Sustainable Energy in Food Production

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GUIDES FOR INTERACTIVE LABORATORY EMPLOYMENT

«STUDY OF HOT SMOKED FISH AND DETERMINATION OF PARAMETERS OF THE ENERGY SAVING MODE»

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1 Purpose: Study the process of heating hot smoke fish with infrared radiation and determination of parameters of the energy saving mode

2. Objectives:

    1. Prepare half-stuff for thermal treatment.

    2. Make a heat treatment on a small sized drying apparatus.

    3. During the heat treatment we need to fix the change dynamics of fish mass, and the temperature on the surface and in the center of the fish.

    4. Determine the organoleptic characteristics of fish after heat treatment.

3. Equipment and materials:

    Compact dryer apparatus; platform scales; personal computer; cutting boards and knives; rods to string fish; grouper; smoking preparation «Antonio-Silver»

4. Brief theoretical information

    Usually ice raw thawed at a temperature about plus 18 ° C. Duration of the defrosting process depends on the kind of raw material and way of defrosting process. Defrosted or chilled fish should be carefully washed, then sorted by size and species, non-standard items must be removed.

    Salting fish. Hot smoked fish salting with taste non-conserved pickling. For salting half-stuff salt should be dissolute in density of 1.08 g/cm3, then add "Antonio-Silver" in value of 1: 4.5. Half-stuff must be salted at a ratio of fish and salting solution 1/2 for 40-60 min. Salted fish must swill out by fresh water and tie to avoid falling under headdress on a cleaning rod and rails, or spread out on a grid.

    Work on hot smoking of fish carried out in two stages: drying and boiling.

    Drying is carried out under the influence of the air temperature from 70 to 80 °C and a relative moisture of 40 to 60%. End of drying must be controlled organoleptically - by tracking dried skin of the fish. Purpose drying is to remove surface moisture and increase the mechanical strength of the fish tissue. Weight loss on drying reaches 5% by weight of the half-stuff.

    Boiling of fish is effected by infrared radiation at the surface of the Half-stuff product from 100 to 120° C. The purpose of this process is to bring the product to a complete culinary readiness, a sign of which is the separation of the fish meat from the bones, blood clotting and complete denaturation of proteins. The fattier fish, the lower should be boiling temperature, otherwise it may be irreparable defect - "burstenets". At this stage, smoking mass of half-stuff product losses about 15%.
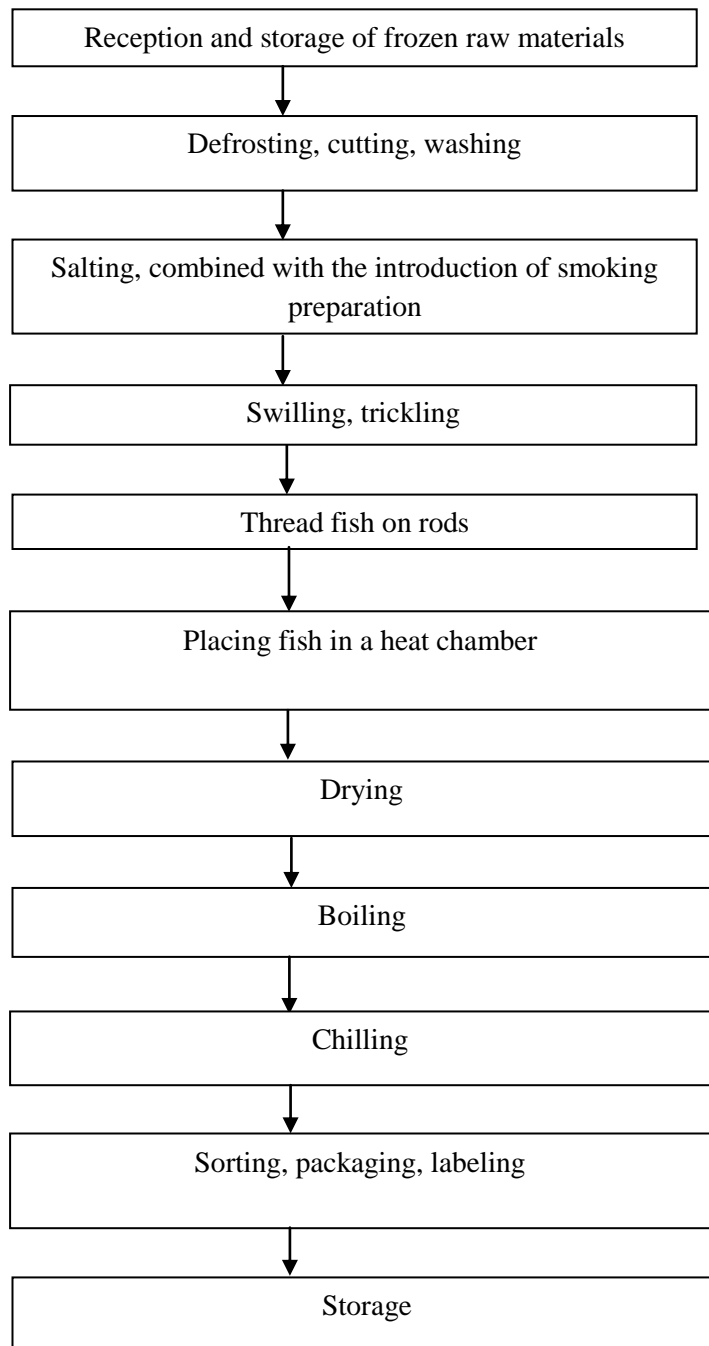
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│   Reception and storage of frozen raw materials  │
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                        ▼
┌─────────────────────────────────────────────────┐
│           Defrosting, cutting, washing           │
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│  Salting, combined with the introduction of      │
│              smoking preparation                 │
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┌─────────────────────────────────────────────────┐
│               Swilling, trickling                │
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│               Thread fish on rods                │
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│          Placing fish in a heat chamber          │
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│                     Drying                       │
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│                    Boiling                       │
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│                    Chilling                      │
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│           Sorting, packaging, labeling           │
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│                    Storage                       │
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Fig. 1. Technological scheme of smoked fish production

