Asian Journal of Research in Botany

5(2): 53-59, 2021; Article no.AJRIB.64542

A Comparative Phytochemical and Nutritional Study on *Cajanus cajan (*L.) Millspaugh and *Vigna unguiculata* (L.) Walp (*Fabaceae*)

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

Editor(s):
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Complete Peer review History: http://www.sdiarticle4.com/review-history/64542

Original Research Article

Received 05 December 2020
Accepted 10 February 2021
Published 08 March 2021

ABSTRACT

A comparative study on *Cajanus cajan and Vigna unguiculata* was evaluated and compared to determine their Phytochemical and Nutritional characteristics as medicine and food. A standard gravimetric and spectrophotometric method was employed. Analysis of variance (ANOVA) was used for data analysis. Results revealed that seeds extract of *Cajanus cajan and Vigna unguiculata* all had the investigated Phytochemicals (alkaloids, flavonoids, saponins, sterols and phenol) in varied compositions. The seed extract of *Cajanus cajan* contained statistically higher percentages of the investigated Phytochemicals (0.34±0.15, 0.46±0.15, 0.22±0.10, 0.44±0.11 for Alkoloid, Flavonoid, Sterol, Phenol respectively) than the seed extract of *Vigna unguiculata* except for saponin. The proximate study revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* contained all the investigated nutrients (carbohydrate, protein, fibre, moisture and ash) in varied compositions. The seed extract of *Cajanus cajan* contained statistically higher percentage of protein, fibre and ash (33.04±0.01, 9.24±0.10, 4.20±0.11 respectively) while the seed extract of *Vigna unguiculata* contained higher percentage of carbohydrate and moisture (54.66±0.01 and 9.57±0.10 respectively). The presence of these investigated biochemicals justifies the species uses in the treatment of diseases. The seed *of Cajanus cajan* can be regarded as more nutritious than that of *Vigna unguiculata.* Malnourished and diabetic patients could be advised to eat more of

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Cajanus cajan seed in relatively high amount than *Vigna unguiculata* seed. The biochemical compounds and the nutrients could be extracted from these species for the development of drugs and foods supplements.

Keywords: Comparison; biochemical compounds; nutrition; fabaceae; supplements.

1. INTRODUCTION

Among the Angiosperms, *Fabaceae* is the third largest after *Orchidaceae* and *Asteraceae*. It comprised 700 genera and nearly 20,000 species of trees, shrubs, herbs and vines and is ubiquitous. Plants belonging to this family are rich in plant protein. Apart from their food value, these plants produce nodules on their roots [1]. These nodules contain a kind of bacteria (*Rhizobium*) which is capable of converting the atmospheric nitrogen into nitrates which can be used by plants [1]. Most species grow rapidly and are used as cover crops to prevent erosion, uphold and increase soil physical features and improve soil organic matter [1]. Some of the most important commercial species which are cultivated for their edible rich seeds include among others pigeon pea (*Cajanus cajan* L.) and cowpea (*Vigna unguiculata* L.) which are the point of interest in this research. Plant proteins are proteins gotten from plant sources such as legumes, mushrooms, etc. In general legumes are seeds of *Fabaceae* such as beans, peas, pulses etc. Legume is used as an alternative to meat in some functions owing to its protein content and reduced price unlike meat and its product [2]. Legume crops are known for their capacity to affix atmospheric nitrogen due to its mutual relationship with bacteria found in the root nodules of these crops [3]. The capacity to form this symbiotic relationship brings the cost of fertilizer low for poor farmers who produce legumes, and also applied it in crop rotation to refill soil with reduced nitrogen [4]. The ability of legumes to fix nitrogen is enriched by having sufficient calcium in the soil and bring down by the ample nitrogen. The seeds of legume and foliage have relatively larger protein constituent than non-legumes, possibly as a result of supplemented nitrogen get from nitrogen-fixation symbiosis by legumes [4]. Legumes are more desirable in agriculture due to its large protein constituent. Its outer part (hulls) contains a great quantity of polyphenols and antioxidants [3].

