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Sensorial acceptability of "leguvoron" and nutritional profile of the different legumes used

Dr. Gloria T Tariga[1], Doname A Reyes[2], Krystal Gay T SO[3]
[1-3] Isabela State University, Roxas Campus, Roxas, Isabela, Philippines

Abstract
Sensory evaluation of "Leguvoron" was done to determine the acceptable level of the different leguvoron product and to compile the nutritional value of the different legumes used in this study. There were three (3) legumes used such as Snap bean (*Phaseolus vulgaris*), Cowpea (*Vigna unguiculata)* and, Mungbean (*Vigna radiate*) at different rations/ concentration at 0, 10, 20, 30 and 40 grams respectively. Purposive sampling was used in the selection of the 150 respondents. The result shows that in general acceptability, Snap bean (SB) with different concentration was equally accepted by the panelist. Furthermore, leguvoron with 10 grams of Cowpea (CP) and 20 grams of Mungbean (MB) added was also highly accepted compared to other concentrations. The most acceptable legumes and rations were mungbeans (MB) at 20 grams of Legume flour (LF), respectively. The nutrient profiling of the different legumes was compiled and it was observed that the nutrient of each legume contains differently.

Keywords: mungbeans, Mungbean, legumes, *Vigna unguiculata*, *Vigna radiate*

1. Introduction

Food processors are faced with increased demand by health professionals and consumers for healthier and fortified food products. Researchers have developed some food ratios and continuously developing to produce healthy foods to answer the problems of malnutrition and hunger in the world.

Polvoron which is considered a delicacy, dessert or snack is really liked by children especially those who are in the elementary, high school, college students and even professionals and household members.

The original polvoron is made up of flour which is more on carbohydrates. Through this research study, the original polvoron will be fortified by adding legume which has a very high nutritional content and a significant source of protein, dietary fiber, and micronutrients like folate, thiamine, manganese, magnesium, and iron. The improved polvoron or polvoron with legume is termed leguvoron. Polvoron is a semi-sweet concoction made of toasted flour, powdered milk, sugar, and butter. This is considered a dessert or snack in the Philippines wherein roasted rice puffs referred to locally as "pinipig" is added.

A legume is a plant in the family Fabaceae (or Leguminosae), or the fruit or seed of such a plant. Legumes are grown agriculturally, primarily for their food grain seed (e.g. beans and lentils, or generally pulse), livestock forage and silage, and as soil-enhancing green manure [1]. Legumes are notable in that most of them have symbiotic nitrogen-fixing bacteria in structures called root nodules.

Legumes are a significant source of protein, dietary fiber, carbohydrates, and micronutrients, including folate, thiamine, manganese, magnesium, and iron. The leguminous plant is an erect or climbing bean or pea plant of the family.

Snap bean (*Phaseolus vulgaris*) is a warm season crop in the legume family, well-suited to small-scale and part-time farming operations. It is known as 'green beans' or 'habitchuelas' is an annual legume grown for its tender green pods or seeds. Snap beans are rich sources of beta-carotene, fiber, potassium, calcium, and phosphorus, but are very low in calories and contain no fat, sodium, or cholesterol. Snap bean is one of the popular legumes in the Philippines. It is known for its richness in protein which can is a good substitute for meat especially in places where there is an inadequate supply of animal protein. Green pods can also be eaten as a side dish or mixed in a stew with meat, fish and other vegetables in so many variations [2].

Cowpea (*Vigna unguiculata)*, are grown mostly for their edible beans, although the leaves, green peas, and green pea pods can also be consumed, meaning the cowpea can be used as a food source before the dried peas are harvested [3]. Like other legumes, cowpeas are cooked to make them edible, usually by boiling [4]. Cowpeas can be prepared in stews, soups, purees, and casseroles, but the most common way to eat them is in curries [5]. They can also be processed into a paste or flour. Cowpeas seeds provide a rich source of proteins and calories, as well as minerals and vitamins [6].

