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## **QUALITY AND SAFETY OF PRESERVES FROM THE BLACK SEA RAPANA MEAT**

*The regularities of ripening of preserves from meat of black sea rapana with spicy aromatic root crops in marinade filling were studied. It was shown that preserves could be stored for 3 months at a temperature of 0 to +5 °C according to a set of ripening and safety parameters.*

*Keywords:* rapana meat, spicy aromatic root crops, quality indicators, product safety, storage.

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*Лебская Т., Павлюченко Ю., Мойсиенко О. Качество и безопасность пресервов из мяса рапаны черноморской. Изучены закономерности созревания пресервов из мяса рапаны черноморской с пряно-ароматическими корнеплодами в маринадной заливке. Определено, что по комплексу показателей созревания и безопасности пресервы могут храниться 3 месяца при температуре от 0 до +5 °С.*

*Ключевые слова:* мясо рапаны, пряно-ароматические корнеплоды, показатели качества, безопасность продукции, хранение.

**Background.** Special value of preserves from aquatic organisms is determined by maximum preservation of food and biological value of raw material, thanks to the use of salt, marinades, oil fillings and no sterilization. Nevertheless, the assortment of preserves on the market is essentially limited. They are mainly from traditional ripening species of fish, or invertebrates like shrimp and squid in its own juice. The change in the structure of the raw material base both in the world and in Ukraine calls for the use of aquatic organisms in the field of preservative technologies, which, in terms of their chemical composition, belong to low-ripening species. L. B. Dobrobabina, M. S. Korshunov, E. N. Kananykhina, A. T. Bezusov, S. D. Bui, M. D. Mukatova and others [1–3], studied the issues of technology of preserves from low ripening aquatic organisms. In these studies, questions of the application of physical methods of processing [1], the use of ingredients in the formulation of preserves that promote their ripening [2], the introduction of enzyme preparations to stimulate the activity of native enzymes of muscle tissue [3].

One of the basic principles of the development of food products, including preserves, is to ensure their quality and safety, as this type of products is not sterilized and stored at temperatures from 0 to +5 °C.

*The aim* of the study was to determine the acceptable shelf life of preserves from the rapana gastropod mollusk with spicy aromatic root crops based on the results of a study of a complex of organoleptic, chemical and microbiological indices during storage.

**Material and methods.** The subjects of the study are *Rapana thomasiana*, root of parsnips (*Pastinaca sativa* L.), parsley (*Petroselinum crispum*), celery (*Apium graveolens* L.) and ginger root (*Zingiber officinale*).

Preserves from rapana without vegetable additives were used as a control sample. Preserves of control samples contained 65 % of mollusk meat and 35 % of pouring.

Samples of preserves were stored under the temperature regime from 0 to +5 °C.

Preparation of the investigated samples for organoleptic, structural and mechanical, physicochemical and microbiological studies was carried out according to GOST 7636–85 [4] and sampling according to GOST 7631–85 [5].

We developed a scoring scale (*table 1*) to carry out an organoleptic evaluation of preserves.

