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# Application of lentil flour (lens culinaris) as a substitute for wheat flour in pastry doughs.

## *Aplicación de la harina de lenteja (Lens culinaris) como sustituto de la harina de trigo en masas de pastelería.*

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**Abstract.**
Ecuador is a diverse country in products of all kinds and an essential part of its wealth are legumes, in the Ecuadorian mountain range the cultivation of legumes is done in a traditional way and they are of great importance for the inhabitants, but nowadays its use is limited, it presents the problem that many of this legumes are not of interest to the population in the bakery industry, which is why this project has as a general objective to apply lentil flour as a substitute for wheat flour in pastry doughs. Through this research it's possible to determine that pastry doughs can not only be made with wheat flour, but also with a partial replacement with lentil flour, for this study an experimental methodology will be used in obtaining lentil flour and the formulation of pastry products, in addition, the qualitative method will be used through sensory analysis of products made from lentil flour that will be evaluated through preference tests and acceptance tests.

**Keywords.**
lentil, substitution, heavy dough, light dough, cutting mass.

**Resumen.**
Ecuador es un país diverso en productos de toda clase y una parte esencial de su riqueza son las leguminosas, en la serranía Ecuatoriana el cultivo de leguminosas se hace de manera tradicional y son de gran importancia para los pobladores, pero en la actualidad su uso es limitado, presenta el problema que muchas de esta leguminosas no son de interés para la población en la industria de la pastelería es por ello que este proyecto tiene como objetivo general aplicar la harina de lenteja como sustituto de la harina de trigo en masas de pastelería. Por medio de esta investigación se logra determinar que las masas de pastelería no solo se pueden elaborar con harina de trigo, sino también con una sustitución parcial con harina de lenteja, para dicho estudio se empleará una metodología experimental en la obtención de la harina de lenteja y la formulación de los productos pasteleros, complementariamente se utilizará el método cualitativo a través de análisis sensoriales de los productos elaborados a base de harina de lenteja que serán evaluados a través de las pruebas de preferencia y pruebas de aceptación.

**Palabras clave**.
Lenteja, sustitución, masa pesada, masa liviana, masa de corte.

## 1. Introduction

This paper seeks to apply lentil flour (Lens Culinaris) as a substitute for wheat flour in pastry doughs. In the country, only wheat flour is used for the preparation of pastry and bakery doughs, therefore there is a need to look for new alternatives for the development of new products. Ecuador is a country rich in legumes which can be used in the production of flours, such as lentils, which are considered one of the largest and most complete legumes. It is native to present-day Syria and southeastern Turkey and was domesticated during the so-called Neolithic Revolution. In Ecuador, it is found in the Sierra region, being the most consumed legume in the country, the lentil.

Lentils have a high concentration of nutrients and carbohydrates, which are primarily made up of starch. Its plant proteins, although in good quantity, are incomplete, as they are deficient in methionine, an essential amino acid. However, if lentils are combined with cereals such as rice, foods rich in this amino acid, they become proteins of high biological value, comparable to those provided by animal foods. The lipid content is very low. The fiber content, although significant, is also lower than that of other legumes. [1]

### 1.1. Origen of the Lentil.

The Lentil (Lens Culinaris), a legume that is part of the large set of species domesticated in the Fertile Crescent during the so-called Neolithic Revolution, had its center of domestication in the northern area of present-day Syria and southeastern Turkey. Lentils were introduced into the human diet along with other legume species such as barley, peas, wheat, chickpeas, fava beans, flax, etc. From the aforementioned countries, these crops were spread westward to Europe, southward to Africa, and eastward to Afghanistan. [2]

### 1.2. Taxonomy

Common Name: Lentil.
Scientific Name: Lens culinaris.
Family: Fabaceae or Papilonaceae.
Genus: Lens.
Species: Lens culinaris and Lens nigricans. [3]

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### 1.3. Morphology.

