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KINETIC REGULATIONS OF THE DRYING PROCESS OF DRUG PLANTS

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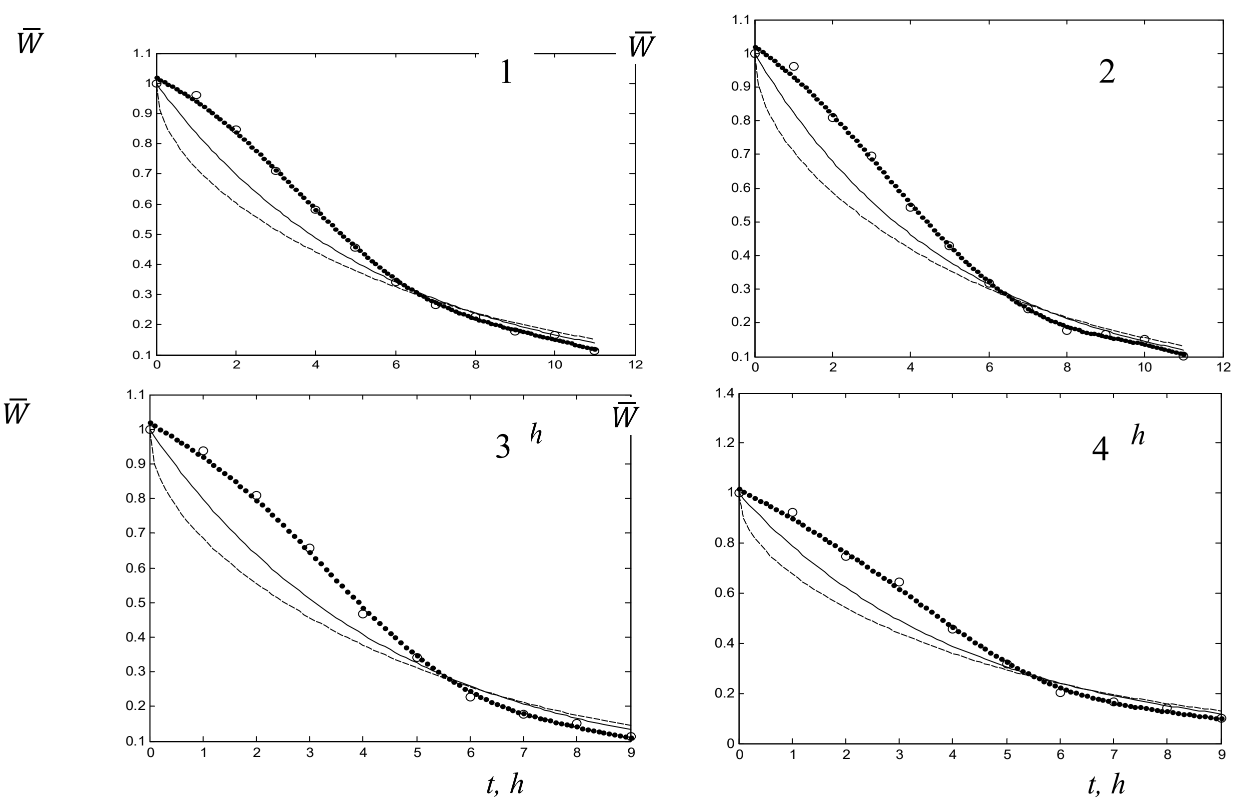
Annotation. In this work, at constant process temperatures, drying kinetics was considered through the Fick diffusion equation with the corresponding initial and boundary conditions. To describe the process with mathematical expressions, the Fick equation expressing the value of moisture content lead to a dimensionless formula. When the I-kind boundary conditions are accepted, the ratios of the moisture diffusion coefficient to the square of the determining size were determined by the least squares method using a special program with subprograms for solving partial differential equations with a sufficient number of exponents in the solution.

