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Proceeding Paper

Evaluation of the Physicochemical, Microbiological and Sensory Properties of a Pasta Based on Lentil Flour and Turmeric †

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Abstract: This project aimed to develop a lentil and turmeric-based paste, where three formulations were evaluated. The elaboration process was carried and subsequently, the physicochemical, microbiological and sensory properties of the paste were (NTC 1055-2007). The sensory results showed that the formulation with the highest acceptance was the one that contained a concentration of 60% lentil and 40% wheat flour, presenting similar characteristics to commercial pasta according to the panelists. The microbiological and physicochemical requirements comply with the provisions of the regulations; highlighting that the final product contains 5% more protein. The standardization of a basic product of the family basket.

Keywords: pasta; lentil flour; vegetable protein; turmeric

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1. Introduction

The current situation in the world of hunger and malnutrition, have led to propose a global solution that was established as a sustainable development goal (SDG), which is why trends have emerged to determine the use of protein sources that allows reducing the deficit of protein products generated by the exponential increase of the population [1]. Based on this need, studies have been carried out whose purpose is to find new technologies that allow the use of known protein sources [2].

Colombia has been considered as a food dispensation for the world due to its biodiversity, but malnutrition is a present problem, which leads to the affectation of the population's health, where the low consumption of proteins in the diet of the Colombians, which according to data from the nutritional survey shows a deficiency in protein consumption that reaches 36.6%, where in minors it is accentuated, generating problems that lead to poor brain development, growth problems, among others [3].

Legumes are characterized by containing a high percentage of protein (20–45%) and are a complement to cereals, due to the balance generated by their components [4]. Lentils (Lens Culinaris) are legumes of which we find several varieties, which differ by their physicochemical properties and color [5]. In general, lentils are rich in phosphorus, potassium, iron, calcium, iodine, zinc, sodium; vitamins such as B1, B2, B3, B5, B6, B9, A, C, K, E and components such as proteins, carbohydrates and fiber [6].

Likewise, in the world the different agri-food industries use the species for the main contribution of flavor, however, nowadays different spices have been used that provide properties to foods of various types, an example of this is turmeric, which is a spice widely used in Asian cooking, known for its vibrant yellow color and distinctive flavor. But in addition to its culinary value, turmeric contains an active compound called curcumin,

which has antioxidant and anti-inflammatory properties that help fight chronic diseases and maintain the immune system [6].

Traditional pastas, while prized for their flavor and versatility, are often made with refined flour, making them high-carbohydrate foods. Therefore, a balance has been sought in the formulation of traditional pastas that improve the nutritional characteristics of these products, whose consumption is high in Colombia.

Therefore, this project aimed to develop and standardize a paste based on lentil and turmeric, combining the nutritional and functional properties of both ingredients (lentil and turmeric), the physicochemical and microbiological properties of the paste were determined according to NTC 1055. and finally, a sensory analysis was carried out to determine the acceptance of the product in a diverse population group.

2. Materials and Methods

2.1. Conditioning of Plant Material

The study was carried out with a sample of 3000 g of commercial lentils (Lens culinaris) from the Pamplona market (Norte de Santander-Colombia), which was washed with drinking water and left to soak for 6 h, to be cooked at 100 °C for 45 min. Subsequently, they were ground in an electronic mill to obtain flour.

The preparation of the dough was carried out following the methodology of Aparicio & Agudelo [7], where the stages of reception, weighing, mixing and kneading, work and cutting of the dough and drying are described.

2.2. Development of Three Formulations

Table 1 shows the three formulations carried out in order to evaluate the best combinations of flours to work with, with the partial replacement of wheat flour by lentils, taking into account precedents given by Markato, [8].

Table 1. Pre-experimentation formulations.

Raw Material	Formulation 1	Formulation 1	Formulation 1
traditional flour	31.25%	25%	37.5%
lentil flour	31.25%	37.5%	25%
Salt	1.25%	1.25%	1.25%
Eggs	8.75%	8.75%	8.75%
Turmeric	2.5%	2.5%	2.5%
Water	25%	25%	25%

2.3. Microbiological Analysis

The following analyzes were performed on the standardized sample: Total count of aerobic Mesophiles, Total Coliforms [9], Escherichia coli, Molds and yeasts [10].

