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AN ANALYSIS OF THE NUTRITIONAL COMPOSITION OF DE-COATED SEED OF BLACK SEEDED COWPEA

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Abstract

Cowpea (Vigna unguiculata), a widely consumed legume, is known for its proteinous and nutrient content. However, the seed coat contains anti-nutritional factors that may hinder nutrient bioavailability. The study analyzes the nutritional composition of de-coated black seeded cowpea to assess its nutritional potential. Standard analytical methods were used to determine moisture, crude protein, fat, ash, fibre and NFE content. Essential minerals and trace elements were determined using Alpha-4 AAS, while Sodium and Potassium were determined using flame photometer Model at their respective wavelength. Also amino acid composition was determined using automatic amino acid analyzer. The results revealed that de-coating significantly influenced the nutritional composition by reducing fibre content while retaining essential nutrients. The protein content remained high, with a well-balanced amino acid composition with high levels of lysine and leucine content. Mineral indicate the presence of essential elements critical for human nutrition. Findings from the study suggest that de-coated black-seeded cowpea is a valuable nutritional resources with potential applications in food fortification and dietary formulations.

Keywords: *Amino acid composition, Black seeded Vigna unguiculata, De-coated cowpea seeds, Minerals and trace elements & Nutritional analysis*

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Introduction

In rural and urban diets throughout west and central Africa as well as certain regions of east and southern Africa, cowpea serves as a main source of plant-based protein (Singh *et al*., 1997). Majority is cultivated in central and south America, with over 70% of global production concentrated in just three countries: Brazil, Nigeria and Niger (Singh *et al*., 1997). According to FAO, Nigeria has about 4.0 Million hectares in cowpea and produces approximate a one million tons annually most of it in the three Northern States of Kano, Sokoto and Borno. Brazil produces about 0.4tons on 1.7 million hectares and Nigeria 0.27 million tons on about 1.1 million hectares (FAO, 1996). Cameroon, Senegal, Togo and Ghana, in West Africa, Tanzania, Kenya and Uganda are other important cowpea producer countries.

Cowpea is essential to the live hoods of millions in tropical underdeveloped regions. From the cultivation of these crops, rural families derive food, animal feed and cash with spillover benefits to their farmlands through, in situ decay of root residues, use of animal manures and ground cover from cowpea spreading and low growth habit. Additionally, the grain is widely traded out of the major production areas providing an affordable and nutritious food for relatively poor urban communities (Singh *et al*., 1983). It is a cheap source of vegetables protein, and a handy crop well adapted to dry habitats, with various uses, as a vegetable, dry seeds which are used for various purposes and as dry haulms and fodder. In addition, several snacks and main meal dishes are prepared from the grain. Plant parts used for food are nutritious, providing protein, vitamins and minerals. Grains of cowpea contain an average 23-25% protein and 50-67% starch. Fresh produce and processed foods sold by market women/men provides both rural and urban opportunities for earning cash, particularly by women (Singh *et al.,* 1997). Majority of plant protein in the diets in many developing countries are provided by cowpea (Aliyu and Wachap, 2014). Cowpea serve as a major source of protein in the absence of adequate animal-derive protein in Nigeria. (Alayande *et al.,* 2012). Cowpea which has a unique starch-protein composition as more versatile applications compared to other legumes which are oil-protein seeds like groundnuts and soya beans in Africa (Alayande *et al.,* 2012).

It is a leguminous plant (Ibrahim *et al.,* 2017) which belong to the family fabaceae, subfamily fabadeae, tribe phaseoleace, subtribe phaseolinae, genus vigna, specie unguiculata. (Verdcourt, 1970; Marechal *et al.,* 1978). It is herbaceous annuals plant with slender stems and branches and most plant characteristics vary depending on the genotype. It growth habit ranges from erect, semi-erect and spreading to climbing and twining, it may have branches (borne from present on the main stem) or they may not (Cobley and Steele, 1979).

Cowpea leaves nutritional value has been largely discounted due to their high water content and the difficulty of documenting their production and consumption (Bittenbender *et al.,* 1984). Cowpea seeds nutrient compared to cooked cowpea leaves contain seven times more calcium and three times more iron (Bitternbender *et al.,* 1984). Comparing, the cowpea leaves minerals are more bioavailable than those in seeds, because phytic acid reduces bio-availability of minerals like calcium and iron (Maga, 1982; Carnovale *et al.,* 1990). Removing the seed coat of cowpea seeds is a potential approach to enhance nutrient availability. Despite their nutritional advantages, the consumer awareness regarding their health benefits is limited. Understanding the nutritional profile of de-coated black seeded cowpea is crucial for optimizing its use in food formulations, dietary supplements and livestocks feed. This study aims to providing information on the nutritional composition of de-coated black seeded cowpea.

