PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 29 (4) 1039-1047 April 2025

Phytochemicals and Effect of Blanching Time on Oxalate and Phytate Content in Leaves of Some Non-conventional Vegetables in Gombi Local Government Area, Adamawa State, Nigeria

[1*]BODA, AH; [2]DOWELL, BF; [2]MALGWI, DW; [3]EMMANUEL, W

*[1]Adamawa State College of Nursing and Midwifery, Yola, Nigeria
[2]Chemistry Department, Faculty of Physical Sciences, Modibbo Adama University (MAU), P.M.B 2076, Yola, Adamawa State, Nigeriav
[3]Department of Science Laboratory, Faculty of Life Sciences, Modibbo Adama University (MAU), Yola, P.M.B 2076, Adamawa State, Nigeria

*Corresponding Author Email: habsy374@gmail.com
*ORCID: https://orcid.org/0000-0001-5926-4279
*Tel: +2348162788002

Co-Authors Email: dowellfarimani@mau.edu.ng, danielmalgwi@mau.edu; w.emmanuel@mau.edu.ng

ABSTRACT: The objective of this paper was to evaluate the phytochemicals and effect of blanching time on oxalate and phytate content in leaves of some non-conventional vegetables in Gombi Local Government Area, Adamawa State, Nigeria using appropriate standard methods. Data obtained reveals the presence of flavonoids, phenols, steroids and alkaloids in the vegetables. Saponins were found in bitter leaf, kenaf leaf and roselle leaf but absent in moringa and cassia tora leaf. The highest amount of oxalate was present in roselle leaves (17.10±2.30 mg/100 g), followed by moringa leaves (12.30±1.30 mg/100 g), and spinach (10.00±0.85 mg/100 g) of the unblanched samples. The greatest decrease in oxalate concentrations was observed in vegetable samples that were blanched for six minutes. As the blanching time increased, the phytate contents of the vegetables under study decreased. High levels of phytate were detected in unblanched samples of spinach (22.20±1.10 mg/100 g), kenaf leaves (22.00±1.10 mg/100 g), and roselle leaves (22.00±1.80 mg/100 g). In terms of phytate and oxalate content, the concentrations in the examined veggies were found to be within the allowable limit of 25 mg/100 g. All six vegetable samples had flavonoids, phenols, steroids, and alkaloids, according to the phytochemical screening. The hazards of exposure to oxalate and phytate contents can be decreased by changing dietary practices, and the blanching duration of vegetables that are frequently consumed should be continuously monitored for oxalate and phytate content.

DOI: https://dx.doi.org/10.4314/jasem.v29i4.4

Cite this Article as: BODA, A. H; DOWELL, B. F; MALGWI, D. W; Emmanuel, W (2025) Phytochemicals and Effect of Blanching Time on Oxalate and Phytate Content in Leaves of Some Non-conventional Vegetables in Gombi Local Government Area, Adamawa State, Nigeria. *J. Appl. Sci. Environ. Manage.* 29 (4) 1039-1047

Dates: Received: 27 February 2025; Revised: 20 March 2025; Accepted: 09 April 2025; Published: 30 April 2025

Keywords: Unconventional vegetables; Phytochemical; Phytate contents; Blanching time; Moringa tree

Since ancient times, both people and animals have used vegetables as food. This plant material, which consists of leaves, flowers, fruits, stems, roots, and seeds, is edible. Around the world, vegetables can be found practically wherever (Wang *et al.*, 2014). In certain societies, certain vegetables are considered either indigenous or non-indigenous, whereas others are not edible (Natesh *et al.*, 2017). They are important source of both micro and macro-nutrients which includes carbohydrates, proteins, fiber, vitamins etc. It is well acknowledged that to meet recommended daily allowance of nutrition, the World Health Organization (WHO) recommendation of at least 400 g of fruit and non-starchy vegetables (WHO, 2013) is to be used. The dietary guidelines for Americans recommend five servings of vegetables

*Corresponding Author Email: habsy374@gmail.com
*ORCID: https://orcid.org/0000-0001-5926-4279
*Tel: +2348162788002

