



Nutritional Values and Medicinal Health Aspects of Brown, Brown-Black and White Cowpea (*Vigna unguiculata* L. Walp.) Grown in Okene, Kogi State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author AAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors KBT and ODO managed the analyses of the study. Authors YJ and AAS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Cowpea (*Vigna unguiculata*) is an annual legume thought to have originated in Nigeria. Cowpea has high protein and carbohydrate content with a relatively low fat content and a complementary amino acid pattern to that of cereal grains make it an important nutritional staple food in the human diet. This study aims to determine the phytochemical, nutritional values and medicinal health aspects of brown, brown-black and white cowpea grown in Okene, Kogi State, Nigeria. Three

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colours of cowpea seeds are dried and ground in powder form. The crude powder was tested for alkaloids, anthraquinone, carbohydrates, cardiac glycosides, fat and oils, flavonoid, Saponins, steroidal ring, terpenoids and tannins. The proximate analysis of the samples was carried out for protein content, ash content, fat content, moisture content, crude fiber and carbohydrate after drying each sample at room temperature. Vitamins and mineral elements were determined by the dry ash extraction. The phytochemical components of secondary metabolites of the extracts from the obtained result, anthraquinone were absent in each of the three colour of the samples and tannins were not present in the white seed. The proximate composition of a nutritive value of each samples. The brown and brown-black seeds has higher value of percentages (%) crude protein, % ash content, % fat content, moisture content, % crude fibre, % carbohydrate of amounting to (57.84, 4.53, 11.60, 7.24, 3.40, 55.98) and (58.59, 4.45, 10.9, 7.06, 3.90, 54.60) while the white seed has (50.20, 3.52, 9.30, 8.56, 4.11, 59.50) has low % crude protein, % ash content and % fat content value compared to brown and brown-black seeds of cowpea. The vitamins components of brown, brown-black seeds and white seed of Cowpea where vitamin A, B, C, E (131, 232, 9, 7) in brown seed, (142, 221, 7, 9) in brown-black seed and (113, 209, 6, 5) in white seed. The Mineral element of brown, brown-black and white seeds of Cowpea where Na, K, Ca, Mg, Fe, Zn, P and Mn (49, 981, 651, 123, 54, 35, 620, 1.0) brown, (58, 789, 668, 98, 43, 38, 590, 2.0) brown-black and (63, 684, 723, 299, 10.11, 23, 843, 0.5) white seeds were detected but Cu and N non-detected in each. The brown and brown-black seeds of cowpea is richer in proximate, vitamins and mineral nutrients compared to white seed of cowpea. Therefore, adoption, utilization and consumption of cowpea grains as source of food will be a step forward towards combating the protein-calorie malnutrition and iron deficiency in this part of the world.

Keywords: Nutritional values; medicinal health; Ikiza; cowpea; proximate; mineral element.

1. INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) a member of the family fabaceae, is an annual legume thought to have originated in Africa (Nigeria) [1]. The crop which may be trailing, erect or bushy in growth habit is widely cultivated in Africa, Asia and the Americas [2]. Cowpea is drought and salinity tolerant. It is an excellent intercrop in tuber and cereal-based farming systems where it is reported to improve yield of the component crops by 30 %. In addition to lowering aluminum ion toxicity in tropical soils, it controls erosion and plays an important role in soil fertility restoration fixing by symbiosis with nodular *Bradyrhizobia* spp. up to 200 kgN/ha per annum [2]. It also functions in sinking greenhouse gases (GHGs) and ameliorating climate change effects (FAO, 2016).

Cowpea is used as medicine, fodder, feed and food ([3]; Okwu and Njoku, 2009). In ethno-medicine, the root is prepared as an antidote against snake bite; its clustered porridge for treating chest pain, epilepsy and dysmenorrhea, infusion of the seed for amenorrhea, while that of the whole plant for fever and schistosomiasis (HBT, 2016). In addition, the role of pulses and pulse-derived vegetables as tonics, appetizers, stimulants, aphrodisiacs and anthelmintics are well documented in literature (FAO, 2016).

Preparations from cowpea also play important roles in reducing the risk of lymphoblastic leukemia and aberrant foci cyst development [4]. As food, the protein-rich grains provide cheap sources of protein for millions of consumers of the crop in meat-scarce communities of the tropics [5]. Besides contributing valuable grains for human consumption, the mild-flavoured leaves are veritable sources of nutrient-rich edible vegetable which could play significant roles in fighting malnutrition [6]; FAO, 2016).

