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Influence of marinade based on vegetable oil blends on the structural-mechanical parameters of natural marinated meat semi-finished products

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Abstract. Marinades based on vegetable oil blends for the production of natural marinated meat semi-finished products substantially affect the rheological and structural-mechanical parameters of the product. They determine the plasticity and consistency of semi-finished products made from raw materials of grades 1 and 2. Therefore, the purpose of the study was to develop recipes for marinades and establish the effect of marinade based on blends of vegetable oils enriched with the enzyme bromelain on the structural and mechanical parameters of natural marinated meat semi-finished products during storage. The research developed 8 samples of semi-finished products, namely: 4 samples using pork: 1 control sample without marinade and 3 samples with marinades based on vegetable oil blends; and 4 samples using beef: 1 control sample without marinade and 3 samples with marinades based on vegetable oil blends. In this regard, it was concluded that it is advisable to use blends of vegetable oils and enzymes in the marinade. An additional effect on natural marinated meat semi-finished products is the better organoleptic and structural-mechanical indicators in comparison with control samples. It was identified that the consistency of semi-finished beef products during the storage period becomes more tender compared to the control sample. It was proved that the plasticity of semi-finished pork products compared to the control sample decreased, which indicates an increase in meat hardness. The results of the study of the plasticity of marinated semi-finished products increased compared to the control sample, which indicates a decrease in meat hardness. The use of vegetable raw materials in the technology of natural marinated meat semi-finished products allows using meat raw materials of grades 1 and 2 and getting a tender, juicy, easily digestible product at the output

Keywords: meat, oil, blend, penetration stress, plasticity, enzyme, hardness of semi-finished products

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Relevance

The structure of the consumer market is changing very quickly. All over the world, there is a tendency to offer consumers a product that requires minimal cooking time. In this regard, semi-finished products and fast food products are becoming more and more popular, simultaneously not losing the biological and nutritional value of the product (Cai *et al*., 2018).

Most of the vital processes of the human body depend on nutrition. Meat and meat products are the most complete food products because they are necessary as a material for building tissues, synthesis, metabolism, and energy (Doneva *et al*., 2018).

Scientists have long proven that nutrition is one of the main factors affecting human health. The nutritional value of meat depends on the amount and quality of proteins (amino acids) and the presence of fats in it. Fats, along with proteins and carbohydrates, form the basis of plastic material for building all cells and tissues of the body. It is important to expand the range of food products, especially meat, not only by replacing animal raw materials with vegetable ones, thereby worsening the nutritional and biological value of the product, but also to approach this issue in a comprehensive way. That is, in the case of improving the product technology, it is necessary to consider all possible options for the influence of all components not only on the product quality indicators but also on the human body (Semeniuk & Shtonda, 2021a).

The use of enzymes with specified properties leads to a substantial increase in the biological and technological functionality of collagen-containing raw materials, allowing for partially replacing the main raw materials, and improving the properties and yield of products due to the conversion of the structure of proteins and the transformation of the properties of complex biological systems in the production of meat products – a well-known source of high-grade protein in diets.

Studies analysis

The unforgettable aroma of fresh meat crackling on a hot grill awakens the appetite and promotes experiments. It remains only to endlessly experiment with the marinade.

The technology of natural marinated meat semi-finished products involves the use of various types of raw materials of animal and vegetable origin.

During the production of natural meat marinated semi-finished products, an important component is the development of marinade. An important place in the technology of marinated semi-finished products is occupied by marinades in liquid form, in particular, made based on blends of vegetable oils. Due to the use of vegetable oil during marinating meat, the effect of the acid used is softened, and the aromas of added spices are well dissolved. Seeping through the structure of the meat, the oil gently envelops the meat, sealing moisture, not allowing it to dry out during further cooking. (Borsolyuk *et al*., 2019; Jinap *et al*., 2018).

When developing a new food product, special attention is paid not only to its biological value but also to the formation of the necessary structural and mechanical indicators.

The use of marinades based on blends of refined vegetable oils gives the product the necessary consistency, ensures the formation of taste and aroma, the enrichment of blends of vegetable oils with the enzyme bromelain allows accelerating the maturation and softening

of meat by 2-2.5 times (Tyshchenko *et al.*, 2019; Semeniuk and Shtonda, 2021b; Semeniuk & Shtonda, 2018).

Verbytskyi S.B., Shevchenko V.V., Gotsyk T.P., Bandurenko G.M. identified that table salt with food acids is used to improve the preservative effect. The most used is acetic acid, but in the food industry it is also allowed to use malic, lactic, citric, and orthophosphate acids in marinades. (Ivankin *et al.*, 2020; Jung *et al.*, 2018).

Peshuk L.V. considered the degree of softening and detection of the maximum shift of marinated wild boar meat. Food acids, interacting with meat, give it a pleasant specific taste and aroma, and also break down proteins and fats, which gives softness to raw materials. Acids and their salts are used as technical food additives to regulate pH during the technological process. Thus, the use of food acids and their salts gives taste, aroma, colour; preserving effect and forming consistency (Ivankin *et al.*, 2020; Obajuluwa *et al.*, 2020; Wie *et al.*, 2020; Wang *et al.*, 2020).