per day based on an intake of 2000 calories (HHS/USDA, 2015). It is also recommended that one of the five servings of vegetables should be green leafy vegetables. Nutritionists and dieticians are of the opinion that people should diversify their diets as no single vegetable meets all the nutritional requirements necessary for good health and wellbeing (Hemmige *et al.,* 2017). Research had indicated that a diet rich in green leafy vegetables lowers the risk of a variety of cardiovascular diseases. It helps in weight management and reduces the risk of cancer (AICR/WCRF, 2007). Oils derived from vegetables are known to be unsaturated thus helping in lowering blood lipids and reducing the occurrences of diseases associated with the damage of the coronary artery (Adenipekun and Oyetunji, 2010). In the Western World, Green Leafy Vegetables are usually consumed in their raw forms. However, in Nigeria, leaf vegetables are affordable and quick to cook; rich in several nutrients particularly vitamin C and B- carotene, which is essential for human health. Consumption of vegetables in daily diet has been strongly associated with stress management and reduction in risk for the major diseases (Alexandria *et al.,* 2011). Although vegetables have high nutritional benefits, they also contain endogenous toxic constituents such as phytate, oxalates, etc., popularly known as anti-nutritional. These toxic compounds can influence the nutrients present. They reduce the ability of nutrients such as minerals, vitamins and even proteins within the plant material. This, in turn, affects the nutritional value of these plants (Essack *et al.,* 2017). In addition to kidney stones and cancer, high concentrations of these vegetables can have an unpleasant numbering effect on the tongue and interfere with calcium absorption, making them unhealthy when consumed as nutritional sources along with these toxic (anti-nutritional) constituents (Nissar *et al.,* 2017). Depending on the type, time of year, soil type, growth, and geographic location, green vegetables may accumulate different amounts of these anti-nutritional substances, such as phytate and oxalates. Vegetables treated afterward have been shown to have lower levels of anti-nutritional substances. Various commercial and domestic processing methods are frequently employed to lessen the anti-nutritional aspects of vegetables. Cooking is the most often used of these processing methods. It alters the vegetable's phytochemistry, which impacts its bioaccessibility and health-promoting qualities. The type of veggies, cooking techniques, and cooking time all have a significant impact on how much these changes occur. Among the most popular vegetables in Gombi and the surrounding area are green leafy vegetables including roselle, bitter leaf, cassia tora, moringa, spinach, and kenaf leaf. For consumers, they are one of the main sources of daily macro and micronutrients. Their effects range from modest reactions to death and can be either direct or indirect. Nitrates, phytates, tannins, oxalates, and cyanogenic glycosides are major anti-nutritional elements that have been linked to a number of health problems. According to Njoki (2014), reducing anti-nutrients in the diet before to eating can increase the bioavailability of nutrients. Around the world, calls have been made to look into alternative food sources. Domesticating, conserving, and using native vegetable and wild fruit species can reduce hunger and increase nutrition and health (Ekue *et al.,* 2010). The majority of them are made locally by cooking them without a set time rating. Therefore, in Gombi local government of Adamawa state, Nigeria, it is necessary to investigate how blanching duration affects the oxalate and phytate levels of non-traditional vegetables. Hence, the objective of this paper is to evaluate the phytochemicals and effect of blanching time on oxalate and phytate content in leaves of some non-conventional vegetables in Gombi Local Government Area, Adamawa State, Nigeria

MATERIALS AND METHODS

Sample collection: Six indigenous vegetables that are grown in Gombi L.G.A. for local consumption were gathered: bitter leaf (*Vernonia amygdalina*), kenaf leaf (*Hibiscus cannabinus*), roselle leaf (*Hibiscus sabdariffa*), Cassia tora (*sickle senna*), and Moringa (*Moringa oleifera*). The samples were taken from various locations around the farm. For identification, it was then brought to the Modibbo Adama University's Biological Science Department in Yola, Adamawa State. After being destalked, distilled water was used to wash the vegetables. The trial was then conducted using the fresh leaves.

Materials and Chemicals/Reagents: Distilled water, beaker, laboratory pestle and mortar, magnetic stirrer, sieved, knife, spatula, HCl, ammonium thiocyanate solution, $FeCl_3$, H_2SO_4, filter paper, $KMnO_4$, UV-Vis Spectrophotometer. All the chemicals used were of analytical grade.

Phytochemical Screening

Plant Extraction and Analysis: The six vegetable species' leaves were cleaned, allowed to air dry, and then oven-dried for seven days at room temperature (26^0C). A mortar and pestle were used to grind the dried leaves into a uniform powder. For later usage, the plant materials were kept in specimen bottles. For the extraction process, two distinct solvents ethanol and distilled water were employed. 120 mL of ethanol and water were used to soak 10g of the dry plant components each for two days at room temperature. A Whatmann filter paper No. 42 (125 mm) was used to filter the extracts and cotton wool was used after that. After being dried out in a hot water bath for seventy-two hours, the extracts were refrigerated for later use.

Screening for Flavonoid (Shindo's Test): 1.3 mL of the extract was mixed with 0.5g of magnesium turnings; the mixture was boiled for 5minutes; the appearance of orange to red color indicated the presence of flavonoid (Saklani *et al.,* 2017).

Screening for Phenol: A few drops of ferric chloride solution were added to 2mL of the extract in a watch glass; the appearance of bluish green color indicated the presence of phenol (Saklani *et al.,* 2017).

Screening for Saponin (Frothing Test): 2.5 mL of the extract was mixed with a few drops of distilled water and the mixture was shaken vigorously, a cupious lather formation was noticed which indicated the presence of saponin, and the absence of the cupious lather meant the absence of saponin (Mercy *et al.,* 2017).

Screening for Tannin (Wohler's Test): A few drops of basic lead acetate solution were added to 1.6mL of the extract; the appearance of a white precipitate indicated the presence of tannin in some of the plant extracts (Saklani *et al.,* 2017).