Mungbean (*Vigna radiate*) is mainly cultivated in East Asia, Southeast Asia, and Indian subcontinent. It is used as an ingredient in both savory and sweet dishes. In the Philippines, *ginisáng monggó* (sautéed mungbean stew), also known as *monggó guisado* or *balatong*, is a savory stew of whole mung beans with prawns or fish. It is traditionally served on Fridays of Lent when the majority Roman Catholic Filipinos traditionally abstain from meat, rants of *ginisáng monggó* may also be made with chicken or pork. Mungbean paste is also a common filling of pastries known as *hopia* (or *bakpia*) popular in Indonesia, the Philippines and further field in Guyana (where it is known as *black eye cake*). In Indonesia, mungbean is also made into a popular dessert snack called *es kacang hijau*, which has the consistency of a porridge. The beans are cooked with sugar, coconut milk, and a little ginger [7]. There are several polvoron recipes available today.

The polvoron recipe that is included in this study is with the combination of a legume which is termed "leguvoron". It is in this context that this study has been conceptualized which

is entitled "Sensorial acceptability of leguvoron" that includes the nutritional profile of the different legumes used in this study.

This study was conducted to determine the sensory acceptability in terms of appearance, aroma, texture, taste, and general acceptability of the product using the 5-point hedonic scale. Likewise, it was done to evaluate the nutritional quality of the different legumes. Specifically, it was studied to determine the most acceptable legumes and rations added to the polvoron. However, the interaction between legumes to different concentration was also analyzed. Furthermore, Pearson correlation was used to determine the relationship among the qualities of the sample bean as leguvoron.

2. Materials and methods

2.1. Legumes flour preparation

Legumes seeds were sorted and washed to remove unwanted particles. Boil it for about 25 minutes without cover. Drained and washed with warm water, then removed the coat and separate the beans from the hull in cold water. Sundry the beans for two days or until it will become crispy and grind until fine.

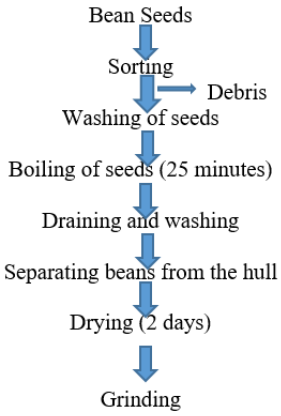

Fig 1: Flow chart of Legume Flour Production

2.2. Leguvoron production

Leguvoron product was developed using the following legumes: Snap bean (*Phasealus vulgaris*), Cowpea (*Vigna unguilulata*) and Mungbean (*Vigna radiata*).

Leguvoron product ratio of wheat to legume flour used is shown in table 1:

Table 1: Ration of wheat flour, legume flour and ingredients' used in each treatment

Sample Codes	Wheat flour (WF) (grams)	Legume flour (LF) (grams)	Sugar (grams)	Star margarine (grams)	Pinipig (grams)	Powdered Milk (grams)
Concentration/ Ration 1	50	0	40	30	10	20
Concentration/ Ration 2	40	10	40	30	10	20
Concentration/ Ration 3	30	20	40	30	10	20
Concentration/ Ration 4	20	30	40	30	10	20
Concentration/ Ration 5	10	40	40	30	10	20

Table 2: Below were the following treatments

Treatment No.	Name of Legumes	The concentration of legume flour (grams)	Treatment Code
1	Snap bean	0	SB0
2	Snap bean	10	SB10
3	Snap bean	20	SB20
4	Snap bean	30	SB30
5	Snap bean	40	SB40
6	Cowpea	0	CP0
7	Cowpea	10	CP10
8	Cowpea	20	CP20
9	Cowpea	30	CP30
10	Cowpea	40	CP40
11	Mungbean	0	MB0
12	Mungbean	10	MB10
13	Mungbean	20	MB20
14	Mungbean	30	MB30
15	Mungbean	40	MB40

2.3. Cooking procedure of Leguvoron

Heat a frying pan or a wok then put-in the flour. Toast the flour until the color turns light brown. Let it cool down for about 10 minutes then transfer to a mixing bowl. Add the powdered milk then stir using a balloon whisk. Put-in the granulated sugar then stir again.

Add-in the legume flour then stir until the ingredient is well distributed. Toast the legume flour again if it not newly cooked for health and safety purposes. Pour in the softened margarine and mix well. After mixing, let it stand for 10 minutes to allow the margarine to cool. This will make the mixture more intact.

By using a molder, scoop the mixture and put it on top of a pre-cut Japanese paper or cellophane then wrap.

