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Proximate Composition, Mineral Content and Mineral Safety Index of *Lablab Purpureus* Seed Flour

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ABSTRACT

Lablab purpureus is one of the annual forage legumes that is widespread throughout the tropics. Lablab beans have a low market value than other legumes due to it underutilization. The proximate composition and mineral content of *Lablab purpureus* were investigated using Standard Analytical Techniques. *Lablab purpureus* contained low concentration of (g/100g): moisture (6.33), ash (3.87) and crude fat (4.57). The protein concentration was high at 19.4 g/100g but still lower than the recommended value of 23-56 g/100g for human daily requirement. The concentration of carbohydrate was also high in the sample (61.2 g/100g), this being typical of plant sources. Most of the major minerals recorded low concentrations (mg/100g): Na (5.74), Ca (9.90); Mg (10.4) except potassium which was high at 597mg/100. Among the trace metals, Copper (2.84 mg/100g) and Manganese (1.64mg/100g) were low in the sample. Lead was not detected at all in the sample and this is good as it is toxic and not useful for any biochemical process. For calculated mineral ratios, Na/K (0.01) level was lower than the critical level of 0.6 that may enhance high blood pressure in man. Ca/P ratio (0.035) was lower than the minimum requirement of 0.5 for favourable calcium absorption in intestine and for proper bone formation. The results of the mineral safety index showed that the body would not be overloaded with any of the minerals. *Lablab purpureus* consumption should therefore be encouraged because of its high protein contents. However, it should be supplemented with food rich in minerals due to low level of most of the minerals investigated.

Keywords: *Lablab, proximate, minerals safety index*

INTRODUCTION

Lablab (*Lablab purpureus* L.) is a summer-growing annual or occasionally short-lived perennial forage legume largely cultivated in South and Central America, East and West Indies, China, South and South-East Asia and Australia. It is a common bean belonging to the Leguminosae (Fabaceae) family; it originated in Africa and now is cultivated throughout the tropics. It is a twining, climbing, trailing or upright herbaceous plant that can grow to a length of 3-6 m. It has a deep taproot and vigorous, glabrous or pubescent trailing stems. Lablab fruits are linear, 4-15 cm long x 1-4 cm broad, smooth and beaked pods that contain between 2 and 8 seeds. Lablab seeds (beans) otherwise known as hyacinth beans are ovoid, laterally compressed with a conspicuous linear hilum. Lablab beans are variable in colour, depending on variety or cultivar, usually white to dark brown, and some are black. Wild varieties and some cultivated varieties tend to have mottled seeds. [1,2] *Lablab purpureus* is the only species of the Lablab genus. There are three subspecies: *Lablab purpureus* subsp. Bengalensis is found in most tropical areas of Africa, Asia and the Americas, and has distinctive tender fruits up to 15 cm × 2.5 cm. *Lablab purpureus* subsp. purpureus is grown in Asia as a field crop for seeds and fodder. It is a semi-erect bushy perennial usually grown as an annual, showing little or no tendency to climb; the fruits are relatively short, up to 10 cm × 4 cm, and the whole plant is tinged with purple. It has a peculiarly strong and

unpleasant smell. *Lablab purpureus* subsp. uncinatus, of East African origin, has relatively small fruits, 4 cm long × 1.5 cm broad. [3] The origin of lablab is debated and it may have originated either from South or South-East Asia, or from Africa. It was probably dispersed by humans as early as 800 BC and is now widespread throughout the tropics. In Australia, lablab became famous as a forage species with the release of the Rongai cultivar in 1962. [4] Lablab seeds contain antinutritional factors including tannins, phytate and trypsin inhibitors. Processing methods, such as removing the seed coat, soaking and cooking, are effective in alleviating the effects of these factors. [5,6]

There is a pressing need in developing/poor countries for alternative food sources that would be readily available, affordable and at the same time, rich in energy and essential nutrients. Attention, in this regard, is now being paid on neglected and underutilized crops, commonly described as orphan crops. Legumes are now being looked into as alternative sources of protein and minerals especially in developing countries such as Nigeria where animal protein is considered scarce. The present study is therefore aimed at investigating and reporting the proximate and mineral profiles as well as mineral safety index of *Lablab purpureus* in order to enhance its usefulness for both domestic and industrial purposes.

MATERIALS AND METHODS

Sample Collection and Preparation

The variety of the seed used for the study was white. The sample was obtained from a local market in Burnu Kudu, Jigawa State, Nigeria. The sample was sorted and dried under the sun, dry milled to fine powder and stored in a cool, dry place prior to use.

Fifty seeds were thoroughly blended together to ensure homogeneous sample and each analysis was carried out in duplicate.

