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Nutritional Assessment of *Vigna unguiculata sub spp. sesquipedalis* Seeds

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Abstract *In order to access the nutritional value of Vigna unguiculata sub spp. sesquipedalis seeds, samples of the seeds were analysed for proximate, elemental, antinutritional factor and amino acid profile were determined using recommended methods. The results obtained for proximate parameters were: %moisture content (7.40± 0.70); ash content (5.11±0.16), % crude fat (1.77± 0.03); % crude fibre (0.72±0.01), % crude protein (14.95±0.14), % crude carbohydrate (70.05±0.14) and the calorific value (355.93±0.03kcal/100g). The anti-nutritional factors had the following mean values: saponins (1.73±0.01 %), tannins (1.51±0.01 %), flavonoids (1.28±0.03 %), oxalates (0.10±0.00 %), and alkaloids (0.36±0.00 %). The functional properties were bulk density (0.89±0.03 g/cm^3), emulsification capacity (56.40 ± 1.43 %), oil adsorption capacity (1.74±0.06 %), water adsorption capacity (3.17±0.92 %), foaming capacity (30.00±0.83 %). and foaming stability (18.00±0.81 %). The selected macro elemental composition of the sample were in the order: magnesium < sodium < calcium < phosphorus < potassium (2.60±0.28, 3.85±0.30, 5.15±0.55, 10.00±1.63 and 24.15±1.15) respectively and the selected micro elemental composition in sample were in the order: copper < zinc < manganese < iron (1.20±0.16, 3.10±0.26, 5.20±0.33 and 5.75±0.59) respectively. The amino acid profile indicated that glutamic acid had the highest value (13.55 g/100g), while cysteine was the lowest (0.78 g/100g). These values indicate that Vigna unguiculata sub spp. sesquipedalis has the tendency of being a good quality food.*

Key Words: *Black pea, nutritional value, functional and elemental composition, amino acid profile*

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1.0 Introduction

Many tropical countries are faced with the problem of inadequate food to meet human nutritional needs. There is also competition between man and some animal for scarce conventional foodstuffs like grains and root crops that are rich sources of nutrients like protein, minerals and vitamins. Good nutrition is relevant to human existence and good health. However, availability and affordability of food has continued to be a major challenge in most developing countries of the world. Consequently, malnutrition, health challenges, crime and other consequences of food security are endangering the peace of several countries in the world (Musah *et al*., 2014). The nutritional potential of any food or food materials can only be known through analysis of its proximate, mineral and antinutritional parameters (Ekop and Eddy, 2005; Eddy and Udo, 2005).

Vigna unguiculata sub spp. Sesquipedalis is one of the most essential ~~food~~ leguminous plants consumed in many countries in the tropics. Seeds of *Vigna unguiculata sub spp. Sesquipedalis* are consumed as food while the leaves, roots and seed shells are utilized as fodders for animals especially the ruminants in Nigeria. Its root has the capability to fix atmospheric nitrogen into the soil. Its shade tolerant ability allows it to be intercropped with other crops such as maize, millets sorghum, sugarcane, cotton, and pigeon peas (Singh *et al*, 1997). This makes black pea an important component of traditional inter-cropping systems.

Vigna unguiculata sub spp. sesquipedalis is known as kidney pea or black pea in English language, locally in Nigeria as Akidi in Igbo, Bakin wake or Achishiru in Hausa and Ewa dudu in Yoruba. In Nigeria, black pea is consumed alone or part of a meal and black pea cultivation in Nigeria has doubled over the last five (5) years.

Some studies have been conducted on the chemical composition of cowpea seed. According to Antova *et al*. (2014), the ranges for the proximate composition of the seed are; protein (22.5 to 25.6%), starch (28.3 to 36.2%), fat (1.3 to 1.9%), insoluble fiber (1.7 to 3.0%) and minerals (3.2 to 3.7%). They also reported relatively low lipid content but high concentrations of biologically active compounds (tocopherols in the oils range from 3838 to 11,475 mg/kg, phospholipids 12.2 to 27.4%) were observed. The oil fraction contain palmitic acids (35.1–47.1%), linoleic acid (21.7–30.9%), linolenic (7.3–16.8%) and oleic acid (6.9–10.6%) while 6.9 to 10.6 % and 42.1-43.3 % were the ranged observed for the concentrations of sterols, namely, stigmasterol and β-sitosterol respectively. Mana *et al*. (2000) obtained mean crude protein contents of V unguiculata seeds (195±261g/kg dry matter) that was comparable with those of several other cowpea varieties, which ranged from 210 to 270 g/kg dry matter The high carbohydrate contents was observed to be in the range, 678±761 g/kg dry matter. The oil content was found to have mean value of 12± 36 g/kg dry matter and ash was 32±41 g/kg dry matter.

