Subgroup 3

Fermented and cooked meat products

TEXTURAL CHARACTERISTICS OF FRANKFURTERS THERMALLY PROCESSED (F_0=3.0-3.3) IN RETORT POUCHES

James C. Acton, Donald L. Burge, Rhoda K. Friesen and S. Kartika
Department of Food Science and Human Nutrition, Clemson University, Clemson, South Carolina 29634-0371 USA

Background

Frankfurter texture has been extensively studied recently with emphasis on reducing fat content (Yang et al., 2001; Crehan et al., 2000) yet no research is available relating to texture changes due to the heat stress in thermal retorting for canned sausage products. In the USA, Vienna sausages are essentially cooked frankfurters that are canned and yield commercially sterile, shelf-stable product (Pearson and Gillette, 1999). In canning, loss of typical frankfurter-type texture occurs resulting in "soft bites" and perceived lower water binding within the Vienna sausage structure. To retain texture that would closely parallel traditional frankfurters, we explored fat reduction of meat ingredients without water replacement in producing retorted, shelf stable frankfurters.

Objective

The objectives of this study were to determine the effect of retorting on the texture of frankfurters in attempting to produce a retorted frankfurter that would have textural attributes comparable to normal, non-retorted frankfurters.

Experimental methods

Four brands of refrigerated, non-retorted frankfurters were purchased from a local retailer and kept refrigerated at 2°C. All brands were analyzed for textural attributes and one brand was selected for studying the effects of retorting on texture along with the experimentally prepared frankfurters. Experimental frankfurters were prepared from mixes of lean beef (4.9% fat) and pork trimmings (55.3% fat) calculated to yield finished frankfurters of 11, 18 and 26% fat. Ingredients per kg of meat were 0.156 g NaNO2, 0.55 g sodium erythorbate, 27.5 g NaCl and 100 g water (as ice). Total batter chopping time was approximately 20 min with a temperature rise from a low of near 0°C (at 4 min) to an endpoint of 16°C. Batters were stuffed in NOJAX No. 24 casings (22 mm diameter) and heat processed in a single truck gas-fired smokehouse (Vortron Model HL) at 30% relative humidity from 55°C to 71°C using 5°C increases at 15 min intervals. On attaining 71°C internally, the frankfurters were initially cooled to approximately 20°C by a water spray and further cooled to 4°C. One-half of the frankfurters were analyzed for textural attributes (TRT=Non-Retorted) and the other half was used for retorting (TRT=Retorted) and then analyzed for textural attributes. The refrigerated non-retorted commercial frankfurter samples were also analyzed to compare to the experimental frankfurters that contained 26% fat. This was done to insure that our experimental processing procedure yielded a product similar to a commercial sample.

For retorting, a single layer of frankfurters was arranged in flexible laminated aluminum retort pouches (American National Can Co., Burlington, IL). The 26% fat commercial frankfurters were thermally processed at 121°C to an F_0 of 6.0 and all of the experimental frankfurters were thermally processed at 115.5°C to an F_0 of 3.0-3.3. Before texture analysis, retorted frankfurters were removed from the pouch and allowed to drain of any adhering fluid and then the surface was wiped dry.

Texture profile analysis (TPA) was performed according to Bourne (1978) using 1 cm thick cross-section slices of approximately 20 mm diameter. An Instron Model 1122 Universal Testing Machine was used for compression of slices to 25% of original height two times (2 bites) in succession. The Instron crosshead speed was 5 mm/min with chart speed at 50 mm/min. The retorting effect (Non-Retorted vs. Retorted) for frankfurters at each fat level was analyzed by ANOVA (Statistical Analysis System) and means of textural attributes where significant ($P<0.05$) were separated by Duncan's test.

Results and discussion

Prior to preparing frankfurters for retorting, traditional frankfurters of 4 manufacturers were analyzed to establish the range of textural attribute values as determined by TPA (Table 1). Based on hardness, first bite energy (Area 1) and other measures, the range of values, although large, is obviously acceptable in the marketplace.

