USE OF VACUUM DRYING IN PRODUCTION OF UNCOOKED SMOKED AND AIR-DRIED MEAT PRODUCTS

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Abstract – Uncooked smoked and air-dried products occupy a special place in sausage production. The technological process of production of these products is labor-intensive and time-consuming with dehydration (convectional drying) as the most durable technological stage. Drying is a complex technological process, which should ensure not only preservation of initial raw material quality but in a number of cases also an improvement in consumer characteristics. This paper presents the results of the examination of meat products produced by convectional and vacuum drying.

Key Words – vacuum drying, meat, curing.

I. INTRODUCTION

The high water content in meat leads not only to its quick spoilage due to the activity of various microorganisms but also reduces its nutritional value, increases the costs of its transportation and storage [1].

Removal of a part of water from raw material is an old technological method for increasing stability of meat products upon long-term storage. In the meat product technology, the process of moisture removal occurs by the combination of drying with the operations such as preliminary curing, cooking (blanching), pressing, smoking etc., which enable production of a wide range of various products with high indices of nutritional value. However, drying, per se, remains to be a rather expensive, energy consuming and durable process [2].

The process of vacuum drying means moisture removal without previous freezing, which consequently reduces the specific energy consumption per a finished product unit almost twice. In addition to economical benefits, the reduction in the number of moisture phase transitions makes it possible to reduce undesirable changes in dried product properties [3]. Vacuum drying also enables elimination of drawbacks, which are typical of high temperature processes, i.e., deterioration of finished product quality owing to protein denaturation, fat oxidation, loss of vitamins and other biologically active substances. At present, vacuum drying is the least studied process regarding the technology of meat products.

II. MATERIALS AND METHODS

The samples of *Longissimus dorsi* muscle subjected to the technological treatment were the subjects of research.

Meat raw material for all samples was dry cured with addition of the nitrite containing curing mixtures and a starter culture. The length of curing was 5 days at a temperature of 0-4^{o}C.

After curing, sample 1 was tied, hanged on frames as a whole piece and put into a universal thermal chamber for smoking and drying by the traditional method. The total duration of drying and smoking was 7 hours.

After the end of curing, samples No. 2-5 were subjected to slight freezing at a temperature of -18^{o}C for 2 hours and sliced using slicing machine with slice width not more than 3 mm. Slices from samples 2, 3 and 4 were spread out on a tray in one layer and put into a laboratory unit for vacuum drying. Sample 5, which was also sliced, was spread out on a tray in one layer and put into a universal thermal chamber. Sample No. 2-5 were dried not more than two hours.

After drying, sample No.1 was sliced using slicing machine and vacuum-packed. Sliced samples No. 2-5 were taken from the trays, placed into the polymer bags and packed in a similar manner. All samples (excluding No. 6) were stored at a temperature of 0-4^{o}C for 30 days. Sample No. 6 served as a control for assessing changes in qualitative indicators in the process of drying.

Physico-chemical and organoleptic indices, digestibility, the content of water-soluble vitamins, the amount of polycyclic aromatic hydrocarbons (PAHs) in dependence of a drying method were detected.

III. RESULTS AND DISCUSSION

The results of the comparative study of the functional and technological properties of the experimental samples are presented.
Moisture mass fraction was measured throughout drying process. The dynamics of moisture loss in the experimental samples at different drying methods is shown in Fig. 1.

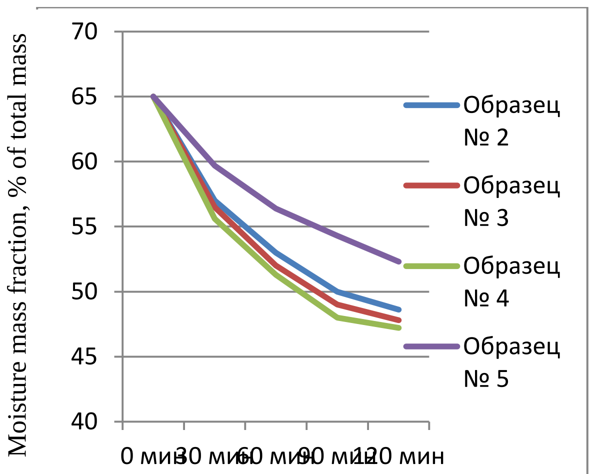

Figure 1. Changes in moisture mass fraction in the experimental samples at different drying methods

