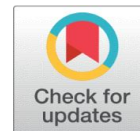


# RESEARCH ON OBTAINING NOODLES FROM NON-BREADABLE FLOURS FOR PEOPLE WITH GLUTEN INTOLERANCE

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## ABSTRACT

In the Republic of Moldova, as in other countries in the world, there is an increase in the number of people suffering from celiac disease, one of the most common chronic digestive disorders. This disease is difficult to diagnose and the only treatment being a strict diet, by avoiding the consumption of gluten-containing products. This article analyzes the assortment and sale price of agglutenic products from the Republic of Moldova and presents new technologies for obtaining noodles from unacceptible brown rice flour with acceptable sensory and physico-chemical characteristics and with a sale price accessible to all social categories of people with gluten intolerance. The following methods were used to achieve the aims of the paper: empirical (observation methods based on the collection of information on types of agglutinative products), experimental methods - for the elaboration of new technologies for the production of noodles, and calculation methods - for determining the energy value, indicators nutritional value and cost of manufactured products. Following this study, recipes, and the technology for obtaining 4 types of noodles from brown rice flour without additives and with additives were developed.

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**Keywords:** Celiac Disease, Agglutenic Products, Noodles

## 1. INTRODUCTION

In the Republic of Moldova in recent decades, there has been an increase in the number of people suffering from celiac disease. Epidemiological studies show that 15% of the world's population suffers from celiac disease, with variations depending on the area, more cases being recorded in Europe and fewer in the USA and Asia. According to the statistics of the Romanian Association for Gluten Intolerance, in Romania the number of people following a gluten-free diet, on the recommendation of the doctor, is estimated at about 1 million people Bureau Veritas Audits Cristim For Gluten Free Certification (2019). In the Republic of Moldova the first celiac disease patients were diagnosed in 1998, since then more than 300 children have been registered suffering from this disease, but some specialists Bukharov, B. (2020) consider that the real share of people affected by celiac disease in our country is unknown, due to the wide spectrum of symptoms, celiac disease is difficult to diagnose, the only treatment being a strict diet, by avoiding the consumption of gluten-containing products. Statistics show that the number of people who need to feed only with agglutenic products, both globally and in the Republic of Moldova is increasing. People in our country diagnosed with celiac disease face problems, such as: the limited assortment of local



agglutenic food products sold in the trade network, but also the lack of public catering establishments where to consume agglutenic dishes. Thus, every sick person is often forced to purchase imported agglutenic products that are expensive compared to the incomes of the population and to prepare their own food.

According to data from BBC World news, in 2015, 70 million Americans excluded gluten from their diet, in the United Kingdom 7% of adults avoid gluten due to food allergies or intolerances and 8% of the population does not consume gluten products out of a desire to have a healthier lifestyle. The director of the Observatory for Scientific Communication of the Pompeu Fabra University (UPF), Gonzalo Casino in the publication "La Vanguardia", stated that there is no scientific reason for a healthy person to eliminate gluten from his diet. The specialist believes that gluten is a vital nutrient for the health of the body, as it helps in the fight against cardiovascular diseases and reduces the risk of certain types of cancer and type 2 diabetes, and the exclusion of gluten from the diet can cause intestinal damage and the occurrence of constipation and respiratory problems Are Gluten-Free Products Healthy or Not (2019).

In the Republic of Moldova there are no official statistics on the number of patients with gluten intolerance, due to the lack of a National Register of primary registered patients, both in public and private medical institutions. The specialist in pediatric gastroenterology at the Ministry of Health, Ion Mișu, says that the real share of people affected by celiac disease in the Republic of Moldova is unknown, as these patients remain underdiagnosed. Taking into account the multitude of atypical clinical manifestations, they are treated in terms of another pathology Bukharov, B. (2020).

## **2. MATERIALS AND METHODS**

For the analysis of information on the assortment and price of gluten-free products sold in grocery stores on the territory of the Republic of Moldova, was used the observation method, which was based on the collection of information on types of agglutenic products, by categories of producers, and their price. The research was conducted between January 2021 and September 2021.

