Nutritional Value and Sensory Properties of Cookies Prepared from Flour Mixes of Carrot (*Daucus Carota*), Lupine (*Lupinus Perennis*) and Barley (*Hordeum Vulgare*)

Herminia Sanaguano Salguero,
R. Angélica Tigre León,
I. Favian Bayas Morejón,
Mª Bernarda Ruilova Cueva,
Centro de Investigación y Desarrollo Biotecnológico, Departamento de Investigación, Universidad Estatal de Bolívar, campus Laguacoto II, Guaranda 020150, Ecuador

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Abstract

Nutritional value and sensory properties of cookies prepared by the combination of different proportions of carrot flour (CF), lupine flour (LF) and barley flour (BF) blends were analyzed. Eight formulations (F) of cookies were prepared from (F1) Control (100% Wheat flour "WF"), (F2) 33.33% CF, 33.33% LF and 33.33% BF, (F3) 33.33% CF, 41.66% LF and 25% BF, (F4) 33.33% CF, 25% LF and 41.66% BF, (F5) 33.33% CF, 25% LF and 41.66% BF, (F6) 41.66% CF, 33.33% LF and 25% BF, (F7) 25% CF, 41.66% LF and 33.33% BF, (F8) 41.66% CF, 25% LF and 33.33% BF. Cookies were subjected to analysis as moisture value, crude protein, Vitamin A as well as mineral analysis (potassium, calcium, phosphorus and iron) and evaluated for consumer acceptance by sensory analysis.

Cookies prepared from formulation F8 showed high levels of vitamin A, (30UI/100 g), potassium (417.42 mg/100 g), calcium (182.40 mg/100 g) and iron (6.88 mg/100 g) in comparison with the others formulations. In the moisture value, F2 had similar value that the control cookies, The F3, F5 and F7 had high value in crude protein. Sensory evaluation established that cookies prepared with the formulation 8 were more acceptable than cookies prepared from other formulations.

Keywords: Cookies, carrot, lupine, barley

Introduction

Cookies are widely consumed throughout the world. In fact, they represent the largest category of snack foods in most parts of the world. The consumption of cereal based foods like cookies require the development of an adequate substitute for wheat (Eneche, 1999). The substitute should be one that is readily available, cheap and able to replace wheat flour in terms of functionality (FAO, 1995). Composite flours produced from cereals and legumes have the advantage of improving overall nutrition (FAO, 1995).

In selecting the components to be used in composite flour blends, the materials should be readily available and provide increased nutritional potential (Okpala and Okoli, 2014). Fruit and vegetable can be a great source of important nutrients, including potassium, dietary fiber, folate (folic acid), vitamin A, and vitamin C. Most vegetables are naturally low in fat and calories, none have cholesterol (Serena and Knudsen, 2007). These characteristics make that fruit and vegetables are essential to the development of nutritional products. Carrot (*Daucus carota L.*) is an inexpensive and highly nutritious vegetable, since it contains appreciable amounts of vitamins B1, B2 and B6 along with carotenes. The dietary carotenes are associated with lowering risk of many cancers. Meanwhile, vitamin A is an antioxidant, which plays a key role in growth and repair of tissues in addition to help the body to fight with infections, keep eyes healthy, nourish epithelial tissues in the lungs and skin as well (Singh et al., 2006). The lupine is a legume that has gained importance as a meal and crop. It is due to its high content of protein, fat, minerals, vitamins, fiber and the presence of the eight essential amino acids and high protein digestibility, which reaches 87%, properties that, placed the grain in a comparable group with soy (Bermudez, 2014). Barley grain is used as feed, malt, and food; our ancestors depended on barley as a staple food more than we do now. Barley played an important role in the origin and development of the cultures. Barley is commonly found in two forms hulled and pearled. Hulled barley has undergone minimal processing to remove only the inedible outer shell, leaving the bran and germ intact. Pearled barley has had the layer of bran removed along with the hull (El Yamlahi and Ouhssine, 2013). Nutritional contain of pearled barley are shown the following table.

