



Quality control of cooked sausages

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Contents

1. Introduction	42
2. Materials and methods	43
3. Results and discussion	44
4. Conclusions	46
References	46

Abstract

Despite the increased interest in the quality and safety of cooked sausages, the situation in the field of food is becoming more complicated and more threatening every year. As a result of research, it should be noted that the consumer market of the Rivne region is saturated with products of good quality, which are made mainly by mini-shops or private enterprises. When inspecting sausages, it was found that the city's stores in 2020 sold more than 50 tons of high-quality products in a wide range. These include boiled sausages, hot dogs and sausages, semi-smoked, boiled-smoked, raw-smoked, beef, pork and chicken delicacies, pâtés, loaves of bread, ham, and skewers. Experimental studies have shown that their name and manufacturer influence the evaluation of cooked sausages. The highest score was given to the sausage "Molochna" and "Teliacha z vershkamy", which has become an authentic brand. Buyers of our country should prefer it.

According to organoleptic and physical studies, further Examination of five samples of cooked sausages from different manufacturers showed that the samples meet the requirements of DSTU 4436: 2005. Microbiological tests revealed that the samples of cooked sausages met the requirements of regulatory indicators. Sausage "Likarska", Yalovycha "Liuks" and "Z vershkamy" on two physical indicators: the content of mass fraction of moisture and mass fraction of salt, did not meet the requirements of DSTU 4436: 2005, this product is a counterfeit.

Keywords: boiled sausage, quality, humidity, salt, starch, nitrites, microbiological indicators.

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1. Introduction

Currently, Ukraine produces a significant number of sausages that may pose a risk to consumer health (Kudriashova et al., 2000; Taran & Ushakov, 2016). Issues of ecological and veterinary-sanitary control of sausages are especially relevant if produced at meat processing enterprises and individual businesses, where the system of quality self-control following the requirements of HACCP is not implemented (Akymenko, 2008; Taran & Ushakov, 2016).

For many centuries, a product such as a sausage has come a long way; its recipes have been improved over time. Modern sausage producers, tiny businesses, are often tempted to forge or increase their sales by diluting the sausage with unconventional raw materials, offal, low-value additives, soy texture, etc. (Kotsiumbas et al., 2012).

The use of world best practices, standards, equipment, compliance with sanitary norms, food safety rules, and food

safety in the production of cooked sausages will provide the consumer with a quality, safe and valuable product (De Sme & Vossen, 2016; Fursik et al., 2019; Halukh et al., 2020; Peshuk & Simonova, 2020).

Analysis of recent research and publications. Despite the increased interest in the quality and safety of cooked sausages, the situation in the field of food is becoming more complicated and more threatening every year. According to scientific data, a person can do without complete proteins, including meat, only four months a year. In addition, B vitamins, Calcium, phosphorus, Zinc, Iron, and other necessary mineral and biologically active substances enter the human body from meat and meat products (Kotsiumbas et al., 2012; Taran & Ushakov, 2016; Drachuk et al., 2018).

The nutritional and biological value of meat and meat products in sausages is influenced by the quantitative content and qualitative composition of nutrients, the presence of specific organoleptic characteristics, consumer and techno-

logical characteristics. At the same time, the selected components of the recipe must meet the second, no less essential, requirement: to have acceptable functional and technological properties, their maximum compatibility or mutual compensation, which provides in the process of processing raw materials to obtain stable meat systems (Shevchenko et al., 2017). In modern conditions of sausage production, compliance with the content of such indicators as protein and starch is of concern. The mass fraction of protein in cooked sausage should be up to 12.0 % (DSTU 4436:2005), and starch may be added in the manufacture of only certain types of sausages according to the recipe. Its amount is strictly regulated and ranges from 3 to 7 %, depending on the type of sausage (Lashko & Dudarieva, 2012). Its content is not allowed in the “Children’s” sausage. Sausages also contain water, flour, and other plant components that do not taste. Moreover, some of the components can not be recognized after processing.