For the development of new technologies for the production of noodles from unapacifiable flours with various additions, was used the experimental method.

For the analysis of organoleptic indicators (appearance, color, consistency, taste, smell) of varieties of noodles, produced in the laboratory, was applied the score scale of 0 - 5 points; and the technological characteristics, such as boiling time, boiling increase, were determined by experimental laboratory methods.

The energy value, nutritional value indicators and the cost of the developed products – were determined by the calculation method.

## **3. RESULTS AND DISCUSSIONS**

In the Republic of Moldova there is no organized environment for this category of patients, there are no food establishments that would have agglutenic dishes in the assortment offer, the menus in schools and kindergartens also do not contain agglutenic dishes, so each patient is forced to prepare his own food or order on-line import products, the quality of which they cannot be sure, but which cost less than the import ones sold in the stores in the country.

There are only a few local producers in the milling and bakery field, such as: BioEM LLC, the primary product of which is sorizul, the brand offers soriz flour and

hemp seeds, both gluten-free; Art-ProEco LLC, the "Ronti" brand, cereal flakes, among which gluten-free flakes. According to the data provided by the sources Produse Din Sorg Fara Gluten, (N.D.), List of Our Gluten-Free Products : Flour, Desserts And Bread, (2020) the list of Moldovan producers and stores offering gluten-free products are:

- Natka Marvelatka artisan bakery-gluten-free bread.
- Networks of Kaufland stores and Nr. 1 propose to the bio shelf gluten-free German bread, biscuits, and other preparations of this category.
- Pure taste-gluten and sugar free desserts and buckwheat bread.
- George Standard-online store with bakery products, including gluten-free.
- Gluten-free sorghum products.

Even if in recent years, some producers of agglutenic products have appeared on the domestic market, their assortment is very limited, mainly being some assortment of flours, bread, biscuits, and there is no gluten-free pasta, these being only imported.

According to the source Bukharov, B. (2020), in Europe in 2017 there were over 17,000 certified gluten-free products, an increase of 47.5% compared to 2016. Currently, there is a global concern about celiac disease, both in its medical aspects and in ensuring adequate nutrition and the supply of agglutenic food products. Concerns regarding the design and creation of agglutenic flour foods come from research and not from industries. It is essential that a gluten-free product is similar to a regular product, in terms of sensory and physico-chemical characteristics.

The Republic of Moldova being a country, where growing wheat and producing bread is a traditional custom, and the traditional pasta are homemade noodles, which are used in various traditional dishes such as *soup (zeama)*, *white baba*, *noodles with cheese*, *noodle pudding* and so on. These noodle dishes are traditionally produced only from wheat flour, which limits people with gluten intolerance to the consumption of these traditional dishes.

Analyzing the supply of noodles, sold in grocery stores in Moldova, we find that are proposed for sale about 7 types of gluten-free pasta made of white and brown rice, buckwheat, corn, hemp, sorghum, and millet that are imported from Ukraine from manufacturer Ms. Tally. The Kaufland store produces under the K-free brand 3 types of corn pasta with the addition of 2% chickpea flour (spaghetti, penne, fusilli). From the Italian manufacturer "Di Nunzio" can be found three types of agglutinative pasta - beans, lentils, and green peas. Information on the assortment and price of gluten-free products sold in grocery stores on the territory of the Republic of Moldova is presented in [Table 1](#). Analyzing the offers of the commercial networks in the Republic of Moldova, we find that the assortment of agglutinated pasta is only imported and at an exaggerated price, ranging from 130 lei to 280 lei per kg.

Based on those mentioned, we intend to develop new recipes and technologies of agglutenic noodles from unapacifiable flours with various additions. It is known that dough from unapacifiable flours is difficult to stretch, and to prevent sticking and deformation, a large amount of flour is required when stretching. To reduce the cooking time and the consumption of flour used for stretching and cutting, was used the KINGH off 3113 pasta machines.

