Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.8955

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (1):** 1037-1043 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Investigation of the Nutritional Composition and Anti-nutritional Factors occurring in *Vigna aconitifolia* (Jacq.) Marechal seeds

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Received: 12.12.2016 | Revised: 22.02.2017 | Accepted: 27.02.2017

ABSTRACT

Vigna aconitifolia (Jacq.) Marechal is a minor, under-utilized leguminous crop, commonly known as mat bean, moth bean, matki, Turkish gram or dew bean belonging to the family Fabaceae. It is produced and consumed especially in tropical and sub-tropical areas of Africa, Asia and Latin America. The pods, protein - rich seeds and sprouts of this crop are generally consumed in India. Nutritional (proximate, vitamin, mineral) composition and anti-nutritional factors of Vigna aconitifolia (Jacq.) Marechal were investigated using standard methods. Moisture, protein, fibre, fat, ash and carbohydrates were the components in the proximate analysis of the sample, while Vitamin A, B_1, B_2, B_3, C and Tocopherol were the vitamins estimated. Calcium, Iron, Magnesium, Potassium, Sodium, and Zinc were the mineral contents while the anti-nutritional factors identified were, alkaloids, saponins, tannins and flavonoids. The benefit of these nutrients in prevention and cure of various ailments and lifestyle related diseases requires further research.

Keywords: *Anti-nutritional factors, nutritional composition, proximate, Vigna aconitifolia (Jacq.) Marechal*

INTRODUCTION

Legumes, which are mainly edible dry seeds consisting of 25% protein thereby serving as substitute for meat play an important role in human nutrition[7]. As legumes and cereals are sources of incomplete proteins due to absence of certain essential amino acids in both groups, cereal-pulse combinations make up to a complete diet. Legumes are a rich source of calcium, iron and zinc[4] and also protective compounds[10] which have some preventive effects on lifestyle diseases (cancer, diabetes and coronary heart disease) and lowering of cholesterol level[3,9,11] .They contain some anti-nutritional factors which inhibit the activity of proteolytic enzymes leading to poor protein absorption and digestion. These anti-nutritional factors may be reduced or destroyed by presoaking and heat treatment. Their pods are made up of fibres which can serve as animal feed[8]. *Vigna aconitifolia* (Jacq.) Marechal belongs to the V*igna* genus of the *Fabaceae* family. It is a minor leguminous crop commonly known as mat bean or moth bean produced and consumed mostly in tropical and sub-tropical areas of Africa, Asia and Latin America[12].

Cite this article: Karel, A., Investigation of the Nutritional Composition and Anti-nutritional Factors occurring in *Vigna aconitifolia* (Jacq.) Marechal seeds, *Int. J. Pure App. Biosci.* 5(1): 1037-1043 (2017). doi: http://dx.doi.org/10.18782/2320-7051.8955

This plant is a short, semi-erect, hairy, bushy, annual crop, with a prostrate creeping habit. It has bright yellow flowers and linear pods green when fresh and brown on ripening. The pod contains about four to nine small seeds which are light brown, whitish-green or mottled[5]. Presoaking activity and cooking before consumption may improve the nutritional quality of the beans[13] and also inactivate some heat labile anti-nutritional compounds increasing the bioavailability of the legumes as well as permit the digestion and assimilation of proteins and starch[6]. It is often consumed as cooked whole seeds, split seeds or sprouts[5]. However, *Vigna aconitifolia* (Jacq.) Marechal is one of the legume species that is underutilized[29] unlike the properly utilized ones, *Cajanus cajan*, *Glycine max*, *Vigna sinensis*, *Vigna unguiculata* etc. Evaluation of nutritional and anti-nutritional compositions of its seeds remains unexplored and data is limited. As, it is a storehouse of various nutrients, there is need to determine the nutritional and anti-nutritional compositions of this legume. This study was undertaken to estimate the proximate, vitamin, mineral and anti-nutritional compositions in unprocessed moth bean seeds.

MATERIAL AND METHODS

Moth bean is a multipurpose, short-day crop and a famine resistant pulse of India (Fig. 1. and Fig. 2.). It has a broad pH range (3.5–10) and can endure salinity[10]. Although dry sandy soil is most favorable for its growth, moth bean can grow in various soil types[10]. Optimum production of moth bean occurs between 24–32 °C, but has been revealed to tolerate up to 45 °C during the day[10,2].

