
Impact on the Quality of Smoked Fish Products

Vasyukova A.T.

Ph.D Technical sciences, Professor

Vasyukov M.V.

Teacher

Annotation: *In the article results of research of influence of various factors on quality of smoked fish production are resulted. Changes in moisture and accumulation of phenolic compounds in fish are shown.*

Keywords: *temperature, smoking the fish, the colour, traditional technology, organoleptic properties, experiments.*

1. INTRODUCTION

A fragrant, inviting smoked fish is one of the most delicious appetizers. Smoking is the treatment of a product with smoke generated during the combustion of sawdust or firewood. Smoked fish has a unique aroma, especially melting, delicate taste, it excites the appetite with all its appearance and smell. (A.T. Vasyukova and N. N. Shvedenko (2003), smoking of pickled fish. - Donetsk: DUNPGO, 104 pp.).

However, a number of factors will influence the quality of fish.

Thus, Agamov AN (AN Agamov (2002) Quality and safety of cold-smoked fish and ways to improve them - Astrakhan, diss ... cts, 132 p.) Determined the effect of shelf life and temperature difference of the salted pre-smoked food, and Also the duration of drying on the quality characteristics of smoked fish. In this process, the importance also has a method for cleaning smoke, which affects not only the change in the qualitative characteristics of smoked fish, but also its state during storage.

Petrov DS (Dmitry Petrov (2013) Influence of infrared processing on the parameters of the quality of capelin cold smoked <http://www.dissercat.com>) established the features of the influence of infrared treatment on the quality of capelin, which was subjected to cold smoking.

A number of authors have studied the influence of the pedigree of the carp of domestic selection on the yield and quality of the products of cold smoking (AI Portnoy, TV Portnaya, DV Chernyakov (2012.) The

influence of the breed carp on the yield and quality of cold products Journal of "Actual problems of intensive development of livestock." - P. 378-380.).

Thus, there is a need for a comprehensive solution to the problem of the quality and safety of cold-smoked fish and the development of more environmentally friendly ways of processing it.

The aim of the work is to improve the quality and safety of marinated cold smoked fish by investigating the effectiveness and environmental friendliness of existing smokehold technologies and their corresponding modernization.

2. MATERIALS AND METHODS

2.1. Plant materials and preharvest treatments

Skinny fish species were used for smoking: salmon, pollock and hake.

Cold smoked fish began with the preparation of carcasses: cleaning, trooping and cutting. To do this, it is important to observe a certain technology to gently pull the insides, including caviar and milk of fish.

The ambassador started with the preparation of the solution. It was prepared from edible salt (NaCl). There are two types of solution concentration - 5-8% or 27-33%. We used a salt solution with a concentration of 5-8%.

For flavoring, fish used spices (lav-roy leaf, garlic, thyme, rosemary, sugar, pepper black peas) and limono acid or table wine, beet or apple juice, vegetable oil. The brine was boiled and cooled (A.T. Vasyukova, N. N. Shvedenko., 2003. Smoked pickled fish - Donetsk: DUNPGO, - 104 pp. A collection of recipes for food and culinary products for public catering enterprises. Moscow: Academy, 1998. - 720 p.).

The brine was prepared in such a quantity that 1.5 parts of the solution came to one part of the fish. This ratio ensures a uniform distribution of fish in the liquid and their salting. The fish was laid out in a non-smooth

plastic pallet, filled with the calculated volume of brine and left in a room with a temperature of 8-10 ° C for 12 hours.

Smoking was carried out with cold smoke at a temperature of 25-30 ° C or 23-40 ° C. Medium carcasses were smoked for 4 days, small (up to 500 g) 2 days, and large specimens - up to 7 days. When the process is completed, the fish are not immediately removed from the frames, but allowed to still hang and sweat up to 2 days. Then the fish acquired a smooth golden hue and rich taste.

