Education

Adzuki (*Vigna Angularis*) beans as food: chemical composition, nutrition and quality identities

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Received 28 Mar 2023; Accepted 3 May 2023; Published 9 May 2023

Abstract

The adzuki beans (*Vigna angularis*) seed used for this research work were obtained in a farm at Rufus Giwa Polytechnic, Owo in Ondo State of Nigeria. They beans were sundried for four weeks, milled, divided into two portions and one portion was defatted with n-hexane. Both defatted and undefatted (raw) powdered samples were subjected to Proximate analysis, mineral analysis, photochemicals screening, functional properties, amylase, resistant starch, soluble protein, total sugar, and vitamin c examination. The result of Proximate composition of both raw and defatted samples were: moisture content (7.50 ± 0.12) and (6.08 ± 0.12), ash contents (4.20 ± 1.10) and (4.25 ± 1.12), crude fiber (3.50 ± 0.05) and (2.20 ± 0.01), crude fat (25.05 ± 0.03)and (5.06 ± 0.01), crude protein (30.50 ± 0.04) and (36.04 ± 0.02), carbohydrate (29.25 ± 0.05) and (30.45 ± 0.15) respectively. Mineral (mg/kg) analysis reveal the presence of potassium (125.15 ± 0.03), phosphorus (378.70 ± 0.00), calcium (65.05 ± 0.02), magnesium (105.16 ± 0.01), zinc (0.11 ± 0.05), and iron (0.60 ± 0.11) in the sample.The macro and micro nutrients in the study is required for optimal functioning of physiological and biochemical process in the body. The result of functional properties of *Vigna angularis* seed flour include bulk density (25.06± 0.01), water absorption or capacity (15.15 ± 0.12), oil absorption capacity (26.01 ± 0.13) and foaming capacity (10.05 ± 0.01) respectively, Amylose (15.08 ± 0.01), Resistant starch (20.05 ± 0.00), soluble protein (2.50 ± 0.11), total sugar (2.25 ± 0.12) and vitamins C (75.01 ± 0.01 mg/100g). The phytochemical screening revealed that Alkaloid, Saponin were slightly present, Phyate, Phenol was moderately present while flavonoid was highly present. The *Vigna angularis* suggesting that seed flour is relatively save for consumption.

Keywords: adzuki beans, photochemical, proximate analysis, functional properties, mineral element, starch soluble protein

Introduction

Adzuki Beans

Beans appear in design on pre-Columbian pottery from new world archaeological sites, and legumes for food are likely as old as agriculture and civilization. The useful benefits of legumes are mentioned in the Old Testament [1]. Bean remains have been discovered in the Guitarrert Cave dating back to 800 BC, and consumption of legumes has evolved alongside cereals, lentils, chickpeas, pigeon peas, grains, and cowpea with wheat, rice, millet, and sorghum in the new world. Thus, it is important to take into account the diary rates of legumes.

As a result of the presence of several bioactive chemicals, including oligosaccharides, phenolic substances, enzyme inhibitor lection, and phytates, which may have metabolic effects on both humans and animals that regularly ingest beans, beans may be used as functional foods [2]. Bean eating has been linked to a number of health advantages, including a decrease in cholesterol levels and coronary heart disorders [3], favorable impact on the prevention of malignancies, a decline in diabetes and obesity, a strong antioxidant capacity, and an inhibitor of mutagenesis and proliferation [4].

Adzuki beans (*Vigna angularis*) are cultivated in more than 30 countries around the world and are a significant legume crop. They are rich in starch-digestible protein, minerals, and vitamins, and come in many different varieties depending on the country and region where they are grown especially in East Asia [5]. According to [6] adzuki beans can be used to make a variety of dishes throughout Asia, including paste for pasties, desserts, cake, porridge, adzuki rice, jelly, adzuki milk, and ice cream. This review will look at the nutritional composition, physical and chemical characteristics of adzuki.

Materials and methods

The Adzuki beans (*Vigna angularis*) seed used for this work were obtained in a farm at Rufus Giwa Polytechnic in Owo Local Government Area of Ondo state.

They were prepared for use by decorating, sun drying and milling. The sample was powdered in milling mill to mash size and stored in screw cap bottle at room temperature prior to further analysis [7]. The moisture content was determine by drying in an oven at 110^0C for 24 hours and was expresses on a percentage basis, Nitrogen content was estimated by the microkjeldal method and crude protein was calculated (NX 6.25). The content of crude lipids, crude fiber, ash and carbohydrate were estimated by method [8]. The minerals like sodium, potassium, calcium, magnesium, manganese, iron, and others were analyzed using Atomic Absorption spectrophotometer (Perkin Elmer model 500). The resistant starch, Amylase, sugar, soluble protein and Ascorbic acid were determined by titrimetric method of [9]. The phytochemical screening was determined by a method described by [7] while the functional properties were equally determined by a method of [10]. Data were analyzed using the statistical table analysis system and analysis of variance and mean deviation were

calculated by the general linear model procedure.