- **Stem:** It is thin, erect, can reach a height of about 20 to 50 cm and sometimes a bit taller, but does not exceed 70 cm.
- **Roots:** Lentil plants with small seeds have a superficial root system that adapts to the terrain, while those plants with large seeds have a deeper root system that adapts to heavy soils.
- **Leaves:** Its leaves are structured by a rachis of 50 mm in length where more than 15 leaflets are found.
- **Flowers:** They are located on floral peduncles in a range of 1 to 3. The flowers are small, bicolor, white or blue.
- **Fruits:** Its fruits are rhomboid in shape and can measure between 7 to 20 mm, and the seed is inside as it can be one or more seeds.
- **Large Fruit:** This fruit can measure between 15 to 20 mm and its seeds measure between 7 to 8 mm. The characteristics of the plant are typical of a herbaceous plant and it reaches a height of 25 to 75 cm belonging to the macrosperma race. The flowers that come from this type of plant have white colorations.
- **Small Fruit:** The fruit reaches a size smaller than the previous fruit of 7 to 15 mm and its seeds are also smaller, from 3 to 7 mm and have a flattened shape. The size of the plant reaches a height of 35 cm at most and its flowers are bluish in color. These plants are of the microsperma race type. [4]

### 1.4. Varieties

- Rubia Castellana: They are large in size and light green in color, measuring 8 to 10 mm in diameter, this is the most consumed in Spain.
- Rubia de armiña: They are larger than the previous ones, but have the same organoleptic characteristics, it is less consumed.
- Verdina: Its main characteristic is that they are small in size, dark in color, and their texture is delicate, they cook very quickly.
- Pardina: It is larger than the verdina, with a quick cooking time.
- Lentejón: Of a yellowish-green color, its size is large between 7 to 9 mm, this variety is the one consumed in Ecuador. [4].

### 1.5. Cultivation

When cultivating lentils, it is necessary to rotate with other plants to prevent the roots from reaching a state of decomposition caused by soil fungi. It is advisable to rotate with cereals such as corn, wheat, barley, oats, or Andean grains grown in the area, for example, quinoa, amaranth. Planting takes place in the month of March, using a monoculture system, with a distance between rows of 25 to 30 cm, and 30 seeds per linear meter with one row per furrow. [5]

## 2. Materials and methods.

### 2.1. Equipment and materials

For the production of lentil flour and pastry doughs from it, various equipment and materials were used, which are detailed below.

Flour production
• Oven (Haceb)
• Blender (Oster)
• Sieve
• Bowls
• Scale
• Ziploc bags

Product manufacturing
• Bowls
• Scale
• Molds
• Spatulas
• Mixer (Oster)
• Sieve
• Oven
• Knife
• Ziploc bags
• Baking sheets

### 2.2. Methods

#### 2.2.1. Production of lentil flour

Test 1

In this first experiment, it was decided to produce the flour with raw lentils. To obtain the flour, the lentils were blended until a fine powder was achieved, which was then sieved to obtain the final product. The process started with a raw lentil weight of 500 grams and, once ground, a total of 426g was obtained, resulting in a final loss of 14.8%.

Through this process, the flavor of the obtained flour was verified, which had a bitter taste, leading to the decision to conduct another experiment with toasted lentils.

Process description

- Reception of raw material: receive the raw material.
- Selection and cleaning: select the grains and separate present impurities.
- Grinding: this is done in a blender to achieve a fine flour.
- Sieving: this is done with a fine mesh, to have a good granulometry.
- Packaging and storage: place the flour in a bag, to prevent it from absorbing moisture and store it at room temperature..

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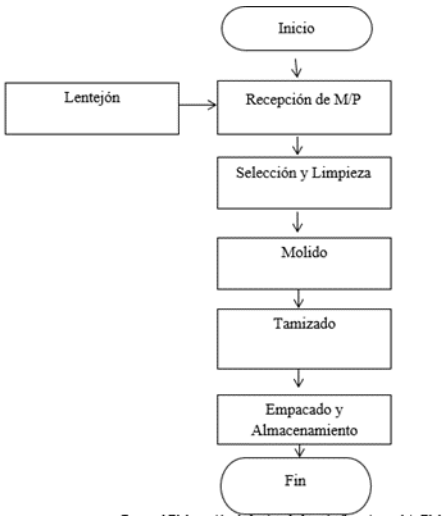


Fig 1. Production of lentil flour (raw lentil)

Test 2

Due to the bitter taste results obtained in the first test, a second experiment was conducted.

