

FORMULATION, PRODUCTION, AND DETERMINATION OF PHYSICAL-CHEMICAL AND SENSORY CHARACTERISTICS OF THREE DIFFERENT FUNCTIONAL OHRID TROUT PÂTÉS

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Abstract

This research aims to formulate and produce functional pâté made of Ohrid trout with different percentages of meat in its content, (40%, 50%, and 60%). The functionality of the pâté is improved by using olive oil as fat and vegetable proteins and pea fibers to stabilize the emulsion. The three pâté formulations were produced without using any E-label additives. The pâtés are characterized by good and stable emulsion and fulfill the technological and sensor characteristics of a pâté. The physical-chemical analyses prove that the final product has a low percentage of fats: 19%, 18.5%, and 16.5% for pâtés A, B, and C, respectively.

Keywords: Ohrid trout, functional pâté, olive oil, vegetable fibers.

1. Introduction

Up until recently, health has generally been defined as the absence of disease (Ashwell, 2003). The connection between food and disease is the basis of preventive nutrition. Functional food is a merge of two important segments in our lives – nutrition and health (Henry, 2010). A functional product has a healthy or physiological effect, but, and not based on the influence of an isolated, individual component (Gibson & Williams, 2000). The sustainability and the success of functional food in the future will depend upon its acceptance by the consumers, their readiness to pay for it, and their belief that functional food will satisfy their expectations concerning health (Prodanović & Lazović, 2015). According to Steen et al. (2014), pâté is a warm emulsion consisting of emulated zones of fat globules surrounded by a protein layer and dissolved proteins in a continuous phase, forming a gel matrix. Today, on the market there are various types of pâtés in the sense of their content: chicken, pork, beef, vegan, and fish pâtés with different percentages of vegetables and fats and different nutritive values. Compared to the others, fish pâtés stand out because of their better nutritive characteristics, presence of omega-3 fatty acids, eicopentanoic acid, docosahexaenoic acid, and a lower level of cholesterol, (Ünlüsayın et al., 2007). Fish is an important functional food with potentially positive effects on people's health. The high nutritional value of fish is due to the beneficial content and the ratio of proteins, fats, carbohydrates, minerals, and vitamins, as to the significant content of unsaturated fatty acids, especially polyunsaturated fatty acids (Kalevska et al., 2020). The functionality of the pâtés is improved with the usage of olegogel, olive oil, and other types of vegetable oils which decrease the percentage of fats and cholesterol and on the other side enrich the fatty acids content (Agregán et al., 2015; Reddy et al., 2015; Branciari et al., 2019; Teixeira et al., 2019; Martins et al., 2020). The functionality and the nutritive value of meat products can also be improved by the addition of dietary fibers (Sofi et al., 2017; Yang, et al., 2017). Vegetable fibers can replace or lower the level of fat components in the products (Yangilar, 2013; Talukder, 2015), increase the protein content (Kazhibayeva et al., 2019; Kambarova et al., 2021), improve the stability of the emulsion, water retention capacity and yield (Yangilar, 2013; Talukder, 2015; Kurt & Ceylan, 2018; Tsareva et al., 2020).

2. Ingredients and methods

The ingredients used for the production of the three functional pâté formulations are Ohrid trout fish (*Salmo letnica*) grown in aquaculture conditions in the fish pond “Tabana”, village Belica in the Porech region of the Republic of North Macedonia. The list of ingredients also includes the commercially produced extra virgin olive oil “Santorina”. The isolated pea proteins and dietary pea fibers by “Cosucra” are used to stabilize the emulsion. The other ingredients used are white pepper and black pepper extract by “Akras”, caramelized onion by “Raps”, and rosemary extract produced by “Fratelli Pagani” as an antioxidant. The ingredients used for the production of the pâtés allow the obtained products to be promoted as “free of E-numbers”.

