POTENTIATION OF THE CONTRIBUTION OF MACRO AND MICRO NUTRIENTS OF (*lupinus mutabilis* south americam lupine) through germination

CLAUDIA AMPARO VELÁSQUEZ CALDERÓN
cavelasquez@utn.edu.ec
https://orcid.org/0000-0003-4173-6818
Magister en alimentación y Nutrición
Universidad Técnica del Norte
Avenida 17 de Julio 521 y General José María Córdoba Sector el Olivo
Ibarra Ecuador

IVONNE ALEXAIDA PERUGACHI BENALCÁZAR
iaperugachi@utn.edu.ec
https://orcid.org/0000-0002-9278-103X
Magíster en Nutrición Clínica
Universidad Técnica del Norte
Avenida 17 de Julio 521 y General José María Córdoba Sector el Olivo
Ibarra Ecuador

JUAN ANÍBAL LECHÓN SANDOVAL
jalechon@utn.edu.ec
https://orcid.org/0000-0001-8292-1492
MASTER UNIVERSITARIO EN NUTRICION Y METABOLISMO EN LA ESPECIALIDAD EN INVESTIGACION
Universidad Técnica del Norte
Avenida 17 de Julio 521 y General José María Córdoba Sector el Olivo
Ibarra Ecuador

CARLOS MAURICIO SILVA ENCALADA
cmsilva@utn.edu.ec
https://orcid.org/0000-0002-3690-0831
Magister en alimentación y Nutrición
Universidad Técnica del Norte
Avenida 17 de Julio 521 y General José María Córdoba Sector el Olivo
Ibarra Ecuador

ABSTRACT: This project was presented aiming to potentiate the nutritional value of the chocho/lupine, through the germination process; and promote its bioavailability to take full advantage of its nutritional content for the human organism. For this study, the variety of bean used was the (*Lupinus mutabilis* Sweet), known as the ¨Andean 450¨ according to the INIAP, (6-7 mm diameter) suitable for the germination process. Prior to this, the legume in its original state (raw and dried) was subjected to hydration for 7 to 8 hours, a necessary process to activate its enzymatic inhibitors. After the time, the water was disposed and the seeds were set to the germination phase for 3 to 4 days, at room-temperature, between

20°C to 22°C, in order to allow the activation of their nutrients with the appearance of the radicle. Then, the germinated grass was cooked at 92°C for 30- 45 minutes. Finally, it was washed under running water for a period of 8 to 24 hours to completely eliminate the residues of alkaloids emitted during cooking which will allow to get rid of the bitterness of the bean. By draining the seeds, the product will be ready to be packed and labeled. Once the process was completed, the lupines were sent to the laboratory for a bromatological analysis.

The bromatological study showed percentages such as 51.70% in protein content, 11.34% fiber; and 0.12% calcium.

KEYWORDS: Lupine, germination, protein, calcium, fiber

INTRODUCTION

Legumes are of great importance for feeding and soil regeneration. These plants have a high percentage of protein, are an accessible and inexpensive food that canreplace meat.

They are very important foods, where they represent an important protein source. In some diets such as vegetarians and in several towns in South America the average consumption of legumes is greater than 25g / person whichrepresents between 10% and 15% of the proteins in the diet. (1)

Some legumes, due to their protein content, exceed that of meat and fish; However, its biological value is lower since the sulfur amino acids methionine and cystine are deficient. (2)

To the nutritional importance of the consumption of legumes, is added the one that is acquired when combined with other foods. (3)

Additionally, legumes provide complex carbohydrates, especially starch, also fiber, vitamins belonging to group B, minerals, such as potassium, phosphorus, magnesium, zinc and especially iron *and* calcium. Recently, the interest of the studyor legumes has increased due to their content in phytochemicals, which biologically active secondary metabolites synthesized by plants. (4)

The United Nations Assembly proclaimed 2016 as the "International Year of Pulses" (IYP). The is the only edible grain legume native to the Andes and its cultivation is maintained in different production systems, from Ecuador to Chile and northeastern Argentina; it played an important role in the high Andean production systems and in the feeding of the indigenous population, before the Spanish conquest.