In experimental samples No. 2, 3 and 4 subjected to vacuum drying at different pressure, the moisture content decreased faster than in sample 5, which was dried in a universal chamber. The mean rate of moisture content changes in samples No. 2, 3 and 4 was about 0.14 %/min., for sample No. 5 – 0.11 %/min.
Samples No. 2- 4 were dried in an experimental unit for vacuum drying at the same temperatures but different pressure. However, the depth of vacuum slightly facilitated an increase in the rate of moisture removal from cured and fermented meat.
The moisture content reduction in the process of drying led to the changes in chemical composition indices and nutritional value of meat. It was noticed that protein content increased by 77% and table salt content by 11% (with respect to the values in the initial raw material) upon moisture content reduction by 25% (with respect to the moisture content in the initial raw material [sample No.6]).
Mass fraction of sodium nitrite in all samples was at the levels not exceeded the normative values established for meat products.
As a result of drying, the level of vitamin stability was on average 86% for sample No. 1, 93.6%, 92.9% and 95.1%, respectively, for samples No.2-4. The maximum reduction in the content of water soluble vitamins was recorded in sample No.5 (up to 77.3%). During storage of the packed samples, further reduction in vitamin content was not recorded.
The total content of PAHs in all samples was approximately at the same level irrespective of subjecting or not subjecting the samples to smoking, and did not exceed the norm both for benzo[a]pyrene and total sum of PAHs.
In sensory evaluation of the samples, the taste panel noticed that sample No. 1 had pronounced pleasant taste and odor of an uncooked smoked product with highly pronounced salty taste, was pink in color with homogeneous coloring of slices.
Sample No. 2 had “rich” slightly sour and slightly sweet taste and odor of an air dried product. Its taste was moderately salty. The color was red; product slices were uniform with homogeneous coloring.
Sample No. 3 had “rich” but slightly sour taste and odor of an air dried product. Its taste was less salty than in sample No. 2. The color was red; product slices were uniform with homogeneous coloring.
Sample No. 4 had slightly sour and sweet taste and odor of an air dried product. The taste was moderately salty. The color of the product was dark red; the product slices had a uniform smooth surface and homogeneous coloring.
Sample No. 5 also had slightly sour taste and odor of an air dried product. The taste was slightly salty (less than sample No. 2). The color of the product was pale red; the product slices had an uneven surface and inhomogeneous coloring. Sample No. 5 was produced in the universal chamber at a temperature of 30^{o} C for 120 min. The results of the investigation showed that this method of drying did not ensure an even moisture removal and obtaining of a uni`form appearance throughout a surface of a finished product, which negatively affected organoleptic indices.
When comparing data of the physico-chemical detection of table salt and organoleptic evaluation of product saltiness, it was noticed that organoleptic perception of salty taste, apparently,

depends on a complex of flavoring substances of a product and their balance. For example, sample No. 1 was assessed by the taste panel as the most salty, although the mass fraction of sodium chloride in it was lower than in samples No. 2-4.

On the basis of the tasters' opinion, samples No. 2 and 3 were marked as "excellent", samples No. 1,4,5 as "good". After 30 days of storage of the finished product samples in vacuum packages, the highest organoleptic changes were observed in samples No. 1 and 5. Samples No. 2, 3 and 4 developed more pronounced taste typical of air dried products.

Moreover, it was established that the finished product was characterized by darker color with increasing vacuum depth, which possibly, was associated with increased oxidative action of low oxygen concentrations in a vacuum packaging.

IV. CONCLUSION

In general, when comparing the consumer characteristics of the products obtained by vacuum and convectional drying, it was noticed that low temperature vacuum drying had the following advantages:

- using low temperatures of drying positively affects an appearance, color and taste of a product;
- vacuum drying ensures high stability of vitamins B;
- digestibility of a product obtained by vacuum drying was 20.5% higher than an initial cured raw material; while digestibility of a product obtained by convective drying was only 13 % higher. This fact could be associated with more durable influence of a starter culture and/or a more even process of moisture removal, accompanied by less denaturation changes in meat protein;
- a process of moisture removal goes faster compared to convective drying at the same temperature;
- the advantages in an appearance, color and taste of a product make it possible to exclude smoking.

At the same time, it is necessary to notice that vacuum drying remains to be "problematic" in terms of ensuring microbiological safety of meat products and requires further research of the possibility of detection and survival of pathogens for its wide incorporation into meat product technology.

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