Screening for terpenoids: Salkowski's test, 5 mL extract was dissolved in chloroform (2 ml) and then 3 ml concentrated sulphuric acid (1 mL) was added to the solution. Formation of reddish brown coloured interface showed the presence of terpenoids (Saklani *et al.,* 2017).

Screening for steroids: 1 mL plant extracts were taken in a test tube and dissolved with 10 ml chloroform and then equal volume of concentrated sulphuric acid was added to the test tube by sides. The upper layer in the test tube turned into red and sulphuric acid layer showed yellow colour with green fluorescence. It showed the presence of steroids (Saklani *et al.,* 2017).

Screening for Volatile Oil: Two (2) mL extract with 0.1 ml dilute NaOH and small quantity of dilute HCl was added and the solution shaken. Formation of white precipitates indicated the presence of volatile oil (Dahiru *et al.,* 2006).

*Screening for alkaloids (*Mayer's *test):* To 2 mL of plant extract 2 mL of concentrated Hydrochloric acid was added. The 3 drops of Mayer's reagent were added. The presence of green color or white precipitate indicates the presence of alkaloids (Kiliobas *et al,* 2019)

Sample preparation: In a 250 mL beaker, each sample was split into seven sections, one of which was left unblanched and the others of which were blanched for varying amounts of time (1–6 minutes). A stop watch was used to help with this. Without pressing the vegetable, a basket was used to decant the water. Following that, the samples both blanched and unblanched were dried without exposure to sunshine. A laboratory pestle and mortar were then used to pound (ground) the dry samples into a fine powder, which was then sieved. The finely ground samples were subjected to chemical analysis.

Study area and Geographical Location: Gombi Local Government Area is located between latitude 10^{o}9'44N and longitude 12^{o}44'24E. It occupied an area of 1,101 square kilometers. Gombi L.G.A has a population of 147,787 (NPC, 2006).

Determination of phytate: For phytate quantification, the Tyohemba *et al* (2019) method was used. After being soaked for three hours in 100 cm^3 of 2% HCl V/V, 4 g of the powdered material was filtered. 5 cm^3 of 0.3% ammonium thiocyanate solution and 53.5 cm^3 of distilled water were added to 25 cm^3 of the filtrate in the conical flask. The mixture was properly mixed, and the mixture was titrated against standard $FeCl_3$ (containing 0.00195 g Fe^{3+}/cm^3) until a brownish yellow tint remained for 5 minutes. Blank were titrated in a similar manner and 1 cm^3 which equals 1.19 mg phytin phosphorus was determined and the phytate content were then calculated by multiplying by a factor 3.55.

Determination of oxalate using titrimetric method: Day and Underwood's (2009) description of the titration procedure was used. 75 mL of 3 M H_2SO_4 was added to a 100 mL conical flask containing 1 g of sample, which was then agitated for one hour using a magnetic stirrer. Whatman No. 1 filter paper was used to filter them. After that, 25 mL of the filtrate was taken and heated to 0.05 M $KMnO_4$ solution for titration until a pink hue lasted for at least 30 seconds. The oxalate content was then determined by calculating that 1 milliliter of 0.05 M $KMnO_4$ is equal to 2.2 milligrams of oxalate.

Determination of oxalate (OA) using UV-Vis Spectrophotometer method: Standard oxalic acid solution (1 mg/ml) was prepared with distilled water. 100 mL of 0.003 M $KMnO_4$ was prepared from appropriate dilution of 0.01 M $KMnO_4$ in distilled water. 500 ml of 2 N H_2SO_4 was prepared in distilled water. Assay mixtures contained different concentrations of oxalic acid ranging from 0.1 to 3.2 mg, 5 ml of 2 N H_2SO_4 and 2 mL of 0.003 M $KMnO_4$. This mixture was incubated for 10 min. at room temperature (27 ± 2^0C). After 10 min. absorbance was recorded at 528 nm on 6850 UV/VIS Spectrophotometer JENWAY. Reagent blank was prepared with distilled water. Absorbance for blank solution was recorded as Ab and for sample it was As. The calibration curve obtained (Appendix 1) is linear in concentration range of 0.1 to 3.2 mg/ml of oxalic acid. The regression equation is $\Delta A = 0.966C - 0.027$ with correlation coefficient 0.983, where C is the concentration of oxalic acid in mg/ml and ΔA is Ab-As (Vishal *et al.,* 2014).

Statistical analysis: The mean and standard deviation of the result were carried out using Minitab 19 and data was generated in triplicate. The results were express as Mean± SD.