In colonial and republican times, these crops were devalued, their consumption was reduced to a minimum and some agricultural systems disappeared. Despite this marginalization, indigenous communities in the Andean countries have conserved and used the genetic variability of these crops until today.

From popular knowledge and ancestral knowledge, medicinal usesof are reported, such as: it helps reduce muscle pain by applying plasters with the water of the debitter; or it can eliminate external parasites from animals. In the current literature, it is recognized that lupine oligosaccharides preventconstipation, reduce cholesterol and blood pressure; isoflavones, decrease the risk of certain types of cancer, osteoporosis and cardiovascular diseases.

Clinical studies conducted in Ecuador report that both the bitter grain and theextracts of alkaloids had an effect on lowering glucose levels in patients with type II diabetes mellitus.

This crop is generally developed between 2800 to 3500 meters of altitude, in areas with low precipitation (300 to 600 mm), and depending on the altitude and the variety planted, the crop cycle ranges from 180 to 240 days. Traditionally, farmers plant it in association with other crops, without tillage and without cultural work. (5)

To eliminate the principles that caused bitterness, primitive man learned to remove them by cooking and washing them in water.

The most traditional forms of consumption of are: grain only, accompanied by toasted corn, onion, in chili, sauce; and, only 4.8% (Imbabura) use it in processed flour form. (6)

The is used both for human food, and to maintain the richness of the land since it fixes nitrogen from the soil, by the nodules of its roots. (7)

The bad reputation of legumes in history is associated with the lower classes and do not present a continuity in gastronomy, however for the human being they are very important not only in their diet but in their lives. (8)

The proteins of legumes havea lower digestibility than those of animal origin due to both their structure, which hinders the action of digestive enzymes, and the presence of non-nutritive factors such as protease inhibitors of the trypsin and chymotrypsin type, pero the heat treatment occurs the inactivation of inhibitors decreasing their impact. (6)

The search for strategies that enhance the nutritional characteristics of foods, as well as the various forms in uses andpreparations, could be in the short term, necessary elements that improve the food/nutritional situation of the country; especially deficiencies or deficiencies of specific nutrients for the growth, development and sustainability of an adequate health and nutrition status.

Sprouts or sprouts are foods characterized by improved nutrients in relation to the same food without germinating, beneficial to health because they contain antioxidants such as vitamin C. (9)

They are left to developpot in a moist, dark, hot environment with enough oxygen. The content of vitamins, minerals and amino acids increases considerably. (10)

Vitamins that can increase their content when germinating are:

- Vitamin C: Increases especially the first days of germination in soybeans, wheat, lentils and chickpeas among others.
- Vitamin A: Quadruples in sprouted alfalfa. And not so much, in cabbage seeds and peas.
- Vitamin E: We can increase its content in rye, oat, alfalfa and almond sprouts.
- Vitamins K: Mainly in alfalfa sprouts.
- Vitamins B1, B2 and B3: Increase in the sprouts of alfalfa, wheat, almonds, rye, and sesame.
- Minerals: In general, we canconsider increasing calcium, iron, potassium, iodine, zinc, selenium, chromium, cobalt and silicon.
- Amino acids. The sprouts provide us with complete proteins, which is ideal for the athlete and his muscular recovery after exercise. (10)

Pose innumerous virtues: they are very easy to digest, are rich in proteins, vitamins, minerals, amino acids, enzymes and carbohydrates, and are also hypocaloric. They help fight anemia and represent energy savings since they are "pre-digested" foods. (11)

Especially legumes, they provide the body with complete proteins that are transformed into the eight essential amino acids. The lack of a single one can favor the appearance of

allergies, weakness, poor digestion, deficiencies in the immunit or premature aging of cells. (11)

When eaten raw, enzymes in sprouted seeds called diastase facilitate the digestion of fiber, protein, and fat. (11)

These foods, in addition to nourishing, give physical and mental well-being,reduce risks of disease, prevent or delay disorders or diseases (7).

