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Original Research

Physico-Chemical Quality Parameters and Metals in Different Types of Flours

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Abstract

Consumer demand for healthier and more sustainable foods has led to a multitude of innovative food products. The aim of the work was to monitor the physico-chemical quality parameters (color, taste, smell, infestation, granularity, humidity, gluten index, falling number, alveographic properties, ash content, hectoliter mass of wheat) for the raw material: wheat, for the flours resulting from the milling, and for different types of flours and resulting mixtures. The mixtures were made with wheat flour and carob, oats, rice, buckwheat, and coconut flour added in proportions of 5%, 10%, and 20%. Heavy metals (Pb, Cd, Zn, and Cu) were also determined for different types of flour. The metal content was determined by the atomic absorption method using a GBC Avanta PM atomic absorption spectrometer. The detection and quantification limits were evaluated using calibration curves. The degree of coloring of the flours differs depending on the degree of extraction and, therefore, also depends on the amount of ash contained. As for infestation contamination, it was not identified in any of the analyzed flour. Rheological properties indicate the quality of flours. Flour types 480 and 550 recorded exceptional values of the rheological parameters, presenting a deformation energy (W) above 200 $10^{-4}J$ and a curve configuration ratio (P/E) of 1.08. The metal concentrations were between the permissible limits defined by the FDA/WHO.

Keywords: wheat, metals, carob flour, oat flour, rice flour, coconut flour, buckwheat flour

Introduction

People have broadened their horizons in relation to food, focusing especially on the health aspects of their food. In recent years, more attention has been paid to the development and production of whole-grain foods to satisfy the food's diverse nutritional and health needs [1-3]. Whole-grain foods help control cholesterol levels, weight, and blood pressure, as well as lower the risk of diabetes and heart disease. This makes them a good choice for a nutritious diet [4-7].

Wheat flour is the most popular and versatile flour, and contains about 75 percent of the wheat grain. Wheat flour proteins are mainly composed of gliadin and glutenin, which, in the presence of water, increase in volume and become colloidal, forming a bound, elastic mass called gluten [8]. The quality of wheat flour is characterized by its content of mineral substances and certain baking properties. This relationship between the degree of extraction and the content of mineral

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substances is given by the uneven distribution in the grain of wheat, with the center of the grain being less present and the outer part, the content, becoming more and more abundant [9, 10]. To determine the type of flour, the content of mineral substances that it has is determined and then related to the dry matter. The obtained result is multiplied by 1000, with the obtained value representing the type of flour. For example, if a flour contains 0.550 mineral substances related to the dry matter, it means that the flour is type 550 [11].

In addition to wheat flour, a wide range of other types of flour from sources such as carob, oat, rice, coconut, and buckwheat are used. These have special properties and are used to obtain food products with much higher nutritional values, introduced specifically to improve their quality.

Oatmeal is obtained from hulled and dried oat grain. It has a high content of glycerides, around 6-9%, which induces a very short storage period, especially if it is made at very high temperatures. As a result of this process, fatty substances go rancid, thus giving oatmeal a bitter, unpleasant taste [12]. Glutenin and ovenin are the protein substances present in oat flour that do not form gluten. So, in baking, oat flour is used in a mixture with wheat flour to obtain higher quality products. When using a combination of these types of flour, the baking time of the dough must be longer to allow the complete gelation of the starch and thus obtain a bread with a high specific volume and also with an increased degree of fluffiness and a fine elastic core [13].

Rice flour is a form of flour made from finely ground or polished rice, which can be used as a raw material in the production of various foods. Rice flour offers a number of benefits, especially for rice bread. This is made for patients with celiac disease who are allergic to wheat proteins [14, 15].

Carob flour is produced by deseeding carob pods, yielding kibbled carob, which is further roasted and milled to obtain a powdered product. Carob flour is progressively used in bakeries, with potential benefits for human health and the environment, as it can be obtained with minimal environmental impact [16, 17].

Coconut flour can not only provide improved income to the industry, but is also a nutritious and healthy source of dietary fiber for humans. Coconut flour, which is very rich in fiber, can play an important role in controlling cholesterol, blood sugar levels, and preventing colon cancer [18, 19].

