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Amino acid profiling of selected ethnic fruits

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Abstract
Human beings and animals require food to carry out essential functions, which include growth, development and reproduction. The amino acid content of fruit and fruit-derived foods is studied intensely because of the contribution to nutritional value, aroma, taste and health-promoting effects and their possible use as markers of origin and authenticity. Fruit is a nutrient rich food with a direct connection to public health. Along with several organic compounds, it is now well to cure diseases, but they play important role in many activities in the body. The aim of the study was to monitor the Amino acid profile of five selected ethnic and edible fruits (*Annona reticulata, Phyllanthus acidus, Averrhoa bilimbi, Syzygium samarangense* and *Citrus maxima*) as well as investigating the nutritional status of these species in terms of available amino acids. Among all the five selected fruits for their amino acid profiling, the fruit *Annona reticulata* emerged as the most potential one with higher concentration of all the non-essential amino acids. The highest concentration was shown by the amino acid proline (70.303mg/g), followed by glutamine (66.475mg/g), glycine (63.043 mg/g) and the least one was found to be aspartate (19.594 mg/g). *Phyllanthus acidus,* was proved to be the next candidate with potential profile of non-essential amino acids, followed by *Averrhoa bilimbi, Syzygium samarangense* and finally *Citrus maxima.* All the samples were also analysed for its chemical score to find out the limiting amino acid. In case of *Annona reticulata,* the highest chemical score was in proline (175757.5) and the lowest score was recorded in aspartate (48985). In the case of *Phyllanthus acidus,* also, highest chemical score was demonstrated in proline (160605) and the lowest score was recorded in aspartate (44762.5). In almost all the samples, the results followed the same pattern.

Keywords: Amino acid profile, Proline, Glutamine, Glycine, Aspartate

1. Introduction
In our environment all living organism requires a continuous supply of large number of substances from food to complete their life cycle. Food is the material that provides the raw materials for growth and repair. Proteins and amino acids are the building blocks of life. Amino acids are theorized to enhance performance in a variety of ways, such as increasing the secretion of anabolic hormones, modifying fuel use during exercise, preventing adverse effects of overtraining and preventing mental fatigue. Foods and ingredients high in free amino acids or made up of protein hydrolysates have been used in cooking for many centuries, in many cultures, in order to enhance the sensory qualities of various foods (Bellisle, 1999) [1]. Amino acids are left when proteins are digested or broken down and can be used as a source of energy by the body. Amino acid play vital role in human life for their healthy growth especially the health of our immune system. They are directly participating in our nervous system and digestive system. Biologically amino acids are very important organic compounds composed of amine (-NH_2) and carboxylic acid (-COOH) functional groups along with a side chain specific to each amino acid. Carbon, hydrogen, oxygen and nitrogen are the key elements of an amino acid where other elements are found in the side chains of certain amino acids. Fruits are the crucial part of human diet and they provide health benefits and helps in preventing illness. Fruits contain variety of nutrients including vitamins, minerals, bioactive compounds and phytochemicals, especially antioxidants which help in reducing risk of chronic diseases. Fruits are naturally rich in fiber, potassium, iron, vitamin C and low in sodium, calories and fat (Ene-Obong *et al*., 2016) [3].

2. Materials and Methods
The study was aimed at monitoring the Amino acid profile of some selected ethnic fruits as well as investigating the nutritional status of these fruits in terms of available amino acids.

The following 5 ethnic fruits were used for the present study- *Annona reticulata*, *Phyllanthus acidus*, *Averrhoa bilimbi*, *Syzygium samarangense* and *Citrus maxima***.**

2.1 Quantification of amino acids: Amino acids were determined using the method of Moore and Stein (1948) [6]

2.2 Estimation of chemical score: Chemical score (amino acid) was computed for each essential amino acid by the following formula:

$$\frac{\text{Milligram of amino acid in 1g of test sample}}{\text{Milligram of amino acid in reference pattern}} \times 100$$

3. Results and Discussion

The amino acid profile of the five selected edible ethnic fruits is given in Table 1. Among all the five selected fruits for their amino acid profiling, the fruit *Annona reticulata* emerged as the most potential one with higher concentration of all the non-essential amino acids. The highest concentration was shown by the amino acid proline (70.303mg/g), followed by glutamine (66.475mg/g), glycine (63.043 mg/g) and the least one was found to be aspartate (19.594 mg/g). These values are sufficient to match the recommended dietary allowances.

