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PREPARATION AND SENSORY EVALUATION OF BISCUIT BASED ON YELLOW PITAHAYA PEEL FLOUR (SELENICEREUS MEGALANTHUS) FLAVORED WITH BASIL (OCIMUM BASILICUM) AND ROSEMARY (ROSMARINUS OFFICINALIS)

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Abstract. This research was done in order to provide humans with natural and nutrient-rich products. The objective is the fortification (sensory) of the classic wheat flour with flour from the yellow pitahaya peel, because this fruit is of high nutritional value. In Ecuador there is enormous production of rosemary and basil, however, little consumption, these raw materials were applied a technological process such as dehydration (hot air drying). For the preparation of the biscuit, 3 formulations with different dosages of aromatic herbs were used: (T1, T2, T3) containing T1: 15% HP, 5% A and 5% R; T2: 15% HP, 7% A and 3% R; T3: 15% HP, 3% A and 7% R, where the percentage of the flour of the pitahaya shell is maintained, which changes are the percentages of the flavorings, which is basil and rosemary. The sensory evaluation was performed using a 4-aspect hedonic scale by a panel of 30 untrained evaluators who scored from 1 (I dislike it) to 4 (I like it very much). The properties evaluated are: color, texture, flavor and aroma in the 3 treatments achieved. A (DBCA) completely randomized block design was applied in the 3 treatments and 3 repetitions, with a study of variances and Tukey's test at 5% probability. The results showed that the T2 treatment (15% HP, 7% A and 3% R) has the highest agreement due to the evaluators, for which a microbiological and physical study was carried out.

Keywords: Yellow pitahaya, cracker, sensory attribute, rosemary, basil.

ELABORACIÓN Y EVALUACIÓN SENSORIAL DE GALLETA A BASE DE HARINA DE CÁSCARA DE PITAHAYA AMARILLA (SELENICEREUS MEGALANTHUS) SABORIZADA CON ALBAHACA (OCIMUM BASILICUM) Y ROMERO (ROSMARINUS OFFICINALIS)

Resumen. Esta investigación se hizo con la finalidad de brindar al ser humano productos naturales y ricos en nutrientes. Como objetivo la fortificación (sensorial) de la harina de trigo clásico con harina de la cascara de pitahaya amarilla, debido a que esta fruta es de alto valor nutricional. En el Ecuador existe enorme producción de romero y albahaca, sin embargo, poco consumo, a estas materias primas se les aplicó un proceso tecnológico como es la deshidratación (secado de aire caliente). Para la preparación de la galleta se usaron 3 formulaciones con diferentes dosificaciones de hierbas aromáticas: (T1, T2, T3) conteniendo T1: 15% HP, 5% A y 5% R; T2: 15% HP, 7% A y 3% R; T3: 15% HP, 3% A y 7% R, donde se mantiene el porcentaje de la harina de la cascara de la pitahaya lo cual cambia son los porcentajes de los saborizantes que es albahaca y romero. La evaluación sensorial ha sido ejecutada utilizando una escala hedónica de 4 aspectos por un panel de 30 evaluadores no entrenados que calificaron del 1 (me desagrada) al 4 (me gusta mucho). Las propiedades evaluadas son: color, textura sabor y aroma en los 3 tratamientos conseguidos. Se aplicó un (DBCA) Diseño de bloque completamente al azar en los 3 tratamientos y 3 repeticiones, con estudio de varianzas y prueba de Tuckey al 5% de probabilidad. Los resultados mostraron que el tratamiento T2 (15% HP, 7% A y 3% R) tiene el más grande asentimiento a causa de los evaluadores por lo cual se le realizo estudio microbiológico y físico.

Palabras clave: Pitahaya amarilla, galleta, atributo sensorial, romero, albahaca.

Introduction

Cookies are defined as a versatile and perishable food obtained by adding ingredients such as wheat flour, water, salt, sugar, fats, and enriching ingredients that provide proteins, complex carbohydrates, fiber, vitamins, and minerals in low quantities (1). The combination of a cereal with organic waste and aromatic herbs has made it possible to have fortified foods for human consumption with high nutritional value (2). The shell of the yellow pitahaya is an organic waste that is not used for industrialization because it contains nutrients such as calcium, phosphorus, iron, and dietary fiber that facilitates nutritional transit (3).