Table 1

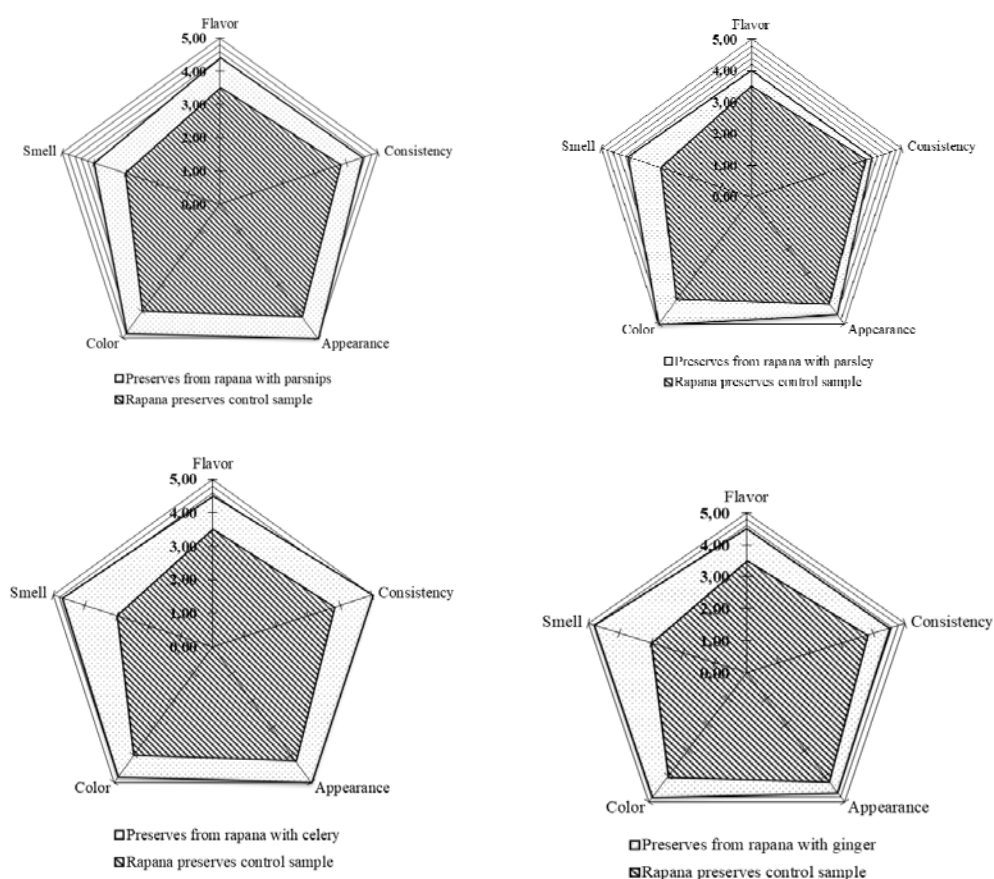
**The scale of the organoleptic evaluation of the rapana meat  
in preserves with spicy aromatic roots**

Name of indicator	Characteristic and scores				
	5	4	3	2	1
	The surface of the pieces is clean				
	shiny				matte
	flat			edges uneven	
Appearance	without damage	mechanical damage			
		insignificant	medium	significant	
Consistency	Soft		Plastic	Dense	Rigid
	when chewing				
	homogeneous mass is formed	small elastic pieces remain	to obtain a homogeneous mass		
		challenging	difficult	impossible	
Smell	Characteristic for this type of product				
	pleasant			satisfactory	
	without foreign smell	with light	with noticeable	with strong	Not characteristic for this type of product
smell of seafood					
Flavor	Pleasant, characteristic for this type of product		Satisfactory	Not typical for this type of product	
	without foreign flavor		with an insignificant	with noticeable	with significant
			foreign flavor		
Color	White	White with a creamy tint	White with a grayish tint	Not characteristic for this type of product	

The mass fraction of volatile base nitrogen (VBN) was determined in accordance with GOST 7636–85 [4], the active acidity by potentiometric method with membrane pH meter HI8314 HANNA according to GOST 26188–84 [6], buffering by titrimetric method in accordance with GOST 19182–89 [7]. The amount of mesophilic aerobic and facultative anaerobic microorganisms (MAFAnM) and bacteria of the *Escherichia coli* group (coliforms) was determined according to GOST 10444.15–94 [8]; *Staphylococcus aureus* in accordance with GOST 10444.2–94 [9]; pathogenic microorganisms, incl. of the *Salmonella* species according to GOST 30519–97 [10].

According to the technology of preserves production, mollusks were subjected to preliminary short-term (20–30 s) blanching and subsequent laying in cans according to the recipe.