The World Health Organization reported that 80% of the world population relies chiefly on traditional medicines involving the use of plant extracts or their active constituents [7]. India with its mega-biodiversity and knowledge of rich ancient traditional systems of medicine (Ayurveda, Siddha, Unani, Amchi and local health traditions) provide a strong base for the utilization of a large number of plants in general healthcare and alleviation of common ailments of the people [7]. *Vigna unguiculata* (L) Walp which is most commonly called as "cow pea" in English language and Epira people called "Ikiza" is an edible legume of the family Fabaceae with high protein contents [2]. It is one of the ancient crop known to man. It is cultivated around primary for seed, but also as a vegetable, cover crop and fodder. It is widely grown all over the world though it is perceived to have originated from

Africa [2]. It is a major staple food crop in sub-Saharan Africa, especially in the dry savanna regions of West Africa & Brazil [8]. Nigeria is one of the world prime producers of Cowpea [9]. The seeds and leaves are a major source of plant proteins and vitamins for man, feed for animals [10].

Some health benefits of cowpea include, toning the spleen, stomach and pancreas helps induce urination and relieves damp conditions like leucorrhoea. Cowpea is rich in potassium with good amount of calcium, magnesium and phosphorus. It also has small amount of iron, sodium, zinc, copper, manganese and selenium [11].

Cowpea is rich in vitamin A & C and also has appreciable amount of thiamin, riboflavin, niacin, vitamin B6 and pantothenic acid as well as small amount of foliate. Cowpea shoots and leaves are rich sources of calcium, phosphorous and Vitamin B [12]. These nutrients provided by cowpea makes it extremely valuable especially where many people cannot afford animal proteins such as meat and fish. We can evaluate nutritional composition and functional properties of some recombinant inherited lines of Cowpea to establish potential usage [13].

Cowpea can be used for the production of high quality food when mixed with crops such as corn or it can be used for rotational grazing. The

seeds of cowpea are major source of protein and other nutrients. It is cultured for its undeveloped pods and full-grown seeds and is eaten by people all around the world, especially in the developing nations [14]. Its amino acid complements those of cereals, while mineral contents: calcium and iron are higher than that of meat, fish and egg and the iron content equates that of milk; the vitamins- thiamin, riboflavin, niacin (water soluble) and their levels compare with that found in lean meat and fish which make them [14].

1.1 Medicinal Uses

The seeds are edible and used as the source of dietary protein. They also used to strengthen the stomach and destroy the worms in stomach. The plant is used in measles, smallpox, adenitis, burns and sores. Decoction or soup is used in affection of the liver and spleen, intestinal colic, in leucorrhoea and menstrual disorder, urinary discharges (HBT, 2016). It is used as astringent, appetizer, Antipyretic, Diuretic, laxative, aphrodisiac, diuretic, anti-hyperglycemic, antinociceptive, galactagogue and liver tonic. It exhibits thrombolytic, antisickling, antioxidant and free radical scavenging activities. Also exhibits Antibacterial activity against both the Gram positive and Gram negative organisms. Useful in jaundice, epilepsy, anorexia, constipation (HBT, 2016).



Fig. 1. Shows different type of cowpea (Brown, Brown-Black and White Colour)

1.1.1 Anthelmintic

Anthelmintic activity *Vigna unguiculata* (L) Walp. seeds are coarse powdered and exhaustively with hot solvent (Soxhlet) extraction by ethanol and maceration with chloroform water I.P. Five concentration (10-100 mg/ml) of ethanolic and aqueous extracts were studied for anthelmintic activity by using *Edriluseuginiae* earthworms. Both aqueous and ethanolic extracts showed paralysis and death of worms in concentration (10-100mg/ml) dependent manner. Alcoholic extract of *Vigna unguiculata* (L) Walp showed significant activity than aqueous extract. Piperazine citrate (10mg/ml) and distilled water were included in the assay as standard drug and control respectively. The result showed seeds of *Vigna unguiculata* (L) Walp possessed potential anthelmintic activity [15].

