

SENSORIAL QUALITY OF BREADS AND COOKIES PREPARED WITH FLOUR FROM THE SHELLS OF TWO VARIETIES OF COCOA IN ECUADOR

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ABSTRACT

This research is carried out as an alternative for the bakery industry when looking for new sources of vegetable flour to be used in the preparation of breads and cookies, because the wheat production in Ecuador is not enough. On the other hand, the cocoa industries in the country produce a high quantity of cocoa shells that are considered as agroindustrial waste, which come from the two main varieties of cocoa, Nacional Arriba and CCN51. That is why, as a product of the grinding of these husks, flour was obtained that was used for the production of breads and biscuits with different dosage percentages based on various bibliographical sources and the authors' own experiences. In the case of the breads, the dosage used was 10% and 20%, while for the cookies a dosage of 70% and 80% was applied. Both the breads and the cookies were evaluated for their sensorial quality, by means of untrained judges using a hedonic scale from 1 to 5. The results confirm a high sensory quality in the cookies compared with the sensory quality obtained in the breads.

Keywords: baked products, cocoa Nacional Arriba, cocoa CCN 51, flour, sensorial characteristics

1. INTRODUCTION

The cocoa sector is one of the most important in the world, according to the information published by The World Cocoa Foundation (WCF, 2013), who confirmed that there are between 5 and 6 million cocoa farmers, in addition to 40-50 million people who depend on the cocoa sector around the world. In Ecuador there are 2 cultivated varieties of cocoa: Nacional Arriba, which is fine or aroma cocoa (native to Ecuador) and clone-type cocoa developed in the country, Castro Naranjal Collection (CCN 51).

The shells of the two varieties of cocoa are considered as agroindustrial waste when they are generated by the manufacture of cocoa byproducts, being that these husks represent approximately 12% of the weight of the roasted cocoa beans according to the data of Cuesta (2008).

Taking into consideration the current trend to change the productive matrix of Ecuador, related to the national plan of good living (2013-2017), one of the main axes is "to encourage exports of new products, from new actors, particularly the popular and solidary economy, or that include greater added value - fresh and processed foods".

In this way, it is considered that this policy will lead to an increase in the amount of agroindustrial waste, in the form of husks, in the case of cocoa.

On the other hand, the bakery industry in Ecuador is growing, according to data from the Ministry of Industries and Productivity (2013). The Ministry and the National Development Bank (BNF) granted new loans within the Renova Bakery Program, which so far has delivered more than USD 5.5 million to 829 breadmakers. Regarding the cookies industries, according to the data of the Export and Investment Promotion Institute (PRO ECUADOR, 2012) in 2012, the consumption of cookies in Ecuador grew 5.2% to US \$ 224 million.

Based on this information, the present research work was carried out in which the shells of both varieties of cocoa were used to make flour, which was dosed with wheat flour for the preparation of breads and cookies. Finally, the sensory quality of both products was analyzed to identify which of them would have better acceptance for their consumption.

2. MATERIALS AND METHODS

2.1. Materials

The shells of the two different varieties of cocoa were taken from 2 cocoa industries in the province of Guayas, the selection criteria of these two factories being the ease and flexibility given by their officials to take the samples, obtaining a variety for each industry. The samples of each variety of cocoa were taken from five different lots for each industry, making the milling of the husks with an ® Oster mill to obtain the flour. For the elaboration of each bread formula, 3000 g of the flour were separated for the breads and cookies. Each bread or cookie formula was made with three repetitions.

The proportion based on the dosage of the flour from the cocoa shells, with respect to the wheat flour, was carried out with two different percentages (10%, 20% of cocoa shells for bread making and 70%, 80% for cookies making) with three repetitions for each product.

The formulation of the bread were coded as P1 to P4 and as G1 to G4 for the cookies, The formulation: P1, refer to bread made with 20% of flour coming from the cocoa Nacional Arriba shells, P2 refer to the bread made with 10% of flour coming from the cocoa Nacional Arriba shells, P3 refer to the bread made with 20% of flour coming from the cocoa CCN51 shells and P4 refer to the bread made with 10% of flour coming from the cocoa CCN51 shells.