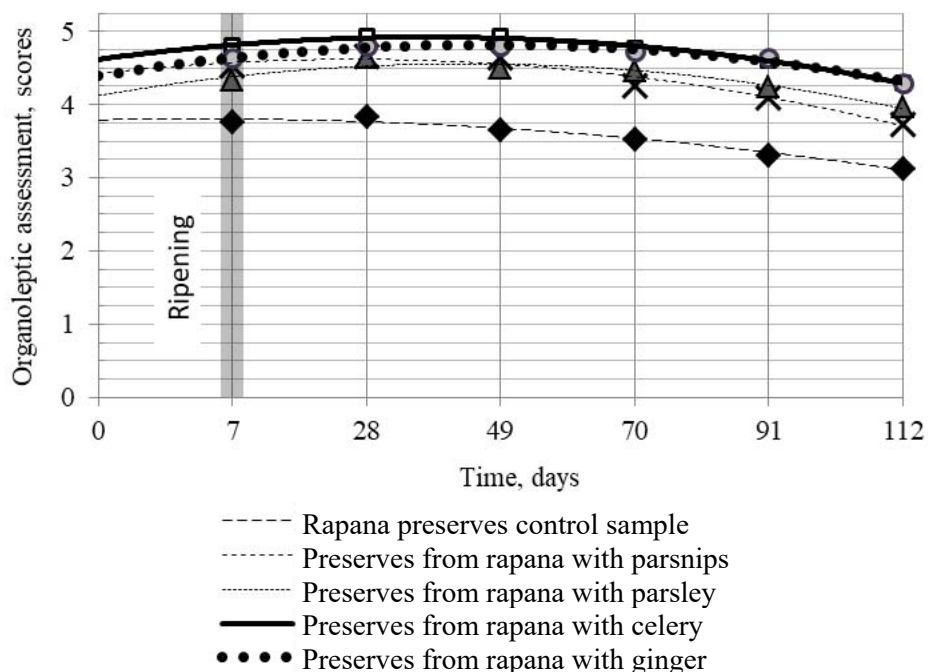
**Results.** Organoleptic characteristic is one of the first and mandatory in assessing the quality of food products. After the preparation, the preserves from the rapana with all the root crops differed from the control samples by the better indicators of consistency, flavor, smell, color and appearance (*figure 1*).



*Figure 1.* Profilograms of organoleptic evaluation of rapana preserves with spicy aromatic roots

The samples with the addition of celery root got the best score – 4.80 points due to harmonious taste, expressed by spicy aroma, juicy and soft consistency of meat, formed into a homogeneous mass during chewing. Preserve samples with the addition of root ginger, parsnip and parsley got lower scores – 4.63, 4.53 and 4.33 points respectively. The control samples were of very poor quality (the average score was 3.70), had specific, intense smell of seafood and acetic acid. These samples for the complex of organoleptic parameters were inferior to preserves with the addition of spicy aromatic roots.

The dynamics of organoleptic parameters of preserves did not show any significant differences depending on the type of spicy aromatic root crop, but differed significantly from the control sample (*figure 2*).



*Figure 2.* Dynamics of organoleptic parameters of preserves from rapana with spicy aromatic roots

In all kinds of preserves, signs of product maturation such as appearance of a gentle consistency of meat, special taste and smell manifest gradually as storage increases, up to the 70<sup>th</sup> day of storage, after which their gradual deterioration is observed.

The consistency of the mollusks meat in all versions of preserves softened after 6 days of storage. The highest score in the maturation process was established for preserves from rapana with the addition of celery and ginger root, so the dynamics of quality parameters of preserves was studied with these roots.

Ripening of fish products, including preserves, is associated with the activity of proteolytic enzymes – cathepsins, the optimum of which is manifested at a pH in the range of 4.0–4.5 [2; 3]. The results of the studies showed that during storage, the pH has two optima: 5.4 after 24 days and 4.4 after 84 days (*figure 3*).

One of the objective indicators of meat preserves ripening is the buffering index. Changes in this indicator during the storage of rapana preserves with celery and ginger are linear and constantly increase with increasing storage duration (*figure 4*).