Buckwheat flour is superior to wheat flour due to its higher content of lysine, iron, copper, and magnesium. The significant contents of rutin, catechins, and other polyphenols, as well as their antioxidant activity, are of great importance. These functional components of buckwheat have health benefits such as reducing high blood pressure, controlling cholesterol and blood sugar levels, and preventing the risk of cancer [20].

The potential toxic elements have become a global concern in recent years around the world. The contamination of crops with heavy metals can mainly originate from anthropogenic sources such as mining, the usage of sewage sludge for irrigation, and even the use of fertilizers and pesticides [21-24].

The aim of the work was to monitor the physico-chemical quality parameters (color, taste, smell, infestation, granularity, humidity, gluten index, falling number, alveographic properties, ash content, hectoliter mass of wheat) for the raw material: wheat, for the flours resulting from the milling, and for different types of flour and resulting mixtures. The mixtures were made with wheat flour and carob, oats, rice, buckwheat, and coconut flour added in proportions of 5%, 10%, and 20%. Heavy metals (Pb, Cd, Zn, and Cu) were also determined for different types of flour.

Experimental

Analyzed Samples

Wheat was obtained from a local seed company and harvested from the Dobrogea area, Romania. Different types of flour were obtained from the milling process using Buhler Milling: 480 flour, 550 flour, 650 flour, 1250 flour, and whole wheat flour. Rice flour, coconut flour, oatmeal flour, carob flour, and buckwheat flour were obtained from a local market. The mixtures were made between 480 wheat flour and carob, oats, rice, buckwheat, and coconut flour added in proportions of 5%, 10%, and 20%.

Methodologies

Humidity was determined by the reference method ISO 712: 2009 [25]. The water content was determined as the difference between the weight of flour (5 g) and the weight recorded after 1h and 30 min heating at 130ºC in an oven. For alveographic properties, the behavior during the deformation of the dough was observed. A disk of dough is subjected to a constant jet of air; in the first moments, it resists the pressure, but depending on its extensibility, it swells in the form of a bubble and breaks. This evolution is measured and recorded in the form of a curve called the alveogram, created by the alveograph (the Chopin Technologies Alveolab), which will indicate the deformation energy (W) and curve configuration ratio (P/L) following the standardized method AACC 54-30 [26]. Determination of the ash was performed after incineration of the sample at 900ºC according to ISO 2171:2007 [27]. From a 10 g sample of flour, the gluten index was determined according to ISO 21415-2:2015 [28]. Infestation was determined according to ISO 6639-1:1986 [29], falling number according to ISO 3093:2009 [30], and mass per hectoliter according to ISO 7971-3:2019 [31]. As for the granularity of the flours, this was done with the help of site numbers 8 and 10 for wheat flours: 480, 550, 650, rice flour, oat flour, carob flour, coconut flour, and buckwheat flour, and for wheat flours 1250 and whole-milled flour, 0.5 μm sieves and sieve number 8 were used. The 0.5 μm sieve is an extremely dense sieve, sieve number 8 of 180 μm is a thick sieve, and sieve number 10 of 125 μm is rarer.

The metal content was determined by the atomic absorption method using a GBC Avanta PM atomic absorption spectrometer. An air-acetylene flame was used for all elements. Hollow cathode lamps were used as a radiation source. The acetylene was of 99.999% purity at a flow rate of 1.8-2.0 L/min. Analyses were made in triplicate, and the mean values were reported. The detection and quantification limits were evaluated using calibration curves. LOD and LOQ values for each calibration line were obtained and calculated using the equations $(3 \cdot s_a - a)/b$ and $(10 \cdot s_a - a)/b$, respectively, where b is the slope of the calibration curve and s_a is the standard deviation of the intercept of the regression equation. The linearity of the calibration curve was evaluated by investigating the correlation coefficient of the calibration curves. The correlation coefficient values were higher than 0.9990 for all of the analytes. The working concentration range was established by analyzing the lowest and highest concentration values of the proposed concentration range, ten times each of them. The recovery studies were carried out in triplicate for replicates of spiked samples. Results were satisfactory, with recoveries between 97 and 100% indicating the high accuracy of the method. These percentage recoveries ranged within the limits imposed by the Horwitz equation (85-110%) for the established concentration range.

Statistical Analysis

The results were analyzed statistically, and average values and standard deviations were determined. A statistical verification of differences between groups was performed using the t-Student test, with a significance level of $p = 0.05$.