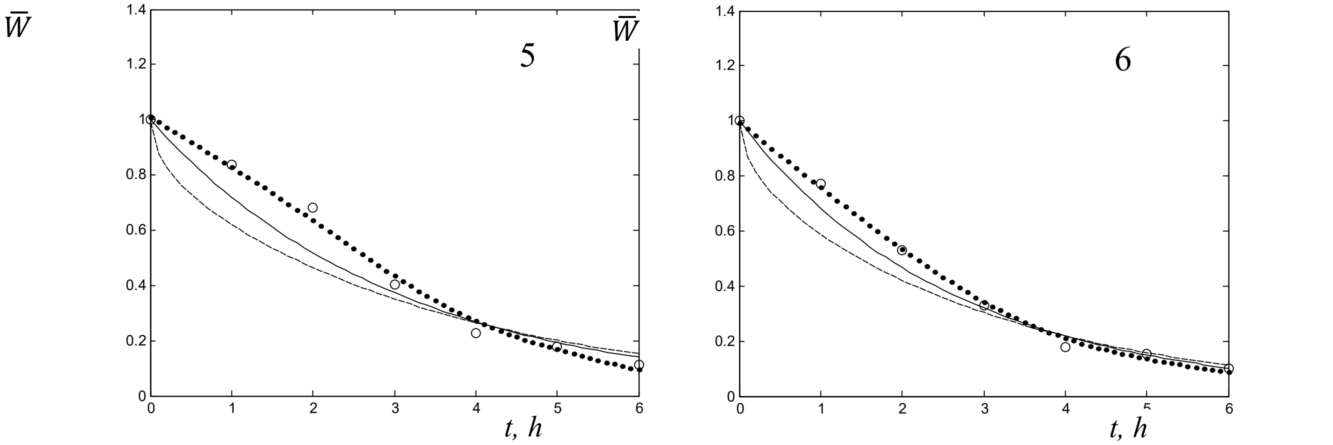
Key words: kinetics, Fick model, medicinal plants, drying rate.

The use of automatic control thermostats in the proposed technological installations allows us to consider the drying process isothermal [1-5]. At constant process temperatures, the drying kinetics can be considered through the Fick diffusion equation with the corresponding initial and boundary conditions. To describe the process with mathematical expressions, the Fick equation expressing the value of moisture content must be reduced to a dimensionless form using the following formula:

$$\overline{W} = \frac{W - W_p}{W_{н} - W_p}, \tag{1}$$

When the boundary conditions of the first kind are accepted, the ratios of the coefficient of moisture diffusion to the square of the determining size were determined by the least squares method using a special program with subprograms for solving partial differential equations with a sufficient number of exponents in the solution.

