

**Technology of curing and fumeless smoking of chicken carcasses under conditions of hydro-pulsed effects**

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**Introduction**

It is shown by many investigations (1, 2, 3) that contamination of meat products by polycyclic aromatic hydrocarbons (PAH) is clearly associated with smoking technology. It was found that hot-smoked meat products often contain a higher content of benzo(a)pyrene as compared to cold smoked meat products. The decisive factor in the contamination of meat products by PAH is the presence of these compounds in a smoking fume, which in turn depends primarily from the temperature of fume formation (4, 5) and as it raises from 400 to 700°C, their content increases. Smoked poultry meat products (smoked whole chickens, smoked chicken legs) are in demand. But technologies of poultry meat smoking involve long time of curing process, and subsequent smoking and frying by a smoking fume lead to the accumulation of carcinogenic compounds in products, such as benzo(a)pyrenes and nitrosamines, that are harmful for health of a human being. Therefore, the produced smoked foods, including those from poultry meat, generally don't meet the to-day's requirements both from ecological safety and technology. A change from treatment of the products by smoking fume to fumeless method of smoking with the use of smoking preparations (6, 7) is an effective method for the elimination of coming of smoking substances in meat products.

**Objective of work**

The investigation of the influence of hydro-pulsed effects of the curing liquid, containing smoking aromatizer on the distribution of curing ingredients and smoking substances over muscular tissue of chickens, the evaluation of properties of the cured semi-prepared product and quality characteristics of smoked-cooked products from poultry meat.

**Methods**

In the experimental investigations the influence of the time period of hydro-pulsed oscillations on the penetration of phenol fraction of the smoking aromatizer and sodium chloride from the cure into the depth of the leg muscle of chickens was studied. The carcasses of broilers with the weight 1000±100 g were placed into treatment tank of the plant, covered it with the cure and applied the pulses with the frequency 50 Hz and amplitude 2 mm during 240 min. The cover cure was prepared as follows: for 100 l of water 5 kg of sodium chloride, 0.01 kg of sodium nitrite, 0.54 kg of sugar and 5 l of smoking aromatizer were used. A new smoking aromatizer with the commercial title "Liquid smoke plus", developed and produced by ZAO "Biotechnological center", Novosibirsk and KemTIPP, Kemerovo was used. In the course of the experiments distribution of phenol substances and sodium chloride over layers of the leg muscle was fixed as well as the total contents of these components in tissues. Comparative investigations of physical and chemical characteristics of muscular tissue of chickens treated in the cure by pulsed effects and kept in the cure according to traditional technology were carried out. Finally, quality evaluation of ready products was performed.

**Results and discussion**

Based on the data obtained it was found that as a result of tensile oscillations of the cure the smoking substances and curing ingredients are intensively penetrating into the depth of muscles and distributed over the whole volume of the product. From the data of Table 1 one can see that the total content of phenols in the average specimen of the muscle increased from 4.2 to 7.2 mg per 100 g of muscular tissue with the increase of time length of treatment from 1 to 4 hours. However, as the results show the content of phenols over the layers of the leg muscle varies, the most part of them was found in the skin, independently on the time length of treatment. But when the hydro-pulses work during 3 hours and longer, the non-uniformity of phenols content over the volume of products is smoothed and doesn't exceed 15%. Similar results were obtained with respect to quantitative distribution of sodium chloride. Sensory evaluation of ready products – cooked-smoked chickens – has shown that the treatment of carcasses with the cure, containing smoking aromatizer, by the method of hydro-pulsed effects during 3 hours ensures the flavour and aroma of a smoked product. The experiments have shown that when keeping the chicken carcasses under stationary conditions the needed amount of phenols, giving a smoking flavour and aroma to the product (5-7 mg per 100 g of the product) is accumulated only after 10-13 hours of keeping in the cure. Results of physical and chemical investigations of cured semi-prepared products and quality characteristics of smoked chickens show (Table 2) that treatment of chicken carcasses in the field of tensile oscillations of the cure, containing smoking aromatizer, by 3.6% reduces water-binding capacity of muscular tissue as compared to the samples kept in the cure during 18 hours without smoking aromatizer. The treatment of carcasses with smoking aromatizer leads to the increase of hydrogen ions concentration in muscular tissue. Plasticity of the samples of muscular tissue of chickens, treated by smoking aromatizer surpassed by 17.4% this characteristic of the initial raw material and by 5.9% of the samples kept in the cure without smoking aromatizer. Based on the data obtained one can conclude that the smoking aromatizer "Liquid smoke plus" generally doesn't have a negative influence on the properties of muscular tissue of chickens. The products manufactured by the existing technology which included keeping of carcasses in the cure at 2...4°C during 16-18 hours and subsequent smoking by wood smoke served as controls. The analysis of quality indices of ready products has shown (Table 3) that smoked chickens produced by experimental and traditional technologies are better digested by digestive enzymes, than cooked poultry meat by 16.5% and 21.6%, respectively. One should note a negligible difference in digestibility of smoked chickens, treated with smoking aromatizer and woods smoke. The yield of the products of smokeless smoking surpassed by 2.4% the yield of chickens smoked by traditional technology, and by 2.9% of cooked chickens. The increase in the yield of experimental chickens, probably, is due to the decrease of the time of heat treatment as a result of elimination of smoking by woods smoke. The investigation of color characteristics has shown that contents of nitrous pigments in the experimental samples is lower by 11.5% than in the carcasses, treated by smoking with a smoke, which is probably associated with