Three different types of functional pâtés are formulated, with different content of Ohrid trout meat: pâté A with 60% meat, B with 50% meat, and C with 40% meat and respectively different content of other ingredients listed below (see Table 1).

Table 1. Formulations of functional Ohrid trout pâtés.

Ingredients (g)	Pâté A 60% trout	Pâté B 50% trout	Pâté C 40% trout
Ohrid trout	600	500	400
Bouillon	138,3	225,3	291,8
Olive oil	130	130	130
Pea fibers	15	23	43
Pea proteins	8	13	26,5
Carrot	70	70	70
Caramelized onion	15	15	15
Salt	17	17	17
White pepper	2	2	2
Black pepper extract	0,5	0,5	0,5
Rosemary	0,2	0,2	0,2
Rosemary Extract	0,02	0,02	0,02
Lemon	4	4	4

The production of pâtés is done in laboratory conditions and encompasses the following three stages presented in Fig1.

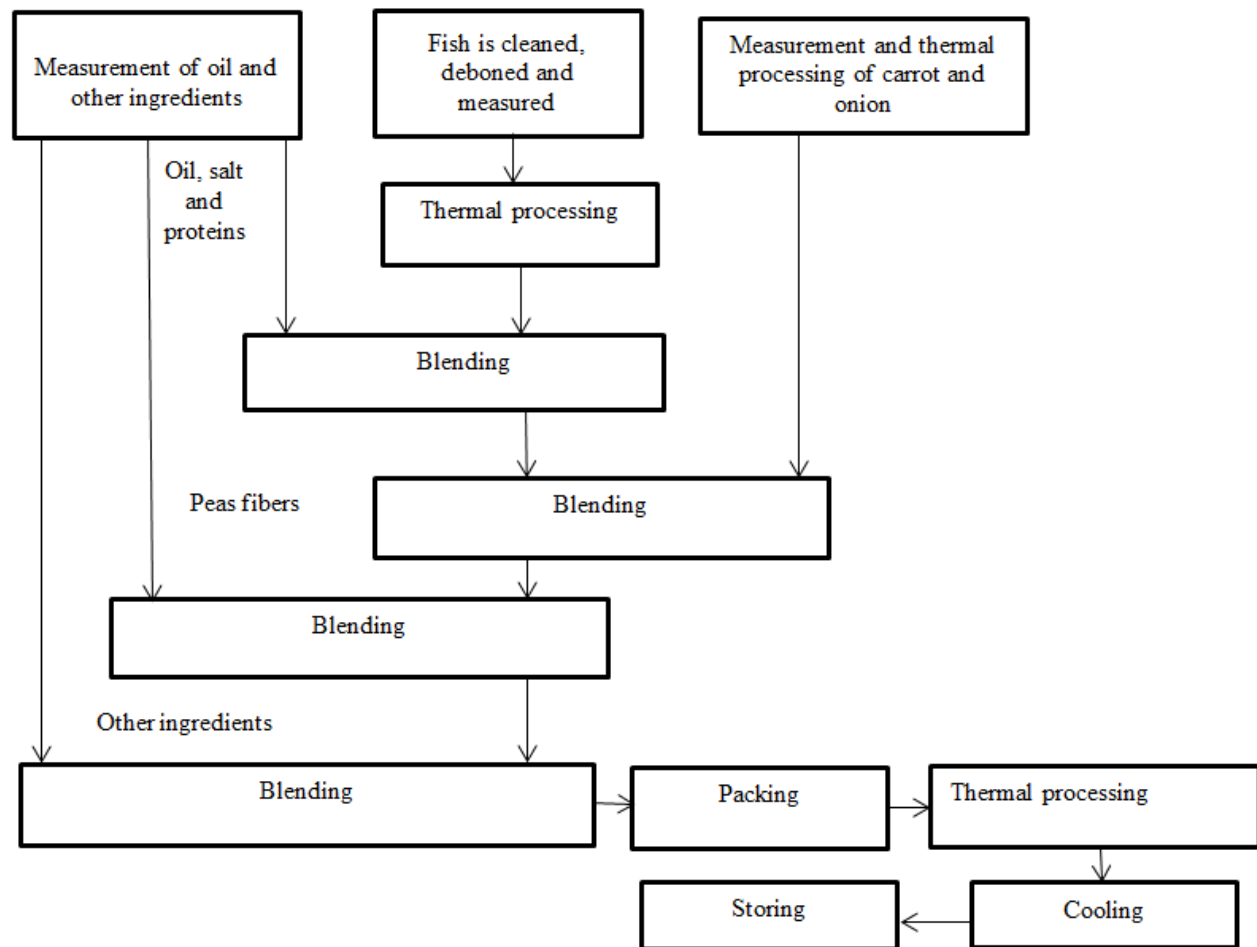


Fig1. Flow chart of production of functional Ohrid trout pâté made in laboratory conditions.

To determine the differences in the physicochemical content of the three pâtés, the following physicochemical analyses were made: determination of proteins according to Kjeldahl (Foss-Kjeltec 8200), fats according to Soxtec (Foss-ST 243 Soxtec), water by drying (VWR-DRY-Line), ash by burning in a muffle furnace (MRC-MSF 12/6), water activity with (Novasina-LabTouch-aw), pH-value (MRC-pH Meter PL-600). All analyses were made in the laboratory at the Faculty of Technology and Technical Sciences – Veles, while NaCl was analyzed at the Food Institute at the Faculty of Veterinarian Medicine in Skopje following the accredited method MKC EN ISO 5943:2010.

The representative sensory characteristics of the three pâtés A, B, and C are estimated following the point system of scoring method (Radovanovic & Popov-Raljac, 2000/2001), using a scale from 0 to 5. The examination of the sensory characteristics includes smell, taste, color, consistency, smoothness, gloss, and fat separation.