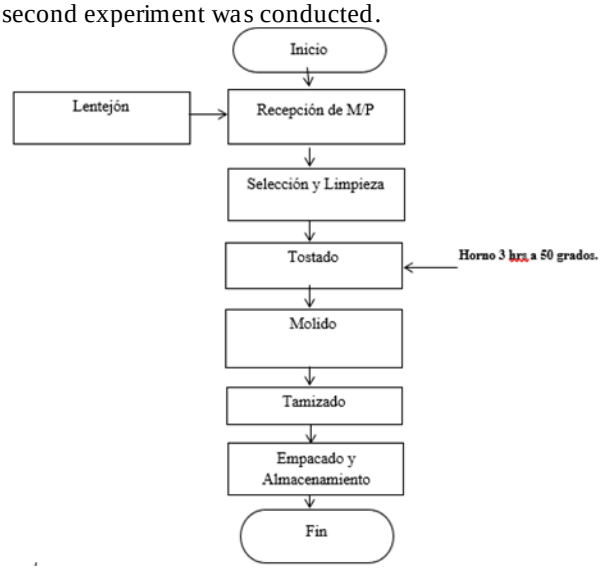


Fig. 1. Production of lentil flour (toasted lentil).

Process Description.

- **Reception of raw material**: receive the raw material.
- **Selection and cleaning:** select the grains and separate present impurities.
- **Toasting**: performed in an oven at a temperature of 50 degrees for three hours.
- **Grinding:** it is done in a blender in order to obtain a fine flour.
- **Sifting:** this is done with a fine mesh, in order to have a good granulometry.
- **Packing and storage**: place the flour in a bag, to prevent it from absorbing moisture and it should be stored at room temperature.

**2.2.2. Elaboración de masas de pastelería a base de harina de lenteja.**

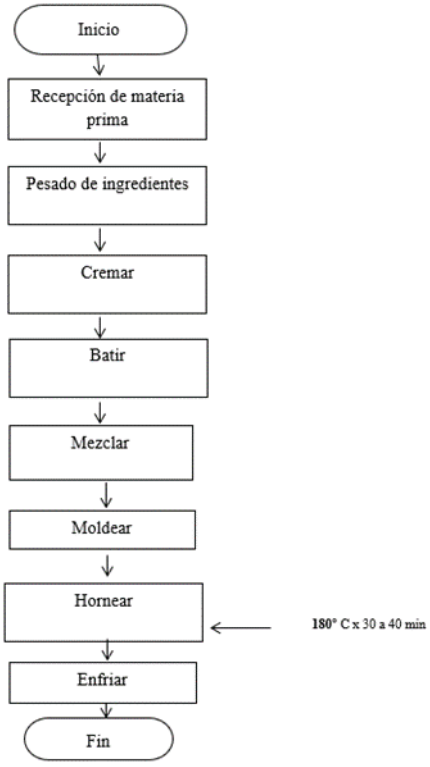


Fig. 2. Production of heavy doughh.

Process Description.

- **Reception of raw material:** receive or acquire all the necessary ingredients for the preparation of the heavy dough.
- **Weighing of ingredients:** weigh each of the ingredients correctly, as the good balance of them will depend on the results of the final dough.
- **Creaming:** the butter with the sugar, until it takes on a whitish color, this process is carried out in order to give volume to the dough.
- **Beating**: the eggs incorporating one by one, until they are completely mixed.
- **Mixing:** the preparation obtained so far with the dry ingredients, beat until the flour is well mixed.
- **Molding:** in previously greased and floured molds, in order to easily pour the already prepared dough.
- **Baking**: at a temperature of 180 degrees for a period of 30 to 40 minutes.
- **Cooling:** at room temperature and once cold wrap in plastic wrap so that the dough does not dry out [6].

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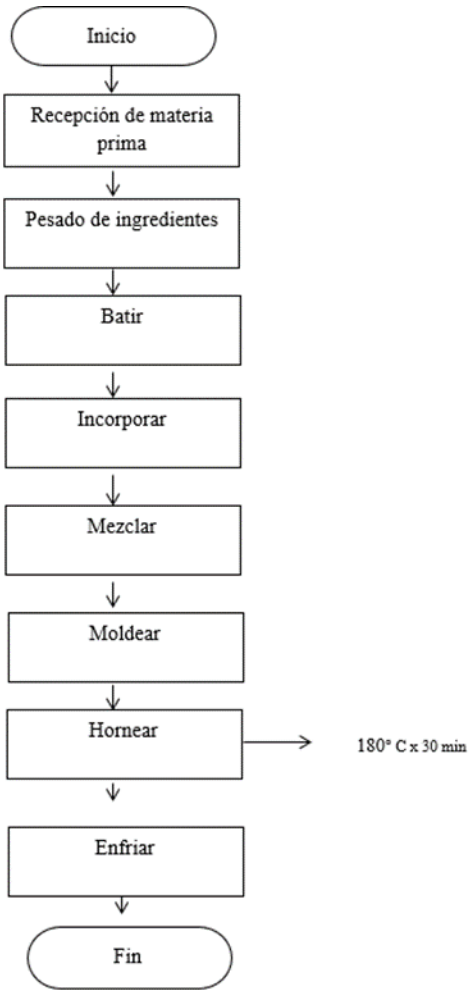


Fig. 3. Production of light dough.

