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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 pasta, where three formulations were evaluated. The elaboration process was carried out, and, subsequently, the physicochemical, microbiological and sensory properties of the pasta were as well (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 staple product of the family diet.

Keywords: pasta; lentil flour; vegetable protein; turmeric

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1. Introduction

The current situation in the world of hunger and malnutrition has led to proposals for a global solution. This was established as a sustainable development goal (SDG), which is why trends have emerged to determine the use of protein sources that allow for a reduction in the unavailability of protein products for the exponentially increasing population [1]. Based on this need, studies have been carried out whose purpose is to find new technologies that allow for the use of known protein sources [2].

Colombia has been considered a food dispenser for the world due to its biodiversity, but malnutrition is a problem presently affecting the Colombian population's health. The low consumption of proteins in the Colombian diet, which, according to data from the nutritional survey, shows a deficiency in protein consumption that affects 36.6% of the population—even higher in minors—generates problems that lead to poor brain development and growth complications, among others [3].

Legumes are characterized by containing a high percentage of protein (20–45%) and are a complement of 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 and sodium; vitamins such as B1, B2, B3, B5, B6, B9, A, C, K and E and components such as proteins, carbohydrates and fiber [6].

Similarly, different agri-food industries use spices mainly for their flavor contributions. Currently, different spices are used to provide these 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 pasta based on lentil and turmeric, combining the nutritional and functional properties of both ingredients (lentil and turmeric). The physicochemical and microbiological properties of the pasta 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, the lentils 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 acquisition, 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 that were prepared 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 established 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 analyses 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) to 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 self-evaluation 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 analyses were carried out according to NTC 1055 [11], which establishes a determination of humidity, ashes and proteins.

3. Results

3.1. Standardizing the Process of Making a Pasta Based on Lentil Flour and Turmeric

The study was carried out with lentils (Lens culinaris Medik) of adequate weight and size according to NTC 937 [12]. The grain was washed with drinking water and was left to soak for 6 h before cooking, 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 traditional flour, where their textures, colors and handling were compared. The process of finding the right one for the preparation of pasta was carried out in the following way: the formulations were prepared in order to be able to choose and standardize the product, and the most appropriate formulation with which it was possible to substitute traditional flour for lentil flour in a large percentage was chosen. For this, the preparation of the pasta was carried out, where the 3 formulations were made and it was observed what percentage of flour could be replaced without altering the product to be created: pasta. Formulation 2, in which traditional flour was replaced by 60% lentil flour, was determined to be the best standardization of this product.

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" where he used a percentage of 70% lentils in his final formulation for the best sensory value, close to the results obtained in the present investigation (treatment 2) whose final percentage was of 60% lentils, in contrast. Likewise, studies carried out by Dominioni et al., (2015) found that a percentage of 40% lentils in the final formulation were established by sensory analyses (smell, color, flavor and texture), indicating values close to our percentage of lentil flour used.

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

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

For the evaluation 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 that the results of the sensory analyses in the selected sample were as follows: it shows the acceptance of the panelists in the choices of I like it and I really like it on the hedonic scale.

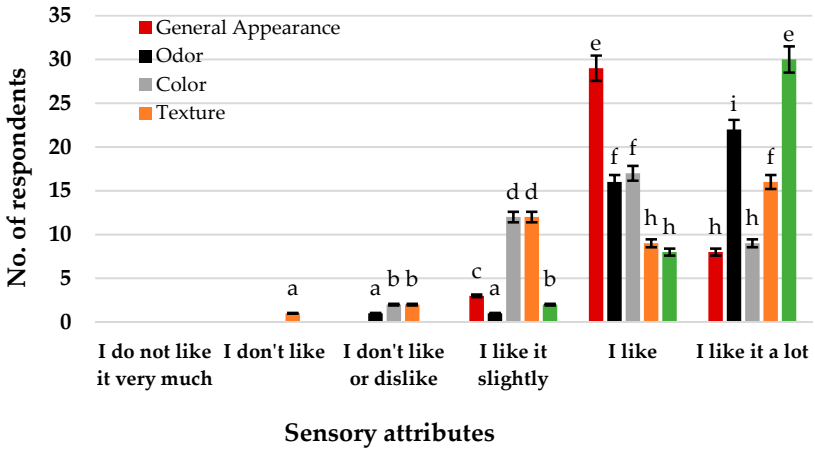

Figure 1. Results of sensory analysis of lentil flour and turmeric-based pastas. Different letters in the columns are minimal significant differences between the formulations for each sensory attribute according to the DMS-Anova test ($p < 0.05$). The vertical bars correspond to the standard error, where 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 pasta; the smell of lentils is not perceived as strong, so it was accepted by the panelists. Color: depending on the lentil, the pasta had a greenish-yellow color, the greenish color disappeared when it was passed through the convective dryer, preserving the authenticity of the color of a commercial pasta. Texture: the texture of the product is very pleasant both to the palate and to the eye, it looks well-presented, but it is also 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 produce any unpleasant or abrupt change, but rather it preserves the natural flavor of a commercial pasta; the acceptance by the panelists was very positive.

3.3. Determination of the Physicochemical and Microbiological Properties of a Pasta Based on Lentil and Turmeric Flour According to NTC 1055

A food product must follow strict microbiological standards to not 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 takes as reference NTC 1055 (2007), Table 2 shows the results of the microbiological characterization of the pasta made with lentil flour and turmeric and establishes the following maximums: total coliforms of 100 CFU /g, Bacillus cereus 100 CFU/g, absence of Escherichia coli, Molds and Yeasts 5000 CFU/g, absence of Salmo-nella spp and less than 200 CFU/g, 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
Staphylococcus aureus coagulase positive	ufc/g	200	<100	Does not record

Source: CICTA food laboratory report, (2023).

Table 3 shows the results of the physicochemical analyses carried out by the CICTA Accredited Food Laboratory, where it can be seen that the pasta made from lentils and turmeric complies 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).

In studies carried out by Garcia et al. [14], moisture analyses of lentil and turmeric-based pastas show a moisture content higher than that allowable by the NTC, reaching values higher than 50% humidity. This is because lentils retain moisture significantly as they are fresh products. In our study, the moisture percentage is allowed since it does not exceed 30% moisture.

The ash analysis showed that there are no significant differences between the data obtained, where the minimum values allowed are 1.4%, the pasta 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 lentils into the formulation increases the percentage of protein significantly.

4. Conclusions

It was possible to prepare and standardize the formulation of a lentil and turmeric-based pasta 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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Data Availability Statement: Data is available from the correspondent author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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