There are several black pea cultivars grown in Nigeria. Indicating that, their chemical composition may differ to some extent. Studies have confirmed that similar species of *Vigna unguiculata sub spp. Sesquipedalis*, cultivated in different countries have different chemical composition. Therefore, the present study is designed to analysed *Vigna unguiculata sub spp. Sesquipedalis* seeds of Nigerian origin for their chemical composition

2.0 Materials and Methods

Seeds of *Vigna unguiculata sub spp. sesquipedalis* used in this study were obtained from ultra-modern market in Minna, Nigeria. The seeds were sun dried for two weeks, then ground into powder form using porcelain mortar and pestle. The powdered sample was sieved with a 4 mesh sieve and stored in plastic container.

2.1 Proximate analysis

Residual moisture was determined by drying 5 g of the powdered sample in a Gallenkamp oven at 105 ºC to constant weight. The difference in weight before and after drying was recorded as the moisture content of the seed (AOAC, 2006). Ash content was evaluated using the method described by Ceirwyn (1998), which involves dry ashing in muffle furnace at 600 ºC until grayish white ash was obtained. Crude lipid was quantified using soxhlet apparatus and n-hexane as solvent according to the AOAC (2006) method. Crude protein of the sample was determined by multiplying (the value obtained from Kjeldahl's nitrogen analysis) by a protein factor of 6.25 (AOAC, 2006). Crude fiber and carbohydrate were also determined according to AOAC (2006) while energy value was calculated using the expression given by equation 1 (Asibey-Berko and Taiye ,1999).

$$Energy\ value = (g\ crude\ protein \times 2.44) + (g\ crude\ lipid \times 8.37) + (g\ carbohydrate \times 3.67) \qquad (1)$$

2.2 Mineral quantification

Six (6 g) of oven dried powdered sample was weighed into dry crucibles in triplicates and ignited in a muffle furnace at 600 ºC until greyish white ash was obtained. The ash was cooled in a desiccator and 5 cm^3 of 1.0 moldm^{-3} HNO_3 was added and evaporated to dryness on a steam bath. The treated sample was heated in a muffle furnace until greyish ash was obtained. The sample was again removed, cooled in a desiccator and retreated by addition of 10 cm^3 of 1.0 moldm^3 HCl before filtering into 100 cm^3 volumetric flasks. Sodium and potassium ions were determined using the standard flame emission photometer while concentrations of the other metals were determined using Atomic Absorption Spectrophotometer (AAS Model SP9) operating with standard air-acetylene flame (AOAC, 2006). Concentration of phosphorus was determined using Jenway 6100 spectrophotometer at 420 nm (Ceirwyn, 1998).

2.3 Determination of antinutrients

Alkaloid and saponin content were determined using the methods reported by Trease and Evans (1996); Tannin and cyanide were quantified according to AOAC (2006) method. Concentration of flavonoid was determined using the method reported by Sofowora (1993) while oxalate was determined using the method reported by Day and Underwood (1996).

2.4 Determination of amino Acids

Amino acid properties of of the samples were determined according to the AOAC (2006) which are also described by Barakat *et al*. (2017).

2.5 Functional properties

Emulsion capacity was determined by adding oil to the powdered sample and centrifuged at 1600 rpm for 5 minutes (Idris *et al*., 2009). Bulk density was determined by gently filling a 10 cm^3 graduated measuring cylinder with the sample and its bottom was gently tabbed until the volume of the sample stopped decreasing (Yoshiyuki and Yukata, 2003). Foam capacity and stability were determined using the method described by Abbey and Ibeh (2006) while water and oil absorptions capacities were determined according to the method reported by Philip *et al*. (1998) and Njintang *et al*. (2001).

3.0 Results and Discussion

3.1 Proximate composition

The results obtained for the proximate composition of *Vigna unguiculata sub spp. Sesquipedalis* seed are presented in Table 1. Residual moisture content was 7.40±0.70 %. This value is lower than 8.05±0.01 % reported for *Artocapus altilis* seed (Tukura and Obliva, 2015) and 14.00 % which is the recommended maximum moisture content for the storage of peas and beans (Crop update, 2018) but higher than the 5.58±0.02 and 5.00±0.02 % for *Jatropha curcas* and *Caesalpina pulcherrima* seeds respectively (Abou-Arab and Abu-Salam, 2010; Musah *et al.,* 2014). Low moisture content is suitable for preservation of shelf life of food materials while -high moisture content can result in growth of moulds. Therefore, within the observed moisture content, the studied seed can be preserved within a reasonable shelf life.

Tab1e 1: Proximate composition of *Vigna unguiculata sub spp. sesquipedalis* seed

Parameter	Percentage (% Dry weight)
Moisture	7.40±0.70
Ash	5.11±0.61
Crude fibre	0.72±0.01
Crude protein	14.95±0.14
Crude fat	1.77±0.03
Carbohydrate	70.05±0.14
Ca1orific value (Kcal/100g)	355.93±0.04

****Va1ues are means of trip1icate determination ± standard deviations**

The mean ash content value (5.11±0.61 %) was higher than 3.30 % reported for *Afzelia Africana* seed (Nzekwe *et al*., 2016) but lower than 10.00±0.25 % reported for *C. pulcherrima* (Musah *et al*., 2014). Ash content is important in determining the amount and type of mineral content in samples. Crude fibre content was low (0.72±0.01 %) compared to values of 2.20±0.01and 2.80 % reported by Tukura and Obiliva (2015) and by Ogungbenle (2006) for *Artocarpus altilis* and gourd seeds respectively. Fibre is known to be useful in providing roughages that aid in digestion and absorption of nutrients in the body, hence these seed may not be a rich source of fibre (Nzekwe *et al*., 2016).

