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Extraction of Vitamin C Content in Selected Fruit Samples from Monguno, Borno State, Nigeria, Using the Iodometric Technique

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ABSTRACT

This study aimed to assess the vitamin C levels in a selection of fruits commonly consumed in-Monguno, Borno State, Nigeria. Fresh fruit samples of orange (*Citrus sinensis)*, lemon *(Citrus limon*), pineapple (*Ananas comosus*), mango (*Mangifera indica*), and watermelon *(Citrullus lanatus*) were sourced from local markets and analyzed using the iodometric titration method. The results showed notable differences in vitamin C concentrations among the fruits. Oranges had the highest vitamin C content at 54.3 mg/100 mL, followed by lemons at 48.6 mg/100 mL, pineapples at 36.1 mg/100 mL, mangoes at 27.9 mg/100 mL, and watermelons at 15.4 mg/100 mL. These findings revealed that citrus fruits are superior sources of vitamin C compared to the other fruits studied. The variations observed may be linked to factors such as fruit species, ripeness, storage conditions, and environmental influences. This study underscores the value of locally available fruits as cost-effective sources of vitamin C and highlights the importance of incorporating fruits into the diets to prevent vitamin C deficiency and enhance public health.

Key Words: Fruits, iodometric titration, nutritional value, vitamin C

INTRODUCTION

Vitamin C is also referred to as hexuronic acid, cevitamin acid or xiloascorbic acid. Vitamin C is generally used to describe all these acids although the representative of which is ascorbic acid [1]. Vitamin C (Ascorbic acid) is the most important mainly found in fruits and vegetables [2]. Except human and other primates most of the phylogenetically higher animals can synthesize vitamin C [3] . More than 90% of the vitamin C in human diets is supplied by fruits and vegetables (including potatoes) [4-6]. Citrus fruits and juices are particularly rich sources of vitamin C but other fruits including cantaloupe and honeydew melons, kiwi fruits, mangoes,

pawpaw, strawberries, tangelo, tomatoes, and watermelon also contain variable amounts of vitamin C [7]. Vitamin C is an essential nutrient that plays a vital role in protecting the body from infection and disease. It is needed for the formation of collagen, the protein that makes up connective tissue, and is essential to muscles, bones cartilages, blood vessels, capillaries, tissues, skin and teeth [7-9]. It also functions in absorption of inorganic iron, reduction of plasma cholesterol level, inhibition of nitrosoamine formation, enhancement of the immune system, and reaction with singlet oxygen and other free radicals. As an antioxidant, it reportedly reduces the risk of arteriosclerosis, cardiovascular diseases, infectious diseases, asthma, cataract, Diabetes Mellitus and some forms of cancer [2, 4-8].

Numerous analytical techniques are available for the determination of vitamin C in different matrices. Some of the techniques include: direct titration [10-13] fluorometric methods, chromatographic methods, and electrochemical [7]. However, some of these methods are time-consuming, some are costly, some need special training operators, or the insufficient sensitivity or selectivity [5]. In this research titration method was used because it is accurate and precise method to determine vitamin C compared to other methods such as high pressure liquid chromatography (HPLC) method and enzymatic methods [9].

Ascorbic acid which is an effective reducing agent belongs to endiol group and has two alcoholic groups with acidic character. It can be quantitatively and reversibly oxidized by different oxidizing agent in aqueous solutions [13]. It is a labile substance, as it is easily degraded by enzymes and atmospheric oxygen. Its oxidation can be accelerated by excessive heat, light, and heavy metal cations [7]. To our knowledge so far there is no investigation of the levels of Ascorbic acid in various types of fruits items including orange, papaya, lemon, mango and tomato commercially available in markets at Monguno town.