Pre-marinated fish carcasses were subjected to smoking (GOST 11482-96 "Cold-smoked fish. Technical specifications"). At the end of the process, the fish was taken out of the chamber, cooled and evaluated for quality of finished products (GOST 7630-96 "Fish, marine mammals, marine invertebrates and their products", section - Acceptance rules, organoleptic methods of quality assessment, sampling methods).

2.2. Analytical methods

The sorption of the smoking components was judged by the content of phenols and acids in the skin of the fish.

The color of the surface (lightness of color,%) of smoked fish was determined using a CR 200 colorimeter from Minolta (Japan). The extraction of smoking components from the skin of the fish was carried out by distillation with a 30% solution of lithium chloride (Scheffer A. & Saatchan A. (1967). Rapid cooling of meat by air-choking. - Moscow: TsIN-Tipishcheprom. - 63 pp.) Followed by the determination of phenols and acids in the distillate (Bal VV, Domintova SR (1967) .The change in the fat of fish when it ripens., Journal "Food technology", No. 2. - p. 36-39). For comparison, smoke-smoked fish, not subjected to preliminary marinating, was prepared using traditional technology from the same cheese.

The concentration of smoking components in the chamber was determined by calculation, based on the amount of the substance to be dispersed during the combustion of wood and the volume of the chamber.

Determination of the moisture content in the skin of fish. To conduct the research, the raw materials were defrosted and then kept in a desiccator with relative air humidity of 100% at a temperature of 4 ° C. After two days of storage of fish under these conditions, hygrometric equilibrium was established.

2.3. Statistical analysis

At least three replicates were carried out for each determination. Results are expressed as mean values \pm standard deviation. Data were subjected to analyses of variance (ANOVA), and multiple comparisons between means were determined using the LSD test ($P \leq 0.05$) (Manugistics, Inc., Rockville, MD, USA).

Correlation coefficient

The geometric meaning of the correlation coefficient: r_{xy} shows how different the slope of the two regression lines is: $y(x)$ and $x(y)$, how much the results of minimizing deviations in x and in y differ. The larger the angle between the lines, then the greater r_{xy} . The sign of the correlation coefficient coincides with the sign of the regression coefficient and determines the slope of the regression line, i.e. General orientation of the dependence (increase or decrease). The absolute value of the correlation coefficient is determined by the degree of closeness of the to-check to the regression line. ([Http://math.semestr.ru/corel/prim.php](http://math.semestr.ru/corel/prim.php)).

Properties of the correlation coefficient

1. $|r_{xy}| \leq 1$;
2. If X and Y are independent, then $r_{xy} = 0$, the converse is not always true;
3. If $|r_{xy}| = 1$, then $Y = aX + b$, $|r_{xy}(X, aX + b)| = 1$, where a and b are constants, and $\neq 0$;
4. $|r_{xy}(X, Y)| = |r_{xy}(a_1X + b_1, a_2X + b_2)|$, where a_1, a_2, b_1, b_2 are constants. ([Http://math.semestr.ru/corel/prim.php](http://math.semestr.ru/corel/prim.php))

3. RESULTS AND DISCUSSION

The quality of fish with cold smoking using smoke when burning sawdust of pine or cherry is associated with the sorption of its smoking components, which in turn depends on the parameters of the working smoking environment (temperature, speed, etc.), the concentration of components in the chamber. (Donchenko LV (2006) Food in the Domestic and Foreign History / LV Donchenko, VD Nadykta .- M.: DeLi Print, - P. 16.).

Carrying out studies to study the rate of accumulation of the working smoking environment in the smoke chamber and the temperature of dispersion of smoke particles by the fish surface are necessary for the development of recommendations for production. Along with the loss of fish weight, it is necessary to take into account the concentration of smoking components

in the chamber, which depends both on their volume and composition (type of wood).