1.1.2 Antibacterial activity

Aqueous and ethanolic extracts of seeds of *Vigna unguiculata* (L) Walp were studied for antibacterial activity and was tested against Gram positive bacteria, *Bacillus subtilis* and Gram negative bacteria, *Escherichia coli* by agar well diffusion method. Different concentrations (100 µg/ml, 200 µg/ml and 300 µg/ml) of the extracts were incorporated into the wells. Both the extracts showed concentration dependent activity against the microorganisms investigated. The results showed the highest positive antibacterial activity with an inhibition diameter of 22 mm in case of aqueous extract of 300 µg/ml concentration, against the Gram negative bacteria; *Escherichia coli*. The *E.coli* species were found to be more sensitive than that of the *Bacillus subtilis*. The aqueous extract exhibited more antibacterial activity against both the Gram positive and Gram negative organisms than that of the ethanolic extract [16].

1.1.3 Antioxidant activity

In screening of antioxidant activity of the methanolic extracts of cowpea (*Vigna unguiculata* (L) Walp.) seeds. Phenolic compounds present in the extracts showed the antioxidant and antiradical properties when investigated using a linoleic acid peroxidation model, FRAP, ORAC and TRAP assays, as well as DPPH, hydroxyl, nitric oxide and superoxide radical scavenging activity. The HPLC analysis of the cowpea extracts showed the presence of neochlorogenic acid, chlorogenic acid and caffeic acids. The results indicated that methanolic

extract of the cowpea resembled in the aforementioned activities those from other leguminous seeds and pulses [17].

1.1.4 Antinociceptive activity

Antinociceptive activity was examined through the observation of decrease in abdominal constrictions in intraperitoneally administered acetic acid-induced pain model in mice. Administration of methanol extract of beans results in dose dependent and significant decreases in blood glucose levels in glucose-loaded mice. The tests for antinociceptive activity results, that the methanolic extract decreases the number of abdominal constrictions by 30.0, 33.3, 36.7, and 43.3%, respectively in all above four doses. This study concluded that the beans can be a good source for alleviating pain and for lowering blood sugar in diabetic patients [18].

1.1.5 Antimicrobial activity

The antimicrobial activity of *Vigna unguiculata* (L)Walp seed oil was investigated against five Gram positive bacteria (*Bacillus megaterium*, *Bacillus subtilis*, *Sarcina lutea*, *Salmonella typhi* and *Staphylococcus aureus*) and four Gram negative (*Escherichia coli*, *Shigella dysenteriae*, *Shigella sonnei*, *Shigella shiga*) and four fungi (*Penicillium* spp., *Mucor* spp., *Candida albicans* and *Aspergillus fumigatus*). Oil at the concentration of 400 µg/disc showed the highest activity against *Sarcina lutea* and *Staphylococcus aureus*. Oil is active against the three tested fungi namely *Penicillium* spp., *Mucor* spp. and *Candida albicans* but showed no sensitivity against *Aspergillus fumigatus* ([19].

1.1.6 Antidiabetic activity

The seed oil of *Vigna unguiculata* (L) Walp was investigated for its anti-diabetic activity against alloxan monohydrate induced diabetes in rats. Levels of blood glucose, TC, TGs, LDL, ALT, AST and ALP decreased and HDL increased in alloxan induced diabetic rats after treatment with 200 mg/kg barbati seed oil for 21 days. The study reported that the seed oil of cow pea may be very useful for the improvement of the complications of diabetes [20].

1.1.7 Hypocholesterolemic activity

The seeds of *Vigna unguiculata* (L) Walp was investigated for its Hypocholesterolemic activity in Wistar rats. Rats were grouped and fed a high

fat diet with 20% Bombay (BO), 20% MI 35 (MI), 20% Cowpea extract, 20% Dawala (DA) in comparison with 20% casein (HFD). Serum total cholesterol, non-HDL cholesterol, triacylglyceride and glucose concentrations were analyzed. Serum lipids and glucose concentrations in cowpea fed rats were significantly lower than HFD. Therefore, raw cowpea produced significant hypolipidemic and hypoglycemic effects in Wistar rats [21].