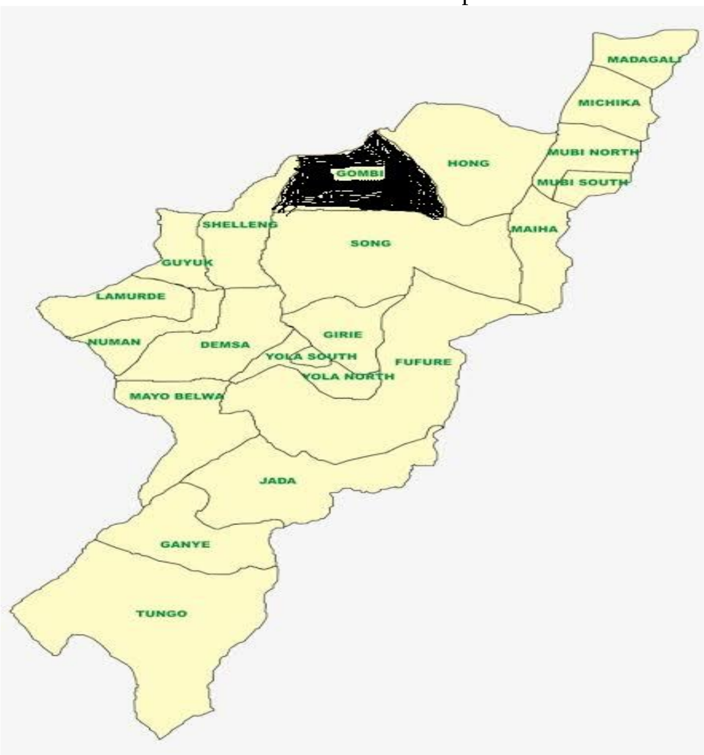

Fig. 1: Map of Adamawa State showing the study Area
Source: Google map 2020.

RESULTS AND DISCUSSIONS

Phytochemical screening of vegetable sample using ethanol extracts: The results of phytochemical screening of roselle leaf, cassia tora, moringa leaf, kenaf leaf, spinach and bitter leaf using ethanol extracts are presented in Table 1. The photochemical screening revealed the presence of flavonoids, phenols, steroids and alkaloids in all the six vegetables samples from the sampling sites. Saponins was found in bitter leaf, kenaf leaf and roselle leaf but absent in moringa and cassia tora leaf. The presence of tannins was also found in bitter leaf, moringa, kanaf leaf, cassia tora and spinach but only absent in roselle leaf (Table 1). Similarly, all the vegetables samples had the presence of volatile oils except kanaf leaf and roselle leaf. There was absence of terpenoids from all the six vegetables samples from the study area (Table 1). It is well known that the phytochemicals present in fruits and vegetables provide both humans and animals with protective health advantages (Webb, 2013). The plant's bioactive phytochemical components, which produce distinct physiological effects on humans, are what give it its therapeutic relevance (Akinmoladunm *et al.,* 2007). Throughout the plant kingdom, flavonoids, a broad family of polyphenolic plant chemicals, are widely distributed. They are also known to have a number of pharmacological properties, including antioxidant, anti-inflammatory, and antimalarial properties (Liu, 2013). While flavonoids have been found to be responsible for numerous beneficial characteristic properties, such as anti-inflammatory, estrogenic, antimicrobial, antiallergic, antioxidant, vascular, and cytotoxic antitumor activity, terpenoids are credited with analgesic and anti-inflammatory activities (Saklani *et al.,* 2017). According to Humaira *et al.* (2017), tannins are plant polyphenols that can complex with metal ions and micromolecules such as proteins and polysaccharides. Diets high in tannins are typically blamed for poor palatability. Tannins can cause kwashiorkor, a protein shortage condition in sub-Saharan Africa, by leaving accessible protein through antagonistic competition (Bolanle *et al.,* 2014). Tannins cause both an unpleasant taste and a slowdown in growth rate. Digestive enzymes are impacted (Soetan and Oyewole, 2009). Alkaloids are a class of organic nitrogen-containing bases that occur naturally. Morphine and nicotine are examples of common alkaloids (Sood *et al.,* 2012). Because of their effects on the neurological system, where they interfere with electrochemical transmission when ingested in significant amounts, alkaloids, which are phytochemicals, are occasionally regarded as antinutrients (Gemede and Ratta, 2014). Many traditional green vegetables are bitter because of alkaloids. Pyrrolizidine and quinolizidine are the two classes of alkaloids (Uusiku *et al.,* 2010).

Table 1: Qualitative screening of vegetable samples

Phytochemical	Bitter leaf	Moringa leaf	Kenaf leaf	Cassia tora	Roselle leaf	Spinach
Flavonoids	+	+	+	+	+	+
Phenols	+	+	+	+	+	+
Saponins	+	-	+	-	+	+
Steroids	+	+	+	+	+	+
Tannins	+	+	+	+	-	+
Terpenoids	-	-	-	-	-	-
Volatile oil	+	+	-	+	-	+
Alkaloids	+	+	+	+	+	+

Key: + = Present; - = Absent

Table 2: Oxalate content of unblanched and blanched vegetables (mg/100 g) using titrimetric method

