



Sustainable Energy in Food Production



GUIDES FOR INTERACTIVE LABORATORY EMPLOYMENT

«DEHYDRATION KINETICS OF FISH AT DIFFERENT DRYING CONDITIONS»

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1. Aim:

To develop rational regimes of dehydration using a technology which helps to find the technological parameters of drying.

2. Tasks:

1. Prepare semi-finished product for dehydration.
2. Determine the initial moisture content of fish and specific surface area.
3. Dry fish using four sections of YΠOP-M at various technological modes.
4. Fix the mass the change during dehydration, temperature, relative humidity of the drying agent inside and outside the device.
5. Determine the waste of electricity during dehydration for each technological regime.

3. Equipment and materials

Device for the search of drying parameters – YΠOP – M ; Balance scales; Personal Computer; Cutting boards and knives; salt, fish rods for stringing; frozen blue whiting.

4. Brief theoretical information

The technological scheme is shown on Figure 1. The production of dried fish is carried out in the following way:

Frozen fish is defrosted at room temperature up to 20 °C. Defrosting completed when the temperature inside the fish reaches - 2 - 0 ° C. Defrosted fish is washed in water at temperature up to 15 ° C. For drying use blue whiting which cut on backs. After cutting the fish is washed thoroughly with clean water with temperature up to 15 ° C; then the water should be drained. Salting of fish is carried out using brine method to achieve the desired salt content of fish. Fish is washed thoroughly. Then the excess moisture should be drained. Chose fish with same dimensional and mass characteristics. Determine the initial moisture content of fish with the express method using the Chizhova's device. Fish is then placed on metal rods for drying. There is a need to prepare at least four rods with fish with the same weight which should be placed inside the sections of YΠOP-M. Back-sides of fish are used for drying-ripening.

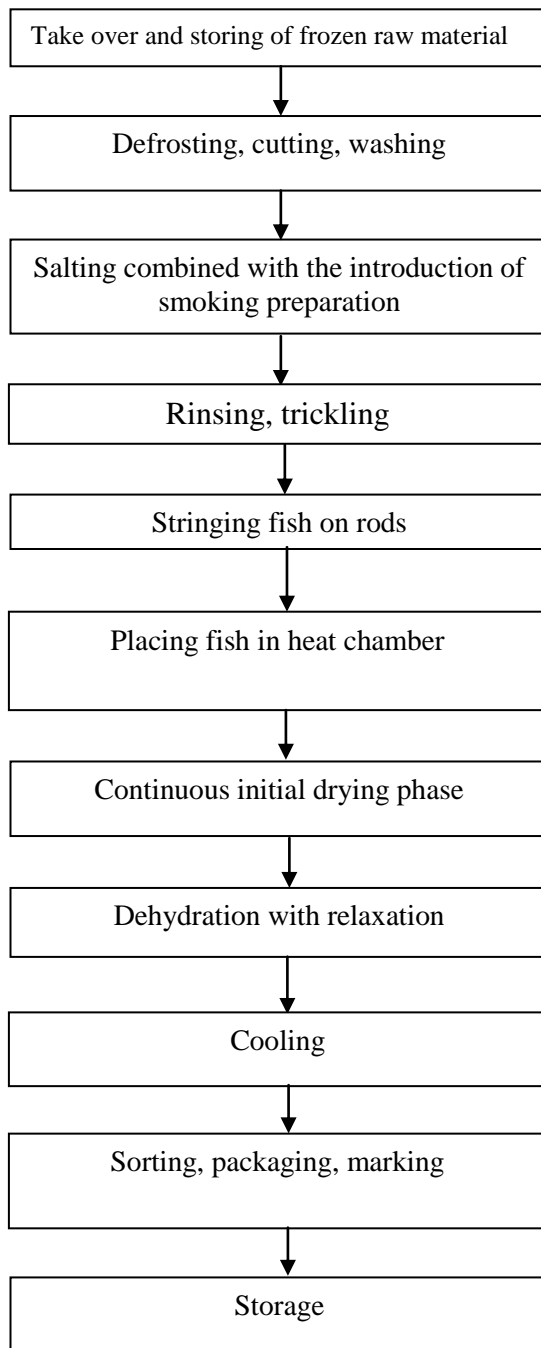


Figure 1 - Technological scheme of dried fish production

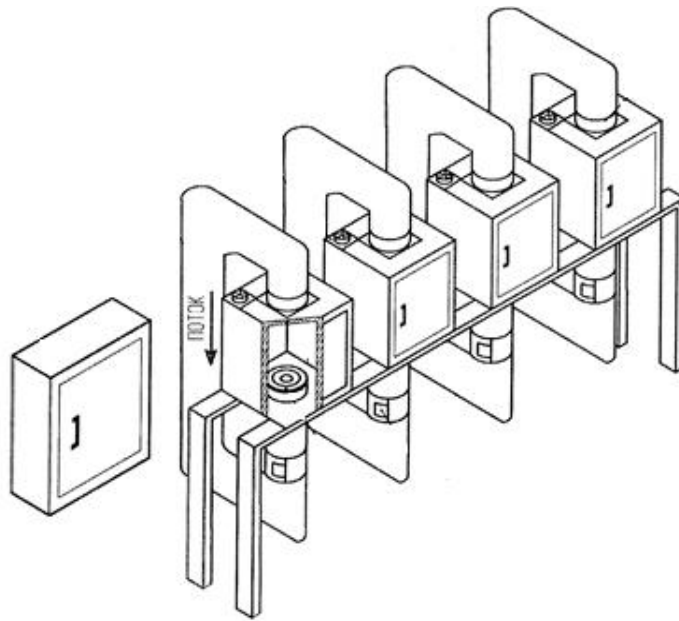


Figure 2 - The appearance of the YIOP-M

After loading the fish in drying chamber or oven, set the regime of dehydration using Table 1.

