The Impact of the Wheat Bran on the Quality of the Biscuits and Their Nutritional Value

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Abstract

The wheat bran represent a byproduct in the industry of wheat milling, which in addition to being used as a food for the livestock, they can also be used as an additional source of the diet fibers for prevention of many illnesses. In the production of biscuits, the latter being the products that have an advantage as compared to the bread, given that they are used in many state run programs in order to adapt to the needs of the population, the utilization of the wheat bran will increase the nutritional values in it and the interest for these products, in addition it will have an impact on the reology attributes of the dough and on the sensory qualities of the biscuits. In this study, the wheat brans have been added in the scale of 5, 10, 15 till 20%. The rheologycal attributes indicate an increase in water absorption, increase in the stability of dough, increase in the level of the degree of softening and a decrease on extensibility and of energy. The biscuits which are produced with added bran of 5 and 10%, exhibit better sensory attributes, respectively they exhibit a smoother surface with an attractive color, specific aroma and taste which increases with the increase of wheat bran. The nutritional values of the biscuits indicate that the calories values decrease with the increase of wheat bran, whereas the amount of the minerals, cellulose and fats increases. All the biscuits, notwithstanding the amount of wheat bran, are safe to be consumed.

Introduction

Development of production of biscuits has led to the increase of the interest for these kinds of confectionary products, given that they exhibit good nutrition and various possibilities for use in various programs, as in the events of catastrophes such are earthquakes or famines (Pratima and Yadava, 2000). In general, for the production of biscuits one utilizes low protein content type wheat, respectively on gluten, the dough of which has a shorter time of development, a weaker elasticity, lower energy and which exhibits contraction and cracking during the baking (Hoseney, 1986).

Biscuits are rewarded a lower attention compared to the bread, however the former exhibit important advantages such are: a wider range of consumption, a relatively long period of consumption, positive nutritional values which are accepted in majority of the countries and they can be modified in order to adapt to the special nutritional needs of any population (Elkhalifa et al., 2002).

Taking into account the nutritional values of the bran as a byproduct of the milling, lately the scientists have an increased tendency to incorporate the bran form various grains into the production of biscuits as a high source of diet fibers (Hegazy et al., 2009). The wheat brans constitute circa 14.5% of the weight of the kernel, they are a rich source of diet fibers (Burkitt, 1988) and of proteins with around 14%, minerals with 5%, fat with 6% and B group vitamins (Kent and Evers., 1994).

The benefits gained by the increase of the diet fibers in the confectionary products are linked to the decrease of the risk of coronary diseases of the heart, the cancer of rectum, disorder in bowels, diabetes and obesity (O'Connor et al., 2003; Anderson et al., 1987; Spiller, 2001).

In this paper we attempt to evaluate the suitability of the utilization of wheat bran as a substitution for wheat flour in different levels 5, 10, 15 until 20% in terms of the rheology and sensory attributes of biscuits, in the safety and the improvement of the nutritional values of them.

Materials and Methods

Materials

The flour that was used is from cultivar Mila and it has the following chemical content: humidity 12.6%, ash 0.61%, moist gluten 23.6%, proteins 13.22%, fat 1.02%, starch 68.38% and cellulose 1.16%, whereas the wheat bran that was sieved in the screens with dimensions 800 μm have the following content: humidity 11.5%, ash 4.10%, proteins 15.03%, fats 5.04, starch 47.86% and celulose 7.54%. The main and additional contents in the production of biscuits are: wheat flour, wheat bran, sugar, fat, glucose, margarine, water, vanila aroma, amonium bicarbonate. Respectively in the table below one can find the content of the biscuits with wheat bran.

Table 1. The content of the biscuits with wheat bran

Ratio wheat vs bran	The amount of contents (g)								
	Flour (g)	Bran (g)	Water (ml)	Fat (g)	Sugar (g)	Margarine (g)	Glucose (g)	Vanilla aroma (g)	Ammonium bicarbonate (g)
100	1000	/	160	220	240	160	0.74	5	5
95/5	950	50	160	220	240	160	0.74	5	5
90/10	900	100	162	220	240	160	0.74	5	5
85/15	850	150	162	220	240	160	0.74	5	5
80/20	800	200	164	220	240	160	0.74	5	5

Preparation and baking

In the beginning, one puts fat and margarine in the mixer and those are mixed until they melt away, then one adds sugar and glucose and all the contents are well mixed, then one adds flour, wheat flour and all other supplements and in the end one adds water as needed and all the ingredients are well mixed for about 5 minutes. The obtained mass is not very moist and it is put in the machines that give shape to it, after the shaping is done, the content is put in the baking trollies on a plate and it is put in the baking oven in the temperature 270-280^{o} C for about 8 minutes, after the cooling at the room temperature, the biscuits get packed.

Analysis of biscuits

The dough that are obtained by adding the wheat bran are analyzed in terms of their rheologycal attributes with the Brabender Farinograph and Extensograph, their analysis are in compliance with the regulations in force and with the ICC standard no. 114/1, 115/1.

