NUTRITIONAL PARAMETERS OF RAW MATERIALS AND MIXTURES AS BASE FOR PRODUCING BREAKFAST CEREALS

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ABSTRACT

From the most eldest times cereals were an important source of food. Their high content in carbohydrates, proteins, lipids, mineral substances (K, Ca, Mg, Si, Na, Cu, Mo, Mn) and vitamins like (B1, B2, B5, B6, PP) offer our organism a high percentage of the energy and mineral substances that it needs for survival. Alongside the cereals, bens vegetables tend to complete the lack of cereals, bringing a high amount of nutrients. The main purpose of this paper was to investigate the relevant nutritional parameters to elaborate breakfast cereals 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. There were analysed the 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. To the studied mixtures, it can be seen that in each case, except *mixture 7* (lentil 25%+ 75 % rice) 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 a good candidate to manufacture cereal flakes. It was observed that mixtures in combination with water gives an gelatinous composition similar to classic bread dough, which makes them ideal for processing in an extruder for cereal flakes.

Keywords: raw materials, breakfast cereals, nutrients, whole flour, protein.

INTRODUCTION

During the history, humans have learned to process those plants and to transform the hard digestion elements into simpler ones that are easy to assimilate. The first tendency was the milling, followed by the manufacturing of the dough and the heat treatments. One of the most efficient and fastest heat treatment used today is the extrusion, which combines the use of high pressure and heat. We obtain this way an almost instant transformation, and shaping of the dough in the product that we want. The composition of the dough has a significant effect on the extrusion process. The soybean, lentil, and common bean mixture is considered a great combination in terms of nutritional value, which is a source of energy and essential amino acids necessary for a healthy diet, besides containing reasonable amounts of vitamins, minerals and dietary fiber (PIRES ET AL., 2006). Millet is a gluten free ancient grain, with its mildly sweet flavor, is tasty, soothing, non-acid forming, and contains a myriad of beneficial nutrients. This readily-available food is one of the least allergenic and most digestible, gluten-free American grains. The most important nutritional values are: 15% protein, high amounts of fiber, B-complex vitamins, high in iron, magnesium, phosphorus, manganese, potassium, calcium and zinc (ANONYM, 2010). Lentils belong to the legume family along with beans, peas and peanuts and are popular in Indian and vegetarian cooking. Lentils come in different colors, including green, red and yellow. The fiber content of lentils lowers cholesterol, helps the body maintain blood sugar and prevents constipation (ANONYM, 2007). Lentils are extremely high in molybdenum, are a good source of iron, with 37 percent of the daily recommended intake provided, and manganese, with 49 percent of the recommended daily intake. Lentils provide over 10 percent of the daily intake of potassium, copper, phosphorus and zinc. Other vitamins in lentils include vitamin A, thiamin, riboflavin, vitamin B6, vitamin

B12, choline, niacin, vitamin C, vitamin K, pantothenic acid and vitamin E (ANONYM, 2011). Soybeans are very rich in nutritive components. Besides the very high protein content, soybeans contain a lot of fiber and are rich in calcium and magnesium. The soy protein has a high biological value and contains all the essential amino acids. Total lipid for soybean is 19.9 g/100g (ANONYM, 2003). One of the most efficient and fastest heat treatment used today is the extrusion; witch combines the use of high pressure and heat. We obtain this way an almost instant transformation, and shaping of the dough in the product that we want. The composition of the dough has a significant effect on the extrusion process. Food with low fat level is favorable for extrusion. The extrusion process minimizes lipid oxidation, thus increasing the nutritional and sensory quality of foods and feeds (SINGH, ET AL. 2007). Many types of lipids occur in foods, the triglycerides are the most common. During the extrusion of foods, native lipids might be present within the raw materials or added to the ingredients. Oilseed flours used in extrusion may be full fat, partially or wholly defatted. Extrusion of high-fat materials is generally not advisable, especially in the case of expanded products, as lipid levels over 5–6% impair extruder performance (CAMIRE AND FLINT, 1991). Torque is decreased because the lipid reduces slip within the barrel, and often product expansion is poor because insufficient pressure is developed during extrusion. Lipid is released from cells owing to the high temperature and physical disruption of plant cell walls. At the same time, small lipid levels (<5%) facilitate steady extrusion and improve the texture (SINGH ET AL.2007).

MATERIAL AND METHOD

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 analyzed 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 of raw materials resulting following mixtures:

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

Were analyzed 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

RESULTS AND DISCUSSIONS

Raw materials used for the mixtures which will be used to produce breakfast cereals have been the following: red lentil, green dry peas, barley flour, rice flour, soybean flour, millet flour, chickpeas flour, wheat flour, oatmeal flour. The nutritional parameters determined for the 9 types of raw materials are shown in *Table 2*.