Phyllanthus acidus, was proved to be the next candidate with potential profile of non-essential amino acids. In this fruit, the highest concentration was given by proline (64.242mg/g), followed by glutamine (60.744mg/g), then glycine (57.608 mg/g) and the least one, aspartate (17.905 mg/g). In the case of *Averrhoa bilimbi*, the amino acid proline showed highest value (53.333 mg/g), followed by glutamine (50.429 mg/g), glycine (47.826 mg/g) and the least one was again aspartate (14.864 mg/g). *Syzygium samarangense* had given the values as proline, 43.636 mg/g; glutamine, 41.260 mg/g; glycine, 39.130 mg/g and was at the next position with an appreciable amount of non-essential amino acids as listed in the table 1. It was noted that *Citrus maxima* showed the least concentration of amino acids (proline, 33.939 mg/g; glutamine, 32.091 mg/g; glycine, 30.434mg/g; the lowest one, aspartate, 9.459 mg/g) when compared with others. Similar observations have been reported by Berhanu Andualem and Amare Gessesse (2014) [2]. It was observed in their study that glutamate was the most abundant non-essential amino acid in both Brebra seed and Soybean seed. Paul Chidoka Chikezie *et al*., 2016 [7], observed that the concentrations of the various amino acids in the cassava peels ranged from 0.54 to 6.54 g/100 g protein, but those of yam peels were ranged between 0.37 and 6.25 g/100 g protein. They contained comparatively high concentrations of leucine and glutamate. But in case of essential amino acids, isoleucine and valine were most abundant in all their samples.

The amount of isoleucine in *Annona reticulata* was found to be 53.828mg/g, and that of valine 44.444mg/g. In case of *Phyllanthus acidus*,, the values were; isoleucine, 49.187mg/g and valine, 40.613mg/g. *Averrhoa bilimbi*, *Syzygium samarangense* and *Citrus maxima* showed almost similar profile of amino acids.The result indicated that non-essential amino acids are higher in concentration compared to essential aminoacids.The amino acid proline is a non-essential amino acid and this compound is responsible for tissue repair, collagen formation, arteriosclerosis prevention and blood pressure maintenance. As a natural moisturing factor, proline brings moisture to the skin and it is also thought to be important in the maintenance of muscles, joints and tendons. Glutamate or Glutamic acid play an important role in the metabolism of sugars and fats, and it helps for the transportation of potassium into the spinal fluid and across blood-brain barrier. Rennie has suggested glutamine supplementation as a strategy to promote muscle growth (Rennie *et al*., 1994) [8]. In a study by Monday A. Dakare *et al*., 2014 [5], the proximate analysis of the yellow maize and processed mango seed kernels (PMSK) showed that glutamic acid, aspartic acid and leucine are the most abundant amino acid in the samples. Udayasekhara, 1994 [9], Fowomola, 2010 [4] and Youssef, *et al*., 2009 [10] have been reported similar finding on raw mango seed kernel and yellow maize.

All the samples were also analysed for its chemical score to find out the limiting amino acid (Table 2). From *Annona reticulata*, highest chemical score was demonstrated in proline (175757.5) and the lowest score was recorded in aspartate (48985). In case of *Phyllanthus acidus*, also, highest chemical score was demonstrated in proline (160605) and the lowest score was recorded in aspartate (44762.5). In almost all the samples, the results followed the same pattern.

