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Research Paper

Amino acid profile of *Bombax Buonopozense* (West African Bombax) Leaves

***[1]Muluh Emmmanuel Khan and [2]Eyo Edem Bassey**

[1]Chemistry Department University of Agriculture, P.M.B, 2373 Makurdi, Benue State, Nigeria.
[2]Chemical Science Technology Department, Federal Polytechnic Mubi, Adamawa State, Nigeria.

*Corresponding Author E-mail: emamulu@yahoo.com

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This article seeks to expose the nutritional value of the plant so as to educate the populace/ community of its nutritional value. A total of seventeen (17) amino acids were determined in the *Bombax buonopozense* leaves with their corresponding values expressed in g/100 g of protein. Eight (8) of the 17 amino acids determined are essential amino acids with leucine having the highest value of 6.80±0.003 and methionine the least with a value of 1.25±0.003. Three (3) of the 17 amino acids determined are non-essential amino acids comprising of alanine (3.20±0.003), Glutamic acid (8.15±0.006) and aspartic acid (8.10±0.03) and six (6) were determined as conditional amino acids with Arginine having a value of 4.62±0.003 as the highest and cysteine as the least with a value of 1.05±0.003. *B. buonopozense* leaves provide all the essential amino acids and offer superior food value for undernourished populations in Nigeria and other developing countries if adequately harnessed.

Key Words: Amino acid, *Bombax buonopozense,* medicinal / nutritional plant value.

INTRODUCTION

Green leafy vegetables constitute an indispensable constituent of human diet in Africa generally and West Africa in particular (Oguntona and Oguntona, *1986*).The varieties of leafy vegetables utilized are diverse, ranging from leaves of annuals and shrubs to leaves of trees. Leafy vegetables are generally good sources of nutrients, important protective foods, highly beneficial for the maintenance of health and prevention of diseases as they contain valuable food ingredients which can be utilized to build up and repair the body. They are valuable in maintaining alkaline reserve in the body and are valued mainly for their high vitamin, dietary fiber and mineral contents (Hanif et al., 2006). The dark green leaves and deep yellow fruits provide a high amount of carotene, ascorbic acid and micro-minerals which play important roles in nutrient metabolism and slowing down of degenerative diseases (Yi-Fang et al., 2002).

Amino acids are considered the building blocks of proteins and they are necessary elements of a healthy diet. Scientists have identified 22 standard amino acids capable of naturally forming polypeptide compounds. Amino acids play vital role in cellular metabolism, immune function and maintaining of a healthy nervous system (Perez-Urria et al., 2009). An evaluation of amino acid profile is a good indicator for overall nutritional status. Amino acids are essential in the synthesis of

proteins and precursors in the formation of secondary metabolism molecules that participate in cell signaling, gene expression and homeostasis regulation, protein phosphorylation, synthesis of hormones and antioxidant capacity (Cuin *et al.,* 2007; Perez-Urria et al*.,* 2009; Wu, 2009). Also, amino acids participate in various physiological processes such as skeletal muscle function and atropic conditions (Nicastro et al*.,* 2011; Dioguardi, 2011).

Amino acids are classified into three groups: Essential amino acids, Non-essential amino acids and the conditional amino acids. Essential amino acids cannot be made by the body and as a result, they must come from food. They include: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. The non-essential amino acids mean that our bodies produce them, if we do not get from food. They include: alanine, asparagine, aspartic acid and glutamic acid. Conditional amino acids are usually not essential except in times of illness and stress. They include: arginine, cysteine, glutamine, tyrosine, glycine, ornithine, proline and serine. One does not need to eat essential and non-essential amino acids at every meal but getting a balance of them over the whole day is important (McDougall, 2002; FAO/WHO/UNU, 2007).