The mean crude protein content of the seeds was 14.95±0.14 %, which is higher than the 11.80 and 8.12±0.02 % obtained for cowpea and *Artocarpus altilis* seeds by Ene-Obong and Carnovale (1992) and by Tukura and Obliva, (2015) respectively. However, the mean protein content was lower than values of 41.10±0.25 and 32.88±3.98 % reported for *C. pulcherrima* and *Jatropha curcas* seeds (Musah *et al*., 2014; Abou-Arab and Abu-Salem, 2010). The mean carbohydrate content of the studied seeds 70.05±0.14 % was observed to be 38.36 % reported for *Afzelia Africana* but lower than 72.66±0.01 and 73.87 % reported for *Artocarpus altilis* seeds and *bambara* nut (Nzekwe *et al*., 2016; Tukura and Oblivia, 2015; Ogbuagu *et al*., 2011). Carbohydrates provide energy that aids in the functioning of body organs and contribute to fat metabolism (Idris *et al*., 2009; Temple *et al*., 1991). Crude fat content was 1.77±0.03 %. The value was similar to 1.70% for soybean but lower than 13.7 % obtain for *A.*

povoninia seeds (Ogbuagu *etal*., 2011). According to Abiodun and Umeonuorah, (2013), low carbohydrate content enhance better shell life by decreasing the chances of rancidity indicating that the these seeds have better shelf life than some other seeds. Mean calculated calorific value was 355.93±0.04 Kcal/100g which is lower than 420.00±0.11 Kcal/100g reported for *C. pulcherrima* (Musah *et al*., 2014).

3.2 Mineral content

Mean concentrations of calcium, potassium, sodium, magnesium, manganese, iron, zinc copper and phosphorus in *Vigna unguiculata sub spp. sesquipedalis* seeds are presented in Table 2. Mean concentration of calcium ion was 5.15 ± 0.55 mg/100g. This value is higher than 2.90±0.03 and 0.18±0.00 mg/100g reported for breadfruit and *A. Africana* seeds (Tukura and Obliva, 2015; Nzekwe *et al*., 2016). Calcium is required for the formation of strong bones and is essential for proper functioning of muscles, nerves and blood clot (Bell *et al*., 1996). Therefore, these seed a maybe good source of calcium nutrition. Mean concentration of potassium ion in the studied seeds was found to be 24.15 ± 1.15 mg/100g, which is higher than 9.40±1.50 mg/100g but lower than 33.00 mg/100g reported for *A. altilis* seed and sickle pod respectively (Tukura and Obliva, 2015; Faruk *et al*., 2002).

Tab1e 2: Mineral composition of *Vigna unguiculata sub spp. sesquipedalis* Seed

Parameter	Concentration (mg/100g)
Calcium	5.15±0.55
Potassium	24.15±1.15
Sodium	3.85±0.30
Magnesium	2.60±0.28
Manganese	5.20±0.33
Iron	5.75±0.59
Zinc	3.10±0.26
Copper	1.20±0.16
Phosphorus	10.00±.63

***Va1ues are means of trip1icate determination ± standard deviations**

High intake of potassium protects against increase in blood pressure and other cardiovascular risks. It also provides a protective effect in the instance of excessive sodium intake and is required for normal tissue protein synthesis in protein depleted animals (Ogbuagu *et al*., 2011; Dzomeku *et al*., 2006; McDonalds *et al*., 1987). Sodium and potassium ions co-functioned in maintaining electrolyte balance of the body (Eddy *et al.,* 2012).

Sodium enhances blood pressure (Yoshimura *et al*., 1991), hence it is advised that the amount of sodium in diet should be limited (American Diabetes Association, 2002). Sodium content was 3.85 ± 0.30 mg/100g, this value was higher than 0.37±0.30 mg/100g obtained by Aremu *et al*. (2012) for *Borassus aethiopum* seeds but lower than 8.83±2.01 mg/100g reported for *Jathropha curcas* seeds (Abu-Arab and Abu-Salam, 2010). Mean concentration of magnesium ion (2.60±0.28 mg/100g) was slightly lower than 2.97±0.04 mg100g reported for *A. altilis* seed (Tukura and Obliva, 2015) but higher than 0.47 mg/100g reported for *A. Africana* (Nzekwe *et al*., 2016). Magnesium ion can helps to maintain electrical potential in the nerves; together with calcium it assist in blood clotting, contraction of muscles and blood pressure regulation (Adeyeye and Agesin, 2007; Swaminathan, 2003). Manganese and iron indicated mean concentrations of 5.20 ±0.33 and 5.75 ± 0.59 mg/100g respectively. These values were higher than 0.02±0.00 and 0.15±0.01 mg/100g reported for manganese and iron concentrations in *A. altilis* seed (Tukura and Obliva, 2015). Manganese is important in digestion and utilization of protein in the body. It is also required for normal functioning of the brain and nervous system. On the other hand, the role of iron in human is associated with the proper functioning of the hemoglobin and its deficiency is the primary cause of anaemia (Goodson, 2018).

