

CHARACTERISTICS OF SAUSAGES PRODUCED OF CARP MEAT*

ĐORĐE OKANOVIĆ, DRAGANA LJUBOJEVIĆ, MIROSLAV ĆIRKOVIĆ,
VESNA ĐORĐEVIĆ, DANIJELA VRANIĆ, NIKOLINA NOVAKOV¹

*SUMMARY: The aim of this study was to examine sensory, microbiological and chemical properties of sausages produced of carp meat obtained from the fish farm Kakovo, property of the monastery Hilandar. Fish meat and fish products are valuable source of nutrients of great importance for diverse and healthy nutrition. The results of sensory analysis showed that odor and taste were typical for that kind of sausages, free of impurities. At cross sections, sausages stuffing consisted of light brown-orange fragmented mass, characteristic consistency for that type of sausage. Microbiological analyzes didn't show the presence of bacteria *L.monocytogenes*, *E. coli*, *Salmonella spp.*, or *B. cereus*, while the number of aerobic bacteria was 3000 g/ml The total protein content was 16.48%, fat 24.5%, water content was 48.06%, ash content was 4.07%. The amount of calcium was 21.0 mg/100 g and sodium chloride content was 3.10%.*

Key words: common carp, sausages, sensory testing, chemistry, microbiology.

INTRODUCTION

Fish meat and fish products are valuable source of nutrients of great importance for diverse and healthy nutrition. The optimal ratio of proteins, fats, carbohydrates, vitamins and minerals contributes to the high nutrient value of fish meat (Ćirkovic et al.,

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¹Đorđe Okanović, PhD, principal research fellow, Insitute for Food technology, Bulevar cara Lazara 1, Novi Sad, Serbia; Dragana Ljubojević, MSc, research assistant, Miroslav Ćirković, PhD, full professor, Nikolina Novakov, PhD, teaching assistant, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia; Vesna Đorđević, PhD, research associate, Danijela Vranić, PhD, research assistant, Institute of Meat Hygiene and Technology, Kačanskog 13, Belgrade, Serbia

Corresponding author: Đorđe Okanović, e-mail: djordje.okanovic@fins.uns.ac.rs, phone: +381 21 485 3703.

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2011). Recommendations for fish regular usages in diet are based on the fact that fish meat is the most important nutritional source of n-3 highly unsaturated fatty acids (n-3 HUFA). Consumption of fish meat helps to prevent cancer development, slowing brain aging and development of Alzheimer's disease (Connor, 2000). Also, positive effect of fish meat consumption was confirmed in a case of prenatal development, maintenance functions of the nervous system, eyes and skin (Allen and Harris, 2001). Regular consumption of fish meat causes the reduction of heart disease risk and vascular disease (Kris-Etherton et al., 2002).

Chemical composition of fish varies among species, as well as between individuals of the same species, depending on diet, age, sex, environment conditions and season (Guler et al., 2008; Ćirković et al., 2012, Ljubojević et al., 2013). Proteins from fish meat have desirable amino acid composition with many free amino acids (Buchtová et al., 2010), contain all the essential amino acids for the human body what can make them the only source of animal protein in the human diet (Vladau et al., 2009). Characteristic of fish meat is very good protein digestibility (Untersmayr and Jensen-Jarolim, 2008). Fish meat contains very low amounts of carbohydrates as glycogen, and a high percentage of water (60-86%) (Ćirković et al., 2012b), which has a negative effect because high percentage of water made that fish meat spoils faster. The most abundant minerals in fish meat are phosphorus (170 to 270 mg%), calcium (15 to 100 mg%) and magnesium (20 to 35 mg%) (Stamenković and Dević, 2006). The amount of fat is also very variable, so fish can be divided based on fat content into lean (<5% fat), medium-fat (5-10% fat) and fat (> 10% fat).

Carp is the most dominant fish species on the fish farms in Serbia (Ćirković et al., 2007), and the cyprinids are the most frequent in the total world production of freshwater fishes (71.9%, 24.2 million tons in 2010) (FAO, 2012).

Consumption of fish meat is increasing, primarily due to the fact that fish is recommended as an essential ingredient of healthy human diet. According to the latest FAO data (2012), Serbia is one of the countries where the average consumption of fish ranges between 5-10 kg per capita per year, which is significantly below European and world average. As reasons for low fish consumption Baltić et al. (2009) blame low standard of the population, but also weak and undiversified offer of fish and fish meat products in the local market. Manufacturing industry in fish processing sector is still underdeveloped. Fish processing and development of new fish products can provide better sale of fish, not only in traditional fish markets, but also in all other consumer goods stores.

Technological processes of processing, preservation and storage are not the same for fish meat and the mammalian meat. During fish processing, it is very important to know chemical composition and properties of raw fish meat, in order to apply the most appropriate technology procedures adjusted to certain fish species. Minced fish meat and surimi are using as a raw material for the production of finely minced cooked sausages, especially in Asia (Konno, 2005).