Bombax buonopozense

Bombax buonopozense is of the family *Malvaceae* formerly *Bombacaceae* and is commonly known as Gold coast Bombax or red flowered silk cotton tree (Beentje et al*.,* 2001). It is known by the following local names: *Akpe (Igbo), Ponpola (Yoruba), Kurya (Hausa), Ukim (Efik) and IdoUndu (Ijaw)*. It is native primarily to West Africa where it is found in rainforests of Sierra Leone in the North West, East Gabon and some parts of Nigeria (Beentje et al*.,* 2001). It is a large tree and often reaches heights of 40 meters (130 feets) and up to 3 meters trunk diameter. The bark of younger trees is covered with spine but sheds the spine with age to some degree and large deep pink to red flowers emerge while the tree is leafless (Germplasm Resources Information Network [GRIN], 2007). According to Beentje et al*.,* 2001 and GRIN, 2007; many parts of this plant are utilized for medicinal and nutritional purposes.This work therefore is aimed at screening the leaves of *B. buonopozense* for its nutritional / amino acid profile.

MATERIALS AND METHODS

Sample collection, preparation and analysis

The fresh leaves of the plant (*Bombax buonopozense*) were obtained from Demsa Local Government Area of Adamawa State, Nigeria, in October 2014. The plant was cited from existing collections deposited at the Herbarium in Ibadan, an international herbarium listed in (Holmgren *et al.,* 1990). *Bombax buonopozense* P. Beauv with Forestry Herbarium Index Number FHI 108415 and a specimen of the plant is there.

The leaves were dried at room temperature so as to prevent the decomposition of volatile chemical compounds present in them and were pounded into fine powder using mortar and pestle. The pounded sample was then analyzed.

Quantitative amino acid profile

The analysis was performed using Isocratic Buck Scientific BLC 10/11-Model HPLC equipped with UV 338 nm detector.

Sample preparation

Two grams of the pounded sample was placed in a 25 ml standard volumetric flask and made up to mark with deionized water. This was centrifuged at 20,000 rpm and decanted. The filtrate was filtered using HPLC grade filter paper.

RESULTS AND DISCUSSION

Results of each analyte in (Table 1) are calculated averages of three (3) analytical values. Statistical values were obtained using the IBM-SPSS software version 22, 2015 edition and are presented as mean ±SD.

Table 1. Amino acid profile of *Bombax buonopozense* leaves

AMINO ACID	VALUE OBTAINED (g/100 g protein)
Lysine	4.10 ±0.10000
Threonine	2.50 ±0.00577
Cysteine	1.05 ±0.00577
Valine	4.30 ±0.01000
Methionine	1.25 ±0.00577
Isoleucine	3.50 ±0.01000
Leucine	6.80 ±0.00577
Tyrosine	3.40 ±0.00577
Phenylalanine	3.20 ±0.00000
Histidine	2.40 ±0.00577
Arginine	4.62 ±0.00577
Aspartic acid	8.10 ±0.05508
Serine	4.00 ±0.05774
Glutamic acid	8.15 ±0.00577
Proline	2.30 ±0.00577
Glycine	3.10 ±0.00000
Alanine	3.20 ±0.00577

Table 2. Values obtained for essential amino acids.

AMINO ACID	VALUE OBTAINED (g/100 g protein)
Histidine	2.40±0.003
Isoleucine	3.50±0.006
Leucine	6.80±0.003
Lysine	4.10±0.06
Methionine	1.25±0.003
Phenylalanine	3.20±0.00
Threonine	2.50±0.06
Valine	4.30±0.01