Wheat flour is one of the staple foods for many countries and among the most important cereals in Ecuador due to its high consumption in products such as bread, biscuits, noodles, etc. Ecuador is being very dependent on imports; internal import requirements are at 98%, while local production is 2% (4).

The wide variety of foods available to the population, which are consumed as fresh food or used as raw material to obtain new agro-industrial products. However, the mixture of a cereal with fruits and aromatic herbs made it possible to have fortified foods for human consumption, with a correct balance of nutrients and important amino acids (5).

Despite the fact that the combination of foods is a source of relevant nutrients, important portions of different fruits, vegetables, cereals, pseudo cereals, aromatic herbs are used, that is, they are not exploited to their full potential. Among these are mentioned certain native foods in the coast and highlands such as quinoa, amaranth, rosemary, basil, also bearing in mind that organic rejects such as the yellow pitahaya husk are not exploited and industrialized (6).

Man has depended on plants throughout his history to take care of his health. Nowadays, it is very difficult to find references to the first uses of medicinal plants in prehistoric times (7). The rosemary plant has had a very important weight throughout history due to its tributes and diversity of minerals such as potassium, calcium, iron, and vitamins B6; it is a refreshing digestive, a depurative, decongestant, tonic, and stimulant (8).

Basil is a natural pain reliever and relaxant. The oils contained in the fiber of its leaves contribute to alleviate the effects of arthritis and are curative for the joints. These leaves are an intestinal anti-inflammatory and favor the correct functioning of the urinary system and are an excellent insect repellent (9). In Ecuador, bibliographic information on basil and rosemary production, industrialization, and consumption is still scarce. Nevertheless, in the universal field, the tendency of its consumption and production shows a sustained growth throughout the last decades (10).

In Ecuador, there is a great variety of fruits that are not commercialized or known in the local and international market, as is the case of Pitahaya (11). The relevant reasons for its consumption are the properties attributed to its use, such as nutrients, minerals, and vitamins (12).

The objective of the population is to lead a healthy life by consuming natural products rich in nutrients. Currently, the processing of by-products, such as cookies, has been included with the intention of taking advantage of the dietary fiber present (13).

Dehydration is one of the oldest forms of food preservation and its objective is to eliminate most of the moisture from the products. Dehydrated foods retain a large proportion of their nutritional value if the process is carried out properly (14).

Flours in the food industry represent an important raw material for obtaining many foods and are generally made from barley, corn, or wheat. Their process consists of milling the grain, but dehydrated milled fruits are currently being used as an alternative to conventional flours (15).

These factors were considered at the time of conducting this research, which pursued the following objectives: to produce a high-quality cookie with attractive organoleptic characteristics obtained from pitahaya peel flavored with different percentages of basil and rosemary. To estimate consumer acceptance with information obtained through a panel of evaluators, to carry out microbiological analysis of the cookie obtained with the highest sensory acceptance.

Method

Location of research

The research was carried out at the facilities of the pilot plant of the Faculty of Agricultural Sciences of the Agrarian University of Ecuador, Milagro campus, located at coordinates 2°8.042' S south latitude and 79°35.649' W west longitude.

Product formulation

Three products were developed (T1, T2, and T3), whose independent variables were the amount of dehydrated aromatic herbs, such as rosemary and basil (Table 1). The dependent variable was the microbiological characteristics. Three replicates were carried out for each treatment under the same conditions. For the statistical analysis of the data, a completely randomized complete block design (CRBD) was used.

Treatments

Table 1. Formulation for the production of traditional cookies.

	PRODUCT		
Ingredients	**Witness g**	**Unit**	**Absolute % Absolute**
Wheat Flour	400	g	45. 97 %
Pitahaya Flour	00	g	00 %
Basil Leaves	00	g	00 %
Rosemary Leaves	00	g	00 %
Lard	200	g	22,99 %
Butter	50	g	5,74 %
Sugar	200	g	22,99 %
Salt	20	g	2,29 %
Total	870	g	100 %

Based on the traditional formula, we will consider the total wheat flour as 100% of the wheat flour in the formula, and on this we will work the difference in the percentages of the yellow pitahaya shell flour and the aromatic herbs.

Table 2. Treatment 1. Formulation for the production of cookies.