Table 1 – Regimes of dehydration for different drying sections of the «YIOP-M»

dehydration regime	section 1	section 2	section 3	section 4
Temperature °C	25	25	25	25
The initial continuous phase, h	The continuous regime (control)	6	6	6
The duration of the dehydration process, h	48	48	48	48
The duration of the period, h	-	3	3	3
The initial duration of the relaxation (the percentage from the total time)	-	10	10	10
The duration of the relaxation (the percentage from the total time)	-	30	30	40
The presence of moisture in the relaxation period (one-time moistening per the relaxation period)	-	-	+	+

5. Work description

Preparation work

After salting, rinsing and draining, the fish is weighed using scales with accuracy of ± 1 g and the surface of the semi-finished product is determined. To do this, the fish is placed on the graph paper and the circuit is encircled taking into account the curvature of the surface. This procedure is repeated for cut parts close to the neck and to the tail parts. Next, count the squares of obtained plots. Then perform the calculation of the specific surface of fish - S / m . The specific surface area in this case, the area ratio of fish S , m^2 , its mass m , kg. Determine the initial humidity ω_0 , fish% using the Chizhova's device.

Stringing fish on rods and placing inside the facility.

For stringing use several rods. Make holes from one side perpendicular to the vertebral bone. Place the fish at the middle of the rods.

Control parameters

During dehydration fix the temperature and relative humidity of the air in all the sections of the facility and outside. After the work is finished, the data processed and presented in the form of graphs. Electric supply is controlled by electric controllers. Before start and after the work it is necessary to record the readings for each section of the facility. During the drying process it is necessary to weigh the fish rods in each section at certain times.

Specifying the program

The data from Table 1 is transferred to a program installation - see Figure 3.

1 Секция			
Время участка	12	12	12
Температура	18	20	22
Поток РАБОТА	2	2	2
Поток РЕЛАК.	0.5	0.5	0.5
Период	4	3	2
R нач	0	15	30
R кон	10	30	30

РАБОТА/РЕЛАКСАЦИЯ

ПУСК

Figure – 3. The form to be filled to set the parameters of dehydration regimes

Report the initial moisture content of fish, ω_0 % and the specific surface area of fish S/m , m^2/kg

Specific surface area, S/m ² /kg	Initial moisture content ω ₀ , %

Fix the initial weight of rods and initial readings of electricity controllers for each section,

Weight of rod, g			
section 1	section 2	section 3	section 4
Initial readings of electricity controllers P ₀ , kW			
section 1	section 2	section 3	section 4

Weight change of fish is fixed in Table 3

Table 3 Weight change of fish during the drying process

Date	Time	Duration of work	Control the mass loss of fish in sections			
			№ 1	№ 2	№ 3	№ 4
			Weight fish with rod (kg)	Weight fish with rod (kg)	Weight fish with rod (kg)	Weight fish with rod (kg)
		0 h. 00 min.				

The completion of the drying process

At the end of the drying process, the device is switched off. Take the fish out of the facility. Take readings of energy consumption fixed by electric controllers in each section.

Evaluation of appearance of finished products

Evaluate the appearance of the product for each regime of drying fish. The evaluation results are reported in Table 4..

Table 4 Fish appearance after drying

Characteristical appearance	section 1	section 2	section 3	section 4
Deformation of fish shape: - Significant (appreciably strong curvature of shape) - Mild (curving shape are present); - A slight (slightly curved shape of fish) - Absent (without the change of fish shape)				

Calculating the energy used for each section of the facility P, kW:

$$P = P1 - P0, (1)$$

Where P0, P1, the initial and final indications of electric controllers P0, kW.

Plotting of curves the kinetics of drying fish

Moisture content of fish at the start of the drying process - this is the initial moisture content of fish, referred to the dry weight, which is given by formula ω_0^c , %:

$$\omega_0^c = \frac{\omega^0 \cdot 100}{100 - \omega^0} \quad (2)$$

where ω_0^0 – moisture content of fish, referred to its total mass, %

To draw the dehydration kinetics curves, there is a need to find the amount of dry matter in fish m_c , kg, according to the formula:

$$m_c = m_H (1 - \omega_0^0 / 100), \quad (3)$$

where m_H – fish weight at the start of the drying process (without the weight of rod Table. 3) kg.

Moisture content of fish ω_i^c , %, at a certain time point τ_i , referred to the dry weight, is given by formula:

$$\omega_i^c = (m_i / m_c - 1) 100 \quad (4)$$

where m_i – weight of fish at a certain time point.

At the end of the work it is necessary to make a conclusion about the effectiveness of the selected regime based on the amount of used electrical energy and evaluate the appearance of the finished product

The content of final report

1. Title of laboratory work
2. Aims and objectives
3. Tasks
4. Technological scheme of production
5. Organoleptic evaluation.
7. The graphs of temperature and relative humidity changes in the sections
УПІОР - М.
8. The conclusion about the effectiveness of the selected regime.