Physicochemical properties of amaranth bars snack

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Abstract

The objective of this study was to evaluate the contribution of nutrients from an amaranth bar, normally useful to be consumed as snacks. Four formulations were elaborated with different proportions of amaranth and other ingredients commonly used in this type of products. The obtained results indicated that the formulations F2 and F3 were the preferred ones by the evaluating panelists, after which paired preference tests were carried out to define which of the bars would finally be the preferred one and analyzed in this study. The chemical composition of the bar (F2, chosen preferred) showed that it has a contribution of 10% protein, 12% of lipids and 69% of carbohydrates, having a caloric intake for each 100 grams of 424 kcal.

Key words: Amaranth, energy bars, snacks.

1. Introduction

The amaranth (Amaranthus spp) (eternal, enduring "Greek") is a pseudocereal that is little more than 70 genera and that has long been part of the basic products used in human nutrition, managing to persist as part of agriculture traditionally from countries such as Mexico, Ecuador and Bolivia. At present, there is a renewed interest in its cultivation due to the potential that it presents in the elaboration of new food products, its nutritional benefits and its agricultural advantages (Sánchez 2000). At present, they are used for the production of grains mainly of species namely: A. cruentus, A. caudatus. and A. hypochondriacus. The amaranth plant produces a small, smooth and shiny seed 1.0-1.5 mm in diameter, slightly flattened. Wild species have black grains with very hard episperm (Chagaray 2005). Many of the amaranth species are popularly known as "bledo", since their seeds are tiny and seem insignificant. In the indigenous communities of Peru, the amaranth is called "Kiwicha", the Venezuelan Caribbean, known as "Caracas", and the name of the tribe settled in the Valley of Caracas. "Pira" which means pea or legume (vegetable) in cumanagoto voice. There are other names and vulgar names such as: Amaranth (Spanish); Amaranth (English), Achita (Ayacucho, Peru), Coyo (Cajamarca, Peru), Achis (Huaraz, Peru), Coimi, Millmi and Inca pachaqui or Inca grain (Bolivia), Sangorache, Ataco, Quinua de Castilla (Ecuador), Alegría and Huanthi (Mexico), Rejgira, Ramdana, Eeerai (India) (Mujica et al., 1997). The amaranth has a high nutritional value standing out within this, a protein content that ranges between 15 and 20 g / 100 grams; Its amino acid content is of high biological value, in particular because of its lysine content (Bressani, 1994, Betschart et al., 1981). The report was published in the scientific report that in the future, has been suggested for use in human nutrition, as well as in whole or expanded grains (TT), or in the form of flours, which have been prepared from the grains or leaves, or the plant in general; with these by-products breakfasts, desserts (bars, panels), energy bars, nougat, granola and even “arepas” are made with the base of precooked cornmeal. In this sense, it can be said that

the development of foods with the use of amaranth is a viable option for the population given that its dissemination is easy, simple and economical, in addition to the excellent nutritional contribution that consumption represents. The objective of this research has been to evaluate the nutritional contribution of energy bars based on amaranth grains.

2. Material and Methods

2.1. Raw material

The amaranth plants used in this study were harvested according to a completely randomized statistical model (COVENIN 612-82). Among the variables considered for the choice of plants were: plant age (3 to 4 months), plant size (between 1 to 2 meters high), panicle density (between 2 and 4 panicles / plant). The plantation chosen for this study was located specifically at Latitude: 10 ° 33'56 "N and Longitude 66 ° 53'31" W or what is the same in the town of Galipán, Manzanares sector of El Nacional Park Ávila, Vargas state, Venezuela.

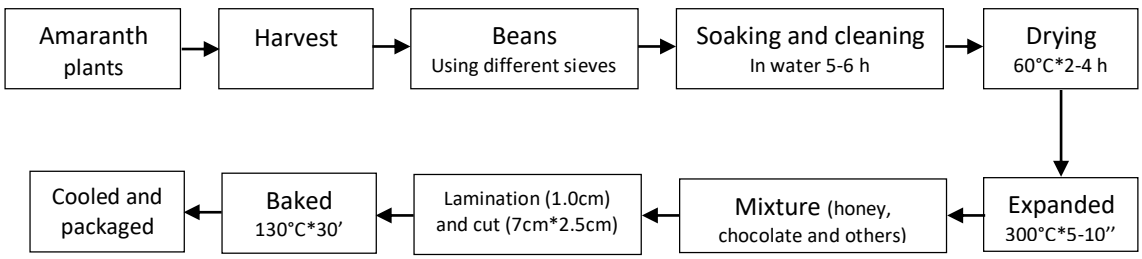
2.2. Preparation of the energy bar

Snack bars were prepared using different proportions of ingredients: amaranth grains (AG), dark chocolate (DC), honey (H), dehydrate fruits (DF) (pineapple, banana), and additive (A) (for stabilizer), according to show in Table 1. In the mixture design, proportions of ingredients must sum to 1.

