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THE INFLUENCE OF RAW MATERIALS ON NUTRITIONAL VALUES AND SENSORY PROPERTIES OF FLIPS

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Abstract

Flips are fully expanded, dried and crispy food products with different shapes and sensory properties. The first basic material in the production of flips is corn crumbs obtained from non-microbial corn. In addition to corn crumbs, other raw materials that can be used for the production of are starchy potatoes, broken rice, fat-free soybeans, etc. The exact purpose of this paper is to use other raw materials such as: bean flour, soy flour, rice flour, peanut crumbs and chickpea flour; by adding 30% to improve nutritional values but maintaining the sensory properties of the flips.
It has been proven that adding 30% of bean flour to the production of flips generally increases the nutritional values of protein, cellulose and minerals, whereas flips with 30% of chickpea flour content also increase the cellulose and mineral content. However, flips produced with bean flour and chickpea flour have average sensory properties, whereas those with 30% of rice flour have better sensory properties. Therefore, these three types of flours are also recommended for further use but with different combinations between each other

Keywords: flips, nutritional values, sensory properties, bean flour

1. Introduction

Consumer interest in ready-to-eat snack foods is growing due to their convenience, value, attractive appearance, taste and texture (Harper, 1981). Cereal-based extruded snacks are the most commonly consumed snacks (Rhee et al., 2004).
Snack products are products that according to their composition and processing methods are known as: chips, flips, pellet-based products, baked goods, etc. Flips are products obtained by the process of extrusion and expansion of raw materials. The raw materials most commonly used for the production of extruded products are rich in starch and protein. Some of these raw materials are corn crumbs, whey protein, wheat, etc. The major role of these ingredients is to give structure, texture and mouth feel (Anton et al., 2009).
Extrusion is defined as an HTST (high temperature in a short time) process, in which the mechanical energy is combined with heating to gelatinize the starch and denature the proteins, plasticizing and reorganizing the material to create new shapes and textures, and it also has the ability to inactivate enzymes, destroy some toxic substances and reduce the microbial activity (Gandhi et al., 2016).
Vitamin stability during extrusion is significantly different and depends on the type of vitamins used (Brennan et al., 2011). Vitamins A, C, thiamine and niacin are sensitive to temperature, while vitamins D and K are quite stable at high temperatures. During extrusion generally we have no loss of minerals, but if we supplement them with minerals before extrusion, we achieve an appearance of a darker color and with it the reduction of product qualities due to the creation of complexes (Kumary, 2011).

The physical properties and sensory properties of an extruded product are generally influenced by a large number of process and ingredient variables (Liu et al., 2000). In order to achieve better acceptability of these products aromatization in which the flavor is sprayed onto final product (Menis et al., 2013) is commonly used after extrusion.

Unfortunately, these products tend to be nutritionally poor as they are high in energy but low in nutritional value. Therefore, the objective of this study is to add different raw materials to improve nutritional values and preserve or improve the sensory properties of flips.

2. Materials and methods

Flips that are on the market are products made from corn crumbs and other additives, but to increase the nutritional value of flips, corn crumbs have been replaced with 30% of rice flour, soy flour, peanut crumbs, bean flour and chickpea flour, i.e. a ratio of 70/30 corn crumbs to one of the other additional ingredients. In order not to affect the sensory qualities of the flips, no other additives such as salt and various spices were used.

The technological process of production of flips has been carried out at the enterprise "Letto Foods Dooel" - Skopje, as in figure 1.

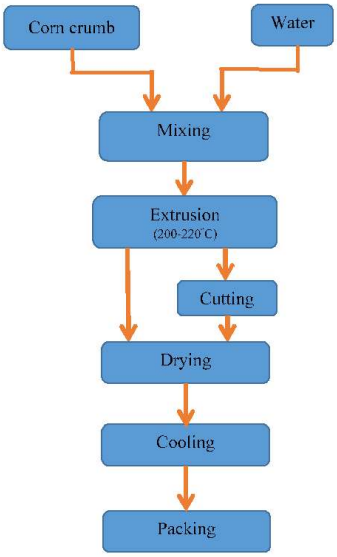

Figure 1. The technological process of flips production.

