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Phytochemical Composition and Nutritional Quality of *Glycine max* and *Vigna unguiculata* (L.) Walp

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Abstract: The present research discussed the nutritive value and phytochemical composition of three cultivars of *Vigna unguiculata* and *Glycine max* grown in Nigeria. Phytochemical studies revealed the presence of bioactive compounds comprising flavonoids (2.36-6.28 mg 100 g^{-1}), alkaloids (1.28-1.64 mg 100 g^{-1}), tannins (0.38-0.77 mg 100 g^{-1}), saponins (0.11-0.23 mg 100 g^{-1}). The protein, carbohydrate, lipids and fiber content were 19.69-39.08, 32.78-67.26, 2.70-21.08 and 1.78-4.68%, respectively. The food energy value ranges from 363.71-477.16 cal g^{-1}. The grains are rich in B-vitamins such as niacin (1.85-4.01 mg 100 g^{-1}), thiamin (0.46-1.72 mg 100 g^{-1}), riboflavin (0.22-170 mg 100 g^{-1}) and ascorbic acid content ranges from (5.20-55.44 mg 100 g^{-1}). These grains are good sources of minerals comprising calcium, magnesium, phosphorus and potassium while sodium content was low. The legumes can be considered as sources of quality raw materials for food and pharmaceutical industries.

Key words: *Glycine max*, chemical composition, flavonoids, phenolic compounds, nutraceuticals, *Vignia unguiculata*

INTRODUCTION

Over the years, man has acquired extensive knowledge regarding the utilization of plants around him as food and for maintenance of his health. The grains not only serve as industrial raw materials but also as staple food throughout the tropics. Leguminous plants synthesize in their cells a great variety of phytochemicals particularly isoflavones, flavonoids, phenolic compounds, lignins, lignans, alkaloids and cyanogenic glycosides (Okwu, 2004, 2005). Isoflavones, which are phytoestrogens effectively and efficiently, modulate estrogen levels in humans. They are of clinical value in low estrogen states like menopause or imbalanced and toxic estrogen sensitive conditions such as breast, uterine and prostrate tumor growth (Okwu and Omodamiro, 2005; Okwu, 2005). Phytochemicals regulates, protects and control cancer of prostrate, testicular cancer and semen quality in men. It prevents breast cancer, cystic ovaries and endometriosis among women (Verger and Leblane, 2003). It is now well recognized that people who consume traditional diets rich in fermented soy foods and beans (mainly the leguminosae) experience less breast, uterine and prostate cancers and increase in semen quality. Lignans are weak phytoestrogens that are found in seeds and grains, especially flaxseed. They have anti-viral, anti-bacterial, anti-fungal, antioxidant and immune enhancing properties (Okwu, 2005). Lignins on the other hand are non-carbohydrate dietary fiber that, along with polysaccharides occurs in the cell wall of plants.

Flavonoids are widely distributed in plants. The widespread distribution of flavonoids, their variety and their relatively low toxicity compared to other plant metabolities (such as alkaloids) resulting that many animals including humans, ingest significant quantities in their diet

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(Close and McArthur, 2002). Naturally occurring flavonoids are potentially anti-allergic, anti-carcinogenic, antiviral and antioxidants (Close and McArthur, 2002). They show anti-inflammatory and anti cancer activity (Okwu, 2005). Consumers and food manufacturers have become interested in flavonoids for their medicinal properties, particularly their roles as potentially important dietary cancer chemo-protective and cardiovascular disease prevention (Okwu and Emenike, 2006).

The grains are rich in phytochemicals, which are vital in health protection, disease prevention and drug production. Phytochemicals act as antioxidants, stimulate the human system, induce protective enzymes in the liver or block damage to genetic materials (Okwu, 2004). Among these plants are *Glycine max* and *Vigna unguiculata* (L.) Walp both leguminosae.