2.4 Taste test procedure

Purposive sampling was used in the selection of the respondents. There were 150 panelists that include the following: fifty (50) pupils of Matusalem Elementary School, Roxas, Isabela, fifty (50) high school students of Alicia National High School, Alicia, Isabela and fifty (50) college students of Isabela State University, Roxas Campus, Roxas, Isabela.

2.5 Data gathering instrument

The respondents rated the product through sensory evaluation of color, aroma, texture, and taste using the hedonic scale wherein 1 was the lowest rate of the product and 5 was the highest rate. Get the average in each treatment to determine to rank. The percentage of each criterion was given by the panelist. The percentage given to the color was 20%, the aroma was 20%, the texture was 20% and the taste was 40%. Whereas, the taste of the product was given the highest among criteria.

The following are the description of its corresponding number in the 5-point hedonic scale:

1. Dislike very much
2. Dislike moderately
3. Neither like nor dislike
4. Like moderately
5. Like very much

2.6 Data analysis

Data were interpreted using the Statistical Package for

Social Sciences (SPSS). Frequency and percentages were used to describe the basic profile of the respondents. Two-way ANOVA was used to test the significant differences between treatments.

3. Results

3.1 Basic profile of the respondents

3.2 Color acceptability of the Leguvoron

The color acceptability of polvoron made of different legumes "known as leguvoron" with different concentrations of legume flour was discussed herein.

Among the group of leguvoron Snap bean (SB), with regards to color, it was noted from the table 3 that 10 grams of snap bean flour (SB10), 20 grams of snap bean (SB20), 30 grams snap bean (SB30) and 40 grams of snap bean (SB40) were not significant with each other compared to 0 grams snap bean (SB0). This means that leguvoron product with snap bean flour was significantly accepted by the panelists compared to the leguvoron without snap bean flour (SBOLF).

Among the group of leguvoron Cowpea (CP), it was observed that product with CP10 with a rating of 4.92 got a significant level compared to other concentrations but comparable to CP40.

Among the group of leguvoron Mungbean, it was noted that concentrations of MB20 got the highest mean rating and significantly higher compared to other concentrations. It shows that leguvoron flavored with 20LF mungbean were accepted by the panelists.

Table 3: The color acceptability of the leguvoron

Legumes	0 LF	10LF	20LF	30LF	40LF
Snap bean (SB)	4.68^{de}α:.648	4.88^{ab}α:.357	4.86^{abcd}α:.413	4.78^{abcde}α:.411	4.86^{abcd}α:.413
Cowpea (CP)	4.78^{bcde}α:.411	4.92^{a}α:.347	4.72^{bcde}α:.594	4.72^{bcde}α:. 449	4.88^{ab}α:.389
Mungbean (MB)	4.80^{bcdef}α:.402	4.86^{bcde}α:.442	5.00^{a}α:.640	4.81^{bcdef}α:.423	4.85^{bcde}α:.424

3.3. Aroma acceptability of the leguvoron

The aroma acceptability of leguvoron with different concentration of legume flour was discussed herein.

Among the group of leguvoron SB, it was noted from the table 4 that 10 grams of snap bean flour (SB10) got the highest score of 4.88 with regards to the aroma but comparable to SB20, SB30, and SB40. It was also observed that SB0 was significantly lower compared to other concentrations. This means that leguvoron product with snap bean flour was significantly accepted by the panelists compared to the leguvoron without snap bean flour.

Among the group of leguvoron CP, the table shows that CP10 received an average rating of 4.92 and significantly higher but comparable to CP40. This means that leguvoron product flavored with cowpea at a concentration of 20LF received most favorable by the panelists.

Among the group of leguvoron MB, concentrations of 20LF received a significant rating compared to other concentrations. MB without LF, 10, 30 and 40LF was not significant with each other and comparable with each other. This means, that leguvoron with mungbean at 20LF concentration is most likely by the panelists with regards to the aroma.