1.1.8 Antiviral and antifungal activity

The *Vigna unguiculata* (L) Walp seeds were examined for the presence of various proteins and amino acids with antiviral and antifungal potency. The two proteins, designated α - and β -antifungal proteins according to their elution order from the CM-Sepharose column, were capable of inhibiting human immunodeficiency virus (HIV) reverse transcriptase and one of the glycohydrolases associated with HIV infection, α -glucosidase, but β -glucuronidase was not repressed. The ability of the proteins was also demonstrated in order to retarding mycelial growth of a variety of fungi, and α -antifungal protein being proved more potent in most cases. β -Antifungal protein was highly active in only one instance. Both antifungal proteins had low cell-free translation-inhibitory activity [22].

1.1.9 Antisickling activity

Natural plant products have been used in Nigerian folk medicine in the management of sickle cell anemia by inhibiting sickling [23]. This work was therefore aimed at investigating the Antisickling potential of the ethanol seed extract of *Vigna unguiculata* used in the Nigerian herbal medicine with a view of proposing an effective herbal recipe for the management of sickle cell disease [23]. Sickling inhibition test, sickling reversal test and polymerization test were carried out using standard methods. The results of the antisickling test showed that *Vigna unguiculata* had significantly ($p < 0.05$) higher antisickling effect than Hbss control. The result of the polymerization showed that, extracts significantly ($p < 0.05$) increased delayed time before polymerization at 50, 25 and 12% concentrations compared to the control. From the results, the extracts *Vigna Unguiculata* have shown to be therapeutically beneficial in the management of sickle cell disease and thus it is strongly recommended by this study to be developed into supplements for the management of sickle cell disease [23].

1.1.10 Thrombolytic activity

Inquisition with methanolic extract of *Vigna unguiculata* (L) Walp (seeds) was carried out to determine the thrombolytic potential of this plant. Five different concentration (2mg/ml, 4mg/ml, 6mg/ml, 8mg/ml, and 10mg/ml) of methanolic extract was used to evaluate thrombolytic activity. In-vitro Thrombolytic model was used. The plant showed significant clot lysis, i.e. concentrations 12.01 ± 1.50 , 16.48 ± 2.31 , 24.88 ± 1.49 , 31.24 ± 0.68 , 40.33 ± 3.64 at 2mg/dl, 4mg/ml, 6mg/ml, 8mg/ml, 10mg/ml respectively, while the standard (streptokinase) and negative control (distilled water) showed 58.41 ± 3.71 and $2.56 \pm 1.23\%$ clot lysis respectively. It is clear that *Vigna unguiculata* (L) Walp (seed) methanolic extract showed thrombolytic activity significantly while comparing with standard [24].

2. MATERIALS AND METHODS

2.1 Collection of Plant Materials

The different seeds type of Cowpea (*Vigna Unguiculata*) were purchased from Okene Central Market (Ohu Variki), Kogi State, Nigeria in 20th March, 2020. The plant's identification was authenticated by Mr. Ayegba Ojochele Sule at the Herbarium Unit of the Department of Biological Sciences, Kogi State University, Anyigba and voucher specimen number of KSU/BS/169 was deposited for future reference.

2.2 Processing of Plant Materials

The different seed types of dried Cowpea were milled into fine power by grinding manually with a grinding machine, stored in sterile containers in a cool dry place till further use.

2.3 Determination of Phytochemical Compounds in Different Types of Cowpea (*Vigna unguiculata*)

The phytochemical compound was carried out in crude powder contents of different types of Cowpea (*Vigna Unguiculata*). The methods of Kokori et al., [25] and Abdullahi et al., [26] was applied for the determination of the presence of phytochemicals. The filtrate obtained from each extraction was tested for alkaloids, saponins, flavonoids, phenol, fat and oils, steroids, tannins and glycosides.

2.4 The Proximate Analysis

The proximate analysis of the samples was carried out according to AOAC [27] for moisture content, ash, fat, crude protein, and crude fibre after drying the samples of three (3) types of Cowpea (*Vigna Unguiculata*) at room temperature.

2.4.1 Moisture

The different colour of seeds (5g each) of both Cowpea were weighed and oven dried at steady temperature of 70°C. The amount of moisture in each samples were then expressed as loss in weight after cool weighing.

2.4.2 Ash content

The samples 5 g each were placed in a crucible and heated to 550°C to eliminate organic components. The crucible and its contents were then cooled and weighed, and the ash evaluated as a proportion of the original dry weight of samples.