For the cookies, the formulation: G1, refer to cookies made with 80% of flour coming from the cocoa National Arriba shells, G2 refer to the cookies made with 70% of flour coming from the cocoa National Arriba shells, G3 refer to the cookies made with 20% of flour coming from the cocoa CCN51 shells and G4 refer to the cookies made with 10% of flour coming from the cocoa CCN51 shells.

After the preparation of the baked products, the sensory characteristics were analyzed to select the best product.

In order to carry out the sensorial analyzes, determining the organoleptic quality of the bread and cookies made with cocoa shells flour, a panel of 30 untrained people was used (they are not trained judges for the organoleptic analyzes), and a sensory evaluation was applied. Hedonic scale, from "I like a lot" to "dislike a lot" with numerical scale from 1 to 5, where 5 corresponds to "I like a lot" and 1 corresponds to "I dislike a lot".

For the sensory evaluation of the bread, each judge was provided with 4 bread samples, each sample of approximately 60 g, and the judges were asked to evaluate the Color, Flavor, Odor, and Texture of each sample and record their evaluations according to the sensory attributes aforementioned.

The same process was used for the evaluation of the cookies, where each judge was provided with 4 cookies of approximately 15 g each and was asked to evaluate the same attributes mentioned above.

Both the bread samples and the cookies were coded to guarantee the reliability of the processes and their results.

The analysis of the results of the sensory tests was carried out through the determination of the analysis of variance, through the statistical program INFOSTAT student version 2014. The variance coefficients for each attribute were analyzed by comparing the variability between the different formulas of each product and the higher the value, the greater the variance.

3. RESULTS AND DISCUSSION

3.1. Results of the sensory analysis of the breads

As it can be observed in the Table 1, the breads made with the flour dosage of the National Arriba cocoa shells, with a percentage of 20% and codified with the code (P1), there was no evaluation by the judges on the scale of "I dislike a lot" for none of the sensory attributes.

It was also obtained, a single vote for "I dislike moderately" and 14 evaluations for "I am indifferent".

On the other hand, 53% of the evaluations were for the highest category in the questionnaire and 34% for the scale of "I like moderately", 13% of the evaluations were assigned for the other scales.

The results of the sensory analysis of the breads made with the 10% dosage, of the same flour and codified with the code (P2), there were 17 evaluations by the judges in the scales of "I dislike moderately" and another on the "I dislike a lot" scale. However, there were 38 votes on the "I am indifferent" scale. In total, 23% of the evaluations of the four attributes were for the highest scale (I like a lot), 30% for the category "I like moderately" and 47% of the evaluations were assigned for the other scales.

With respect to the sensory analysis of the breads made with the dosage of 20% flour from the CCN 51 cocoa shells (Table 2), codified with the code (P3), there was an evaluation by the judges in the scale of "I dislike moderately", one on the scale of "I dislike a lot" and 21 votes on the "I'm indifferent" scale. In total, 46% of the evaluations of the four attributes

were for the highest scale (I like a lot), 34% for the "I like moderately" scale and 20% of the evaluations were for the other scales.

Table 1. Results of the sensory analysis of the bread made with flour from the National Arriba cocoa shells.

Attribute	I like a lot	I like moderately	I am indifferent	I dislike moderately	I dislike a lot
Bread made with 20% of flour from the National Arriba cocoa shells					
Color	15	12	2		
Flavor	16	7	4	1	
Odor	15	12	5		
Texture	18	10	3		
Total	64	41	14	1	
Bread made with 10% of flour from the National Arriba cocoa shells					
Color	9	7	10	4	
Flavor	4	10	10	6	
Odor	8	9	9	4	
Texture	7	10	9	3	1
Total	28	36	38	17	1

Source: Own elaboration, 2017.