Results and Discussion

In order to monitor the quality of the flour for consumption, the analysis of the raw material, i.e., the wheat grains, was carried out in the first place. In Table 1, the results obtained from the analysis of the raw material, wheat, used to obtain wheat flour are presented.

Following the results obtained in Table 1, it was found that the analyzed wheat is healthy and of good quality, from which qualitatively appreciated flours can be manufactured. which then help in the process of forming pastry and bakery products.

In Table 2, values for the analyzed metals are presented.

For all types of analyzed flour, the metal concentrations are between the permissible limits defined by the FDA/WHO [24] as 0.41, 0.21, 3, and 27.4 for lead, cadmium, copper, and zinc for whole grain. Lead concentrations were between 0.008 and 0.05 mg/kg, cadmium between 0.013 and 0.026 mg/kg, zinc ranges between 11.33 and 19.6 mg/kg, and copper between 0.33 and 2.56 mg/kg. The results demonstrated the highest lead concentration in wheat flour, the highest cadmium concentration in buckwheat flour, and the highest concentration of zinc and copper in oatmeal flour.

Several studies reported different levels of metals in flours and grains. Ertl and Goessler [32] found levels of Cu in flour within a range of 1.0–8.1 mg/kg and Zn content in grains and flours from 3.8-50 mg/kg, in accordance with our levels. Cu was also found in cereals between 1.8 and 11 mg/kg [33, 34]. Wheat milling demonstrates a reduction in As in grains [35], a decrease in levels of Pb [36], or a reduction in the Cd concentration in cereals [37].

In Table 3, physico-chemical parameters for different types of flour are presented.

For flour 1250, the moisture is low due to the addition of dust during the technological process.

Table 1. Physico-chemical parameters analyzed for wheat.

No. Crt.	Analysis	Wheat	The allowed limit
1.	Moisture	13.7 %	max 14.5
2.	Gluten index	24.0 %	min 22.0
3.	Falling index	264 s	min 200
4.	The hectoliter mass	77.2 kg/hl	min 75.0
5.	Infestation	-	Not allowed
6.	W	239 J	min 140
7.	P/L	1.24	min 0.80
8.	Taste	Characteristic of healthy wheat	No rancid taste
9.	Smell	Pleasant, specific to wheat, no musty or burning smell	No foreign smell
10.	Color	From golden yellow to darker yellow	No different colors from healthy wheat

Table 2. Metals concentration analyzed for different types of flour.

No.crt.	Types of flour	Metal concentration (mg/kg) ± SD			
		Pb	Cd	Zn	Cu
1	Wheat flour	0.05±0.01	0.019±0.003	12.58±0.03	1.04±0.02
2	Rice flour	0.008±0.0004	0.021±0.001	17.02±0.02	2.36±0.08
3	Coconut flour	0.006±0.003	0.014±0.01	13.4±0.002	0.33±0.002
4	Oatmeal flour	0.03±0.01	0.023±0.04	19.6±0.001	2.56±0.05
5	Carob flour	0.002±0.02	0.013±0.005	15.16±0.05	1.23±0.001
6	Buckwheat flour	0.04±0.01	0.026±0.002	11.33±0.004	2.18±0.0002

The 480 flour has a lower moisture content of 14% due to the lack of water from the wetting process, which cannot reach the core of the wheat grain. At the same time, the 650 flour has a slightly higher moisture content due to the extraction that takes place not only from the kernel of the wheat grain but also from the portions in close proximity to the kernel. The closest moisture to wheat flour is rice flour with 11.3%, followed by oatmeal flour with 9.99% and buckwheat flour with 9.73%. The lowest moisture values are recorded for coconut flour, 6.07%, and carob flour, 5.44%. Zhang et al. [38] found for brown rice flour a value of 6.56% for moisture, while for white corn and rice flour, Djeukeu Asongni et al. [39] obtained a value of 12.5% for moisture content. Different values of moisture are related to the different contents of water in the studied flours. The higher the moisture content, the lower the amount of dry solids in the flour.