For the development of new recipes and technologies, brown rice flour was subjected to research 5 samples of dough for noodles were prepared, namely:

- sample without additions, prepared of flour without additions.
- sample with the addition of flaxseed flour.

- sample with the addition of tomato paste.
- sample with the addition of chopped spinach.
- sample with the addition of chopped beetroot.

**Table 1 Assortment and price of agglutenic products sold in stores in the Republic of Moldova**

Store name	Brand	Product assortment	Price(lei/kg)
1	2	3	4
NaturMD	BioEM	soriz flour	31
		semolina of soriz	48
It is an online store that deals with the sale and delivery of natural products without taste enhancers, chemical additives, and E-s. The first presentation and sales room appear on March 15, 2020.		groats of soriz	31
	Aliment Ulei	flour of sea buckthorn fruits	420
		flour of armor seeds	120
		flour of pumpkin seeds	108
		flaxseed flour	72
		flour of grape seeds.	72
	Art- ProEco	ronți buckwheat flour cereals	95
		ronți cereal from soriz flour	90
		ronți pumpkin seed cereals	95
		ronți cereals of hemp flour	90
		ronți cereals made from grape flour	95
	Ms. Taily	amaranth flour	176
		sorghum flour	72
		green buckwheat flour	72
		chickpea flour	72
	brown rice flour	90	
	white rice flour	80	
	buckwheat pasta	260	
	rice pasta	235	
	corn pasta	170	
	sorghum pasta	260	
	color pasta	130	
	millet pasta	280	
	hemp pasta	220	
Conah International		hemp flour	460

<b>BIOMed</b>	Solaris	buckwheat flour	140
BIO products store		chickpea flour	75
		rice flour	130
	Probios	corn flour	340
		almond flour	260
BIO products store	ViVio	almond flour	260
<b>AromeBio</b>	BioPlanet	tapioca flour	137
a store of BIO products imported from Poland		almond flour	1600
		green banana flour	495
<b>Bliss</b>	Di Nunzio	bean pasta	276
		lentil pasta	276
		green pea pasta	276

Source: elaborated by the authors

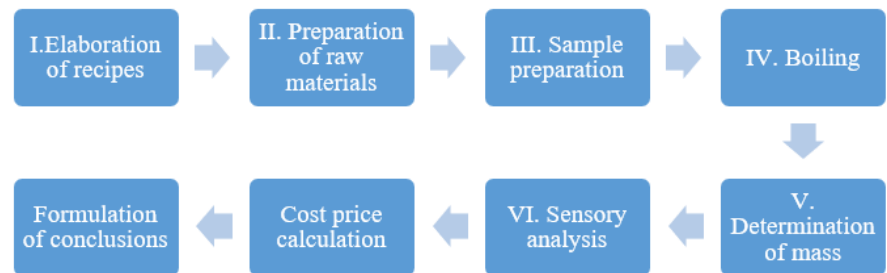
In order to compare the quality indices of noodles obtained according to new recipes, for each type of sample were prepared and control samples of wheat flour. The ingredients in the recipes and their proportions from which the control samples were prepared are presented in Table 2. The researchers were subjected to 5 samples of dough.

**Table 2** Sample recipe for 100 g of wheat flour dough

No. sample	Name of the sample	Flour (%)	Eggs (%)	Salt (%)	Additions (%)
1	Wheat flour noodles	56	40	4	-
2	with the addition of flaxseed flour	46	40	4	10
3	with the addition of tomato paste	56	30	4	10
4	with the addition of chopped spinach	56	30	4	10
5	with the addition of chopped beets	56	30	4	10

Source: elaborated by the authors

The algorithm of the experiments performed in laboratory conditions is shown in the Figure 1.