Vegetables	Unblanched	1 min	2 min	3 min	4 min	5 min	6 min
Bitter leaf	11.00±0.21	9.20±0.10	8.40±0.15	8.20±0.12	7.10±0.20	4.60±0.23	4.30±0.12
Moringa leaf	12.30±1.30	11.00±1.22	10.00±0.10	8.00±0.23	7.00±0.11	6.50±0.10	5.30±0.53
Kenaf leaf	11.00±1.10	8.00±0.90	7.30±0.20	6.00±1.10	5.00±0.22	4.90±0.22	3.50±0.11
Cassia tora	11.00±1.25	10.70±0.33	9.30±0.11	8.20±1.55	7.30±0.70	6.00±0.45	5.20±1.00
Roselle leaf	17.10±2.30	13.30±1.40	8.00±0.22	7.10±1.42	6.80±1.24	6.00±0.20	5.50±0.33
Spinach	10.00±0.85	9.00±0.70	8.90±0.15	7.80±0.88	6.50±0.12	5.20±0.18	4.50±0.12

The mean ± Sd concentration of oxalate contents in vegetables was carried out using two different methods (titrimetric and UV/Vis). The result of the mean concentrations of oxalate in vegetables using titrimetric method was presented in Table 2 while the mean concentrations of oxalate using UV/VIS (6850 UV/VIS Spectrophotometer JENWAY) are presented in Table 3.

Mean Concentrations of Oxalate contents using titrimetric method: Using the titrimetric method, the oxalate content (mg/100 g) of blanched and unblanched vegetables from Adamawa's Gombi Local Government area was determined. The findings are shown in Table 2. It was discovered that as the blanching duration increased, the oxalate contents of all the veggies decreased. In unblanched samples, roselle leaves (17.10±2.30 mg/100 g) had the highest oxalate content, followed by moringa leaves (12.30±1.30 mg/100 g), while spinach (10.00±0.85 mg/100 g) had the lowest. The concentrations of oxalate in Roselle leaf (13.30±1.40 mg/100 g) (Table 2) was found to be higher among all the vegetables after 1 minutes of blanched from the samples analyzed. Similarly, moringa leaf (11.00±1.22 mg/100 g) was found to contained second highest concentrations of oxalate among all the vegetables, followed by cassia tora (10.70±0.33 mg/100 g) and the least was found in Kenaf leaf (8.00±0.90 mg/100 g) after the first 1 minutes of blanched Table 2. After blanched for 2 minutes, moringa leaf (10.00±0.10 mg/100 g) was found to contain higher concentrations of oxalate content in all the vegetables samples analyzed. The least concentration of oxalate content after 2 minutes of blanched was found in kanaf leaf (7.30±0.20 mg/100 g) (Table 2). The greatest decrease in oxalate concentrations was observed in vegetable samples that were blanched for six minutes (Table 2). This can be explained by the fact that blanching may cause the superficial layer of vegetables to break, which has a higher concentration of anti-nutritional substances (Udousoro *et al.,* 2014). The amount of oxalate (oxalic acid) in all of the leafy vegetables from the research area was considerably decreased after 6 minutes of blanching. Many common green vegetables and plant foods contain oxalate. Oxalate/oxalic acid can exist as soluble potassium and sodium salts, insoluble calcium, magnesium, or iron salts, or as a mixture of soluble and insoluble salts, depending on the species. Soluble salts are absorbed by the body, while insoluble salts are expelled through the feces. This inhibits the absorption of dietary calcium by forming potent chelates with it (Humaira *et al.,* 2017). One possible explanation for the rise in calcium contents of blanched samples could be the notable decrease in oxalate value from 1 to 6 minutes. The decrease in blanching time (anti-nutritional composition) is consistent with other research that found that processing vegetables reduced their tannin, oxalate, and phytate content (Adegunwa *et al.,* 2011). Oxalate and phytates are anti-nutrients that bind divalent cations including Ca^{2+}, Mg^{2+}, Zn^{2+}, and Fe^{2+}, lowering their bioavailability. Therefore, lowering their amount during cooking may be beneficial for consumers' health (Sandberg, 2002).

Mean Concentrations of Oxalate contents using UV/VIS method: Using UV/VIS, the oxalate content (mg/L) of blanched and unblanched vegetables was measured; the findings are shown in Table 3. All the vegetables' oxalate contents decreased as the blanching time increased, with the exception of the roselle leaf, which had higher oxalate contents after 6 minutes of blanching (0.1798±0.01 mg/L) than after 5 minutes (0.0456±0.01 mg/L). The highest amount of oxalate was detected in the unblanched samples of Moringa leaves (27.0352±2.65 mg/L), followed by bitter leaves (25.0880±2.30 mg/L) and Roselle leaves (23.578 Roselle leaf mg/L) (Table 3). After blanching the samples for one minute, the oxalate concentrations in the Moringa leaf (26.9420±1.40 mg/L) (Table 3) were found to be greater than those in any other vegetable. Similarly, after the first minute of blanching, the second-highest concentration of oxalate was reported in spinach leaves (24.277±0.95 mg/L), followed by kenaf leaves (23.69±1.65 mg/L) and bitter leaves (21.734±1.55 mg/L) (Table 3). Moringa leaf (26.9140±1.30 mg/L) had the highest oxalate level of any vegetable sample examined after being blanched for two minutes. After two minutes of blanching, bitter leaf had the lowest concentration of oxalate content (20.988 ± 2.00 mg/L) (Table 3). The greatest decrease in oxalate concentrations was observed in vegetable samples that were blanched for six minutes (Table 2).