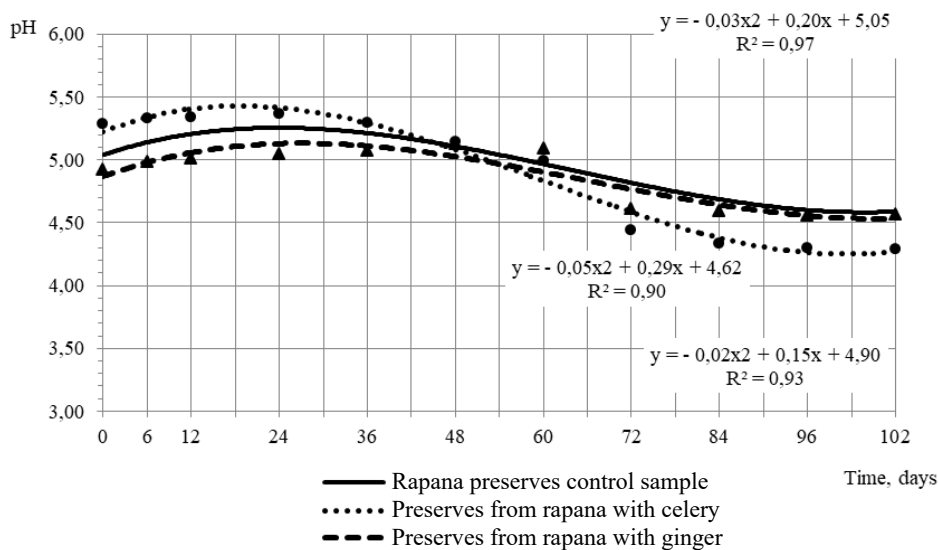


Figure 3. Influence of storage duration of preserves on the pH dynamics of rapana meat

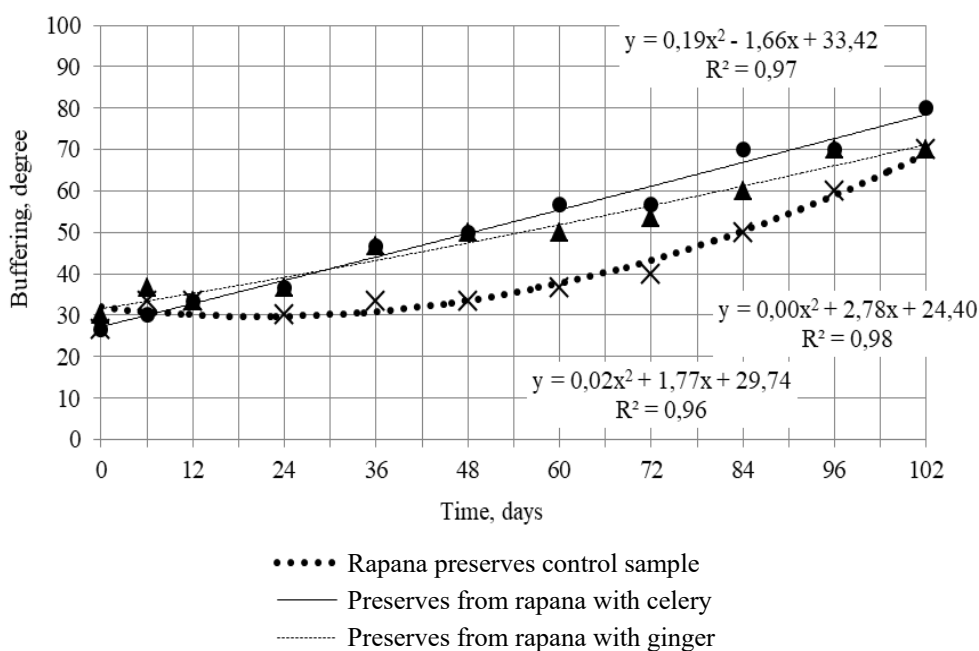
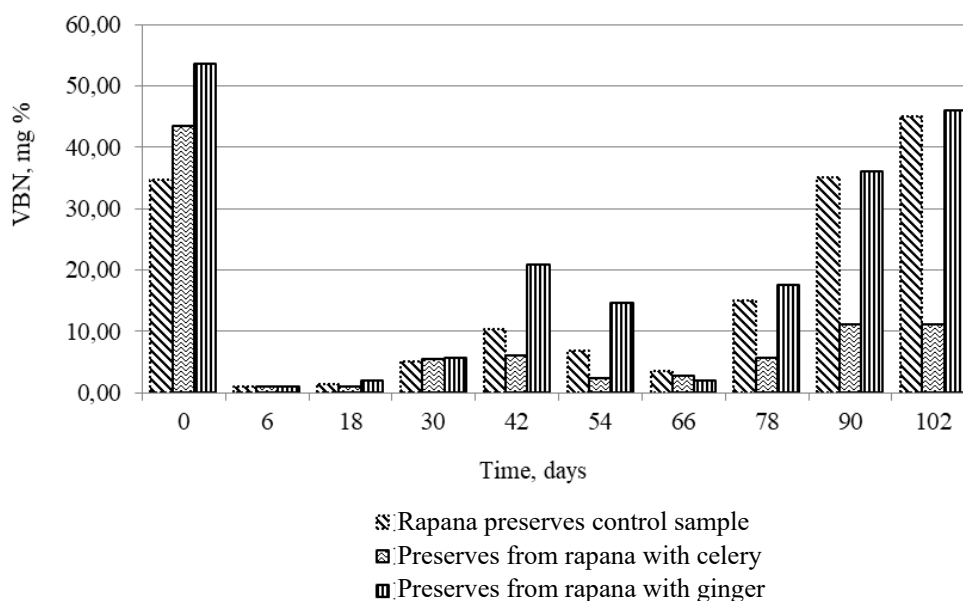