Mean concentration of zinc ion in the analyzed seeds was 3.10±0.26 mg/100g; a value that was lower than 4.46±0.05 mg/100g reported for sesame seed (Bamigboye *et al*., 2010). Zinc is vital in healing of wound and breaking down of carbohydrates. It is also needed for proper functioning of the body's immune system (Kubala, 2018). Copper ions in the studied seeds had a mean concentration of 1.20±0.16 mg/100g, which is higher than 0.05±0.00 mg/100g observed in *A. altilis* by Tukura and Obliva, (2015). However, it is lower than mean value of 19.01±0.03 mg/100g reported for *C.pulcherrima* seed (Musah *et al*., 2014). Copper is important in maintaining nerve cells and body immune system. It also aids the body in collagen formation and absorption of iron (Wilson, 2017). Measured mean concentration of phosphorus in the studied seeds was 10.00±1.63 mg/100g, which is lower than 157.00 mg/100g reported for sesame seed (Bamigboye *etal*., 2010).

3.3 Antinutritional Content

Mean concentrations antinutritional constituents of *Vigna unguiculata sub spp. sesquipedalis* seeds are presented in Table 3. Saponin content was found to has a mean value of 1.73±0.01 g/100g, which is higher than 1.51±0.02 g/100g reported for *Jatropha curcas* seed (Abu-Arab and Abu-Salam, 2010) but lower than 2.16 g/100g reported for *Adenanthera pavonina* seed (Ogbuabu *et al*., 2011). Saponins are considered useful in the treatment of cardiovascular diseases (Del-Rio *et al*., 1997). Value obtained for Tannin was 1.51±0.01 g/100g and was higher than 0.50±0.30 g/100g reported for *C. pulcherrima* seed (Musah *et al*., 2014). Tannin can cause decrease in feed intake, growth rate and protein digestibility; hence food rich in tannin are considered to have low nutritional value (Chung *et al*., 2010).

Tab1e 3: Antinutritional content of *Vigna unguiculata sub spp. sesquipedalis* seed

Parameter	Concentration (g/100g)
Saponins	1.73±0.01
Tannins	1.51±0.01
Oxalates	0.10±0.00
Flavonoids	1.28±0.03
Alkaloids	0.36±0.00

****Va1ues are means of trip1icate determination ± standard deviations**

Oxalate content (0.10 ± 0.00 g/100g) was significantly lower than 4.04±1.71 and 3.55±3.32 g/100g reported for *C. oliforus* and *M. corchorifolia* respectively (Ndamitso *et al*., 2016). Accumulation of oxalate is known to cause kidney stones (Gemede, 2014). Flavonoid and alkaloid content were 1.28±0.03 and 0.36±0.00 g/100g respectively. These values were lower than 3.91±0.08 and 2.19±0.01 g/100g obtained for flavonoid and alkaloid in *Avena fatna* (Abbas *et al*., 2012). However, flavonoid has been implicated for its role as antioxidant, antibacterial and anti-inflammatory properties and act as free radical scavengers (Ruiz-Cruz *et al*., 2017), alkaloid which has a characteristics bitter taste can act on the central nervous system either depressant or stimulant (Victor, 2014). Considering the observed antinutritional factors in the seeds of the studied plant, it is indicative that they are moderately rich in anti-nutrients.

3.4 Amino acids

Values obtained for the concentration of essential (EAA) and non essential (NEAA) amino acids are presented in Table 4. The total concentration of amino acids (TAA) in the sample was 88.78 g/100g. The EAA that had highest concentration was leucine (9.34 g/100g) while the least concentration was recorded for methionine (0.88 g/100g). Other EAAs identified in the seed samples were lysine (6.31 g/100g), isoleucine (3.40 g/100g), phenylalanine (3.46 g/100g), tryptophan (0.89 g/100g), valine (4.35 g/100g), histidine (3.58 g/100g), threonine (5.10g/100g) and arginine (7.40 g/100g). Arginine is known to help in maintaining the balance in muscles (Ingale and Shrivastava, 2011). Total concentration of EAA in the seed was 44.71 g/100g representing 50.36 % of TAA. This value closely approximates the value of 50.31 % reported for soybean (Ogundele *et al*., 2012). Values of EAA obtained were significantly higher than 1.002, 0.513, 1.665, 0.667 and 0.061 g/100g reported for leucine, lycine, arginine, histidine and threonine present in *Carthamus tinctorius* seed (Ingale and Shrivastava, 2011).