Properties:

Sprouts help prevent diseases or treat them if they have already manifested. The following properties are highlighted:

- They favor the processes of detoxification, purification and elimination of waste stored in tissues or blood
- Strengthen the immune system
- Antioxidants, fight the action of free radicals
- Stimulate secretions from the pancreas
- They facilitate digestion, activate the processes of regeneration and inflammation of the digestive system, revitalize the internal metabolic mechanisms
- Improve intestinal function, relieve constipation, strengthen the intestine and intestinal flora, contribute to eliminate gas and waste
- Lower cholesterol
- Tone the nervous system
- They contribute to maintaining the elasticity of the arteries and the vitality of the glandular system

- Delay aging, its components allow the body's cells to stay young for longer
- They promote metabolism by their reconstituent action
- Its consumption is recommended in cases of anemia due to its richness in chlorophyll, and for people with a delicate stomach. (11)

MATERIALS AND SUPPLIES:

- Plastic tub
- Seeds of variety INIAP 450 Andino
- Drinking water
- Glass container with lid and labeling
- Bromatological laboratory chemical materials and inputs
- Lab Report

METHODS:

Quasi-experimental study of longitudinal cut period 2017 – 201 8,carried out in the different spaces within the university, such as in the Physical, Chemical and Microbiological Analysis Laboratories of the Campus of the Technical University of the North Hospital San Vicente de Paul.

For the present work, theuse of seeds of good quality, varietal purity, physical purity, vigor, good germination and free of transmissible pathogenic organisms was considered; for

which the INIAP 450 Andean variety was considered, since it has been evaluated in transformation processesor with added value for human consumption. (12)

Physiologically, germination begins with biochemical reactivation, and ends with the emergence of the radicle. (13)

Aerobic germination: The process by which the seed is moistened and releasedinto contact with the air for a defined period of time.

1. Classification: it must be taken finds the size and form in which it is found, that is, the seed does not have to be subjected to any cooking time, so that it is calleda living seed otherwise it will not be able to germinate.

2. Hydration: "Activating nuts and seeds consists of soaking them to eliminate their enzyme inhibitors" (14).

This process is carried out by soaking in water the dried seeds that are raw for a certain period oftime of 7-8 hours. The seed is protected by enzyme inhibitors, which protect it until it finds the right environment for its development. Antinutrients when in contact with water are inactivated. Thus allowing the seed toactivate the process of enhancing its nutritional content.

3. Germination: in this phase the absorption of water is reduced considerably, even stopping. (15)

Reserve mobilization begins because when theexpiration components are set in motion germination begins, which includes the mobilization of reserves and seedling growth. (13)

The following metabolisms begin:

- Carbohydrates
- Lipids
- Proteins
- Intrigue

Carbohydrate metabolism

After hydration, gibberellins are released from their synthetic folds.

"Some of these released gibberellins (GA3) are transported from the embryonic axis to the scutellum (cotyledon) and from there released to theendosperm where they diffuse to the aleurone layer" (13).

In the aleurone layer, gibberellins cause the synthesis of hydrolytic enzymes, which in turn go to the mealy endosperm (13).

The enzyme amylase acts on starchby converting it into glucose, which is then used for the synthesis of sucrose (13).

Protein metabolism in legumes

"The reserve proteins are legume and vicilin, they are glycoproteins that contain small amounts of cough carbohydrate"(13)

For the degradation of these proteins, protease enzymes intervene, which stand out are peptidases, which break the polypeptide chains.

There are two types of peptidases:

- Endopeptidases: which destroy the internal bonds of polypeptides.
- Exopeptidases: which release amino acids

In turn, peptides are degraded by peptic hydrolases, also releasing amino acids.

4. Cooking: it should be done at a temperature of 92ºC for a time of approximately 30 to 45 minutes

5. Washing: it must be subjected to a source of constant water flow to eliminate the alkaloids found in the seed already cooked, andthese alkaloids cause the bitter taste of the so through the source water is reduced to the maximum. This should be left for 4-5 days

6. Draining: The residues or excesses of water that the seed has by subjecting it to the avado process are removed.

7. Packaging and labelling: place it in a labelled plastic container; It can already be consumed its duration time is 8 days.

8. Transfer of the samples to the laboratory: once the previous steps have been completed and the procedure has been carried out with theUniversity, the product was left in the hands of the biochemical specialist technician so that within a week the results were delivered.

The methods used for the tests were: protein was AOAC 920.87, Fiber AOAC 978.10 and Calcium SPECTROFOMETRY; the procedure described by the laboratory technician for the analysis was: rinse the sample to remove substrate residues, absorb excess moisture with napkins (at which time some shells were finished) and then put them in the chemical analysis equipment.