Process Description.

- **Reception of raw material:** receive the necessary ingredients for the preparation of the dough.
- **Weighing of ingredients:** a good dough will be obtained from the good balance of the ingredients.
- **Beating:** the eggs with the sugar, until reaching the ribbon stage, with the purpose of giving volume and fluffiness to the dough.
- **Incorporating**: the vanilla essence.
- **Mixing:** the flour with a spatula applying enveloping movements so as not to lose the volume previously granted.
- **Molding:** in previously greased and floured molds.
- **Baking:** at a temperature of 180 degrees for about 30 minutes.
- **Cooling:** at room temperature and then cover the doughs with plastic wrap so they do not lose moisture [7].

### 2.2.3. Cookie production.

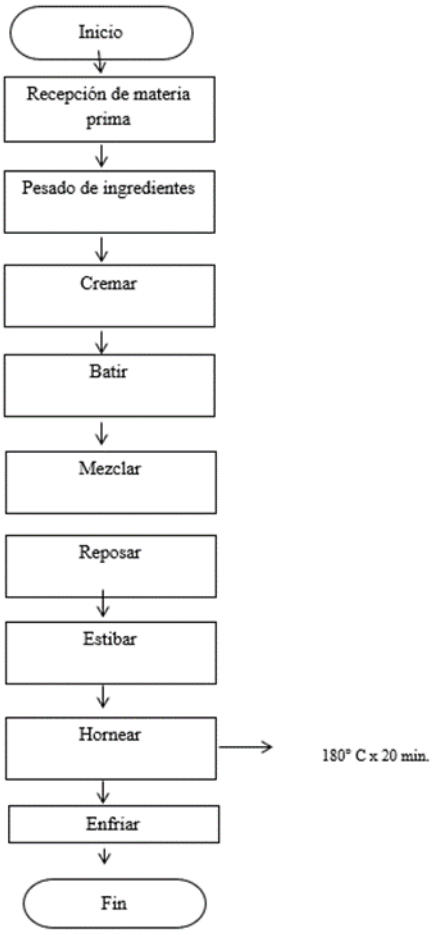


Fig. 4. Cookie production.

Process Description.

- **Reception of raw material:** receive the necessary raw material for the preparation of the dough.
- **Weighing of ingredients:** weigh the ingredients correctly, as the final result of the dough depends on them.
- **Creaming**: the butter and sugar until it changes color, this process aims to give volume to the dough.
- **Beating**: the eggs until completely mixed.
- **Mixing:** the dry ingredients with a spatula, until a homogeneous dough is obtained.
- **Resting:** once the dough is ready, send it to refrigeration, so that it has a better consistency.
- **Staging:** the dough on a tray, with wax paper, so that it does not stick.
- **Baking:** in the oven at a temperature of 180 degrees.
- **Cooling**: once the cookies are ready, they cool to room temperature [8].

## 3. Results.

### 3.1. Production results.

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Below are the results of the product production, as well as the proposals to be established through the experimental method and the results thrown by the various tests carried out to determine the acceptance of the products.

### 3.1.1. Experimentation results in the production of lentil flour.

In Ecuador, lentil flour is not produced, which is why it was decided to experiment with the production of flour based on raw lentil grain. To obtain lentil flour, the grains were crushed with the help of a blender several times until a fine powder was obtained, then it was sifted to reach a granulometry similar to flour[9].

Table 1. Production of lentil flour with raw lenti

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Weight | Ingredients | Percentage | |
| 3 hours 50° | 500g | | Loss: 18.4% | Dark lentil flour Bitter flavor |
| | | Toasted Lentil | Lentil Flour 408g | |

After obtaining a bitter sample, the lentil grains were toasted to see if the flavor that was present in the first test improved. This test was carried out first by placing 500g of lentils to toast for a period of 3 hours at a temperature of 50°, the temperature control was very important so that the lentil does not lose its nutritional properties, once this was done it was allowed to cool and proceeded to crush the lentil until it is completely pulverized, from here it is only sieved and the final product of 408g is obtained giving a loss of 18.4%, with respect to the flavor was obtained a bitter taste and a dark color and odor similar to coffee.