Kidney stones can develop by consuming large amounts of this soluble oxalate. Accordingly, mineral supplements are necessary to prevent deficiencies in diets high in oxalic acid (Uusiku *et al.,* 2010). Compared to unblanched veggies, blanched vegetables had much reduced levels of oxalic acid. When the vegetable samples were blanched for six minutes, this drop was greatest (Table 3). According to Yadav and Sehgal (2003), boiling causes oxalate to be lost. According to research by Gupta *et al.* (2005), Amaranthus species also have significant levels of oxalic acid. A study by Patricia *et al* (2014) found that oxalates decreased as boiling duration increased from 15 to 45 minutes in leafy vegetables, which is consistent with the decrease in oxalates as blanching time increased. Cooking leafy vegetables is another detoxifying method that Ekop *et al.* (2005) reported using to get rid of these anti-nutrients. Oxalic acid reacts with divalent metallic cations like calcium and iron in the human body. These oxalates have the potential to clog the kidney's tubules by forming bigger kidney stones.

Mean concentration of phytate content of vegetables: Using the titrimetric method, the mean phytate concentration (mg/100 g) of blanched and unblanched vegetables from Adamawa's Gombi Local Government area was determined. The findings are shown in Table 4. As the blanching time increased, the phytate level of the vegetables under study decreased. Phytate content in unblanched samples was highest in spinach (22.20±1.10 mg/100 g), followed by kenaf and roselle leaves (22.00±1.10 and 22.00±1.80 mg/100 g), followed by moringa leaves (15.00±0.20 mg/100 g), and lowest in Cassia tora leaves (10.00±0.08 mg/100 g) (Table 4). After one minute of blanching, the samples examined showed that the phytate concentrations in Kenaf leaf (21.20±2.31 mg/100 g) were higher than those in any other vegetable (Table 4). Similarly, following the first minute of blanching, the second-highest concentration of phytate content among all the vegetables was detected in spinach leaves (20.00±1.20 mg/100 g), followed by roselle leaves (18.00±2.01 mg/100 g), and Cassia tora (6.80±0.70 mg/100 g) (Table 4). Kenaf leaf (18.60±1.60 mg/100 g) has the highest phytate content of any vegetable sample examined after being blanched for three minutes. Following three minutes of blanching, Cassia tora leaf had the lowest concentration of phytate content (6.60±0.15 mg/100 g) (Table 4). The veggies samples with the biggest reduction in phytate contents were those that were blanched for six minutes (Table 4). According to Ramiel (2013), the phytate content of every vegetable sample under study was less than the harmful threshold of 25 mg/100 g. Green leafy vegetables can have their phytotate concentration decreased by blanching and frying, among other processing techniques. According to Ilelaboye *et al.* (2013), blanching and cooking Amaranthus hybridus decreased its phytate level from 191 mg/100 in raw veggies to 81.65 mg/100 and 56.67 mg/100 g, respectively. According to Schlemmer *et al* (2009), the primary phosphorus storage molecule found in African leafy crops is phytotate. Despite being an antioxidant, it has been demonstrated to prevent minerals from being absorbed. Foods high in fiber include a lot of phytotic acids, which are advised because they shield people from heart disease and cancer (Norhaizan and Nor-Faizadatul-A, 2009; Akaneme *et al.,* 2014).

Table 3: Oxalate content of unblanched and blanched vegetables (mg/L) using UV/Visible

Vegetables	Unblanched	1 min	2 min	3 min	4 min	5 min	6 min
Bitter leaf	25.088±2.30	21.734±1.55	20.988±2.00	20.616±1.39	19.777±1.70	15.492±1.60	12.976±1.00
Moringa leaf	27.035±2.65	26.942±1.40	26.914±1.30	26.904±2.10	26.895±2.30	26.019±1.45	24.156±1.55
Kenaf leaf	23.971±1.60	23.69±1.65	21.547±2.50	19.964±1.30	12.976±1.80	2.169±0.10	1.424±0.45
Cassia tora	23.737±2.10	23.644±1.70	23.569±1.44	23.541±1.50	23.485±1.00	23.467±1.35	23.401±2.10
Roselle leaf	23.578±2.32	23.569±1.30	22.023±2.40	5.551±1.70	0.884±0.22	0.045±0.01	0.179±0.01
Spinach	24.510±1.12	24.277±0.95	24.044±1.80	23.476±2.00	23.262±2.40	23.187±1.80	22.889±2.15

Table 4: Phytate content of unblanched and blanched vegetables (mg/100 g) using titrimetric method