Figure 4. The influence of the storage duration of preserves from rapana with spicy aromatic roots on the buffering index

In the control sample of preserves, the buffering index remained practically unchanged for 48 days.

Volatile base nitrogen (VBN) is also one of the indicators of fish products ripening. The results of studies of the change in this indicator during the storage of preserves are shown in *figure 5*.

The analysis of the obtained data testifies to cyclic changes in the VBN content. Thus, in all samples an identical increase in the VBN value was revealed by the 30<sup>th</sup> day of storage, an increase in their amount in the control sample and in preserves with ginger by the 42<sup>nd</sup> day and a decrease to the level of the onset of the maturing of preserves and the subsequent consistent increase in the control samples and in preserves with ginger in subsequent storage periods up to 66 days (see *figure 5*). In preserves with ginger, the intensity of VBN accumulation dominated in comparison with control and preserves with celery, which may be due to the participation of ginger enzymes in the processes of protein hydrolysis.



*Figure 5.* Influence of the storage duration of preserves from rapana with spicy aromatic roots on the volatile base nitrogen

Microbiological parameters of preserves in both control samples and in experimental ones did not show any significant changes throughout the shelf life (*table 2*).

In preserves with spicy aromatic roots, the content of MAFAnM in the initial samples and during storage was significantly lower compared to the control one. It should be noted that in preserves with ginger, the total microbial contamination was lower in comparison with preserves with celery and the control sample.

Ripening of preserves irrespective of the type of raw material occurs during their storage and the intensity of this process is determined mainly by the activity of its own meat enzymes. The change in the raw material base and the prevalence on the market of low ripening raw materials necessitated the development of various methods of preliminary processing with the aim of ensuring its ripening [3]. The meat of the rapana gastropod

mollusk is chemically related to a low ripening raw material as it contains less than 1 % fat, more than 80 % moisture and is characterized by a dense and rigid consistency [11]. To soften the structure of the meat, we used short-term blanching, but the first signs of the ripening of preserves, characterized by the formation of smell, taste, appearance, juicy consistency were identified after 6 days storage at a temperature of 0 to +5 °C. Dynamics of organoleptic indices indicates that the ripening process takes place up to 49 days of storage, after which, up to 91 days, it decreases to the values of the onset of ripening. Thus, according to organoleptic indicators, the shelf life of preserves can be limited to 90 days.

