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THE DETERMINATION OF KINETIC PARAMETERS
IN HEAT PROCESSING OF BABY FOOD

A thesis presented in partial fulfilment
of the requirements for the degree of Ph.D.
in Biotechnology at Massey University

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1980

02370_18

ABSTRACT

Two methods of heat processing kinetic parameter determination by steady-state and unsteady-state heating procedures were studied. The unsteady-state procedure was used for colour and viscosity where large amounts of samples were required for measurement, and both were used in considering the destruction of ascorbic acid and riboflavin in a baby food.

To obtain accurate determination of the kinetic parameters, standard k and E_a , experimental methods had to be developed to measure the quality factors within narrow limits of accuracy.

Determination of the kinetic parameters by unsteady-state procedure involved the development of a computer method for the can temperature distribution calculation, the quality retention calculation, and finally determination of the empirical relationships of the standard parameters, k and E_a , to the residuals (differences between experimental and predicted concentrations). Temperature distribution in a can was predicted by a modified computer program based on an analytical solution to obtain a form fitting of the experimental heat penetration curve. From this, the quality retention was calculated by numerical integration. The standard k and E_a were roughly estimated from the literature either on the studied quality or on a similar quality. Then the ranges of standard k and E_a were assigned in an orthogonal composite design and used to calculate the retained quality which then was compared with the experimental result to obtain the absolute residual at each standard k and E_a . The average residual at each processing temperature was used in multiple linear regression to determine the relationships between the standard k and E_a , and the residual. By optimising the empirical equation the best values for the standard k and E_a were determined.

The standard k and E_a for ascorbic acid and riboflavin were also determined by the steady-state procedure. In this, small tubes of the baby food were heated in a constant temperature oil bath. Nearly identical results obtained for ascorbic acid by both methods indicated that the method used was feasible and the degradation of ascorbic acid

was best described by a first order reaction. For riboflavin, different results were found from the two methods but these could be explained as the results of the low destruction rate of riboflavin on heating, the analytical error and the change in physical conditions from cans to tubes. So, use of the steady-state kinetic parameters for quality retention calculation in unsteady-state was confirmed experimentally.

For colour and viscosity changes in processing, the method of kinetic parameter determination in unsteady-state heating procedure was used assuming first order kinetics.

It was concluded in this food system for the temperature ranges of 60-139°C, the kinetic reaction rate at 129°C and the activation energy were $0.42-0.44 \times 10^{-4} \text{ s}^{-1}$ and $77-85 \text{ kJ mole}^{-1}$, $0.11-0.25 \times 10^{-4} \text{ s}^{-1}$ and $84-105 \text{ kJ mole}^{-1}$, $1.20 \times 10^{-4} \text{ s}^{-1}$ and 122 kJ mole^{-1} and $1.65 \times 10^{-4} \text{ s}^{-1}$ and 151 kJ mole^{-1} for ascorbic acid, riboflavin, colour and viscosity respectively.

ACKNOWLEDGEMENTS

The success of this research was due to the experience and confidence of my supervisors, Professor R.L. Earle and Dr Mary D. Earle, whom I shall always be grateful. Their untiring interest, patience and encouragement are deeply appreciated.

This work would not have been possible without the support of Chulalongkorn University to whom I am indebted. This scholarship would not have been possible to obtain without the help of Dr Mary D. Earle and the Chemical Technology Department, in particular, Dr K. Santiyanont, Dr C. Thanyapittayakul, Mr V. Premyothin and Dr P. Chittaporn.

I also wish to express my appreciation to various people who assisted this research in many ways. In particular I would like to thank:

Dr A.C. Cleland for his valuable discussions and criticisms and also his willing assistance.

Food Technology Research Centre, Department of Food Technology for financing the experimental work.

Professor R. Richards for providing the facilities and funding the computer expenses.

Mr T. Gracie for his assistance in experimental work.

Miss S.A. Wilkinson for helpful guidance in setting up steady-state heating experiments.

All taste panelists for taking part in the preliminary work and all those in the Faculty of Food Science and Biotechnology for making such a happy working environment.

Also to my typist, Vivienne Mair, for her efficiency and patience,
and Nuch for taking part in the final preparation.

Finally to my mother, sister and brothers for their continual
moral support during the study.

Kalaya Taimmanenate
October, 1980

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