Cooked sausage must be free of soy and GMOs, which must be indicated on the label with the label “GMO-free”, meet the standards, and have a certificate of quality and all accompanying documents provided by the current legislation of Ukraine (conclusions, certificates, certificates, etc.). Therefore, now there is a need to control the production of cooked sausages and their clear labeling (Zhuravskaia & Alekhyna, 1985; Rohov, 1988; DSTU 4436:2005).

In Ukraine, the meat industry, abandoning virtually the production of products according to DSTU, allowed companies to develop and approve their range in technical conditions, which often allows you to produce meat products with quality indicators that do not meet state standards, in particular, on the content not specified in the regulations and labeling of components (Kopilevych et al., 2003; Kundieieva, 2010). Falsification of sausages can be achieved in the following ways: high water content; replacement of fresh meat with stale; replacement of natural meat with vegetable protein; introduction of non-traditional raw materials; coloring of sausages with beet juice and other dyes; violation of the recipe; introduction of foreign additives. They were also used to produce low-value additives not provided by the

recipe (larynx, trachea, diaphragm, esophagus, stomach, testicles, uterus, etc.) (Lashko & Dudarieva, 2012). In the meat industry, the use of meat products, which is obtained by rolling bones in a meat-bone separator, is widespread in cooking sausages. It remains a significant amount of tiny bones that damage the mucous membrane of the gastrointestinal tract during consumption of the product. The amount of meat mass added to sausages is 40–76 %, depending on the type and variety of sausages. However, products often do not have the appropriate labeling (DSTU 4436:2005).

The increase in the content of nitrites and nitrates in a sausage, in general, increases their entry into the human body, and thus to the emergence of diseases caused by the toxic effects of nitrates and their metabolites. Although nitrates are present in almost all foods, their amount should not exceed the concentration limits. Comprehensive toxicological and hygienic studies have established the permissible daily dose of NO_3 – 320 mg per day or 4–5 mg per 1 kg of body weight (Vinskyi, 2015).

An important indicator of quality for the product is also its shelf life. The residual shelf life of cooked sausages is not less than 90 % of the total, without preservatives, dyes, flavor enhancers, stabilizers (DSTU 4436:2005).

Therefore, assessing the quantitative content and qualitative composition of nutrients, specific organoleptic characteristics, consumer and technological characteristics of cooked sausages is very important for consumers because cooked sausages are a constant favorite product of Ukrainians.

The goal of the work – is to assess the quality of cooked sausages of well-known brands that were purchased in grocery stores in Rivne.

2. Materials and methods

The material for the research was five samples of cooked sausages of the highest quality of well-known Ukrainian producers, which were purchased in grocery stores in Rivne (table 1). Each type of sausage was selected in 3 units from different batches.

Table 1

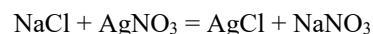
List of investigated sausages

№	Name of cooked sausages	ND on which sausages are made	Manufacturer, address
1	“Molochna”	DSTU 4436: 2005	TM “Stovpinsky sausages”, village Stovpyn, Rivne region
2	“Teliacha z verzhkamy”	DSTU 4436:2005	LLC “Inus-LTD”, village Tuchyn, Rivne region
3	“Likarska”	DSTU 4436:2005	LLC “Meat Factory” Favorite Plus”, village Slobozhanske, Dnipropetrovsk region
4	Yalovycha “Liuks”	TU U 15.1-37373551-001:2011	LLC “Meat Factory” Favorite Plus”, village Slobozhanske, Dnipropetrovsk region
5	“Z verzhkamy”	TU U 15.1-24615640-022:2008	LLC “Meat Factory” “Yuvileyni”, village Slobozhanske, Dnipropetrovsk region