Total concentration of non-essential amino acids (TNEAA) was observed to be 44.07 g/100g which represent 49.64 % of TAA present in the sample. The NEAA with the highest concentration was glutamic acid (13.55 g/100g) followed by aspartic acid (10.20 g/100g). Others were proline (3.55 g/100g), tyrosine (3.44 g/100g), cystine (0.78 g/100g), alanine (4.28 g100g), glycine (4.46 g/100g) and serine (3.81 g/100g). Values of aspartic acid, proline, tyrosine and alanine were higher than the 6.87, 2.63, 3.28 and 3.66 g/100g obtained in *Parkia biglobosa* seed (Hassan and Umar, 2005). Cystine content was also higher than the 0.074 g/100g reported for seed of *Citurllus colocynthis* (Abudayeh *et al*., 2016) but lower than 1.23 g/100g obtained for *Parkia biglobosa* seed (Hassan and Umar, 2005). Inadequate amount of cystine may impair the function of immune system and reduce the body's ability to prevent free radical damage. Deficiency in aspartic acid will lead to decrease in cellular energy and chronic fatigue (Ingale and Shrivastava, 2011).

Tab1e 4: Amino acid profi1e of *Vigna unguiculata sub spp. sesquipedalis* seed

Amino Acid	Concentration (g/100g)
*Leucine	9.34
*Lysine	6.31
*Isoleucine	3.40
*Phenylalanine	3.46
*Tryptophan	0.89
*Valine	4.35
*Methionine	0.88
*Arginine	7.40
*Histidine	3.58
*Threonine	5.10
Proline	3.55
Tyrosine	3.44
Cystine	0.78
Alanine	4.28
Glutamic acid	13.55
Glycine	4.46
Serine	3.81
Aspartic acid	10.20
Total Amino Acid (TAA)	88.78
(TEAA)	44.71
(TNEAA)	44.07
(% TEAA)	50.36 (%)
(% NTEAA)	49.64 (%)

3.5 Functional Properties

Estimated functional properties of the studied seeds are presented in Table 5. These properties are important parameters that can affect how food materials behave during processing and storage (Olorode *et al*., 2014). Bulk density was 0.89±0.03 g/cm^3, although low yet slightly higher than 0.49±0.01, 0.63±0.10 and 0.501 g/cm^3 reported for *Corchorus oliforus*, *Melochia corchorifolia* and water melon seed flour respectively (Ndamitso *et al*., 2016; Olorode *et al*., 2014). Bulk density is an important parameter to be considered when packaging and handling product (Akubor and Chukwu, 1991). Emulsion capacity was found to be 56.40±1.43 %. This value was higher than the 29.60±0.72 % reported for *Boerhavia elegans* choisy seed flour (Al-Farga *et al*., 2016) but lower than 61.08±0.05 % obtained for *Corchorus oliforus* flour (Ndamitso *et al*., 2016). Emulsifying property is usually attributed to the flexibility of solutes and exposure of hydrophobic domain (Niangoran *et al*., 2015).

Foam capacity and foam stability were 30.00±0.83 and 18.00±0.81 % respectively. These values were higher than 8.00±0.989 and 3.00±0.622 % obtained for foam capacity and foam stability in *Cassia hirsutta* (Ojo and Ade-Omowaye, 2015) but lower than 116 % (foam capacity) and 92.8 % (foam stability) reported for Haage blaue (Antonio *et al*., 2017). Foam capacity is the increase in volume upon introduction of air into the slurry of a given food while foam stability is the ability of the formed foam to retain its maximum volume over a period of time (Ojo and Ade-Omowaye, 2015). These properties depend upon viscosity, surface tension and interfacial film formed which maintain bubbles in the suspension slow the rate of coalescence (Al-Farga *et al*., 2016; Morr, 1990).

Tab1e 5: Functiona1 properties of *Vigna unguiculata sub spp. sesquipedalis* seed

Parameter	Concentration
Bu1k density (g/cm^3)	0.89±0.03
Emu1sion capacity (%)	56.40±1.43
Foam capacity (%)	30.00±0.83
Foam stability (%)	18.00±0.81
Oil absorption capacity (%)	1.74±0.06
Water absorption capacity (%)	3.17±.92

Va1ues are means of trip1icate determination ± standard deviations

The oil absorption capacity (1.74±0.06) was lower than the 2.43±1.52 % obtained for *Boerhavia elegans* choisy seed flour (Al-Farga *et al*., 2016). Oil serves to retain flavor and improve the soft texture of food (Niangoran *et al*., 2015); oil absorption capacity is attributed to the physical entrapment of oil food (Ojo and Ade-Omowaye, 2015). The value of water absorption capacity was 3.17±0.92 %; and is higher than 2.04±0.05 % reported *Melochia corchorifolia* (Ndamitso *et al*., 2016). As a functional property, water absorption capacity is used to determine the suitability of utilizing materials in baked foods (Kone *et al*., 2014).