Pigeon-pea *(Cajanus cajan L)* is a shrub that attains a height of 1.2-1.5 m. it characteristically has thin pubescent branches. The leaves are compound trifoliate and individual leaflets are lanceolate in shape with acute apices. The fruits is a short pubscent pod about 4-8 cm long with an acute apex. The seeds are cooked and eaten either alone or together with yam (*Dioscorea sp*) [5]. Pigeon- pea is a good source of protein and vitamin. It is applied for the treatment of liver inflammation, dysentery, high blood sugar and rubeola. The leaves extract is applied in the treatment of injuries, malaria, lesions, it also lowers oxidation effects and anti-cancerous in nature [6-8]. The seeds of pigeon- pea possess anti-sickling potential [6-8]. *Cajanus cajan* is applied traditionally to treat chickenpox and smallpox [6-8].

Cow-pea (*Vigna unguiculata (L)*) is a herb that could be procumbent, climbing or prostrate in habit. Leaves are compound of the trifoliate type. Fruit is a pod which is usually pendulous in position, often occurring in clusters, long and narrow. It the seeds in these fruits that are eaten in a variety of ways: cooked alone or with yam, plantain or maize. They could also be made into a paste together with pepper, onions and fried or baked with palm oil into 'akara' or moi moi respectively [5]. *Vigna unguiculata* is a great legume, especially in tropics and subtropics of sub-Saharan Africa. It is extremely nutritious and tolerant to drought. Cowpea is among the old crops consumed by man all over the world for its nutrients [9].

Utilization of plants and plant extracts as foods and in the treatment of sicknesses is a lasting and an eternal practice. In the recent decennium, request in the search of bioactive compounds in plants is on the rise since plants are the fundamental sources of food and new drugs. Also, some plants are packed with nutrients and bioactive compounds more than others. Although, *Cajanus cajan* and *Vigna unguiculata* have been used extensively as food and in traditional medicine, yet there is need to investigate the seeds of these plants for Phytochemical and proximate constituents with the view of ascertaining which one has more nutrients and bioactive agents, Thus, the objective of this research was to evaluate and

compare the Phytochemical and proximate contents of *Vigna unguiculata* L. and *Cajanus cajan* L.

2. MATERIALS AND METHODS

2.1 Study Area

This research was carried out at Central Laboratory Service Unit in National Root Crops Research Institute, Umudike, Abia State.

2.2 Collection and Identification of Plant Species

Cajanus cajan and Vigna unguiculata were collected between April- May 2019 from Awka market in Awka-south Local Government Area, Anambra State. The species was authenticated at the Department of Biology, Nwafor Orizu College of Education Nsugbe, Anambra State where the voucher specimens were deposited.

2.3 Preparation of Plant Sample

Dried seeds of *Cajanus cajan and Vigna unguiculata* were ground into fine powder and stored in an air-tight container until when required.

2.4 Materials for Phytochemical Analysis

The materials and instruments used include; plant specimen, blender, masking tape, mortar and pestle, moistuer cans, crucibles, Whatman filter paper No. 42 (SIGMA-ALDRICH Laboratories, USA), burettes, volumetric flasks, beakers, conical flasks, sample tubes, desiccators, spectrophotometer (Analytic Jena, Germany), muslin cloth, oven, measuring cylinder, spatula, electric scale, Bunsen burner, funnels, aluminium foils, test tubes, syringes, pipettes and cotton wools.

2.5 Chemical and Reagents Used

Ethanol, concentrated acetic acid, sulphuric acid, diluted ammonia, water, ferric chloride, potassium ferrocyanide, ethyl acetate, hydrochloric acid, petroleum ether, sodium hydroxide, potassium hydroxide, Hydrogen peroxide, sodium chloride, copper sulphate, sodium picrate, methyl red, cresol green, folin-cio caltean reagent, folin-dennis reagent, Erichrome black and solechrome darkblue, Listed reagentsfolin-cio caltean reagent, folin-dennis reagent, Erichrome black and solechrome dark blue, Listed reagents (SIGMA-ALDRICH Laboratories, USA).

2.6 Materials for Proximate Analysis

The following materials were used: dessicator, muffle furnace, spectrometer, silica dish, kjeldahl flask, funnel, soxhlet apparatus, filter paper, thimble, electric oven, grinder, retort stand, test tube and test tube rack, crucible, weighing balance, petric dish. The chemicals used include: tetrahydrosulphate (vi) acid, Boric acid indicator solution, Sodium hydroxide, Hydrochloric acid, petroleum ether, Potassium hydroxide, Acetone, phenolphthaline indicator, Ammonia, Dithezone solution, carbon tetrachloride, Hydroquinoline, Phenonthroline, Vanado Molybidic acid, Selenium oxide.

