The use of non-traditional meat stuffing in onigiri preparation

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Abstract. This paper considers the possibility to use various fillings – smoked chicken breast fillet, lightly salted salmon with cottage cheese, imitation crab meat and mayonnaise in the manufacture of rice balls named "onigiri", using porphyry algae, and their effect on the quality indicators of the samples obtained. To achieve this goal, the samples of onigiri rice balls prepared with the introduction of various types of fillings were studied. In the Japanese cuisine recipe of the classic rice ball instead of lightly salted salmon, which was a control sample, smoked chicken fillet was introduced - sample 1, imitation crab meat surimi and mayonnaise - sample 2, lightly salted salmon with cottage cheese - sample 3. An organoleptic assessment of the quality indicators of the rice sandwich showed that sample No. 3 with a filling of lightly salted salmon and cottage cheese turned out to be the best. According to the results of the experiment, it can be concluded that the introduction of such a prescription component as imitation of crab meat and mayonnaise into the recipe not only improves organoleptic requirements, but also enriches the result product with the microelement iron.

1 Introduction

The author Mary G. McDonald from Hawaiian university (Honolulu, Hawaii, the USA) describes the development of the Japanese food market. Industrial "economic growth was accompanied by an increase in the industrial production of foods, based on scientific, mechanized and energy-intensive methods and sold as regional and national goods, paid for hire" [1]. Demographic changes and food habits of the Japanese have increased and restricted the sale of various foods over time, the consumption of processed foods and frozen food products has grown along with the acceleration of the pace of life and the expansion of labor force participation" [1]. Japan began to identify itself with the world through products that expressed its national culture.

The main consumer products are rice, marine products, fish, algae of various types consumed in food. Particular attention is paid to seaweed, which is an integral part of

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"regional cuisines around the world, especially in Southeast Asia and Polynesia, where they have been a part of the daily diet for thousands of years" [2]. The author Ole G. Mouritsen in his article notes that in Europe and America, there are a significant number of coastal areas that have traditionally consumed seaweed, and in recent years there has been an increased interest in the revival of seaweed cuisine, as well as the use of "seaweed in simple modern dishes, as well as in molecular and modernist cuisines". [2]. Nori is made from porphyry seaweed. Nori is a popular, but at the same time expensive product both in Japan and around the world, mainly due to the popularity of sushi culture all over the world. Traditionally, Japanese dishes, including breakfast, comprise nori in one or another form. Nori can also be cooked and stewed with soy sauce and sweet rice wine to form a product, "nori tsukudani is like a thick and viscous paste that can be used as a spice to boiled rice" [2]. Rodin J. and Mancuso J. note that the "craving for rice" may be characteristic of Asian countries that consume rice, and that there is a significant "craving for sushi" in Japan. "Rice was a food beloved only in Japan." [3]

The benefits of the nori rice sandwich component are reflected in the works of many researchers. Researchers Shogo Isaka, Takashi Kuda, in their works have shown the antioxidant and anti-inflammatory activity of brown algae, including porphyry, capable to restore iron and remove free radicals [4, 5]. Experiments conducted on rats showed that seaweed was a good source of dietary fiber and improved the digestibility of protein and minerals [6]. Tomoki Nishiguch and co-authors in their article provide data on products using algae as a healthy and functional food of Japanese cuisine, and data on the protective antitoxic porphyran effect isolated from algae. [7]. Researcher V. Romarns-Hortas and co-authors in their investigation determine the iodine-containing protein in porphyry algae [8]. Fahmida Sultana and her team cite in their review article the proved opinion that algae are promising to provide various environmental, social and economic benefits.