Vegetables	Unblanched	1 min	2 min	3 min	4 min	5 min	6 min
Bitter leaf	14.40±0.11	14.00±0.39	10.60±0.22	10.40±0.13	10.00±0.90	9.50±0.11	9.00±0.20
Moringa leaf	15.00±0.20	14.10±0.10	12.00±0.70	10.60±0.55	10.40±0.11	10.00±0.07	9.90±0.10
Kenaf leaf	22.00±1.10	21.20±2.31	20.00±1.25	18.60±1.60	16.60±1.22	15.50±0.15	14.00±1.51
Cassia tora	10.00±0.08	6.80±0.70	6.60±1.10	6.00±0.15	4.60±0.10	2.40±0.11	2.10±0.10
Roselle leaf	22.00±1.80	18.00±2.01	16.80±2.10	16.00±0.10	15.00±1.60	14.50±0.24	14.00±0.11
Spinach	22.20±2.11	20.00±1.20	18.50±0.11	16.90±2.18	15.00±1.10	14.00±1.30	13.00±1.55

Because phytate is a potent inhibitor of iron-mediated free radical production and chelates multivalent metal ions including calcium, iron, and zinc, a diet high in phytate lowers the bioavailability of iron and zinc. Phytic acid levels in green leafy vegetables vary, according to several researche (Agbaire, 2012; Nkafamiya *et al.,* 2010). According to some research, however, domestic thermal processing techniques can considerably lower the amount of phytate in vegetables (Yada and Sehgal, 2003; Imaobong *et al.,* 2013). According to other research, heat processing either increases or maintains the phytate content (Embaby, 2010). The amounts of oxalate and phytate in Justicia schimperi (Abushi), Hibiscus sabdariffa (Ashwe), Fiscus sur ("Tur"), Cucurbita spp. ("Furum"), and Ocimum gratissimum ("Kunguleku-Utamen") were measured by Tyohemba *et al.* (2019) both before and after blanching. After blanching for 5 minutes, the phytate level of Cucurbita spp. (Furum) decreased from 1.2357 mg/100g in the unblanched sample to 0.1697 mg/100g. Following five minutes of blanching, the phytate content of Ficus sur (Tur), Ocimum grastissimum (Kunguleku-Utamen), and Justicia schimperi (Abushi) in mg/100g dropped from 1.7505, 1.7711, and 2.1830 to 0.6590, 0.4531, and 0.9679, respectively. Nwusu (2010) observed a time-dependent decrease in the amount of trypsin, tannins, and phytates after boiling, which lends credence to the current study.

Conclusion: The presence of flavonoids, alkaloids, tannins, phenols, and steroids could have unfavorable effects on humans if consumed in excess. Vegetables that are typically nutrient dense and beneficial to health might include antinutritional elements (oxalate and phytate) at specific amounts. The amount of vegetables that contain phytochemicals that cause food poisoning varies on a number of factors, including personal susceptibility and cooking technique. The phytate content concentration from the examined veggies was found to be within the allowable range.

Declaration of Conflict of Interest: The authors declare no conflict of interest

Data Availability: Data are available upon request from the corresponding author or any of the other authors

REFERENCES

Adegunwa, MO, Alamu, EO; Omitogun, LA (2011). Effect of processing on the nutritional contents of yam and cocoyam tubers. *J. Appl. Biosci.* 46: 3086– 3092

Adenipekun, CO; Oyetunji, OJ 2010. Nutritional values of some tropical vegetables. *J. Appl. Biosci.* 35:2294-2300.

Agbaire, PO (2012). Levels of anti-nutritional factors in some common leafy edible vegetables of southern Nigeria. *Afr. J. Food. Sci. Technol.* 3(4):99-101.

AICR/WCRF (2007). A systematic review and meta-analysis of the 2007 WCRF/AICR score in relation to cancer-related health outcomes

Akaneme, FI, Igata, D, Okafor, H; Anyanebechi, O. (2014). Breeding for nutritional quality for Corchorus oliterius, Annona muricata and Pentaclethra macrophylla: A study of their nutritional contents. *Afr. J. Agr Res.,* 9(14): 1107-1112

Akinmoladunm, AC, Ibukun, EO, Afor, E, Obutor, EM; Farombi, EO (2007). Phytochemical constituent and antioxidant activity of extract from leaves of *Ocimum gratissimum*. *Sci. Res. Assay.* 2: 163-166.

Alexandria, DB , Liane SR; Barbara J R (2011). Hidden vegetables: an effective strategy to reduce energy intake and increase vegetable intake in adults. *Am. J. Clini. Nutr.* 93(4):756-63.

Bolanle, OA, Bolanle, S; Akomolafe, AA (2014). Proxiamte analysis, mineral contents, amino acid composition, anti-nutrients and phytochemical screening of *Brachystegia Eurycoma Harms* and *pipper Guineese Schum and Thonn*. *Am. J. Food. Nutri.*

Dahiru, D, Sini, JM; John-Africa, L 2006. Antidiarrhoeal activity of *Ziziphus mauritiana* root extract in rodents. *Afr. J. Biotechnol*, 5 (10): 941-945

Day, RA; Underwood, AL (2009). Quantitative Analysis 8th ed. Prentice. Hall Publication, p. 701.