Table 1. Major components of the four amaranth bar formulation

Ingredients	F1	F2	F3	F4
AG	0.26	0.26	0.21	0.21
DC	0.18	0.18	0.12	0.13
H	0.26	0.26	0.21	0.20
DF	0.24	0.24	0.40	0.40
A	0.06	0.06	0.06	0.06

The amaranth grains for the elaboration of the bar were expanded, this grain was made according to Carpio (2009) with modifications (soaking phase). The amaranth grains were placed in direct contact with a Teflon surface heated to 300 °C for a time of 5 or 10 seconds, or until observing that most of the grains expanded and the sound of the expanded was no longer heard. Once the grains were expanded, the bar was elaborated mixing all the ingredients. The ingredients were weighed according to the formulation to obtain the bar. The estimated weight of the bars was 25 grams. The Figure 1, show the process.



The product was stored at 25 °C until used for further analysis. Then the samples were used within 1–2 weeks for chemical composition, for the sensory test, the bars were elaborated one day before.

2.3. Selection of best formulations

Sensory evaluation was conducted using 30 students from central university of Venezuela (Caracas, Venezuela). an affective test was used making use of a verbal hedonic scale of 9- points, to evaluate the level of liking or dislike that the participants had about the 4 elaborated formulations. Once this test was concluded, an equality between two formulations was obtained, for which a paired preference test was applied. Finally, the bar formulation that was the winner was analyzed, yielding the results presented in this study. This determination was made according to the methodology proposed by Toricella et al. (2007), using a hedonic scale of nine points.

2.4. Chemical and physiochemical analysis

Proximate composition: moisture (method 925.10), lipid (method 920.39), ash (method 923.03), and nitrogen (method 920.87) was performed in agreement with AOAC (2000). Carbohydrates were determined by difference. pH (AOAC 934.02), Titrable acidity (AOAC 934.02) and water activity (AOAC 978.18)

2.5. Profile of Sugars

It was determined according to the AOAC methodology 982.14 (1990) and YMC HPLC column catalog (2005-2006).

2.6. Fatty acid profile

was determined in the form of methyl ester derivatives solubilized in hexane by ISO 5909 (ISO 5909:2000), in a Gas Chromatograph (GC) Perkin Elmer model Clarus 500, with flame ionization detector (FID), with autosampler injector. Column: Supelco 2560 (100m, 0.25mm, d.i. 0.2μm) and working conditions A.O.A.C 996.06 (2000) modified: Gas arc: Hydrogen at 30 psi. Flow rate: 1.1 mL / min, Detector temperature: 250 ° C, Injector temperature: 225 ° C, 1 μL of sample. Heating ramp: 100 ° C 4 min, increase up to 240 ° C at 3 ° C / min, and 240 ° C for 10 min. The identification was made through the use of a standard reference standard of Supelco 189-1 methyl esters. The areas integrated with the Tutorial Totalchrom Version 6.2 software and the quantification by means of the area normalization method (COVENIN 2281, 2002).

2.7. Statistical Analysis

Data were expressed as mean ± standard deviation (SD). The statistical analysis was performed using the statistical package SPSS version 17, for Windows 2007.

3. Results and discussion

3.1. Sensory evaluation

The panelists showed to have a 34% preference for the formulations 2 and 3 (F2 and F3). These formulations differ in their composition, F3, for example, has a ratio of amaranth and dark chocolate superior in 11% with relation of F2. However, F2 has a 16% higher proportion in dehydrated fruits. As for honey, F2 had a content 5% higher than F3, which contributed to that this bar had a slight pleasant sweet taste. The preference of F3 was possibly favored by the mixture of

