

Assessment of Minerals, Vitamins and Parasite Contamination in Fruits and Vegetables in Selected Markets of Bali, Taraba State, Nigeria

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Abstract

The presence of parasites in fruits and vegetables poses a serious risk to consumers. A total of Fifty (50) parasite infested samples were collected, comprising Twenty-five (25) fruits and twenty-five (25) vegetables. These samples were washed thoroughly with rapid shaking in 250ml normal saline (0.85%NaCl w/v) for the removal of egg, cyst, or larvae. Each preparation was centrifuged at 1500 rpm for 5minutes. A drop of lugols iodine was added and observed under light microscope at x10 and x40 objectives. The leafy vegetables and fruits were then rewashed, cut into pieces and dried under shed at room temperature for 4 weeks. Different methods and solvents were applied for the determination of vitamins and minerals in the selected fruits and vegetables. *Ascaris lumbricoides* was found on tomatoes and the larva of *strongeloides* on pumpkin and spinach. Vit.B2 was found in citrus (0.13mg/100g), Banana (0.77 mg/100g), watermelon (0.18 mg/100g), pumpkin (0.39 mg/100g) and spinach (0.30 mg/100g). Vit.B9 was found in Citrus (24.03 mg/100g), Banana (29.20 mg/100g), Tomato (15.81 mg/100g) and Spinach (10.57 mg/100g). Vit.E was present in Pumpkin (1.74 mg/100g) and Spinach (0.28 mg/100g) and absent in other fruits and vegetables. Setting up proper measures can help in reducing the risks associated with the consumption of contaminated fruits and vegetables, promoting good health of the people. Based on the findings, it is recommended that steps be taken to ensure the safety and quality of fruits and vegetables available in local markets through regular monitoring and food safety rules.

Keywords: *Ascaris lumbricoides*, *Strongeloids*, Vitamins, Minerals, Fruits, Vegetables.

Introduction

Fruits and vegetables no doubt form important parts of human diet globally. Their consumption serves as a non-Pharmacological prophylaxis against chronic disease like cancer (Solomon, 2018). The World Health Organization (WHO) and Food and Agricultural Organization (FAO) have recommended at least 400g of fruits and vegetables, which are rich in essential Biochemicals such as Carbohydrates, Proteins and Carotene. The leaf of vegetable is also used to improve the quality of soup (Mohammad and Sharif, 2011). The nutrients derived from the intake of fruits and vegetables has shown to reduce substantially

the risk of non-infectious diseases like hypertension, coronary heart disease, stroke, glaucoma, and type-2-diabetes among many others (Solomon, 2018). Fruits and vegetables like Orange (*Citrus sinensis*), Banana (*Musa acuminata*), Date (*Phoenix dactylifera* L.), Watermelon (*Citrullus Lamatus*), Tomato (*Solanum lycopersicum*), Onion (*Allium cepa* L.), Pumpkin leaf (*Telfaria occidentalis-ugu*), Spinach (*Spinach oleracea*) to mention a few are important sources of vitamin C, β - carotene, vitamin B- complex, vitamin K, Iron, Sodium, Potassium, Phosphorus, Calcium, selenium, Zinc, copper, Sulphur, fluorine, manganese , protein, glucose, fructose, fructo-oligosaccharides, lowers blood pressure and dietary fibers (Agbalaka *et al.*, 2018). The phytochemicals function as antioxidants and anti-inflammatory agents. They also prevent constipation, hemorrhoids, erectile dysfunction among others (Duedu *et al.*, 2014; Adebayo *et al.*, 2020).

Different fruits and vegetables displayed for sale at the market in different African countries have been contaminated with eggs and larvae of Helminthes and protozoan cysts and oocysts (Istifanus and Panda, 2018; Auta *et al.*, 2017). Rapid transmission of parasites is being facilitated through the consumption of raw infected fruits and vegetables contaminated with larvae and eggs (Kanaan and Raiaan, 2020). High number of infections occur among children and rural dwellers due to poor hygiene and sanitation practices, poverty, poor health facilities, malnutrition, eating with unwashed hands after contact with contaminated surfaces, soil quality and climate (Tadesse *et al.*, 2020; Gbebi *et al.*, 2018; Ukwubile and Yohanna, 2015). Globally, about 247 to 760 million people are infected with soil transmitted Helminthiasis and 90% of these number is domicile in sub-Saharan Africa, South Asia, Latin America and the Caribbean Island (Tadesse *et al.*, 2020; Robert *et al.*, 2015; Bekele *et al.*, 2017; Enameh *et al.*, 2015).