Moisture Content Determination

The moisture content was determined using oven-drying method as described by Association of Official Analytical Chemists (A.O.A.C.). [7] Clean and dry petridishes were weighed and their weights were recorded (W_1). 3g of the sample was weighed into the dishes (W_2). The petridishes containing the samples were transferred into the oven maintained at temperature of 105^{o}C and dried for three hours. The petridishes were transferred to the desiccators, cool and the weights were noted. The process was continued until a constant weight (W_3) was obtained. The percentage loss in weight during drying was taken to be the percentage moisture content.

$$\%\ moisture\ content = \frac{weight\ loss}{weight\ of\ sample} \times \frac{100}{1}$$

$$\%\ moisture\ content = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

Ash Content Determination

The ash content was determined by the method described in AOAC. [7] 3g of finely ground sample was weighed into a clean, dried, pre-weighed crucible with lid (W_1). The organic matter was burnt off by igniting the sample over a low flame (with lid remove) until the sample became charred. The crucibles were then transferred to the muffle furnace at 550^{o}c (lid remove). The ashing continue until a white ash was obtained. The crucible was then cooled in a desiccator and weighed (W_2).

The percentage ash content was calculated as follows;

$$\%Ash = \frac{W_1 - W_2}{Weight\ of\ sample} \times \frac{100}{1}$$

Crude Fat Determination

Soxhlet extraction method [7] was used for fat determination. 2g of the sample was weighed into a weighed filter paper and folded neatly. This was put inside a pre-weighed thimble (W_1). The thimble with the samples was weighed (W_2) and inserted into Soxhlet apparatus and extraction under reflux was carried out with petroleum either (40-60^{o}C boiling range) for six hours. At the end of the extraction, the thimble was dried in the oven for about 30 minutes at 100^{o}C to evaporate the solvent. The thimble was later cooled in desiccators and then weighed

(W_3). The fat extracted from the sample was then calculated.

$$\%Fat = \frac{weight\ loss\ of\ sample\ (extracted\ fat)}{original\ weight\ of\ sample} \times \frac{100}{1}$$

$$\%fat = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

Crude Fibre Determination

2.0g (W_1) of the sample was weighed into one litre conical flask; 200ml of boiling 1.25% H_2SO_4 was added and boiled gently for 30 minutes. The mixture was filtered through muslin cloth and rinsed well with hot distilled water. The sample was scraped back into the flask with spatula and 200ml of boiling 1.25% NaOH was added and allowed to boil gently for 30 minutes, it was filtered through Muslin cloth and the residue washed thoroughly with hot distilled water and then rinsed once with 10% HCl, twice with industrial methylated spirit and rinsed to drain dry. The residue was scraped into a crucible, dried in an oven at 105^0C, cooled in a desiccator and weighed (W_2). The residue was ashed at 550^0C for 90 minutes in a muffle furnace, cooled in a desiccator and weighed (W_3). [8]

Crude Protein Determination

1.0g of the sample was weighed into a micro-Kjeldahl digestion flask and one tablet of selenium catalyst and 15ml of concentrated H_2SO_4 were added. The mixture was digested on an electro thermal heater until clear solution was obtained. The flask was allowed to cool after which the solution was diluted with distilled water to 50ml. 5ml of this was transferred into the distillation apparatus. 50ml of 2% boric acid was pipette into a 100ml conical flask (the receiver flask) and four drops of screened methyl red indicator were added. 50% NOH was continually added to the digested sample until the solution turned light yellow which indicated that the solution had become alkaline. Distillation was carried out into the acid solution in the receiver flask with the delivery tube below the acid level. As the process of distillation was still going on, the pink colour solution of the receiver flask changed to blue which indicated the presence of ammonia. The distillation was continued until the content of the round bottom flask was about 50ml after which the delivery of the condenser was rinsed with distilled water. The resulting solution in the conical flask was titrated with 0.1M HCl. [9]

Calculation;

$$\%\ Nitrogen = \frac{titre\ value\ of\ acid\ \times\ 0.1MHCl\ 0.0014\ \times\ 100\ \times\ 10}{original\ weight\ of\ the\ sample}$$

$$\%\ protein = \%\ Nitrogen\ \times\ 6.25\ protein\ conversion\ factor$$ [9]

Carbohydrate Determination

The carbohydrate content was determined as difference:

$$Carbohydrate = 100 - (moisture + Ash + fibre + protein)$$

Metal Content Determination

Ash of the sample was dissolved in 10% HCl, heated, cooled, filtered and made up to the mark in 100ml standard flask with distilled water. The metal contents of the samples were analyzed with the aid of atomic absorption spectrophotometer (Buck scientific instrument).

RESULTS

The results of proximate compositions of *Lablab purpureus* are shown in Table 1. The results are as follows (g/100g): moisture content (6.33), total ash (3.87), crude fat (4.57), crude protein (19.4), crude fibre (4.68) and carbohydrate (61.2).