Table 2. Preparation of lentil flour with roasted lentils

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 30 min | 180° | Raw lentil flour | 24.85 | Bitter flavor |
| | | Butter | 24.85 | |
| | | Sugar | 24.85 | |
| | | Eggs | 24.85 | |
| | | Baking powder | 0.099 | |
| | | Vanilla essence | 0.49 | |
| | | Total | 100,00% | |

### 3.1.2. Experimental results of lentil flour-based pastry doughs.

After obtaining the flour, we proceeded to elaborate the doughs based on 100% raw lentil flour, three types of dough were elaborated: light, heavy and cut, of which the elaborated products were tasted. The three types of flour were tested to determine which was the best for each dough.

Three doughs were elaborated with the three types of flour with a 100% substitution of raw lentil flour, with roasted lentil flour and roasted raw lentil flour and later experiments were carried out with 70% only with raw lentil flour and 30% wheat flour and once the results of these experiments were obtained, preference tests, acceptance tests and laboratory tests were carried out.

### 3.1.3. Resultados y formulación de masas al 100% de sustitución con harina de lenteja.

Test 1.

Weighed dough with raw lentil flour at 100% substitution.

This first test was elaborated with raw lentil flour at 100% substitution, which resulted in a dough with a bitter taste, the texture was unstable because the dough crumbled easily, for this reason, tests continued to be carried out in order to improve the product.

Table 3. Heavy dough formulation with 100% substitution of raw lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| | | Lentil | 500g 100% Loss: 14.8% | Light brown flour Lentil Flour 426g |

Test 2

Heavy dough with toasted lentil flour at 100% substitution.

In this second test the products were made with toasted lentil flour with a 100% substitution, this dough had a dark color, similar to chocolate, its flavor was bitter like the previous test and as for its texture it was not adequate because it also crumbled easily, with these results we proceeded to make new tests again to continue looking for the product with acceptable commercial characteristics.

Table 4. Heavy dough formulation with 100% substitution of roasted lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 30 min | 180° | Toasted lentil flour | 24.85 | Strong (bitter) flavor Unstable texture Dark color |
| | | Butter | 24.85 | |
| | | Sugar | 24.85 | |
| | | Eggs | 24.85 | |

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| | | |
|---|---|---|
| | Baking powder | 0.099 |
| | Vanilla essence | 0.49 |
| | **Total** | 100,00% |

Test 3

Weighed dough with roasted raw lentil flour at 100% substitution.

The products were elaborated with roasted raw lentil flour with 100% substitution. As a result, its flavor was imperceptible, the lentil flavor was not felt, the texture of the dough was not adequate, and the color was light brown.

Table 5. Formulation of heavy dough with 100% substitution of roasted raw lentil flour.

| Variables | | | | Results |
|---|---|---|---|---|
| **Time** | **Temperature** | **Ingredients** | **Percentage** | |
| 30 min | 180° | Roasted raw lentil flour | 24.85 | Strong (bitter) taste |
| | | Butter | 24.85 | |
| | | Sugar | 24.85 | |
| | | Eggs | 24.85 | |
| | | Baking powder | 0.099 | |
| | | Vanilla essence | 0.49 | |
| | | **Total** | 100,00% | |

Test 4

Light dough with raw lentil flour with 100% substitution

The first time that the light dough was elaborated, raw lentil flour was used with a 100% substitution, this type of dough usually has a neutral flavor, and when it was elaborated with this flour, it was observed that it had a good color, which was light brown, but as for the flavor, it was strong and bitter.

Table 6. Light dough formulation with 100% raw lentil flour substitution

| Variables | | | | Results |
|---|---|---|---|---|
| **Time** | **Temperature** | **Ingredients** | **Percentage** | |
| 30 min | 180° | Raw lentil flour | 28.9 | Sabor fuerte |
| | | Sugar | 28.9 | Textura inestable |
| | | Eggs | 41.23 | |
| | | Essence | 1.03 | |
| | | **Total** | 100,00% | |

Test 5

Light dough with 100% substitution of toasted lentil flour

After the test carried out previously, we proceeded to elaborate again the light dough, this time it was elaborated with the toasted lentil flour obtaining as results an unstable dough, dry and with a bitter flavor similar to coffee, this is due to the toasting process since there the lentil lost humidity, in general bad results were obtained, reason why the light dough is elaborated again, to improve the product.