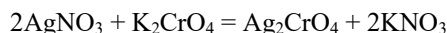
Organoleptic evaluation of sausage samples was performed according to (Zhuravskaia & Alekhyna, 1985) chemical analysis according to the methods described in (Rohov, 1988). The moisture content in the sausage was characterized by the mass fraction of moisture (W) – is the percentage of the difference between the masses of the product sample before and after drying to the mass of the sample before drying;

$$W = \frac{m_1 - m_2}{m_1} \cdot 100 \%,$$

Where m_1 is the sample weight before drying, g; m_2 – the weight of the sample after drying, g. Study of Sodium Chloride in sausage – by the Moore method (neutral medium). The method is based on the deposition of chlorine ions by silver ion in a neutral medium in the presence of potassium chromate as an indicator. When the chlorine ion interacts with the silver ion, a white precipitate of Silver Chloride is formed:



When the deposition of Chlorine ions ends, the excess silver nitrate reacts with the indicator, forming a precipitate of Silver chromate orange-red color:



The order of execution. Weigh 5 g of the crushed medium sample in a beaker to the nearest 0.01 g and add 100 cm³ of distilled water. After 40 minutes of infusion (with periodic stirring with a glass rod), the aqueous extract is filtered through a paper filter. Transfer 5–10 cm³ of the filtrate with a pipette into a conical flask and titrate from the burette with 0.05 mol/dm³ of silver nitrate solution in the presence of 0.5 cm³ of 10 % potassium chromium solution until an orange color appears. A portion of cooked sausages is heated in a glass on a water bath to 40 °C, kept at this temperature for 45 minutes (with periodic stirring with a glass rod).

Furthermore, it is filtered through a paper filter. After cooling to room temperature, the titration is carried out the same way as in the previous case. The mass fraction of Sodium Chloride (X) is calculated as a percentage. Study of starch – titration of the test solution of 0.05 n solution of Sodium Thiosulfate, nitrites – reaction with diphenylamine. Place 5 to 6 drops of a solution of diphenylamine in concentrated H₂SO₄ on a thoroughly washed and dry laboratory glass. There, on the tip of a clean glass rod, add a few drops

of the nitrate test solution and mix. In the presence of NO₃, an intense blue color appears due to the oxidation of diphenylamine to form nitric acid (Kopilevych et al., 2003).

Microbiological analysis of sausages was performed according to regulatory and technical documentation (DSTU 21237-75 “Meat. Methods of bacteriological analysis”) in the microbiological sector of the laboratory for quality control, safety and registration of veterinary drugs and feed additives LLC “DEVIE” (Rivne) (Byletova et al., 1980; Kostenko et al., 1989; Semaniuk et al., 2007).

Statistical processing of the results was performed according to the generally accepted method (Rokytskyi, 1973).

3. Results and discussion

The sale of sausages in Rivne is mainly carried out by small grocery stores (more than 150). The largest of them in terms of sales: “Tuchyn sausages”, “Stovpinsky sausages”, “Hoshchanskyi gifts”, “Kopeyka”, “Taste”, and more.

Using its many years of sales experience, based on the best Ukrainian traditions, the city’s stores in 2020 sold more than 50 tons of high-quality products in a wide range. These include boiled sausages, frankfurters, and sausages, semi-smoked, boiled-smoked, raw-smoked, beef, pork and chicken delicacies, pâtés, loaves of bread, ham, and skewers (Fig. 1).