Table 4: The aroma acceptability of the leguvoron

	0 LF	10LF	20LF	30LF	40LF
Snap bean (SB)	4.68^{de}α:.648	4.88^{ab}α:.357	4.86^{abcd}α:.413	4.78^{abcde}α:.411	4.86^{abcd}α:.413
Cowpea (CP)	4.78^{bcde}α:.411	4.92^{a}α:.347	4.72^{bcde}α:.594	4.72^{bcde}α:. 449	4.88^{ab}α:.389
Mung bean (MB)	4.80^{bcdef}α:.402	4.86^{bcde}α:.442	5.00^{a}α:.623	4.81^{bcdef}α:.423	4.85^{bcde}α:.424

3.4 The texture acceptability of the leguvoron

The texture acceptability of the leguvoron product with different concentration was discussed herein.

Among the group of leguvoron SB, the leguvoron in terms of texture was highly in table 5 wherein SB with 10LF was significantly accepted higher compare to no LF. However, the 10LF was comparable to SB20 and SB40. This shows that SB with 10LF, 20LF, and 40LF was most accepted by the panelists.

Among the group of leguvoron CP, the product with CP10 got the highest score of 4.93 but not significant to CP0, CP20, and CP40. Statistics show that leguvoron CP without LF and with LF at different concentration were commonly accepted by the panelists except for CP30 with regards to texture.

Among the group of leguvoron MB at the different concentrations shows that there is no significant level except on MB20 with a mean score of 5.00. This means that the product flavored with MB20 was most accepted by the panelists with regards to texture.

Table 5: The texture acceptability of the leguvoron

	0 LF	10LF	20LF	30LF	40LF
Snap bean (SB)	4.55^{g}α:.654	4.92^{b}α:.266	4.78^{bcdef}α:.566	4.72^{cdef}α:.502	4.85^{bcd}α:.355
Cowpea (CP)	4.78^{bcdef}α:.411	4.93^{b}α:.243	4.82^{bcd}α:.497	4.70^{defg}α:. 461	4.88^{bc}α:.424
Mung bean (MB)	4.77^{bcdef}α:.42	4.85^{bcd}α:.424	5.00^{a}α:.640	4.81^{bcde}α:.392	4.81^{bcd}α:.530

3.5 The taste acceptability of the leguvoron

The taste acceptability of leguvoron with different concentration of legume flour was discussed herein.

Among the group of leguvoron SB, it was noted from the table 6 that 20 grams of snap bean flour (SB20) got the highest score of 4.90 with regards to taste but comparable to SB10, and SB40. It was also observed that SB0 was significantly lower compared to other concentrations. This means that leguvoron product with 10, 20 and 40 grams of snap bean flour was significantly accepted by the panelists

compared to the leguvoron without snap bean flour.

Among the group of leguvoron CP, the table below shows that both CP10 and CP40 received an average rating of 4.88 and significantly higher but comparable to CP0 and CP20. This means that leguvoron product flavored with cowpea at a concentration of 10LF and 40LF received most favorable by the panelists.

Among the group of leguvoron MB, concentrations of MB20 received a significant rating with a mean rate of 5.00 compared to other concentrations. Mungbean (MB) without LF, was significantly lower among concentrations of MB. Furthermore, MB with 0LF, 10, 30 and 40 LF was comparable with each other. This means, that leguvoron with mungbean at 20LF concentration is most likely by the panelists with regards to taste.

Table 6: The taste acceptability of the leguvoron

	0 LF	10LF	20LF	30LF	40LF
Snap bean (SB)	$4.71^{efg}\alpha$:.532	$4.83^{bcdef}\alpha$:.266	$4.90^{bc}\alpha$:.341	$4.73^{cdefg}\alpha$:.411	$4.87^{bcde}\alpha$:.413
Cowpea (CP)	$4.72^{defg}\alpha$:.502	$4.88^{bcd}\alpha$:.355	$4.80^{bcdefg}\alpha$:.537	$4.66^{g}\alpha$:. 449	$4.88^{bcd}\alpha$:.389
Mung bean (MB)	$4.71^{efg}\alpha$:.508	$4.87^{bcde}\alpha$:.401	$5.00^{a}\alpha$:.636	$4.78^{bcdefg}\alpha$:.423	$4.85^{bc}\alpha$:.424

3.6 General acceptability of the leguvoron

The general acceptability of leguvoron with different concentrations of legume flour was discussed herein.

Among the group of SB, the table7 shows that there were no significant differences among concentrations. However, based on hedonic score, leguvoron without SB (SB0) and SB40 received both the highest score at 4.90, followed by SB10 at 4.88, SB20 at 4.75 and SB30 at 4.72. Furthermore, all concentrations including the product without SB were comparable with one another.