Result and discussion

Table 1: Proximate composition of Adzuki beans (*Virgna angularis*) seed flour

Parameters %	Raw samples	Defatted sample
Moisture content	7.50 ± 0.12	6.80± 0.12
Ash content	4.20 ± 1.10	4.25 ± 1.12
Crude fiber	3.50 ± 0.05	3.20 ± 0.01
Crude fat	25.05 ± 0.03	5.06 ± 0.02
Crude protein	30.50± 0.04	36.04 ± 0.02
Carbohydrates	29.25 ± 0.05	30.45 ± 0.45

Mean ± standard derivation of triplicate determination

Table 1 shows the proximate composition of raw and defatted sample of Adzuki beans (*Virgna angularis*)seed flour. The result of the assessment was as follows, moisture content (7.50± 0.72) and (6.80 ± 0.12), ash content (4.20 ± 1.10) and (4.25 ± 1.12), crude fiber (3.50 ± 0.05) and (3.20 ± 0.01), crude fat (25.05 ± 0.03) and (21.06 ± 0.02), crude protein (30.50± 0.04) and (36.04 ± 0.02) while carbohydrates (29.25 ±0.05) and (30.45±0.45) respectively. The moisture content of *Vigna angularis* flour was relatively low for both samples but that of raw is slightly higher than that defatted sample. The low moisture content of the sample will therefore enhance long shelf life and prevents growth and spoilage by microorganism [11].

The ash content of both samples almost revealed the same result of 4.20±1.01 and 4.25±1.12) respectively. This reflects that, there are abundant minerals present in the seed. The ash contents obtained was almost the same as 4.29% for soya beans [12]. The fiber content of raw sample (3.50 ± 0.05) and defatted sample (3.20±0.01), though the value of raw is a little but higher than that of defatted. The fiber content is higher than 1.17% reported for Adzuki beans by [13]. Fiber cleans the digestive tracks by removing potential carcinogenic substances from the body and prevents the absorption of excess cholesterol [7].

The crude fat values for both samples are (25.05±0.03 and 5.06±6.02). The value of raw is higher than that of defatted; this as a result of processing method by removing oil from other samples [14]. The high crude fat content of both samples suggest that *Vigna angularis* is a vital source of oil as most legumes contain low crude fat. The samples could be used in improving the palatability of food. Both samples could be considered as a potential source of vegetable oil for domestic and industrial purposes [7]. The high protein content of both samples (30.50± 0.04 and 36.04 ± 0.02) suggests that it could be used in the management of protein deficiency cases such as kwashiorkor. Some proteins are involved in structural support while others are involved in bodily movement and defense against germs [15]. The three main energy source of food are carbohydrate protein and fat. Energy stored as carbohydrate is released by the process of respiration which is a reaction between glucose and oxygen to produce energy, carbon dioxide and water. The value recorded for both samples are very high (29.25 ± 0.05 and 30.45 ± 0.45) respectively but lower compared with 41.62% as recorded for Lima beans [13].

Table 2: Show the mineral composition of Adzuki beans (*Vigna angularis*)

Parameters	Values(mg/kg)
Potassium	125.5 ± 0.03
Calcium	65.05 ± 0.02
Magnesium	105.16 ± 0.01
Zinc	0.11 ± 0.05
Iron	0.60 ± 0.11
Phosphate	378.70 ± 0.00

Mean ± standard deviation of triplicate determination

Adzuki beans (*Vigna angularis*) have higher Phosphorus, Potassium, Calcium, and Magnesium content in compares to other beans [16]. The result revealed that phosphorus (378.70 ± 0.00), Potassium (125.5±0.03), Calcium (65.05±0.02), Magnesium (105.16 ± 0.01), Zinc (0.11 ± 0.05), Iron (0.60 ± 0.11), and Phosphate (378.70 ± 0.01) respectively. The presence of calcium and magnesium indicate that its consumption could be a good source of minerals. The high calcium content suggest that the flour could be used in complementary food to help build the bones and teeth, since calcium is the main component of teeth, bones and play a role in blood clothing [17]. Magnesium is involved in making protein and releasing energy and help hold calcium in the enamel of the teeth [17]. Phosphorus combines with calcium to form calcium phosphate to give bone their rigid structure. Potassium is responsible for nerve action and osmoregulation in the body fluids [18]. Zinc is required for optimal functioning of physiological and biochemical processes [14]. Iron is used in the management of iron deficiency "anemia" Since iron is a vital part of red blood cells that carry and released oxygen [12].