Vigna unguiculata (L.) Walp (cowpea) is traditionally grown in most parts of the savanna and forest belts of Southeastern Nigeria (Okpara and Oshilim, 2001). The crop contributes substantially to the dietary proteins of the rural population. The production period is from May to October. The crop ensures and provides uninterrupted protein supply throughout the year either as fresh immature pods or as dry grains (Okpara and Oshilim, 2001).

V. unguiculata can be cooked and eaten as vegetable when the pods are still green, fresh and tender. Dried mature *V. unguiculata* can be cooked dehulled and undehulled and eaten as the main dish. The seeds can be converted into flour or paste and used for the preparation of indigenous food such as akara (fried paste) and moi-moi (steamed paste).

V. unguiculata flour has been processed and used in many other food preparations such as baby foods and baked products (Enwere, 1998). Among the various varieties of *V. unguiculata* cultivated in Nigeria include large Kano white (iron beans), small Kano white (potasco beans) and Ife brown beans.

Glycine max L. Merr (soy-bean) is an important oil seed and is usually grown as food crop. *G. max* is mainly cultivated for its seeds or grains, used commercially as human food, livestock feed and for the extraction of oil (Iwe, 2003). In many countries, the seed is crushed into oil and defatted into meal. The oil is produced for human consumption while the meal is mainly used as animal feed (Liu, 2000; Iwe, 2003). Soy foods are becoming some of the fastest growing categories in food industry, with products ranging from traditional soy foods to protein ingredients and from diary and meat alternatives to various types of western and traditional foods enriched with soybean flour (Liu, 2000; Iwe, 2003).

It is used for the preparation of soymilk, soy beverages, soy sauce and tamari sauce (Enwere, 1998). *G. max* and *V. unguiculata* are incorporated into cereals, tubers and roots and other legumes. They are used to prepare the main dish, breakfast foods for adults and children, weaning foods and convalescent diets (Enwere, 1998). Seed of *G. max* yield edible, semi-drying oil. The oil is used as salad oil and for the manufacture of margarine and shortening. The oil is used in industry in the manufacture of paints, linoleum, oilcloth, printing inks, soap, insecticides and disinfectants (Iwe, 2003; Fukushima, 1999). Lecithin phospholipids obtained as a by product of the oil is used as a wetting and stabilizing agent in food, cosmetic, pharmaceutical, leather, paint, plastic, soap and detergent industries (Liu, 2000; Iwe, 2003). Soy meal is very rich protein feeding stuff for livestock.

Studies on the protein, carbohydrates, vitamins and mineral contents of *G. max* and *V. unguiculata* have been reported (Enwere, 1998; Iwe, 2003). In spite of the various uses of *V. unguiculata* and *G. max* as food in Nigeria, their phytoconstituents have not been fully documented. The present study was undertaken to evaluate the secondary metabolite constituents and consequently assess the nutritional quality of *G. max* and other varieties of *V. unguiculata*. The aim is to generate and provide alternative raw materials for food and pharmaceutical industries and seek means the peasant farmers of rural communities can very economically market their produce.

MATERIALS AND METHODS

Seeds were purchased from Umuahia main market, Umuahia Abia State, Nigeria. The plant materials were identified and authenticated by Dr. A. Meregini of the taxonomy Section, Forestry Department, Michael Okpara University of Agriculture Umudike, Nigeria.

The seeds of three cultivars of cowpea (*Vigna unguiculata* L. Walp) comprising Ife brown, iron beans and potasco beans and soybean (*Glycine max* L.) were each weighed 500 g and separately ground into uniform flour using Thomas-Wiley machine (Model: Ed-5 USA). The flours were then dried and stored for up to three weeks in airtight bottles for chemical analysis. The yields were as follows:

V. unguiculata (ife brown), 392.5 g,
V. unguiculata (iron bean 389.5 g,
V. unguiculata (potasco beans) 390 g
G. max 396.1 g.

