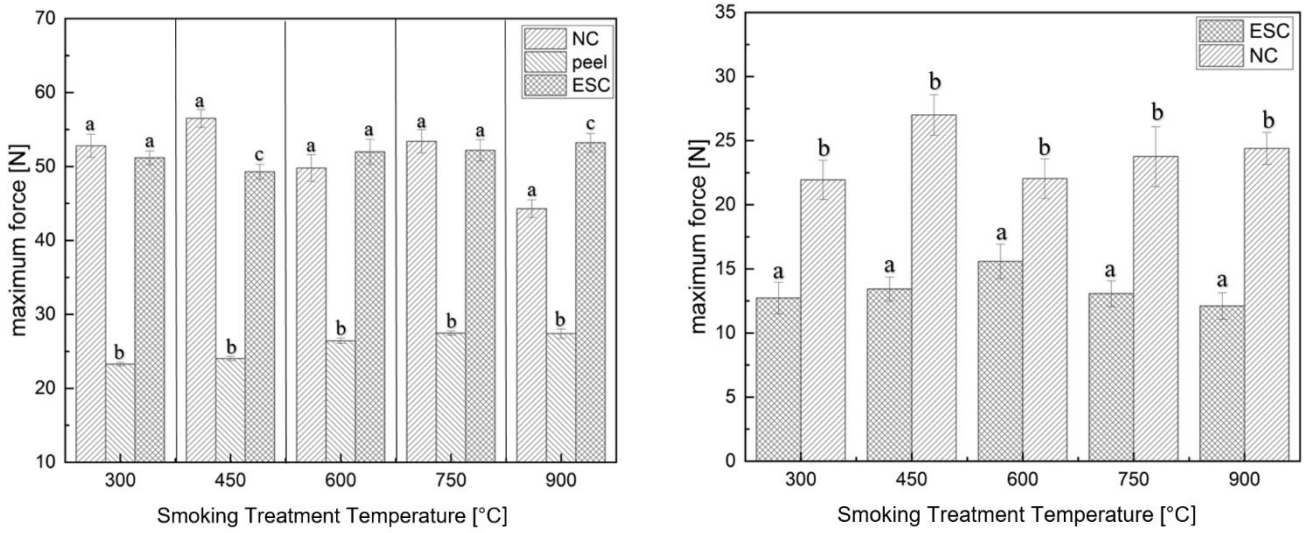

Figure 1: Maximum force [N] of the Warner Bratzler analysis of all casing types and temperatures (left) and of the Tensile strength test of collagen (ESC) and natural casing (NC) and all smoking temperatures.

The statistical analysis of the data displayed in Figure 1 (right) indicate that NC and ESC frankfurters are significantly different from each other, regardless of the smoking temperature. While the values for the collagen casings range from 12.1 ± 1.0 N (900 °C) to 15.6 ± 1.3 N (750 °C), the natural casing samples endured a higher force between 21.9 ± 1.5 N (300 °C) to 27.0 ± 1.6 N (450 °C). These results suggest that the hardness of the casings does not depend on the smoking temperature but rather on the type of casing that is being used.

IV. CONCLUSION

Different experiments were conducted to investigate the characteristics of frankfurters produced with natural casings, collagen casings, and peeled cellulose casing. The texture analysis clearly showed a more tender first bite in peeled cellulose casing frankfurters when compared to those encased in natural or collagen casings. Furthermore, the results demonstrated the higher tensile resistance of natural casings in comparison to collagen casings.

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