Using Brand D from Table 1, we retorted the product and the results (Table 2) demonstrate the "softening effect" due to changes ($P<0.05$) in all characteristics except springiness and cohesiveness. SEM micrographs (Figure 1) indicated a slight structural change with a more condensed "platelet" structure after retorting. Before further study of retorting, we determined that our frankfurter process for a 26% fat content product (Table 2) could yield a product with texture characteristics very similar to the 30% fat commercial frankfurter.

Experimental frankfurters of 18% and 11% fat content were prepared and TPA conducted before and after retorting in flexible pouches (Table 3). Data confirm the effects of thermal processing to the commercially sterile, shelf-stable state, as there was a decline ($P<0.05$) in most textural attributes with some exceptions in springiness and gumminess. Retorted experimental frankfurters, however, of 18% fat content yielded final textural properties near to or between those of the non-retorted commercial Brands C and D frankfurters.

Conclusion

By proper formulation for reducing the fat content of the meat ingredients and without water replacement for fat, textural characteristics of retorted frankfurters can be attained that are similar to those of non-retorted normal commercial products.

Pertinent literature

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Table 1. Variation of TPA characteristics for commercially manufactured frankfurters.

Texture Measure	Brand A	Brand B	Brand C	Brand D
Hardness (kg)	2.16	2.21	4.04	6.60
Fracturability (kg)	1.59	1.41	1.70	5.49
Area-1 (kg-cm)	0.588	0.634	0.954	2.16
Springiness (mm)	5.09	4.97	5.49	5.21
Cohesiveness	0.232	0.203	0.244	0.175
Gumminess (kg)	0.519	0.450	0.984	1.15
Chewiness (kg-cm)	2.55	2.24	5.40	6.06

All values are means of five samples within a brand. Composition averaged 51.3% moisture, 10.9% protein, 30.6% fat, and 2.8% ash.

Table 2. TPA characteristics of 30% fat commercial frankfurter and non-retorted 26% fat experimental frankfurter.

Texture Measure	30%Fat Commercial Product		26% Fat Experimental
	Non-Retorted	Retorted[1]	Non-Retorted
Hardness (kg)	6.60a	4.38b	6.11
Fracturability (kg)	5.49a	3.65b	4.15
Area-1 (kg-cm)	2.16a	1.51b	1.74
Springiness (mm)	5.21	5.44	4.37
Cohesiveness	0.175	0.148	0.192
Gumminess (kg)	1.15a	0.647b	1.16
Chewiness (kg-cm)	6.06a	3.54b	11.8

[1] Brand D in Table 1 was retorted at 121°C (F_o = 6.0).
Row means within the 30% fat content frankfurter with a different letter are different (P<0.05).

Table 3. TPA characteristics for experimental frankfurters at reduced fat and restricted moisture content.

Texture Measure	18% Fat Experimental		11% Fat Experimental	
	Initial	Retorted[1]	Initial	Retorted[1]
Hardness (kg)	8.71a	4.17b	20.09a	14.75b
Fracturability (kg)	5.20a	2.80b	7.81a	7.10b
Area-1 (kg-cm)	2.47a	1.24b	4.85a	3.82b
Springiness (mm)	5.22b	6.20a	5.36	5.35
Cohesiveness	0.197	0.195	0.260a	0.215b
Gumminess (kg)	1.71a	0.819b	5.22a	3.22b
Chewiness (kg-cm)	8.82a	5.13b	28.00a	17.24b

[1] Retorted at 115.5C (Fo = 3.0-3.3). All experimental frankfurters had only 10% added water.
Row means within 18% or 11% fat content frankfurters with a different letter are different (P<0.05).

Figure 1. Scanning electron micrographs (400X) of non-retorted (left) and retorted (right) commercial frankfurters.