Among the group of CP, CP20 was significantly lower compared to other concentrations. Moreover, CP0, CP10, CP30, and CP40 were comparable with each other. This means that the said concentrations of cowpea added in the leguvoron product were highly accepted by the panelist compare to CP20. Furthermore, based on the average score, CP10 was rated highest among them.

Among the group of Mungbean (MB), MB20 was significantly higher compared to other concentrations. However, the remaining concentrations were regarded as not significant with each other. In view of this result, it was further notices that MB20 was highly accepted by the panelist compared to others.

Table 7: The general acceptability of the leguvoron

	0 LF	10LF	20LF	30LF	40LF
Snap bean (SB)	$4.90^{bcd}\alpha$:.341	$4.88^{bcde}\alpha$:.423	$4.75^{cde}\alpha$:.605	$4.72^{bcdef}\alpha$:.595	$4.90^{bcd}\alpha$:.376
Cowpea (CP)	$4.86^{bcdef}\alpha$:.443	$4.90^{bcd}\alpha$:.376	$4.71^{ef}\alpha$:.555	$4.86^{bcdef}\alpha$:381	$4.84^{bcdef}\alpha$:.434
Mung bean (MB)	$4.83^{bcdef}\alpha$:.489	$4.89^{bcde}\alpha$:.389	$5.00^{a}\alpha$:.704	$4.83^{bcdef}\alpha$:.489	$4.88^{bcde}\alpha$:.389

3.7 Most acceptable legumes

The different legumes used in this study was further discussed herein. The mungbean (MB) received a significant score compared to SB and CP. Table 8 shows that MB was greatly accepted by the panelist compared to SB and CP.

Table 8: Most acceptable legumes

Legumes	Mean
Snap bean (SB)	4.83^{b}
Cowpea (CP)	4.83^{b}
Mungbean (MB)	5.00^{a}

3.8 Most acceptable rations of legumes

The different concentrations/rations of every legume used in this study were discussed herein. Table 9 below shows that 20LF was significantly higher among all concentrations at a rate of 5.00. Furthermore, 0LF, 10LF, 30LF were comparable to each other while 0, 30 and 40FL were not significant with each other. The result shows that 20 grams of LF were highly regarded concentrations among the panelists.

Table 9: Most acceptable rations of legumes used

Concentrations/Rations of Legumes	Mean
0 grams of LF	4.84^{bc}
10 grams of LF	4.88^{b}
20 grams of LF	5.00^{a}
30 grams of LF	4.83^{bc}
40 grams of LF	4.81^{c}

3.9 Nutritional profile of the different legumes used

3.9. A Nutrition Facts of Snap Bean (SB)

The nutrition facts of SB per 1 cup per serving comprises the following: calories 34, total fat 0.13g, cholesterol 0mg, sodium 7mg, potassium 230mg, total carbohydrates 7.84g, protein 2g, vitamin A 15%, vitamin C 30%, Calcium 4%, and iron 6%. The Percent Daily Values was based on 2000 calorie diet. Nutrition Values are based on USDA Nutrient Database SR18.

Table 10: Nutrition Facts of Snap Bean (SB) per 1 cup of serving size

Amount Per Serving	
Calories from Fat 1	
Calories 34	
	% Daily Values *
Total Fat 0.13g	0%
Saturated Fat 0.029g	0%
Polyunsaturated Fat 0.065g	
Monounsaturated Fat 0.006g	
Cholesterol 0mg	0%
Sodium 7mg	0%
Potassium 230mg	
Total Carbohydrates 7.84g	3%
Dietary Fiber 3.7g	15%
Sugar 1.54g	
Protein 2g	
Vitamin A 15%	
Vitamin C 30%	
Calcium 4%	
Iron 6%	

*Percent Daily Values based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calories needs. Nutrition Values are based on USDA Nutrient Database SR18.

3.9. b Nutrition Facts of Cowpea (CP)

The nutrition facts of CP per 1 cup per serving comprises the following: calories 158, total fat 0.63g, cholesterol 0mg, sodium 376mg, potassium 686mg, total carbohydrates 33.33g, protein 5.2g, vitamin A 26%, vitamin C 6%, Calcium 21%, and iron 10%. The Percent Daily Values was based on 2000 calorie diet. Nutrition Values are based on USDA Nutrient Database SR18.