Vigna aconitifolia (Jacq.) Marechal is native to India and Pakistan, developed for food production and as a cover crop[2]. It is predominately grown in India[10], with Rajasthan, as the major moth bean growing state contributing to almost 86% area of the nation [28].

Fig. 1. An uprooted plant of *Vigna aconitifolia* (Jacq.) Marechal

Fig. 2. Mature seeds of *Vigna aconitifolia* (Jacq.) Marechal

Sample Collection, Identification and Preparation

The *Vigna aconitifolia* (Jacq.) Marechal seed samples used for this study were bought from markets of Ajmer district of Rajasthan. The seeds were air dried for 3 days after selection and purification (removal of broken seeds, immature seeds and foreign particles) before they were ground into fine powder and then packed in sterilized bottles. The packed samples were then taken to the laboratory for analyses.

Chemicals and Reagents

All Chemicals of analytical grade of reputed companies were used for analyses.

Determination of Studied Parameters

Proximate analysis

Proximate analysis was carried out to determine moisture, protein, fibre, fat, ash and carbohydrate content using the methods of association of analytic chemists[4].

Vitamin analysis

Vitamin C and tocopherol were determined [35] while Vitamins A, B_1, B_2 and B_3 were determined by spectrophotometric method [22].

Mineral analysis

Sodium and Potassium were determined using flame photometry. Calcium, magnesium, iron and zinc were determined by atomic absorption spectrophotometric methods[32]. Each sample was analyzed twice and the mean data (mean ± SD) were reported.

Anti –nutritional factors analysis

The alkaloid and saponin content of the sample were determined by the colorimetric method[32]. The absorbance of each sample was measured at 420 nm (for alkaloid) and at 620 nm (for saponin) using spectrophotometric method and the quantity of the antinutrients estimated from a standard curve obtained by plotting the concentration of the standard anti-nutrient concentration against absorbance. The Folin-Denis Spectrophotometric method [37] was used to determine the tannin content in the samples. The absorbance of the developed color was measured at 760 nm wavelength with the reagent blank set at zero.

The flavonoid content was determined [8].

Statistical Analysis

Proximate compositions, vitamins, minerals and anti-nutritional factors were estimated in duplicate determinations. Estimates of mean and standard deviation for the above mentioned parameters were calculated using MS excel.

RESULTS AND DISCUSSION

The proximate compositions of the seeds are as shown in **Table 1**.

Proximate analysis of food is usually the principle for the consideration of nutritional quality of food. The results of this research are in accordance with other scientists on moth bean and other related *Vigna* species [18,39,42]. However, the protein content of the present investigated sample was lower than the values reported [42] on *Vigna acontifolia* and *Vigna unguiculata*. This difference could be attributed to the geographical location of the plants. Proteins are essential for cell and tissue growth and repair. They also play a vital role in immune regulation[34]. The carbohydrate content of the investigated sample was higher than those of *Glycine max* and *Phaseolus lunatus*[23]. The most important function of carbohydrates in the body is to provide energy. The moisture content of the investigated sample is comparable with the value (11.25±0.11) reported[20] for *Mucuna pruriens* but higher than those reported for mung bean, chickpea and green pea[18,45]. It is a known fact that lower the moisture content of the sample longer is the shelf life. The ash content was similar to the values reported[39,42]. The *Vigna aconitifolia* sample contains nutritionally important mineral elements. *Vigna aconitifolia* can be considered as a source of dietary fibre due to comparable values with reports on *Vigna unguiculata* and mash bean[39,42]. Fibre is important as it provides roughage and food bulk to prevent constipation[3,14].

Table 1. Proximate composition of *Vigna aconitifolia* (Jacq.) Marechal

Parameter	Concentration (%)
Moisture	12.87±0.03
Crude protein	14.06±0.01
Crude fibre	0.33±0.01
Crude fat	3.52±0.00
Ash	2.81±0.00
Carbohydrate	66.41±0.00

Values are calculated as mean of duplicates on a dry weight basis ± standard deviation

The results of the vitamin compositions of *Vigna aconitifolia* (Jacq.) Marechal (moth bean) are as shown in **Table 2**.

