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Research Article

Physical Properties, Chemical Composition and Anti-nutritional Factors Analysis of Hyacinth Bean (*Lablab purpureus* L.) for Animal Production

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ABSTRACT
The study determined the physical properties, chemical composition, and the anti-nutritional factors of hyacinth bean (*Lablab purpureus*). The seed weight was determined using an automated weighing scale. The length and width of the leaf and seed were determined using a Vanier caliper and a flexible measuring tape. The chemical compositions were determined according to the standard procedures detailed by the Association of Official Analytical Chemists. It was observed that the seed was creamy white in color, while the leaves were green. The average seed weight was 0.25±0.12g, and the seed length and width were 1.06±0.33 cm and 0.76±0.12 cm. The leaves' length and width were 3.2-4.5 inches and 3-5 inches, respectively. It was observed that the seeds and the leaves contain protein value of 32-38% and 14.2-18.6%, carbohydrate 52.7-62.5% and 40.6-44.0%, and crude fibre 10-13% and 7.5-9.8% respectively, while the seeds contain 384.63 kcal/100 grams of energy. However, hyacinth bean seeds contain anti-nutritional factors such as tannins (91.78 mg/100g), phytates (3.94 mg/100g), oxalate (0.02 mg/100g), nitrate (86.84 mg/100g), and cyanide (103.97 mg/100g). In conclusion, the results of this study demonstrate that the seeds and leaves contain high amounts of protein, carbohydrates, and other nutrients, which have the potential to meet the nutritional requirements of animals. The seeds also contained some anti-nutritional factors, which impart negative effects on digestion and performance in farm animals. Therefore, there is a need to process the hyacinth bean seeds in order to reduce the anti-nutritional factors, without altering the quality of the bean.

Keywords: Anti-nutritional; Dimensions; Farm animal; Hyacinth bean; Total protein

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INTRODUCTION
The world population has been projected to rise from the current seven billion to about 10 billion people by the year 2050, and about 1 billion derive some part of their livelihood from domesticated animals (United Nations, 2019). The global challenges of hunger and malnutrition, are likely to become worst due to climate change, particularly in sub-Saharan Africa (FAOSTAT, 2021), in addition, competition between humans and animals for conventional feeds such as soy bean, maize and sorghum, makes it difficult to provide adequate protein feed for livestock (Julia *et al.,* 2020). Therefore, livestock production needs to be improved so as to meet the FAO recommendation of 35 g caput/day of animal protein (Ajiji *et al.,* 2015; FAOSTAT, 2021). These challenges necessitate exploring the potential of non-conventional forage legumes to mitigate the feed and nutrition insecurity.

Hyacinth bean (*Lablab purpureus*) also referred to as *lablab purpureus* or *Dolichos lablab* is one of the non-conventional forage legumes that are not commercially used for feeding livestock (Amit, 2018). This bean is a multipurpose leguminous plant cultivated as an annual or short perennial crop suitable for tropical and sub-tropical climate, and is a fast-growing legume that can provide fodder in less than three months after sowing (ILRI, 2013). The hyacinth plant is usually cultivated after the normal cropping season, thereby acting as a buffer crop for ruminant feed during the dry season, It is a drought resistance legume with no direct human use and industrial value and reaches its full potential for herbage yield and quality in the late dry season when other fodders are scarce (Abba *et al.,* 2025). The seed gross morphology also acts as a guide for the design of relevant machines and facilities for agro-allied industries in handling and processing of the cereals grains (Asif *et al.,* 2013).

Hyacinth beans contain many anti-nutritional factors such as tannins, phytate and trypsin inhibitors which impart negative effects on digestion and performance in farm animals (Mrinal *et al.,* 2020). Previous studies have demonstrated that animal metabolism could be affected by anti-nutritional factors in different ways. The effects include bloating in ruminants, reduced nutrient absorption, liver cholesterol and reduced intestinal absorption of many nutrients through binding to the small intestine cells, and overall interfering with growth rate and development in farm animals (Addisu and Assefa, 2016; Mrinal *et al.,* 2020). However, different processing methods such as soaking, boiling, roasting, germination and fermentation are commonly used to alleviate the negative effects of these anti-nutritional factors in this bean (Patterson *et al.,* 2017).

Globally, hyacinth bean has received little research attention in comparison to other leguminous crops, though, it might be a good source of valuable nutrition to livestock (Hossain *et al.,* 2016).

Extensive research is still needed to explore other nutritive values, and also discover elimination methods for the anti-nutrients, without altering the quality of the product (Abhishek *et al.,* 2019). This study was design to determine the physical properties, proximate composition and the anti-nutritional factors of hyacinth bean seed, which is an emerging protein source for livestock in developing countries.

MATERIALS AND METHODS

Sample collection and preparation

The freshly harvested hyacinth bean seed and leaves were obtained from livestock farms in Sokoto state, Nigeria, and authenticated by a Botanist of the Department of Botany, Faculty of Science, Usmanu Danfodiyo University Sokoto, Nigeria, with a voucher specimen number UDUSH/ANS/0078.