The purpose of the study is the determination of structural-mechanical parameters, namely penetration stress and plasticity, of natural marinated meat semi-finished products, which show the feasibility of using the blends of vegetable oils and an enzyme of vegetable origin in the production of marinated meat semi-finished products.

Materials and Methods

For the study, the following was used: beef meat, pork meat, rapeseed oil, olive oil, sunflower oil, the enzyme bromelain, crushed and dried herbs and spices.

The degree of penetration was determined on an Ulab 3 – 31 M penetrometer, in accordance with (GOST R 50814-95, 2010).

The determination of the plasticity index was conducted using the pressing method (Keniiz *et al.*, 2019).

Results and Discussion

For the meat industry, the most interesting are enzymes that affect meat proteins at the appropriate pH of the medium (which is inherent in meat and meat products) and temperatures characteristic of refrigeration and heat treatment of meat, and information about the properties of their effect on the collagen of internal connective tissue. Marinade based on blended oils enriched with the enzyme bromelain has a substantial effect on the consistency of the product. Recipes for multifunctional marinades are shown in Table 1.

Table 1. *Options for multifunctional marinades*

Ingredient name	Sample No.1	Sample No.2	Sample No.3
Turmeric	+	+	+
Roman cumin	+	+	+
Paprika	+	+	+
Black pepper	+	+	+
Red pepper	+	+	+
Fennel	+	+	+
Coriander	+	+	+
Bay leaf	+	+	+
Onion	+	+	+
Cumin	+	+	+

Table 1. Continued

Ingredient name	Sample No.1	Sample No.2	Sample No.3
Ginger	+	+	+
Sodium Ascorbate	+	+	+
Salt	+	+	+
Sugar	+	+	+
Rapeseed oil	+	-	-
Blend No.1 (sunflower : rapeseed oil)	-	+	-
Blend No.2 (sunflower : olive oil)	-	-	+
The enzyme bromelain	+	+	+
Yeast extract	+	+	+

The degree of penetration (penetration stress) of all prototypes during the storage period was determined to confirm this fact, which is shown in Fig. 1 and 2. Samples No.1, No.2, No.3, No.4 – semi-finished pork products, samples No.5, No.6, No.7, No.8 – semi-finished beef products.

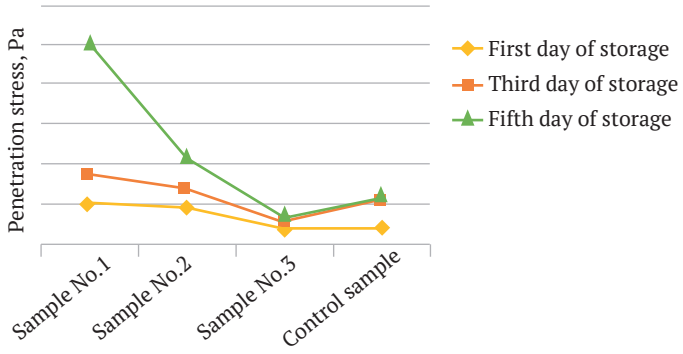

Figure 1. Change in the penetration stress of semi-finished pork products depending on the storage period

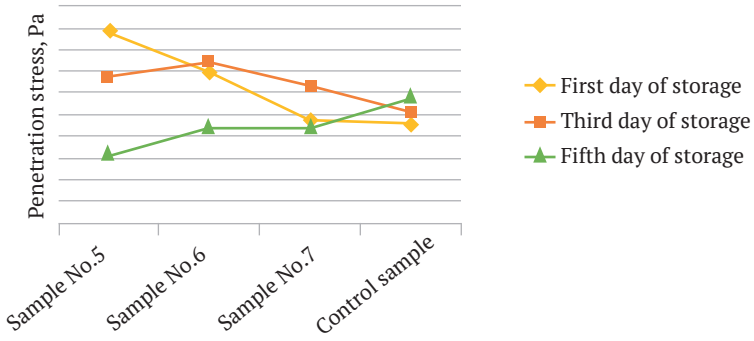

Figure 2. Change in the penetration stress of semi-finished beef products depending on the storage period

The results of determining the penetration stress show that the consistency of semi-finished beef products becomes more tender during the storage compared to the control sample.

An important indicator of a marinade based on vegetable oil blends enriched with the enzyme bromelain is a decrease in the hardness of semi-finished products, so the plasticity of the samples was determined on the first and third days of storage, as shown in Fig. 3 and 4. Plasticity is the ability of a product to undergo irreversible deformations (the original shape changes, and after the external action ceases, the new shape is preserved).