Chemical Analysis

Total Nitrogen was determined by using (Micro-kjeldahl MD 55 Singapore). The protein content was calculated as N×6.25. Crude fat (ether extract), crude fiber and ash content were determined according to the methods of AOAC (1984). Total carbohydrates were estimated as the remainder after accounting for ash, crude fiber, protein and fats (Muller and Tobin,1980). The gross food energy was estimated according to the methods of Osborne and Voogt (1978), using the equation:

$$FE = (\%\ CP\times) + (\%\ CHO\times) + (\%\ Fat\times)$$

Where:
FE = Food energy (in gm calories)
CP = Crude protein and
CHO = Carbohydrates.

The major elements were comprised of calcium; potassium, magnesium and sodium were determined according to the method of Shahidi *et al*. (1999). Phosphorus content of the digest was evaluated calorimetrically according to the method described by Naphatian and Bassiri (1995).

Alkaloids and phenols were determined according to the method of Harborne (1973) while tannin was determined using the method of Van-Burden and Robinson (1981). Saponin was determined using the method of Obadoni and Ochuko (2001). Flavonoids were determined according to the method of Boham and Kocipai (1994).

The B-complex vitamins (thiamine, riboflavin and niacin) were determined according to the methods of SKALAR analyzers (2000) while ascorbic acid (vitamin C) was determined using the method of Barako *et al*. (1993).

Statistical Analysis

All measurements were replicated three times and standard deviation determined. The Turkeys student's-test at $p<0.05$ was applied to assess the difference between the means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The phytochemical content of three varieties of *V. unguiculata* (ife brown, iron beans and potasco beans) cultivated in Nigeria and *G. max* (soybean) is shown in Table 1. The flavonoids content was

Table 1: Phytochemical composition of *Vigna unguiculata* and *Glycine max* seeds on dry weight basis (mg 100 g^{-1})

Scientific name	Common name	Local name	Flavonoids	Alkaloids	Tannins	Phenols	Saponins
Vigna unguiculata	Cowpea	Ife brown beans	2.36 ± 0.22^{a}	1.44 ± 0.10^{a}	0.77 ± 0.22^{a}	0.05 ± 0.11^{a}	0.11 ± 0.10^{a}
Vigna unguiculata	Cowpea	Iron beans (large kano white)	5.98 ± 0.10^{b}	1.28 ± 0.20^{a}	0.33 ± 0.20^{a}	0.04 ± 0.20^{a}	0.22 ± 0.20^{a}
Vigna unguiculata	Cowpea	Potasco beans (small Kano white)	5.28 ± 0.20^{b}	1.49 ± 0.10^{a}	0.73 ± 0.10^{a}	0.06 ± 0.10^{a}	0.23 ± 0.10^{a}
Glycine max	Soybeans	Soybeans	3.84 ± 0.11^{a}	1.64 ± 0.10^{a}	0.46 ± 0.20^{a}	0.04 ± 0.10^{a}	0.17 ± 0.11^{a}

Data are means±standard deviation of triplicate determination on dry weight basis (mg 100 g^{-1}). Values with superscript that are the same in each row are not significantly different at ($p<0.05$)

very high in *V. unguiculata* with potasco variety having (6.28 mg 100 g^{-1}), followed by iron beans, which contained (5.98 mg 100 g^{-1}) of flavonoids while *G. max* and *V. unguiculata* (Ife brown) contained 3.84 and 2.36 mg 100 g^{-1} of flavonoids, respectively. Flavonoids are a group of compounds found in seeds, fruits and vegetables. The family encompasses flavanols, flavanones, flavones and anthocyanidns (Waladkhani and Clemens, 2001). In addition to their free-radical scavenging activity, flavonoids have multiple biological functions, including vasodilator, anti-carcinogenic, anti-inflammatory, anti-bacterial, immune stimulating, anti-allergic, anti-viral and estrogenic effects, as well as being inhibitors of phospholipase A2, cyclo-oxygenase, lipoxygenase, glutathione reductase and xanthine oxidase (Kandaswami and Middleton, 1998; Middleton and Kandaswani, 1992; Waladkhani and Clemens, 2001; Okwu and Omodamiro, 2005). Epidemiological and experimental evidence suggests that consumption of *G. max* is associated with a decreased risk of cancer (Iwe, 2003). The anti-cancer effects of these crops may be due to the high isoflavone content in *G. max* (Iwe, 2003). The peculiar advantages and health protective properties of soy isoflavone prompted its utilization as a nutraceutical and functional foods. Functional foods are those that resemble traditional foods, but render benefits beyond their nutrition and energy value in promoting health and preventing certain chronic diseases especially cardiovascular disease, cancer, diabetes, autoimmune disorders, arthritis and arrhythmia (Shahidi, 2002).