Table 2

**Influence of the storage duration of preserves from rapana with spicy aromatic roots on changes in microbiological indices,  $\times 10^2$**

Indicators	The number of mesophilic aerobic and facultative anaerobic microorganisms, CFU in 1 g							Bacteria of <i>E. coli</i> group, in 0.001 g	<i>Staphylococcus aureus</i> in 0.01 g	Sulphide-reducing clostridia in 0.01 g	Pathogenic m/o, incl. of the genus <i>Salmonella</i> , in 25.0 g
	Permissible levels	Not more than $1 \times 10^5$							Not allowed		
Shelf life, days	0	7	28	49	70	91	112	0–112			
Content, CFU per 1 g of preserves	Control	0.10	0.10	0.10	0.10	0.20	0.22	1.10	Not detected		
	Preserves with celery	0.06	0.06	0.06	0.06	0.11	0.23	0.78			
	Preserves with ginger	0.04	0.04	0.04	0.01	0.06	0.19	0.66			

It is known that proteolytic enzymes – cathepsins play an active role during the ripening of preserves. Their maximum activity occurs at certain pH values of the environment. Our data do not agree with these views, because at the beginning of ripening after 6 days of storage, the rapana meat has pH values above 5, so outside the maximum activity values of cathepsins. It can be assumed that the onset of maturation is due to the influence of spicy aromatic roots, as well as the preliminary blanching of the rapana meat.

Changes in the buffering index during preserves storage are consistent with the nature of the change in this indicator, found on other



species of low ripening hydrobionts and indicates the gradual accumulation of protein hydrolysis products.

During the ripening of preserves under the influence of endogenous enzymes of muscle tissue and the action of microorganisms, protein decomposition products are formed and non-protein nitrogenous substances are accumulated, the content of which is estimated from the accumulation of VBN and trimethylamine. The identification of these compounds is recommended by the EU norms and by the standards of other countries. However, the literature data on the possibility of using VBN as an objective indicator of the quality of seafood and assessing the ripening degree are highly contradictory. Some data indicate that the content of these substances characterizes the quality of fish and seafood at the beginning of storage, but does not allow assessing its freshness in the interim period and at the beginning of decay. High VBN concentration is detected in the muscle tissue of fresh squid, which decreases, as it is stored [12–14]. Our data are consistent with the results of these studies. Both in the raw material and after the preparation of rapana preserves, we detected high concentration of VBN in the muscle tissue, which, as the preserves are stored and ripen, reduces to traces amounts and then increases. Thus, in all samples, by the 30<sup>th</sup> day of storage, an identical increase in the VBN value was revealed, by the 42<sup>nd</sup> day an increase in their amount in the control sample and in preserves with ginger; in the subsequent storage period up to 66 days – a decrease to the level of the beginning of the preserves ripening and the subsequent coordinated increase in the control samples and in preserves with ginger. In preserves with ginger, the intensity of VBN accumulation dominated in comparison with the control sample and preserves with celery, which may be due to the participation of ginger enzymes in the processes of protein hydrolysis.

The results of microbiological studies indicate the safety of preserves based on the rapana meat and spicy aromatic roots and indicate that the roots show antimicrobial activity.

The coordination of organoleptic and physico-chemical methods provides the basis for limiting the storage time of preserves from rapana with spicy aromatic roots in three months at a temperature of 0 to +5 °C.

**Conclusion.** A complex of organoleptic and physicochemical indicators shows a higher quality of preserves from rapana and spicy aromatic roots such as celery and ginger compared to the control sample.

Ripening of preserves from rapana meat with spicy aromatic roots according to the organoleptic evaluation starts on the 6th day and ends on the 70<sup>th</sup> day of storage. The buffering dynamics of the meat is consistent with the well-known patterns of changes in the process of ripening of preserves and their storage. At the same time, the pH of meat and VBN cannot be used to characterize the degree of rapana meat ripening.

Microbiological studies confirm the safety of preserves from rapana with spicy aromatic roots during 3 months of storage at a temperature of 0

to +5 °C and give grounds for suggesting the antimicrobial activity of celery and ginger roots.

The shelf life of preserves from meat of rapana with celery and ginger should be limited to 3 months at a temperature of 0 to +5 °C.

Further research will be aimed at assessing the social and economic effectiveness of introducing preserves based on rapana meat with spicy aromatic roots into production.

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*Лебська Т., Павлюченко Ю., Мойсієнко О. Якість і безпека пресервів із м'яса рапани чорноморської.*

**Постановка проблеми.** Особлива цінність пресервів із гідробіонтів визначається максимальним збереженням харчової і біологічної цінності сировини за рахунок використання харчової солі, маринадів, олійних заливок і відсутності стерилізації. Проте асортимент пресервів на ринку переважно з традиційних дозріваючих видів риб чи безхребетних – креветок, кальмарів у власному соку – суттєво обмежений.