A total of seventeen (17) amino acids were determined and their corresponding values obtained from the sample were compared to other medicinal plants like the *Moringa oleifera (drumstick tree)*, *Tricholoma matsutake* (wild edible mushroom), *Afzelia africana* (*akpalata in Igbo,apa in Yoruba, yiase in Tiv, ukpo in Idoma and kawa in Hausa*), *Telfaria occidentalis* (*ugwu*) and *Corchoruso litorius* (*ewedu*).Table 1 gives the breakdown of values (in g/100 g of protein) obtained for the 17 amino acids determined from the sample. Eight (8) of which are essential amino acids; three (3) are non-essential amino acids and six (6) are conditional amino acids. Essential amino acids cannot be made by the body and as a result must come from food (Escott-Stump, 2013). The eight (8) essential amino acids and the quantities identified in the sample include the followings (Table 2).The highest value obtained was that of leucine (6.80 ±0.003); *Moringa oleifera*, *Tricholoma matsutake*, *Afzelia africana*, *Telfaria occidentalis* and *Corchorus olitorius* have leucine values of 1.73g, 1.87±0.002, 2.67g, 7.60g and 7.35 g respectively (Gang *et al.,* 2010; Umedum *et al.,*2014; Omoyeni *et al.,*2015 and www.themoringa.com/nutritional values 2015). These values for leucine were all lower than that recommended by Impact Whey Amino acid profile (10.60 g). This value is acceptable since leucine helps to lower blood sugar and also helps to slow the deterioration of muscle tissue by increasing the combining of muscle protein (White, 2014). An excessively high intake of leucine has also been linked to the development of pellagra, a deficiency of the vitamin-niacin that causes dermatitis, diarrhea and mental disorders. Too much leucine in the diet can disrupt liver and kidney function and increase the amount of ammonia in the body (www.vtaminstuff.com/amino-acid-leucine.html, 2015) and hypoglycemia, marked by weak motor control (loss of awareness), extreme forgetfulness and subsequent loss of consciousness. Leucine deficiency can result in muscle wasting, depression, low energy levels, muscle weakness and blood sugar irregularities (www.bodybuilding .com, 2015).

The least was methionine with a value of 1.25 ±0.003 while *Moringa oleifera*, *Tricholoma matsutake*, *Telfaria occidentalis* and *Corchoruso litorius* have methionine values of 0.280 g, 0.45±0.001, 1.10 g and 0.75 g respectively. (Gang *et al.,* 2010; Umedum *et al.,*2014, Omoyeni *et al.,*2014 and www.themoringa.com/nutritionalvalues 2015).Impact Whey Amino acid profile recommends methionine value of 2.2g/100 g protein. Methionine plays important roles in cell function. For instance; it is used to prevent liver damage in acetaminophen (Tylenol) poisoning. It is also used for increasing the acidity of urine, treating of liver disorders and improving wound healing (http://www.webmd.com/vitaminssupplements/ingredient mono-42, 2015). Other uses include treating of depression, alcoholism, allergies, asthma, copper poisoning, radiation side effects, schizophrenia, drug withdrawal and Parkinson's disease. The body also needs plenty of methionine to produce two other sulfur-containing amino acids, cysteine and taurine, which help the body eliminate toxins, build strong, healthy tissues, and promote cardiovascular health. Methionine helps prevent bacteria from sticking to and proliferating in the walls of the urinary tract (http://www.vitaminstuff.com/methionine.html. 2015), from the analysis carried out on the plant sample, the methionine value obtained is higher than that of *Moringa oleifera*, *Tricholoma matsutake*, *Telfaria occidentalis* and *Corchoruso litorius* (Gang *et al.,* 2010; Umedum *et al.,*2014; Olubunmi *et al.,*2014 and www.themoringa.com/nutritional values 2015). It is reported that methionine is commonly deficient in green leafy vegetables (Kubmarawa *et al.,* 2009). This means that sources of this amino acid should be consumed with other condiments. Methionine deficiency results in hair loss and greying of hair. Too much of methionine can cause brain damage and death. It can increase blood levels of homocysteine, a chemical that might cause heart disease; it can also promote the growth of tumors when in excess (www.webMD.com/vitamins, 2015).

Histidine is important for the synthesis of red and white blood cells. It is a precursor for histamine which is good for sexual arousal and improved blood flow. High dosage of histidine however increases stress and anxiety (Cox *et al.,* 2011). The sample under investigation has a histidine value of 2.40 g. Umedum *et al.,* 2014 documented 2.19 g for *Afzelia Africana*, Omoyeni *et al.,* 2015 reported 1.99 g, 1.81 g and 1.93 g for *C. olitorius*, *Vernonia amyldalina*(*ewuro*) and *T. occidentalis* respectively. Impact Whey Amino acid profile gave a recommended Histidine value of 1.70 g. The histidine value of *B. buonopozense* leaves is higher than those stated above. The presence of Histidine and arginine in the vegetable indicates that it could be recommended for children since they need these amino acids in food (Kubmarawa *et al.,* 2013). Low levels of this amino acid are reported to contribute to the development of rheumatoid arthritis and

deafness that result from nerve damage (www.vitaminstuff.com, 2015).