The results of the sensory analysis of the loaves made with the flour from the CCN 51 cocoa shells but with a 10% dosage (Table 2), which were codified with the code (P4), there were 10 evaluations by the judges on the "I dislike moderately" scales, 4 for the "I dislike a lot" scale. In addition, there were 38 evaluations on the scale "I am indifferent", being 11 for color, 8 for flavor, 1 for odor and 9 for texture.

Table 2. Results of the sensory analysis of the bread made with flour from the CCN51 cocoa shells.

Attribute	I like a lot	I like moderately	I am indifferent	I dislike moderately	I dislike a lot
Bread made with 20% of flour from the CCN 51 cocoa shells					
Color	14	9	7		
Flavor	15	11	4		
Odor	14	9	6		1
Texture	13	12	4	1	
Total	56	41	21	1	1
Bread made with 10% of flour from the CCN 51 cocoa shells					
Color	7	7	11	3	1
Flavor	6	13	8	4	1
Odor	7	11	10	1	1
Texture	7	10	9	2	1
Total	27	41	38	10	4

Source: Own elaboration, 2017.

In total, 22% of the evaluations of the four attributes were for the highest scale (I like a lot), 34% for the "I like moderately" scale and 44% for the other scales.

Applying the numerical scale for the four evaluations mentioned above, multiplying the assigned number of each scale by the number of evaluations and adding the results of each formula of the breads, it can be concluded that the breads made with flour from the National Arriba Cocoa shells, with a dosage at 20% (P1) have better sensory acceptance with 528 points, as can be seen in Table 3. The breads made with the same flour with a percentage of 10% (P2) were in fourth place with a total of 433 points and the breads made with CCN 51 cocoa shells with a percentage of 20% (P3) occupied the second place with a total of 509 points.

On the other hand, the loaves made with 10% flour from CCN 51 coca shells (P4) ranked third with a total of 437 points.

Table 3. Total results of the score sum of the sensory evaluation.

Bread	P1	P2	P3	P4
Total score	528	433	509	437

Source: Own elaboration, 2017.

3.2. Analysis of variances between the formulas of the breads

Using the INFOSTAT student version 2014 to analyze the results and verify whether or not there is a significant difference between the different formulas, it is observed that, in relation to the attributes (Color, Flavor, Odor and Texture), for the answer "I like a lot", the coefficient of variation was 15.75%; for the answer "I like moderately" the coefficient of variation was 18.73%; for the answer "I am indifferent", the coefficient of variation was 15.98%; for the answer "I dislike moderately", the coefficient of variation was 27.76%; and for the answer "I dislike a lot", the coefficient of variation that was obtained was 35.09%; therefore, analysis of variance indicates that there is a significant difference between the formulas of the breads, thus confirming the previous data.

Comparing the results obtained from the sensory evaluation of bread made with different formulas with the research carried out by CERÓN *et al.* (2011), where the partial replacement of wheat flour by potato flour (*solanum tuberosum*) is carried out for the preparation of breads, it was observed that those elaborated with a partial substitution of 20% obtained the highest scores in the sensory analysis, which is in agreement with the results of the present investigation.

Contrary to what was reported in the research conducted by AMIR *et al.* (2013) to develop high fiber bread by utilizing the cocoa pod husk with five different percentages, For the overall acceptance, the formulation with 5% of the flour coming from the cocoa pod husk, had the highest mean score among the composite breads.

On other hand, GUERRA and VERANZA (2014) on the preparation of bread with mashua flour (*Tropaeolum tuberosum*), where it was confirmed that the formula with the lowest evaluation was 20% mashua flour.

In the work carried out by ORDONEZ and OVIEDO (2010), for the elaboration of bread based on wheat flour, banana and rye, it was concluded that the best formula, in relation to the organoleptic characteristics, was with the dosage 25% banana flour and 5% rye flour. Similar results can be observed in the research conducted by DÍAS and SEVILLA (2011) on the mixture of rice flour and wheat flour for baking, where they reported that the

breads with the best sensory characteristics were those made with 30% rice flour. In both investigations, higher percentages than those reported in the present investigation were obtained to substitute wheat flour.

