High Temperature Processing of Fish Sausage IV- Heat Penetration Study

Fish sausage can be considered similar to thermally processed canned product since it is sealed airtight in synthetic casing and hence the chances of growth of aerobic bacteria are very negligible. However, the anaerobic forms, which are likely to be present mostly in the form of spores can withstand a high temperature and spoil the product consequently. In this experiment, the rate of penetration of heat into fish sausage when processing at 115.6°C was studied. The thermal process was also calculated as to how best we could eliminate the highly heat resistant organisms from such a product.

Heat penetration test was carried out in an experimental autoclave using standard plug-in-type copper-constantan thermocouples (ELLAB-Copenhagen). The thermocouples were provided with suitable lead wires of sufficient length which were brought out of the autoclave and connected to the temperature reading instrument through a connection box. In each test four sausages were made use of, the sealings of which were removed at one end and the needle-type thermocouples introduced from the other end, so as to keep the needle tip at the sausage centre. Two other thermocouples insulated by nylon tubing were also kept inside the autoclave to read the retort temperature. Then all the thermocouples were connected to a digital thermometer. The autoclave was brought to processing temperature within 10 minutes. The experiment was conducted at 115.6°C for 30 min. Cooling in tap water was started at the end of processing. Temperature reading was taken every two minutes while processing and every minute during water cooling.

The heat penetration data and the results of thermal process calculation are presented in Tables 1 and 2. For calculation of thermal process, sausage showing the slowest rate of heat penetration was taken and Patasnik's method was adopted. In this test F_{250} values at centre were found to be 2.73, 3.72 and 5.29 min when sausages were processed at 115.6°C for 20, 24 and 30

Table 1. *Heat penetration data and thermal process calculation of sausage processed at 115.6°C for 30 min*

Time (min)	Temp. at sausage centre °C	Lethal rate	Patasnik's modification
0	33.6	—	—
2	33.8	—	—
4	40.8	—	—
6	54.0	—	—
8	68.0	—	—
*10	81.0	—	—
12	91.7	—	—
14	98.1	0.004999	0.0024995
16	103.4	0.016939	0.016939
18	107.3	0.041581	0.041581
20	110.0	0.077427	0.077427
22	111.9	0.119920	0.119920
24	113.1	0.158085	0.158085
26	113.8	0.185733	0.185733
28	114.4	0.213250	0.213250
30	114.8	0.233824	0.233824
32	115.0	0.244844	0.244844
34	115.1	0.250547	0.250547
36	115.2	0.256383	0.256383
38	115.3	0.262355	0.262355
**40	115.4	0.268466	0.268466
42	114.1	0.199017	0.199017
44	109.7	0.072259	0.072259
***46	106.9	0.037922	0.037922
47	100.2	0.008108	0.008108
48	97.1	0.003971	0.0019855

*Come up time for the retort
**Steam off
***Water cooling started

Table 2. *Different processing levels and corresponding F_{250} values*

Processing time and temperature	F_{250} value(min)
115.6°C for 20 min	2.73
115.6°C for 24 min	3.72
115.6°C for 30 min	5.29

min respectively. It can be seen that processing at 115.6°C for 20 min as determined by Esty & Meyer (1922) is just sufficient to destroy *Clostridium botulinum* spores. If sausage is processed for 24 min at the same temperature, the process exceeds the time required to bring about complete destruction of *C. botulinum* and if the processing time is increased to 30 min the destruction of highly heat resistant organisms most likely to cause spoilage in fish sausage (Tanikawa, 1971) can be ensured. This concluded that the high temperature processing of fish sausage at 115.6°C for 30 min destroys almost all the spoilage causing organisms, thereby prolonging the shelf-life of the product.

References

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