	PRODUCT		
Ingredients	**T1 g**	**Unit**	**Absolute % Absolute**
Wheat Flour	300	g	75 %
Pitahaya Flour	60	g	15 %
Basil Leaves	20	g	5 %
Rosemary Leaves	20	g	5 %
Total	400	g	100 %

Table 3. Treatment 2. Formulations for cookie production.

	PRODUCT		
Ingredients	**T2 g**	**Unit**	**Absolute % Absolute**
Wheat Flour	300	g	75 %
Pitahaya Flour	60	g	15 %
Basil Leaves	28	g	7 %
Rosemary Leaves	12	g	3 %
Total	400	g	100 %

Table 4. Treatment 3. Formulations for cookie production.

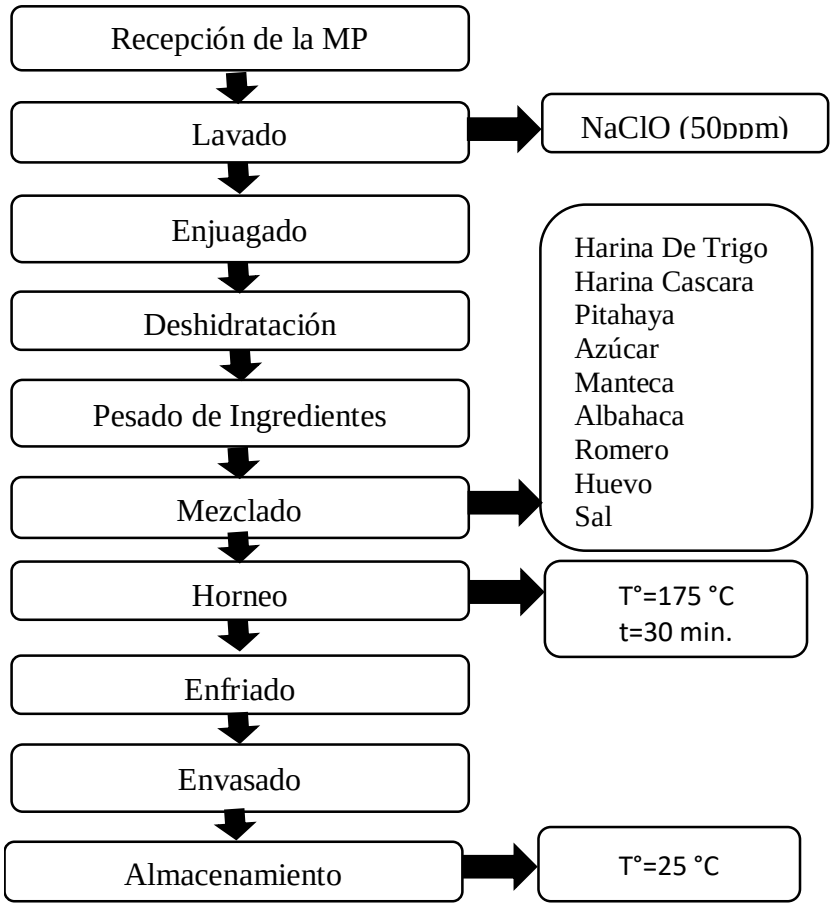
	Product		
Ingredients	**T3 g**	**Unit**	**Absolute % Absolute**
Wheat Flour	300	g	75 %
Pitahaya Flour	60	g	15 %
Basil Leaves	12	g	3 %
Rosemary Leaves	28	g	7 %
Total	400	g	100 %

The sensory evaluation of the treatments was carried out by a panel of untrained evaluators for the 3 formulations. The evaluators were students of the Agricultural Engineering career, agro-industrial mention, Milagro campus, of both sexes, between 18 and 25 years of age. Each panelist was trained based on the hedonic evaluation of 4 points of view that they applied to all treatments, and were given a glass with water, samples of each cookie, and an evaluation form. The water was used to rinse off any residue after each tasting. The data obtained were evaluated using the INFOSTAT statistical program.

Obtaining the product

The process is briefly explained in Figure 1. The materials used were selected based on their quality. The yellow pitahaya, basil, and rosemary hulls were washed using a solution of sodium hypochlorite (50 ppm concentration), then rinsed with pasteurized water. Then, the yellow pitahaya peel was dehydrated at a temperature of 53 °C for 23 hours, after which the peel was milled to obtain a good quality flour. In addition, the rosemary and basil leaves were dehydrated at a temperature of 53 °C for 5 hours, then the raw materials to be used were weighed, once the materials were weighed, the elements were mixed for the preparation of the cookies, Afterwards, the cookies were baked at a temperature of 175°C for 30 minutes. Finally, the product was cooled for its respective packaging in polyethylene bags, the cookies were stored at room temperature from 24 to 28°C, having a shelf life of 9 days for consumption.