The chemical and physical analysis of raw materials and final products such as moisture determination were performed with the standard drying method at 105 °C for 2.5 hours (ICC 109/1), determination of complete minerals by burning in the muffle furnace at 900 °C for 2 hours (ICC 104/1) in Norbertherm apparatus (Xhabiri et al., 2011). Proteins with the Kjeldal method according to the AOAC 920.87 method, the determination of fats with the Soxhlet apparatus according to the AOAC 922.06 method, were determined by the AOAC (2005) standard methods while carbohydrates were calculated by difference (Eyeson and Ankrah, 1975). Total

calories were calculated by the formula of James, 1995 as follows: Total calories = Fat x 9 + Protein x 4+ Total carbohydrate x 4

In the flips, the sensory properties were analyzed, starting from the uniformity of color, structure-crispness, consistency, flavor and taste. This part was conducted in the laboratories of the Faculty of Food Technology and Nutrition together with third- year students of the study program Food Technology, which included 36 students.

Statistical analysis such as mean, standard deviation and significance were performed with SPSS 16 program.

2. Results and Discussion

The production of extrudes which are enriched with high protein or other substance content is closely related to the analysis of grain-based or other raw materials. There are more studies on this that are closely related to the moisture and temperature of the mixture prepared for extrusion. But by following the nutritional properties of flips and the demands that consumers face, most researchers enriched flips products with certain ingredients. Seiler and Seibler (1981) used soy and milk proteins to increase protein values.

Characteristics of the raw materials

In Table 1 we notice that the lowest moisture has chickpea flour and peanut crumbs with 7.93±0.09% and 8.42±0.03%, while the highest is rice flour with 12.67±0.13%. Carbohydrate content differs significantly ($p < 0.05$), corn crumbs and rice flour as cereal products with the main content of starchy carbohydrates have much higher values than other raw materials, that corresponding to the research of Coutinho et al., 2013, who used broken rice grains, rice bran and soybean okara in the production of snack products.

Table 1. Results of chemical and physical analysis of raw materials

	Corn Crumbs	Bean Flour	Soy flour	Rice flour	Peanut Crumbs	Chickpea Flour
Moisture (%)	12.36 ± 0.08^{b}	11.21 ± 0.11^{c}	9.82 ± 0.06^{d}	12.67 ± 0.13^{a}	8.42 ± 0.03^{e}	7.93 ± 0.09^{f}
Carbohydrates (g/100g)	70.62 ± 0.21^{b}	45.17 ± 0.14^{d}	24.02 ± 0.06^{e}	73.43 ± 0.108^{a}	16.49 ± 0.02^{f}	52.38 ± 0.32^{c}
Protein (g/100)	8.83 ± 0.13^{e}	24.41 ± 0.18^{b}	35.39 ± 0.08^{a}	7.43 ± 0.11^{f}	22.31 ± 0.08^{c}	18.26 ± 0.14^{d}
Fat (g/100g)	2.93 ± 0.04^{d}	1.42 ± 0.09^{e}	17.64 ± 0.08^{b}	0.96 ± 0.09^{f}	42.14 ± 0.10^{a}	6.17 ± 0.103^{c}
Celulose (g/100g)	1.07 ± 0.09^{f}	12.34 ± 0.11^{a}	8.72 ± 0.12^{bc}	1.48 ± 0.08^{e}	5.05 ± 0.11^{d}	9.41 ± 0.03^{b}
Minerals (g/100g)	2.33 ± 0.16^{e}	3.96 ± 0.11^{a}	2.35 ± 0.02^{d}	2.49 ± 0.11^{c}	1.57 ± 0.06^{f}	3.47 ± 0.06^{b}

Mean values in row for all the samples with different superscripts are significantly different ($p<0.05$). Value are expressed as mean ± SD ($n = 3$).

The protein content of all raw materials is different, the highest in legumes soy and bean flour, while lower in cereals rice and corn crumbs, similar results had Algarin et al., 2019, who in their research for the production of snack products had used sweet potato, sweet lupine and rice flour.

Fat content differs significantly ($p < 0.05$). The fat content is much higher than in all other raw materials in peanut crumbs with 42.14±0.10 g/100. Cellulose content as a representative of dietary fiber is higher in chickpea flour and bean flour, while much lower content is seen in corn crumbs and rice flour, but soy flour and chickpea are significantly ($p < 0.05$). The mineral content is higher in bean flour with 3.96±0.11 g/100g, followed by chickpea flour with 3.47±0.06 g/100g.

Nutritional values of produced flips

In order to improve the nutritional values of flips, we have created mixtures between corn crumbs and additional raw materials that we have presented in Figure 2. The moisture of all flips mixtures is within the boundaries of the regulations. The carbohydrate content of the produced flips is higher in the mixture of corn crumbs with 30% rice flour with 78.68 g/100g, while much lower content has mixtures with 30% soy flour and 30% peanut crumbs.