2.4.3 Crude protein

This was done using the micro-Kjedahl method. The nitrogen proportion of the protein in 5 g of each of the sample was converted into ammonium sulphate by digestion with concentrated hydrogen tetraoxosulphate (VI) acid using copper sulphate as a catalyst. The liberated ammonia was collected in boric acid double indicator solution and the nitrogen quantified through standard hydrochloric acid titration until end point was reached. The amount of crude protein was then obtained by multiplying by a factor of 6.25.

2.4.4 Crude fat

Crude fat was extracted from both plant part samples using 5 g of the plant samples, petroleum ether and soxhlet extractor apparatus. The weight of the fat obtained after evaporating off the petroleum ether from the extract gave the crude fat in the samples and this was expressed as a percentage.

2.4.5 Crude Fibre

The defatted samples of 5 g were used to determine the fibre contents in samples via extraction by acid digestion, filtration and base digestion. The resulting residues were eventually ignited at 550°C. Fibre content was then

expressed as a percentage lost on ashing and initial weight.

2.4.6 Carbohydrate

The amount of carbohydrate in each of the samples was then estimated as the difference from 100 of the sum of crude protein, fat, ash, and fibre.

2.5 Determination of Vitamins

Vitamins A, E, B and C were determined according to methods previously described by AOAC [28].

2.6 Determination of Mineral Elements

The mineral elements were determined by the dry ash extraction method of AOAC [29].

2.7 Statistical Analysis

Results obtained were recorded as mean \pm SEM and subjected to one way analysis of variance (ANOVA) and where significant differences exist, means were compared using Waller Duncan test was performed using Statistical Analysis System (SAS, software version 2002) at 0.05 significant level ($P < 0.05$).

3. RESULTS AND DISCUSSION

The Table 1 shown the Phytochemical screening of the crude powered seed of three (3) types of (Brown, Brown-Black and White Cowpea) revealed the presence of tannins, terpenoids, saponins, flavonoids, alkaloids, cardiac glycosides, carbohydrates, fat and oil and Steroidal ring (shown in Table 1 below). These compounds have potentially significant application against human pathogens, including those that cause enteric infections [30]. Several authors have linked the presence of these phytopharmacological compounds to the antimicrobial properties of this cowpea plant [31]. The presence of alkaloids is interesting, as significant quantities are used as antimalarials, analgesics and stumilants [32]. The presence of glycosides moieties like saponins, cardiac glycosides and Flavonoids which are known to inhibit tumor growth and serve also to protect against gastrointestinal infections are of pharmacognostic importance and give evidence to the use of the plant in ethnomedicinal herbs. Plant that have tannins as their components in the seed extract are astringent in nature and are

used for treating intestinal disorders such as diarrhea and dysentery thus exhibiting antibacterial activity [33].

Tannins are widely used in traditional medicine in treating wounds and to arrest bleeding [34]. Most legumes contain tannins. Red-coloured beans contain the most tannins, and white-coloured beans have the least because tannins produce different colours with ferric chloride (either blue, blue-black, brown, brown-black, green, or green-black) according to the type of tannin.

Some of these phytochemical compounds which are synthesized as secondary metabolites as the plant grows also serve to protect the plant against microbial attacks and predation by animals. The increasing reliance on the use of medicinal plants by a sizeable proportion of the people in the so-called industrial world has been traced to the extraction and development of several drugs and chemotherapeutic agents' from these plants as well as from traditionally used rural herbal remedies [35].

The Table 2 shows the proximate composition of a nutritive value of three (3) types of (Brown, Brown-Black and White Cowpea). The brown and brown-black seeds has higher value of (percentage) % crude protein, % ash content, % fat content, moisture content, % crude fibre, % carbohydrate of amounting to (57.84, 4.53, 11.60, 7.24, 3.40, 55.98) and (58.59, 4.45, 10.9, 7.06, 3.90, 54.60) while the white seed has (50.20, 3.52, 9.30, 8.56, 4.11, 59.50) has low % crude protein, % ash content and % fat content value compared to brown and brown-black seeds of cowpea. The percentage ash content which is

an indicator of the quality of mineral nutrients present has low in the white seed. By implication, the brown and brown-black seeds are richer in mineral nutrients / elements than the white seeds.

Table 3 shown estimation of vitamins of brown, brown-black seeds and white seed of Cowpea (*Vigna Unguiculata*) where vitamin A, B, C, E (131, 232, 9, 7) in brown seed, (142, 221, 7, 9) in brown-black seed and (113, 209, 6, 5) in white seed.