Table 7. Light dough formulation with 100% substitution of roasted lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| **Time** | **Temperature** | **Ingredients** | **Percentage** | |
| 30 Min | 180 grados | Toasted lentil flour | 28.9 | Strong flavor Dark color Dry texture |
| | | Sugar | 28.9 | |
| | | Eggs | 41.23 | |
| | | Esencia | 1.03 | |
| | | **Total** | 100,00% | |

Test 6

Light dough with 100% substitution of toasted raw lentil flour

Taking into account the results previously obtained, this time the light dough was elaborated with a 100% substitution of roasted raw lentil flour, the dough lost a lot of moisture, when tasted it felt very dry and had a bitter taste almost astringent.

Table 8. Formulation of light dough with 100% substitution of roasted raw lentil flour.

| Variables | | | | Results |
|---|---|---|---|---|
| **Time** | **Temperature** | **Ingredients** | **Percentage** | |
| 30 min | 180° | Roasted raw lentil flour | 28.9 | Bitter taste Astringent Dry and unstable texture |
| | | Sugar | 28.9 | |
| | | Eggs | 41.23 | |
| | | Essence | 1.03 | |
| | | **Total** | 100,00% | |

Test 7

Cutting dough with raw lentil flour 100% substitution

In this first test we proceeded to elaborate the cut dough to make the cookies with a total substitution of the raw lentil flour, that is to say, 100% of the lentil flour was used, the flavor was very strong, the texture was not the characteristic of the cookie, because it lacked crunchiness and a dark color that was given by the caramelization of the honey that was added.

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Table 9 Cookie dough formulation with 100% substitution of raw lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 20 min | 180° | Raw lentil flour | 45 | Strong flavor |
| | | Butter | 25 | |
| | | Sugar | 24 | Hard texture |
| | | Eggs | 5 | |
| | | Esencia | 0.5 | |
| | | Baking powder | 0.5 | |
| | | **Total** | 100,00% | |

Test 8

Cutting dough with toasted lentil flour at 100% substitution.

In the second experiment, the cookies were made with a substitution of toasted lentil flour and almost the same observations were obtained, so it was decided to change the substitution to improve the texture and color of the cookie.

Table 10. Cookie dough formulation with 100% substitution of roasted lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 20 min | 180° | Toasted lentil flour | 45 | Strong flavor |
| | | Butter | 25 | |
| | | Sugar | 24 | Hard texture |
| | | Eggs | 5 | |
| | | Essence | 0.5 | |
| | | Baking powder | 0.5 | |
| | | **Total** | 100,00% | |

Test 9

Cutting dough with roasted raw lentil flour at 100% substitution.

In this last experiment of 100% substitution, the same previous formula was used and the results were the same, the only change was a lower color tone than the previous one, for which it was decided to substitute 70% lentil flour and 30% wheat flour and to change one ingredient.

Table 11. Cookie dough formulation with 100% raw lentil flour substitution

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 20 min | 180° | Raw lentil flour | 45 | Strong flavor |
| | | Butter | 25 | |
| | | Sugar | 24 | Hard texture |
| | | Eggs | 5 | |
| | | Essence | 0.5 | |
| | | Baking powder | 0.5 | |
| | | **Total** | 100,00% | |

### 3.1.4. Results and formulation of doughs at 70% substitution with lentil flour

Once the previous tests had been carried out, it was decided to prepare the doughs again, this time with a 70% substitution because the doughs prepared with 100% did not obtain good results. In the previous tests, the doughs were prepared with the three types of flours; due to the poor results, it was decided to prepare the doughs only with raw lentil flour with a 70% substitution.

Test 1

Heavy dough with 70% raw lentil flour substitution

This first formula made with raw lentil flour at 70% obtained a good texture, i.e. its correct sponginess, its golden color and very faint flavor.

Table 12. Formulation of heavy dough with 70% substitution of raw lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 30 min | 180° | Raw lentil flour | 17.4 | Spongy texture |
| | | Wheat flour | 7.45 | |
| | | Butter | 24.85 | Golden color |
| | | Sugar | 24.85 | |
| | | Eggs | 24.85 | |
| | | Baking powder | 0.099 | |
| | | Vanilla essence | 0.49 | |
| | | **Total** | 100,00% | |

Test 2

Light dough with raw lentil flour 70% substitution

The sponge cake was made with a 70% substitution of lentil flour and 30% wheat flour, which helped to have a better texture in the cake, in its color and flavor, although it should be taken into account that this type of dough is somewhat neutral, that is to say, with little flavor