During the cold smoking process, the fish were dried and smoked at temperatures of 23-40 ° C. The effect of warm air and smoke-air mixture causes directional changes in the fish tissues, which contribute to the formation of specific properties of cold-smoked fish. Smoked fish was sent to smoked fish, which was soaked after pickling, so changes in tissues during cold smoking are to some extent similar to changes in the ripening of salted fish, but ripening in this case takes place in slightly different conditions. (Vinnikova LG (1997), Physical and Chemical Aspects of the Interaction of Proteins with Insoluble Polysaccharides, Magazine "Storage and Processing of Agricultural Materials", No. 12. - P. 13-17; Functional foods by Goldberg Chapman & Hall. 1994. - No. 4. - 582 pp. Flak E. (1987) Modern food production // Food Sci. And Tech. Today - No. 4. - P. 240 - 243).

Significant changes in fish during cold smoking occur under the action of enzymes contained in tissue cells (tissue enzymes), enzymes of the gastrointestinal tract, enzymes produced by microorganisms in fish, as well as components of smoke smoke.

Under the influence of enzymes, protein and fat breakdown. These questions will be examined by us in the following areas of research. However, changes in the skin, the diffusion of smoke components and pigmentation marinade into muscle tissue and other tissue types are of direct interest in the development of a new smoking technology, both whole carcasses of pickled fish and skinned. The results of the studies are given in Table. 1.

Table 1: Effect of smoking on fish color and moisture content

Name samples	The color of smoked fish at the concentration of phenols in the chamber			The moisture content of the skin of fish, %
	0,2 %	0,3 %	0,4 %	
Smoked fish (control)	Very yellow	Straw color	Golden	9,7
Salmon marinated smoked	Intensely yellow	Straw color	Intensely golden	10,2
Marinated smoked pollack	Intensely yellow	Sand color	Golden	12,5
Hake marinated smoked	Very yellow	Straw color	Golden	12,5

The obtained results indicate that at the concentration of phenols in the chamber to 0.3% leads to the production of a very yellow colored surface.

This relationship is observed in the study of all samples and the control. The most pronounced color is noted in Alaska pollack with flavoring additives of cold smoking, since when it is marinated it is used svek-lye juice, which enters one of the components into the marinade mixture. However, the introduction of vegetable oil with saline in the solution makes it possible to improve the juiciness of the skin of the fish and at low concentrations of phenols in the smoking chamber, the moisture content in the skin of all fish samples is greater (in salmon 10.2% in pollock and hake-12.5%)

Reducing the concentration of smoking components in the working environment of the smoking chamber leads to a reduction in the signs of smoked products: the color, taste and smell of fish weaken. This is confirmed by the results of chemical analyzes: the phenol content in the skin of fish is reduced by 2.7 times, and the acid content is 1.29-1.32 times.

According to the organoleptic properties and objective indicators, the traditional smoky smoke fish was similar to the sample of cold smoked salmon, but the skin surface had a less intense color. The results of the chemical analysis also showed similar levels of phenols in the skin.

The consumption of sawdust during smoking is associated most often with the mass loaded into the fish chamber. Therefore, the relationship between the smoke concentration of the chamber and the amount of fish raw material was established. The indicators are shown in Table. 2.

Table 2: Efficiency of Pair-Lined Correlation Between Influenced Factors and Studied Parameters

Influenced factors	Studied parameters		
	Concentration of phenol on fish skin		Lightness of coloration, %
	mg/100g raw material	% dry stuff	
Phenol concentration in medium g/m ³	0,92	0,93	0,90
Phenol quantity in chamber per unit of fish quantity, g/kg	0,83	0,84	0,77

The analysis (Table 2) showed that the closest correlation between the concentration of smoking components in the chamber and the quality of the smoked product (the concentration of phenols in the

skin). It is known that the color of smoked products is most affected by the carbonyl compounds of the smoking environment, but their definition is fraught with a number of difficulties, since a number of extraneous factors influence the results of the chemical analysis of the content of carbonyl compounds in smoked fish.

Shown in Table. 2, the correlation coefficients between the phenol content in the medium and the color of the smoked product may indirectly indicate a similar relationship between the concentration of carbonyl compounds in the medium and their sorption by the skin of the fish during the smoking process.