3. Results and discussion

The results obtained from the physical-chemical content analyses of the three pâtés are shown in Table 2. The differences in the values point towards mutual connection and internal correlated influence of the different quantities of the ingredients during the production of the pâtés.

Table 2. Physical-chemical content of the three Ohrid trout pâté formulations

	Pâté A 60% fish	Pâté B 50% fish	Pâté C 40% fish
Proteins%	12,227	11,894	10,728
Fats %	19	18,5	16,5
Salt %	2,46	2,25	1,99
Water %	63,058	64,127	65,148
Ash %	2,477	2,125	1,957
aw	0,973	0,974	0,975
pH	5,77	5,63	5,57

From the results in Table 2 conclusion can be made that protein quantity in the pâtés is directly correlated with the quantity of meat in the product, i.e. the decrease in the percentage of meat in the content of the pâté leads to a decrease in the percentage of the proteins in the pâtés. The type of fish and its percentage in the content of the product also influences the product quantity and nutritive value of the proteins in it, (Ünlüsayın et al., 2007; Skalecki et al., 2021). Another factor that influences the protein content in the pâtés besides the number of meat proteins is vegetable proteins and fibers that are also added to the product, (Shoaib et al., 2018; Kambarova et al., (2021). The quantity of ash (minerals) in the three pâté formulations is correlated with the percentage of meat in the pâtés and is 2.447% in pâté A, 2.125% in pâté B, and 1.957% in pâté C. According to Martins et al. (2020); Branciari et al. (2019) the replacement of animal fats with vegetable ones results in a decrease in ash values.