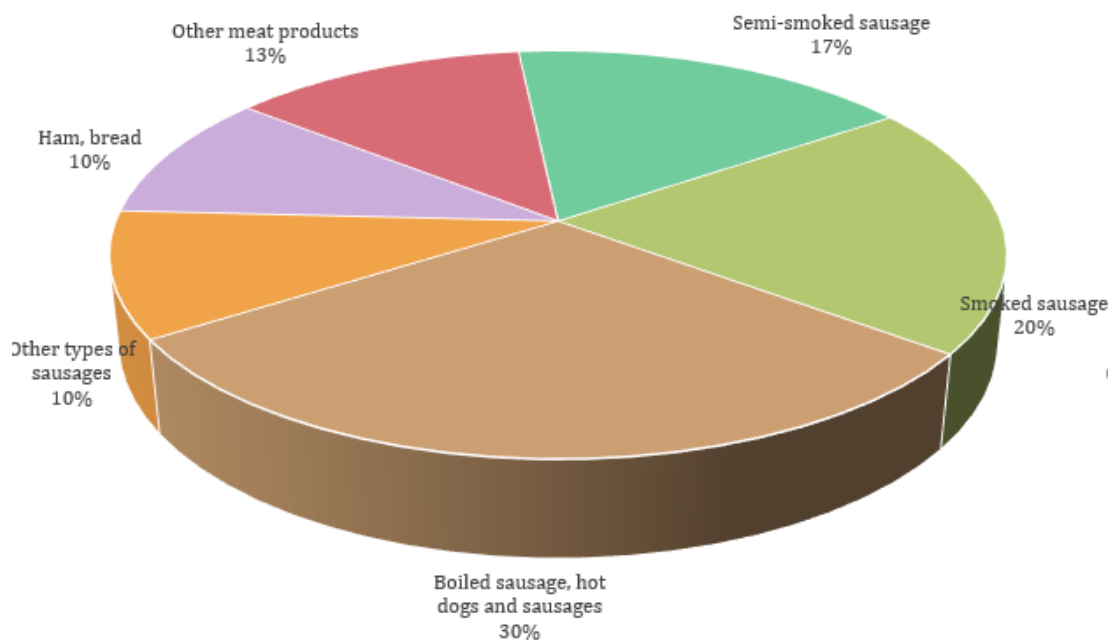


Fig. 1. Assortment of meat products sold by grocery stores in Rivne

Source: Calculated by the author based on data from grocery stores in Rivne

Given the volume of cooked sausages sold and the constant changes in the external competitive environment, there is a need to provide a quality control system that would help achieve the primary goal of the business – to make a profit, increase it, maintain a stable level and meet consumer needs.

One of the first stages of research was the organoleptic evaluation of the studied sausages. All tested samples of cooked sausages were made following DSTU 4436: 2005, TU U 15.1-37373551-001: 2011, and TU U 15.1-24615640-022: 2008. At organoleptic research of all grades of sausages, it is established that the surface of loaves is clean dry.

The consistency is elastic; in section, sausages are evenly colored in light pink. The shell of sausages is artificial, easily separated from the product. The studied sausage differed only in taste and smell (Table 2).

We used a measuring method to determine the quality of sausages, carried out based on technical measuring instruments and reagents. The measuring method determined the physical quality and safety indicators of the studied cooked sausages. According to physical indicators, cooked sausages were compared with the data given in table 3.

Table 2
Organoleptic characteristics of the studied samples of sausages

Name of cooked sausages	Color	Consistence	Scent
Sausage “Molochna”	Light pink, close to the body	Homogeneous	Natural, noticeable excess of spices
Sausage “Teliacha z verzhkamy”	Light pink, close to the body	Homogeneous	Natural, typical of beef
Sausage “Likarska”	Light pink, close to the body	Relatively homogeneous with a splash of broth	Natural, noticeable excess of spices
Sausage Yalovycha “Liuks”	Uniform, pink, light pink, without gray spots	Homogeneous	Natural, typical of beef
Sausage “Z verzhkamy”	Uniform, pink, light pink, without gray spots	Relatively homogeneous with a splash of broth	Natural, typical of beef and pork
Requirements according to DSTU 4436: 2005	Uniform, pink, light pink, without gray spots	Elastic, dense, unbreakable	Pleasant, with the aroma of spices, without signs of mustiness and acidity

