PE8.10 **Amino acids as an indicator of microbial and chemical spoilage of meat products during storage**
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Abstract – The changes in the most important biochemical index of meat produce condition, free amino acid content, in relation to storage duration were studied. It was shown that the total free amino acid content in meat and fish food raw material changed from the initial level of 0.2-0.3% of sample weight (1.5-2% of protein content level) to 0.4-1.2%. The pattern and the level of the free amino acid increase correlate with the food produce storage duration of 20-170 days at +4…50C. Casing type used for product protection affects significantly the level of changes in amino acid content.

Key words – amino acids, cooked sausages, storage duration

I. INTRODUCTION

The safety and quality of food products as well as maintaining their properties during long-term storage are important directions for food industry development. The application of the state-of-the-art hurdle technologies coupled with the use of effective casings and packaging materials enables stabilization of product properties. The presence of casing prevents the penetration of toxicants and microbes from outside and facilitates to a large extent the decrease in the process of catalytic degradation of proteins, lipids and polysaccharides during storage. Biochemical indices, in particular those that are determinated by the presence of the main nutritional component, protein, and the products of its decomposition, can indicate the initial quality level and its possible changes during storage. One of the possible and quite informative ways to assess the stability of meat product biochemical properties during storage is amino acid analysis, the direct method for assessing the condition of food protein matrix [1, 2]. Examination of amino acid composition and detection of free and 'bound' amino acid content in muscle tissues enable obtaining of data that characterize directly or indirectly qualitative and to some extent quantitative muscle protein composition, and give the opportunity to estimate the primary structure of proteins, the nature of proceeding metabolic processes and the possibility of subsequent uptaking by other heterotrophic organisms when included in the diet of the latter.

II. MATERIALS AND METHODS

The aim of this work was to establish the quantitative correlation between amino acid content and the food produce status in relation to the storage duration and conditions. Two kinds of cooked sausage, "Doktorskaya" and "Slavyanskaya", were used as the object of research. The "Doktorskaya" sausage in the natural casing with 15.0% of protein was produced under GOST 23670-79 that stipulates the use of high quality meat raw material without vegetable additives and preservation agents. The "Slavyanskaya" sausage in the multilayered polyamide casing 'Kosior ' with 11.9% of protein was produced under TU 9213-011-51032326-00 that authorizes the use of fatty meat raw material of the 1st grade with soya proteins and starch. The produce was stored at 50C and the relative humidity of 85% for 168 days. The total amino acid content of proteins was determined in the hydrolysate obtained according to the standard method by treating with 6M HCl solution at 1200C for 24 h under an Ar gas flow followed by thrice-repeated stripping to dryness of volatiles, and the dissolution of the sample in the buffer with pH 2.2. Free amino acids were determined by the extraction with 85% ethyl alcohol solution in water. Then, the extract was stripped to dryness and the residue was resuspended in the buffer for sample dissolution with pH 2.2 [3].

III. RESULTS AND DISCUSSION

The total free amino acid content in the samples in relation to storage duration is shown in table 1. It can be seen that the level of the amino acid content within the measurement error increases approximately two-threefold. Particularly, quite a large amount of valine and a decreased quantity of other essential branched-chain amino acids, isoleucine and leucine, playing an important role in gluconeogenesis and synthesis of many nonessential amino acids and other organic

compounds necessary for normal vital activity of macro- and microorganisms, from bacteria to humans, were found in the obtained composition. The other essential dibasic amino acid, lysine, which is necessary for normal growth and development of a mammal and the lack of which leads to mental deficiency of humans [4-5], is contained in the minute amounts. Arginine, a semi-essential amino acid, playing an integral role in urea cycle, and methionine, the essential sulfur-containing amino acid that provides available sulfur for a mammalian organism, primarily for liver, are contained in smaller amounts. The ratio of essential amino acid content to the total content of amino acids is virtually constant and makes up ca. 40%. The typical level of amino acid content in meat raw material (beef) is TAU (0.4), ASP (8.3), THR (3.1), SER (3.6), GLU (22.2), PRO (3.5), GLY (6.1), ALA (5.0), CYS (1.4), VAL (4.1), MET (2.2), ILEU (3.6), LEU (6.3), TYR (1.7), GAMA (0.02), PHE (3.8), HIS (4.2), OPN (0.15), LYS (7.6), ARG (6.4) with total amount of 93.67 g/100 g of protein [1, 3]. Considering that the total content of amino acids during storage in terms of the dry residue virtually does not change the more informative index in this case is the evaluation of free amino acid content. It is known that the total content of free amino acids in meat raw material is ca. 0.2-0.3% of sample weight (1.5-2% of protein content) [1-3]. This level increases considerably due to proteolytic activity. For example, the special treatment of meat raw material in the presence of 0.1% of enzyme actively decomposing meat proteins, collagenase, at 250C for 3 h leads to virtually threefold increase in free amino acid content. The similar process of protein degradation also develops under the action of intrinsic enzymes during food storage, however, the degradation velocity is less than in the presence of specially introduced enzymes. In the case of long-term storage of the food produce a steady increase in the free amino acid content from 362 to 674 mg/100 g for the ‘Doktorskay’ sausage and from 358 to 798 mg/100g of the sample for the ‘Slavyanskaya’ sausage was observed at 168 day of storage. This correlates with the obtained undependably data on the change of amino-ammonia nitrogen content from 40.6 to 50.4 mg% for the ‘Doktorskay’ sausage and from 35.0 to 38.5 mg% for the ‘Slavyanskaya’ sausage. In the instant case, the polyamide casing had a more significant protective effect than the natural casing used in the ‘Doktorskay’ sausage. It is necessary to note that the similar data on the significance of the free amino acid change were obtained for fish produce, in particular, for vacuum-packed smoked mackerel. For example, the total content of protein-bound amino acids determined by the total hydrolysis remained unchanged at 8-12 g/100g of product, while on the 20th day of product storage at 50C in vacuum polyamide casing the proportion of the free amino acids increased virtually fourfold from 215 to 940 mg/100g. The reliable calibrating relationships between the free amino acid content and storage duration of the produce at preset conditions (temperature, humidity) can be constructed for different variants of meat and fish produce samples. All investigated products in terms of microbiological indices conformed to the established national food safety norms for the examined time duration. The total aerobic plate count changed from less than 1x101 to 1x103.

IV. CONCLUSIONS

Thus, no significant changes in the amino acid content in cooked sausages produced using gas and water impermeable casings and subjected to extra long-term storage up to 168 days were found. At the same time, the steady increase in the free amino acid content gives the evidence of the gradual development of proteolytic processes and labile protein degradation. The presence of the intact casing contributes to almost complete preservation of nutritive properties and biological value of examined food produce samples during long-term storage.

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