Table 1: Proximate composition (g/100g) of *Lablab purpureus* (L)

Parameters	Concentration
Moisture	6.33 ± 0.01
Total ash	3.87 ± 0.01
Crude fat	4.57 ± 0.02
Crude protein	19.40 ± 0.03
Crude fibres	4.68 ± 0.01
Carbohydrate	61.20 ± 0.01

Table 2 depicts the mineral composition (mg/100g) of *Lablab purpureus*. The composition of major minerals were (mg/100g): sodium (5.74), potassium (597), calcium (9.90), magnesium (10.4) and phosphorus (285). The content of zinc was 6.01 mg/100g; iron was 6.30 mg/100g. Other trace metal contents were (mg/100g): copper (2.84) and manganese (1.64). Lead was not detected in the sample.

Table 2: Mineral content (mg/100g) of *Lablab purpureus* (L.)

Parameter	Concentration
Sodium	5.74 ± 0.02
Potassium	597 ± 0.01
Calcium	9.90 ± 0.02
Magnesium	10.40 ± 0.01
Zinc	6.01 ± 0.01
Iron	6.30 ± 0.01
Copper	2.84 ± 0.02
Lead	Not detected
Manganese	1.64 ± 0.01
Phosphorus	285 ± 0.02

The summary of results of the calculated mineral ratios of the sample was presented in Table 3. While Na/K ratio had the lowest value of 0.010, [K/(Ca + Mg)] had the highest level of 29.4; Ca/Pb and Fe/Pb could not be determined.

Table 3: Calculated mineral ratios of *Lablab purpureus*

Parameters	Level
Ca/Mg	0.952
Na/K	0.010
Ca/K	0.020
Na/Mg	0.550
Zn/Cu	2.1320
Ca/P	0.035
Fe/Cu	2.220
Ca/Pb	–
Fe/Pb	–
[K/(Ca + Mg)]	29.4

Mineral safety index (MSI) of the sample was shown in Table 4. The MSI values for the minerals in the sample were; Na (0.055), P (2.38), Mg (0.390), Ca (0.083), Zn (13.2) and Cu (31.2). The highest level of index was recorded for Na whereas, Cu had the least.

Table 4: Minerals Safety Index (MSI) of *Lablab Purpureus*

Mineral	TV	CV	D
Sodium	4.80	0.055	4.75
Calcium	10.0	0.083	9.92
Magnesium	15.0	0.390	14.61
Zinc	33.0	13.2	19.8
Iron	6.70	2.81	3.89
Copper	33.0	31.2	2.00
Phosphorus	10.0	2.38	7.62

TV = table value, CV = calculated value, D = difference

DISCUSSION

The moisture content was low at 6.33g/100g. The low moisture content would afford a long shelf life for the sample especially in places where there is epileptic electricity supply. The value for total ash content in the sample (3.87 g/100g) was a bit lower than 4.36 g/100g reported for bambara groundnut seed by Olaleye *et al*. [10] Ash is a rough estimate of the mineral content of any sample. The crude fat level in this study was lower than the value of 6.99 g/100g reported for dehulled bambara ground nut. [10]

The crude protein content of *Lablab purpureus* was high at 19.4 g/100g, this being typical of all legumes. However, the value obtained in this report was lower than the value (29.0 g/100g) reported for raw groundnut seeds [11] and 23.6 g/100g reported for *Prosopis africana*. [12] High level of protein in this study will make lablab useful in supplementing the nutrients derived from tubers and cereals in places where other legumes are not readily available. The protein content of this sample was however comparatively lower than the recommended 23-56 g/100g human daily protein requirement. [13] The crude fibre is important in facilitating faecal elimination. The fibre level in this report (4.68 g/100g) would make reasonable contribution to this fibre function. The result of crude fibre in this study also compared favourably with 4.9 g/100g reported for bambara groundnut sample. [14] The carbohydrate content of *Lablab purpureus* sample was high at 61.2 g/100g; this value was higher than those reported for most of the animal samples; 47.2 g/100g report for *Anaphe infracta*, [15] 31.4 g/100g reported for larva and pupa of silkworm. [16] The carbohydrate level was however close to most the plant samples: 61.9 g/100g and 60.8 g/100g reported for dehulled and whole seed flour of *vigna subterranea* respectively [10] and 64.9 g/100g reported also for bambara groundnut sample. [14]

Most of the major minerals in this study were low at (mg/100g); Na (5.74), Ca

(9.90) and Mg (10.4). However, potassium was detected with high concentration (597 mg/100g). Both sodium and calcium in the present study were comparatively lower than 12.2-24.9 mg/100g (Na) and 35.2-82.2 mg/100g (Ca) reported for *Vigna subterranea* seeds flour; [10] potassium content of the present sample (597 mg/100g) was however higher than the levels in *V. subterranean* seeds flour (25.8-50.7 mg/100g). Sodium and potassium are useful in checking nerve irritability, controlling glucose absorption and enhancing normal retention of protein during growth. [13]

