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Review Article

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Study of nutritional value of macaroni pasta from composite flour

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ABSTRACT

This paper presents the results of nutritional value of pasta made from composite flour. The composite flour comprises 90% of wheat flour, 8% of buckwheat flour and 2% of flax flour. Analysis of chemical composition in pasta made from composite flour revealed that the content of protein and fat higher by 38.5% and 3.4% compared to products made from wheat flour. In addition, there is a high content of minerals and vitamins. According to physiological norms, the developed pasta satisfies more than 15% of the required daily allowance by iron, phosphorus, potassium, zinc, selenium, copper, vitamins B1 and E. As a result of these investigations, the developed pasta can be classified as functional foods.

Keywords: Pasta, Composite Flour, Buckwheat, Flax, Nutrients, Minerals.

Introduction

Pasta (macaroni product) is a very common and popular food product due to its long-term storage, fast and simple cooking, high nutritional value and low cost. The modern food market is replete with different kinds of pasta that can satisfy the various needs of the modern consumer. However, only 1% of the products produced relates to dietary and functional products [1, 2].

In the macaroni industry, developing new macaroni products with increased nutritive and biological value, enriched with functional ingredients is mainly solved by using new non-traditional raw materials in formulations [3, 4].

Studying the ingredients of the food products is important for determining the human body's physiological needs for particular nutrients. Accordingly, the theory of adequate nutrition considers not only the presence in the products of high-grade proteins, fats and carbohydrates, but also the intake of all nutrients, including minerals and vitamins in an optimal ratio [5, 6].

Vitamins of group B are the group of water-soluble vitamins that play a significant role in cellular metabolism. Lack of these vitamins lead in human body lead to the development of various human diseases [7, 8].Vitamins of group B are the most important energetics, supporting the vital activity of the brain cells and nervous system, protecting human body from free radicals and promoting normal metabolism [9]. Fe participates in blood formation processes, normalizes the functioning of the thyroid gland, regulates immunity and participates in tissue respiration [10, 11, 12]. Fiber improves the digestive function of the intestines, helps to eliminate cholesterol from the body, reducing the heart disease emergences [13].

The chemical composition of buckwheat and flax flour is significantly different from high-grade wheat flour in the content of functionally important food ingredients [14, 15].

The production of pasta from the composite flour includes different kind of food ingredients and it seemed appropriate to study the chemical composition of pasta, as well as the degree of satisfaction of the daily need for proteins, fats, carbohydrates, minerals and vitamins.

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The aim of the work was to develop the formulation and technology of gluten-free composite flour and the development of technology of gluten-free bread.

Materials and methods of research

Wheat, buckwheat and flax flour were sampled from the local supermarkets of Chelyabinsk city, Russia. Vitamin-mineral premix for wheat flour enrichment based on the standard GOST R 53494–2009 and comprises vitamins B1, B2, PP, B6, B9, C, and minerals such as calcium, iron and phosphorous. The following testing samples were selected: river fish, wheat bread, cow's milk, beef.

Pasta is dried in ARMADIO ESSICCATOIO dryer at 50–52 °C and 58–60% of relative air humidity (Figure 1).

Dough water quantity calculated by equation 1:

$$G_w = G_f \cdot \frac{(W_d - W_f)}{(100 - W_d)}$$

where, G_w – water quantity, ml
G_f – flour weight, g
W_d, W_f –dough and flour humidity, %.

Dough water quantity with additional supplement in formulation can be calculated by formula 2:

$$G_w = \frac{G_f \cdot (W_d - W_f)}{(100 - W_d)} + \frac{D(W_d - W_s)}{(100 - W_d)}$$

where, *D* – amount of supplement, g
Ws – supplement humidity, %

Vitamin composition was determined according the method developed by Institute of Nutrition of the Russian Academy of Medical Sciences, reported in [16]. The mineral composition was determined using ICP-28 spectrophotograph by MPU 4-C semi-quantitative spectral method.

