Acta Societatis Mathematicae Latviensis
Abstracts of the 5th Latvian Mathematical Conference, April 6–7, 2004, Daugavpils, Latvia

THERMO PHYSICAL PARAMETERS DETERMINATION OF FROZEN BERRIES WITH MATHEMATICAL MODELLING

AIVARS ĀBOLTIŅŠ[1], ULDIS ILJINS AND IMANTS SKRUPSKIS

Latvia University of Agriculture

Lielā iela 2, LV-3001, Jelgava, Latvia

E-mail: [1]aivars@cs.llu.lv

Knowledge of thermo physical properties is important for determining the best freezing and storage conditions for frozen foods. It is very important to accurately know the freezing and thawing temperatures because many mathematical models use them as the basis for predicting other thermo physical properties.

The study was done with black and red currants after frozen storage in Dobele state Horticultural Plant Breeding Research station. Berries was analysed after freezing, after 3- month and 6- month storage at temperature $-20 \pm 2\ ^oC$. The layered berries with are thawing in room temperature.

Theoretical model considers the first stage of defrostation, t.i. warming of frozen products until the melting point. At the first stage of defrostation we will not considered transference processes of mass in this approximation. Defrostation is unstationary process and unstationary thermal conductivity equation in an infinite layer was taken as basis

$$\frac{\partial T}{\partial \tau} = a \frac{\partial^2 T}{\partial x^2} \tag{1}$$

with following initial and boundary conditions

$$T|_{\tau=0} = T_1 \tag{2}$$

$$\lambda \frac{\partial T}{\partial x}\bigg|_{x=0} = \alpha_a (T|_{x=0} - T_0) \tag{3}$$

$$-\lambda \frac{\partial T}{\partial x}\bigg|_{x=H} = \alpha_v (T|_{x=H} - T_0) \tag{4}$$

To solve the problems (1) – (4) we use Fourier method.

Using least square method (to compare theoretical and experimental data) we find best thermo-physical parameters for frozen black currants which we take as changing:

$\lambda = 0.15 \quad W/(m \cdot K)$ (thermo conductivity coefficient)

$a = 7.79 \times 10^{-8} \quad m^2/s$ (temperature conductivity coefficient)

$\alpha_a = 5.6 \quad W/(m^2 \cdot K)$ (coefficient of heat emission from the bottom of the layer)

$\alpha_v = 27.4 \quad W/(m^2 \cdot K)$ (coefficient of heat emission from the surface of the layer)

Simultaneous heat and mass loss cannot be handled with analytical methods but can be treated in numerical modelling. In the most cases analytical calculations cannot be performed without assuming that materials is homogeneous and has constant thermal properties.