The gluten formation process is characteristic of wheat flour and largely depends on the amounts of the two components, glutenin (30%) and gliadin (70%). It was observed that there was a slow decrease in gluten from the type of flour 480, where the largest amount of gluten was found (28.2%), up to the value of 23.6% attributed to wholemeal flour. The lower the degree of extraction of the flour, the more gluten it will have, as only the core of the wheat grain is ground. At higher extractions, the coatings of the grains that do not contain gluten also intervene, and thus it is considerably reduced. From Table 3, it can be seen the total lack of gluten in the rice, carob, buckwheat, oats, and coconut flour.

The fall number, which indirectly measures amylase activity by gelling the flour suspension in a hot water bath and measuring the liquefaction of the gel under the action of α-amylase, indicated values between 260 and 333 seconds for wheat flours, results that support the quality of the flours. The falling number could only be identified for carob and rice flour; the rest of the flours did not record values for this parameter.

For the variation of ash in the wheat flour, it can be observed that this parameter registers the highest value for whole milled flour, 1.4%, and the lowest value, 0.47%, for flour 480. The ash of the flour reflects the amount of mineral substances it contains and is influenced by the degree of flour extraction. The higher the degree of extraction of a flour, the darker it tends to be and contains more minerals due to the grinding of a greater portion of the wheat grain, including the outer hulls. Compared to wheat flour, the lowest value recorded for rice flour was 0.41%, meaning that it has the lowest amount of mineral substances, and the highest was 5.55% for coconut flour. Researchers [39, 40] have associated ash loss with an increase in moisture content.

The granularity of the flours reflects their degree of fineness. As for the granularity of the flours, flour type 480 is the finest flour, while the most granular flour was oat flour with a refusal of 43.5% and 50.6% sifted, and the finest flour was carob flour, where the refusal was 18.4% and the sifted 79.9%. The smell of a healthy flour, obtained from quality wheat and also from a well-established technological grinding process, must be a pleasant one, characteristic of cereals. Any other foreign smell of mold, stale, hot, chemical, or other substances can lead to the flour not being used in the food industry because this unpleasant smell can be imprinted on the finished product, which destroys its quality. The origin of the non-specific smell of the flour can be taken from the ground grains with defects, from the inadequate storage spaces of the flour or from a pest attack. Flour is a hygroscopic product that has the ability to pick up the smell from the surrounding space. The taste and smell of the flours are specific to each ground raw material, without rancid taste or other foreign smells. The degree of coloring of the flours differs depending on the degree of extraction and, ultimately, the amount of ash contained. Djeukeu Asongni et al. [39] reported that the characteristics of breads made from processed flours are better than those of unprocessed ones.

As for infestation contamination, it was not identified in any of the analyzed flour.

Rheological properties are the ones that clearly indicate the quality of flour today. The determination of the deformation energy [W], i.e., the strength of the flour, and the ratio between the maximum pressure in the bubble (toughness) [P] and the average of the values on the abscissa of the breaking points (extensibility) [L] are some of the most important parameters for flour quality.

Table 3. Physico-chemical parameters for different types of flour

No. crt	Analyses	Types of wheat flour					Carob flour	Rice flour	Buckwheat flour	Coconut flour	Oatmeal flour
		Flour 480	Flour 550	Flour 650	Flour 1250	Wholemeal flour					
1.	Moisture %	14.0	14.3	14.1	13.7	13.2	5.44	11.3	9.73	6.07	9.99
2.	Gluten index %	28.2	26.0	25.2	24.0	23.6	-	-	-	-	-
3.	Falling index s	260	278	273	317	333	62	890	-	-	-
4.	Ash %	0.47	0.53	0.63	1.24	1.40	3.29	0.41	1.83	5.55	1.89
5.	Infestation	no	no	no	no	no	no	no	no	no	no
6.	Granulosity %	1.2	2.4	3	6.8	7	18.4	38.6	26.1	30.5	43.5
		78.6	78.0	80.0	44.4	40.8	79.9	60.5	73.3	68.5	50.6
7.	W ·	290	217	198	145	178	-	-	-	-	-
8.	P/L	1.08	1.08	1.15	2.05	6.00	-	-	-	-	-
9.	Taste	Normally slightly sweet	Normally slightly sweet	Normally slightly sweet	Normal neither bitter nor sour	Normal neither bitter nor sour	Normally slightly sweet	Sweet	Specifically buckwheat	Sweetish specific to the coconut	Bitter specific to oats
10.	Smell	Pleasant specific to flour	Pleasant specific to flour	Pleasant specific to flour	Pleasant no foreign smell	Pleasant no foreign smell	Intense, pungent	Pleasant, specific to rice	Pleasant, specific to buckwheat	Very pleasant specific to coconut	Plesant, specific to oats
11.	Color	White, slightly yellowish	Yellowish white	Yellowish white with faint gray undertones	Light gray with bran particles	Gray with coarse bran particles	Brown with a very fine appearance	White, with a very fine appearance	Dark gray with coarse particles	Yellowish with coarse particles	Light gray with coarse particles