4.0 Conclusion

Results of the nutritional analysis of *Vigna unguiculata sub spp. sesquipedalis* seeds reveals they are good sources of carbohydrate, protein and minerals. The seeds also contain essential and non essential amino acids which makes these seeds useful in the growth and repair of body tissues. *Vigna unguiculata sub spp. sesquipedalis* seeds can therefore be used to supplement feed that are deficient in protein, potassium or amino acids.

5.0 References

Abbas, M. N., Rana, S. A., Shahid, M., Mahmud-ul-Hassan, M. & Hassan, M. (2012). Chemical evaluation of weeds mixed with wheat grains at harvest. *The Journal Animal and Plant Sciences*, 22, 2, pp. 283-288.

Abbey, B. W. & Ibeh, G. O. (2006). Functional properties of raw and heat processed cowpea (*Vigna unguiculata*) flour. *Journal of Food Science*, 53, 6, pp. 1775-1777.

Abiodun, A. O. & Umeonuora, U. C. (2013). Mineral, vitamins and antinutritional component of African breadfruit (*Treculia africana*) seed processed with alum and trona. *IOSR Journal of Environmental Science*, *Technology and Food Technology*, 5, 5, pp. 71-78.

Abu-Arab, A. A. & Abu-Salem, F. M. (2010). Nutritional quality of *Jatropha curcas* seeds and effect of some physical and chemical treatments on their anti-nutritional factors. *African Journal of Food Science*, 4, 3, pp. 93-103.

Abulayeh, Z. H. M., Lamazian, H. R., Serade, P., Chekman, I., Al-Khalifa, I. I., Al-Azzam, K.M. & Hassouneh, L. K. M. (2016). Comparative study of amino acid composition in the seeds, pulp and rind from *Citurllus colocynthis* fruit. *International Journal Pharmacognosy and Phytochemical Research*, 8, 3, pp. 433-437.

Adeyeye, E. I. & Agesin, O. O. (2007). Dehulling the African yam bean (*Sphenostylis stenocarpa* Hoshst) seed: any nutritional importance? *Bangladesh Journal of Science and Industrial Research,* 42, 2, pp. 163-174.

Akubor, P. I. & Chukwu, J. K. (1999). Proximate composition and selected functional properties of fermented and unfermented African oil bean (*Penthaclethra macrophylla*) seed flour. *Plants for Human Nutrition*, 54, pp. 227-238.

Al-Farga, A., Zhang, H., Siddeeg, A., Shamoon, M.,Chamba,M. V. M. & Al-Hajj, N. (2016). Proximate composition, functional properties, amino acid, mineral and vitamin contents of a novel food: Alhydwan (*Boerhavia elegana* Choisy) seed flour. *Food Chemistry,*211, pp. 268-273.

American Diabetes Association (2002). Evidence based nutrition principles and recommendations for the treatment of diabetes and released complications, *Diabetes*, 25, 1, pp. 550-560.

Antonio, H. L., Pedro, G., Laura, M. L., Raman, R. M., Pedro, M. G. L. & Juan, F. Z. N. (2017). Functional properties of *Lupinus angustifolius* seed protein isolates. *Journal of Food Quality,* 7, 3, pp. 1-8.

Antova, G. A.., Stoilova, T. D., Ivanova, M. M. (2014). Proximate and lipid composition of cowpea (*Vigna unguiculate L.)* cultivated in Bulgaria*. Journal of Food Composition and Analysis,* 33, 2, 146-152.

AOAC (2006). Methods of analysis of the Official Analytic Chemists, 18th edition. Association of Analytical Chemists, Washington, DC

Aremu, M. O., Salau, R. B. & Suleiman, A. A. (2012). Compositional evaluation of young shoot of Delep palm (*Borassus aethiopum,* mart) and white yam (*Dioscorea rotundata*) flour. *International Journal of Chemical Science*, 5, 2, pp. 168-171.

Asibey-Berko, E. & Taiye, F. A. K. (1999). Proximate analysis of some under-utilized Ghanian vegetables. *Ghanian Journal of Science*, 39, pp. 91-92

Bamigboye, A. Y., Okafor, A. C. & Adepoju, O. T. (2010). Proximate and mineral composition of whole and dehulled Nigerian sesame seed. *African Journal of Food Science and Technology*, 1, 3, pp. 71-75.

Barakat, H. Khalifa, I. Ghazal, G. A. Shams, A. & Denev, P. N. (2017). Chemical composition and nutritional value of seeds from quinoa accessions, cultivated in Egypt. *Bulgerian Chemical Communication*, 49, pp. 231-238.

Bell, L., Halstensen, C. E., Macres, M. & Keane, W. F. (1996). Cholesterol lowering effects of calcium carbonate in patients with mild to moderate hypercholesteromia. *Archive of Internal Medicine*, 152, 12, pp. 2441-2444.

