New fish product enriched with essential micronutrients

T N Suhareva, K I Toporkova and N Yu Tolstova

Michurinsk State Agrarian University, 101, International st., Michurinsk, 393760, Russia

E-mail: t-suh@inbox.ru

Abstract. In order to improve the nutritional value of fish products and intensify metabolic processes, various micronutrients are added into fish products. They enrich the products with proteins, vitamins and minerals and reduce the calorie content. When developing a recipe for fish products, the possibility of partial replacement of wheat bread with flaxseed bran with seeds and water with turnips was analyzed. The addition of flaxseed bran with seeds and turnips can enrich the product with dietary fiber, micro- and macroelements, vitamins. To determine the optimal percentage of plant raw materials, samples with the addition of linseed bran with seeds and turnips (10, 20 and 30%) were analyzed. A higher percentage has a negative effect on the organoleptic properties of the product.

1. Introduction

The problem of healthy diet is one of the most pressing. In the context of constantly growing competition and the trend for a healthy lifestyle, Russian fish processors can take advantage of the unoccupied niche of specialized and functional fish products [1].

These products have a high nutritional value and can improve the health of consumers. They can prevent a number of diseases due to the fact that fish is a functional product: it has a balanced amino acid composition, including all essential amino acids (e.g., tryptophan, lysine and methionine), high levels of minerals (e.g., B vitamins). It has high nutritional and biological values [2-4].

In order to maximize the nutritional value of fish products and intensify the metabolic processes, various micronutrients can be added into the fish products. They can enrich the products with proteins, vitamins and minerals, and reduce the calorie content.

Flaxseed bran is a by-product of the milling industry, which is a hard shell of flaxseed. In the manufacture of flax flour, bran waste products are seed germs, the aleurone layer, endosperm and flower coat of seeds. When flax seeds are cleaned, about 90% of all biologically valuable substances remain in the bran. Adding whole flax seeds to the bran increases the value of products, since the seeds are rich in omega-3 fatty acids, fiber, A, B1, E, F vitamins, magnesium, phosphorus, copper, and manganese [3, 5].

Adding a small amount of linseed bran with seeds improves appetite, increases the volume of production of intestinal secretions, improves the defensive function of the body, stimulates the production of red blood cells and soothes the nervous system. Plant fibers can fight against dysbiosis, serve as a breeding ground for beneficial intestinal microflora, an adsorbent of harmful substances, including allergens. Flaxseed bran with seeds helps to recover from allergic diseases, promotes intestinal peristalsis. This effect is used to combat constipation. Fiber, swelling in the gastrointestinal tract, creates a feeling of satiety, which allows overweight people to reduce food portions and fight obesity. In a dry
form, flaxseed bran with seeds is used for preparing soups and cereals, added to meat, minced fish and baked goods. Bran does not serve as a finished food product. It is a biologically active food supplement to saturate the body with useful components and maintain the normal level of metabolism. Bran is added steamed [3, 6-9].

Turnip has been known since ancient times; it can be baked, boiled, stuffed, used for preparing casseroles and stews, garnishes for meat and fish; it is used in salads. Turnip is easily absorbed by the body and used for baby food. Due to its frequent and long-term use, the phraseological unit “as easy as preparation of steamed turnip” is often used in Russian [6].

Turnip has long been considered as a means of cleaning the body of toxins. The taw turnip contains up to 9% sugars, vitamin C (twice more than in any root vegetable), B1, B2, B5, PP, provitamin A (especially in yellow turnip), easily digestible polysaccharides, sterol (required for treating atherosclerosis), glucoraphanin, the plant analogue of sulforophane with anti-cancer properties.

The turnip contains rare micro- and macroelements: copper, iron, manganese, zinc, iodine and sulfur, required to purify blood and dissolve kidney and bladder stones. The latter cannot be found in any other vegetable. A large amount of magnesium helps the body to store and absorb calcium. The turnip contains an antibiotic that inhibits the development of certain fungi, including those dangerous to the human body (not acting on E. coli and staphylococci). Turnip accelerates liver activity, formation and secretion of bile, which prevents the formation of gallstones. Fiber activates the intestinal motility and eliminates the stagnation of nutrients - this helps to lower the level of cholesterol and prevent atherosclerosis. The presence of lysozyme, a substance with strong antimicrobial activity, helps to destroy or prevent skin and mucous membrane diseases [6, 10, 11].