Isoleucine and valine had values of (3.50 and 4.30) g/100 g protein respectively. Impact Whey amino acid profile recommends 6.40g and 5.90g for isoleucine and valine. However, 1.71g/100g and 1.95g (isoleucine and Valine) is recorded for *Afzelia africana* by Umedum *et al.,* 2014. Isoleucine is needed for the healing and repair of muscle tissue, skin cells and bones. This essential amino acid is particularly useful to athletes. It also regulates blood sugar. Valine is needed for muscle metabolism and coordination: it supplies energy to the muscle tissue to promote muscle growth and tissue repair. During intense physical activity, it supplies the muscle with extra glucose for energy production, thereby preventing breakdown of muscle fibers. High levels of valine could lead to hallucinations. Low levels or deficiency may also affect the myelin covering of the nerves and cause degenerative neurological conditions (www.vitaminstuff.com,2015).

Appreciable amounts of lysine and threonine were obtained (2.50 and 4.10) g/100 g protein; and when compared to the Impact Whey amino acid profile with values of (9.60 and 6.70) g/100 g protein for lysine and threonine respectively seems lower. Lysine helps in the absorption and conversion of calcium; formation of collagen and conversion of fatty acids to energy. It is needed for enzymes and hormone synthesis. Olubunmi *et al.* 2015 recorded the following lysine and threonine values for *C. olitorius* and *T. occidentalis* (4.21 and 3.00) g/100 g protein and (4.60 and 3.40) g/100g protein respectively. Lysine deficiency may include symptoms of bloodshot eyes, hair loss, an inability to concentrate, irritability, lack of energy, poor appetite, reproductive disorders, retarded growth and weight loss. Threonine supports cardiovascular, liver, central nervous and immune system functions (www.vitaminstuff.com, 2015). Without enough threonine in the body, fats could build up in the liver and cause ultimate liver failure. Symptoms of threonine deficiency include emotional agitation, confusion, digestion difficulties and fatty liver (www.vitaminstuff.com, 2015). High amounts of threonine can disrupt liver function and cause the formation of excess urea and consequently ammonia toxicity in the body.

Phenylalanine was found to be 3.20 g which is higher than that documented for *Afzelia africana* (2.27g) by Umedum *et al.,*2014 but lower than those reported for *C. olitorius*, *V. amygdalina* and *T. occidentalis* (3.70, 3.83 and 3.92) g/100 g protein (Omoyeni *et al.,*2015). This amino acid is beneficial for healthy nervous system, boosts memory and learning, it elevates mood and alertness and useful against depression (Umedum *et al.,* 2014). High intake of this amino acid causes nerve damage.

Table 3. Values obtained for non-essential amino acids.

AMINO ACID	VALUE OBTAINED (g/100 g protein)
Alanine	3.20±0.003
Glutamic acid	8.15±0.006
Aspartic acid	8.10±0.03

Table 4**.** Values obtained for Conditional amino acids.

AMINO ACID	VALUE OBTAINED (g/100 g protein)
Arginine	4.62±0.006
Cysteine	1.05±0.003
Tyrosine	3.40±0.003
Glycine	3.10±0.000
Proline	2.30±0.003
Serine	4.00±0.03

The three (3) non-essential amino acids identified on the course of analysis are shown in (Table 3).