Likewise, in the research carried out by AROZARENA and MARIN (2014) for the production of bread using flour composed of wheat, cassava and soybean, it was confirmed that the breads made with partial replacement of wheat flour with 5% soybean meal and 10% cassava flour is the best treatment.

According to the results obtained from the work carried out by COBO *et al.* (2013), it was confirmed that the percentage to replace wheat flour with white carrot flour (*Arracacia xanthorrhiza* B.) for bread making, obtaining the best characteristic sensory and physical, was 10%.

This percentage is in agreement with the one reported in the research of bread making with wheat flour and kiwicha flour (*Amaranthus caudatus* L.) made by CHAGMAN and HUMÁN (2010), where they confirmed that the best formula was the one elaborated with 10% of kiwicha flour and 90% wheat flour. In this way, it is observed that the sensory evaluation varies depending on the origin of the vegetable flour to be dosed in the baking processes, which is responsible for significant changes in the organoleptic characteristics of the loaves.

3.3. Results of the sensory analysis of cookies

In relation to the sensory analysis of cookies made with the flour dosage of the National Arriba cocoa shells (Table 4), with a percentage of 80% and codified with the code (G1), there was no evaluation on the "I dislike moderately" scale or on the "I dislike a lot" scale. On the other hand, approximately 83% of the evaluations were for the "I like a lot" scale, the rest of the evaluations for the other scales.

The results of the sensory analysis for the cookies made with the flour from the National Arriba cocoa shells, but with a percentage of 70% (Table 4), and with the coding (G2), there was no evaluation on the scales of "I dislike moderately" or "I dislike a lot" and 78% of the total evaluations are on the highest scale.

Table 4. Results of the sensory analysis of cookies made with flour from the National Arriba cocoa shells.

Attribute	I like a lot	I like moderately	I am indifferent	I dislike moderately	I dislike a lot
Cookies made with 80% flour from the National Arriba cocoa shells					
Color	25	5			
Flavor	25	4			
Odor	26	4			
Texture	26	4	1		
Total	102	17	1		
Cookies made with 70% flour from the National Arriba cocoa shells					
Color	23	4			
Flavor	24	7	1		
Odor	24	7			
Texture	23	6	1		
Total	94	24	1		

Source: Own elaboration, 2017.

With regard to the sensory analysis of cookies made with the dosage of 80% of flour from the CCN 51 cocoa shells, which were coded (G3) it is observed that there is no evaluation for the scale "I dislike a lot," however, there are 15 evaluations for the "I dislike moderately" scale. In total approximately 50% of the evaluations are on the "I like it a lot" scale, the rest of the evaluations correspond to the other scales.

As we can see in Table 5, the sensory analysis of the cookies made with the flour from the CCN 51 cocoa shells and with a dosage of 70%, which were coded (G4), it is observed that there is no evaluation for the scale "I dislike a lot", nor for the scale "I dislike moderately". In total, approximately 71% of the evaluations were obtained on the "I like a lot" scale, while the rest of the evaluations correspond to the other scales.

Table 5. Results of the sensory analysis of cookies made with flour from the CCN 51 cocoa shells.

Attribute	I like a lot	I like moderately	I am indifferent	I dislike moderately	I dislike a lot
Cookies made with 80% flour from the CCN 51 cocoa shells					
Color	15	9		4	
Flavor	15	8	5	3	
Odor	16	8	4	3	
Texture	15	7	3	5	
Total	61	32	12	15	
Cookies made with 70% flour from the CCN 51 cocoa shells					
Color	21	6	3		
Flavor	22	8	3		
Odor	22	6	1		
Texture	21	6	1		
Total	86	26	8		

Source: Own elaboration, 2017.

Applying the aforementioned numerical scale for the four evaluations, multiplying the assigned number of each scale by the number of the evaluations and adding the results of each formula of the cookies, it can be concluded that those made with flour from the National Ariba cocoa shells 80% (G1) have the best sensory acceptance with 581 points, as can be seen in Table 6. The cookies made with the same flour, with a percentage of 70% (G2), occupied the second place in sensory acceptance, with a total of 572 points. The cookies made with the flour from the CCN 51 cocoa shells, with a percentage of 70% (G4), occupied the third place with a total of 558 points and in the last place are the cookies made with this same flour, with a percentage of dosage of 80% (G3), with a total of 499 points.