In Nigeria, the prevalence of these parasites has been reported in some states including Katsina (Auta *et al.*, 2017; Adebayo *et al.*, 2020), Bauchi (Istifanus and Panda, 2018), Abuja, Kano (Muhammad and Sharif, 2011) and Taraba (Gbebi *et al.*, 2018). According to Ukwubile and Yohanna (2015), prominent of these parasites with wide spread and distribution, resulting in thousands to millions of human infections are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), hookworm (*Necator americanus*, *Ancylostoma duodenal*) and threadworm (*Strongyloides stercoralis*). Bali local government area of Taraba state is home to most of these parasites (Ukwubile and Yohanna, 2015).

Statement of the Problem

Researchers around the world, either independently or corporately have carried out extensive work on parasite contamination of fruits and vegetables, how these parasites spread faster among human population and have identified the parasite involved but the effects of these parasites on the vitamins and mineral content of fruits and vegetables are not well examined.

Research Questions

1. What is the effect of parasites on the vitamin content of fruits and vegetables?

2. What is the effect of parasite on the mineral content of fruits and vegetables?

Aim and Objectives of the Study

Therefore, the aim of this study is to assess the effect of parasite on the mineral and vitamin content of some infested fruits and vegetables in selected markets of Bali Town.

Specific Objectives

1. To identify the parasites on the infested fruits and vegetables
2. To determine parasite effect on the vitamin contents of selected fruits and vegetables
3. To determine parasite effect on the mineral contents of selected fruits and vegetables

Methodology

Location and Study Area

Bali is a town in Taraba state, Northeast of Nigeria, west Africa, Africa. It is located on latitude 8.1554° North, longitude 10.9685° East, with an area of 9,146Km² and a population of 208,935 according to the 2006 census (Abubakar and Ibrahim, 2016). Bali town, the headquarter of Bali local government shares common boundaries with Ardo-kola and Gassol local government in the north, Donga and Kurmi in the West and Gashaka local government to the south. The developing town is an important economic Centre because of its booming food crop market, farming being the major occupation of the inhabitant. The climate falls under the tropical savannah, with an annual rainfall of 500mm and a temperature range between 37°C-39°C. The situation of the town along the upper coast of river Taraba also supports all year-round farming activities (Ukwubile and Yohanna, 2015).

Sample Collection

A total of Fifty (50) parasite infested samples were collected, comprising Twenty-Five (25) fruits and twenty-five (25) vegetables. These fruits and vegetables were purchased from Kasuwa kifi, Sabon-layi, sabon kasuwa and Anquan tiv, all in Bali town. Fruits collected were Orange (*Citrus sinensis*), Banana (*Musa acuminata*), Date (*Phoenix dactylifera* L.) and Watermelon (*Citrullus lamatus*), While the vegetables collected were Tomato (*Solanum lycopersicum*), Onion (*Allium cepa* L.), Pumpkin leaf (*Telfaria occidentalis-ugu*) and Spinach (*Spinach oleracea*).

Parasite Identification

Analysis of the fruits and vegetables was carried out according to the methods of Auta *et al*, (2017) with slight modification. Briefly 100g of each vegetable and fruits samples were placed separately in a plastic container and was washed thoroughly with rapid shaking for 2 minutes in 250ml normal saline (0.85%NaCl w/v) for the removal of egg, cyst, or larvae.

The suspension was strained through a 0.4 mm² standard sieve to remove unwanted materials. The filtrate was left to stand for 24 hours. Each preparation was dispensed into a clean centrifuge tube and centrifuged at 1500 rpm for 5 minutes. Roughly 90% of the supernatant was decanted and the deposits vortexed for another 10 seconds. Two drops of the suspension were placed on clean microscope slide. A drop of lugols iodine was added, covered with a clean cover slip and observed under binocular compound light microscope at x10 and x40 objectives. The leafy vegetables and fruits were then rewashed under running water to wash off the saline, chopped into pieces and dried under shed at room temperature for 4 weeks. The leaves were ground into a fine powder using a mortar and pestle, sieved and stored in air-tight containers (Achikanu *et al.*, 2013). Different methods and solvents were applied for the determination of vitamins and minerals in the selected fruits and vegetables.

Mineral Elements Determination

Determination of Calcium

Determination of calcium was According to Samuel *et al* (2014). Samples were digested using a mixture of concentrated nitric acid, sulphuric acid and hydrogen peroxide. A 25.0 mL aliquot of each digest was pipetted into a beaker and 1M NaOH solution was added to adjust the pH to 12-13. Two drops of solochrome dark blue were then added and immediately titrated against a 0.01M EDTA solution to the blue end-point. Standard curve of mass of calcium (mg) versus amount of EDTA (millimoles) was plotted.

Determination of Magnesium

Magnesium was determined as described by AOAC (1990). Two milliliters (2mls) of the sample were pipette into a test tube. Then 2ml of 0.5N sulphuric acid (H₂SO₄), 0.5ml of 0.5% titan yellow was added ,0.5ml of 0.01% gum acacia was added and 2mls of 10% sodium hydroxide (NaOH) was also added. The solution was mixed and the absorbance was read at 520nm against the blank.