Figure 1. Flow diagram of the cookie manufacturing process. [Source: Own elaboration.]



Results

The pitahaya shell flour was obtained by dehydration, which consisted of a gradual increase in temperature to reduce the water in the food. The main factors involved in dehydration were time (23 hours) and temperature (53 °C), in a tray dehydrator, followed by milling to reduce sizes and thus obtain a good quality flour.

For aromatic herbs, it was obtained by dehydration, which consisted of a gradual increase in temperature with a time of (5 hours and temperature of (53 °C), in order to eliminate the water from these leaves.

The butter type cookie was made with 3 formulations of different dosages of basil, 20g, 28g and 12g; and of rosemary, 20g, 12g, and 28g, keeping the same quantity of the pitahaya shell flour that is observed in tables 1, 2, and 3. The industrial type equipment used for the elaboration of the cookie was a laminator whose function was to lengthen the dough and stretch it, it is composed of metal rollers whose advantage is to increase the warmth of the product and decrease the physical effort. In relation to the INEN 2945 norm, it complied with the established or stipulated requirements, the organoleptic part, specifically the external aspects, complied with the characteristics according to the different formulations and dosages of the pitahaya shell flour.

Table 4 shows the results of the sensory evaluation carried out on 30 untrained evaluators. The cookie made with flour obtained from pitahaya husk flavored with aromatic herbs has a good acceptance mainly in the characteristics of flavor, odor, color, and texture where there is no significant difference in the treatments.

Table 5. Sensory analysis results.

Answer Option		Features				Total
		Taste	Odor	Color	Texture	
Treatment 1	I like it very much	10	13	15	19	57
	I like it	14	12	8	10	44
	I do not like it	5	4	5	1	15
	I dislike it	1	1	2	0	4
Treatment 2	I like it very much	**16**	**17**	**21**	**24**	**78**
	I like it	12	11	6	5	**34**
	I do not like it	2	2	3	1	**8**
	I dislike it	0	0	0	0	**0**
Treatment 3	I like it very much	11	12	13	19	55
	I like it	13	13	10	10	46
	I do not like it	4	1	5	1	11
	I dislike it	2	4	2	0	8
Total		**90**	**90**	**90**	**90**	**360**

Table 5 shows a comparison between treatment 1, treatment 2, and treatment 3 of the averages with respect to flavor, which have a great acceptance. Differences are evident in the results of table 4 between treatments 1, 2, and 3 in each of the attributes. And, for this reason, the second treatment was the accepted one. Therefore, the microbiological and physical analysis was carried out.

Table 6. Results of microbiological and physical analysis.

Parameters	**Unit**	**Results**	**Requirements**	**Methods**
Total coliforms	CFU/g	1×10^1	1×10^2 CFU/g	NTE INEN 1529-10
Staphylococcus aureus	CFU/g	<3	<3 CFU/g	NTN INEN 1529-6
Molds	CFU/g	Absence	.....	NTN INEN 1529-6
Humidity	%	9,13 ± 0.10	12	INEN ISO 6496
Ash	%	13,92 ± 0.11	24	INEN ISO 5984

Table 6 shows the microbiological and physical results where they are within the permitted range, according to the INEN standard.

Discussion and conclusions

Currently, it has been possible to make several partial substitutions of wheat flour for other types of flours to produce biscuits, bakery products, noodles, for example: soy, breadfruit, spinach, rice, chickpea, banana, etc.

According to Barreto (16), "in which he elaborated a gourmet bread based on chickpea and wheat flour" was incorporated, basil with improved nutritional qualities with percentages of wheat flour substitution in: 25%, 50%, and 75% of chickpea flour and 100% wheat flour, the formulation that obtained better results in the nutritional part was 25% wheat flour and 75% chickpea flour presenting high protein, minerals (potassium, magnesium, calcium, phosphorus, and iron) ethereal extract and crude fiber. While this study of cookie with the yellow pitahaya shell flour treatment 2 of 300 g of wheat flour corresponding to 75% and 100 g of the remaining 25% (100 g) is divided into three sections, first section which is 15% (60 g) of the yellow pitahaya shell flour, 7% (28 g) of basil and 3% (12 g) of rosemary.