the interaction of the components of smoking aromatizer with sodium nitrite, which can be seen from spectral characteristics of smoking aromatizer, containing sodium nitrite (8). Differences in residual contents of sodium nitrite between chicken carcasses that were smoked without smoke and those treated with smoke were insignificant and did not exceed the allowed limit values ( $50 \text{ ml}^{-1}$ ).

### Conclusions

It was experimentally established that the pulsed effects of the cure on muscular tissue accelerates significantly the process of penetration and distribution over the volume of not only main curing ingredients, but also of smoking components, being in the cure. Efficiency of smokeless smoking of meat products using hydropulsed effects has been shown. Based on the fulfilled investigations a technology of smoked-cooked products from poultry meat was developed which allowed to reduce the time length of the production cycle 4-5 fold, increase the yield of ready product by 2.4 – 2.9 %, improve their hygiene characteristics.

### References

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Table 1

Content of phenol substances (mg/100 g of product) and sodium chloride (%) in leg muscles of chickens

Sample	Time length of vibrations, hours							
	1		2		3		4	
	Phenols	Sodium chloride	Phenols	Sodium chloride	Phenols	Sodium chloride	Phenols	Sodium chloride
Skin	5.7	1.29	6.4	1.79	7.1	1.85	9.2	1.94
±σ	0.62	0.15	0.38	0.09	0.42	0.13	0.17	0.14
1 layer	3.7	0.84	5.4	1.12	6.2	1.30	7.0	1.39
±σ	0.44	0.11	0.56	0.26	0.24	0.14	0.33	0.21
2 layer	3.1	0.71	4.4	0.93	5.3	1.17	5.5	1.29
±σ	0.15	0.12	0.18	0.12	0.18	0.09	0.21	0.10
Average value	4.2	0.95	5.4	1.28	6.2	1.44	7.2	1.54
±σ	0.18	0.13	0.12	0.23	0.27	0.16	0.46	0.20

Table 2

Physical and chemical characteristics of chickens muscular tissue

Sample	pH	Water-binding capacity, %	Plasticity $10^{-6}, \text{m}^2/\text{H}$
Unsalted raw materials	6.41±0.03	68.2±2.34	45.3±6.55
Chicken carcasses kept in cure during 18 hours	6.58±0.02	71.7±4.02	50.5±7.56
Chicken carcasses subjected to hydro-pulsed treatment during 3 hours	6.25±0.01	70.1±3.27	53.2±5.41

Table 3

Qualitative characteristics of products

Sample	Yield, %	Content		Digestibility, tyrosine per g of protein
		Nitrous pigments, %	Residual $\text{NaNO}_2, \text{mln}^{-1}$	
Chickens, cooked	74.3±4.05	-	-	29.1±0.43
Chickens treated with woods smoke	75.6±5.12	63.05±0.14	32.2±0.06	35.4±0.28
Chickens with smoking aromatizer	77.2±3.88	55.82±0.23	37.0±0.08	43.6±0.37