Table 1. Nutritional value of pearled barley

Nutrients	Content for each half a cup of pearled barley (%)
Calcium	3
Iron	18
Thiamin	40
Riboflavin	15
Niacin	21
Phosphorus	25

Potassium	12
Zinc	17
Copper	23

Warre (2016)

Furthermore, many studies have suggested that increasing consumption of plant foods like barley decreases the risk of obesity, diabetes, heart disease, and overall mortality (Grando, 2005; Warre, 2016). A product considered nutritional must contain levels of protein, vitamins and minerals necessary for normal and healthy growth. They can act as coenzymes and are indispensable to various metabolic reactions in the organism. Deficiencies in vitamin "A", iron and iodine contribute to deficiencies in vitamins C, B complex and zinc (Liberato and Pinheiro-Santana, 2006). Among the important functions of some minerals be "Ca" fulfills the function of strengthens bones and teeth; "P" It is bound to calcium, it is also fundamental to enjoy strong bones and a muscular system in optimal state. It also intervenes in the nervous system and in the storage and use of energy; "Fe" plays a key role in the formation of hemoglobin; "K" fulfills functions similar to sodium, is part of the bones and participates in the osmotic equilibrium.

The purpose of this study was to prepare cookies from carrot, lupine and barley, to evaluate its nutritional contents and sensory properties. In addition, of this way to obtain the best formulation to be elaborated.

Materials And Methods

Carrot, lupine and barley were procured from local market of Guaranda, Ecuador, and were stored at 4 ºC till further use. In this work was necessary a lupine´s disaponified step to eliminate the bitter flavor of grain according to the method establishing by Peralta et al. (2012). Carrot, lupine and barley were converted into flour in a stone-disc mill (Cepco, 20533, Quito, Ecuador).

Preparation of cookies

Cookies were prepared using a formulation described in Table 2. Cookie dough was prepared from different proportions of CF, LF and BF (according formulation), 30 g of shortening and 30 g of sugar.

Table 2. Formulation for preparation of cookies

Formulation No.	Wheat flour (%)	Carrot flour (%)	Lupine flour (%)	Barley flour (%)
1	100	--	--	--
2	--	33.33	33.33	33.33
3	--	33.33	41.66	25.00
4	--	33.33	25.00	41.66

5	--	25.00	33.33	41.66
6	--	41.66	33.33	25.00
7	--	25.00	41.66	33.33
8	--	41.66	25.00	33.33

The dough was aged for 30 min and then the mass was extended using an electric laminator (Metvisa, 01CLM-400, Brazil) to a thickness of 5 mm. The cookies were cut with a 50-mm diameter cookie cutter. These were baked at 200°C for 15 min in a baking oven (Hornipan, Model 20555, Ecuador). Then the cookies were left standing at room temperature and packed until their respective analysis.

Nutritional content analysis of cookies

The proximate composition of samples like moisture content and crude protein was analyzed on dry weight basis of the cookies according to American Association of Cereal Chemists (2005). Furthermore, mineral analysis such as potassium, calcium, phosphorus and iron, as well as vitamin A content were analyzed according to the methods established by Laboratory of food analysis – LABOLAB CÍA. LTDA.

Sensory evaluation of cookies

The sensory quality of cookies were analyzed using 5-point hedonic scale (5= excellent, 4= good, 3= Average, 2= fair, 1= poor). The sensory panel involved 10 semi-trained panelists of the Julio Moreno School (Guaranda). The order of presentation of samples to the panel was randomized. Mineral water was provided to rinse the mouth between evaluations. The panelists were instructed to evaluate the coded samples for color, taste, texture, and acceptability. The criteria used for the evaluation were according to the established by Galdámez et al. (2009).

Statistical analysis

All the experiments were conducted in triplicate for each sample. The data generated were analyzed using the software "Statistics". The data obtained were treated to analysis of variance (ANOVA). Significance was accepted at $p \leq 0.05$ level.

Results And Discussion

Nutritional content of cookies

Moisture content varied from 4.37 to 4.58% with an average moisture content of 4.61%. It was also observed that the moisture content of cookies increased with the increase in carrot flour level. This may be due to carrot flour characteristics in the cookies. Regarding protein analysis, mean values ranged of 3.60 to 6.05% was obtained, all formulations have been more protein level that the control cookies, according to INEN 2085, 519. (2005) a

minimum of 3% in protein is recommended. Assis et al. (2013), reported similar values to ours (5.75%). Results of moisture values, crude protein and vitamin A are showed in the table 3.