Proximate analysis was carried out to determine the presence of these nutrients: carbohydrate, crude protein, moisture content crude fibre and ash content.

2.7 Phytochemical Analysis

The species extracts were obtained using ethanol solvent. 50 g of the powdered seeds of *Cajanus cajan and Vigna unguiculata* were soaked in 50 ml of ethanol and left for 48 hrs before filtration. Qualitative Phytochemical screening of the extracts was carried out to determine the presence of the following Phytochemicals: flavonoids, alkaloids, saponins, tannins, sterols and phenol. The procedure was as outlined by [10].

Quantitative Phytochemical analysis of the extracts was carried out to determine the percentage quantitative compositions of Phytochemicals: flavonoids, alkaloids, saponins, tannins, sterols and phenol. The procedure was as outlined by [10-11].

2.8 Statistical Analysis

The results were analyzed using ANOVA. The Duncan's multiple range test significance was used to test the difference among treatments. All analyses were carried at 5% level of significance.

3. RESULTS

The results of the study are shown in Tables 1-3 and Figs. 1-2.

3.1 Qualitative Phytochemical Screening of Seeds of *Cajanus cajan and Vigna unguiculata*

The result of the study revealed that all Phytochemicals (alkaloid, flavonoid, saponins, sterol and phenol) assayed were present in the seeds extracts of It was revealed from the result that all phytochemicals (alkaloid, flavonoid, saponin, sterol and phenol) investigated were present in the seeds extracts of *Cajanus cajan and Vigna unguiculata* (Table 1).

3.2 Quantitative Phytochemical screening of seeds extract of *Cajanus cajan and Vigna unguiculata* (%)

Results revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* all had the investigated Phytochemicals in different quantities (Table 2). The seed extract of *Cajanus cajan* had higher percentage of the investigated Phytochemicals than the seed extract of *Vigna unguiculata* except for saponins (Table 2).

3.3 Percent Proximate Compositions of seeds extract of *Cajanus cajan and Vigna unguiculata* (%)

Results revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* contained all the investigated nutrients (carbohydrate, protein, fibre, moisture and ash) in varied compositions (Tables 3). The seed extract of *Cajanus cajan* contained higher percentage of protein, fibre and ash while the seed extract of *Vigna unguiculata* contained higher percentage of carbohydrate and moisture (Table 3).

Fig. 1. a and b. *Cajanus cajan* seeds

Fig. 2. a and b. *Vigna unguiculata* seeds
Source: self collection

Table 1. Qualitative phytochemical screening of seeds extract of *Cajanus cajan and Vigna unguiculata*

Phytochemicals	Alkaloids	Flavonoids	Saponin	Sterol	Phenol
C. cajan	+	+	+	+	+
V. ungiculata	+	+	+	+	+

Key: Positive (+ve) = Presence
Negative (-ve) = absence

Table 2. Percent quantitative phytochemical screening of seeds extract of *Cajanus cajan and Vigna unguiculata* (%)

Phytochemical	Alkaloids	Flavonoids	Saponin	Sterol	Phenol
C. cajan	0.34±0.15[a]	0.46±0.15[a]	0.13±0.10[b]	0.22±0.10[a]	0.44±0.11[a]
V. ungiculata	0.21±0.10[b]	0.30±0.13[b]	0.21±0.11[a]	0.15±0.10[b]	0.40±0.13[b]

Results are in mean ± standard deviation. Means with the same letter in a column are not significantly differently (P<0.05)

Table 3. Percent proximate compositions of seeds extract of *Cajanus cajan and Vigna unguiculata* (%)

Nutrients	Carbohydrate	Crude protein	Crude fibre	Moisture	Ash content
C. cajan	43.21±0.00[b]	33.04±0.01[a]	9.24±0.10[a]	5.56±0.00[b]	4.20±0.11[a]
V. ungiculata	54.66±0.01[a]	25.05±0.10[b]	7.20±0.10[b]	9.57±0.10[a]	4.18±0.13[b]

