Titrimetric Estimation of Ascorbic Acid Content of *Parkia biglobosa* Yellow Powder

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Abstract
The health benefit of ascorbic acid (vitamin c) is indispensable. The demand for it is increasing on a daily bases as people are faced with health challenges. This necessitates needs to seek for means of increasing its supply for consumption especially that humans are incapable of synthesizing it endogenously. Parkia biglobosa yellow powder a common plant fruit become the target source for investigation in this research work. Ascorbic acid content of parkia biglobosa was estimated using titrimetric method. The ascorbic acid concentration was calculated with the values shown below; the number of moles estimated was 0.000028mole, molarity of 0.0014mol/dm^3, 0.2464g/dm^3, and 24.64mg/g. This implies that when an individual consumes 1 gram of parkia biglobosa yellow powder, he or she might have taken 24.64mg (approximately 25mg) of vitamin c. This is the amount recommended for people of age 4 – 8 years. Parkia biglobosa is therefore a good source of ascorbic acid. People are encouraged to use the source for vitamin c supply. It was however recommended that the yellow powder should not be wasted when processing the seed, and search should be made to improve method of processing to channel the vitamin c content into useful product and expand the scope of parkia biglobosa usage among economic trees.

Keywords: *ascorbic acid (Vitamin c), Parkia biglobosa*

Introduction

Vitamin C, also known as L-ascorbic acid, is a water-soluble vitamin that is naturally present in some foods like fruits and vegetables (Du, Cullen and Buettner, 2012), added to others, and available as a dietary supplement. It is synthesized from glucose in the liver of many mammalian species, allowing the maintenance of physiological levels. However, higher primates, including humans, lack the functional enzyme for the final step of synthesis, rendering them dependent on exogenous sources of ascorbic acid (Lachapelle and Drouin, 2011; Nishikimi, Kawai and Yagi, 1992).

Vitamin C is required for the biosynthesis of collagen, L-carnitine, and certain neurotransmitters; vitamin C is also involved in protein metabolism. Collagen is an essential component of connective tissue, which plays a vital role in wound healing. Vitamin C is also an important physiological antioxidant and has been shown to regenerate other antioxidants within the body, including alpha-tocopherol (vitamin E). Its Recommended Dietary Allowance and maximum dose for different category of people are shown in tables 1 and 2

below.

Table 1: Recommended Dietary Allowances (RDAs) for Vitamin C

Age	Male	Female	Pregnancy	Lactation	
0–6 months	40 mg*	40 mg*			
7–12 months	50 mg*	50 mg*			
1–3 years	15 mg	15 mg			
4–8 years	25 mg	25 mg			
9–13 years	45 mg	45 mg			
14–18 years	75 mg	65 mg	80 mg	115 mg	
19+ years	90 mg	75 mg	85 mg	120 mg	* Adequate Intake (AI).

Source (https://ods.od.nih.gov, US department of Health Service, National Institute of Health June 24, 2011)

Table 2: Showing the upper limits for vitamin C

Life Stage	Upper Limit
Birth to 12 months	Not established
Children 1-3 years	400 mg
Children 4-8 years	650 mg
Children 9-13 years	1,200 mg
Teens 14-18 years	1,800 mg
Adults	2,000 mg

Source (https://ods.od.nih.gov, US department of Health Service, National Institute of Health June 24, 2011)

It is equally reported in the prevention and treatment of cancer (Du, Cullen and Buettner, 2012). This it does through the following proposed mechanisms; enhancement of the immune system, stimulation of collagen formation necessary for wailing off tumors, inhibition of hyaluonidease which keeps the ground substance around the tumor intact and prevents metastasis, prevention of oncogenic viruses, correction of an ascorbate deficiency often seen in cancer patients, expedition of wound healing after cancer surgery, enhancement of the effect of certain chemotherapy drugs, reduction of the toxicity of other chemotherapeutic agents such as andriamacin, prevention of free radical damage, and neutralization of carcinogenic substances (Kathleen, 1998).