Table 13. Light dough formulation with 70% substitution of raw lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| Time | Temperature | Ingredients | Percentage | |
| 30 min | 180° | Wheat flour | 8.66 | Golden color |
| | | Raw lentil flour | 20.20 | |
| | | Sugar | 28.9 | Spongy texture |
| | | Eggs | 41.23 | |
| | | Essence | 1.03 | |
| | | Total | 100.00% | |

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Test 3
Cutting dough with raw lentil flour at 70% substitution. In this formula changes were made since honey was replaced by butter, this dough was elaborated with a substitution of 70% lentil flour and 30% wheat flour, the characteristics of the product were favorable, it was obtained crunchiness, color and adequate flavor.

Table 14. Formulation of cookie dough with 70% substitution of raw lentil flour

| Variables | | | | Results |
|---|---|---|---|---|
| **Time** | **Temperature** | **Ingredients** | **Percentage** | |
| 30 min | 180° | Wheat flour<br>Raw lentil flour<br>Sugar<br>Eggs<br>Essence<br>Butter<br>**Total** | 10<br>35<br>24<br>5<br>0.5<br>0.5<br>100,00% | Crunchy dough Golden color |

### 3.2. Preference test results.

Once the experiments with the three types of dough and the two substitutions were completed, the preference tests were carried out. The doughs that were evaluated were: heavy, light and cut doughs with 100% and 70% substitution for which each attribute was evaluated (color, flavor, residual flavor, odor and texture) with a scale of 1 to 5 being 1 not acceptable and 5 very acceptable, from these tests it is possible to identify that the doughs with greater preference among the panelists are those elaborated with 70% substitution of lentil flour

### 3.2.1. Results of the weighed mass preference tests 70%.

The following are the results of the preference tests, which are measured through a scale, the number of panelists evaluated is 30.

Table 15. Preferred level of heavy mass 70%.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 3 | 2 | 12 | 13 |
| General flavor | 0 | 0 | 5 | 5 | 20 |
| Residual flavor | 0 | 0 | 10 | 17 | 3 |
| Texture | 0 | 0 | 0 | 14 | 16 |
| Odor | 0 | 3 | 7 | 14 | 6 |

This graph shows that the levels of preference of the heavy dough 70% of the scores were the highest because it is observed that its general flavor is very acceptable by the panelists, as well as the residual flavor, color, smell and texture, the results of this dough were the most favorable, because it had the appropriate characteristics.

### 3.2.2. Resultados de las pruebas de preferencia masa pesada 100%

Table 16. Nivel de preferencia masa pesada 100%

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 2 | 16 | 8 | 5 |
| General flavor | 0 | 2 | 11 | 13 | 4 |
| Residual flavor | 0 | 2 | 13 | 13 | 2 |
| Texture | 0 | 4 | 10 | 13 | 3 |
| Odor | 0 | 1 | 9 | 14 | 6 |

It is observed in the graph that in the levels of preference of the dough weighed at 100% its attributes were not of preference for the panelists, since as for the color this was very pronounced as well as its flavors, the texture of this dough was not very pleasant due to the fact that lumps were felt when consuming it, for these characteristics this dough was not one of the preferred ones [10].

### 3.2.3. Results of the light mass preference tests 70%.

Table 17. Preferred level of light mass 70%.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 13 | 10 | 5 | 2 |
| General flavor | 0 | 0 | 5 | 10 | 15 |
| Residual flavor | 0 | 4 | 5 | 16 | 5 |
| Texture | 0 | 8 | 21 | 0 | 9 |
| Odor | 0 | 8 | 5 | 10 | 7 |

According to the graph it can be seen that in the level of preference of the light dough 70% in its color attribute is not very acceptable since it was not the characteristic of this type of dough, as for its flavors were regular because it became a little bitter which did not please the panelists, in the attributes texture and odor these obtained good results because they obtained the appropriate characteristics [11].

### 3.2.4. 100% light mass preference test results

Table 18 Preference level light dough 100%

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 15 | 8 | 7 | 0 |
| General flavor | 4 | 9 | 11 | 6 | 0 |
| Residual flavor | 4 | 13 | 10 | 3 | 0 |
| Texture | 0 | 0 | 21 | 9 | 0 |
| Odor | 0 | 15 | 7 | 8 | 0 |

The present graph details the results regarding the levels of preference of the light dough at 100%, the same ones that say that this dough has low scores, it can be observed that the color was not ideal which does not make it acceptable to this attribute, referring to the flavors it is appreciated that like the color this attribute does not have a good degree of preference, The smell was also disliked by the panelists because it was very pronounced and the only attribute that has a good score is the texture, thus suggesting that this product is not preferred by the panelists evaluated [12].