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Materials and Methods

Black seeded cowpea samples with an ID number IT24K-1101-5 were collected from the International Institute of Tropical Agriculture (IITA), Tarauni, Kano State. Nigeria. The seeds were de-coated using milling machine followed by winnowing to remove the seed coats. The de-coated seeds were sun-dried and ground into a fine powder in a steel – bladed electric mill machine. The samples were stored in air tight container before analysis. All chemicals used were of analytical grade. The proximate analysis of the de-coated seed sample was analysed for moisture content, crude ether extract, ash, crude protein, crude fibre, NFE and dry matter using standard method of Association of official analytical chemist (AOAC, 1984). The determination of copper, calcium, lead, manganese, zinc, chromium, magnesium, iron and nickel were carried out after digestion of the ash content at their respective wavelengths using Alpha-4 Model AAS. The determination of sodium and potassium were carried out using flame photometer Model at their respective wavelengths. The amino acids profiles of the seed coat were quantitatively determined as described by Spackman *et al.,* (1958), using automatic amino acid analyzer (Technicon (TSM) Sequential multisample amino acid analyzer). Samples were hydrolysed for determination of amino acids except for tryptophan in constant boiling of 6mol/dm^3 hydrochloric acid for 24 hours under nitrogen flush (Ayodele *et al.,* 2000).

Results and Discussion

De-coat seed of *vigna unguiculata* (cowpea) was analyzed for proximate composition, mineral, trace elements and amino acid composition. The analyses results are shown in Tables I-V.

Table I: *Percent proximate composition of De-coated seed of Vigna unguiculata (cowpea)*

Parameter	Percentage
Moisture	3.41 ± 0.42
Ash	3.19 ± 0.12
Crude protein	15.86 ± 0.78
Crude ether extract	6.66 ± 0.09
Crude fibre	0.54 ± 0.40
NFE	73.77 ± 1.17
Dry matter	96.60 ± 0.42

The proximate composition of the seed coat of *Vigna unguiculata* (cowpea) is as shown in Table I. From the study, the results of these analysis shows that the de-coated seed have an average moisture content of the dry sample as 3.41 ± 0.42% and is within the accepted range for keeping (Sena *et al.,* 1998). The ash content was 3.19 ± 0.12%. The crude protein has a smean of 15.86 ± 0.78 %. The crude ether extract is 6.66 ± 0.09% whilst its nitrogen free extract is 73.77 ± 1.17%. The crude fibre content is 0.54 ± 0.40% while the dry matter has a mean value of 96.60 ± 0.42%.

The average ash content and crude fibre for the de-coated seed are low while the ether extract and NFE for the de-coated seed are high when compare with those reported by (Ajeigbe *et al.,* 2008).

These result indicates that de-coated black-seeded cowpea is a good source of protein. The relatively low fibre content after de-coating suggests improved digestibility. The carbohydrate content provides a significant energy source, while the crude fat level contributes essential fatty

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acids. The de-coated seed has higher protein and carbohydrate which serves as a protein-rich ingredient for human and animal nutrition.

Table 2: *Mean Trace Metal Concentration (mg/100g) in the De-coated seed of Vigna unguiculata (cowpea).*

Element	Concentration (mg/100g)
Calcium	20.85 ± 5.87
Chromium	1.00 ± 0.00
Copper	4.75± 1.77
Iron	2.35 ± 1.77
Lead	2.35 ± 0.92
Magnesium	7.40 ± 0.28
Manganese	1.50 ± 1.06
Nickel	1.25 ± 0.35
Potassium	23.35 ± 9.40
Sodium	33.75 ± 1.77
Zinc	48.50 ± 23.33

The mean metal concentrations are shown in Table 2. The result of mineral composition of the de-coated seeds show the presence of both mineral and trace elements such as; copper, zinc, manganese, Iron, chromium, nickel, calcium, magnesium, lead, potassium and sodium. It also indicates that the seeds are rich in zinc, sodium, potassium and calcium.

Also the level of calcium and iron were lower than those reported by Imungi and potter (1983). The order of metal concentrations in de-coated seed are Zn>Na>K>Ca>Mg>Cu>Fe>Pb>Mn>Ni>Cr respectively. These minerals are important for physiological functions. Sodium maintains fluid balance and is essential for and muscle function. Fluid balance, nerve signals and muscle contractions are regulated by potassium, magnesium helps in muscle relaxation, nerve function and enzyme activity. Also calcium is important for bone and teeth strength, muscle function and nerve signaling while iron is essential for oxygen transport in the haemoglobin and energy production. Zinc supports immune function, wound healing and cell growth while copper is helps in metabolism, enzyme function and nerve health. Manganese play a role in the formation of bone, enzyme function and metabolism. Chromium supports insulin function and blood sugar regulation (Daniel, 1990).