Table 4 Shown Mineral Composition of brown, brown-black and white seeds of Cowpea (*Vigna Unguiculata*) where Na, K, Ca, Mg, Fe, Zn, P and Mn (49, 981, 651, 123, 54, 35, 620, 1.0) brown, (58, 789, 668, 98, 43, 38, 590, 2.0) brown-black and (63, 684, 723, 299, 10.11, 23, 843, 0.5) white seeds were detected but Cu and N non-detected in each.

3.1 Phytochemical Screening of the Extracts

The table below is a summary of the phytochemical components of secondary metabolites of the extracts. From the obtained result, anthraquinone were not present in all three different colour of cowpea.

3.2 Proximate Analysis

The result obtained showed that the proximate composition of a nutritional values of (*Vigna Unguiculata*) seeds is higher in protein (58.59) Brown-Black showed significant value $P < 0.05$ compared with that of percentage (%) Brown and White (57.84, 50.20) (See Table 2).

Table 1. Is a summary of the phytochemical components of secondary metabolites of the crude powders of brown, brown-black and white cowpea

Phytochemical compounds	Interference		
	Brown	Brown-Black	White
Alkaloids	+	+	+
Anthraquinone	-	-	-
Carboydrates	+	+	+
Cardiac glycosides	+	+	+
Fats and oils	+	+	+
Flavonoid	+	+	+
Saponins	+	+	+
Steroidal ring	+	+	+
Terpenoids	+	+	+
Tannins	+	+	-

Key: + = present, - = absent

Table 2. Shown summary of proximate composition of different colour seeds of cowpea (*Vigna Unguiculata*)

Parameters	Sample (g)		
	Brown	Brown-Black	White
% Crude Protein	57.84	58.59	50.20
% Ash Content	4.53	4.45	3.52
% Fat Content	11.60	10.90	9.30
%Moisture Content	8.24	7.06	8.56
% Crude Firbre	3.40	3.90	4.11
% Carbohydrate	55.98	54.60	59.50

Table 3. Estimation of vitamins of different colour seeds of Cowpea (*Vigna Unguiculata*)

Vitamins (mg/100 mL)	Cowpea (<i>Vigna Unguiculata</i>)		
	Brown	Brown-Black	White
A	131	142	113
B	232	221	209
C	9	7	6
E	7	8	5

Table 4. Mineral composition of different colour seeds of Cowpea (*Vigna Unguiculata*) (mg/100 g dry matter)

Minerals	Cowpea (<i>Vigna Unguiculata</i>) (mg)		
	Brown	Brown-Black	White
Na	49	58	63
K	981	789	684
Ca	651	668	723
Mg	123	98	299
Fe	54	43	10.11
Zn	35	38	23
Cu	n	n	n
P	620	590	843
N	n	n	n
Mn	1.0	2	0.5

Key: n-non detected

3.3 Determination of Vitamins

Table 3 shows determination of vitamins of different colour seeds of Cowpea (*Vigna Unguiculata*).

The above plant contains enormous phytochemical constituents. The extensive survey of literature revealed that *Vigna Unguiculata* (L) Walp, is an important medicinal plant with diverse pharmacological spectrum.

3.4 Determination of Mineral Elements

Table 4 shown determination of mineral elements present (Na, K, Ca, Mg, Fe, Zn, P and Mn) in each seed of cowpea (brown, brown-black and white).

The phytochemical composition, proximate and mineral analysis of the crude powder seed of different colour of cowpea (*Vigna Unguiculata*) indicate the presence of nine active constituents. The presence of these phytotherapeutic potentials is an indicative that the plant may has nutritional values and medicinal health aspects and it will be used as source of food supplement against diseases. Further investigation, purification and determination of these promising constituents can be done to assay their antimicrobial and antiviral activity and food supplements as alternative medicine in rural and

4. CONCLUSION AND RECOMMENDATION

Medicinal plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions.

urban settlement. Hence, this plant provides a significant role in the prevention and treatment of a disease. The brown and brown-black seeds of cowpea is richer in proximate, vitamins and mineral nutrients compared to white seed of cowpea. Therefore, adoption, utilization and consumption of cowpea grains as source of food will be a step forward towards combating the protein-calorie malnutrition and iron deficiency in this part of the world.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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