2. Materials and methods
The use of flaxseed bran with seeds and turnips will enrich the product with dietary fiber, micro- and macroelements and vitamins. To determine the optimal percentage of plant raw materials, samples were with the 10, 20 and 30% share of linseed bran with seeds and turnips were studied. A higher percentage has a negative effect on the organoleptic properties of products.

To determine the optimal formulation of the semi-finished product in terms of functional, technological and organoleptic characteristics, the samples were produced. The physicochemical and organoleptic parameters of the experimental samples with the addition of vegetable raw materials and the control sample were studied. Depending on the amount of linseed bran with seeds and turnips added, the semi-finished fish products change their indicators, but sample 2 with the replacement of wheat bread with 20% linseed bran with seeds and water with turnip had better properties. The organoleptic properties of the combined fish cakes depend on the quality of the pike perch meat and added plant materials, which form additional organoleptic properties of the product.

The organoleptic quality was assessed on the 5-point scale. The tasting assessment is presented in Table 1.

Table 1. Tasting evaluation of the samples of fish cakes

| Parameter          | Control sample | Experimental sample 2 |
|--------------------|----------------|-----------------------|
|                    | Scores | Scores taking into account W.C. | Scores | Scores taking into account W.C. |
| Appearance         | 4,5    | 0,45                  | 5,0    | 0,50                  |
| Consistency        | 4,9    | 0,98                  | 5,1    | 1,0                  |
| Sectional view     | 4,5    | 0,45                  | 4,9    | 0,49                  |
| Odor               | 4,8    | 1,44                  | 5,0    | 1,50                  |
| Taste              | 4,5    | 1,35                  | 5,0    | 1,50                  |
| Total *            | 4,67   |                        | 4,99   |                      |

*4.6-5.0 – excellent quality; 3.6-4.5 – good quality; 2.6-3.5 – satisfactory quality; less than 2.5 – bad quality
The scores for all parameters for the control and experimental samples were multiplied by the weight coefficients, the results were added, and the total quality scores of the control sample and the experimental sample 2 were obtained taking into account the weight coefficients.

The fish cakes produced from minced pike perch with the addition of turnips and flaxseed bran have a lower calorie content and improved organoleptic properties.

The tasting assessment of the samples using the 5-point scale confirms the results of the descriptive organoleptic assessment: sample 2 (with the replacement of wheat bread with 20% linseed bran and water with turnip) received the highest scores by all the parameters.

The effects of linseed bran with seeds and turnips on the quality of fish cakes were used to develop a recipe for Selyanochka fish cakes where wheat bread was replaced with 20% flaxseed bran and water with turnips. The recipe for Selyanochka fish cakes is presented in Table 2.

Table 2. Recipe for Selyanochka fish cakes.

| Name of products, semi-finished products | Weight, g |  |
|------------------------------------------|-----------|---|
|                                          | gross     | net|
| Zander                                   | 80        | 80 |
| Wheat bread                              | 14        | 14 |
| Flaxseed bran with seeds                 | 4         | 4  |
| Water                                    | 16        | 16 |
| Turnip                                   | 12        | 4  |
| Butter                                   | 2         | 2  |
| Semi-finished product weight             | 118       | 100|
| Weight of finished cakes                 | 118       | 100|

Product characteristics.

The product is oval-flattened with a pointed end. The color is typical of the raw materials with a grayish tint. Raw materials and materials used in the production must comply with the regulatory and technical documents.

In the manufacture of fish cakes using plant raw materials, the following raw materials are used [11]:
- fish, non-fish products and products made from them GOST R 55503-2013
- wheat bread made from first grade flour GOST 27842-88
- drinking water GOST R 51232
- butter GOST 32261-2013
- fresh turnip GOST 32791-2014
- linseed bran with seeds TU9290-006-58032938-13.

3. Results and Discussion

Proteins are the most important and complex chemical substances in the muscle and connective tissue that make up fish meat. They are built from a variety of amino acids. Amino acids form the plastic reserve of the human body [2, 6, 8]. These are muscle, connective, bone, adipose and nervous tissues. The results of studies of the amino acid content in fish cakes with vegetable raw materials are presented in Table 3.

Table 3 shows that the content of amino acids in the Selyanochka fish cakes was higher than in the control sample, which indicates their higher biological value.