According to Cabrera (17), where they elaborated cookies with freeze-dried vegetables, the result of the analysis had an increase in the nutritional, physicochemical and sensory attribute of the product. In addition, since most of the vegetables have inside antioxidant in a natural way, with them the oxidation of the cookie was diminished, it had a procedure of dehydrated in this situation the lyophilization, perfecting the characteristics of color and smell. As results of the analysis showed that the cookie with flour obtained from the yellow pitahaya shell and the combinations of aromatic herbs, such as basil and rosemary increased its organoleptic property because they were subjected to dehydration at drying temperature to preserve the aroma of freshness since, in the sensory evaluation, the third procedure comparatively with the above mentioned obtained similar results in color and texture.

According to Silva (18), in which several percentages of wheat flour were replaced in 20, 15, and 10% by soy flour and soluble fiber, by means of the sensory study, the consumer's favorite was selected, and then the nutritional characteristics of the cookie were evaluated. After making the sensory research the formula chosen by the panelists has been the one made with 20% soy flour and 80% wheat flour. The preferred scoring components were texture, color, and flavor, while the smell was not so much liked by the panelists, taking as an allusion the INEN rule (19), Venezuela COVENIN 226-88. In what for this analysis the element of approval has been the smell, in procedure 1 of 60 gr of yellow pitahaya shell flour, 20 gr of basil, and 20 gr of rosemary because the color had assent in the 3 treatments.

According to Tapia (20), whose research was based on "obtaining cookies with partial substitution of chontaduro flour (Bactris gasipaes Kunth)" and the percentage of substitution has been in wheat flour of 5, 10, 20% by chontaduro flour and wheat flour at 100%. In the sensory analysis, the formulation that had the highest level of acceptability was the 5% of chontaduro flour, among the attributes of pleasure were flavor, color, texture, after the physicochemical analysis was made, and its nutritional benefits were known, there was a growth in humidity, in the results of protein reduced the proportion of the same compared to the one elaborated with wheat flour at 100%, and the fat content grew in the chontaduro bread. Meanwhile, in this analysis the cookie with flour obtained from the yellow pitahaya shell and the combinations of aromatic herbs in procedure 2 of 75% wheat flour, 15% of pitahaya shell flour, 7% of dehydrated basil, and 3% of dehydrated rosemary have had similar results in the sensory part, and, in the microbiological part, the results have been within the established parameters.

In the same way, a comparative analysis is made with the standard under the parameters of microorganisms that is assimilated to the analysis made by the laboratory generating the microbiological parameters; whose results are favorable since it is seen the compliance that they are within the parameters in the same way the mold is analyzed in which in the analysis they maintain absenteeism. According to Arando (21), indicates that, from the compositional analysis, digestibility tests and microbiological quality of this compared with a conventional raw material, such as fish meal; corresponding to the quality control of food and ingredients for animal consumption, with counts of aerobic mesophiles, total coliforms. According to Ramos (22), the study carried out with insects' proportion of conventional raw materials that have antibacterial substances; and, therefore, the possibilities of pathogenic microorganisms are limited. Microbiological quality indicators provide timely warning of inadequate handling or contamination that increases the risk of the presence of pathogenic microorganisms in food (23).

From the present analysis it can be concluded: 3 types of cookies containing different percentages of basil and rosemary were formulated and elaborated; the products presented attractive and innovative organoleptic properties for the consumer; it is recommended to carry out an investigation using the yellow pitahaya shell flour as an alternative for animal feed.

Sensory acceptance was evaluated by an untrained panel for the three cookie formulations. In general, the degree of acceptance of the three cookies was quite satisfactory. The cookie of treatment 2 with 300 grams of wheat flour, 60 grams of flour obtained from the yellow pitahaya shell, 28 grams of basil, and 12 grams of rosemary in its composition, which in total gives 400 grams, 75% of wheat flour, and the remaining 25% is derived from 15% flour from the pitahaya shell in combination with 10% of aromatic herbs, deriving 7% in basil and 3% in rosemary. In the microbiological and physical analyses, the results obtained for mold, total coliforms, Staphylococcus aureus, humidity, and ash are within the parameters established in NORMA INEN; and, therefore, the product is safe and suitable for the consumer.

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