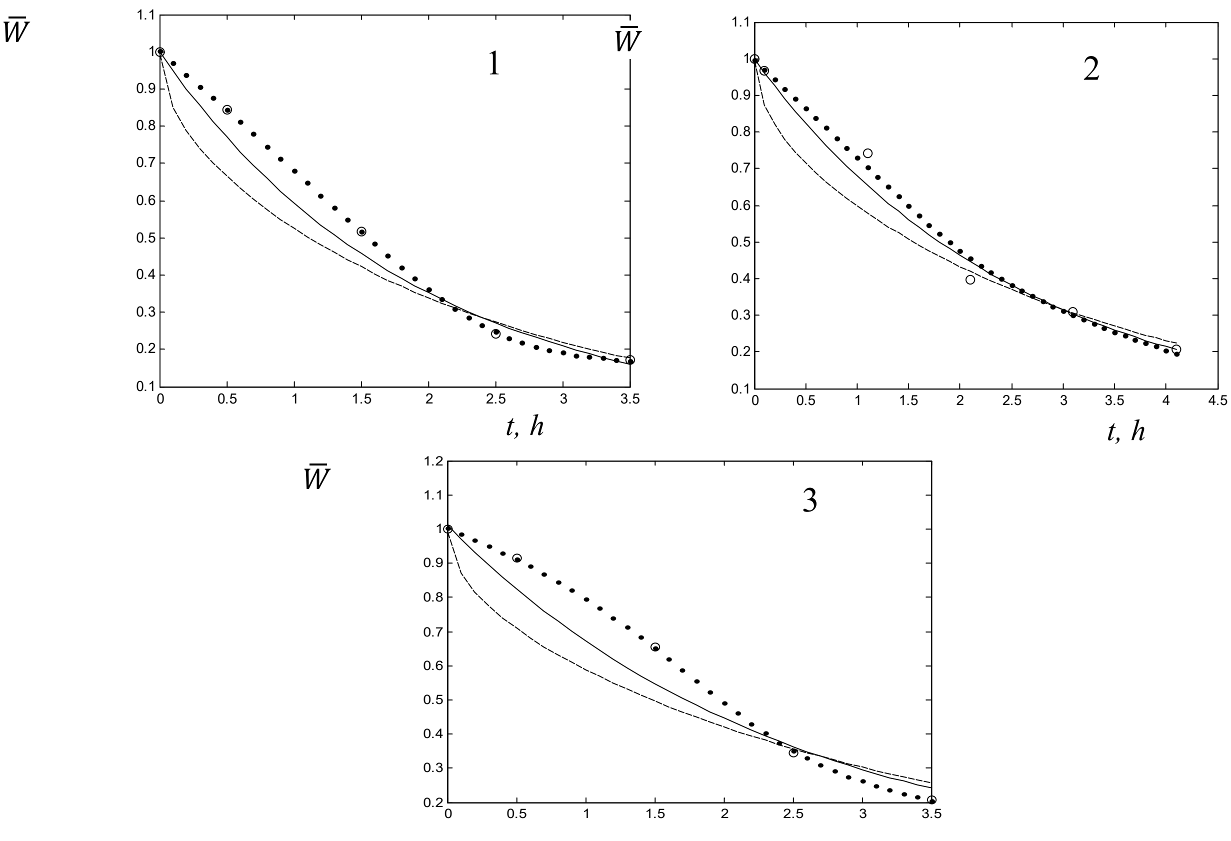




— - 1st-kind Fick model; – – – - 3-kind Fick model

1-curve drying ginger slices with IR heating; 2-curve drying the crushed mass of ginger with IR heating; 3-curve drying ginger slices in vacuum with infrared heating; 4-curve drying the ground mass of ginger in vacuum with infrared heating; 5-curve drying ginger slices in vacuum with infrared heating and vibration; 6-curve drying the ground mass of ginger in vacuum with infrared heating and vibration

Fig. 1. Kinetic laws of drying ginger



— - 1st-kind Fick model; – – – - 3-kind Fick model

1-vacuum drying with IR heating (drying temperature 50 0C; vacuum -0.8 atm); 2-vacuum drying with IR heating (drying temperature 65 ° C; vacuum -0.8 atm); 3-vacuum drying with IR heating (drying temperature 80 0C; vacuum -0.8 atm);

Fig. 2. Kinetic laws of the process of drying rose hips

Comparison of calculated and experimental data shows (Fig. 1 dashed line) that it is necessary to take into account the mass transfer coefficient between the phases. The results of data processing for various drying conditions and boundary conditions are given in table. 1-2 (Fig. 1-2).

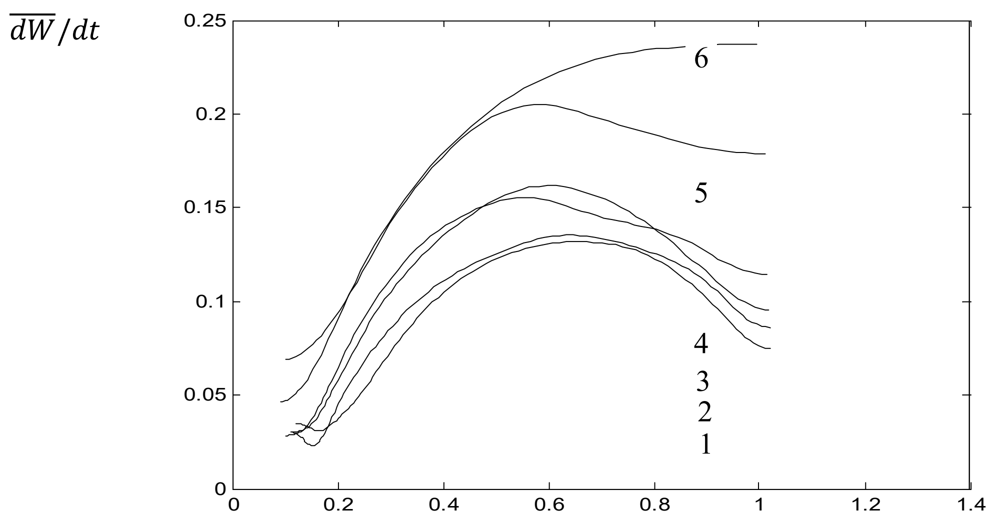
Table 1
Ginger kinetic data processing results

Model and drying parameters \ Drying mode		1	2	3	4	5	6
Fick equation with I-kind boundary conditions D/R^2, 1/h		0,0617	0,0668	0,0777	0,0824	0,1129	0,1328
Fick equation with III-type boundary conditions	D/R^2	1,410	1,776	1,7193	1,54	2,47	2,11
	Bio	0,133	0,1732	0,1367	0,1622	0,14	0,19