RESULTS:

Table 1. Analysis of Protein, Fiber and Calcium of the

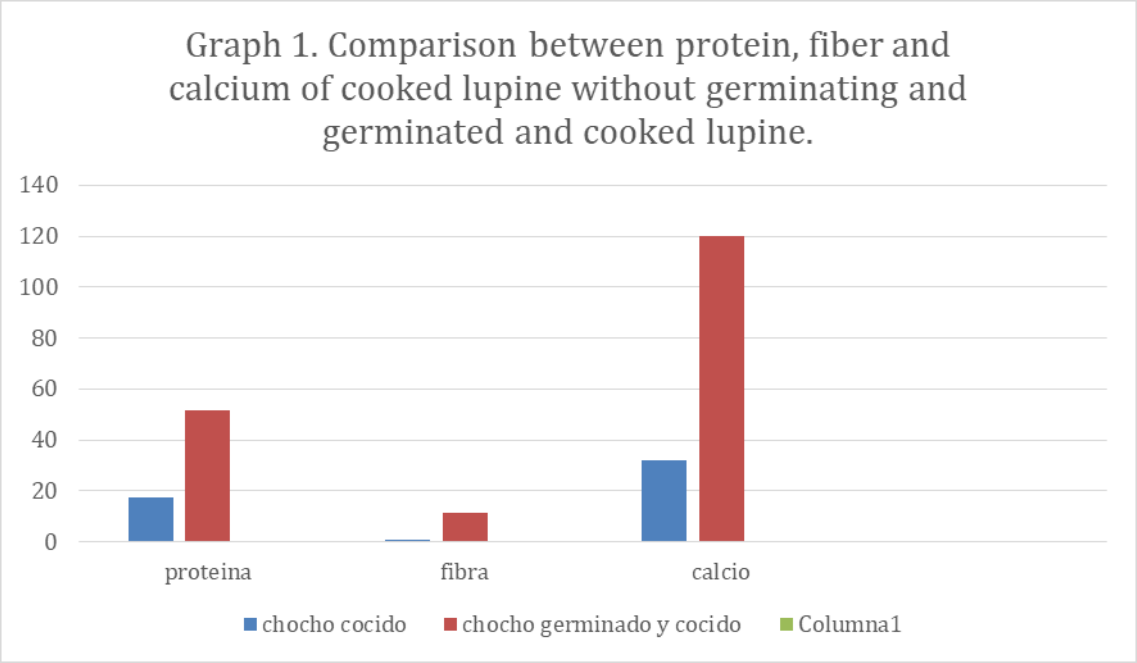
Food	Protein g	Fibre g	Calcium mg
*Cooked pork	17,30	1,00	32,00
**germinated and cooked	51,72	11,34	120,00

*Ibero-American University Foundation, 2005-2017 (16)

**Results obtained from the samples analyzed in the Laboratory of Physical, Chemical and Microbiological Analysis belonging to FICAYA. Resultsexpressed in 100 grams of dry base.

In Table 1. It is presented that in the sample of sprouted and cooked, the values of protein is 51.72%, fiber is 11.34%, and calcium is 120%.

Figure 1. Protein, Fiber and Calcium of the



It was: Prepared by the author

DISCUSSION:

The feasibility of this study was presented both in the selected food and the cost for the bromatological analysis.

In the analysis carried out by the Ibero-American University Foundation 2015-2017 determines that cooked pork has values of proteina 17.30 g, fiber of 1.00 g and calcium of 32.00 mg.

The Bromatological Analysis of the germinated and cooked sample shows high differences in terms of macronutrients and micronutrients; such as protein content at 51.72 g, fiber at 11.34 g and calcium at 120.00 mg.