Ceiwyn, S. J. (1998). *Analytical Chemistry of food*. Chapman and Hall publisher, London, pp 75-77.

Chung, K. T., Wong, T. Y., Wei, C., Huang, Y. W. and Lin, Y. (2010). Tannins and human health: A review. *Critical Review in Food Science and Nutrition*, 38, 6, pp. 421-464.

Crop Update (2018). Harvest and storage of pulses: combining pea and field bean desiccation https://www.pgro.org/crop-update-8-august-2018

Day, R. A. and Underwood, A. C. (1986). *Qualitative analysis*. 5th ed. Prentice Hall Publisher, New Jersey. P. 701.

Del-Rio, A., Obdulio, B. G., Costillo, J., Mann, F. G. & Otuno, A. (1997). Uses and properties of citrus flavonoids. *Journal of Agriculture and Food Chemistry*, 46, pp.4505-4515.

Dzomeku, B. M., Bam, R. K., Abu-Kwarteng, E. E. & Ankomah, A. A. (2006). Comparative study on the nutritional values of FHIA-21 (TetraploidHybrid) and 'apem' (Triploid French plantain) in Ghana. *Journal of Plant Science,* pp.181-191.

Eddy, N. O. & Udoh, C. L. (2005). Proximate evaluation of the nutritional value of some soup thickeners. *CHEMCLASS Journal* 2, pp. 12-14.

Eddy, N. O., Udofia, P. J. & Ukpong, I. J. (2012). The roles of leguminous plant in mineral nutrition. Published in the proceedings of the Chemical Society of Nigeria 27th International Conference (a supplement of the Journal of Chemical Society of Nigeria), pp. 329-332.

Ekop, A. S.. and Eddy, N. O. (2005). Comparative studies of the level of toxicant in the seeds of *Terminalia catappa* (Indian almond) and *Coulaedulis* (African walnut). *CHEMCLASS Journal* 2, pp. 14-76.

Ene-Obong, H. N. & Carnovale, E. (1992). A comparison of the proximate, mineral and amino acid composition of some known and lesser known legumes in Nigeria. *Food Chemistry*, 43, pp. 169-175.

Faruk, U. Z., Sani, A. & Hassan, L. G. (2002). Proximate composition of sickle pod (*Sennaobtusi folia*) leaves. *Nigerian Journal of Basic and Applied Sciences*, 11, pp.157-164.

Gemede, H. F. (2014). Potential health benefits and adverse effects associated with phytate in foods: A review. *Global Journal of Medical Research*, 14, pp. 23-31.

Goodson, A. (2018). 10 evidence-based benefits of magnesium. www.healthline.com/nutrition/manganese

Hassan, L. G. & Umar, K. J. (2005). Protein and amino acids composition of African lowcost bean (*Parkia biglobosa*). *Tropical and Subtropical Agroecosystem*, 5, pp. 45-50.

Idris, S., Yisa, J, & Itodo, A. U. (2009). Analysis of nutritional components of leaves of *Moringa oleifera*. *International Journal of Chemical Science*, 2, 2, pp. 268-274.

Ingale, S. & Shrivastava, S. K. (2011). Amino acid profile of some new varieties of oil seeds. *Advanced Journal of Food Science and Technology*, 3, pp. 111-115.

Kone, D., Kone, F. M., T., Dje, M. K., Dabonne, S. & Kouame, P. (2014). Effect of cooking time on biological and functional properties of flour from yam "kponan" (*Dioscorea cayenensis rotundata*) tubers. *British Journal of Applied Science and Technology*, 4, pp. 3402-3418.

Kubala, J. (2018). Zinc: everything you need to know. https://www.healthline,com/nutrition/zinc

Mana, F. M. M., Oliveira, J. T. A., Matos, M. R.T., Moreira, R. A. & Vasconcelos, I. M. (2000). Proximate composition, amino acid content and haemaglutinating and trysin-inhibiting activities of some Brazillian *Vigna unguiculate)L). Walp cultivars. Journal of the Science of Food and Agriculture,* 80, pp. 453-458.

McDonald, P., Edwards, R. A. & Greenhalgh, T. F. D. (1987). *Animal nutrition*. 4th ed. Longman Group Ltd, Hong Kong, pp. 126-134.

Morr, C. (1990).Current status of soy protein functionality in food systems. *Journal of the American Oil Chemists' Society*, 67, pp. 265-271.

Musah, M., Ndamitso, M. M., Olamide, A. O., Yerima, H. and Musa, Y. (2014). Assessment of the nutritional composition of *Caesalpina pulcherrima* seeds. *Lapai Journal of Science and Technology*, 2, pp. 13-21.

Ndamitso, M. M., Jagaba, M., Musah, M., Mann, A., Mohammed, E. B. & Umar, A. (2016). Chemical composition, antinutritien content and functional properties of *Corchorus olitorius and Melochia corchorifolia*. *FUW Trends in Science and Technology*, 1, pp. 96-100.