Protein content in the produced flips is higher in flips with 30% bean flour with 12.5 g/100g, even flips with soy flour and peanut crumbs also have high content, which is consistent with the research of Tobias-Espinoza et al., 2019 who have proven that with the addition of flaxseed and amaranth the protein content increases. Also, Baraiya et al., 2016 in their research have increased protein in snack products with the addition of shrimp flour.

The fat content in the produced flips is significantly higher in the flips produced with 30% peanut crumbs with 11.78 g/100g, which is consistent with the research of Coutinho et al., 2013. The highest content of cellulose is seen in flips produced with 30% bean flour and 30% chickpea flour and 4.27 g/100g and 3.55 g/100g Flips produced with soy flour also have significant cellulose content, while flips produced with rice flour have a lower content, similar results had Algarin et al., 2019. Flips produced with bean and chickpea flour have a higher mineral content.

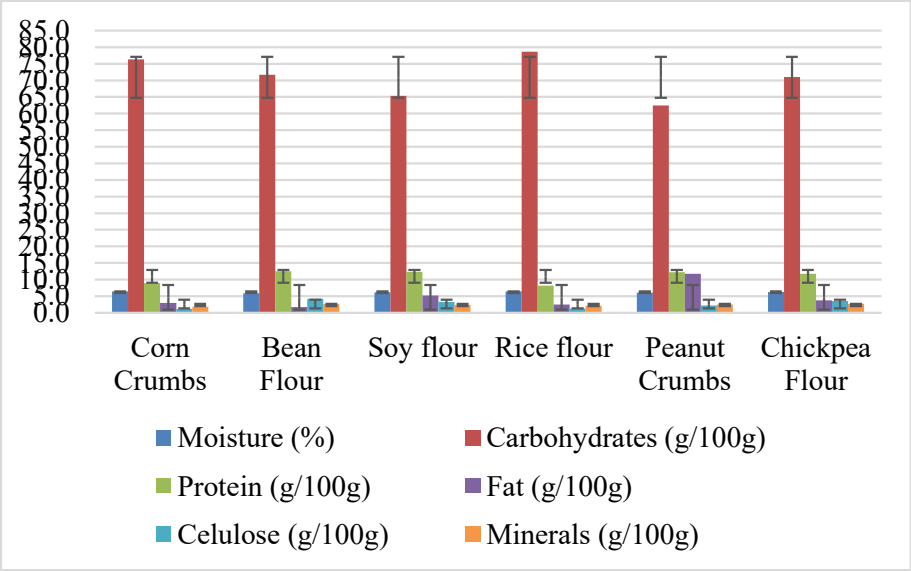

Figure 2. Content of nutrition value of flips obtained from the mixtures

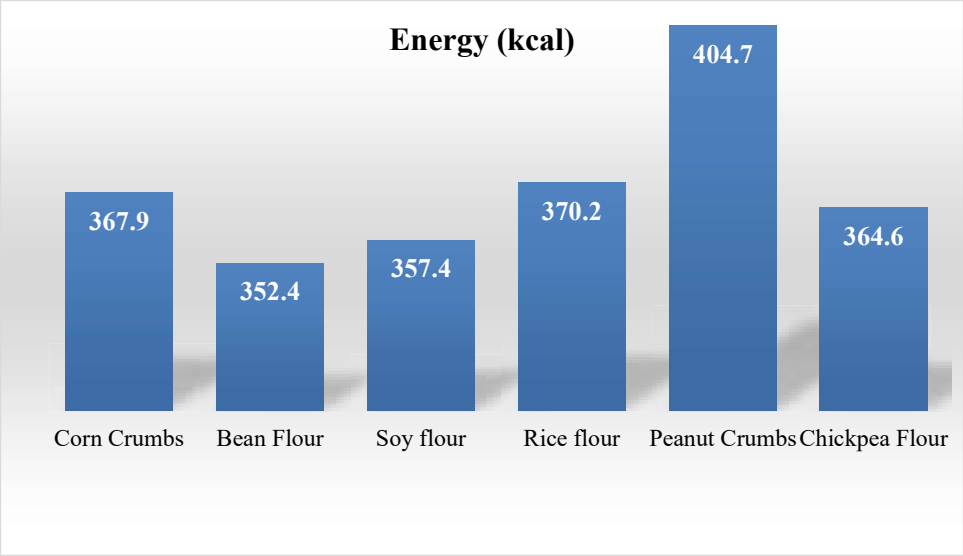

Figure 3. Energetic value of flips obtained from the mixtures

As a result of the increase of malnutrition diseases such as obesity or obesity in children, in the study, we analyzed the energy values of such flips from mixtures (Figure 3). The results show that in flips with 30% bean flour we have the most reduction in calories compared to reference flips or flips with corn flakes with 352.4 kcal, while flips produced with 30% peanut crumbs have much more energy with 404.7 kcal.