2.4. Sensory Analysis

The sensory acceptability of the final product was evaluated using a 6-point hedonic scale, 1 (I dislike it very much) and 6 (I like it very much), for five sensory characteristics. In addition, two open questions of like or dislike were incorporated into the evaluation sheet according to the own appreciation of the respondents. The evaluation was carried out on 40 people between 20 and 30 years of age, who declared themselves frequent consumers of products such as pasta, (minimum consumption of 1 time per week).

2.5. Physiscochemical Analysis

The physicochemical analyzes were carried out according to NTC 1055 [11], which requests: determination of humidity, ashes and proteins. The physicochemical analyzes

were carried out according to NTC 1055 [11], which requests: determination of humidity, ashes and proteins.

3. Results

3.1. To Standardize the Process of Elaboration of a Paste Based on Lentil Flour and Turmeric

The study was carried out with lentils (Lens culinaris Medik), with an adequate state of weight and size according to NTC 937 [12]. The grain was washed with drinking water, it was left to soak for 6 h for cooking, its respective cooking was carried out, in order to acquire the lentil flour.

Three formulations were made, which were subjected to a visual test to identify which was the most suitable to replace the traditional flour where its texture, color and handling were compared, thus finding the right one for the preparation of pasta, the process was carried out in the following way, the formulations were elaborated to be able to choose and standardize the product, the most appropriate formulation was chosen, with which it was possible to change the traditional flour for lentil flour in a large percentage of the standard formulation, For this, the pasta elaboration flow was followed, where the 3 formulations were made and it was observed what percentage of flour could be replaced without damaging the product to be elaborated (pasta), the standardization of the product was obtained, choosing the 2 formulation of this product. This is how we proceeded to make pasta where traditional flour was replaced by lentil flour up to 60%.

These results are consistent with those reported by Sánchez, [13] in his experimental work called "Elaboration of vegetarian hamburgers with different natural products (oats and lentils) vacuum packed" he used a 70% percentage of lentils in his final formulation for the best sensory treatment value close to the results obtained in the present investigation (treatment 2) whose final percentage of the formulation was 60% of lentil in contrast. Likewise, studies carried out by Dominioni et al., (2015) found that 40% of lentils in the final formulation were defined by sensory analyzes (smell, color, flavor and texture), indicating values close to our percentage of lentil flour used.

3.2. To Establish the Sensory Analysis of the Pasta Based on Lentil and Turmeric Flour in the Organoleptic Properties (General Appearance, Smell, Color, Texture and Flavor)

The sensory evaluation was carried out by 40 untrained panelists. Each panelist was given a paste made from lentil and turmeric addition. The attribute ratings were: general appearance, smell, color, flavor and texture of the sensory evaluations carried out.

For the qualification of each attribute, a sensory card was used with a 6-point hedonic scale, where 1 = I do not like it very much, 2 = I do not like it, 3 = I neither like nor dislike it, 4 = I like it slightly, 5 = I like it and 6 = I like it very much.

Figure 1 shows the results of the sensory analyzes were the following in the selected sample, it showed the acceptance of the panelists in the concept of I like it and I really like it in the executed hedonic scale.

