

Physicochemical Characterization of Protein Concentrates Obtained from *Phaseolus lunatus*

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Abstract

The protein concentrates of *Phaseolus lunatus* were characterized physicochemically. The protein concentrate was obtained from an integral flour determining flour / water ratio, time, pH and temperature. For the determination of the chemical characteristics, the proximal analyzes were carried out: humidity, crude protein, total solids. Regarding the physical characteristics, color, odor and texture were evaluated, taking descriptive scales, using tests of preference with hedonic scales. Reaching a final product with more than 60% protein. The product contains 10% moisture and approximately 28% total solids. It presents a light color, pleasant smell and smooth homogeneous texture.

Keywords: Legumes, Proximal analysis, Proteins, Food technology

Introduction

As the world population grows, the need to increase food production is generated [1]. The science of food today aims to contribute to the development of food products with highly nutritional value and that possess functional or technological capacity, aimed at attacking the problem of hunger [2].

In the Colombian Caribbean coast, there is a wide variety of crops, among which are some legumes, one of these species is the Zaragoza Bean, its nutritional properties and the way of consumption are very similar to those of the Common Bean, and it becomes in an alternative for use in the food industry [3]. Although its production is very reduced due to the rural exodus and the change of peasant customs; however, work has been developed for the recovery of this species [4].

Zaragoza Bean is a nutritious food product and is excellent for obtaining a variety of processed forms, such as canning, freezing quickly, dehydrating; being an important product in the industry of elaboration of vegetables in developed countries [5, 6]. Concentrates and protein isolates can also be obtained from this raw material because they have a representative percentage of proteins that allow their use in food systems thanks to their functional properties, which were evaluated during this investigation [7]. For all the above in this work, the protein concentrates of *Phaseolus lunatus* were characterized physicochemically.

Materials and methods

Selection of raw material

Seed bean Zaragoza (*Phaseolus lunatus*) of commercial variety duly selected to obtain a representative sample, taking as a universe of study grains of this product.

Preparation of flour samples

To obtain the integral flour, the following stages were carried out [8]:

- 1) Conditioning: In this first operation, the raw material was weighed, then washed and disinfected in a 150 ppm sanitizer solution.
- 2) Classification: Grains that were not healthy and that did not comply with the phytosanitary conditions were eliminated.
- 3) Drying: This operation was carried out by exposing the product directly to the sun.
- 4) Ground: This operation was necessary to perform it four times, in order to obtain a low tegument flour and achieve a finer and more homogeneous material.
- 5) Sieving: A 1 mm² area sieve was used. Once the flour was obtained, a 50 gram sample was taken to perform the proximal analyzes.

Chemical characteristics

For the determination of the chemical characteristics, the proximal analyzes were carried out: humidity, crude protein, total solids [9].

Moisture: It was obtained by means of drying, using a muffle.

Raw protein: It was determined by the Kjeldahl method.

Total solids: They were obtained by differentiation.

Physical characteristics

For the determination of these characteristics, color, odor and texture were evaluated, taking descriptive scales, using tests of preference with hedonic scales, which consisted of choosing the appropriate characteristic of a series of different degrees of intensity. It was done with a group of 10 untrained panellists [8].

For the color: five degrees of intensity were taken: 1 very light, 2 light, 3 neither light nor dark 4 dark and 5 very dark.

For the Odor: The following degrees of intensity were taken: 1 very pleasant, 2 pleasant, 3 little pleasant and 4 unpleasant.

For texture: The following degrees of intensity were used: 1 Very large, 2 Slightly thick, 3 Soft and 4 Very soft.

Results

Preparation of flour samples

1000 grams of bean grains previously selected and disinfected were taken, which were ground and sieved, obtaining 818 grams of wholemeal flour and 182 grams of shells and other particles, having a yield of 77.8%.

The whole meal was subjected to a bromatological analysis, which is shown in Table 1, which was compared with an integral bean flour of another very common commercial species, obtaining the following results.

Table 1 Bromatological composition of fríjol Zaragoza

Composition	Units	Method	Commercial species	Native species
Proteins	%	Kjeldalh	20.75	26.25
Humidity	%	Gravimetry	12.46	13.98
Fat	%	Soxleth	1.76	1.09
Carbohydrates	%	Differentiation	66.03	58.68

The integral flour of zaragoza presented a bone white color with small particles of vinotinto color (residues of tegumento) and characteristic odor, in addition the percentage of proteins is higher than the one of the commercial species, being of great interest for science and technology of the foods.

Protein extraction method

The extraction of proteins was carried out following the technological line used to obtain protein concentrate, which is sustained in two stages. The first stage, the effect of the relationship was studied: load, water and treatment time, data shown in Table 2.

Table 2 Effect of flour-water relationship and load on the distribution by products of zaragoza beans proteins at different times

Integral flour - water ratio	Time (hours)	Load flour (grams)	Protein content in the concentrate
1:5	0.5	100	47.63
1:6	0.5	100	48.75
1:7	0.5	100	50.00
1:8	0.5	100	52.81
1:5	1	100	55.19
1:6	1	100	56.13
1:7	1	100	60.81
1:8	1	100	56.25
1:10	1	150	42.31

As it is observed, when increasing the water ratio in the flour, the amount of protein that is solubilized is greater until reaching the load-flour ratio 1: 7, as this ratio increases the protein percentage is lower, increasing the amount of residue amylase, this may be due to the increase of the amount of solvent, decreasing the ionic strength and therefore the solubility of the proteins; therefore, the yield of the extraction decreases.