Sensory properties of produced flips

Table 2 and Photo 1 present the results of sensory estimates of the produced samples as well as the standard deviation from which we can observe the consumer estimates for the sensory attributes. All sensory features are rated with points from 1 point to a maximum of 5 points for each feature.

Table 2. Sensory properties of flips from the created mixtures

Sensory properties	Corn crumbs (100%)	Bean flour (30%)	Soy flour (30%)	Rice flour (30%)	Peanut crumbs (30%)	Chickpea flour (30%)
Uniformity of color (1-5)	3.82 ± 0.63^{a}	3.29 ± 0.84^{c}	3.05 ± 1.34^{d}	3.52 ± 0.87^{b}	2.88 ± 0.99^{ef}	2.97 ± 0.85^{e}
Structure – crispness (1-5)	4.00 ± 0.93^{a}	3.35 ± 0.70^{c}	2.64 ± 0.96^{f}	3.63 ± 0.78^{b}	2.78 ± 0.85^{e}	3.00 ± 0.97^{d}
Consistency (1-5)	3.94 ± 0.82^{a}	3.37 ± 0.80^{c}	2.94 ± 0.74^{e}	3.70 ± 0.84^{b}	2.88 ± 0.85^{f}	3.30 ± 0.72^{cd}
Aroma (1-5)	3.30 ± 0.78^{b}	2.58 ± 0.87^{e}	2.47 ± 0.87^{f}	3.00 ± 0.61^{c}	3.41 ± 0.71^{a}	2.87 ± 0.62^{d}
Taste (1-5)	2.82 ± 1.07^{c}	2.70 ± 1.10^{d}	2.52 ± 1.28^{e}	2.76 ± 1.09^{cd}	3.64 ± 1.27^{a}	3.10 ± 1.07^{b}

Mean values in row for all the samples with different superscripts are significantly different ($p<0.05$). Value are expressed as mean ± SD ($n = 3$).

Photo 1. Appearance of the produced flips

Uniformity of color closest to control flips have flips with 30% rice flour with 3.52±0.87, while flips produced with chickpea and peanut flour are significant ($p < 0.05$). The results are similar to the research of Bodroza-Solarov et al., 2006 who used amaranths grist.

Structure - crispness of all flips is different ($p < 0.05$), but flips produced with 30% rice flour and 30% bean flour are good structure. The results are consistent with the research of Gabr et al., 2013 who for the production of snack products in their formulations have used rice, chickpea, wheat germ, barley and milk powder.

The consistency of flips produced with 30% rice flour it is very good, while flips produced with bean and chickpea flour have a medium consistency and are significant ($p < 0.05$).

The aroma of all flips is different ($p < 0.05$). Flips produced with 30% peanut crumbs is very attractive to consumers, in fact the tasters have valued the flips higher than the corn crumb flips with 3.41± 0.71. Flips with 30% rice flour and 30% chickpea flour have a medium aroma, the results are similar to the research of Maziya - Dixon et al., 2017 who used cassava flour and legume blend for the production of snack products.

In Table 2 we note that all flips have very low value flavors, which is characteristic of flips produced without additives, i.e. tasters are accustomed to the characteristic taste of market flips which contain significant amounts of various additives. They expected that even the studied flips have a similar taste without taking into account that all flips are produced without additives. The taste of all flips is different ($p < 0.05$).

3. Conclusion

In general, the raw materials used for the production of flips are not significant. The raw materials selected generally improve the nutritional value of the flips, especially in the flips with 30% bean flour content we have higher values of proteins, cellulose and minerals, the flips with 30% chickpea flour content also have higher cellulose content and minerals.

Sensory analyzes of flips show that they differ significantly ($p < 0.05$), but flips produced with 30% rice flour have better sensory properties.

Based on the content of nutritional values and the sensory properties of the flips produced with 30% of other raw materials, it is recommended to use rice flour, bean flour and chickpea flour. But they should be combined with each other in order to have better sensory properties and preserve nutritional values.

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