Determination of Iron

The method of Jaseela (2022) was adopted in the determination of iron. The total mass of each of the fruits and vegetables samples obtained (2 g) were placed in a 500mL volumetric flask. It was dissolved in distilled water, 20 mL of 3 M H₂SO₄ added and then diluted to volume with distilled water. Five milliliter (5mL) portions of these sample solutions were transferred into 13, 50-mL volumetric flasks.

Standard Solutions

Into a set of five 50 -mL flasks, 5, 10, 15, 20 and 25 mL of the standard iron solution were pipetted and blank was prepared by adding 0.4 mL (about 10 drops) of 3 M H₂SO₄ to another 50mL volumetric flask. 1 mL of 10% hydroxylamine hydrochloride solution, 10 mL of 0.25% phenanthroline solution, and 4 mL of 10% sodium acetate solution, mixing after each

reagent was added and diluted to volume. The absorbance was read at 400nm after 20min interval each (Jaseela ,2022).

Determination of Phosphorus

Phosphorus was determined using the Vanado Molybdate method by Shyla *et al.*, (2021). Five grams (5g) of sample solution from digest was pipetted into 50ml volumetric flask and a little water was added. 10ml of vanado Molybdate reagent was added and was made to 50ml mark and was allowed to stand for 10 minutes. Absorbance of standard was read against concentration, a graph of Absorbance against concentration (wavelength 400nm).

Vitamin Determination

Determination of Vitamin B₁ (Thiamine)

Five grams(5g) of (0.5ml) of the sample was homogenized with 50ml (5ml) 10% ethanoic sodium hydroxide. It was filtered into a 100ml conical flask, 10 ml(1ml) of the filtrate was pipetted and the color was developed by addition of 10 ml(1ml) of (1%) potassium dichromate, the absorbance was measured at 360 nm (Okwu and Josiah 2006).

Determination of Vitamin B₂ (Riboflavin)

Five grams (5g) of the sample was extracted with 100 ml of 50% ethanol and shaken for one hour. This was filtered into 100 ml flask. 10 ml of the extract was pipetted into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30% H₂O₂ was added and allowed to stand over a hot water bath for 30 min. 2 ml of 40% sodium sulphate was added. This was made up to 50 ml mark and the absorbance measured at 510nm using spectrophotometer (Okwu and Josiah 2006).

Determination of Vitamin E

This was determined according to the method of (Rutkowski *et al.*,2007). The sample extract, 0.5 ml was mixed with 0.5 ml of anhydrous ethanol and shake for 1 min. This was followed by the addition of 3 ml of xylene. The tube was shaking again for 1 minute and the content of the tube was centrifuged for 10 mins at 1500 rpm. The absorbance was measured at 539 nm with tocopherol used as the standard (23.2 µm).

Determination of Vitamin C

This was done using 2, 4-dinitrophenyl hydrazine (DNPH) method as described in (AOAC 2000). The sample (20 g) was extracted (blended) with 200 ml of 6% trichloroacetic acid (TCA) solution and filtered. One milliliter of the filtrate was pipetted into a test tube. Ascorbic acid standard (1 ml) was also pipette into another test tube and 1 ml of 6% trichloroacetic acid pipetted into a third test-tube as a blank. Dinitrophenyl hydrazine-theourea – copper sulphate (1 ml) reagent (DHTCS) was added to all the test tubes, capped,

mixed and incubated in a water bath at 37°C for 3 hours. The spectrophotometer was adjusted with the blank to read zero absorbance at 520nm.

Statistical Analysis

The results obtained were analyzed as Mean $\pm$ Standard error (SE) of the concentration of the values obtained. Analysis was carried out using SPSS version 16.0.

Results

Table 1. Parasitic Identification

Samples	Parasite	Frequency of occurrence
Onions	Non	0
Tomato	<i>Ascaris lumbricoides</i>	5
Pumpkin	Larva of <i>strongeloides</i>	15
Spinach	Larva of <i>strongeloides</i>	20
Banana	Non	0
Date	Non	0
Citrus	Non	0
Watermelon	Non	0

Table 2. Effect Parasites on Vitamins of Fruits and Vegetables (mg/100g)

Vitamins	Citrus	Banana	Date	Watermelon	Tomato	Onions	Pumpkin	Spinach
Vit. C	32.16	10.86	2.50	9.11	11.57	1.06	4.37	6.91
Vit. B2	0.13	0.77	0.00	0.18	0.00	0.00	0.39	0.30
Vit. B9	24.03	29.20	0.00	0.00	15.81	0.00	0.00	10.57
Vit. E	0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.28

Table 3. Effect Parasite on Minerals of selected Fruits and Vegetables(mg/100ml)

Minerals	Citrus	Banana	Date	Watermelon	Tomato	Onions	Pumpkin	Spinach
Fe	2.18	2.97	4.45	4.65	1.0	3.80	2.48	2.0
Mg	0.1	0.67	0.068	0.138	0.05	0.046	0.04	0.041
Ca	0.691	0.34	0.29	0.307	0.822	1.18	0.77	0.57
P	2.40	2.20	0.10	1.20	0.70	2.70	2.10	2.90

The table above (table 1) shows higher prevalence of *strongeloides* larva found in pumpkin and spinach leaves. *Ascaris lumbricoides* is seen in tomatoes and all the fruits had no presence of any parasite.