Table 2. Nutritional parameters of main raw materials

Product	Protein (%)	Moisture (%)	Lipids (%)	Fiber (%)	Carbohydrates (%)
Red lentil	28.0	11.5	1.0	-	-
Green dry peas	15.7	10.7	0.3	1.1	50.1
Barley	9.9	11.2	1.2	15.6	73.3
Rice	7.9	9.8	2.9	3.5	77.2
Soybean	45.2	11.7	7.9	10.0	37.9
Millet	16.0	10.8	6.0	11.4	64.4
Chickpeas	22.4	11.6	7.0	9.7	60.7
Wheat flour	10.0	12.1	1.6	15.1	60.4
Oatmeal	14.8	12.7	5.2	10.0	70.0

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

Studied qualitative indices of raw materials were: protein, humidity, lipids, fiber, and carbohydrates.
The range of protein content of raw materials studied was between 7.9% (rice) and 45.2% (soybean).
Literature studies showed for protein following values: 14.66 % barley flour, 10.5 % oat meal flour, 11.02 % millet, 5.4 % green dry peas flour, 22.39 % chickpeas, 8.9 % red lentil flour, 46.5 % soybean, 13.7 % wheat whole flour (TUDORANCEA, 2008). Cereals, such as wheat and corn are typically low (2%) in oils, although oats may contain up to 10% oil. The oil is concentrated in the bran and germ portions of the seed kernel, and is removed during milling to decrease stability. Oilseeds, such as soybeans and cottonseed may contain up to 50% by total seed weight as oil. The range of lipid content in studied raw materials was between 0.3 % for green peas and 7.9 % for soybean (*Table 2*). Moisture content value of raw materials range between 9.8 % (rice) – 12.7 % (oatmeal). The moisture content of rice set at 11.74 % is close to those reported by (LIMBERGER, 2009), who found moisture contents of 13.2% and

10.87%. The results of protein, lipids, fiber, and ash (*Table 2*) obtained for raw materials studied are close to those reported by (CARVALHO, ET AL., 2012). Similar results were reported by (BANU, ET AL., 2007) for these raw materials regarding humidity, lipids and carbohydrates.

Table 3. Nutritional parameters of formulations studied

No.	Mixture	Protein %	Humidity%	Lipids %	Ash %	Gluten %
1	whole wheat flour 75% + lentil 25%	18,50±0,23	11,09±0,21	1,31±0,15	1,62±0,34	23,14±0,53
2	whole wheat flour 75%+ soybean 25%	20,34±0,74	12,84±0,39	1,42±0,18	1,40±0,29	22,17±0,81
3	whole wheat flour 75% + chickpeas 25%	14,06±0,20	13,26±0,40	2,53±0,62	1,98±0,18	20,57±0,34
4	whole wheat flour 75%+ dry peas 25%	19,72±0,39	13,29±0,89	2,75±0,25	3,30±0,11	25,67±2,67
5	lentil 25% + 25% millet + 50% oat	18,06±0,35	13,60±0,85	4,38±0,23	2,51±0,10	25,27±2,43
6	oatmeal 75 % + 25 % soybean	23,05±0,28	12,94±0,31	5,38±0,18	2,78±0,44	20,18±0,73
7	lentil 25% + 75 % rice	14,38±0,31	11,23±0,18	1,32±0,24	1,63±0,34	17,02±0,39
8	dry peas 25 % + barley flour 75%	13,21±0,14	12,53±0,26	2,31±0,41	2,13±0,29	18,12±0,13
9	millet 25 % + chickpeas 25% + 50% barley flour	16,0±0,23	12,31±0,11	1,36±0,24	2,21±0,18	17,24±,36
10	soybean 25% + millet 25 % + chickpeas 25 % + rice 25 %	16,23±0,13	12,43±0,61	2,31±0,36	2,67±0,28	17,69±0,39

* 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 was from 13.21 % to 23.05%. The highest value being recorded in mixture composed of oat 75% + 25% soybean and the lowest in mixture with barley 75% and 25% peas.

Moisture in cereals, according with literature studies is 14%. The values registered of studied mixtures have been between 11.09 % (*mixture 1*- whole wheat flour 75% + lentil 25%) – 13.60 % (*mixture 5* - lentil 25% + 25% millet + 50% oatmeal). Lipid content in studied mixtures was between 1.31% (*mixture 1* - whole wheat flour 75%+ lentil 25%) and 5.38 % (*mixture 6* - oatmeal 75 %+ 25 % soybean). The highest lipid content was recorded in *mixture 6* with 5,38%, but a higher lipid content was registered also in *mixture 5* (lentil 25% + 25% millet + 50% oatmeal) with 4.38 %.

Regarding ash content values ranged from 1.40% (*mixture 2* - whole wheat flour 75%+ soybean 25%) to 3.30 % (*mixture 4* - whole wheat flour 75% + dry peas 25%) see *Table 3*. The lowest amount of gluten content was recorded in *mixture 7* (lentil 25% + 75 % rice) – 17.02 %, and the highest values were recorded in *mixtures 4* (whole wheat flour 75 % + dry peas 25%) – 25.67 % and also *mixture 5* (lentil 25% + 25% millet + 50% oatmeal) – 25.27 % (*Table 3*).

CONCLUSIONS

It can be noticed from the represented data that each mixture is quite a good candidate to manufacture cereal flakes.

It can be seen that in each case of studied mixtures, except *mixture 7* (lentil 25%+ 75 % rice) there were recorded high values of gluten, followed by proteins, minerals and fats.

It was observed by the test that mixtures in combination with water gives gelatinous composition similar to classic bread dough, which makes them ideal for processing in an extruder for cereal flakes.

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