Appearance, color, texture, odor and taste of fish sausage present the most important sensory properties of sausage and their quality is based on these properties. From the aspect of food safety, it is very important to determine the microbiological status of the obtained product. Chemical composition of sausage is an important indicator of nutritional quality, as well as checking whether the product is in accordance with the Regulations (Regulations of quality and other requirements for fish, crayfish, shellfish, sea urchins, sea cucumbers, frogs, turtles, snails and their products; 2003).

According to available literature in Serbia, examinations including these types of products were not conducted. The aim of this paper is to show process of production for carp meat sausages, and to determine the sensory, microbiological and chemical characteristics of the resulting product.

MATERIAL AND METHODS

Carp cultured in the Kakovo monastery fishpond in Greece, was overfished and immediately sacrificed. Mean values of the masses of carps were approximately 2850 g. The fish were decapitated and eviscerated, washed with cold water and skin and bones were manually removed. Further processing was done in the monastery facilities. Pieces of fish meat were minced in the meat grinder by using a grid with Ø 5 mm holes. Sausages were produced according to the production procedures for boiled sausages, by the recipe: 60% of fish meat, 15% of smoked fish meat, 15% hydrated soy flakes (1:2) and 5% of ice. In this was added 2% of NaCl, 1% mixture of natural spices and 2% soy isolate. The raw material was stuffed into collagen casings Ø 32 mm and processed in the chamber for heat treatment: heated, dried and smoked at 55 °C and roasted at 75 °C until achieving the temperature of 70 °C in the center of product. The sausages were refrigerated, vacuum-packed, and the samples were stored at a temperature of 4 °C until the end of the analysis.

Analyses of sausages were carried out at the Institute of Meat Hygiene and Technology in Belgrade.

The main chemical composition was evaluated by determining moisture content (ENG ISO 1442), total protein (SRP ISO 937), free fat (ENG ISO 1443) total ash (SRP ISO 936), and the calcium and NaCl content (SRP ISO 1841-1). To determine calcium content, sample preparation was done by destroying of 1 g homogenized carp meat sausage sample by microwave's digestion in a mixture of concentrated nitric acid and hydrogen peroxide in a microwave oven START D (Milestone, Italy). Calcium from solution was determined by flame atomic absorption spectrometry at 422.7 nm on the device SPEKTRAA 220 (Varian, Australia).

Microbiological tests were conducted according to the legislation (Regulation of micro-biological safety of food on the trade, "Offic. Journals of SRJ" no. 26/1993, 53/1995 and 46/2002) by determining: the total number of microorganisms (EN ISO 4833), the presence of *Salmonella* species (EN ISO 6579), *Escherichia coli* (ISO 16 649), *L.monocytogenes* (EN ISO 11290-1) and *Bacillus cereus* in g /ml (EN ISO 7932).

Sensory characteristics of sausages were evaluated by using quantitative-descriptive test (SRPS ISO 6658), at the scale intensity from 1 to 5, and sensory properties of sausages (outward appearance, cut appearance, color, texture, taste, flavor and overall acceptability) were rated. A group of five assessors formed a panel for sensory properties evaluations. Assessors have been previously tested by using a test to sense of taste determination (SRPS ISO 6658), as well as a test for the training of assessors based on detection and recognition of odors (SRPS ISO 3972).

RESULTS AND DISCUSSION

Sensory characteristics of examined sausages were specific to the type of product. On the surface of sausages, the odor was without foreign odors. At intersections, sausage stuffing was consisted of light brown-orange fragmented mass and characteristic consistency to the type of sausage. Odor and taste were characteristic for the type of sausage, without foreign flavors and odors.

The paper of Ćirković et al. (2012c) shows the results of chemical composition of carp cultured in the Kakovo fishpond which was used for sausages production. These results showed how inappropriate rearing technology can effect on the quality of fish meat. The carp was cultured in the earthen ponds of Kakovo (property of the monastery Hilandar, Greece, recipient wellspring) in semi-intensive production system with addition of corn. The results of the analysis showed that sampled carp meat had 37.12% of fat what was higher than in other carp meat results of analysis available from literature. Such a high percentage of fat caused a low percentage of water, (48.8%) in meat, especially for the fish. The amount of protein which was 11.37 %, was lower than in the previous analyses of chemical composition of carp meat.

Meat with a higher fat content required addition of protein products (hydrated extruded soybean flakes). Addition of smoked carp meat, in which during the heat treatment was reduced the fat and water content, contributed to improvement in taste and correction of the chemical composition of the sausages.

Results of chemical analysis sausages produced from carp meat are presented in Table 1.

Table 1. Results of chemical analysis of sausages produced from carp meat

Characteristic	According to Regulations*	Content
Water content %		48,06±0.93
Total protein content %	min 11%	16,48±0.45
Fat content %	max 25%	24,50±0.76
Ash content %		4,07±0.09
Sodium chloride content %		3,10±0.07
Calcium content mg/100g		21,00±0.11

*Regulations on quality and other requirements for fish, crayfish, shellfish, sea urchins, sea cucumbers, frogs, turtles, snails and their products (2003).