Table 2 indicates the effects of parasites on the vitamins of selected fruits and vegetables. Parasites were identified on three vegetables. Vitamin B2 was absent in tomatoes, Vitamin B9 was absent in pumpkin leaf and Vitamin E was absent in tomato. Spinach though infected with parasite showed no deficiency in any of the vitamins tested. Contrary to expectation, some fruits like dates and watermelon showed deficiency in vitamin B9 and onion showed only the presence of Vitamin C though no parasite was identified. The

selected fruits showed no evidence of parasite infestation. However, there was an absence of Vitamin B₉ in Date and watermelon.

The effects of parasite on mineral elements of selected fruits and vegetables is tabulated in table 3. Parasites had no effect on the mineral contents of selected fruits and vegetables, as the presence of minerals were seen in variable quantity.

Discussion

The presence of *Ascaris lumbricoides* on tomatoes and the larva of *strongeloides* on pumpkin and spinach (table 1) agrees with Solomon (2018) who reported the presence of *Ascaris lumbricoides* on edible vegetables in Nigeria with wide geographical distribution and prevalence in the south-east. Alemu *et al* (2020) also confirmed the presence of *Strongeloides* larva on vegetables. Studies conducted on various items of fruit and vegetable samples have shown that *Ascaris lumbricoides*, infect humans who consume contaminated fruits and vegetables without cooking or washing them properly (Alemu *et al.*,2020).

The result in table 2 indicates the presence of vitamin C in the selected fruits and vegetables. While vitamin E was only present in pumpkin and spinach. The presence of vitamin C in these fruits is in concordance with the work of Anal and Shuchi (2019). Vitamin C was found in both green leafy vegetables and fruits. Reasonable amount of vitamin C activity is lost during cooking, processing and storage because of its water- solubility property and irreversible degradation into inactive molecules (Chatterjea and Rana, 2012). Rizvi *et al* (2014) had reported the presence of vitamin E in tomatoes. The absence of vitamin E in tomatoes obtained from the area under study could be as a result of the parasitic infection (*Ascaris lumbricoides*). The presence of vitamin B₂ (riboflavin) (0.30) and B₉ (folate) (10.57) in spinach agreed with the work reported by Aamir *et al* (2017). Riboflavin (VitaminB₂) is distributed widely in plants because higher plants synthesize them. It occurs in free form and as nucleotides or Flavoproteins (Chatterjea and Rana, 2012). However, parasite infestation did not affect the vitamin contents of the infected vegetables. The absence of vitamin B₉ for pumpkin could be attributed to the effect of parasite infection. This report disagrees with Aamir *et al* (2017) who reported the presence of vitamins B₉ in pumpkin. Vitamin B₉ (folic acid) is found in abundance in green leafy vegetables like spinach (Chatterjea and Rana, 2012). There could be some unidentified microorganisms or factors that could be responsible for the absence of vitamins in these selected fruits and vegetables.

Table 3 showed the mineral content in fruits and vegetables. The presence of mineral in fruits and vegetables had been reported by Achikan *et al* (2013), Isam and Rayan (2017). These mineral and vitamin were present in different concentration.

Parasites effects on the vitamins content of infested vegetables has not been adequately proven because few fruits and vegetables which no parasites were identified on them showed deficiency of few vitamins. Interestingly, mineral content of fruits and vegetables

are not affected by parasite infestation. Infested vegetables and fruits are medium through which humans get infected by parasites. Infected fruits and vegetables are not healthy for consumption.

Conclusion

Diets high in fruits and vegetables are widely recommended for their health- promoting properties. Fruits and vegetables have historically held a place in dietary guidance because of their concentrations of vitamins and minerals. Parasites which infest fruits and vegetables do not affect either the mineral content nor the vitamin content. In spite of the benefits of consuming fruits and vegetables, they are used as vehicles for transmission of parasites to humans. Fruits and vegetables must be washed thoroughly before consumption. The following recommendations are made;

1. Fruits and vegetables should be washed before consumption.
2. Government should put some measures in place to monitor vegetables and fruits sold by market women to ensure uninfected ones are not sold to the public.

Conflict of Interest

There is no conflict of interest by the authors.

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