**Figure 1** Algorithm of experiments conducted in laboratory conditions

Source: elaborated by the authors

For the research, was used brown rice flour grown in Urcaina, from the manufacturer Ms. Taily. In order to establish the optimal ratio between the raw materials used, several dough samples were prepared. As a result of several

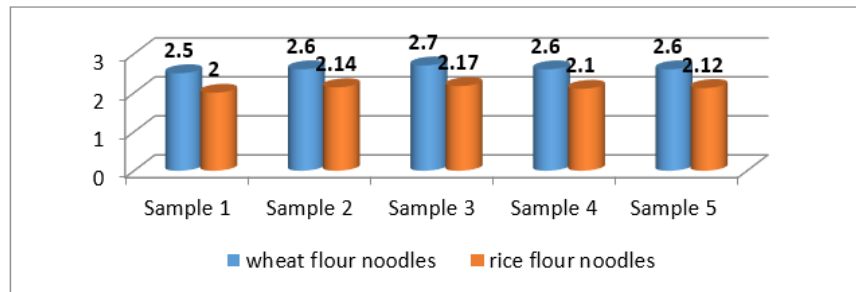
attempts, the optimal recipes for 100 g of dough were developed, which are presented in [Table 3](#).

**Table 3 Sample recipes for 100 g of brown rice flour dough**

No. sample	Name of the sample	Flour (%)	Eggs (%)	Salt (%)	Additions (%)
1	Brown rice flour noodles	56	40	4	-
2	- flaxseed flour	51	35	4	10
3	- tomato paste	56	30	4	10
4	- chopped spinach	56	30	4	10
5	- beet puree	56	30	4	10

Source: elaborated by the authors

Thus, as presented in [Table 3](#), [Table 5](#) recipes for brown rice flour noodles were developed. Recipe 1- no additives; recipe 2 - 15% brown rice flour was replaced with flaxseed flour; for recipes 3,4, and 5 the addition constituted 10% of the flour mass. The samples were boiled to obtain soft-boiled noodles, the cooking time being 5 minutes from the time of cooking for the rice flour noodles and 8 minutes for the wheat flour noodles. To get the “al dente” consistency, the cooking time is 3 minutes from the time of cooking for the brown rice flour noodles and 6 minutes for the wheat flour noodles. It is found that for samples 1 and 2 the boiling water is opalescent, for samples 3, 4, 5 the water was colored specifically for the raw materials used. During the boiling of the noodles, they did not deform, and no foam formed on the surface. The mass increase of brown rice flour noodles compared to wheat flour noodles is shown in [Figure 2](#).



**Figure 2** Mass growth of noodles from brown rice and wheat flour (n times)

Source: elaborated by the authors

Sample 1 (rice noodles without addition) after boiling was increased by 2 times in volume, and samples with added 2, 3, 4, and 5 were increased by 2.1 times in volume. In comparison with wheat flour noodles, which after boiling increased the volume by 2.5 and 2.7 times, the samples obtained from brown rice flour show a smaller increase in volume. The greatest increase in volume after boiling shows samples with the addition of tomato paste. After boiling the noodles were squeezed through a sieve and rinsed with cold boiled water, then the organoleptic indices were analyzed, which are characterized in [Table 4](#).

**Table 4** Characteristic of the organoleptic indices of brown rice flour noodles

No. sample	Consistency	Appearance	Colour	Smell	Taste
1	Soft, elastic.	Well preserved shape	Golden yellow	Specific to wheat flour	Somewhat salty, with a weak taste of boiled rice.



2	Soft, when chewed, it tends to agglomerate.	Agglomerate, with small brown particles	Light brown	Specific to flour, no foreign smell	To the extent salty, pronounced taste of flax seeds.
3	Soft, sticky.	Well preserved shape	Light orange	Specific to flour, with a faint tomato smell	Somewhat salty, with a tomato-specific taste
4	Soft, sticky.	Well-preserved shape with small pieces of spinach	Light green	Specific to flour, with a faint smell of spinach	To a certain extent salty with a slightly pronounced spinach taste
5	Soft, sticky.	Well-preserved shape with small pieces of beetroot	Light red	Specific to the flour, weakly pronounced by the beet	To the extent salty with a pleasant taste of boiled beets

Source: elaborated by the authors

The images of the noodles obtained from brown rice flour are shown in the Figure 3:



**Figure 3** Images of brown rice noodles with various additives before and after boiling a-rolled dough; b-noodles before boiling; c-noodles after boiling

Source: elaborated by the authors

To assess the indices of organoleptic, the score scale of 0-5 points was used, the sensory analysis of the resulting samples was evaluated by 5 people, who analyzed the appearance, consistency, colour, smell and taste of brown rice noodles. The data obtained are presented in [Table 5](#).