Table 4. Physico-chemical parameters obtained for different mixtures of wheat flour with carob flour, rice flour, buckwheat flour, coconut flour, oatmeal flour.

No. crt	Parameters	Wheat flour mixed with carob flour in proportions of			Wheat flour mixed with rice flour in proportions of			Wheat flour mixed with buckwheat flour in proportions of			Wheat flour mixed with coconut flour in proportions of			Wheat flour mixed with oatmeal flour in proportions of		
		5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
1.	Moisture %	11.4	10.5	9.90	12.1	11.1	10.6	11.8	11.1	10.2	11.4	10.6	9.4	11.9	11.5	10.9
2.	Gluten index %	24.0	22.0	19.0	24.0	22.4	21.6	24.0	23.2	21.2	24.0	23.2	22.4	26.0	25.0	22.0
3.	Falling index s	374	356	347	460	525	564	493	475	433	533	498	494	498	494	490
4.	Ash %	0.78	0.85	1.28	0.46	0.70	0.88	0.58	0.72	0.94	0.91	0.99	1.75	0.59	0.70	0.88
5.	Infestation	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
6.	Granulosity %	79	79.3	89.7	73.4	72	67.6	78	73.4	68.6	71	65.3	56.4	88.3	86.2	83.8
7.	W ·	212	227	254	200	169	134	208	159	120	210	182	145	214	183	139
8.	P/L	1.82	1.71	2.17	1.90	2.11	2.29	1.76	2.14	2.32	2.75	3.37	3.88	2.13	2.25	2.58
9.	Taste	Normal, slightly sweet	Normal, slightly sweet	Slightly sweet	Sweetish specific to wheat	Slightly sweet, specific to rice	Specific to rice	Sweet, specific to wheat	Slightly sweet, specific to buckwheat	Specific to buckwheat	Sweetish	Sweetish with slight traces of coconut taste	Sweet, specific to the coconut	Sweetish	Sweet with slight traces of bitterness from the oats	Slightly bitter
10.	Smell	Specific to wheat	Specific to wheat with hints of carob scent	Intense, specific to carobs	Pleasant, specific to wheat	Pleasant, specific wheat with hints of rice	Pleasant, specific to rice	Pleasant, specific to wheat	Pleasant, specific with traces of buckwheat smell	Pleasant, specific to the smell of buckwheat	Pleasant, specific to wheat flour	Pleasant with slight traces of coconut	Pleasant, specific to the coconut	Pleasant, specific to wheat	Pleasant with slight traces of oats	Specific to oats
11.	Color	Yellowish white with brown tints	Slightly brown	Marone	White-yellowish	White-yellowish	Slightly yellowish white	Yellowish white with slight coarse particles	Light grayish white with coarse particles	White Dark gray with coarse particles	White-yellowish	White-yellowish with coarse coconut particles	Yellowish with slightly coarse particles	White-yellowish	Yellowish white with gray tints and slight coarse particles	Light gray with coarse particles

Flour types 480 and 550 recorded exceptional values of the rheological parameters, presenting a W above 200 $10^{-4}J$ and a P/E ratio of 1.08. Type 650 flour is not inferior either, having a W of 198 $10^{-4}J$ and a P/E ratio of 1.15. 1250 flour and wholemeal flour are part of the category of black flours that have different rheological conditions compared to white flours. The W of black flours is between $145 \cdot 10^{-4}J$ for 1250 flour and $178 \cdot 10^{-4}J$ for wholemeal flour, lower than that of white flours due to the doughs lack of rising power. As for the P/L ratio, it has increased, reaching a value of 2 for the 1250 flour and even up to 6 for the wholemeal flour. The dough made from black flour is lower in gluten, and thus its elasticity is limited. High values of P/L ratios are due to foreign doughs. Following the analyses, it can be stated that black flours cannot be used as such in the manufacturing processes of bakery products, even if they are much more nutritious than white flours, but only in combination with white wheat flours or with the help of food additives, which can help the dough rise and thus obtain quality products. Ge et al. [41] stated that the addition of tannin acid and oligomeric proanthocyanidins significantly improved the rheological property of wheat flour through their interactions with gluten.