Table 11: Nutrition Facts of Cowpea (CP) per 1 cup of serving size

Amount Per Serving	
Calories from Fat 6	
Calories 158	
% Daily Values *	
Total Fat 0.63g	1%
Saturated Fat 0.157g	1%
Polyunsaturated Fat 0.264g	
Monounsaturated Fat 0.056g	
Cholesterol 0mg	0%
Sodium 376mg	16%
Potassium 686mg	
Total Carbohydrates 33.33g	11%
Dietary Fiber 8.2g	33%
Sugar 5.3g	
Protein 5.2g	
Vitamin A 26%	
Vitamin C 6%	
Calcium 21%	
Iron 10%	

*Percent Daily Values based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calories needs. Nutrition Values are based on USDA Nutrient Database SR18.

3.9. C Nutrition Facts of Mungbean (MB)

The nutrition facts of MB per 1 cup per serving comprises the following: calories 151, total fat 3.96g, cholesterol 0mg, sodium 466mg, potassium 307mg, total carbohydrates 23.82g, protein 5.2g, vitamin A 158%, vitamin C 6%, Calcium 21%, and iron 10%. The Percent Daily Values was based on 2000 calorie diet. Nutrition Values are based on USDA Nutrient Database SR18.

Table 12: Nutrition Facts of Mungbean (MB) per 1 cup of serving size

Amount Per Serving	
Calories from Fat 36	
Calories 151	
% Daily Values *	
Total Fat 3.96g	6%
Saturated Fat 0.748g	4%
Polyunsaturated Fat 1.212g	
Monounsaturated Fat 1.76g	
Cholesterol 0mg	0%
Sodium 466mg	19%
Potassium 307mg	
Total Carbohydrates 23.82g	8%
Dietary Fiber 8g	32%
Sugar 5.72g	
Protein 5.2g	
Vitamin A 158%	
Vitamin C 6%	
Calcium 21%	
Iron 10%	

*Percent Daily Values based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calories needs. Nutrition Values are based on USDA Nutrient Database SR18.

4. Discussion

The improved "polvoron", when consumed, will help the food industry to create more nutritious food for the children. In addition to the control sample using only wheat flour, three (3) different formulations were prepared using varying wheat and three legume rations. The sensory assessment of the products on the 5-point scale depicted that all products score were more on three of the scale which is an indication that all sensory attributes were positive. Positive purchase intent was noticed among the panel hence offering new sales potential.

In making leguvoron, combine it with flour. Flour is a powder which is made by grinding cereal grains or other seeds or roots (like cassava). It is the main ingredient of bread, which is a staple for many countries, making the availability of adequate supplies of flour a major economic and political issue at various times throughout history.

Snap bean (*Phaseolus vulgaris)* is a warm season crop in the legume family, well-suited to small-scale and part-time farming operations. Snap bean originated in southern Mexico, Guatemala, Honduras, and Costa Rica. Cowpea (*Vigna unguiculata*) is one of the most important food legume crops in the semiarid tropics covering Asia, Africa, southern Europe, and Central and South America. Mungbean (*Vigna radiata*) is a plant species in the legume family. Native to the Indian subcontinent, the mungbean is mainly cultivated today in India, China, and Southeast Asia. It is also cultivated in hot, dry regions in Southern Europe and the Southern United States. It is used as an ingredient in both savory and sweet dishes. Mungbean is one of the cheapest sources of plant protein which contains protein ranging from 22-27%. It is also a good source of minerals such as calcium and sodium. Dried mungbean seeds are high in vitamins A & B.

5. Conclusion

This study was conducted to determine the sensorial acceptability of “Leguvoron” and nutritional profile of the different legumes used.

a. Based on the general acceptability result, the leguvoron at different concentrations among the group of SB were comparable with each other and this means that all concentrations were equally accepted by the panelists. Furthermore, leguvoron with 10 grams of CP and MB20 was highly accepted by the panelists compared to others.
b. The most acceptable legumes and rations were mungbean (MB) and 20 grams of LF, respectively.
c. The nutrient profiling of the different legumes was presented properly and it was observed that the nutrient of each legume contains differently.

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