Results are in mean± standard deviation. Means with the same letter in column are not significantly different at (P<0.05)

4. DISCUSSION

Results of the phytochemical study revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* had all the investigated Phytochemicals (alkaloid, flavonoid, saponin, sterol and phenol) in different quantities (Table 1-2). The biochemical contents of plant extracts differ greatly from one plant to another [12,13]. These biochemicals are known to have medicinal potentials. Plants manufactured these biochemical compounds, mostly to help them flourish or frustrate competitors, predators, or pathogens [14]. The seed extract of *Cajanus cajan* contained higher percentage of the investigated Phytochemicals than the seed extract of *Vigna unguiculata* except for saponins (Table 2).The importance of alkaloid in plants is yet to be apprehended. They are mainly excretory products of plant metabolites though may serve specific biological functions. Alkaloids may serve as a protective agent to certain insect species. They function actively in animals even at low concentrations, and are mostly employed in medicine (e.g. morphine, atropine, cocaine, colchicines and quinine) [15]. Morphine is an active narcotic employed for pain alleviation but the additive effect limit its usage. Quinidine is applied for the treatment of irregular heartbeat. Cocaine is administered to reduce pain or to induce numbness. Quinine is an effective antimalarial agent. Flavonoids are Phytochemical that function therapeutically through cell indication pathways and antioxidant potential. They regulate cellular activity and fight off free radicals that cause oxidative stress [16,17]. Research has shown that saponins have great pharmacological and therapeutic properties. Plants that contain saponins have healing activities [18,19] because saponins have the throughput to precipitate and sticky Red Blood Cells (RBCs) [17,20]. Sterol is any class of widely unsaturated solid alcohols of the steroid group, such as cholesterol and ergosterol, present in the fatty tissues of plants and animals. They are applied for the treatment of skin ailment [13].

The proximate study revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* contained all the investigated nutrients (carbohydrate, protein, fibre, moisture and ash) in varied compositions (Table 3). The seed extract of *Cajanus cajan* contained higher percentage of protein, fibre and ash while the seed extract of *Vigna unguiculata* contained higher percentage of carbohydrate and moisture (Table 3).These nutrients are necessary for the maintenance of life. Carbohydrates are the main source of energy in the body. In addition, they are used to build certain body parts (exoskeletons of arthropods). Mucus, an important lubricant in our bodies, is composed of carbohydrates [21]. Proteins are the strong body-building compounds vital for growth and repair of old tissues. They are crucial for the production of enzymes and hormones [14,21]. Fibres are good in aiding digestion and may be used as forage for animals [22,23]. An ash content of a species is an indication of mineral present in the parts [24]. Plants belonging to Fabaceae family are rich in plant protein. Apart from their food value, these plants produce nodules on their roots [1]. These nodules contain a kind of bacteria (*Rhizobium*) which is capable of converting the atmospheric nitrogen into nitrates which can be used by plants [1]. Most species grow rapidly and are used as cover crops to prevent erosion, uphold

and increase soil physical features and improve soil organic matter [1]. Their seeds are used as an alternative to meat in some functions owing to its protein content and reduced price unlike meat and its product [2].

5. CONCLUSION

Results of the study revealed that the seeds extract of *Cajanus cajan and Vigna unguiculata* contained all the investigated phytochemicals and nutrients in varied compositions. The seed extract of *Cajanus cajan* contained higher percentage of the investigated phytochemicals than the seed extract of *Vigna unguiculata* except for saponins. The seed extract of *Cajanus cajan* contained higher percentage of protein, fibre and ash while the seed extract of *Vigna unguiculata* contained higher percentage of carbohydrate and moisture. The presence of these investigated biochemicals justifies the species uses in the treatment of diseases. The seed *of Cajanus cajan* can be regarded as more nutritious than that of *Vigna unguiculata.* Malnourished and diabetic patients could be advised to eat more of *Cajanus cajan* seed in relatively high amount than V*igna unguiculata* seed. The biochemical compounds and the nutrients could be extracted from these species for the development of drugs and foods supplements.

DISCLAIMER

The products used for this research are commonly and predominantly use products in my area of research and country. There is absolutely no conflict of interest the author and producers of the products because I do not intend to use the products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the author.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/64542