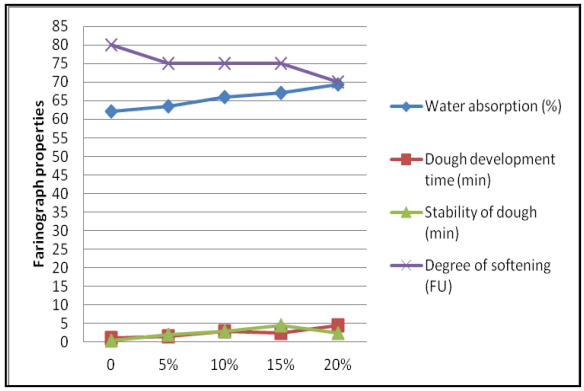
One day after, one performs the sensory analysis on the packaged biscuits in compliance with the regulation on physical and chemical methods for analysis of wheat, of milling products and of baked products, pastas, frozen dough products, Official Gazette of RSFJ 74/88. (Official Methods of Analysis of the cereals, December 1988). The analysis of the nutritional ingredients such are: minerals, proteins, fats, carbohydrates and cellulose are also in compliance with the regulation in force, whereas the energetic value is calculated theoretically by using the following conversion factors 4.0, 4.0 and 9.0 kcal/g for proteins, carbohydrates and fats, respectively in accordance with the method prescribed by Paul and Southgate.,1979.

Given the fact that biscuits represent a product which has a longer consumption period, one performed the microbiology analysis of the products in compliance with the standard methods ISO 6579, ISO 6888, ISO 16649, ISO 4832, ISO 4833. The statistical results are processed with Microsoft Excel 2007.

Results and Discussions

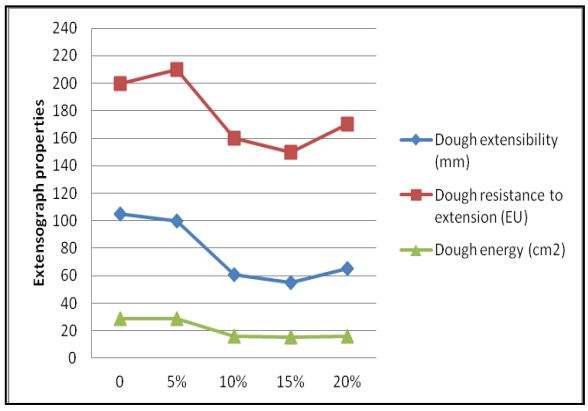
The farinograph results are represented in figure 1, from which one can observe that by increasing the wheat bran one increases the absorption of the water from 62.2% for the dough which is produced only with flour, till 69.4% for the dough which is produced with 20% wheat bran, this result is expected given that one increases the amount of fibers which have a higher number of hydroxyl groups. The results are in compliance with those of El-Sharnouby et al., 2012, who have utilized wheat brans and flour of dates in ratio 1:1 by adding 10, 20, 30 till 40% in the production of biscuits. In addition, the development of the dough and stability increases with the increase of the wheat. The degree of softening of the dough is decreased with the increase of the wheat bran.

Figure 1. The impact of increasing the wheat bran in the farinograph attributes



The effect of increasing the wheat bran in various proportions on the extensograph attributes is depicted in figure 2. The dough resistance in pulling is decreased with the addition of wheat bran, the extensibility of dough is also decreased by adding the wheat bran, however the ratio R/E is increased with the increment of wheat bran from 2.0 for the dough with wheat flour without bran, until 2.72 for the dough with 15% wheat bran. The energy of the dough is expressed in cm^2 and gets decreased with the addition of bran, that is from 28.5 cm^2 to 16.0 cm^2 for dough with 20% wheat bran.

Figure 2. The impact of adding the wheat bran in the Extensograph attributes



Notwithstanding the percentage of the wheat bran, all the biscuits have the optimum amount of moisture; respectively they do not surpass the allowed limit of 4.5%, even though with the increase of the level of bran, one increases also the level of moisture. The amount of mineral increases along with the increase of bran in the biscuits, in addition the amount of cellulose as a representative of the diet fibers increases with the increase of the wheat bran. The results are in compliance with the study performed by Abd El-Hady., 2012 who used the fat free flour from the embryo of the wheat.