Table 6. Total results of the sum of the score of the sensory evaluation of the cookies.

Galletas	G1	G2	G3	G4
Puntaje Total	581	572	499	558

Source: Own elaboration, 2017.

3.4. Analysis of variances between cookie formulas

The INFOSTAT student version (2014) was used again to analyze the results and verify if there is a significant difference between the formulas. The results indicated that, in relation to the attributes (Color, Flavor, Odor and Texture), for the answer "I like a lot", the coefficient of variation is 2.34%, that is, there is no significant difference between the formulas for making cookies; for the answer "I like moderately", the coefficient of variation is 16.33%, that is, there is a significant difference between the cookie-making formulas; for the answer "I am indifferent", the coefficient of variation is 71.79%, which indicates that there is a significant difference between the cookie-making formulas and, finally, for the answer "I dislike moderately", the coefficient of variation is 36.47%, that is, there is a significant difference between the formulas for making cookies. In this way, analysis of variance indicates that there is a significant difference between cookie formulas, confirming the high acceptance for their consumption. Therefore, by analyzing the results, it is concluded that the cookies have higher sensory acceptance than the breads.

Comparing the results obtained from this research with the work done by CEDEÑO *et al.* (2014), for the preparation of cookies with mango rinds and pineapple peels in Ecuador, it was observed that the best formulas for making cookies were those made with 8% pineapple flour and 92% wheat flour and those made with 12% mango husks and 88% wheat flour, which have very low percentages of shell flour as a substitute for wheat flour, what was applied in this investigation.

On the other hand, in the work carried out by GONZÁLEZ and GOMES (2007) in Mexico for the preparation of cookies with orange bagasse flour, different levels of substitution of wheat flour for orange bagasse flour were used (0%, 10%, 20%, 30% and 40%) and with the application of sensory tests it was determined that the best formulas were cookies made with 10% and 20% orange bagasse flour, because the highest levels of This flour caused bitter taste and tougher texture in the cookies. Contrary to the present investigation where the best formula, in relation to the sensory analysis, was the one elaborated with a high flour level of the cocoa shells.

In another work carried out in Peru by Rodríguez (2014), potato peel flour was used with dosages of 30%, 50% and 70%, while the rest of the flour corresponded to wheat flour for the preparation of cookies. These studies confirm, through sensory analysis, that the ideal formula is that which has a percentage of 30% of potato peel flour, being higher than what was reported in the aforementioned research.

In the investigation of MICHELIN *et al.* (2014) to develop cookie recipes using different amounts of guava peel flour (GPF) levels (30%, 50%, and 70%), the cookies containing 50% and 70% GPF received satisfactory acceptance regarding to aroma only. However, the percentage is still lower compared to the dosage of flour from the shells used in the present investigation.

Therefore, the flour originating from the shells of the Nacional Arriba cocoa is the flour with the best sensory quality in the preparation of breads or cookies, likewise that the cookies made with the flour coming from the shells of the Nacional Arriba cocoa have better sensory acceptance compared to breads made with the same flour.

4. CONCLUSIONS

Once the sensory analysis of the bread and cookies, made with flour from the shells of the two analyzed cocoa varieties, it was determined that the flour with the best organoleptic characteristics was obtained from the shells of the Nacional Arriba cocoa, presenting a better sensory quality in the preparation of breads or cookies.

Likewise, it was determined that the biscuits made with the flour coming from the shells of the Cacao Nacional Arriba, with a percentage of 80%, have a better sensorial acceptance compared with the breads made with the same flour.

Finally, through this research it has been possible to verify the importance of using other sources of vegetable flour, in this case from the cocoa shells, to be used in the bakery industry, being an incentive for countries such as Ecuador where the production of wheat is not enough for the demand of the bakery industry.

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