The results show that the most suitable parameters for the extraction were a ratio of flour-water 1: 7 with a load of 100 grams at pH 7 and constant agitation for one hour at 40 ° C. In the later stage, the effect of pH on extraction, with the related conditions, was evaluated. The results are shown in the graph and Table 3.

Table 3 Effect of pH on the extraction of bean proteins from zaragoza

pH	% of proteins in the concentrate
6.5	56.5
7	60.61
7.5	56.7
8	61.8

As shown in Figure 1, pH 8 is the optimum for the extraction of proteins, since the solubility of proteins at alkaline pH is higher, obtaining a protein percentage of 61.8%, and a yield of 22.6% per 100 grams of wholemeal flour.

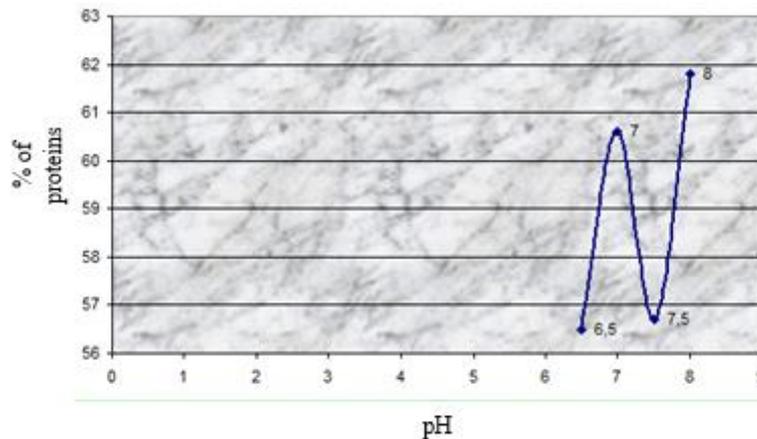


Figure 1 Effect of pH on the extraction of bean proteins from zaragoza

Chemical characteristics

Once the clot is dehydrated by lyophilization, a concentrate with 10% humidity, 61.8% protein and 28.2% total solids results.

Physical characteristics

The results obtained in the sensory evaluation, highlight that from the zaragoza beans, the native legume species with 26.25% protein, a concentrate with more than 60% of proteins with optimal extraction conditions at pH 8 and a flour ratio is obtained. - Water 1: 7 at 40 ° C for one hour. The product contains 10% moisture and approximately 28% total solids. It presents a light color, pleasant smell and smooth homogeneous texture.

Conclusion

From the results presented, from their discussion and from the background of the literature exposed through the article, the following main conclusions can be obtained: A final product with more than 60% protein was reached. The product contains 10% moisture and approximately 28% total solids. It presents a light color, pleasant smell and smooth homogeneous texture.

References

- [1] J. Jaimes, I. Rios and C. Severiche, Nanotechnology and its applications in the food industry, *Revista Alimentos Hoy*, **25** (2017), 51 – 76.
- [2] J. Jaimes, Y. Marrugo and C. Severiche, Toxins in the Environment and Food Safety, *Cap & Cua*, **6** (2014), 16 – 23.

[3] I. Diaz, M. Ahumado, E. Bedoya, L. Ballesteros, C. Diaz, C. Severiche and A. Torregroza, Effect of transpiration in post-post-state condition on the agroindustrial quality of *Chrysobalanus icaco* L fruit variety, *Contemporary Engineering Sciences*, **10** (2017), 1517 – 1527.
<https://doi.org/10.12988/ces.2017.79109>

[4] Y. Marrugo, D. Ramirez, N. Trujillo, C. Severiche and J. Jaimes, Development of a scalded meat product added with modified bean starch Zaragoza (*Phaseolus lunatus*) red variety, *Contemporary Engineering Sciences*, **10** (2017), 1473-1483. <https://doi.org/10.12988/ces.2017.7886>

[5] Y. Marrugo, I. Rios, C. Martínez, C. Severiche and J. Jaimes, Elaboración de un alimento tipo compota utilizando como espesante el almidón del frijol Zaragoza (*Phaseolus lunatus*), *Revista de Investigación Agraria y Ambiental*, **8** (2017), 119 – 125.

[6] Y. Marrugo, C. Blanco, C. Severiche and J. Jaimes, Effect of Acetylation of Bean Starch Zaragoza (*Phaseolus lunatus*) Red Variety on its Functional Properties, *International Journal of ChemTech Research*, **10** (2017), 506-514.

[7] Y. Marrugo, C. Vargas, C. Severiche, J. Jaimes and E. Bedoya, Evaluation of the Functional Properties of Bean Starch Zaragoza (*Phaseolus lunatus*) White Variety in a Food Type Sausage, *International Journal of Engineering and Technology*, **9** (2017), 3674 – 3679.
<https://doi.org/10.21817/ijet/2017/v9i5/170905068>

[8] J. Jaimes, J. Torres and C. Severiche, Analysis of the quality of a scalded meat product made with *Prosopis juliflora* flour, *Ingenium*, **9** (2015), 21-28.
<https://doi.org/10.21774/ing.v9i26.590>

[9] J. Jaimes, A. Acosta, C. Severiche, Y. Marrugo and E. Bedoya, Evaluation of the Functional Properties of *Prosopis juliflora* Protein Concentrate Obtained by Different Methods, *International Journal of Engineering and Technology*, **9** (2017), 3841-3847. <https://doi.org/10.21817/ijet/2017/v9i5/170905128>

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