Apart from flavonoids, other secondary metabolite constituents of *V. unguiculata* and *G. max* detected include the alkaloids. Enormous quantity of alkaloids were found on the *G. max* (1.64 mg 100 g^{-1}), followed by *V. unguiculata* (potasco variety), which contained (1.49 mg 100 g^{-1}) of alkaloids. The ife brown contained (1.44 mg 100 g^{-1}) of alkaloids while iron beans variety contained (1.28 mg 100 g^{-1}) of alkaloids. Legumes contain toxic components (alkaloids), which interfere with digestive process and prevent efficient and effective utilization of the legumes as food (Ihekoronye and Ngoddy, 1985). *V. unguiculata* contained aminopropionitriles which are readily soluble in water and extractable from the seeds by soaking and then discarding the steeping water. The use of *G. max* as food is limited by its bitter taste and the presence of trypsin inhibitor (Ihekoronye and Ngoddy, 1985).

Goitergenic compounds, which cause enlargement of the thyroid glands, have been found in legumes such as *G. max*.

Apparently consumption of inadequately processed or raw *G. max* is responsible for goiter in some infants fed soy milk (Enwere, 1998; Iwe, 2003), Adequate cooking, steaming or boiling removes the bitter principle and destroys the trypsin inhibitor in *G. max* (Enwere, 1998). Hemaglutinin activity, which compares the utilization of *V. unguiculata* is usually removed by the traditional methods of household cooking and industrial autoclaving (Ihekoronye and Ngoddy, 1985). Thus, preliminary soaking, prior to cooking is required for complete inactivation of the grains. Careful processing of the legumes is required before consumption.

Tannin content was more in *V. unguiculata* (Ife brown) variety having (0.77 mg 100 g^{-1}) of tannin. The potasco variety contained (0.73 mg 100 g^{-1}) of tannin, followed by *G. max*, which contained (0.46 mg 100 g^{-1}) and *V. unguiculata* (iron beans) variety contained (0.33 mg 100 g^{-1}) of tannins. The presence of tannins and alkaloids on the grains behave as nutritional inhibitor because they combine with proteins and makes them indigestible and unavailable to the body (Enwere, 1998). These grains with high tannins and alkaloids content should be properly processed before being used as food especially for humans. Indigenous people have learnt on how to use these grains as sources of digestible and nutritive food. Some of the methods include germination, soaking in water for long and adequate cooking (Enwere, 1998; Ihekoronye and Ngoddy, 1985). The total content of phenols was (0.06 mg 100 g^{-1}) in potasco variety; the ife brown contained (0.05 mg 100 g^{-1}) of phenol, while iron beans and *G. max* both had (0.04 mg 100 g^{-1}) of phenol, respectively. The phenolic components of higher plants may act as antioxidants or as agents of other mechanism contributing to anti-carcinogenic or cardio-protective actions (Okwu, 2004, 2005). Excessive production of oxygen species by the organism is known to be involved in a number of pathological problems including cardiac and cerebral ischemia, atherosclerosis and rheumatic or pulmonary disease (Quettier-Delen *et al*., 2000). The activated phagocytic cells are known to produce potentially destructive oxygen species like super-oxides (O^{2-}), hydrogen peroxides (H_2O_2) and hypochlorous acid (HOCl) during chronic inflammatory disorder (Quettier-Delen *et al*., 2000; Bhargava *et al*., 2005). Many polyphenolics are known to exhibit anti-oxidative properties. They are excellent oxygen free radical and hydroxy scavengers (Quettier-Delen *et al*., 2000; Del-Rio *et al*.,1992).