Table 2. Nutritional composition of biscuit

Ingredients	**Biscuit**				
	0	**95/5**	**90/10**	**85/15**	**80/20**
Humidity (%)	1.5±0.02	1.5±0.02	1.49±0.035	1.78±0.015	1.69±0.03
Minerals (g)	1.61±0.015	1.79±0.02	2.27±0.025	2.68±0.02	2.89±0.036
Proteins (g)	7.80±0.025	7.69±0.043	7.81±0.02	7.84±0.026	7.98±0.036
Fat (g)	23.85±0.083	25.91±0.21	26.28±0.19	26.79±0.095	27.07±0.11
Carbohydrates (g)	63.08±0.191	58.84±0.176	56.59±0.367	54.05±0.119	52.62±0.121
Cellulose (g)	1.32±0.025	1.65±0.015	2.19±0.02	2.51±0.02	3.04±0.03
Energy kcal/100g	498.17±0.15	499.35±0.12	494.07±0.14	488.65±0.11	486.06±0.15

Values are mean ± SD from triplicate determinations; different superscripts in the same row are significantly different ($P< 0.05$)

The amount of the proteins in the biscuits does not differ and it is in the range of 7.80±0.025 for bran free biscuits till 7.98±0.036 % for biscuits with 20% wheat bran. The amount of the fat is in compliance with the standards, respectively it is higher than the minimum of 15.0 g/100g, it increases along with the increase of the content of wheat bran in the biscuits in the range 23.85±0.083 % for bran free biscuits until 27.07±0.11 % for the biscuits with 20 % wheat bran, the results are in compliance with the study performed by Kârkliòa et al., 2012, who have used Jerusalem artichoke powder and cocoa bean shells. The amount of the carbohydrates decreases with the increase of wheat bran. The energetic value expressed in kcal/100g with the increase of the level of wheat bran in the biscuits is decreases from 498.17±0.15 for biscuits with 20% wheat bran, the results are in compliance with the study performed by Pasha et al., 2008 who have used various fibers for the production of the biscuits.

From table 3 we observe that the outer look of the biscuits decreases with the increase of wheat bran, that is it becomes darker and more rigid compared to the biscuits which are produced using only the flour, which is in compliance with the study performed by Baljeet et al., 2010 who have used buckwheat flour in ratio 10, 20, 30 and 40% for the production of biscuits, however the biscuits produced with 5 and 10% of wheat bran have a much better outer look compared to those produced with 15 and 20% of wheat bran.

The color of the inner part of the biscuits becomes darker with the increase of the bran and one can see the bran particles, these data are in compliance with the study performed by Stanyon & Costello, 1990, who have used the wheat bran and polidextrose for the production of biscuits. A feature of the biscuits produced with wheat bran is the smell and the taste, given that with the increase of bran the biscuits obtain a specific and attractive smell which is more expressed in biscuits with 15 and 20% of wheat bran, the results are in compliance with the study of Pasha et al., 2008 who have used different fibers in the production of biscuits. The major part of the biscuits are soft, except for those with 20% of wheat bran.

Table 3. Sensory attributes of the biscuits produced with wheat bran

Ratio flour/bran		The outer look (color and surface)	The inner color	The smell and the taste	Consistency
0		Yellow brownish, smooth	Dark white	Specific	Soft
95/5		Yellow brownish, smooth	White brownish	Specific	Soft
90/10		Yellow brownish, smooth	Brown	Specific, very pleasant	Soft
85/15		Brown, a little coarsely	Brown	Specific, very pleasant	Soft
80/20		Dark Brown, coarsely	Dark Brown	Specific, very pleasant	Little Soft

Microbiologic attributes of the biscuits are represented in table 4 and they are very important for consumers given the ingredients and the technological processes, in case one surpasses the permitted limits according to the analytical reference methods, then one has to improve the hygiene during the production or one has to choose the ingredients.

The microbiologic analysis of the biscuits with wheat bran indicate that none of the analyzed microorganisms does not surpass the permitted levels as stipulated in the regulation. It is worth mentioning that the bacteria *Escherichia coli* was not found in any of the products, this indicates the high level of the hygiene during the preparation of the biscuits.

Table 4. Microbiologic attributes of the biscuits

	Mila 0	95/5	90/10	85/15	80/20	Reference Method
Aerobic Mesophyll Bacteria (cfu/g)	<10	<10	<10	<15	<25	ISO 4833
Yeast and Mold (cfu/g)	They were not found	They were not found	They were not found	They were not found	They were not found	ISO 21527
Escherichia coli (cfu/g)	They were not found	They were not found	They were not found	They were not found	They were not found	ISO16649
Salmonella spp.(cfu/g)	They were not found	They were not found	They were not found	They were not found	They were not found	ISO 6579
Staphylococcus aureus (cfu/g)	They were not found	They were not found	They were not found	They were not found	They were not found	ISO 6888

Conclusion

Farinography attributes of the dough improve due to the impact of wheat bran in the deceleration of the water absorption, however the extensographic attributes worsen with the increase of wheat bran, therefore one observes the decrease of extensibility, resistance and dough energy.

The nutritional values of the biscuits with the increase of wheat bran improve, especially one can observe the increase in minerals and cellulose and decrease in calories.

The biscuits that are produced with 5 and 10% wheat bran and they exhibit favorable sensory attributes, whereas those with 15% exhibit a bit lower, and those with 20% even less favorable, however they have the characteristic smell and taste that improves with the increase of bran, which renders them preferred by the consumers.

All the biscuits, notwithstanding the percentage of wheat bran, they are all safe for consumption, respectively all the analyzed microorganisms are within prescribed levels.
As a conclusion, we recommend the biscuits with 10 and 15% of wheat bran for consumption.

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