Niangoran, N. A. M., Due, A. E., Fankroma, M. T. K. & Kouame, L.P. (2015). Functional properties of seed flours of different cultivars of *Citrullus lanatus* cultivated in Cote d'Ivoire. *International Journal of Research Studies in Agricultural Sciences*, 1, 5, pp. 32-48.

Njintang, N. Y., Mbafung, C. M. F. & Waldron, K. W. (2001). In vitro protein digestibility and physicochemical properties of dry red bean (*Phaseolus vulgaris*) flour: effect of processing and incorporation of soybean and cowpea flour.

Journal of Agricultural and Food Chemistry, 49, pp. 2465-2471.

Nzekwe, U., Ajuziogu, G. C., Njoku, E. U., Okafor, G. I., Sani, M. B., Onyeke, C. C., Onyeonagu, C. C., Ohaneje, A. A. & Eze, C. S. (2016). Nutritional food content of seed and effects of five different growing media on the seed germination and seedling growth of *Afzelia Africana* SM *Caesalpiniaceae*. *African Journal of Biotechnology*, 15, 11, pp. 384-391

Ogbuagbu, M. N., Odoemelam, S. A. and Ano, A. O. (2011). Chemical composition of under-utilized tropical African seed: *Adenanthera pavonina*. *Journal of Chemical Society of Nigeria,* 36, 1, pp. 23-28.

Ogundele, J.O., Oshodi, A. A. and Amoo, I. A. (2012). Comparative study of amino acids, proximate composition of *Citurllus colocynthis and Citrullus vulaaris* seeds. *Journal of Nutrition*, 11, 3, pp. 247-251.

Ogungbenle, H. N. (2006). Chemical composition, functional properties and amino composition of some edible seeds. *Rivista Italia Delle Sostanzamarzo,* 14, pp. 81-86.

Ojo, M. A. & Ade-Omowaye, B. I. O. (2015). Some functional and physical properties of selected underutilized hard-to-cook legumes in Nigeria. *American Journal of Food Science and Nutrition*, 2, pp. 73-81.

Olorode, O. O., Idowu, M. A., Bamgbose, A. & Ayano, A. E. (2014). Chemical, phytochemical and functional properties of selected seeds' flour. *International Journal of Nutrition and Food Sciences*, 3, 6, pp. 572-578.

Philips, R. D., Chinnan, M. S., Branch, A. L., Miller, J. & McWaters, K. H. (1998). Effects of pretreatment on functional and nutritional properties of cowpea meal. *Journal of Food Science*, 53, pp. 805-809.

Ruiz-Cruz, S., Hernandez, S.C., Hernandez-Ruiz, K. L., Civa-Chavez, L. A. Estroda-Alvarado, M. I., Ortega, L. E., Ornelas-Paz, J. J. & Mata, M. A. L. (2017). Favonoids: important biocompounds in food. https:/www.intechopen,com/books/flavonoids-from-biosynthesis-to-human-health/flavonoids-imortant-biocompounds-in-food

Singh, B.B., Chambliss, O.L. & Sharma, B. (1997). Recent advances in black pea. In: B.B. Singh, D.R. Mohan Raj, K.E. Dashiel and L.E.N. Jackai (eds.). Advances in black pea, research co-publication of international institute of tropical agriculture (IITA) and Japan international research center for agriculture sciences (JIRCAS). Ibadan, Nigeria, pp. 30 –49.

Sofowora, A. (1993). *Medicinal plants and traditional medicine in Africa*. 2nd ed. John Wiley and Sons Ltd, New York, pp. 14-20.

Swaminathan, R. (2003). Magnesium metabolism and its disorders. *The Clinical Biochemist Review*, 24, 2, 47-66.

Temple, V. J., Odewumi, L. & Joseph, K. (1991). Soya bean and soya bean based diets. Proceedings of the 3rd Regional Workshop on Rural Development, Jos, pp. 45-50.

Trease, E. & Evans, W. C. (1996). Phytochemical of plants. In: Pharmacognosy, 14th ed., Alden Press, Oxford, pp. 213-233.

Tukura, B. W. & Obliva, O. (2015). Proximate and nutritional composition of breadfruit (*Artocarpus altilis*) seeds. *IOSR Journal of Environmental Science, Technology and Food Technology*, 9, 3, pp. 68-73

Victor, B. (2014). Health benefits of plant alkaloids. https://benvictor.blogspot.com/2014/04/therapeutic-value.of.plant-alkaloids.htm

Wilson, D. R, (2017). Health benefits and risks copper. Medical News Today. https//medicalnewstoday.com/articles/288165

Yoshimura, M., Takhashi, H. and Nakanishi, T. (1991). Role of sodium, potassium, calcium, magnesium on blood pressure regulation and antihypertensive dietary therapy. *Japanese Journal of Nutrition*, 49, pp.53-62.

Yoshiyuku, S. and Yukata, K. (2003). Pyrolysis of plant, animal and human wastes: physical and chemical characterization of the pyrolytic product. *Bioresource Technology,* 90, 3, pp. 241-247.