Generally, nontoxic phenolic compounds are believed to play vital roles in the development of adverse flavors, color reactions and odors of oilseed protein sources (Iwe, 2003). The main phenolic component in the case of *G. max* is syringic acid (Iwe, 2003).

Saponin content was more in *V. unguiculata* (iron and potasco beans contained (0.23 mg 100 g^{-1}) and (0.22 mg 100 g^{-1}) of saponin, respectively. The Ife brown variety of *V. unguiculata* contained (0.11 mg 100 g^{-1}) while *G. max* contained (0.17 mg 100 g^{-1}) of saponin. Some of the general properties of saponins include formation of forms in aqueous solution, hemolytic activity and cholesterol binding properties and bitterness (Sodipo *et al*., 2000). They are responsible for imparting a bitter taste and astringency properties to raw *V. unguiculata* and *G. max* seeds (Iwe, 2003).

The seeds of *V. unguiculata* and *G. max* have high content of protein and lipids (Table 2). The highest quantity of crude protein was found in *G. max* which contained 39.08% of crude protein, followed by *V. unguiculata* (ife brown variety) containing 27.13% crude protein, while potasco and iron beans contained 21 and 19.69% crude protein, respectively. These findings agreed with the results of Ihekoronye and Ngoddy (1985), Enwere (1998) and Iwe (2003). Like *G. max*, *V. unguiculata* is a good source of lysine, adequate in tryptophan but deficient in methionine and cystine (Enwere, 1998). Consequently, its protein, which is rich in lysine but poor in methionine and cystine, can be used to complement cereal proteins, which have low lysine but high methionine and cystine (Bressani, 1975). This implies that the quality of *V. unguiculata* proteins can be improved by the addition of methionine and cystine from other sources.

The legumes contained carbohydrates ranging from 32.78% obtained from *G. max* to 67.26% found in potasco beans. Ife brown variety and iron beans contained 63.19 and 62.15% carbohydrates,

Table 2: Proximate composition (%) and energy content (g cal^{-1}) of *Vigna unguiculata* and *Glycine max* seeds on dry weight basis

Scientific name	Common name	Local name	CP	CF	Lipids	CHO	ASH	RE
Vigna unguiculata	Cowpea	Ife brown Beans	27.13 ± 0.10^b	1.78 ± 0.110^a	2.70 ± 0.11^a	63.19^a	5.20 ± 0.11^b	363.71^a
Vigna unguiculata	Cowpea	Iron beans (large Kano white)	19.69 ± 0.20^a	3.04 ± 0.11^b	9.82 ± 0.10^a	62.15^a	5.30 ± 0.10^b	415.74^b
Vigna unguiculata	Cowpea	Potasco beans (small Kano white)	21.00 ± 0.20^a	3.26 ± 0.10^b	4.98 ± 0.11^a	67.26^a	3.50 ± 0.11^a	397.86^a
Glycine max	Soybeans	Soybeans	39.08 ± 0.10^b	4.68 ± 0.11^b	21.08 ± 0.11^b	32.78^b	3.40 ± 0.20^a	477.16^b

Data are means±standard deviation of triplicate determination on dry weight basis (%). Values with superscript that are the same in each row are not significantly different at ($p<0.05$). CP = Crude Protein, CF = Crude Fiber, CHO = Carbohydrate, FE = Food Energy respectively. The carbohydrates include starch, sugars, lignin and cellulose and other minor carbohydrates comprising pectic substances, arabinogalactans and oxylogucans (Iwe, 2003). Seeds of *G. max* do not however contain starch as found in cereals or roots and tuber crops (Belitz and Grosch, 1987; Fukushima, 1999; Salunkne *et al*., 1992; Katz, 1998). Prominent sugars of *G. max* include sucrose, raffinose and stachyose (Iwe, 2003).