Skin integuments of the fish, which are the surface layer that determines the fish tissues from the environment, have a special colloidal-chemical structure, different from the structure of the muscle tissues.

The conditions for the transfer of energy and matter in skin integuments of fish depend on their colloidal and structural-mechanical properties, as well as on their changes in the process of smoking.

As is known, the skin of the fish, which is 80% of its surface, consists of the epidermis, the thin semi-epidermal layer (basal membrane), and the dermis proper.

According to our experiments, the moisture content of the skin of the autumn-winter silver hake is less than that of its muscle tissues and constitutes, on the average, $55 \pm 3\%$. For the experiments we used a hake stored in cold boxes in boxes at a temperature of $\sim 15^\circ \text{C}$.

At the same time, moisture evaporated from the surface of the fish. The moisture content of the skin and muscle tissues of silver hake is given in Table. 3.

From the data given, it can be seen that the moisture content of the skin layers throughout the entire experiment remains less than the moisture content of the muscular tissue and approximately constant.

Table 3: *Moisture of the skin and muscle tissue silver hake*

Measurement time	Humidity, %		
	Skin sheets	The exterior layer of muscle tissue	The inner layer of muscle tissue
0	65,0	78,8	85,3
24	63,6	69,3	74,2
30	64,0	74,6	77,4

Thus, the given data on the moisture content of the skin and muscle tissues in a state of hygrothermal equilibrium suggest that the skin has a more dense colloidal structure than the muscle tissue.

To determine the conditions for the transfer of moisture in the skin and muscle tissues, experiments were carried out on a drying unit for drying silver hake with removed skin and in general form. Sub-drying was carried out at constant air temperatures ($t_c = 40^\circ \text{C}$ $\varphi = 10$ $v = 2 \text{ m / s}$).

The results of the experiments are shown in Fig. 1.

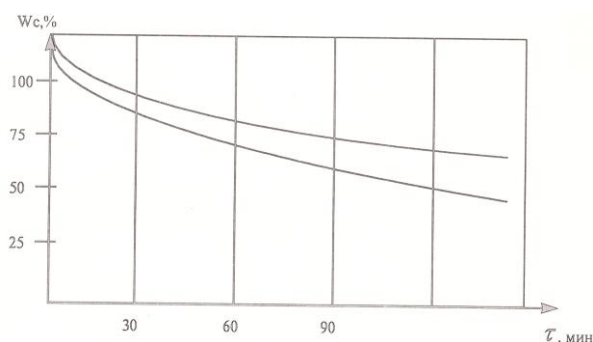


Fig 1: *Effect of skin integument on the drying process*

The graph shows that the drying of whole fish 1 goes 2-3 times more slowly than fish with removed skin. Skin covers are formed by a large number of pores and capillaries.

The drying of whole fishes proceeds with a continuous decrease in the speed, which can be explained by the peculiarities of the structure of the tissues and the transfer of gluten into the surface layers of the skin of the integument. In the drying process, gluten gelatinizes in the pores and capillaries of the skin, gradually worsening the conditions of moisture transfer. In this case, the cells and tissues of the skin are not destroyed.

Overdrying the skin of fish slows the deposition of smoke components on the surface of its body. To improve the conditions of cold smoking, it is necessary to choose the optimal drying conditions for each fish species, ensuring the maintenance of the moisture content of the skin at a level that determines the normal smoking conditions. Our further research answers these questions. Their results are included in the technological instructions for the production of smoked flavored fish products: salmon, pollock, hake.

4. CONCLUSIONS

Thus, as a result of the conducted studies, it has been established that skin integuments of fish have a denser colloidal structure than muscle tissues, therefore they

worsen the process of moisture transfer from muscle tissues to the environment. The product remains juicy.

The drying of whole fishes proceeds with a continuous decrease in speed, while the cells and tissues of the skin do not collapse.

During the cold smoking process, the fish are dried and smoked. Significant changes occur under the action of enzymes contained in tissue cells and produced by microorganisms, as well as components of smoke smoke. The breakdown of proteins and fat occurs.

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