Researchers express the opinion that "seaweed is an excellent source of nutritious food for humans due to its low lipid content, high quantity of minerals, fiber, polyunsaturated fatty acids, polysaccharides, vitamins and biologically active compounds" [9]. Various "functional products for the food industry" are produced and developed from algae [10]. To compensate for the effects of climate change, "seaweed farms absorb carbon, reduce agricultural emissions, and provide raw materials for the production of biofuels and livestock feed" [10]. Scientist Todor I. Todorov and his team conducted a study of forty-six samples of algae presented on the US market, and found out that algae accumulate necessary for humans a large amount of micro and macroelements, but toxic elements were also found in them [11]. Author Isabel Goñi cites research data on the effect of nori algae on the reduction of the glycemic index in volunteers who took part in the experiment [12]. Researcher Shireen R.L. Flores and co-authors conducted a comparative assessment of the content of such an important element as iron in spinach and thirteen species of seaweed, but only nori and sea lettuce provided more bioavailable iron than spinach [12]. Rochelle Embling with a group of scientists conducted a "study of the acceptability for consumers of seaweed-based products in the UK as an alternative to animal proteins" [13]. The authors found out that consumers accept the possibility of using seaweed and determine their perspective when developing future products [13]. I. López-López and a group of researchers cite data on the effect of the addition of edible seaweed, including nori (porphyry) on the structure of fatty acids, amino acid profile, protein index, "mineral content and antioxidant capacity in model emulsion systems for meat with a low salt content, the adding of seaweed caused an increase in the content of polyunsaturated fatty acids" [14]. Yaoyao Peng and co-authors in their article give convincing arguments for the use of algae as an alternative source of protein, since "animal proteins are good food sources of protein, but their production is associated with high carbon emissions" [15].

When studying the issue under consideration about the properties of the ingredients included in rice sandwiches, no data was found on the study of the entire complex product – a rice sandwich. There is no information about the use of other fillings for this dish, except for the classic ones. The purpose of the research is to investigate the use of non-traditional fillings in the manufacture of onigiri rice balls. The purpose has outlined such tasks as the selection of components for recipes to create new types of onigiri rice balls with various fillings, using traditional nori sheets. Prototypes of the resulting product were examined according to quality indicators, the best samples were identified, combining high organoleptic indicators with benefits for the health.

2 Materials and methods

2.1 Materials

In the classical Japanese version, onigiri dish includes rice balls or triangles with stuffing. Salmon fish is traditionally applied as a filling. Rice for such balls should be fresh, and the main taste is provided by the filling. In cooking the following fillings were used: sushi rice, some lightly salted salmon, a nori sheet, rice vinegar "Mitsukan", cottage cheese, smoked chicken breast meat, imitation crab meat surimi, mayonnaise, some salt and sugar.

2.2 Recipes of the samples investigated

Source products and recipes of the samples are given in the Table 1.
The weight of the result product is 100 grams.

Table 1. Recipes of samples (rice balls onigir).

Source products	Control sample		Sample No.1		Sample No.2		Sample No.3	
	Spending source products and ingredients per 1 portion, g							
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Sushi rice	35	70	35	70	35	70	35	70
Water	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
Salmon light salted	42	30	-	-	-	-	16	13
Nori sheet	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Food salt	-	-	0.1	0.1	0.1	0.1	0.1	0.1
Smoked chicken fillet	-	-	35	30	-	-	-	-
Rice vinegar "Mitsukan"	-	-	10	10	10	10	10	10
Sugar	-	-	9	9	9	9	9	9
Surimi crab meat imitation	-	-	-	-	20	20	-	-
Mayonnaise	-	-	-	-	10	10	-	-
Cottage creamy cheese "Muletto"	-	-	-	-	-	-	13	13

It was decided to use rice vinegar, salt and sugar as a dressing in the experimental samples. Rice vinegar "Mitsukan" was taken as a necessary ingredient for making sushi. Sugar gives a sweet taste to rice, being the main source material to make the onigiri rice balls. Resulted from the experiments conducted during the selection of ingredients and according to the ratio, the following formulations were selected, indicated below in Tables 2, 3, 4. The weight of the result product is 100 grams.

2.3 Samples manufacturing technology

Rice for sushi was weighed, washed in running water to clear flushes. An EKSIRC – 5.5L rice cooker was used. the ratio of water to rice was 1:1. Rice was boiled for 40 minutes at a temperature 95-98 ° C. To prepare rice dressing were taken rice vinegar, sugar and salt, all the ingredients were finally mixed with boiled rice.

Lightly salted salmon was cut into small cubes. The peeled fillet of smoked chicken breast was diced. Imitation surimi crab meat was crushed and mixed with mayonnaise in a ratio of 2:1, respectively. Sheets of dried nori seaweed were cut into strips: 3×7 cm.

The rice was compressed into a ball and formed into a triangle, pressed so that the rice would not crumble. In the middle of the lower side of the triangle, a strip of nori leaf was put with its rough side inside. The ready output product should weigh 100 grams.