In comparison with the results obtained by other authors (Branciari et al., 2019; Martins et al., 2020 & Skalecki et al., 2021) who worked to improve the functionality of the pâtés by replacing the animal with vegetable fats, a conclusion can be made that Ohrid trout pâtés are characterized by lower percentual values of fats in the final product. The three pâtés' formulations are produced with the same percentage of olive oil, and yet there are results with a different percentages of fats in pâté A, pâté B, and pâté C: 19%, 18.5%, and 16.5%, respectively. The determined differences are due to the different percentages of meat in the three pâtés. The fat content in the pâtés varies depending on the type of fats and other ingredients used in the pâté content, (Branciari et al., 2019; Skalecki et al., 2021). The enrichment of the pâtés with vegetable fibers contributes to the production of pâtés with a lower percentage of fats, (Andronikov et al., 2017; Kazhibayeva et al., 2021; Kambarova et al., (2021).

The usage of different quantities of bouillon in the production of the three pâté formulations has the biggest influence on the percentage of water in the final product which ranges from 65.148% in pâté C, to 63.058% in pâté A. These results are similar to the results obtained by Ünlüsayın et al., (2007). Although the addition of bouillon in the pâtés leads to an increase in the water percentage in them, the water activity (aw) in all three pâté formulations is insignificantly different and is 0,973, 0,974 и 0,975 for pâtés A, B, and C, respectively. These insignificant differences are due to the addition of vegetable ingredients that allow the reduction of aw. The addition of vegetable ingredients lowers the water activity from 0,936 to 0,923, at turkey pâté, Kambarova et al., (2021).

The NaCl content in the three Ohrid trout pâté formulations (A, B, and C) is 2.46%, 2.25%, and 1.99%, respectively, while the pH value is 5.775, 5.635, and 5.570 in the three formulations A, B, and C. The pH value of the pâtés is lower compared to the results obtained by Martins et al. (2020), which is due to the usage of olive oil. Teixeira et al., (2019) also confirmed that pâtés made with olive oil had a lower pH value compared to pâtés produced with animal fats.

The sensory attributes of the three Ohrid trout pâté formulations were estimated by 30 panelists with different backgrounds and profiles.

The sensory evaluation (Table 2) of the pâtés was made with the point system of scoring method. The best results were obtained for pâté B with the pondered average value of 4.578, then pâté C with a value of 4.480, and finally pâté A with the pondered average value of 4.368. It should be noted that pâté C has the best sensory attributes concerning color, smell, and taste.

Table 2. Sensory evaluation of pâtés

Sensory attributes	Pâté A	Pâté B	Pâté C
Smell	4,233	4,233	4,366
Taste	4,233	4,300	4,433
Color	4,033	4,433	4,766
Consistency	4,533	4,766	4,533
Smoothness	4,566	4,666	4,366
Gloss	4,233	4,366	4,166
Fat separation	4,866	4,933	4,933
Pondered average value	4,368	4,578	4,480

Pâté C, in comparison to pâtés A and B, is characterized with not so intense fish aroma and brighter color. No artificial colors or flavor enhancers were used in the production of the pâtés, so these formulations have natural color and taste that are the results of the original attributes of the ingredients used in the process of production. Concerning the technological attributes of the pâtés as consistency, smoothness, gloss, and fat separation, the results show that pâté B has the highest scores. These technological characteristics (consistency, smoothness, gloss, and fat separation) are closely connected to the presence of fats in the pâtés and their dispersion, which leads to a stable emulsion obtained by a good balance between the vegetable fibers and pea proteins on one side and the olive oil and fish meat on the other.

The results lead us to the conclusion that all three pâté formulations obtained high scores for the technological characteristics, sensory attributes, and qualities, which suggests their acceptability for production concerning the technological and sensory part of the quality of the product.

4. Conclusion

Formulations of three types of functional fish pate were made (60%, 50%, and 40% fish meat). Ohrid trout, extra virgin olive oil, dietary pea fibers, and spices, all ingredients free of E-numbers, were used in the production. The results obtained from the physical-chemical analyses of the pâté formulations, as well as the high scores obtained by the sensory evaluation of the trout pâtés, suggest that they are acceptable food products for consumers. Determination of the commercial potential of these products should be the next phase to develop the new product line.

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