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### 3.2.5. Preference test results cut-off mass 70%.

Table 19. Preferred level of cut mass 70%.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 0 | 7 | 15 | 8 |
| General flavor | 0 | 2 | 4 | 16 | 8 |
| Residual flavor | 0 | 0 | 15 | 9 | 6 |
| Texture | 0 | 10 | 16 | 4 | 0 |
| Odor | 0 | 0 | 19 | 6 | 5 |

In the graph you can see that the color of the dough has a good preference which makes it acceptable to the panelists, the flavors of this dough also have a good reception, with regard to the texture this dough obtained a good crunchiness, the smell of the dough has an acceptable preference since the smell felt a pleasant smell, making an analysis of all the attributes can be determined that this dough has a great reception by the panelists.

### 3.2.6. Results of the 100% cut mass preference tests

Table 20. Preferred level of cut mass 100%.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Color | 0 | 15 | 7 | 8 | 0 |
| General flavor | 5 | 15 | 10 | 0 | 0 |
| Residual flavor | 13 | 14 | 3 | 0 | 0 |
| Texture | 13 | 14 | 3 | 0 | 0 |
| Odor | 2 | 10 | 18 | 0 | 0 |

In the results of this dough it can be appreciated that it is not pleasant since the texture was not adequate because it was hard without crunchiness, the flavors of this dough were very strong and it had a bitter taste, so it is determined that this dough is not one of the preferred ones, and the odor attribute is the one that stands out in this dough since it was the same characteristic of the raw material used for the elaboration.

### 3.2.7. Overall mass preference result.

Table 21 General level of preference

| | heavy mass | | light mass | | cutting mass | |
|---|---|---|---|---|---|---|
| | 70 | 100 | 70 | 100 | 70 | 100 |
| 1 | 0 | 0 | 0 | 1,6 | 0 | 6,6 |
| 2 | 1 | 2,2 | 6,6 | 10,4 | 2,4 | 13,6 |
| 3 | 4,8 | 11,8 | 9,2 | 11,4 | 12,2 | 8,2 |
| 4 | 12,4 | 12,2 | 8 | 6,6 | 10 | 1,6 |
| 5 | 11,6 | 4 | 7,6 | 0 | 5,4 | 0 |

This graph shows the general results of the comparison of all the doughs evaluated by each one of the panelists, these results reflect that as for the heavy doughs there is a great difference between 70% and 100% because it is observed that the 70% dough has a greater preference because this dough has the appropriate characteristics for this type of dough, As for the light doughs in the 70% dough, it can be observed that they had a greater acceptance before the 100% dough, this was thanks to the good texture and flavor that this dough had, and finally, the 70% cut dough is appreciated, which obtained good results being very pleasant for the panelists. Thanks to the results obtained, it was determined that the doughs elaborated with 70% were the most preferred by the panelists, for this reason it was decided to carry out acceptance tests on these products [13].

## 4. Conclusiones.

Through bibliographic research it is determined that lentil flour contains a good amount of nutrients, among them are protein, B vitamins and minerals such as zinc and iron, which remain intact in the process of obtaining the flour because it does not undergo any refining process as is the case of wheat flour that loses most of the nutrients in the milling process. [14].

Through the preference tests it was determined that the doughs with 100% substitution did not have a good acceptability while those with 70% substitution were the ones with the best score and therefore the ones that were taken to acceptance tests. Through the acceptance tests it was verified that the dough that the panelists liked the most was the dough weighed with 70% substitution, this dough was then taken to laboratory analysis.

Laboratory analysis of lentil flour and lentil dough determined that these products meet the microbiological requirements, therefore, the products can be consumed safely.

That this research serves as reference material and for the development of new proposals for bakery products based on other alternative flours such as leguminous flours, which have a high percentage of protein and also benefit people intolerant to gluten. To experiment with different types of flours, be it fruit, leguminous, etc. Since these flours provide a greater amount of nutritional values to the products to be elaborated. It is recommended to carry out physical-chemical studies of the flour produced, as well as a nutritional analysis of the products made with lentil flour to verify that the lentil's own protein has not been affected by the baking process of the dough, since these were not carried out due to a low budget.

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