2.4 Physical parameters of samples

The amount of dry source products, the mass fraction of moisture, the titrated acidity and the hydrogen index of the samples were determined after manufacturing, according to the methods described in AOAC (2000) [16]. The iron content in food was tested using a spectrophotometer based on measuring the color intensity of a solution of a complex compound of divalent iron with orthophenanthroline, with preliminary dry mineralization of samples.

2.5 Organoleptical characteristics of samples

According to organoleptic parameters, onigiri must meet the requirements specified in the table (Table2). The evaluation of the organoleptic properties of the samples was carried out by the experts applied organoleptic methods [17].

According to organoleptic indicators, onigiri must meet the requirements specified in the table (Table 2).

Table 2. Onigiri organoleptical indicators.

Parameter	Characteristic
Shape	a regular triangular shape according to this type of product; without any damage.
Colour	corresponds to the grade of used rice groups, without extraneous inclusions and stains.
Sectional view	the sandwich does not disintegrate, the filling is spread equally between the layers of rice.
Taste and smell	are corresponding to the product name and the components included in the composition, without any side impurities and discrediting signs.

3 Results and discussion

Based on the given above information, the organoleptic parameters of onigiri rice balls samples were evaluated. Control sample with the shape of a regular triangle and rounded corners, has a color characteristic of the rice variety that is used in cooking. The surfaces are smooth, there are no cracks and no visible sticking filling. The nori sheet is attached to the lower side of the triangle. The smell is fresh, it is of rice, there is also some smell of algae, when the aroma of salmon, being ataken as a filling, is not felt. When being cut, the rice falls out. Salmon is cut into small pieces, lies in a neat layer, does not fall out of the sandwich. The aroma of salmon and other ingredients is felt on the cut. The taste is a little bland, the rice does not have enough power, but it goes well with the filling. The taste of the added filling is pleasant, no extraneous tastes or impurities were detected.

Sample 1, Figure 1a – rice ball onigiri with smoked chicken fillet looks corresponding to this type of cookery product, it has the correct shape of an equilateral triangle.

The filling is not visible behind the rice, it does not stick out. In the middle of one side a sheet of nori for the convenience of eating a sandwich is attached. The color corresponds to the variety of the selected rice, it is white, it does not contain spots of extraneous color. The smell corresponds to the source products, due to the nori sheet, the smell of seafood and seaweed prevails. You can feel the sweet aroma that is obtained by using a special rice dressing, and you can also smell smoked chicken filling. When dividing a sandwich with a knife, the filling is slightly poured out. The consistency of the rice is dense, it does not stick to the hands, the product is well molded. The filling is sufficiently crushed. The taste corresponds to this product and the raw materials used. The rice is sweet due to the dressing, a pleasant combination of flavors with smoked chicken, filling is not dry, substantial. There are no extraneous tastes and odors, no crunch and impurities were detected. Sample 2, Figure 1b – onigiri with imitation crab meat and mayonnaise. A triangle of regular shape with smooth sides, a strip of nori sheet is glued in the middle. The color corresponds to boiled rice, without color additives, the filling does not break through and does not color the rice. The smell is sweet with the aroma of algae. The smell of the filling is not felt. When cut, the filling does not fall out, it holds its shape well. The flavor on the slice corresponds to the filling used in this sandwich. Rice does not stick to your hands, it is cooked well, soft enough, is not dry. The taste is sweet due to the rice sauce used. There are no extraneous tastes and odors. Sample 3, Figure1c – onigiri rice ball with slightly salted salmon and cottage cheese has the shape of a regular equilateral triangle with a strip of nori in the middle of one side. The filling does not stick out. The smell of rice and fish is a little sweet. Rice does not stick to your hands, keeps its shape well. In the section, the filling does not fall out. In the section there is a smell of cottage cheese, a faint aroma of salmon. The color of the filling is slightly pink because of salmon. The combination of filling and sweet rice is delicious. There are no extraneous tastes and crunch. onigiri rice ball is tender and juicy, the aftertaste is fishy, but pleasant.
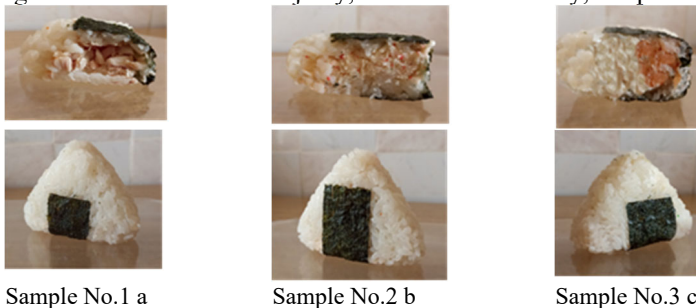

Sample No.1 a   Sample No.2 b   Sample No.3 c

Fig. 1. Onigiri balls samples.