Table 3
Physical indicators of quality assessment of cooked sausages

Kind of sausage	Fillers, number of sausages (pcs.)							
	mass fraction of protein		mass fraction of fat		mass fraction of hyaline cartilage		mass fraction of unidentified impurities	
	number of samples	%	number of samples	%	number of samples	%	number of samples	%
“Molochna”	3	14.2	3	22.0	3	9.2	3	3.7
“Telyacha z verzhkamy”	3	13.7	3	20.0	3	8.7	3	2.9
“Likarska”	3	13.9	3	21.0	3	4.3	3	3.0
Yalovycha “Lyuks”	3	15.3	3	26.0	3	9.9	3	4.7
“Z verzhkamy”	3	14.8	3	24.0	3	9.1	3	3.1
Requirements according to DSTU 4436: 2005	not less than 13.0		not more than 28.0		not more than 10.0		not more than 5.0	

The laboratory method determined the mass fraction of moisture, mass fraction of table salt, mass fraction of fat and protein, starch content, and sodium nitrite content. The results of the chemical analysis of the studied samples of cooked sausage are presented in table 4.

According to the results of the chemical analysis, the investigated sausages did not meet the requirements of DSTU 4436: 2005. Samples of sausage “Likarska”, “Yalovycha “Liuks”, and “Z verzhkamy” had an increase in moisture content.

Table 4
Chemical analysis of the studied samples of sausage

Kind of sausage	The contents of the sausage, %		
	moisture	NaCl	starch
“Molochna”	66.9 ± 0.02	1.95 ± 0.04	1.9 ± 0.01
“Teliacha z verzhkamy”	65.8 ± 0.04	1.85 ± 0.01	3.9 ± 0.03
“Likarska”	70.9 ± 0.03	3.95 ± 0.01	3.4 ± 0.01
Yalovycha “Liuks”	74.8 ± 0.05	2.97 ± 0.09	1.9 ± 0.01
“Z verzhkamy”	69.4 ± 0.01	2.62 ± 0.02	2.0 ± 0.05
Requirements according to DSTU 4436: 2005	67	2	-

According to regulations, the amount of starch is strictly regulated by the recipe and ranges from 3 to 7 %, depending on the type of sausage (Lashko & Dudarieva, 2012). Its content is not allowed in the “Children’s” sausage.

The reaction with diphenylamine was used to study the concentration of nitrates in the studied cooked sausages. The sensitivity of the reaction is 0.001 mg per 1 ml of solution. The nitrate content was determined by comparing the color of the test extract solution with a standard scale. The results of the study are presented in the table. 5.

As can be seen from the table. 5 in the selected samples of sausages of domestic producers, the content of nitrates

does not exceed one mg/l. This corresponds to the normative values regulated by GOST 8558.2-78 “Meat products. Method for determination of nitrate”.

Microbiological indicators characterizing the product's safety and the right to use it are given in the regulatory and technological documentation for cooked sausages and are a mandatory criterion for assessing the quality of the product during sanitary and microbiological control. The results of microbiological studies of cooked sausages are given in the table. 6.

Table 5

The results of the study of nitrate content in sausages

Trademark	The results of laboratory tests			Standard scale	
	Kind of sausage	Staining of the solution	Nitrate concentration	Staining of the solution	Nitrate concentration
TM "Stovpinsky sausages."	"Molochna"	Light blue	> 0.001 mg/l	Light blue	> 0.001 mg/l
LLC "Inus-LTD"	"Teliacha z vershkamy"	Light blue	> 0.001 mg/l	Light blue	> 0.001 mg/l
LLC "Meat Factory» Favorite Plus"	"Likarska"	Light blue	> 0.001 mg/l	Light blue	> 1 mg/l
LLC "Meat Factory» Favorite Plus"	"Yalovycha "Liuks"	Light blue	> 0.001 mg/l	Light blue	> 1 mg/l
LLC "Meat Factory» "Yuvileyny"	"Z versh-kamy"	Light blue	> 0.001 mg/l	Light blue	> 0.001 mg/l

Table 6

Microbiological indicators of cooked sausages

Kind of sausage	KMAFANM, COU/g	Bacteria of the Escherichia coli group (BGKP), in 1.0 g of product	Staphylococcus aureus в 1,0 г product	Pathogenic microorganisms, mainly bacteria of the genus Salmonella, in 30 g of product.
"Molochna"	-	-	-	-
"Teliacha z vershkamy"	-	-	-	-
"Likarska"	-	-	-	-
"Teliacha z vershkamy"	-	-	-	-
"Z vershkamy"	-	-	-	-

So, based on the definition of five indicators, we can conclude the quality of cooked sausages.