The level of phosphorus in the sample (285 mg/100g) was lower than the recommended daily allowance (RDA) of 800 mg but higher than 10.0 -80.5 mg/100g reported for *V. subterranean* seeds flour. [10]

Among the trace metals, copper (Cu) and manganese (Mn) recorded low concentrations. The iron (Fe) content in the present report (6.30 mg/100g) was comparatively higher than 1.91- 5.27 mg/100g reported by Olaleye *et al*. [10] for bambara groundnut seeds flour. The requirement of iron by human beings is 10-15 mg for children, 12 mg for men and 18 mg for women. [17] Inadequate iron in the diet had been associated with poor learning and decreased cognitive development. [18] Also, Fe facilitates the oxidation of carbohydrates, proteins and fats. [19] The zinc level in the sample (6.01 mg/100g) was lower than the zinc allowance of about 15-20 per day. [17] It has been reported that Zn is one of the several trace minerals that are deficient in the diet. [20] Zinc deficiency has been associated with impaired growth and reproduction, immune disorders and a variety of other symptoms. [19] The low level of zinc in the present study conforms to the conclusion of the National Academy of Science [21] that Zn in plant sources is not as available as animal sources.

The Na/K ratio (0.01) in the sample was good as it was lower than 0.6; a ratio that favours enhancement of high blood pressure in man as a result of too much sodium as compared to potassium. [22] Na/K ratio level in the sample was also lower than those in bee brood (1.97); silkworm larva (1.71); silkworm pupa (2.12), and snout beetle (0.299); [16] 0.75 (catfish), 0.74 (snakefish) and 0.91 (tilapia fish). [23] The Ca/P ratio in the sample (0.035) was comparatively lower than the 0.5 minimum requirements for favourable calcium absorption in the intestine and for bone formation. [22] Food is considered good if the Ca/P ratio is above 1.00 and poor if the ratio is less than 0.5. [12] The Ca/Mg ratio (0.952) was lower than the required 6.67 whereas the miliequivalent ratio [K/(Ca + Mg)] in the sample (29.4) was higher than the recommended 2.2. [24] This high level was contributed to by the relatively high value of K as against low level of Ca and Mg. The following ratios were also lower than the recommended Na/Mg (0.550). Ideal = 4.17, Ca/K (0.020), ideal = 4.00. However, the following toxic ratios could not be determined due to the absence of lead in the sample: Ca/Pb, Zn/Pb and Fe/Pb. Absence of lead in the sample was good because Pb is not biochemically useful to human beings and its presence could be as a result of onset of pollution. The importance of mineral ratios had been discussed; Analytical Research Laboratories [25] indicated that ratios are sometimes more important than levels. This is because ratios represent homeostatic balances. They are also indicative of future metabolic dysfunction.

The standard MSI for the elements are; Na (4.8) P (10), Mg (15), Ca (10), Zn (33), Fe (6.7) and Cu (33). The implication of the MSI results was that the sample might not be overloading the body in any of the minerals. The standard MSI for Zn in this study (33) was unusually higher than the calculated value (13.2). This is highly desirable as excess Zn in the body can decrease the amount of high density lipoprotein (HDL) present in the blood and this may increase the risk of heart disease. Also, excess zinc can interact with other minerals such as Fe and Cu and as a result decrease their absorption. [22] However all

the MSI values were within the United State Recommended Daily Allowance (USRDA). [24]

CONCLUSION

The results of proximate composition showed that *Lablab purpureus* has low concentration of moisture content, total ash and crude fat. Therefore, the sample could be stored for a reasonable period of time without being spoilt due to its low moisture content. The sample is a good source of protein and would therefore be a good supplement for other conventional protein sources. The carbohydrate level in the sample was higher than those from many animal sources. The result of the mineral composition revealed that the sample was very low especially in the most of the macro-minerals. However, the iron content in the sample was higher than most other leguminous crops. The absence of lead, a toxic metal in the sample would make lablab seed very safe for consumption. The result of mineral ratios showed that most of the ratios are far from ideal. The Na/K ratio in the sample would prevent the development of higher blood pressure which could invariably lead to hypertension. The mineral safety index revealed that the sample would not be overloading the body with virtually all the minerals present especially zinc.

It could therefore be recommended that *Lablab purpureus* consumption should be encouraged especially for children because of its high protein content and moderate level of crude fibre as the elementary system of children is not so developed to digest very high fibre food. However, the sample should be consumed with foods that contain high mineral levels due to low levels of minerals in the sample.

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