Statistical analysis was performed using Statistica 12.0 (STATISTICA, 2014; StatSoft Inc., Tulsa, OK, USA). The differences between samples were evaluated using ANOVA method. The differences were considered to be statistically significant at $p \leq 0.05$..

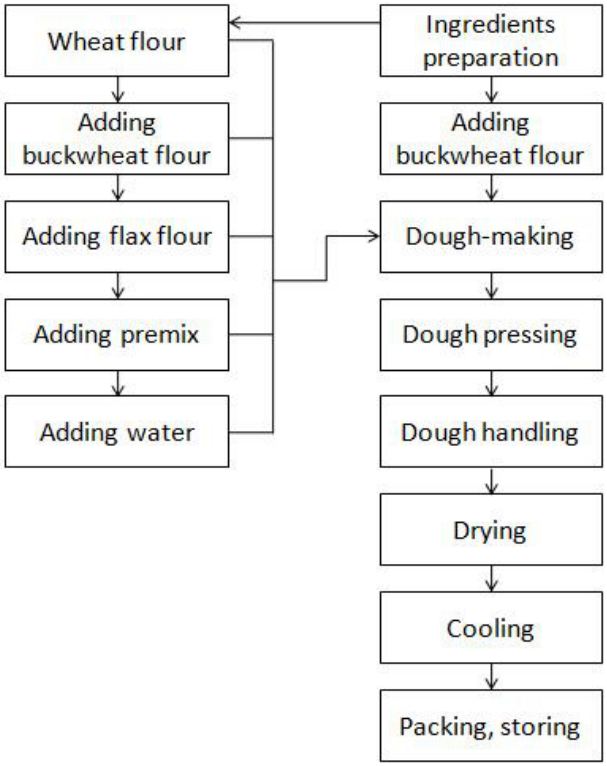

Figure 1. Flowchart of pasta production

Research results

It was found that the protein content of pasta from the composite flour is higher by 38.5%, the fat content higher by 3.4% and the carbohydrate content is lower by 1.9% than in the pasta made from wheat flour. It was established that the content of fiber in pasta from a

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composite flour (0.71 g /100 g) is higher to 3.5 times than that of wheat flour (0.2 g/100 g) (Figure 2, Table 1). The content of macro - and microelements in pasta from the composite flour was relatively high compared with pasta made from wheat flour, namely calcium by 20%, phosphorus - 14%, magnesium - 22%, potassium - 41% , sodium - 47%, iron - 51%, zinc - 141%, copper - 5.4%, manganese - 4.5%.

Composite flour pasta is rich comparing with wheat flour pasta in vitamins, such as thiamine by 40%, riboflavin - 23%, pyridoxine - 26%, nicotinic acid - 21%, tocopherol - 10%.

Satisfaction of recommended daily allowance of nutrients of 100g of composite flour pasta is presented in Table 1. It follows from the calculations that composite flour pasta satisfies the daily need for iron by 15.55%, vitamin B1 by 16.66%, vitamin B2 by 8.88%, vitamin B6 by 14.50%.

Thus, we can conclude that the developed pasta is enriched products with high nutritional value in view of their satisfaction of daily needs.

The average content of macro and microelements, vitamins in composite flour pasta complies with the principles of food combinatorics and MP 2.3.1.2432-08 "The norms of physiological needs for energy and nutrients for different groups of the population of the Russian Federation" [17].