Recent report showed that vitamin c is a key antioxidant of the Central Nervous System (CSN). When it is taken up by neurons it scavenges reactive oxygen species (ROS) generated during synaptic activity and neuronal metabolism where it is then oxidized to dehydroascorbic acid and released into the extracellular space, where it can be recycled by

astrocytes. In addition to that, vitamin c can also switch neuronal metabolism from glucose consumption to uptake and use of lactate as a metabolic substrate to sustain synaptic activity (Adriana, Anibal, Felipe, Leandro and Maite, 2015). Exploring the fruits that are sources of this kind of biologically important molecule is expedient. Parkia biglobosa yellow powder is a common fruits that is usually washed away or wasted when people process the fruit to obtain the locust bean part of the fruit. It is therefore the target fruit which this research work tries to estimate its vitamin c content by titrimetric method of analysis.

Parlia biglobosa is a plant that is also known as African locust bean. It is a perennial deciduous tree of the fabaceae family. It is grown as an economic tree which produces pods that contain both yellow powder and valuable seeds (Special information, 2013). The tree is used in traditional medicine in Africa for treatment of parasitic infection, circulatory, respiratory and digestive systems disorders. The fermented seed is used as food condiment (Janick, 2008).

The yellow pulp, which contains the seeds, is naturally sweet "and is processed into a valuable carbohydrate food known as sikomu and daddawa among the Yoruba, Igbo and Hausa people of Nigeria, respectively (Olaniyan, 2013). The yellow pulp being fruit is a potential source of vitamin c. The purpose of this study therefore is to investigate and estimate the vitamin c content of *parkia biglobosa* yellow powder, to expand the scope of its use as food supplement.

Method

The locust bean powder used in this work was collected from Otite, Okehi Kogi Central; Nigeria and identified by a botanist in the Department of Biology Federal College Okene. The pods were cut from a tree, the back was removed and yellow powder equally removed from the seed as well. The yellow powder was dried to constant weight and used for ascorbic acid estimation.

One gram of the yellow powder was weighed and dissolved in a measuring cylinder with 50cm^3 of distilled water. 20cm^3 of the aliquot sample solution was placed in a 250cm^3 conical flask and volume made to 100 cm^3 with distilled water followed by addition of 1ml of starch solution. The solution was titrated against 0.05 mol/dm^3 iodine solution until a permanent trace of dark – blue colour was observed. The titration was carried in triplicates until two concordant results (titres agreed with 0.1cm^3) were gotten.

Result

The result from the titration of iodine with the sample for estimation of its vitamin c content is shown in the table below.

Table 3: Showing titre value of sample titration against 0.05mol/dm^3 iodine

Burette Reading	**1st titre (cm^3)**	**2nd titre (cm^3)**	**3rd titre (cm^3)**
Final reading	5.80	12.10	33.10
Initial reading	0.00	6.50	27.50
Volume of Iodine used	**5.80**	**5.60**	**5.60**

Average volume of iodine = $\frac{5.60 + 5.60}{2} = \frac{11.20}{2} = 5.60cm^3$

Equation of reaction Ascorbic acid + I_2 ⟶ 2I + dehydroascorbic acid

Morality of iodine = $0.05moles/dm^3$

Volume of iodine = $5.60cm^3$

Morality = $\frac{\text{amount (mole)}}{\text{Volume (dm3)}}$

$0.05 = \frac{\text{amount X 1000}}{5.60}$

1000 X amount = 0.05 X 5.60

1000 X amount = 0.028

Amount (in mole) = $\frac{0.028}{1000}$ = 0.000028mole = $2.8 \text{ X } 10^{-5}$ moles

The number of moles of ascorbic acid can be estimated from the equation of reaction.