Therefore, this study was carried out with an aim of determining the ascorbic acid contents of some natural freshly prepared fruit juices purchased from local market in Monguno town, Borno State, Nigeria

MATERIALS AND METHODS

Preparation of reagents

To prepare 1 litre of 0.005 mol/dm^3 iodine solution, about 1.27 g of elemental I_2 crystals and 2 g of potassium iodide were dissolved in distilled water and diluted to a final volume of 1 litre. Because elemental iodine is lowly soluble in pure water, potassium iodide acts as a solubilizing agent by reacting with I_2 to form a highly water soluble triiodide (I_3^-). Starch indicator solution was prepared by weighing 0.25 g of soluble starch that was added to 50 ml of near boiling water in a 100 ml conical flask. This was stirred to dissolve and allowed to cool before use [14].

Sample preparation

Fresh samples of lemon, orange,water melon, pineapple and mango were obtained from a regular market in Monguno, Borno State. Nigeria. The samples were washed and stored inside a refrigerator. The orange samples were washed again with distilled water, peeled and sliced into two transversely, and squeezed. The juice obtained was filtered with a muslin cloth. The water melon samples were sliced into smaller portions and squeezed. The juice obtained was also filtered. The same treatment was applied to the other fruit samples.

Procedures for ascorbic acid determination in samples

About 10 ml of each of the fruit samples was pipetted into a pre-washed 250 ml conical flask and I added 2 ml of freshly prepared starch indicator solution. The mixture was titrated with 0.005 mol/dm^3 of iodine solution until a permanent blue-black colouration appeared, indicating end point. The titration was performed in triplicate for each fruit sample, and the average titre value was calculated.

Reaction principle

Ascorbic acid reduces iodine to iodide ions while being oxidized to dehydroascorbic acid as shown in Equation 1:

$$C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2HI \quad \text{.....(1)}$$

Ascorbic acid dehydroascorbic acid

Vitamin C concentration was calculated using Equation 2:

$$\text{Vitamin C (mg/100 mL)} = \frac{V \times M \times 88 \times 100}{Volume of Sample} \quad \text{..... (2)}$$

Where V = Volume of iodine (mL), M = Molarity of iodine solution, 88 = Equivalent weight of ascorbic acid.

RESULTS AND DISCUSSION

Table 1 shows the concentration of Vitamin C (mg/100 mL) calculated using the formula shown in Equation (2).

Table 1: Concentration of Vitamin C in the fruit samples

S/N	Sample	Botanical name	Average titre value (mL)	Concentration of Vit. C in (mg/100mL)
1	Orange	*Citrus sinensis*	12.34	54.3
2	Lemon	*Citrus limon*	11.05	48.6
3	Pineapple	*Ananas comosus*	8.20	36.1
4	Mango	*Mangifera indica*	6.34	27.9
5.	Watermelon	*Citrullus lanatus*	3.50	15.4

The results obtained indicate considerable variation in vitamin C content among the selected fruits samples. Orange contained the highest concentration of vitamin C (54.3 mg/100mL), while watermelon exhibited the lowest concentration (15.4 mg/100mL). The high ascorbic acid content concentration was observed in orange and lemon is consistent with previous reports indicating that citrus fruits are among the richest natural sources of ascorbic acid. Their elevated vitamin C concentration may be attributed to their genetic composition and physiological characteristics.

Pineapple and mango showed moderate levels of vitamin C, suggesting that they can also contribute significantly to daily dietary requirements. Watermelon recorded the lowest concentration, which agrees with findings reported by previous researchers [6] who observed lower vitamin C. levels in melon fruits compared to citrus fruits. Considering the Recommended Diatery Allowance (RDA) for vitamin C of approximately 75-90 mg/day for adults, consumption of vitamin C rich fruits such as oranges and lemons can contribute substantially to meeting daily nutritional requirements.

CONCLUSION

This study successfully determined the vitamin C in selected fruit samples commonly consumed in Monguno, Borno State, using the iodometric titration method. The results revealed that all sampled fruits contained measurable amounts of vitamin C, although significant variations existed among the samples. Orange and lemon exhibited the highest vitamin C concentrations, while water melon contained the lowest. These findings emphasize the nutritional importance of locally available fruits as affordable sources of vitamin and support the promotion of fruits consumption as strategy for improving dietary quality and preventing vitamin C deficiency.

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