A total of 100 grams of fresh leaves were collected and physical dimensions were recorded. While 200 randomly selected seeds were hand counted and weighed in triplicate, using an automated weighing scale (SF-400®), and the mean weight of one seed was determine as described by Zdzislaq *et al.,* (2022).

The seed and leaf morphometric such as length, and width of 20 seeds and 20 leaves were measured using a Vernier caliper (Triclebrand®6-150mm, Sigmat Jangkasorong, China), and the mean length, and width of one seed and leaf was determined according to a method of Zdzislaq *et al.,* (2022). The leaves and seeds of the hyacinth bean were screened to remove foreign materials, immature seeds, damage seeds and leaves. The leaves were chopped into small sizes, and allowed to dry under the shed. The air-dried samples were powdered in a mill to 40-mesh size and stored in screw-capped bottles at room temperature for further analyses

Chemical compositions and Anti-nutritional factor Analysis

A total of 200g of hyacinth bean seed and 100g of the leaves sample were ground, using a pestle and mortar, and sieved (1.18 mm sieve size) to a comparable particle size, and submitted for chemical analysis.

Chemical compositions (proximate and anti-nutritional factor) of hyacinth beans seeds and leaves were determined using high performance/pressure liquid chromatography (HPLC) analysis (AOAC, 2000**:** WHO/FAO, 2002) at the Biochemistry laboratory, Faculty of Science and Chemical Laboratory, Faculty of Agriculture, Usmanu Danfodiyo University Sokoto.

RESULTS

Hyacinth bean leaves and seeds are presented in Figure 1 and 2, and their parameters recorded were presented in Table 1. The leaves were green in color with a length of about 3.2-4.1 inches and a width range between 3-5 inches. The seeds are creamy white in color, the values obtained for weight, length and width of one seed was determined and recorded in Table 1.

Chemical composition of hyacinth bean leaves and seed powder was presented in Table 3. The result revealed that, the leaves contained 12-18%, crude fibre (7-9), carbohydrate (40%), and 13% moisture contents. while the seeds composed of crude protein 31.83 %, moisture 7.5 %, ash 2.5 %, lipid/fat 1.5 %, carbohydrate 52.68 %, crude fibre 10 % and energy 384.0 kcal/100g.

Anti-nutritional factor analysis of hyacinth bean seed is presented in Table 3. The result revealed that, hyacinth bean seed had Tannin nitrate, cyanide, pyatate and oxalate (Table 3).

Figure 1. Hyacinth Bean leaves

Figure 2. Hyacinth Bean Seeds

Table 1. Physical properties of hyacinth bean leaves and seeds

Parameters	Leaves	Seeds
Colour	Green	Cream white
Surface texture	Hairy	Smooth
Length (inches)	3.2-4.5	1.06±0.33
Width (inches)	3-5	0.76±0.12
Weight (g)		0.25±0.12
Arrangement	Alternate	
Shape	Oval	

Table 2. Chemical Compositions of Hyacinth Bean

Variables	Seed (%)	Leaves (%)
Crude Protein	32-38	14.2-18.6
Ether extract	1.5-24	2.4-3.5
Crude fibre	10-13	7.5-9.8
Ash	2.5-3.3	2.1-3.3
Dry matter	82.5-91.1	86.5
Carbohydrate	52.7-62.5	40.6-44.0
Calcium mg	0.06-0.09	0.8-2.8
Phosphorus mg	0.15-0.81	0.25-0.75
Total energy (kcal/100g)	384.63	

Table 3. Anti-nutritional Compositions of Hyacinth Bean Seed

Anti-nutritional factors	mg/100g
Nitrates	86.84
Tannins	91.78
Cyanide	103.97
Phytate	3.94
Oxalate	0.02

DISCUSSION

Legume leaves and seeds are structurally similar but differ morphologically such as leaves, seed size, shape, colour, thickness and height (Pretheeksha *et al.,* 2022). Low nutritive value of grain legumes has been associated with presence of some anti-nutritional substances which include tannins, phytates and trypsin inhibitors. It was observed in this study that hyacinth bean seed contain high amount of anti-nutritional compounds such as *tannins (91.78 mg/100g), phytates (*3.94*), oxalate (0.02), nitrate (*86.84) *and cyanide (*103.97), this finding is in accordance with the reports of (Wang *et al.* (2010) reported that common beans and *Lablab beans* contain relatively high quantities of anti-nutrients, especially tannins and phytic acid presence in varying concentrations, similar findings were observed in the current study.