4. Conclusions

In the study, it was found that their name and manufacturer influenced the evaluation of cooked sausages. The highest score was given to the sausage "Molochna" and "Teliacha z vershkamy", which became an authentic brand. Buyers of our country should prefer it. Further Examination of five samples of cooked sausages from different manufacturers by organoleptic, physical, and microbiological studies showed that the tested samples meet the requirements of DSTU 4436:2005. However, sausage "Likarska", "Yalovycha "Liuks" and "Z vershkamy" on two physical indicators: the content of mass fraction of moisture and mass fraction of salt, does not meet the requirements of DSTU 4436:2005, i.e., this product is a counterfeit.

Prospects for further research. Based on the results, some cooked sausages do not meet sanitary standards. This may be due to non-compliance with the storage conditions, transportation of the product, low quality of raw meat, falsification, and high level of physical wear of equipment of meat processing plants. These problems can be solved only with the active participation of the state in the process of regulation and control of quality characteristics of cooked sausages on the market of Ukraine. Bacteriological laboratories of meat processing enterprises can use the research results to improve product quality.

Conflict of interest

The authors declare that there is no conflict of interest.

References

Akymenko, E. A. (2008). Vnedrenye systemy upravleniya bezopasnostiu pyshchevoi produktsyy. [Implementation of a food

safety management system]. *Standarty i kachestvo*, 2, 90–92 (in Russian).

Byletova, N. V., Kornelaeva, R. P., & Kostyrykyna, L. H. (1980). Sanyarnaia mykrobiologiya. [Sanitary Microbiology]. M.: Pyshchevaia promyshlennost (in Russian).

De Sme, S., & Vossen, E. (2016). Meat: The balance between nutrition and health. A review. *Meat Science*, 120, 145–156. DOI: 10.1016/j.meatsci.2016.04.008.

Drachuk, U., Simonova, I., Halukh, B., Basarab, I., & Romashko, I. (2018). The study of lentil flour as a raw material for production of semi-smoked sausages. *Eastern-European journal of enterprise technologies*, 6(11(96)), 44–50. DOI: 10.15587/1729-4061.2018.148319.

DSTU 4436:2005. Kovbasy vareni, sosysky, sardelky, khliby miasni (33977) (in Ukrainian).

Fursik, O., Strashynskyi, I., Pasichnyi, V., & Svyatnenko, R. (2019). Biological efficiency of cooked sausages protein. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Food Technologies*, 21(91), 48–53. DOI: 10.32718/nvlvet-f9109.

Halukh, B., Drachuk, U., Simonova, I., Basarab, I., & Romashko, I. (2020). Expanding the range of sausage products of special purpose. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Food Technologies*, 22(94), 37–43. DOI: 10.32718/nvlvet-f9408.

Kopilevych, V. A., Kosmatyi, V. Ie., Voitenko, L. V. ta in. (2003). Analitichna khimiia dlia ahrarnykh spetsialnostei (khimichniy analiz). [Analytical chemistry for agricultural specialties (chemical analysis)]. K.: Vydavnychiy tsent NAU (in Ukrainian).

Kostenko, T. S., Skarshevskaia, E. Y., & Hytelson, S. S. (1989). Praktikum po veterynarnoi mykrobiologii y ymmunologii. [Workshop on veterinary microbiology and immunology]. M.: Ahropromyzdat (in Russian).

