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Qualitative indices of raw materials and mixtures used in the composition of expanded cereals

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Abstract

From previous experiments we have seen that the best results at extrusion are given by dough's with high starch content. Also dough's with high protein content are very appreciated on the market. In odder to complete certain lacks of cereals dough's, these are supplemented with beans vegetables. The main purpose of this paper was to investigate the relevant nutritional parameters to elaborate breakfast cereal from a mix of whole wheat flour, soybean flour, millet flour, lentil, rice, oatmeal chickpeas in order to see which flours and combination of flours gives the ideal dough for extrusion. We have analysed certain protein content (%), moisture (%), ash (%), fat(%) , gluten content (%), in the laboratory of milling and baking from the Faculty of Food Processing Technology of USAMVB Timisoara. The analyses were performed by spectrophotometer with Fourier transformer, Infra LUM FT – 10. After the mixture we have successfully obtain several dough's with high protein and gluten content witch makes them ideal for extrusion. Also the high protein content gives them a high nutrition value.

Keywords: raw materials, breakfast cereals, nutrients, dough, protein.

1. Introduction

The first modern and commercial cereal foods were created by the American Seventh-day Adventists. The Adventists formed the Western Health Reform Institute in the 1860s. The Institute was later renamed the Battle Creek Hospital after its location in Battle Creek, Michigan. The Adventists manufactured, promoted, and sold wholesome cereals. Will Keith Kellogg was the founder of the W.K. Kellogg Foundation, founded in 1906. In 1894, Will Keith Kellogg's brother Doctor John Harvey Kellogg was trying to improve the diet of hospital patients. He was searching for a digestible bread substitute using the process of boiling wheat. Kellogg accidentally left a pot of boiled wheat to stand and the wheat became tempered (soften). When Kellogg rolled the tempered or softened wheat and let it dry, each grain of wheat emerged as a large thin flake. The flakes turned out to be a tasty cereal. Kellogg had invented corn flakes. On May 31, 1884, John Harvey Kellogg filed for patent for "flaked cereals and process of preparing same." Patent #558,393 was issued on April 14, 1896 [8,9].

Since then a various number of companies have appeared on the market. Their main purpose was to improve the original recipe. One of the biggest problems in corn flakes was the starch content and the nutritional components. The starch has a very important role in the mixing of the dough because it hydrates the flour. During this process an important role have also the starch grains that are mechanically deteriorated. These grains are surrounded by protein foils, the size of the grain, has a big influence on the interaction forces and the rheological properties. During the cooking process starch gelatinized and the starch grain ties the water freed by the proteins during coagulation. The maltose that forms during the enzymatic hydrolysis of starch plays important

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roles in forming the colour of the crust and the flavour substances [10].

The other main problem is the nutritional substances. Even with high starch content if the final product is low on nutritional components it does not have a big value on the market. There are very few cereals that have high starch and nutritional components. Even if some have some high nutritional components they lack other important ones. The best way to obtain high starch and nutritional flakes is to combine different types of flour.

2. Materials and Methods

The main purpose of this paper was to investigate the relevant nutritional parameters to elaborate breakfast cereal from a mix of whole wheat flour, soybean flour, millet flour, lentil, rice, oatmeal, chickpeas in order to see which flours and combination of flours gives the ideal dough for extrusion. The analysed samples are 100% natural whole grain flours without any trace of additives or improvers, provided by S.C SOLARIS PLANT S.R.L.

To elaborate the formulations for breakfast cereal it was applied different percentages for raw materials resulting following mixtures:

1. whole wheat flour 50% + soya 25% + millet 25%
2. lentil 25% + rice 25% + whole wheat flour 50%
3. peas 25% + whole wheat flour 75%
4. oatmeal 50% + chickpeas 25% peas + 25%
5. barley 50% + lentil 25% + soya 25%
6. rice 50 % + millet 25 % + lentil 25%
7. oatmeal 50% + peas 25 % + chickpeas 25%
8. whole wheat flour 75 % + millet 25%
9. rice 50 % + peas 25% + oatmeal 25%
10. barley 25 % + whole wheat flour 50 % + lentil 25 %

Were analysed the following parameters: protein content (%), moisture (%), ash (%), fat(%), gluten content (%), in *Laboratory of milling and baking* of Faculty of Food Processing Technology of *Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania.* The analyses were performed by spectrophotometer with Fourier transformer, Infra LUM FT – 10, this equipment achieve a fast and non destructive analysis of the sample. The characteristics of this equipment are presented in *table 1.*

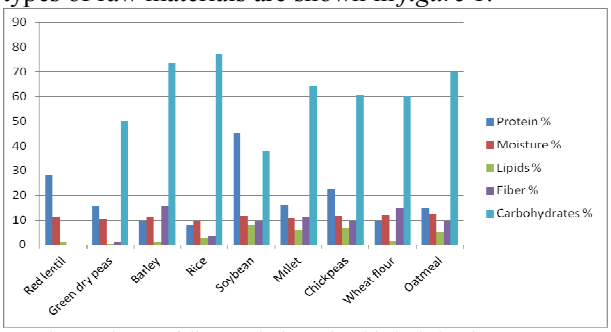
Table 1. Characteristics of Fourier transformer Infra LUM FT – 10

Spectral zone	14000 - 8000 cm^{-1}
Resolution	1, 2, 4, 8, 16 cm^{-1}
Accuracy	0,01 cm^{-1}
Photometric	<0,1% T
Radiation source	halogen incandescent lamp
Detector	silicon photodiode
Beam – splitter	Si/SiO2
Power source	110/220 V
Power	110 W
Size	580x515x295 mm, 37 kg

*Software Spectra LUM/Pro USER'S MANUAL

3. Results and discussion

The results obtained are shown in table 2 and figure 1. The nutritional parameters determined for the 9 types of raw materials are shown in *figure 1.*



Results are given as follow analysis made with the help of NIR equipment.