Equation of reaction Ascorbic acid + I_2 ⟶ 2I + dehydroascorbic acid

Mole ratio 1 : 1 = $\frac{0.028}{1}$ = 0.000028mole

1. To calculate the concentration in mo/dm^3 of ascorbic acid in *Parkia biglobosa* solution.) = $\frac{\text{Molarity (mol/dm3)}}{\text{volume}}$ ascorbic acid in the sample = $\frac{0.000028 \text{ X } 1000}{20}$ = $0.0014mol/dm^3$

2. To calculate the concentration in mg/100ml of ascorbic acid in *Parkia biglobosa* yellow powder, Molarity (mol/dm^3) = $\frac{\text{mass (g/dm3)}}{\text{Molar mass}}$, where molar mass of ascorbic acid = 176.12g/mol.

Therefore 0.0014 = $\frac{\text{mass (g/dm3)}}{176.12}$ = 0.0014 X 176.12 = $0.2464g/dm^3$

Thus if $1000cm^3$ solution of *Parkia biglobosa* contains 0.2464g of ascorbic acid

then $100cm^3$ will contain $\frac{100 \text{ X } 0.2464}{1000} = \frac{24.6}{1000}$ = $0.02464g/100cm^3$

If 1000mg = 1g, it means 0.02464g X 1000 = 24.64mg/g. It can be inferred that 1g of *Parkia biglobosa* yellow powder contains 24.64mg ascorbic acid.

Discussion

We have been able to estimate the ascorbic acid content of *Parkia biglosa* yellow powder by titrimetric approach. The result reveals that the yellow powder of *parkia biglobosa* contains a reasonable amount 24.64mg/g of ascorbic acid (vitamin c). This Value is approximately equal to 25mg Recommended Dietary Allowance for people of age 4 – 8 years reflected in table 1 above (https://ods.od.nih.gov, US department of Health Service, National Institute of Health, 2011). The fruit can serve as a dietary supplement or substitute for shelf vitamin c. People who are attracted to eating the fruit because of its relatively yellowish colour and sweet nature are indirectly taking vitamin c which is needed for their body maintenance.

The yellow powder is usually washed away during processing. However, the amount of ascorbic content in it is sufficient enough to make this portion of the fruit useful as a natural source of vitamin c. Considering the Recommended Dietary Allowance for vitamin c of different categories of people shown in table 1 above, it implies that if an adult takes approximately 4g dry weight of the yellow powder of *Parkia biglobosa,* he or she would have taken the dosage of vitamin c required for a day.

Conclusion

Parkia biglobosa yellow powder is a good source of vitamin c and the powder should not be wasted in the course of processing.

Recommendation

1. It is recommended that research should be carried out to look into ways of enhancing the method of processing it to avoid wastage of the yellow powder.

Reference

Adriana, C., Aníbal I. A., Felipe, A. B., Leandro, T. and Maite, A. C (2015). Old Things New View: Ascorbic Acid Protects the Brain in Neurodegenerative Disorders. *International Journal of Molecular Science,* 16, 28194 – 28217, doi:10.3390/ijms161226095

Du, J.; Cullen, J.J.; Buettner, G.R. Ascorbic acid: Chemistry, biology and the treatment of cancer. *Biochim. Biophys. Acta* ***2012****, 1826, 443–457.*

Janick, J. (2008). Parkia biglobosa African Locust Bean. The encyclopedia of fruit & nuts (pp.395-400). Wallingford, U.K.: CABI North American Office.

Kathkeen, A (1998). Ascorbic acid in the prevention and treatment of cancer. *Alternative Medicine Review, 3(3), 174 – 186*

Lachapelle, M.Y.; Drouin, G. (2011). Inactivation dates of the human and guinea pig vitamin C genes. *Genetica, 139, 199–207.*

National Institute of Health (2011). https://ods.od.nih.gov, US department of Health Service, National Institute of Health June 24, 2011

Nishikimi, M.; Kawai, T.; Yagi, K. (1992). Guinea pigs possess a highly mutated gene for L gulono—lactone oxidase, the key enzyme for L-ascorbic acid biosynthesis missing in this species. *J. Biol. Chem, 267, 21967–21972.*

Olaniyan, A. (2013). Locust Bean Products. Non-Wood News, N0.10, fao.org.

Special Information – *Parkia biglobosa* (n.d). (2013). Agroforestry Tree Database.