Vitamin deficiencies can adversely affect human metabolism. Vitamin A is required for maintenance of healthy epithelial tissue and normal vision. Deficiency of Vitamin A may lead to anaemia, decreased resistance to infections and cancer[25]. The vitamin A content of the investigated *Vigna aconitifolia* was 13.36 IU. This value was below the Recommended Dietary Allowance for Vitamin A but comparable with the value reported [16] on mango seed. Vitamin C, also known as ascorbic acid is an enzyme cofactor required for many important biochemical pathways[11]. Vitamin C is a powerful antioxidant involved in wound healing[17] the deficiency of which results in breakage of capillaries, scurvy and anaemia[11]. Vitamin C was obtained in the highest concentration (43.52 mg/100 g). This value was higher than the values 37.84 and 38.4 mg/100 g) reported in *Glycine max* [33]and *Cajanus cajan* [24]. Vitamin B complex (B_1, B_2 and B_3) are water soluble vitamins, and are essential for regulation of normal human metabolic activities. Niacin is known as pellagra-preventive while the deficiency of thiamin causes the disease beriberi [17]. The symptoms of riboflavin deficiency include glossitis and cheilitis[17,43]. The tocopherol content was found to be similar to the value reported for *A. conyzoides*[30].

Table 3 shows the mineral composition (mg/100 g) of *Vigna aconitifolia* (Jacq.) Marechal .

Among all the investigated minerals, potassium was present in highest concentration. Therefore, the incorporation of *Vigna aconitifolia* in the diet of people who take diuretics to control hypertension could be beneficial [40]. The value obtained for sodium in the present sample was similar to that reported [42], but higher than that reported [45] for Mung bean. The values indicated for calcium, and phosphorus in the present sample were lower than the values reported [42]for *Vigna aconitifolia* and Mung bean[45]but the magnesium content of the seed was higher as compared to that of chickpea, cowpea and green pea[7]. The Zinc content of the sample was higher than that obtained for *Vigna aconitifolia* and *Vigna unguiculata* [11b] while the iron content was lower than that reported for chickpea and cowpea[18].

Table 2. Vitamin constituents of *Vigna aconitifolia* (Jacq.) Marechal

Vitamins	Concentration(mg/100g)
Vitamin A	13.36 ± 0.05 (IU)
Vitamin B_1	0.26 ± 0.00
Vitamin B_2	0.39 ± 0.00
Vitamin B_3	0.41 ± 0.00
Vitamin C	43.52 ± 0.01
Tocopherol	0.23 ± 0.01

Values are mean of duplicates on a dry weight basis ± standard deviation

Table 3. The mineral constituents of *Vigna aconitifolia* (Jacq.) Marechal

Minerals	**Concentrations (mg/100 g)**
Sodium	32.85 ± 0.02
Calcium	18.74 ± 0.01
Magnesium	19.28 ± 0.01
Potassium	49.25 ± 0.02
Iron	1.52 ± 0.00
Zinc	2.09 ± 0.00

Values are mean of duplicates on a dry weight basis ± standard deviation.

Table 4. Anti-nutritional factor composition of *Vigna aconitifolia* (Jacq.) Marechal

Anti-nutrients	Concentration (mg/100 g)
Alkaloids	1.98±0.02
Saponins	0.72±0.05
Tannins	2.78±0.01
Flavonoids	1.25±0.01

Values are mean of duplicates on a dry weight basis ± standard deviation

The results of the anti-nutritional factors obtained in this investigation are as presented in **Table 4**.

Legumes contain several anti-nutritional factors that reduce the bioavailability of nutrients, which can be reduced by conventional techniques[13] such as dehulling, roasting, soaking and cooking.

Alkaloids are secondary plant metabolites with great pharmacological significance[1]. The alkaloid content of *Vigna aconitifolia* was higher than the value (1.44 ± 0.10) reported for *Vigna unguiculata* [12]. The saponin content was comparably higher than the values (0.11 ± 0.10 and 0.17 ± 0.11) reported for *Vigna unguicalata* and *Glycine max* respectively [33] but lower than the value (6.0 ± 0.06) reported for *Punica granatum* seeds [12]. Saponins have foaming properties, astringent taste and haemolytic activity on red blood cells[41]. Tannins registered a higher value (2.78 ± 0.01) than those reported for *Mucuna pruriens* and water melon seeds[21,9]. Tannins reveal astringent and antimicrobial potentials and are involved in healing of wounds and mucositis. The flavonoid content of *Vigna aconitifolia* was lower than the value (2.03 ± 0.2) reported for water melon seeds [9]but higher than that reported for *Vigna aconitifolia* [2]. Flavonoids are antioxidants and free radical scavengers[31].

CONCLUSION

Vigna aconitifolia (Jacq.) Marechal seeds could serve as a good source of nutrients notably carbohydrates, proteins, vitamin A, vitamin C, potassium, sodium and flavonoids. The undetermined parameters of the sample would be tackled with in further studies.

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