Table 1: Amino acid profile of five selected ethnic fruits

Amino Acids (mg/g)	*Annona reticulata*	*Phyllanthus acidus*	*Citrus maxima*	*Averrhoa bilimbi*	*Syzygium samarangense*
Arginine	27.884	25.480	13.461	21.153	17.307
Histidine	27.985	25.572	13.510	21.230	17.370
Isoleucine	53.828	49.187	25.986	40.835	33.410
Leucine	36.193	33.073	17.472	27.457	22.464
Lysine	30.169	27.568	14.564	22.886	18.725
Methionine	21.990	20.094	10.616	16.682	13.649
Phenylalanine	42.181	38.545	20.363	32	26.181
Threonine	29.629	27.075	14.303	43.933	18.390
Tryptophan	29.667	27.109	14.322	22.506	18.414
Valine	44.444	40.613	21.455	33.716	27.586
Proline	70.303	64.242	33.939	53.333	43.636
Serine	56.310	51.456	27.184	42.718	34.951
Tyrosine	48.033	43.892	23.188	36.438	29.813
Alanine	34.782	31.784	16.791	26.386	21.589
Aspartate	19.594	17.905	9.459	14.864	12.162
Cysteine	43.364	39.626	20.934	32.897	26.915
Glutamine	66.475	60.744	32.091	50.429	41.260
Glycine	63.043	57.608	30.434	47.826	39.130

Table 2: Chemical Score of five selected ethnic fruits

Amino Acids	*Annona reticulata*	*Phyllanthus acidus*	*Citrus maxima*	*Averrhoa bilimbi*	*Syzygium samarangense*
Arginine	69710	63700	33652.5	52882.5	43267.5
Histidine	69962.5	63930	33775	53075	43425
Isoleucine	134570	122967.5	64965	1020875	83525
Leucine	90482.5	82682.5	43680	68642.5	56160
Lysine	75422.5	68920	36410	57215	46812.5
Methionine	54975	50235	26540	41705	34122.5
Phenylalanine	105452.5	96362.5	50907.5	80000	65452.5
Threonine	74072.5	67687.5	35757.5	109832.5	45975
Tryptophan	74167.5	67772.5	35805	56265	46035
Valine	111110	101532.5	53637.5	84290	68965
Proline	175757.5	160605	84847.5	133332.5	109090
Serine	140775	128640	67960	106795	87377.5
Tyrosine	120082.5	109730	57970	91095	74532.5
Alanine	86955	79460	41977.5	65965	53972.5
Aspartate	48985	44762.5	23647.5	37160	30405
Cysteine	108410	99065	52335	82242.5	67287.5
Glutamine	166187.5	151860	80227.5	126072.5	103150
Glycine	157607.5	144020	76085	119565	97825

4. Conclusion

The benefits of taking dietary supplements that contain amino acids by the general public has provoked interest on the study of the biological functions of amino acids. The quality of protein depends on the level at which it provides the nutritional amounts of essential amino acids needed for overall body health, maintenance, and growth. Protein or amino acids play an important role in the normal growth of children and maintaining health in adults and the average food intake in developed countries well surpasses the required level. Taking amino acids as dietary supplements with their advantages or expected advantages mainly come from their useful biological activities. Proteins are important substances of human cells and they play an important role in human nutrition. The amino acid content, their proportions and digestibility by humans characterize protein's biological value. Proteins consist of 20 amino acids, but the most important are essential amino acids which the human body needs to take from food. The amino acid composition of food proteins provides important information and perspective about their nutritive value. The ethnic fruits have contained alternative sources of feeds offering high quality nutrients, especially proteins, limiting amino acids and also energy. Among all the five selected fruits for their amino acid profiling, the fruit *Annona reticulata* emerged as the most potential one with higher concentration of all the non-essential amino acids. The highest concentration was shown by the amino acid proline, followed by glutamine, glycine and the least one was found to be aspartate. *Phyllanthus acidus,* was proved to be the next candidate with potential profile of non-essential amino acids, followed by *Averrhoa bilimbi, Syzygium samarangense* and finally *Citrus maxima*. Results showed that, these fruits can be recommended to be included in our daily diet. Future studies are to be made to replenish our ancestral knowledge about these fruits that will be helpful for the betterment of upcoming generations.

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