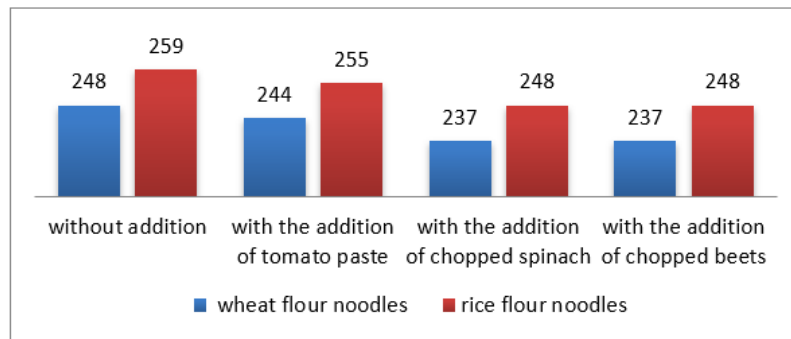
Sample 2, with the addition of flaxseed flour, after organoleptic analysis has accumulated an unsatisfactory score of 2.84 points, because after boiling it presented an inappropriate appearance, an uneven color and during mastectomy shows a tendency to agglomerate, this sample is not accepted for consumption.

**Table 5 Sensory analysis by score scale of brown rice flour samples**

No. sample	Average number of points awarded					Total score
	Appearance and shape	Consistency	Colour	Smell	Taste	
1	5	5	5	5	5	5
2	2,6	1,6	2	3	3	2,84
3	4,6	4	5	5	4,8	4,68
4	5	4	4	4,6	5	4,52
5	5	4	4,4	5	4,6	4,6

Source: elaborated by the authors

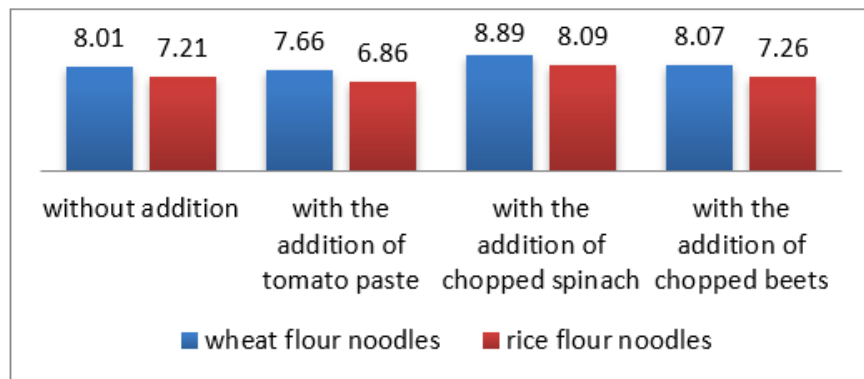
Samples 1, 3, 4 and 5 have accumulated a satisfactory score and can be accepted for consumption. After the sensor analysis, the energy value of rice flour noodles was calculated as shown in Figure 4.



**Figure 4** Energy value of rice and wheat flour noodles (kcal / 100g)

Source: elaborated by the authors

Compared to wheat flour noodles the energy value of rice flour noodles is higher by 4% and the nutritional value index is lower by 10%, for the reason that rice flour contains a higher amount of lipids and carbohydrates and a lower amount of minerals and vitamins. The nutritional value indices of the noodles are shown in Figure 5. According to the obtained data it is observed that the additions of raw materials contributed to a decrease in the energy value, for the reason that a smaller amount of egg was used in the reception of these samples.



