S7P20.WP

INFLUENCE OF DIFFERENT SMOKING METHODS AND CONDITIONS ON THE QUALITY OF CANNED FRANKFURTERS

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INTRODUCTION

Frankfurter type sausages have approximately 60% of the market for all canned sausages in Germany. Products within the Frankfurter group differ with respect to composition, type of casing, type of packaging and shelf life (half-, threequarter- or fully-preserved). The relatively severe heating which is necessary to get a fully preserved product can sometimes lead to faults in the water-binding, fat-binding and the consistency of frankfurters. Also bursting of natural and artificial (collagen) casings may occur during or after heating. While some of the conditions required for the production of threequarter- and fully preserved canned frankfurters with a good eating quality are well known (water- and fat-binding, structure formation), the effects of the smoking method and technology are not well understood.

MATERIALS AND METHODS

Batches of the raw materials for each set of experiments with one smoking method were purchased before starting the set of experiments. Beef and pork and pork back fat were each mixed, ground though a 2mm plate then mixed again. Each material for a cutter batch was vacuum packaged in a foil laminate pouch and stored frozen at -20°C.

Recipe

33.3% beef forequarter
21.7% pork shoulder
20.0% pork backfat
25.0% water (ice)

Additives

20.0g/kg nitrite curing salt (99.5-99.6% sodium chloride and
0.4-0.5% sodium nitrite)
20.0g/kg common salt (sodium chloride)
3.0g/kg pyrophosphate
0.5g/kg sodium ascorbate
5.0g/kg spices

The material of each batch (40kg) was coarse comminuted to fist size pieces with a band saw. Those meat pieces were fine comminuted in a bowl chopper with salt, curing salt, phosphate and ice under 80% vacuum until the temperature rose to 0°C. Subsequently, the backfat, spice mix and ascorbate were added and the meat was chopped again until the temperature rose to 16°C. Each batch of the experiment series was manufactured under the same standardized conditions. Each batch was divided into three portions. One portion was filled into sheep casings calibre 20-22mm;

one into collagen casings, calibre 21mm (ESC, Naturin-Werk Becker and Co., Weinheim/Bergstrae); and one into cellulose-peelable casings, calibre 21mm (Pellete P, Fa. Kalle Aktiengesellschaft, Wiesbaden Bieberich). Each sausage had a filled weight of between 60 to 70g. The quantity of sausages in each type of casing would usually be hung on five smoke-drying sticks. One smoke-drying stick of sausages in each type of casing were smoked together under the same conditions. On each day that sausages were prepared, five batches were smoked under different conditions with the same smoking system. Generally the conditions for one of the important factors of the smoking process was changed each day. These were temperature, relative humidity and the times of preconditioning (curing and drying) and smoking the sausages. Therefore six of the 10 batches, with five variations of smoking conditions, were used from the prepared raw material. The four other batches were used for repeats if the resulting treatments were not clear and to safeguard the last results (Müller *et al.*, 1985; 1988).

The way of working was the same for all four smoking systems. After smoking, the frankfurters were not scalded, but were dried for 1.5 to two hours (determined after the first experiment of each series) at 70°C with low but inconstant relative humidity and high air circulation. During drying the sausages lost about 20% of their filling weight (Reichert and Kofahl, 1974; Wirth, 1973a; 1973b; Wirth, 1976). Depending on the drying loss, six or seven frankfurters (about 320g) were placed in each can (size 73x210mm). Shortly before heating in a retort, the cans were filled with brine to leave a headspace of 10mm. After that the cans were closed and heated immediately. The brine used did not include salt, because the sausages were already highly salted. In effect, the 2% of salt that is usual in a brine for canned frankfurters was incorporated in the stuffing, to improve the water binding capacity of the meat protein. During the first week after canning the salt concentration in the frankfurters and the brine equilibrated. After one week the salt concentration in the frankfurters and the brine was about 1.8% when each is about 50% of the can contents. The composition of the added brine was 4.0g/l food seasoning, 0.3g/l glutamate, and 0.5g/l ascorbic acid.

The conditions for heating cans to give to threequarter- or fully-preserved products are shown in Table 1.