The highest value obtained was that of glutamic acid (8.15 ±0.006) followed by aspartic acid (8.10 ±0.03) and alanine (3.20 ±0.003). *Tricholoma matsutake* had the following values 5.49±0.007, 2.31±0.002 and 2.36±0.005 for glutamic acid, aspartic acid and alanine respectively (Gang, 2010). Non-essential amino acids are those amino acids that the human body produces or synthesizes even if they are not eaten in food (Trumbo et al*.,* 2013).Umedum *et al.,* 2014 cited the following glutamic acid, aspartic acid and alanine figures for *Afzelia africana*: 1.09, 1.14, and 1.01 g respectively. Omoyeni *et al.,*2015 reported the following glutamic acid, aspartic acid and alanine values for *Corchoruso litorius*, *Vernonia amygdalina* and *Telfaria occidentalis* (10.05, 10.43 and 11.02; 9.10, 7.91 and 9.25; 3.89, 3.77 and 4.10) g/100 g protein respectively. Impact Whey amino acid profile documents the following permissible limits for these amino acids in diets; glutamic acid (18.10g/100 g protein), aspartic acid (11.00g/100 g protein) and alanine (5.00g/100 g protein). Thus values for (*Bombax buonopozense*) are within the permissible limit. Glutamic acid is important in the metabolism of sugars and fats and aids in the transportation of potassium into the spinal fluid and across blood-brain barrier (www.vitaminstuff.com,2105).Glutamic acid deficiency results in muscle strands becoming thinner and saggy skin (Bowtell *et al.,* 1999). Aspartic acid keeps the mind sharp by increasing concentrations of NADH in the brain, it also removes excess toxins from the cells particularly ammonia which is very dangerous to the brain, nervous system as well as the liver (www.vitaminstuff.com, 2015). A deficiency of this amino acid results in extreme fatigue and depression and glandular fever. Alanine helps preserve balanced levels of nitrogen and glucose in the body. High intake of alanine results to chronic fatigue syndrome (www.vitaminstuff.com), alanine deficiency is rare since it is manufactured in the body (www.vitalhealthzone.com, 2015).

Conditional amino acids are usually not essential except in times of illness or stress and six (6) of these amino acids were identified in the sample (Table 4). On analysis, arginine had the highest value of 4.62±0.006 while *Moringa oleifera, Tricholoma matsutake, Afzelia africana, Telfaria occidentalis, Corchoruso litorius and Vernonia amygdalina* had (1.027, 1.11, 1.28, 4.51, 4.00, and 3.81)g respectively. Arginine helps strengthen the body's immune system, regulate hormones and blood sugar and also promote male fertility (www.vitaminstuff.com).Researchers theorize that delay in sexual maturity results from arginine deficiency (www.vitaminstuff.com). The body produces arginine but high intake of this amino acid can result to thickening and coarsening of the skin.

Serine and proline values obtained from the analysis (4.00 and 2.30) g/100 g protein lower than the permissible limits documented by Impact Whey amino acid profile 4.6 and 5.5 g respectively. In order to manufacture these amino acids in the body, sufficient amounts of vitamin B3, vitamin B6 and folic acid must be present which can be obtained naturally from the food we eat (www.vitaminstuff.com). The least was cysteine with 1.05 ±0.003 while *Moringa oleifera* had a cysteine value of 2.50 as documented Chioma *et al.,2013* by and 2.2g is cited by Impact Whey amino acid profile as the permissible limit for it food.

A deficiency of this amino acid may either contribute to, or result from, immune suppression associated with HIV. Symptoms of cysteine deficiency include slowed growth in children, decreased levels of serum essential proteins, apathy, loss of pigmentation in hair, edema, lethargy, liver damage, muscle loss, skin lesions, weakness, fat loss (http://www.vitamins-supplements.org/amino-acids/cysteine.php., 2015), it helps maintain a healthy, youthful appearance by encouraging collagen production and skin elasticity (www.vitaminstuff.com).

CONCLUSION

Comparing the sample with *Moringa oleifera, Tricholoma matsutake* (wild edible mushroom), *Afzelia Africana*, *Telfaria occidentalis* (*ugwu*) and *Corchoruso litorius*(*ewedu*); the sample is deduced to have a good amino acid profile as 8 of the amino acids identified are considered to be essential amino acids, 3 as non-essential and 6 as conditional amino acids. Plant foods that provide more than 12% of their calorific value from protein have been shown to be good sources of protein. Thus, the plant investigated is a good source of protein. Vegetables that are low in fat contents make them good for consumption, the low amount of fat indicates that the vegetable is not a source of lipid accumulation and the plant is very rich in fiber.

Just as *Moringa* is regarded both as a medicinal plant and consumed as food, so also are the leaves of *Bombax buonopozense* especially when adequately cooked alongside with other condiments.

RECOMMENDATIONS

Other parts of the plant should be screened both qualitatively and quantitatively so as to ascertain the active components present in them. Anti-nutrients and toxicological analysis should also be performed on the leaves of the plant as well as other parts like the stem, bark, roots and fruits.

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