Figure 1. Nutritional parameters of main raw materials

The main raw materials were taken into study were: red lentil, green dry peas, barley, rice, soybean, millet, chickpeas, wheat flour and oat. The nutritional parameters determined in these materials were: protein, moisture, lipids, fibber, and carbohydrates.

Protein content ranged between 7.9% for rice – 45.2% for soybean (*figure 1*). Previous studies showed for protein following values: 14.66 % barley flour, 10.5 % oat flour, 11.02 % millet, 5.4 % green dry peas, 22.39 % chickpeas, 8.9 % red lentil flour, 46.5 % soybean, 13.7 % wheat whole flour [7]. Cereals, such as wheat and corn are typically low (2%) in oils, although oats may contain up to 10% oil [3]. The range for lipid content in studied raw materials was between 0.3 % for green peas and 7.9 % for soybean (*figure 1*). Moisture content values of raw materials range between 9.8 % rice – 12.7 % oatmeal. The moisture content for rice set at 11.74 % is close to those reported by [6], who found moisture contents of 13.2% and 10.87%.

The results of protein, lipids, fibber, and ash (table 2) obtained for raw materials studied are close to those reported by [2].

Similar results were reported by [3] for these raw materials regarding humidity, lipids and carbohydrates.

Table 2. Nutritional parameters of analysed mixtures

No.	Mixture	Protein %	Humidity %	Lipids %	Ash %	Gluten %
1	Whole wheat flour 50% + soybean 25% + millet 25%	23.40±0.18	12.12±0.15	5.16±0.25	2.40±0.18	24.31±0.43
2	Lentil 25% + 25 % rice+ 50 % whole wheat flour	15.68±0.31	11.54±0.26	1.83±0.23	1.81±0.19	19.37±0.34
3	Dry peas 25 % + whole wheat flour 75%	14.48±0.28	12.50±0.18	1.19±0.08	1.43±0.21	23.36±0.98
4	Oat 50% + chickpeas 25% + dry peas 25 %	18.31±0.78	11.32±0.18	1.89±0.13	1.78±0.23	19.31±0.15
5	Barley flour 50% + lentil 25%+ soybean 25 %	26.41±0.17	12.05±0.98	4.91±1.16	2.51±0.21	20.48±0.44
6	Rice 50 %+millet 25%+ lentil 25%	13.32±0.31	11.28±0.17	1.39±0.73	1.98±0.24	17.34±0.19
7	Oat 50% + dry peas 25% + chickpeas 25 %	19.15±0.39	12.24±0.16	1.75±0.25	2.15±0.41	21.71±0.14
8	Whole wheat flour 75% + millet 25 %	14.15±0.26	11.64±1.02	1.82±0.81	1.81±0.16	23.19±0.71
9	Rice 50 % + dry peas 25% + oat 25%	11.14±0.21	12.15±0.42	1.30±0.18	2.16±0.08	17.25±0.13
10	Barley 25 %+ wheat flour 50 % + lentil 25 %	15.21±0.75	11.05±0.29	1.41±0.23	1.66±0.31	20.16±0.24

* Results are given as results of 3 determinations ± SD (standard deviation)
** Results are given as follow analysis made with the help of NIR equipment.

The proteins value range from 11.14 % (*mixture 9* - rice 50% + dry peas 25% + oat 25 %) to 24.41% (mixture 5 - barley flour 50% + lentil 25%+ soybean 25 %). High protein value was determined also to mixture 1 (whole wheat flour 50% + soybean 25% + millet 25%) – 23.40 %.

High protein content of *mixture 1* and *mixture 5* is due to soybeans which there are in the composition of both mixtures. Soybean has a protein content of 45.2 % (*figure 1*).

Moisture in cereals, according with literature studies is nearly 14 %, the values registered for mixtures studied have been between 11.05 (*mixture 10* - Barley 25 %+ wheat flour 50 % + lentil 25) and 12.50% (*mixture 3* - dry peas 25 % + whole wheat flour 75%).

The highest lipid content was registered in the case of *mixture 1* (whole wheat flour 50% + soybean 25% + millet 25%) – 5.16 % and *mixture 5* (barley flour 50% + lentil 25%+ soybean 25 %) – 4.91 %, given the fact that both have in their composition soybean in a proportion of 25 %, and lipid content in soybean was 7.9%. The lowest lipid content was registered to mixture 3 (dry peas 25 % + whole wheat flour 75%) – 1.19 % (*table 2*).

Regarding ash content values ranged from 1.43% (*mixture 3*- dry peas 25 % + whole wheat flour 75%) and 2.51 % (*mixture 5*- barley flour 50% + lentil 25%+ soybean 25 %) (*table 2*).

The highest amount of gluten content was recorded to *mixture 1* (whole wheat flour 50% + soybean 25% + millet 25%) 24.31 %, and the lowest value was recorded in *mixtures 9* (Rice 50 % + dry peas 25% + oat 25%) – 17.25 % and *mixture 6* (rice 50 % + millet 25 %+ lentil 25 %) – 17.34 % (*table 2*).

4. Conclusion

To the studied mixtures, it can be seen that in each case, except *mixture 6 (*rice 50 % + millet 25 %+ lentil 25 %) and *mixture 9* (rice 50 % + dry peas 25% + oat 25%) was recorded high values of gluten, followed by proteins, minerals and fats. From the above data it can be noticed that each mixture is a quite good candidate to manufacture cereal flakes.

After the tests were made we have observed that mixtures in combination with water gives gelatinous composition similar to classic bread dough, which makes them ideal for being processed in extruder for cereal flakes.

Compliance with Ethics Requirements

Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

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