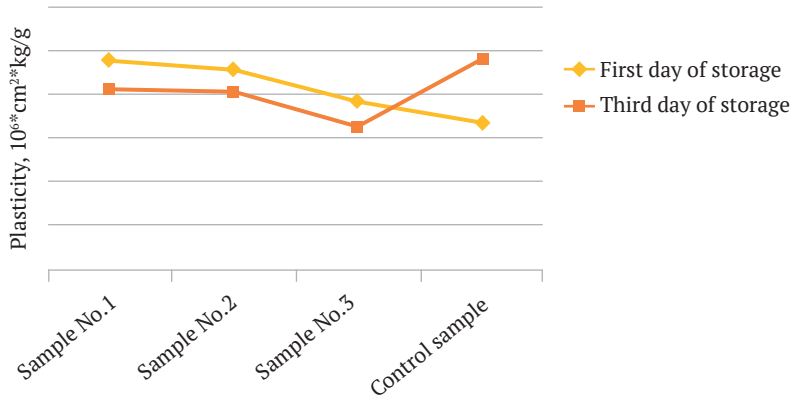

Figure 3. Changes in the plasticity of semi-finished pork products depending on the storage period

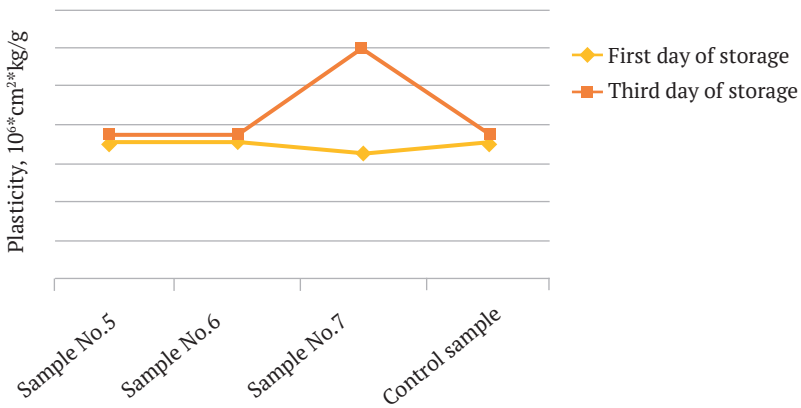

Figure 4. Change in the plasticity of semi-finished beef products depending on the storage period

The results of the studies shown in Figure 3 demonstrate that the plasticity of semi-finished pork products compared to the control sample decreased, which indicates an increase in meat hardness. The results shown in Fig. 4, demonstrate that the plasticity of marinated semi-finished products increased compared to the control sample, which indicates a decrease in meat hardness.

The use of enzyme preparations in the meat processing process allows for substantially accelerating a number of biochemical reactions and opens up interesting prospects for modifying and intensifying processing, accelerating softening, and increasing the tenderness of tissues.

Conclusions and Prospects

The results of the examination of structural-mechanical parameters of natural meat marinated semi-finished products showed that pork products have a tender, juicy consistency at the beginning of the storage period, this is due to the structure of muscle fibres and a large content of adipose tissue. Beef products are more tender and juicy in the middle and at the end of the storage period, because they have a rough structure of muscle fibres and a substantially lower fat content compared to pork. The use of bromelain in the technology of semi-finished meat products will increase the biological value of products, reduce the maturation time of meat, and will also contribute to better and faster fermentation of the product.

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Вплив маринаду на основі купажів рослинних олій на структурно-механічні показники натуральних м'ясних маринованих напівфабрикатів

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Анотація. Маринади на основі купажів рослинних олій для виробництва натуральних м'ясних маринованих напівфабрикатів суттєво здійснюють вплив на реологічні та структурно-механічні показники продукту. Саме вони визначають пластичність та консистенцію напівфабрикатів, виготовлених із сировини 1 та 2 гатунків. Тому метою роботи була розробка рецептур для маринадів та встановлення впливу маринаду на основі купажів рослинних олій, збагачених ферментом бромелаїном на структурно-механічні показники натуральних м'ясних маринованих напівфабрикатів у процесі зберігання. Дослідженнями було розроблено 8 зразків напівфабрикатів, а саме: 4 зразки із використанням свинини: 1 контрольний зразок без застосування маринаду та 3 зразки із маринадами на основі купажів рослинних олій; та 4 зразки із використанням яловичини: 1 контрольний зразок без застосування маринаду та 3 зразки із маринадами на основі купажів рослинних олій. У зв'язку з цим прийшли до висновку про доцільність застосування в складі маринаду купажів рослинних олій та ферменту. Додатковим впливом на натуральні м'ясні мариновані напівфабрикати є кращі органолептичні та структурно-механічні показники в порівнянні із контрольними зразками. З'ясовано що консистенція напівфабрикатів зі яловичини впродовж терміну зберігання стає ніжніша у порівнянні з контрольним зразком. Доведено, що пластичність напівфабрикатів зі свинини проти контрольного зразка зменшилась, що свідчить про збільшення жорсткості м'яса. А результати дослідження пластичності маринованих напівфабрикатів збільшились порівняно з контрольним зразком, що свідчить про зменшення жорсткості м'яса. Застосування рослинної сировини в технології натуральних м'ясних маринованих напівфабрикатів дає можливість використовувати м'ясну сировину 1 та 2 гатунків та на виході отримати ніжний, соковитий, легкозасвоюваний продукт

Ключові слова: м'ясо, олія, купаж, пенетраційна напруга, пластичність, фермент, жорсткість напівфабрикатів