Table 2
Rosehip kinetic data processing results

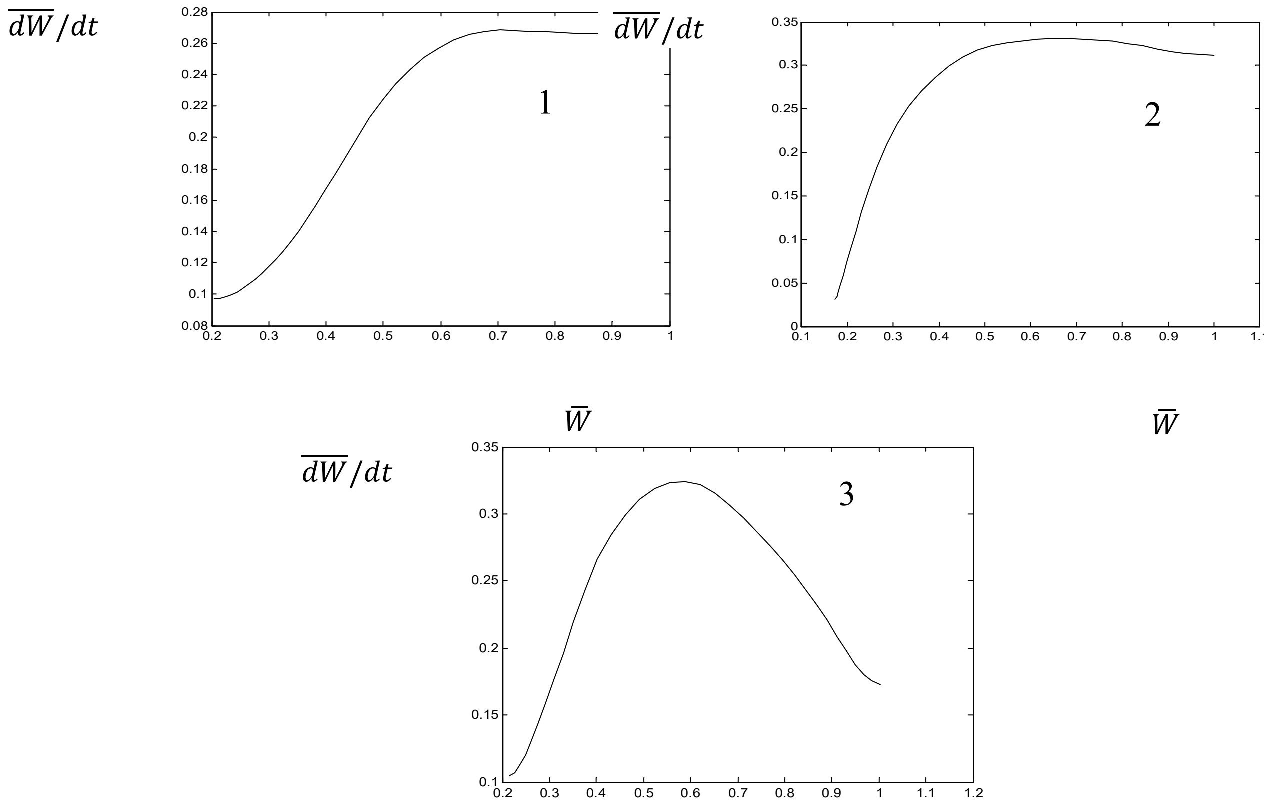
Model and drying parameters \ Drying mode		1	2	3
Fick equation with I-kind boundary conditions D/R^2, 1/h		0,1767	0,1328	0,1098
Fick equation with III-type boundary conditions	D/R^2	3,1663	5,0427	2,2966
	Bio	0,1744	0,0843	0,1537

We construct the drying curves using experimental data with a pre-leveled spline approximation (Fig. 3-4).



1-curve drying ginger slices with IR heating; 2-curve drying the crushed mass of ginger with IR heating; 3-curve drying ginger slices in vacuum with infrared heating; 4-curve drying the ground mass of ginger in vacuum with infrared heating; 5-curve drying ginger slices in vacuum with infrared heating and vibration; 6-curve drying the ground mass of ginger in vacuum with infrared l $\overline{W}$ ng and vibration

Fig. 3. Ginger Drying Curves



1-vacuum drying with IR heating (drying temperature 50 °C; vacuum -0.8 atm); 2-vacuum drying with IR heating (drying temperature 65 °C; vacuum -0.8 atm); 3-vacuum drying with IR heating (drying temperature 80 °C; vacuum -0.8 atm).

Рис.4. Кривые скорости сушки плодов шиповника

The quantitative formalization of the drying intensity under various drying conditions allows us to compare them: by the intensity of both internal diffusion and external mass transfer by arranging them in a row indicated in Table 1-2. According to the values of the Bio criterion, it can be stated that IR vacuum drying solves the problems associated with the limiting internal diffusion of drying. Further improvement of drying in the technological and constructive plans is based on the intensification of external exchange at the boundaries of particles and layers of material.

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