Due to the lack of gluten in the five types of flour obtained from varieties other than classic wheat, they cannot be used as such in the technological processes of pastry and bakery because they do not provide strength to the rising dough. So, the five types of flour, carob, buckwheat, oat, rice, and coconut have been added in various percentages (5%, 10%, and 20%) in mixtures with wheat flour and possess particular nutritional properties to give a high-quality finished product. In Table 4, physico-chemical parameters obtained for different mixtures of wheat flour with carob flour, rice flour, buckwheat flour, coconut flour, and oatmeal flour are presented.

The results of the analyzes carried out on the mixtures of wheat flour with carob flour, coconut flour, and oat flour in proportions of 5, 10, and 20% indicated a decrease in the first three parameters, such as moisture, gluten, and the falling index, with an increase in the amount of added carob. Having no gluten, the added carob flour only reduced the gluten already present in the wheat flour. For the mixtures with buckwheat flour, the falling index increased from the value of 460s for the mixture with 5% rice flour to the value of 564s for the mixture with 20% rice flour. This suggests that rice contains a large amount of starch, which automatically indicates an increased presence of alpha amylase in rice flour.

Ash increases with the addition of different types of flour. If, with an addition of 5%, the ash was 0.78%, at 10% it was 0.85%, and at 20% it was 1.28%, it means that carob flour is rich in mineral substances. However, coconut flour, compared to the rest of the mixtures, has the highest recorded values for ash: 0.91%, 0.99%, and 1.75%. As for the organoleptic properties, these intensify with an increase in the amounts of added flours, with coconut flour being the most intense in terms of its strong, pleasant smell and sweet taste. In contrast, oat flour mixes are much more bitter. The granularity of all mixtures in the different combinations showed that these samples were highly granular with an increase in the percentage of non-conventional flours added.

Carob flour has no rheological properties since the gluten content of enriched bread formulations is lower than in white wheat flour, and, in general, blending it with wheat flour negatively affects these properties in the resulting bread. The incorporation of the carob pulp powder increases the deformation energy [42]. Thus, with the addition of 5 and 10% carob flour, the mixture has a W of $212 \cdot 10^{-4}J$ with a P/L ratio of 1.82, and, respectively, a W of $227 \cdot 10^{-4}J$ with a P/L ratio of 1.71. These mixtures, although possessing a high P/L ratio, can be used strictly from the perspective of rheological properties in production. The mixture with 20% carob flour showing a W of $254 \cdot 10^{-4}J$ with a P/L ratio of 2.17 is a mixture unsuitable for its use in the processes of obtaining pastry and bakery products. The rheological properties of the coconut and oat flour blends showed high values of W and their P/L ratios, so these mixtures cannot be used in the technological processes of obtaining finished products. The rheological properties identified for the mixtures with rice and buckwheat flours indicate normal values, often used in production processes. It was reported that the addition of phenolic acids to dough decreases mixing time, tolerance, elasticity, and bread volume [43-45]. The P/L ratios for rice flour blends are also slightly increased.

Conclusions

In recent years, due to the desire for the evolution of the technologies used in the technological processes of obtaining food products, an attempt has been made to introduce other types of flour from raw materials other than wheat in the food industry. This idea was born from the desire of technologists to add nutritional properties to food products, but also due to the increase in the number of cases of celiac disease or the large number of people with gluten intolerance. It was also desired to capitalize on certain plants or the waste resulting from certain technological processes and biological resources.

The addition of different amounts of ground flour from raw materials other than wheat in the processes of obtaining bakery products on the classic wheat flour brings an important addition in terms of the amount of dry matter obtained after the calcination of the samples. This indicates that the flours obtained through the mixing process produce great changes in the nutritional values of the finished products. The addition of carob, coconut, buckwheat, oat, and rice flours to mixtures with wheat flour presents a major benefit from a nutritional point of view, thus obtaining much higher quality and more appreciated products.

Conflict of Interest

The authors declare no conflict of interest.

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