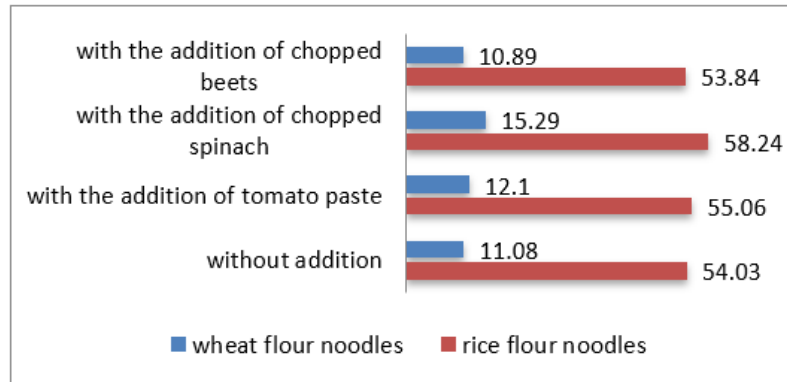
**Figure 5** Nutritional value indices of rice and wheat flour noodles

Source: elaborated by the authors

According to the data obtained, it can be observed that the addition of spinach and chopped beets for rice and wheat flour noodles contributes to a decrease in



energy value by 5% and an increase in nutritional value by 11% (for spinach addition) and by 0.7% (for beet addition), and the addition of tomato paste contributes to a decrease in nutritional value by 11%, for the reason that compared to beets, spinach contains a lower amount of vitamins, such as A and C. The price calculated for 1 kg of rice and wheat flour noodles is shown in the Figure 6.



**Figure 6** Price of rice and wheat flour noodles (lei / kg)

**Source:** elaborated by the authors

From the above, we conclude that rice noodles compared to wheat flour noodles have the following:

- a change in mass less by 20% and a boiling time less by 60%.
- the energy value is higher by 5%, and the nutritional value is lower by 10.
- the addition of flaxseed flour forms an agglomerated appearance and an uneven color.
- the price for 1 kg of noodles is more than 4 times.

For consumption, noodles made from brown rice flour without addition and noodles with the addition of tomato paste, chopped spinach and chopped beets were accepted.

#### 4. CONCLUSIONS

The agglutenic products market on the territory of the Republic Of Moldova is characterized mostly only by import products (from Ukraine, Poland, Italy, and Romania) with an assortment of agglutenic pastes (from hemp, rice, chickpeas, peas, beans, soriz, corn, buckwheat, lentils, pumpkin seeds) and with an assortment of about 20 types of agglutenic flours.

In the Republic of Moldova are sold local agglutenic flours with the brand Lacrima de Aur (of sea buckthorn fruits, armor seeds, pumpkin seeds, flax seeds, and of grape seeds).

As a result of the research, recipes were elaborated and the technology of obtaining noodles from brown rice flour without additions and with additions was developed. Thus, the research resulted in 4 samples of brown rice flour that are accepted for consumption and production:

- Sample 1 (Brown rice flour noodles)
- Sample 3 (Brown rice flour noodles with the addition of tomato paste)
- Sample 4 (Brown rice flour noodles with the addition of chopped spinach)
- Sample 5 (Noodles from brown rice flour with the addition of beets).

Sample 2 (brown rice noodles with added flaxseed flour) did not meet the quality indices and was not accepted for consumption.

Compared to wheat flour noodles, brown rice noodles have the following characteristics: boiling time with 60% lower (5 minutes), volume after boiling with 20% lower, energy value with 4% lower (259 kcal/100 g), nutritional value indices with 10% lower (VN10=7, 21) and cost price 4 times higher (54.03 lei/kg). The addition of spinach contributes to an increase in nutritional value by 11% and the addition of tomato paste to a decrease in nutritional value by 11% and the addition of beets contributes to an increase in nutritional value by 0.7%.

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