4.   Work implementation
Measuring work

After salting, swilling and trickling the fish is weighed in the weighing machine with an accuracy of $\pm$ 1 g and determine the surface of the half-stuff product. To do this, the fish is placed on the graph paper and then encircled by a pencil, while taking into account the curvature of the surface of half-stuff product. This procedure is repeated for the cut parts and tail chapter. Then counts areas of received plots. Calculations specific surface fish - S / m. The specific surface area in this case, the area which depends on of fish S, m2, its mass m, kg.

Thread on fish bars and accommodation in the installation.

For threading use multiple rods. The fish is pierced by one of the side surfaces perpendicular to the vertebral bone. Length rods are aligned on each side of the fish so that the half-stuff product located approximately in the middle.

Temperature control

To control the temperature in the center of the fish use sensor made of a probe. The sensor is placed along the vertebra of the fish. Fish along the probe is placed on a special bracket in a small dryer which had previously been heated to a temperature of 80° C. Installation diagram is shown in figure 2.
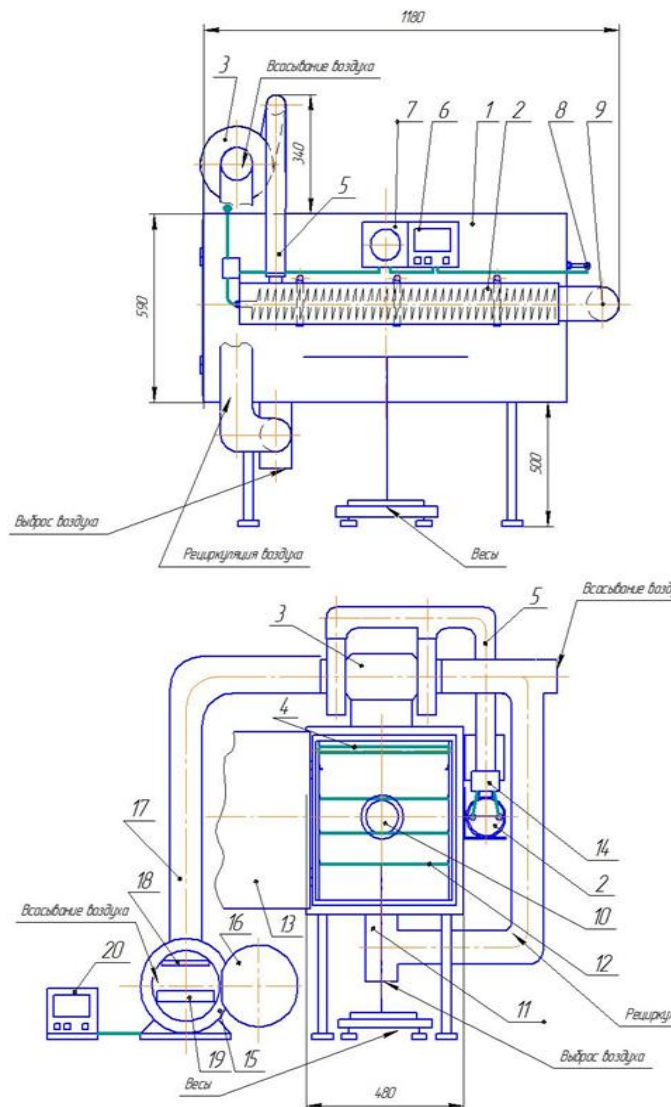
1 – corpus; 2 – air heating chamber; 3 – double-sided centrifugal fan; 4 – infrared lamps; 5 – forcing air conduit; 6 – meter - temperature control; 7 - radiator for cooling triac; 8 - temperature sensor «ДТС-125-50М»; 9 - air inlet into the chamber; 10 - air intake window in the chamber; 11 - socket for air ejection out of the chamber; 12 - mesh trays; 13 - door loading and unloading; 14 - junction box; 15 - infrared smoke generator; 16 - door loading infrared smoke generator; 17 - smoke-air mixture supply pipe in the installation; 18 - infrared lamp heating chip; 19 - the tray to accommodate the chip; 20 - voltage converter.