Table 3: *Amino Acid composition of De-coated seed of Vigna unguiculata (cowpea)*

Amino Acid	g/100g Protein
Alanine	4.01 ± 0.02
Arginine	6.05 ± 0.13
Aspartic Acid	9.98 ± 0.04
Cystine	1.27 ± 0.02
Glutamic Acid	13.45 ± 0.30
Glycine	3.59 ± 0.04
Histidine	2.36 ± 0.08
Isoleucine	3.69 ± 0.26
Leucine	7.35 ± 0.15
Lysine	5.80 ± 0.28
Metheonine	1.29 ± 0.04

Phenylalanine	4.59 ± 0.13
Proline	2.22 ± 0.15
Serine	3.43 ± 0.11
Threonine	3.19 ± 0.09
Tryptophan	ND
Tyrosine	3.36 ± 0.18
Valine	3.96 ± 0.10

Quantitative chromatographic analysis of de-coated seed hydrolysate revealed seventeen amino acids (Table 3). The hydrolysates were rich in both essential and non-essential amino acids. Cysteine and methionine are the insufficient amino acids. The amino acid profile demonstrates a rich concentration of essential acids, particularly lysine and leucine, which are essential for human growth and tissue repair. The levels of glutamic and aspartic acid are also notable, which reflects a strong presence of non-essential amino acids contributing to flavour and metabolic function.

Table 4: *Essential Amino Acid in De-coated seed of Vigna unguiculata (cowpea) compared with FAO reference*

Essential Amino Acids	FAO Reference	De-coated seed of *Vigna unguiculata* (cowpea)
Histidine	2.40	2.36
Isoleucine	4.20	3.69
Leucine	4.80	7.35
Lysine	4.20	5.80
Metheonine	2.20	1.29
Phenylalanine	2.80	4.59
Threonine	2.80	3.19
Tryptophan	1.40	ND
Valine	4.20	3.69

A comparative study of de coated seed hydrolysates with that of the FAO reference revealed that the amino acid score of de-coated seed meets the required levels for some essential amino acids, except methionine which is lower but can be complemented through dietary diversification. The sulphur containing amino acid is important in diet for growing children, nursing mothers and pregnant women as its deficiency has been linked to fetal resorption in pregnant rats (Aykerod and Joyce 1964). Isoleucine is also an essential amino acid that aids the development of haemoglobin and acts as energy regulator, while valine promotes mental virgo, muscle coordination and calm emotions (Young and Pellet 1994).

Table 5: *Chemical Score of Seed coat of Vigna unguiculata (cowpea) Amino acids relative to hens' egg (Eka 1987)*

Amino Acid	De-coated seed	Hens egg	% Chemical Score
Alanine	4.01	5.87	68.31
Arginine	6.05	7.06	85.69
Aspartic acid	9.98	5.80	172.07
Cystine	1.27	0.64	198.44
Glutamic acid	13.45	3.36	400.30
Glycine	3.59	13.14	27.32
Histidine	2.36	2.96	79.73

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Isoleucine	3.69	7.32	50.41
Leucine	7.35	9.58	76.72
Lysine	5.80	7.26	79.89
Methionine	1.29	3.52	36.65
Phenylalanine	4.59	6.58	69.76
Proline	2.22	4.43	50.11
Serine	3.43	7.45	46.04
Threonine	3.19	1.92	166.15
Tryptophan	nd	4.96	nd
Tyrosine	3.36	-	nd
Valine	3.96	8.04	49.25

Comparing the amino acid of the De-coated seed with that of hen's egg (Table V). It is rich in glutamic acid, aspartic acid, cystine and threonine. However, it is deficient in glycine and methionine. These findings indicate that the de-coated black-seeded cowpea seed sample can serve as a functional ingredient in food processing, especially in protein-rich diets and food fortification programs. These results also highlight the potential nutritional and industrial applications.

Conclusion

The study demonstrates that de-coated black-seeded cowpea seeds are nutritionally rich, offering high protein content and a favourable amino acid profile. De-coating the seed significantly reduces crude fibre, potentially enhancing digestibility and nutrient absorption. The presence of important amino acids like lysine, leucine and valine further establishes its value as a dietary protein source. These findings further suggest that the de-coated cowpea seeds can serve as a functional ingredient in food processing, especially in protein-rich diets and food fortification programs.

Recommendation

It is recommended that further studies be conducted to assess the bioavailability of the nutrients and the extent to which de-coating the seed reduces the anti-nutritional compounds in order to optimize its use in food systems.

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