Table 3: Shows the phytochemical screening of Adzuki beans (*Vigna angularis*) flour

Parameters	Result
Phenol	++
Flavonoid	+++
Phytate	++
Alkaloid	+
Saponin	+

Note: + (slightly present), ++ (moderately present) +++ (highly present)

The result of investigated phytochemical screening of (*vigna angularis*) revealed that phenol and phytate were moderately present, alkaloid and saponin were slightly present while flavonoid is highly present. Phytochemicals exhibit various pharmacological and biochemical action when ingested by animals. Plant used in the treatment of diseases are said to contain bioactive principles with biological activities, some of which are responsible for the characteristics of odour, pungencies and color of plants while others give the particular plants its culinary, medicinal or poisonous virtues [19]. The presence of phenol and flavonoid content positively contributes to antioxidants [20]. Moreover total phenol and flavonoid

content were highly correlated with antioxidant capacity [21]. Saponin and alkaloid are slightly present. Saponin has the properties of precipitating and coagulating red blood cells [22] while Alkaloid serves as a repellant to predator and parasites. Several Alkaloid containing medicinal plants are used as pain relievers [23].

Table 4: The functional properties of Adzuki Beans (*Vigna angularis*) seed flour

Parameters	Values
Bulk density (g/ml)	25.06 ± 0.01
Water absorption capacity (%)	15.15 ± 0.12
Oil absorption capacity (%)	26.01 ± 0.13
Foaming capacity (%)	10.05 ± 0.01

Mean ± standard derivation of triplicate determination

Table 4 shows the functional properties of Adzuki beans (*Vigna angularis*) seed flour. The result of the assessment is as follows: bulk density (25.06±0.01), water absorption density (15.15±0.12), oil absorption density (26.01±0.13), and foaming density (10.05±0.01). Bulk density is the ratio of mass per unit volume of substances which indicate the porosity, package size, mouth feel and flavor of a product [24]. The bulk density values of 25.06 ± 0.01 g/ml of *Vigna angularis* implies that soaking in water over time modify the particles size. The foaming capacity is 10.05 ± 0.01. The low foaming is as a result of reduction in acidic content of the flour [11]. Water absorption capacity of 15.15±0.12 is very low compare with 32.05±0.02% reported for *Musa paradisiacal* and 35.15±0.01% (C*anmabis sativa*). Fine particles size is associated with higher water absorption capacity [24]. The oil absorption capacity of the seed flour was 26.01±0.13 which indicates high value when compare with *Cajanus cajal* of 20.02±0.01 and 25.01±0.12 for *Cannabis sativa* seed flour [7]. The ability of food to absorb water and oil help to enhance sensory properties such as mouth feels and flavor retention [25].

Table 5: Shows starch soluble protein, total sugar and vitamins

Parameters %	Values
Amylose (%)	15.08 ± 0.01
Resistant starch (%)	20.05 ± 0.00
Soluble protein (g/100g)	2.50 ± 0.11
Total sugar (g/100g)	2.25 ± 0.12
Vitamin c (mg/100g)	75.01 ± 0.01

Mean ± standard derivation of triplicate determination

The amylose and resistant starch contribute 15.08 ± 0.01% and 20.05 ±0.00 of total starch respectively. Resistant starch has its importance because of the features of non-digestibility in small intestine. It is recognized as the main components in cereals that could improve but microbiota composition as a result of fermentation in gut [26]. The vitamin C of 75.01 ± 0.01 mg/100g is higher compared with that of *Discorea villosa* (64.20 ± 0.21) [14] while the values obtained for soluble protein and sugar content (2.50 ± 0.00 and 2.25 ± 0.12) were higher than 1.30 ± 0.15 and 1.10 ± 0.01 reported for *Discorea villosa* and *Discorea alata* [14].

Conclusion

The study has established the prominent nutrients and minerals concentration of Adzuki beans. The result indicate that the flour sample is rich in proteins, fats and carbohydrates and are therefore a source of micro and macro nutrients which can be used in intervention programmes aims at alleviating protein energy malnutrition. The flour has good protein content and could be used to fortify flour with low protein content such as maize and rice. The mineral contents indicate that the flour sample is an important source of mineral for human and farm animals.

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