Fig. 2. Small-sized dryer scheme

After placing the fish in the apparatus, we produce measurement of the mass of fish, rods and probe using the weighbridge. The adequacy of the instrument operation is checked with a test weight (200 g).Together with the teacher, students are input technological mode parameters (Table 1) in the control unit.

Table 1

Modes of smoking	Type of raw materials, cutting	
	grouper	**mackerel**
	gutted headless	gutted
Drying	а) τ_{dr}= 20 min; б) τ_{dr}= 30 min. Operating mode Auto - surface temperature control t_{con} = 80^0 C. *Power of tubular electric heater (TEN)* N_{ren} **= 100 %;** **The power of infrared light (IR) N_{ik}:** **N_{ik} = 0%;**	τ_{dr} = 20 min. Operating mode Auto - surface temperature control t_{con} = 80^0 C. *Power of tubular electric heater (TEN)* N_{ren} **= 100 %;** **The power of infrared light (IR) N_{ik}:** **N_{ik} = 0%;**
Boiling + smoking	*Duration of boiling to a temperature in the fish center = 83° C.* t_{center} = 83 °C. *Power of tubular electric heater (TEN)* N_{ren} **= 100 %;** 1. Operating mode Auto - surface temperature control: а) t_b = 100 °C; б) t_b = 110 °C; в) t_b = 120 °C. **The power of infrared light (IR) N_{ik}:** **а) N_{ik} = 70 %;** **б) N_{ik} = 80 %;** **в) N_{ik} = 90 %;** **г) N_{ik} = 100 %**	

Every 5 min. produce readings monitored parameters:

1. The mass of the half-stuff product;

2. The air temperature in the chamber;

3. The temperature of the half-stuff product surface;

4. The temperature at the center of the fish.

The data are entered in the laboratory work report (Table 2).

The parameters of the process are

Mass of fish_____ kg

The number of fish on the bars _____ n

Mass of the fish with rods and probe _____ kg.

Table 2 -Changes in temperature and weight of the fish during the heat treatment

Date	Time	Duration of work	Parameters control			
			№ 1	№ 2	№ 3	№ 4
			Mass of	Temperature	Temperature	Temperature

			the fish with rods and probe (kg)	in the chamber (°C)	on the fish surface (°C)	in the fish centre (°C)
		Drying 0 h. 00 min.				

Construction of temperature changes during the heat treatment.

Construction of temperature changes in the chamber, on the surface and in the center of the fish are performed automatically by the software "compact automatic control system of the drying apparatus".

Plotting fish mass changes during the heat treatment.

Plotting fish mass changes during the heat treatment are based on the data of Table 2. On the plots are marked periods of drying and boiling fish.

Calculation of mass loss during drying V_p (kg/h) is conducted according to the formula:

$$V_p = (M_{dn} - M_{dk})/\tau_p \qquad (1)$$

wear M_{dn}, M_{dk} - the initial and final weight of the fish at the stage of drying, kg;

τ_d – duration of drying, h.

Calculation of mass loss during drying *boiling* V_{pr} (kg/h)) is conducted according to the formula:

$$V_{pr} = (M_{bn} - M_{bk})/\tau_\text{п} \qquad (2)$$

wear M_{bn}, M_{bk} - the initial and final weight of the fish at the stage of boiling, kg;

τ_b – duration of boiling.

Chilling

At the end of the process apparatus and smoke generator must be disconnected from the network. To ake the fish out of the installation, you need to use gloves to avoid burns. The resulting product is placed on clean trays to cool.

Tasting

Fish tasting after cooling. Organoleptic characteristics must be compared with the requirements of regulatory documents. The report is in the table 3.

Table 3 - Table of hot smoked fish organoleptic evaluation

Index	Characteristics	Result
appearance	Condition of the skin (the presence or absence of skin breaks), color from light golden to brown	
Aroma of hot smoking	Pronounced, moderate, weak, absend	
Consistency	Thick or soft, juicy	
Taste of hot smoking	Pronounced, moderate, weak, absend	

The conclusion bases on the temperature changes schedules and weight of fish in the stages of drying and boiling, make the decision about the impact of the methods of thermal energy supply to the process of warming up the tissues of fish.

The content of the report

1. Title of work

2. Aims and objectives

3. Work objectives

4. Technological scheme of production

5. Sensory evaluation.

7. The graphs of temperature changes on the surface of the fish and its centre, fish mass loss during the heat treatment.

8. Conclusion