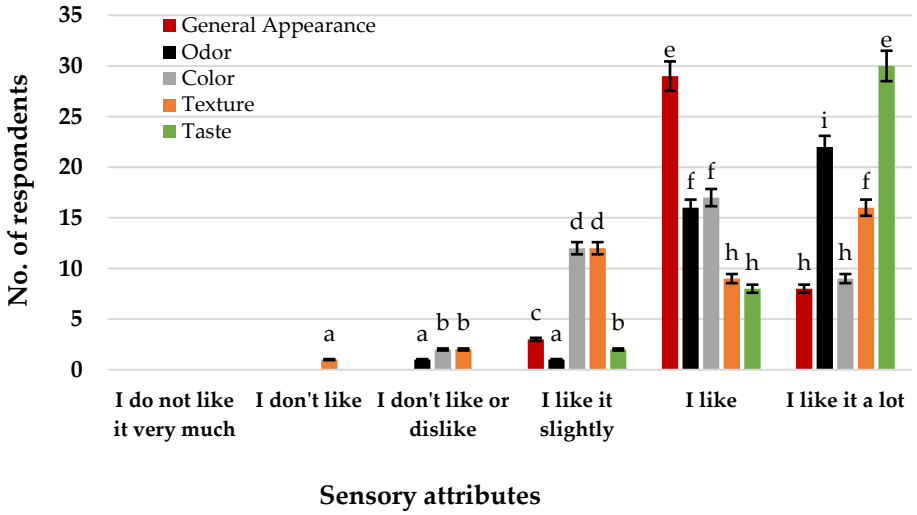

Figure 1. Results of sensory analysis of lentil and turmeric flour-based pastas. Different letters in the columns are minimal significant differences according to the DMS-Anova test ($p < 0.05$) between the formulations for each sensory attribute. The vertical bars correspond to the standard error. n = 3. *General appearance:* The general appearance at first glance is pleasant, it manages to preserve the essential characteristics of a commercial pasta, it is highly liked by the panelists. *Smell:* A smell very similar to a commercial pasta was achieved, therefore it was very characteristic of the pasta, the smell of lentils is not perceived as strong, so it was accepted by the panelists. *Color:* Depending on the lentil, the pasta was obtained with a greenish-yellow color, the greenish color disappeared when it was passed through the convective dryer, preserving its authenticity in the color of a commercial pasta. *Texture:* the texture of the product is very pleasant both to the palate and to the eye, in a certain way it looks very well presented, but it is possible to demonstrate its artisanal process, therefore its acceptance was neutral. *Taste:* The lentil has a very particular flavor but when making this combination the flavor of the pasta does not change, it remains exactly the same, the lentil does not achieve any unpleasant or abrupt change, but rather it preserves its natural flavor of a commercial pasta, the acceptance by the panelist was very positive.

3.3. Determine the Physicochemical and Microbiological Properties of a Paste Based on Lentil and Turmeric Flour according to NTC 1055

A food product must follow strict microbiological standards in order not to become a risk to human health. Currently, in Colombia there are technical standards that establish microbiological quality criteria for a large part of the food sector; Due to this, this work uses NTC 1055 (2007) as a reference, which considers the microbiological parameters and establishes a maximum number of total coliforms of 100 UFC/g, of Bacillus cereus 100 UFC/g, absence of Escherichia coli, Molds and Yeasts 5000 UFC/g, absence of Salmonella spp and less than 200 CFU/g, of Staphylococcus aureus coagulase positive.

Table 2. Microbiological characterization of the pasta made from lentil and turmeric flour.

Determination Microbiological	Units	NTC 1055	Result	Specification
Bacillus cereus	ufc/g	100	60	Does not record
Total Coliforms	ufc/g	200	150	Does not record
Escherichia coli	ufc/g	<10	<10	Does not record
Molds and yeasts	ufc/g	5000	<10 Molds, 2560 Yeasts.	Does not record
Salmonella spp.	Absence	Absence	Absence	Does not record
Staph*ylococcus aureus* coagulase positive	ufc/g	200	<100	Does not record

Source: CICTA food laboratory report, (2023).

Table 3 shows the results of the physicochemical analyzes carried out by the CICTA Accredited Food Laboratory, where it can be analyzed that the pasta made from lentil and turmeric comply with the provisions of NTC 1055 with respect to ash and protein.

Table 3. Physicochemical characterization of lentil and turmeric-based pasta.

Parameter	Units	NTC 1055	Minimum Values Result
Humidity	%	13-14	25.66
Ashes	%	1.4	1.44
Protein	%	10,5	13.16

Source: CICTA food laboratory report, (2023).

The moisture analysis of lentil and turmeric-based pastas has a moisture content higher than the NTC, studies carried out by Garcia et al., [14] indicated that this percentage is allowed since it does not exceed 30% moisture, other In research where lentil flour is used for other products, it reaches more than 50% humidity. This is because lentils retain moisture significantly and they are fresh products.

The ash analysis showed that there are no significant differences between the data obtained, where the minimum values allowed are 1.4%, the paste sample being 1.44%. The protein in the analysis of the lentil and turmeric-based pasta sample is 13.16%, higher than that required by the NTC, which means that the incorporation of lentil into the formulation increases the percentage of protein significantly.

4. Conclusions

It was possible to elaborate and standardize the formulation of a lentil and turmeric-based paste, which is suitable for human consumption, rich in protein, and also complies with the microbiological and physicochemical parameters required by the NTC (1055), therefore it can be concluded that the objectives proposed in this research were achieved. The final result of this project was the creation of a pasta based on lentils and turmeric, which complies with the physicochemical and microbiological parameters established by the NTC (1055), as well as being delicious and healthy for all types of consumers.

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