Similarly the values of crude fiber was found to be highest in *G. max* (4.68%), followed by potasco variety of *V. unguiculata* which contained 3.26% while iron beans and ife brown varieties contained 3.04 and 1.78% crude fiber, respectively. Fiber is an indispensable component of a healthy and balanced food. This is because fiber has a physiological effect on the gastrointestinal function of promoting the reduction of tracolonic pressure, which is beneficial in diverticular disease such as cancer of the colon (Akobundu, 1999). Fiber also has a biochemical effect on the absorption and re-absorption of cholesterol and bile acids, respectively (Okwu and Emenike, 2007). The fiber content in these seeds helps in the excretion of bile acids and prevents the re-absorption of bile acids and consequently the absorption of dietary fat cholesterol. This in turn lowers the cholesterol pool and prevents the formations of plaque whose components are cholesterol, some fats and protein (Akobundu, 1999; Okwu and Emenike, 2007).

The results of lipids was low in ife brown and potasco varieties of *V. unguiculata* which contained 2.70 and 4.98% of lipids, respectively, while iron beans contained 9.82% of lipids. The highest lipid content was obtained in *G. max* containing 21.08%. This may be the reason behind the utilization of *G. max* seeds for the production of edible oil. Soy lipids are characterized by a relatively high content of unsaturated fatty acids, especially oleic and linoleic acids (Iwe, 2003). It was reported (Iwe, 2003) that during maturation of *G. max*, the concentrations of pamlitic, stearic and oleic acids generally decreased while linoleic and oleic acids level increased in most cases.

The energy values ranged from 477.16 cal g^{-1} in *G. max* to 363.7 cal. g^{-1} in Ife brown variety of *V. unguciculata* while iron and potasco varieties contained 415.74 and 397.86 cal g^{-1}, respectively. The highest food energy value obtained in *G. max* might have been due to high lipid content of 21.08%.

The seeds contain significant amounts of ascorbic acid, niacin and thiamin. (Iron beans) have the highest content of ascorbic acid (55.44 mg 100 g^{-1}), followed by *G. max* which contained (37.84 mg 100 g^{-1}) while ife brown variety contained (31.68 mg 100 g^{-1}) of ascorbic acid. The lowest amount of ascorbic acid was detected from the potasco variety of *V. unguciculata* containing (5.20 mg 100 g^{-1}) ascorbic acid (Table 3). In human, ascorbic acid is a highly effective antioxidant, acting to lessen oxidative stress, a substrate for ascorbate peroxide as well as an enzyme cofactor for the biosynthesis of many important biochemicals (Okwu, 2005). It is widely known as the vitamin that prevents scurvy in humans (Okwu, 2005). Similarly, *V. unguciculata* (iron beans) had the highest content of niacin (4.01 mg 100 g^{-1}), followed by *G. max*, which contained (3.04 mg 100 g^{-1}) and ife brown variety had (2.58 mg 100 g^{-1}) of niacin. The least niacin content of (1.85 mg 100 g^{-1}) was found on potasco variety of *V. unguciculata*.

Furthermore, the seeds contained significant amounts of minerals encompassing calcium, magnesium and phosphorus while sodium content was low (Table 4). All the legumes analyzed had 5.21 mg 100 g^{-1} of calcium except for iron beans, which contained 4.10 mg 100 g^{-1} of calcium. A lack of calcium or phosphorus in the diet causes a disease known as rickets (Okwu and Emenike, 2007) and osteoporosis disease (Hunt *et al*., 1980) normally results due to lack of calcium. In osteoporosis condition, the bone mass is so decreased that adequate mechanical support can no longer be provided and sustained, spontaneous fractures often results (Hunt *et al*., 1980; Okwu and Emenike, 2007). It occurs more on the adults' humans, particularly women. Improvement has revolved around increased intake of calcium and fluorine (Hunt *et al*., 1980; Okwu and Emenike, 2007). This can be derived through consumption of legumes. Results of minerals for *G. max* and *V. unguciculata* are comparable with those of tropical legumes such as groundnut (Oyenuga, 1982), chickpea, green pea, pigeon pea,

Table 3: Vitamin content of *Vigna unguiculata* and *Glycine max* seeds on dry weight basis (mg 100 g^{-1})