When studying the content of lysine, methionine and tryptophan, we came to the conclusion that Selyanochka fish cakes are better than the control sample in terms of lysine by 26.7%. By the content of amino acids that affect the growth and development (leucine, isoleucine and threonine), their content is higher by 7.7%; 33.3% and 42.8%, respectively.
Table 3. Amino acid composition of fish meat cutlets for functional nutrition.

| Parameters                      | Control Content, g / 100g | Selyanochka Content, g / 100g |
|---------------------------------|---------------------------|-------------------------------|
| Essential amino acids including |                           |                               |
| valine                          | 0.9                       | 1.2                           |
| Isoleucine                      | 0.9                       | 1.2                           |
| Leucine                         | 1.3                       | 1.4                           |
| Lysine                          | 1.5                       | 1.9                           |
| Methionine                      | 0.5                       | 0.5                           |
| Threonine                       | 0.7                       | 1.0                           |
| Tryptophan                      | 0.1                       | 0.1                           |
| Phenylalanine                   | 0.6                       | 0.7                           |

Table 4. Satisfaction of daily nutrient requirements.

| Nutritional value | Daily requirement, g | Control Content, per 100 g | Degree of satisfaction of the daily requirement, % | Selyanochka Content, per 100 g | Degree of satisfaction of the daily requirement, % |
|-------------------|----------------------|-----------------------------|--------------------------------------------------|-------------------------------|--------------------------------------------------|
| Carbohydrates, g  | 261                  | 15.0                        | 5.75                                             | 12.4                          | 4.75                                             |
| Proteins, g       | 54                   | 12.6                        | 23.3                                             | 14.9                          | 27.6                                             |
| Fat, g            | 60                   | 5.9                         | 9.8                                              | 8.0                           | 11.4                                             |
| Dietary fiber, g  | 10                   | 1.2                         | 12.0                                             | 3.45                          | 5.75                                             |
| Sodium            | 700                  | 1588                        | 226.8                                            | 87.6                          | 12.5                                             |
| Potassium         | 600                  | 283                         | 47.2                                             | 813.7                         | 135.6                                            |
| Calcium           | 900                  | 64                          | 7.1                                              | 44.04                         | 4.89                                             |
| Magnesium         | 200                  | 32                          | 16.0                                             | 39.1                          | 19.55                                            |
| Phosphorus        | 800                  | 172                         | 21.5                                             | 230.6                         | 28.83                                            |
| Iron              | 12.0                 | 1.2                         | 10.0                                             | 1.15                          | 9.55                                             |
| A μg%             | 500                  | 10                          | 2.0                                              | 8.0                           | 1.6                                              |
| B₁                | 0.9                  | 0.09                        | 10.0                                             | 0.15                          | 16.7                                             |
| AT₂               | 1.0                  | 0.13                        | 13.0                                             | 0.11                          | 11.0                                             |
| PP mg%            | 11.0                 | 1.8                         | 16.4                                             | 1.84                          | 16.7                                             |
| C mg%             | 50.0                 | 0.4                         | 0.8                                              | 3.22                          | 6.44                                             |

The results of satisfaction of the daily nutrient requirements by Selyanochka in comparison with fish steamed cakes is presented in Table 4.

As can be seen from Table 4, when linseed bran with seeds and turnips are added to fish cakes, the daily requirements are satisfied better: for proteins - by 4.3%, dietary fiber - by 4.2%; potassium - by 88.4%, phosphorus - by 7.33%, magnesium - by 3.6%, vitamins: B1 - by 6.7%.

4. Conclusion

The study revealed that depending on the amount of linseed bran with seeds and turnips added to semi-finished fish products, their parameters change. The most optimal option is replacement of wheat bread with 20% flaxseed bran and water with turnip. In Selyanochka fish cakes, the amino acid content was higher than in the control sample, which indicates their higher biological value. When studying the
content of lysine, methionine and tryptophan, we came to the conclusion that Selyanochka fish cakes are better than the control sample in terms of lysine by 26.7%. By the content of amino acids that affect the development (leucine, isoleucine and threonine), their indicators are higher by 7.7%, 33.3% and 42.8%, respectively. This new recipe of fish cakes with functional ingredients has a number of beneficial properties for the human body and can be recommended for preventive nutrition.

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