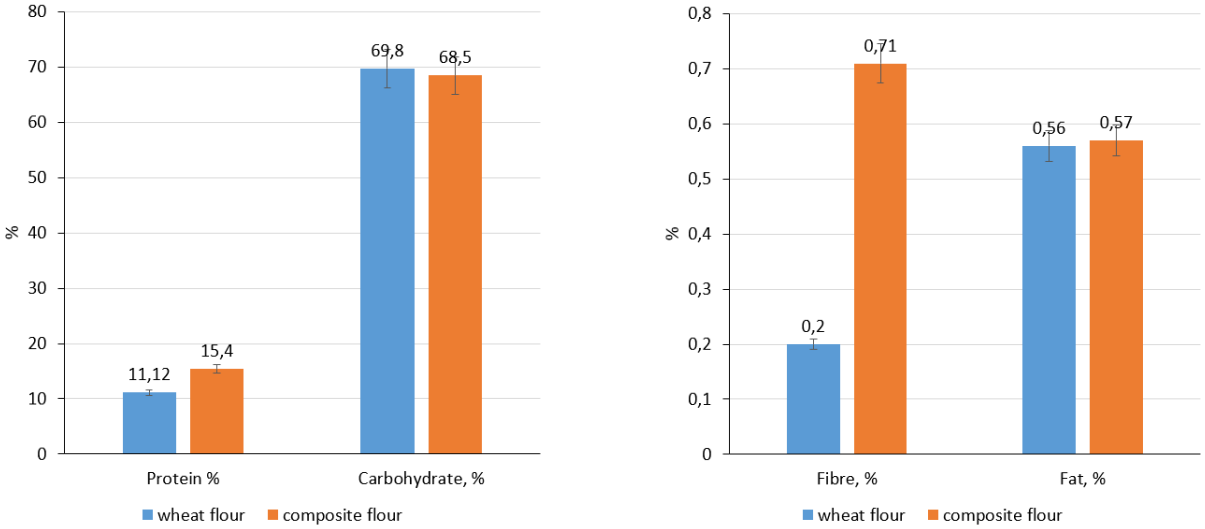

Figure 2. Chemical composition of paste made from wheat and composite flour

Table 1. Comparative chemical composition of pasta

Indicator	Recommended daily allowance	Pasta		Satisfaction of recommended daily allowance of nutrients of 100g of macaroni product, %
		wheat flour	composite flour	
Protein %	65,00	11,12	15,40	23,69
Fat, %	70,00	0,56	0,57	0,81
Carbohydrate, %	257,00	69,80	68,50	26,65
Fibre, %	20,00	0,20	0,71	3,55
Minerals, mg %				
Calcium (Ca)	1000,00	47,42	56,90	5,69
Phosphorus (P)	800,00	198,25	225,97	28,24
Magnesium (Mg)	400,00	41,31	50,40	12,60
Potassium (K)	2500,00	302,38	426,20	17,04
Sodium (Na)	1300,00	3,19	4,67	0,35
Iron (Fe)	18,00	1,85	2,80	15,55
Zinc (Zn)	12,00	1,20	2,90	24,16
Selenium (Se)	0,05	0,002	0,009	18,00
Iodine (I)	0,15	0,000002	0,000061	0,04
Copper (Cu)	1,00	0,37	0,39	39,00

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Manganese (Mn)	2,00	0,22	0,23	11,50
Vitamins, mg %				
Thiamine (B_1)	1,50	0,18	0,25	16,66
Riboflavin (B_2)	1,80	0,13	0,16	8,88
Pyridoxine (B_6)	2,00	0,23	0,29	14,50
Nicotinic acid (PP)	20,00	2,16	2,63	13,15
Tocopherol (E)	15,00	2,13	2,34	15,60
Energy value, kJ/100g of pasta	2100,0	1302,4	1353,9	15,40

Conclusion

It was established that the nutritional value of composite flour pasta exceeds the nutritional value of wheat flour products in terms of vitamin content (thiamine by 40%, riboflavin - 23%, pyridoxine - 26%, nicotinic acid - 21%, tocopherol - 10.0%), mineral (calcium by 20%, phosphorus - 14%, magnesium - 22%, potassium - 41%, sodium - 47%, iron - 51%, zinc - 141%, copper - 5.4%, manganese - 4.5%), biological (asparagine by 24%, serine –12%, cystine - 15%, tryptophan - 5.5%, lysine - 9.4%) value and fiber content 3.5 times. The daily need for iron is satisfied by 15.55%, vitamin B1 by 16.66%, vitamin B2 by 8.88%, vitamin B6 by 14.50%. Developed composite flour pasta is recommended for the production of pasta and bakery industries at enterprises with the aim of expanding the range of products. Prospects for further research will be studying the effect of new types of composite mixtures from vegetable raw materials on the technological properties of other types of pasta products.

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