Phytic acid reduces the bioavailability of some essential minerals, with most affected minerals being calcium, iron and zinc (Gupta *et al.,* 2015). The phytates or phytic acid in this study compared to the levels (4.0%) documented in literature by Deshpande, (1993). The phytic acid levels in this study were higher compared to 1.2% and 2.1% obtain for Highworth and Rongai lablab varieties by Shaahu *et al.* (2015). Tannins on the other hand inhibit the digestibility of protein by forming protein crosslink (Rehman and Shah, 2005). The tannin levels in this study were similar to the findings of Shaahu *et al.* (2015). However, tannins in rosecoco beans were significantly higher compared to lablab beans. This may be contributed to the colour differences, as argued by Feedipedia, (2016), that tannins content vary with the colour of the seed coat. Some studies have found that, the darker the variety of hyacinth been seeds, the higher the contents of anti-nutritional compound (Parmar, *et al.,* 2017). Previous studies have demonstrated that animal metabolism could be affected by antinutritional factors in different ways. The effects include bloating in ruminants, reduced nutrient absorption, liver cholesterol and reduced intestinal absorption of many nutrients through binding to the small intestine cells, and overall interfering with growth rate and development in farm animals (Addisu and Assefa, 2016; Mrinal *et al.,* 2020). Therefore, extensive research is still needed to discover the elimination methods for the anti-nutrients, without altering the quality of the product (Abhishek *et al.,* 2019).

Proximate analysis of feed compound is used to assess the nutritional value (macro-nutrients), such as the moisture content, protein, carbohydrates, fat, ash and energy. However, the results of the high performance/pressure liquid chromatography (HPLC) analysis of the chemical compounds of hyacinth bean seed in the current study revealed that the sample had an average moisture content of 8.5%, which is somehow intermediate when compared with the moisture values of other legumes ranging between 5.0 and 11% (Hossain *et al.,* 2016), However, the moisture content in the current research as compared to 8.47 and 8.70% reported by Sheila *et al.* (2017), the value obtained was lower compared to that of common bean varieties (12-14 %) reported by Barros and Prudencio, (2016). This variability in the moisture content is mainly dependent on drying and storage conditions as further stated by Kamatchi *et al*. (2010). Emebu and Anyika (2011) reported that micro-organisms that encourage feed spoilage flourish well in feeds with high moisture contents, thereby reducing the shelf life, however, lower moisture content could give a longer shelf life and also ease of transportation.

The ash content is a reflection of the amount of mineral elements present in the feed. High ash content would suggest high levels of macro and micro-minerals, therefore improved the nutritional quality (Hossain *et al.,* 2016). The ash content of 4.50% was recorded for hyacinth bean seed in this study. This value is in agreement with 4.0 to 4.5% reported in other studies (Kamatchi *et al.,* 2010; Barros and Prudencio, 2016). Hossain *et al.* (2016) reported 3.50% ash content in hyacinth bean seed which is slightly lower. The similarities and dissimilarities may be an indication that seed varieties and environmental factors (season, soil type, geographical location and stage of maturity) play an important role in determining the nutritive value of hyacinth bean as reported by Sheila *et al.* (2017). However, the amount of lipids/fats content of hyacinth bean seed obtained in the current research was 2.1%. This value is in agreement with the result of Hossain *et al.* (2016), who recorded values between 0.9 to 4.2%. Similar results concur with other observations for lablab beans (Shaahu *et al.,* 2015).

Plant protein still remains a main source of food nutrient for the less privileged population in developing countries, Nigeria inclusive (Emebu and Anyika, 2011). The average crude protein content of hyacinth bean seed from the analysis was 28.75% this is similar to what was reported in other studies (Myrene, 2013). However, a black variety of lablab beans analyzed by Hossain *et al.* (2016) in Bangladesh reported similar protein content of 25 to 28%, other studies reported lower protein content in lablab beans than observed in this study. Kalpanadevi and Mohan (2013) reported lower protein content of 20% in brown lablab beans grown in Tamil Nadu, India. Most of the values obtained for total protein, ash and lipid in this study fall within the range obtained by Sheila *et al.* (2017). Achmad and Naofumi (2008) reported that the protein content of hyacinth bean seed makes it fit to be considered as a good plant protein supplement in livestock feeds industries, which is not eaten frequently by human. Hyacinth bean seed have carbohydrates content of 47.85%, its consumption will provide the body with energy that is required for daily activities and exercise (Udousoro and Ekanem, 2013). Adequate carbohydrate is also required for optimum function of the brain, heart, nervous, digestive and immune system while carbohydrate deficiency causes depletion of body tissue (Offor *et al.,* 2014). The fiber content may improve bowel function and provide fecal bulk; however, the total fiber content in hyacinth bean seed in this study was 7.5%.

The calorific value of the hyacinth bean seed determined by calculation was 373.0 kcal/100g. This is in agreement with results of Shaahu *et al.* (2014) who recorded 352.4 kcal/100g in processed lablab seed.

CONCLUSION

In conclusion, the results of the physical properties and chemical composition of hyacinth bean in this study demonstrate that, the seeds and the leaves contain high amount of protein, carbohydrates and other nutrients, which have the potentials to meet the nutritional requirements of animals. The seeds also contained some anti-nutritional factors such as tannins, phytates, nitrate, oxalate and cyanide, which impart negative effects on digestion and performance in farm animals. Therefore, there is need to process the hyacinth bean seeds, in other to reduce the anti-nutritional factors, without altering the quality of the bean.

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