The results of chemical analysis showed that the composition of the sausages were in accordance with regulations on quality and other requirements for fish, crayfish, shellfish, sea urchins, sea cucumbers, frogs, turtles, snails and their products (2003). Lower moisture content is common for products stuffed into permeable collagen casings. The fat content (24.50±0.76) is the result of the use of carps, which were fed with a lot of corn. Increasing of salt content in sausages (3.10%) is a result of smoked carp meat addition, which usually has a high salt content. Salt did not affect a taste correction, because the sausages had lower moisture content and feeling of salinity is most expressed in the products with higher moisture percentage.

Fish sausage produced by Al-Bulushi et al., (2011) contained 12.22% of fat, while

the sausages from the market that they were tested contained 5.5% of fat. Chuapoehuk et al. (2001) have published results of sausages made of catfish which contained 74.5% of water, 3.16% of fat protein and 13.73% of protein.

Table 2. Results of microbiological analysis of sausages produced from carp meat

Microorganisms	Number of microorganisms
L.monocytogenes in 25 g/mL	not determined
E.coli in g/mL	not determined
Number of erobic colony in g/mL	3 000
Salmonella species in 25 g/mL	not determined
Bacillus cereus in g/ml	not determined

Results of microbiological analysis of sausages produced from carp meat (Table 2) showed that the minimal number of aerobic bacteria (3 000) was found in the sausage. This suggests that the carp meat was hygienic safe and that good manufacturing and hygiene practices in the facilities of monastery Kakovo were correct. Also, a thermal treatment was carried out in a satisfactory way, what resulted in destroying of most microorganisms. It is significant that the presence of any pathogen bacteria was no found.

Used spices did not have bacterial contamination, and contributed to safety of sausage. When considering the microbiological analysis of meat sausages obtained from carp, it is important to consider the amount and type of spices, which are used in the production process. Many spices show antioxidant properties that enhance the stability of fats (Gulcin, 2005), and Yin and Cheng (2003) have found that the antioxidant potential of spices is relatively low and depends on the dose. Spices can also show antibacterial effects against pathogenic bacteria such as *Bacillus cereus*, *Staphylococcus aureus* (Kumudavally et al., 2011), *Salmonella enteritidis* (Benkeblia, 2004), *Shigella* spp. (Bagamboula et al., 2004), *Aeromonas hydrophila* (Fabio et al., 2003). Antibacterial capacity in the reduction of bacteria showed cinnamon, garlic, onion and caraway (Arici et al., 2005; Das et al., 2011).

CONCLUSION

According to presented investigations of sausages produced from carp meat, it can be concluded:

Sensory characteristics of examined sausages are specific to the type of product: texture, odor and taste are characteristic for the type of sausage, without foreign impurities.

Microbiological analysis of sausages from carp meat showed the absence of pathogenic bacteria and confirmed that the product was safe and suitable for human consumption.

Chemical analysis showed that the product complies with the Regulations in terms of chemical composition and because sausage contains less fat than sausages produced from the meat of farm animals, is suitable for consumption of human risk groups.

On the facts above, it can be said that by technological process of sausages production from carp meat it was obtained good product.

Presented results can serve as a basis for development of quality standards for home-made fish sausages. In addition, these results may help to develop similar products of different species of fish, which would complement the current offer of fish and fish products in the market, as well as to improve the market value of the product.

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KARAKTERISTIKE KOBASICE PROIZVEDENE OD MESA ŠARANA

ĐORĐE OKANOVIĆ, DRAGANA LJUBOJEVIĆ, MIROSLAV ĆIRKOVIĆ,
VESNA ĐORĐEVIĆ, DANIJELA VRANIĆ, NIKOLINA NOVAKOVIĆ

Izvod

Cilj ovog rada je bio da se ispituju senzorne, mikrobiološke i hemijske osobine kobasice koja je proizvedena od mesa šarana, izlovljenog iz jezera na Kakovu, metoh manastira Hilandara. Riblje meso i proizvodi od ribe predstavljaju vredan izvor hranjivih materija od veoma velikog značaja za raznolik i zdravu ishranu. Rezultati senzorskih ispitivanja su pokazali da su miris i ukus svojstveni za vrstu kobasice, bez stranih primesa, a na presecima, nadev kobasice se sastojao od usitnjene mase, svetlo smeđe-narandžaste boje, svojstvene konzistencije za vrstu kobasice. Mikrobiološkim analizama nije ustanovljeno prisustvo bakterija *L.monocytogenes*, *E.coli*, *Salmonella* spp., niti *B.cereus*, dok je broj aerobnih kolonija u g/ml bio 3000. Sadržaj ukupnih proteina bio je 16,48%; sadržaj masti 24,5%; sadržaj vode 48,06%; sadržaj pepela 4,07%. Količina kalcijuma je bila 21,0 mg/100g, a sadržaj natrijum hlorida je iznosio 3,10%.

Ključne reči: šaran, kobasica, sensorika, hemija, mikrobiologija.

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