HEAT TRANSFER DURING PROCESSING OF MEAT AND FISH IN RELATION TO PRODUCT QUALITY

BY

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THESIS

Submitted in Partial Fulfilment Of the Requiements

for the Degree of

DOCTOR OF PHILOSOPHY

TO

Food Science Department

Faculty Of Agriculture

Ain-Shams University

1975

APPROVAL SHEET

HEAT TRANSFER DURING PROCESSING OF MEAT AND FISH IN RELATION TO PRODUCT QUALITY

This Thesis for the Ph.D.Degree has been approved by :

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Committee in charge

Date : 1/4/1975.

Dedicated To :

My Parents who offered me the best in life, education

My wife SEHAM, who was the stimulator to the success

My daughter AMAL, who gave me the hopeful.

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ACKNOWLEDGEMENT

The auther wishes to express his deep gratitude to Prof. Dr. M.F.Hussein; Professor of Food Technology , Prof. Dr. A.F.El-Sahrigi, Professor of Food Engineering , and Dr. Y.M.Hassan, associate Professor of Food Technology, in Food Science Department of the University of Ain-Shams , for their sympathetic guidance and supervision during this work and for suggesting the problem.

To all my colleogues in the food science department, many thanks for their co-operation and encouragement.

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Most of fish and meat processing methods include heat transfer operations. Fish and meat products have texture characteristics oriented in such a manner that heat conduction is the primary mode of heat transfer during thermal processing. Increased efforts to maintain high quality in food products for longer periods of time introduce new problems and increase the desire to deal accurately with problems of heat transfer.

There are two distinct phases in heat processing which are among the most important operations in food canning; the heating phase and the cooling phase. For many years the canning industry has employed the science of mathematics and heat transfer to determine the efficiency of the canning process. Heating and cooling curves are usually used to describe the temperature history of canned foods during thermal processing. These two curves should be predicted accurately so that the proper heat processes for a canned food can be determined.

From the design point of view of equipment used in the fish and meat processing industry, it is essential to determine the basic thermophysical properties of fish and meat for the proper choice of the technological procedure as well as for a possible prediction of process results under specified conditions.

The quality of the canned fish is greatly affected by the thermal processing operation. The size of cans used also governs the heat treatment needed to ascertain the proper commercial sterilization. The resistivity of the contaminant sporeformer should be studied as a factor that controls the quality of the canned product, especially during storage

This work is planned to study the following points which are higher correlated to the quality of the fish and meat products.

1. Determining the heating and cooling curves of some fish and meat varieties and products.
2. Estimation of the thermal conductivity and the thermal diffusivity of these food stuffs.
3. Identification of spore former bacteria and measurment of their characteristic heat resistivity.
4. Calculation and measurment of heat transfer parameters during thermal processing of food stuff as a means of thermal process evaluation using different available methods.
5. Possibly modifying presently accepted methods for determining thermal process lethality and times.

REVIEW OF LITERATURE

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I. Determining Of The Heating And Cooling Curves

Use of thermocouples in heat penetration measurements :

When two wires of different material are joined together at either end, giving two junctions, and these are maintained at different temperatures, an e.m.f is produced which causes a current to flow round the loop. It is considered that two processes contribute to this potential :(1) the Peltier effect, due to the junctions and (2) the Thompson effect, due to the temperature differences between the ends of the individual wires. The resultant potential, the sum of these two effects, is approximately in linear reletion with the temperature difference. This attributed to the predominate Peltier effect which is directly proportional to temperature difference, while the Thompson effect is proportional to the difference in the square of the temperatures (Donaldson, 1958 and Joslyn, 1970).

The following equation shows the relationship between the total thermo e.m.f. of a thermocouple and the temperature of one junction (T_2) when the other junction is kept at constant temperature (T_1) :

$$E = P\,(T_2 - T_1) + \tfrac{1}{2}\,q(T_2^2 - T_1^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where. E = the total thermo e.m.f. of a thermocouple, P is a constant reperesenting the Peltier effect, and q is a constant representing the Thompson effect. Theraja (1972) gave values for the constants P and q for different metals which may be used as thermocouples.