Table 3. Moisture, crude protein and vitamin A of cookies

Formulation	Moisture (%)	Crude protein (%)	Vitamin A (UI/100 g)
1	4.52	3.60	16.35
2	4.52	5.60	28.79
3	4.50	6.05	15.96
4	4.45	5.60	16.57
5	4.37	6.00	29.57
6	4.58	5.63	11.25
7	4.41	6.01	10.04
8	4.55	5.61	30.00

Regarding vitamin A analysis, formulation 8 has the highest concentration with 30.00 IU / 100 g (1 IU is a biological equivalent of 0.3 μg of retinol or 0.6 μg of beta- Carotene), followed by F5 with 29.57 IU/100 g and F2 with 28.79 IU/100 g. Our results are similar to the published by Logue (2012), the concentrations of vitamin A in two types of cookies (chocolate peanut cookies and white chocolate-cranberry cookies) were 17 IU/100 g and 14 IU/100 g respectively. In addition, we can attribute that the increase of this vitamin in the F1, F4 and F8 is due to the contribution made by barley and carrot in the base mix.

Analysis of minerals

Data for mineral analysis of cookies is presented in Table 4. The increase in carrot substitution causes the potassium content to increase to 417.42 mg / 100g of cookie in the formulation F8. In calcium content, formulat+ion 8 had a concentration of 182.40 mg/100 g, followed by F6 with 172.31 mg/100 g and by F5 with 167.07 mg/100 g. In iron, the formulation 8 presented highest concentration with 6.88 mg/100 g, followed by F7 with 6.48 mg/100 g.

Of the results of phosphorus analysis, F 8 presented a disadvantage in relation to the other formulations, whereas F 3 had a highest concentration 382.84 mg/100 g.

In the comparison of the mineral concentration of our cookies with values of control cookies, our results showed similar and highest values.

Table 4. Mineral content in cookies

Formulation of cookies	Potassium (mg/100 g)	Calcium (mg/100 g)	Phosphorus (mg/100 g)	Iron (mg/100 g)
1 Control	132.50	135.12	242.02	5.32
2	128.94	150.43	358.21	5.00
3	46.52	140.41	382.84	6.34

4	35.00	115.50	255.41	5.25
5	78.32	167.07	231.29	5.09
6	273.92	172.31	276.61	6.09
7	86.50	160.12	228.05	6.48
8	417.42	182.40	246.18	6.88

The recommendation for sodium intake is 2.4 grams per day; therefore, salt consumption should not exceed 6.0 grams per day. The consumption of 100 g should not be greater than a sodium content of 1000 mg; this reaches approximately 50% of the recommended daily level of sodium intake (Assis *et al*., 2013).

Sensory evaluations

The results for the sensory evaluation of cookies are given in Table 5, and it is revealed that the formulation 8 (41.66% CF, 25% LF and 33.33% BF) results in different impact on sensory attributes like taste, texture, and acceptability whit scores of between 4.50 and 4.67. These values are similar to that of control (formulation 1), while, in the color there are not statistic difference.

Table 5. Sensory perception of cookies

Formulation	Color	Taste	Texture	Acceptability
1	4.43^{a}	4.43^{a}	4.43^{a}	4.63^{a}
2	4.64^{a}	3.97^{a}	3.97^{bcd}	4.0^{bc}
3	4.60^{a}	3.87^{b}	3.87^{abc}	4.37^{ab}
4	4.53^{a}	3.70^{b}	3.70^{d}	3.97^{bc}
5	4.33^{a}	3.53^{b}	3.53^{d}	4.0^{bc}
6	4.53^{a}	3.77^{b}	3.77^{d}	3.73^{c}
7	4.47^{a}	3.54^{b}	3.54^{cd}	4.44^{ab}
8	4.60^{a}	4.50^{a}	4.50^{ab}	4.67^{a}
$p \leq 0.05$	0.288	0.001	0.0001	0.0001

Different lowercase letters are significantly (p=0.05) different according to Tukey`s test

Conclusion

In conclusion, the results of this study indicate that the formulation F8 (41.66 % CF, 25% LF and 33.33% BF) cookie samples were nutritionally rich, being the first time cookies were make from the carrot, lupine, and barley flours mixture. In addition, sensory evaluation results revealed that this formulation scored highest in most of the attributes.

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