flavors contributed by the dehydrated fruits. The sensory evaluation of the amaranth bar snack in the attributes of appearance, texture and taste on a hedonic scale from 1 to 9, it was found that for the appearance attribute, a percentage of 33.3% of the people that comprised the panel, neither liked or disliked the appearance of the product, 30% liked it slightly and 23.3% liked it moderately, on the other hand, 13.3% disliked the appearance of the bar. These results show that in terms of the appearance attribute there were different opinions, fact that could be influenced by the typical coloration of this bar based on the luminosity coordinates (L *) of the expanded grains (25,37), which indicates an intense tonality towards black colors, the same as once with the presence of dark chocolate (75%) also obtains certain brown colorations. It is important to note that the presentation of food with this type of coloration causes subjectivity, since the consumption of an bar with such dark colorations is not common, since bars are generally made from cereals (corn, rice, oats) and nuts (peanuts, almonds, merey, pistachio, nuts) which tend to have a coloration based on their luminosity (L *) greater than 60, that is, light tones. The texture attribute found that the product had greater acceptance, finding that 40% of the panelists moderately liked the texture of the bar, 33.3% liked it very much and 23.3% liked it slightly; only 3.3% was neutral. Even though the texture of the bar could have been improved with the use of untreated grains, they caused a feeling of grittiness in the mouth when chewed, which tends not to be palatable by consumers. The flavor attribute showed the greatest acceptance, where 36.7% of panelists liked the taste of the bar, 33.3% liked it moderately and 30% liked it slightly, not finding negative opinions with respect to it. to this attribute, this accords with what was initially described based on the ingredients employed in the preferred formulation.

When performing the paired preference test, the total of preferences obtained was analyzed by chi-square, obtaining with a level of significance of 0.5% that F2 is the preferred formula.

Chemical composition

The moisture content (Table 2) of the energy bar was 6%, this is because the bars once prepared were subjected to a dehydration process (24 hours at 45°C), in which the largest amount of water present is eliminated initially, which comes mainly from honey whose moisture content is between 13 and 17% (COVENIN 2136-84) and glycerin added 85% (FEDNA 2012). The expanded amaranth, dehydrated fruits and dark chocolate (75%), have low moisture content and its contribution of water in the energy bar is negligible. There are reports (Aptonia, Energy Cake, Enervit, and Power Bar) of moisture content between 5 and 11%.

Table 2. Chemical composition of the amaranth bars selected as best formulation

	F4
Protein (g/100g)	10.34 ± 0,13
Lipids (g/100g)	12.13 ± 0,40
Carbohydrate (g/100g)	69.03 ± 0,55
Energy* (kcal)	424
Ash (g/100g)	2.65 ± 0,02
Moisture	5.85 ± 0,14
% Glucose	11.76 ± 0,03

% Fructose	9.88 ± 0,08
% Sucrose	9.62 ± 0,04
pH	6.30 ± 0,03
Titrable acidity	0.09 ± 0,01
water activity (a_w)	0.52 ± 0,03

* Energy (kcal) was calculated using the Atwater factors on a 100 g basis. Each value represents the average of two independent experiments by triplicate ± standard deviation

The low moisture content of the energy bar provides physicochemical and microbiological stability to the product, causing the reduction of water available for metabolic activity of microorganisms. The bar had a crude protein content (10.34%) according to what is reported commercially, highlighting that this protein content is contributed mainly by the amaranth grains used (18% protein), this indicates that it is feasible to use this type of material premium for the development of energy bars. The bar showed a raw fat content according to what is reported commercially, said content is mainly contributed by dark chocolate (35% crude fat), which indicates that said bar could have an interesting fatty acid intake, given the known ones nutritional benefits of cocoa butter, the total carbohydrate content showed values around 70%, which guarantees a forceful contribution of energy easily metabolizable and usable during intense regimes of physical effort. The evaluation of the content of sugars were obtained significant glucose, fructose and saccharose contents, said sugars that are associated with the use of honey, which is the ingredient in our formulation that, with the highest contribution of sugars, among them the monosaccharides fructose and glucose. Dark chocolate naturally does not have a large amount of sugars, but sucrose is added in its formulation to increase its sweetness, therefore, the added chocolate could be contributing a high value of this disaccharide in the bar. It is worth noting that glucose, fructose and sucrose are sugars of rapid absorption, and being present in high proportion in the energy bar formulated, they cause a rapid supply of energy by ingesting the bar. It was found that the energy bar has an interesting contribution of saturated fatty acids (57.10%), followed by monounsaturated (34.94%) and finally polyunsaturated (5.74%), this result (see in Table 2) is of great nutritional interest because the studied energy bar presents acids fatty acids that are essential in the diet and that therefore give an added value to the bar under study, considering that the raw materials that make this contribution are vegetables and therefore neither trans fatty acids nor the presence of cholesterol are registered in said bar.

Table 2. Fatty acid profile in the amaranth bar

Fatty acid (FAME)	Name	% (p/p) AG
C16:0	Palmitic	**24.65**
C18:0	Stearic	**32.45**
C18:1 (cis-9)	Oleic (omega 9)	**34.94**
C18:2 (cis-9,12)	Linoleic (omega 6)	**5.74**

Conclusion

The previous results showed that it is feasible to obtain a snack-type amaranth bar, with a significant contribution of nutrients. which can be used for feeding regimes of healthy consumers and with special feeding regimes as athletes.

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