Through sensory evaluations we determined the best conditions for the relative humidity, temperature and time during preconditioning and smoking. Furthermore, we counted the number of burst sheep and collagen casings in a constant number of cans. From the results of the burst casing enumerations and of the sensory evaluations the exact values for the processing variable were progressively fixed. For example, the temperature during preconditioning was varied in five steps, viz 35°C, 40°C, 45°C, 50°C, 55°C. If we found the best results in sausages preconditioned at 45°C, the evaluation of the effect of relative humidity was performed with all sausages preconditioned at 45°C. The relative humidity values tested were 20, 40, 60, 80 and 100%. If the results were not clear, another test was conducted with a smaller increment between r.h. values, eg., 40, 45, 50, 55 and 60.

RESULTS AND DISCUSSION

The temperature, relative humidity and the times of preconditioning and smoking effect the colour, odour, taste and burst resistance of sausages. The optimum conditions differ for each smoking system. The results for sheep casings are shown in Table 2.

The results for collagen casings are shown in Table 3. For organizational reasons, experiments were not conducted with collagen and cellulose-peelable casings subjected to wood shaving glow smoke (reduced system). To get a sufficient bursting resistance for the sheep and collagen casings during the heating process it was necessary to have drying losses of 15% for the threequarter and 20% for the fully-preserved products.

The results for cellulose-peelable casings are represented in Table 4. It is not necessary to dry frankfurters manufactured in collagen-peelable casings, because this type of frankfurter is burst resistant. However, if the collagen tissue in the stuffing is too high, it can cause the development of rosettes at both ends of the sausage. There were no problems with the development of rosettes with the recipe used in this study. The effect of the smoking process on the mechanical, high speed peeling of casings was not examined.

With some smoking methods there were small differences in the relative humidity (10%), temperature (10°C) or time

(10 minutes) of smoking required to get the best results for collagen and cellulose-peelable casings.

CONCLUSIONS

The temperature, relative humidity and the times of preconditioning and smoking the sausages effect the colour, odour, taste and burst resistance of frankfurters filled into sheep and collagen casings, but not the frankfurters filled into the cellulose-peelable casings. The optimum conditions are different for each of the evaluated smoking systems. In most cases, the results for the sheep casings were representative for the other casings. In some smoking methods, small differences in the relative humidity, temperature or smoking time required to get the best results for collagen and cellulose-peelable casings. To get sufficient bursting resistance for the sheep and collagen casings, it is necessary to have drying losses of 15% for the threequarter and 20% for the fully preserved products.

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Table 1. Heating conditions for threequarter- and fully-preserved products.

	Threequarters-preserved cans	Fully-preserved cans
Store kettle temperature	135°C	145°C
Working kettle temperature	115°C	125°C
Heating time	15 minutes	10 minutes
Pressure	2.5 bar	3.5 bar
Fc-value	≥0.6	≥4.0

Table 2. Optimized programs for smoking for sheep casings.

	Curing/drying			Smoking		
	rel. humid	temp. °C	time min.	rel. humid	temp. °C	time min.
Sawdust glow smoke system open system	40	50	40	80	70	60
Friction smoke open system	45	50	40	80	60	30
Steam smoke open system	60	60	50	100	80	8-10
Wood shavings glow smoke reduced system	40-50	40	45	70-80	75	10-15
Wood shavings glow smoke recirculation system	50	50	50	85	60	8-10

Table 3. Optimized programs for smoking collagen-peelable casings.

	Curing/drying rel. humid	temp. °C	time min.	Smoking rel. humid	temp. °C	time min.
Sawdust glow smoke system open system	40	50	40	70	70	60
Friction smoke open system	45	50	60	85	70	40
Steam smoke open system	60	60	50	100	80	10
Wood shavings glow smoke recirculation system	50	50	50	75	60	10

Table 4. Optimized programs for smoking cellulose-peelable casings.

	Curing/drying rel. humid	temp. °C	time min.	Smoking rel. humid	temp. °C	time min.
Sawdust glow smoke system	40	50	40	90	70	60
Friction smoke open system	45	50	60	85	70	50
Steam smoke open system	60	60	50	100	60	12
Wood shavings glow smoke reduced system	50	50	50	75	60	8