A similar study conducted at the Polytechnic School of Chimborazo (ESPOCH), performed an analysis of raw sprouts to increase the nutritional value of the grain; shows that: the antinutritional raffinesA, stachyose and alkaloids decreased significantly, while the minerals of the debittered sprouts: Calcium (0.63%), magnesium (0.078%), copper (112ppm), Fe (121 ppm), Mn (101ppm) and zinc (184 ppm), increased. The effectiveness of the germinative processwas especially reflected in the better profile of fatty acids and amino acids of the germinated debittered grain in relation to the ungerminated. (17)

In the annual bulletin of chemical sciences of the Pontificia Universidad Católica del Ecuador, they definethat the is a food with high nutritional value due to the content of protein, water, fats and even its contribution of fiber and carbohydrates. (18)

The comparison between the studies shows that the germination of regardless of whether it is raw or cooked, significantly potentiates macronutrients and micronutrients.

As a weakness presented in the study, it could be mentioned that the specific indications were not given to the laboratory technician, on the management of the sampleunder study, since its shell was lost.

CONCLUSIONS:

1. The sprouted, potentially becomes a "superfood", which would improve the quality of the diet, in all population groups, being a food of easy access and very seesatile in its preparations adapting to the gastronomy of the different regions particularly of the Andean population.

2. The amount of protein, fiber and calcium in the sprouted and cooked pork was considerably increased.

3. Exceeded the standards determined in other analyses referred to by other bibliographic sources

ACKNOWLEDGEMENTS:

We thank the Faculty ofHealth Sciences, of the Technical University of the North for supporting the research project; and the students of the subject of Basic Nutrition II, who collaborated with the bibliographic search.

REFERENCES:

1.	Silva L. www.laverdadeterna.com. [Online].; 2010 [cited 2018 01 07. Available from: www.laverdadeterna.com.
2.	Astiasaran, Iciar; Martinez, Alfredo Jorge; Muñoz, Mercedes. Keys to an optimal diet: what food gives us and how to use it throughout life Madrid: Díaz de Santos; 2015.
3.	Mataix Verdu J. Nutrition for educators. Second ed. Madrid: Fundación Universitaria Iberoamericana; 2013.
4.	www.propagacionvegetal.com. [Online].; 2017 [cited 2018 01 08. Available from: https://propagacionvegetal.wordpress.com/por-semlla/la-germinacion/.
5.	www.fao.org. [Online].; 2016 [cited 2018 01 28. Available from: http:www.fao.org/americas/eventos/ver/es/c/451018/.
6.	Peralta L. E. The in Ecuador. 2016..
7.	Blanco de Alvarado-Ortiz T. Food and nutrition: fundamentals and new citerios [Internet] ProQuest , editor. Lima: Universidad Peruana de Ciencias Aplicadas (UPC); 2015.
8.	Jimeno C, Ron Pedreira AM. Legumes Madrid: CSIC Consejo Superior deInves estigaciones Científias; 2016.
9.	Ponce C. www.utilidadenalimentacion.com. [Online].; 2013 [cited 2018 01 24. Available from: http://www.utilidadenalimentaciondealgunassemillasgerminadas.com.
10.	Lorenzo M. www.enforma.com. [Online].; 2015 [cited 2018 01 26. Available from: https://enforma.hola.com/nutricion/20150813810/propiedades-y-beneficios-alimentos-

	germinados/.
11.	Silva L. www.laverdadeterna.com. [Online].; 2010 [cited 2018 01 22. Available from: http://www.laverdadeterna.com.
12.	Peralta E, Nelson M. Agricultural Manual of Andean Grains. 2012..
13.	Propagación vegetal. [Online].; 2017 [cited 2018 Enero 14. Available from: https://propagacionvegetal.wordpress.com/por-semilla/la-germinacion/.
14.	D. D. www.mywholisticicle.com. [Online].; 2015 [cited 2018 Enero 15. Available from: http://www.mywholisticlife.com/2015/05/activar-frutos-secos/.
15.	Euita. [Online].; 2003 [cited 2018 Enero 14. Available from: http://www.euita.upv.es/varios/biologia/temas/tema_17.htm.
16.	www.composicionnutricional.com. [Online].; 2005-2017 [cited 2018 01 27. Available from: http://www.composicionnutricional.com.
17.	Allauca V. www.iniap.gob.ec. [Online].; 2005 [cited 2018 01 30. Available from: http://repositorio.iniap.gob.ec/bitstream/41000/1424/1/iniapscta416d.pdf.
18.	Annual Bulletin of Chemical Sciences, Pontificia Universidad Católica del Ecuador. 2015.