Kotsiumbas, H. I., Shchebentovska, O. M., & Kotsiumbas, I. Ia. (2012). Ekspertyza kovbasnykh vyrobiv histolohichnym metodom [Examination of sausages by histological method]. Lviv (in Ukrainian).

Kudriashova, A. A., Lebedev, E. Y., & Aryas Depre, Kh. Kh. (2000). Vtorychnye resursy y ykh yspolzovanye dlia resheniya prodovolstvennykh, ekolohycheskykh y enerhetycheskykh problem [Secondary resources and their use to solve food, en-

- vironmental and energy problems]. *Khraneny y pererabotka selkhozsyria*, 12, 45–46 (in Russian).
- Kundieva, H. O. (2010). Suchasnyi stan ta perspektyvy rozvytku miasnoi promyslovosti. [Current state and prospects of meat industry development]. *Teoretychni ta prykladni aspekty ekonomiky*, 23, 201–207 (in Ukrainian).
- Lashko, N. P., & Dudarieva, H. F. (2012). Khimiia i fizyka moloka ta miaso-molochnykh produktiv [Chemistry and physics of milk and meat and dairy products]: navchalno-metodychni posibnyk dlia studentiv osvithno-kvalifikatsiinoho rivnia “bakalavr” napriamiv pidhotovky “Khimii” i “Ekolohii”, “okhrona navkolyshnoho seredovyscha ta zbalansovane pryrodokorystuvannia” dennoho viddilennia. Zaporizhzhia: ZNU (in Ukrainian).
- Peshuk, L., & Simonova, I. (2020). Influence of different methods of heat treatment on the technology of special purpose meat delicacies. *Modern engineering problems, challenges and modernity: Collectivmonograf. Riga: Baltija Publishing*, 351–369. DOI: 10.30525/978-9934-588-47-1.16.
- Rohov, A. Y. (1988). Tekhnolohyia miasa i miasoproduktov [Technology of meat and meat products]. M.: Ahropromyzdat (in Russian).
- Rokytskyi, P. F. (1973). Biolohicheskaiia statistika. [Biological statistics] Minsk: Vysheishaia shkola (in Russian).
- Semaniuk, V. I., Krushelnytskyi, Z. V., & Kozak, M. V. (2007). Miaso i miasni produkty. Dovidnyk u zapytanniakh i vidpovid-iakh. [Meat and meat products. Handbook of questions and answers]. Lviv (in Ukrainian).
- Shevchenko, I. I., Kryzhova, Yu. P., & Zhuk, V. O. (2017). Osoblyvosti vykorystannia molochnykh bilkiv u skladi kovbas varenoi hrupy. [Features of the use of milk proteins in the composition of cooked sausages]. *SWorld*, 14(3), 73–77 (in Ukrainian).
- Taran, T. V., & Ushakov, O. F. (2016). Mikrostrukturnyi analiz kovbasnykh vyrobiv. [Microstructural analysis of sausages]. *Naukovi dopovidi Natsionalnoho universytetu bioresursiv i pryrodokorystuvannia Ukrainy*, 6. URL: http://nbuv.gov.ua/UJRN/Nd_2016_6_24 (in Ukrainian).
- Vinskyi, V. V. (2015). Vykorystannia yakisnykh i kilkisnykh metodiv analitychnoi khimii dlia vyznachennia vmistu nitrativ u kovbasnykh vyrobakh. [The use of qualitative and quantitative methods of analytical chemistry to determine the content of nitrates in sausages]. *Tezy Vseukrainskoi naukovo-praktychnoi on-line konferentsii aspirantiv, molodykh uchenykh ta studentiv, prysviachenoj Dniu nauky*. URL: <http://eztuir.ztu.edu.ua/bitstream/handle/123456789/1413/190.pdf> (in Ukrainian).
- Zhuravskaia, N. K., & Alekhyna, L. T. (1985). Tekhnolohycheskyi kontrol proyzvodstva miasa y miasoproduktov. [Technological control of the production of meat and meat products]. M.: Ahropromyzda (in Russian).