*Мета дослідження* – визначення допустимого терміну зберігання пресервів із червоного молюска рапани з пряно-ароматичними коренеплодами на основі комплексу органолептичних, фізико-хімічних і мікробіологічних показників під час зберігання.

**Матеріали та методи.** Об'єкти дослідження: рапана чорноморська (*Rapana thomasiana*), коренеплоди пастернаку (*Pastinaca sativa L.*), петрушки (*Petroselinum crispum*), селери (*Apium graveolens L.*) і кореневище імбиру (*Zingiber officinale*).

Як контроль використано пресерви із рапани без рослинних добавок. До рецептури пресервів контрольних зразків входило м'ясо молюска (65 %) і заливка (35 %).

Зразки пресервів зберігали за температурного режиму від 0 до +5 °С.

Підготовку й відбір проб зразків для органолептичних, структурно-механічних, фізико-хімічних і мікробіологічних досліджень здійснювали за стандартами [4; 5].

Органолептичну оцінку пресервів проведено за розробленою 5-бальною шкалою (табл. 1).

Масову долю азоту летких основ (АЛО) визначено за ГОСТ 7636–85 [4], активну кислотність – потенціометричним методом на мембранному рН-метрі HI8314 HANNA за ГОСТ 26188–84 [6], буферність – титриметричним методом за ГОСТ 19182–89 [7]. Кількість мезофільних аеробних і факультативно анаеробних мікроорганізмів (МАФАНМ) і бактерій групи кишкової палички (БГКП) (коліформи) визначено за ГОСТ 10444.15–94 [8]; золотистого стафілококу – за ГОСТ 10444.2–94 [9]; патогенних мікроорганізмів, зокрема роду *Salmonella*, – за ГОСТ 30519–97 [10].

За технологією виготовлення пресервів молюски піддавалися попередньому короткочасному (20–30 сек) бланшуванню і подальшому закладанню в банки за відповідною рецептурою.

**Результати дослідження.** Для всіх видів пресервів ознаки дозрівання продукту – поява ніжної консистенції м'яса, набуття особливого смаку й запаху – виявляються після шести днів зберігання.

Зміни буферності як одного з об'єктивних показників дозрівання м'яса під час зберігання пресервів з рапани із селерою та імбиром мають лінійний характер і виявляють постійне її підвищення з подовженням терміну зберігання.

Накопичення продуктів розпаду білка за показником АЛО мало екстремальний характер упродовж терміну зберігання пресервів, що підтверджує недоцільність використання цього показника як критерію дозрівання.

Мікробіологічні дослідження підтверджують безпеку пресервів із рапани з пряно-ароматичними коренеплодами впродовж трьох місяців

зберігання за температури від 0 до +5 °С і дають підстави припустити про наявність антимікробної активності коренеплодів селери й кореневища імбиру та встановлення гарантійного терміну зберігання досліджуваної продукції. За комплексом органолептичних і фізико-хімічних показників ця продукція має вищу якість порівняно з контрольним зразком.

**Висновки.** Дозрівання пресервів із м'яса рапани з пряно-ароматичними коренеплодами за органолептичною оцінкою починає проявлятися на шосту й закінчується на сімдесяту добу зберігання. Динаміка буферності м'яса узгоджується із загальновідомими закономірностями змін під час дозрівання пресервів і їх зберігання. Водночас рН м'яса й АЛО не можуть використовуватися для характеристики ступеня дозрівання м'яса рапани.

Мікробіологічні дослідження дають підстави припустити про наявність антимікробної активності коренеплодів селери та кореневища імбиру в складі пресервів.

Термін зберігання пресервів із м'яса рапани із селерою та імбиром треба обмежити трьома місяцями за температури від 0 до +5 °С.

*Ключові слова:* м'ясо рапани, пряно-ароматичні коренеплоди, показники якості, безпека продукції, зберігання.