The quality of the finished rice balls of onigiri was evaluated according to the following physico-chemical indicators: the mass fraction of ash content, the amount of dry material, the mass fraction of moisture, titrated acidity, hydrogen index and the amount of iron in the product. The physico-chemical indicator of the amount of dry substances determined by the standard method meets the standards. All results correspond to the values allowed for this type of product and the features of the source products. Sample 3 contains the largest amount of dry substances 24.33% of all tested samples, the lowest result was shown by sample 2 - 4.435% compared to sample 1, dry substances of which are equal to 20.47% and control sample – 22.75%. Next, the mass fraction of moisture of ready-made rice balls of onigiri was determined. The conducted studies proved that the largest mass fraction of moisture in sample 2 is 87.25%, and the smallest in sample 3 is 75.67 %.

According to the research, the highest acidity has a sample of $3 – 12.8 °$ T, the lowest control sample – $5.55 °$ T.

The priority parameters were the amount of dry matter, the mass fraction of moisture, titrated acidity and hydrogen index, the results are presented in the table (Table 3).

Table 3. Physical parameters of samples

Samples	Name of indicators			
	Control Sample	Sample 1	Sample 2	Sample 3
Mass fraction of dry substances, %	22.75	20.47	12.75	24.33
Mass fraction of moisture, %	77.25	79.53	87.25	75.67
Titrated acidity, deg	5.55	11.52	8.96	12.8
The hydrogen index	5.12	4.59	4.21	4.86

After the analysis of iron content in the samples, the following data were obtained, they are presented in Figure 2.
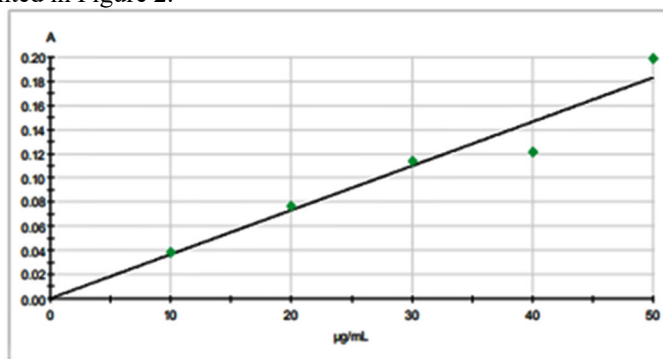

Fig. 2. Iron content in the onigiri samples.

Data on the iron content in the considered samples are presented in the table (Table 4).

Table 4. Iron content in the onigiri samples.

Sample Number	Sample name	Iron content, mg/100g
Control	Classic rice ball with lightly salted salmon	0.755
1	Rice ball with smoked chicken fillet	0.98
2	Rice ball with imitation crab meat	6.04
3	Rice ball with salmon and cottage cheese	4.05

Iron in combination with protein, vitamins, chlorophyll and silicic acid stimulates carbohydrate and protein metabolism, which is accompanied by an increase in the tone of the cardiovascular, respiratory and other body systems, contributes to an increase in the hemoglobin content in the blood and the number of red blood cells [18, 19]. Based on the daily needs of the human body in iron, the most suitable for consumption is a rice ball of onigiri with imitation crab meat, followed by a sample with salmon and cottage cheese. An insignificant amount of iron is contained in onigiri stuffed with smoked chicken fillet, and even less in a classic salmon sandwich.

4 Conclusions

According to the results of this work, the rice sandwich in 3 samples was considered. So, it has been revealed that the best according to organoleptic indicators was sample No. 2 with a filling of imitation crab meat and mayonnaise as well as sample No. 3 with a filling of lightly salted salmon and cottage cheese. Testing researches on physical and chemical parameters were also carried out. In terms of iron presence the best sample has been sample No.2. Summing up these results, the research has proved that the rice balls with stuffing correspond to the indicators of normative documents.

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