Scientific name	Common name	Local name	Riboflavin	Thiamin	Niacin	Ascorbic acid
Vigna unguiculata	Cowpea	Ife Brown Beans	0.22 ± 0.10^{a}	1.48 ± 0.20^{b}	2.58 ± 0.10^{a}	31.68 ± 0.10^{b}
Vigna unguiculata	Cowpea	Iron beans large Kano white)	0.28 ± 0.11^{a}	0.86 ± 0.10^{a}	4.01 ± 0.11^{b}	55.44 ± 0.20^{b}
Vigna unguiculata	Cowpea	Potasco beans (small Kano white)	1.70 ± 0.10^{b}	0.46 ± 0.10^{a}	1.85 ± 0.20^{a}	5.20 ± 0.11^{a}
Glycine max	Soyabeans	Soyabeans	0.32 ± 0.10^{a}	1.72 ± 0.11^{a}	3.24 ± 0.10^{b}	37.84 ± 0.10^{b}

Data are means±standard deviation of triplicate determination on dry weight basis. Values with superscript that are the same in each row are not significantly different at ($p<0.05$) (mg 100 g^{-1})

Table 4: Mineral composition of *Vigna unguiculata* and *Glycine max* seeds on dry weight basis (mg 100 g^{-1})

Scientific name	Common name	Local name	P	K	Ca	Mg	Na
Vigna unguiculata	Cowpea	Ife Brown Beans	0.61 ± 0.10^{a}	0.61 ± 0.10^{a}	5.21 ± 0.11^{a}	2.43 ± 0.10^{a}	0.10 ± 0.11^{a}
Vigna unguiculata	Cowpea	Iron beans (large Kano white)	0.62 ± 0.10^{a}	0.56 ± 0.20^{a}	4.01 ± 0.10^{a}	1.82 ± 0.20^{a}	0.10 ± 0.10^{a}
Vigna unguiculata	Cowpea	Potasco beans (small Kano white)	0.56±0.11a	0.20 ± 0.11^{b}	5.21 ± 0.10^{a}	1.95 ± 0.11^{a}	0.09 ± 0.20^{a}
Glycine max	Soybeans	Soybeans	0.57 ± 0.10^{a}	0.54 ± 0.10^{a}	5.21 ± 0.11^{a}	2.19 ± 0.10^{a}	0.09 ± 0.11^{a}

Data are means±standard deviation of triplicate determinations on dry weight basis. Values with superscript that are the same in each row are not significantly different at ($p<0.05$) (mg 100 g^{-1})

kidney bean, lima bean and jack bean (Apata and Ologbo, 1994). However, the low sodium content of *G. max* and *V. unguciculata* as compared to other leguminous seeds might be an added advantage due to the direct relationship of sodium intake with hypertension in humans (Dahl, 1974).

G. max and *V. unguciculata* provides great benefits as nutritious food crops. Their high protein content can be useful for the peasants of rural communities who cannot afford protein rich food like meats and eggs. The plants provides numerous medicinal benefits and the presence of phytochemicals (natural flavonoids) impart upon them antioxidants, anti-inflammatory and emulsifying properties.

The major limitation for the utilization of these crops is that production of *G. max* and *V. unguciculata* is mainly in Northern Nigeria particularly the Tiv area of Benue State. Production of these crops in Nigeria does not meet its demands as a staple food. Farmers in Southeastern Nigeria do not cultivate these crops. Moreover farmers in Northern Nigeria cultivate local and poorly adapted varieties. The qualities of the grains are variable depending on variety and breed. Superior high quality grains should be supplied to the growers. Farmers in Eastern Nigeria should be supplied with varieties that have characteristic to make them productive and adaptable in the moist savannah and forest areas. A grain breeding programme to develop varieties and hybrids that will make *G. max* and *V. unguiculata* a more dependable, sustainable and profitable food crops for the peasant farmers and better product for industrial utilization must be undertaken by Governments and Research Institutes in the country. The nutritional and health benefits place these crops in an excellent position for utilization as nutraccuticals.

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