Ekue, MRM;, Sinsin, B; Eyog MO; Finkeldey, R (2010). Uses, traditional management, perception of variation and preferences in ackee (Blighia sapida KD. Koenig) fruits in Benin:implications for domestication and conservation, *J. Ethnobiol. Ethnomed.* 6 (12): 1 – 14.

Embaby HE (2010). Effect of soaking, dehulling and cooking methods on certain antinutrients and in vitro protein digestibility of bitter and sweet lupin seeds. *Food Sci. Biotechnol* 19:1055-1062.

Essack, H, Odhav, B; Mellem, JJ (2017). Screening of traditional South African leafy vegetables for specific anti-nutritional factors before and after processing. *Food Sci. Technol*, 37(3), 462-471.

Gemede, HF; Ratta, N. (2014). Antinutritional factors in plant foods: Potential health benefits and adverse effects. *Int. J. Nutri. Food Sci., 3(4): 284-289.* DOI: 10.11648/j.ijnfs.20140304.18

Gupta, S, Jyothilakshmi, A, Manjunath, M; Prakash, J (2005). Analysis of nutrient and antinutrient content of underutilized green leafy vegetables. LWT-*Food Sci. Technol* 38:339-345.

Hemmige, NN, Abbey, L; Asiedu, SK (2017). An overview of nutritional and anti-nutritional factors in green leafy vegetables. *Horti. Int. J.,* Volume 1 Issue 2-2017.

Humaira, E, Bharti O; John J Mellem (2017). Screening of traditional South African leafy vegetables for specific anti-nutritional factors before and after processing. *J. food Sci. Technol*. ISSN 0101-2061.

Ilelaboye, NOA, Amoo, IA, Pikuda, OO (2013). Effect of cooking methods on mineral and anti-nutrient composition of some green leafy vegetables. *Arch. Appl. Sci. Res* 5(3):254-260.

Kiliobas, KS, Gramso, PC; Susan Pwakangdi Artimas (2019). Phytochemical analysis, proximate composition and antinutritional factors of Corchorus oliterius plant. *Int. J. Bio. Chem. Sci.* 13(4): 2147-2157.

Liu, RH. (2013). Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. *Am. J. Clin. Nutri., 78(3): 5175-5205.*

Mercy, GA, Light, FW; Gospel A (2017). Qualitative and Quantitative Phytochemical Screening of Some Plants Used in Ethnomedicine in the Niger Delta Region of Nigeria. *Food. Nutri. Sci.*; 5(5): 198-205

Natesh, H. N., Abbey, L., Asiedu, S. K. (2017). An overview of nutritional and antinutritional factors in green leafy vegetables. *Horti. Int. J.* 1(2), 00-011.

Nissar, J, Ahad, T, Naik, HR; Hussain, S. Z. (2017). A review phytic acid: As antinutrient or nutraceutical. *J. Pharm. Phytochem.* 6(6), 1554-1560.

Njoki, JW (2014). Impact of Processing Techniques on Nutritional Composition and Anti-Nutrient Content of Grain Amaranth. In Scientific Conference Proceedings.

Nkafamiya, II, Osemeahon, SA, Modibbo, UU; Aminu, A (2010). Nutritional Status of non-conventional leafy vegetables, Ficusasperifolia and Ficussycomorus. *Afr. J. Food. Sci.,* 4(3): 102-108.

Norhaizan, ME; Faizadatul, AW. (2009). Determination of phytate, iron, Zinc, Calcium contents and their molar ratios in commonly consumed raw and prepared food in *Malaysia. Mal. J. Nutri.,* 15(2): 213-222.

Ramiel, N (2010). Living with Phytic Acid. http://www.westonaprice.org/health-topics/living-with-phytic-acid/ retrieved 20 October, 2015.

Saklani, P, Mehta, S; Rana PS (2017). Phytochemical Screening and TLC Profiling of Various Extracts of Reinwardtia indica. *Int. J. Pharm. Phytochem. Res;* 9(4); 523-527

Sandberg, AS (2002). Bioavailability of minerals in Legumes. Brit. J.Nutr.(88), pp 281-285.Schlemmer U, Frolich, W, Prieto, RM; Grases F (2009). Phytate in foods and significance for humans: food sources, intake, processing, bioavailability, protective role and analysis. *Mol. Nutri. Food. Res 53 (Suppl. 2)* S330-375

Soetan KO; Oyewole OE (2009). The need for adequate processing to reduce the anti-nutritional factors in plants used as human foods and animal feeds. *Afr. J. Food. Sci.* 3(9): 223-232.

Sood, A, Uniyal, PL, Prasanna, R; Ahluwalia, AS 2012. Phytoremediation potential of aquatic macrophyte. *Azolla*. *Ambiol.* 41 (2): 122–137

Tyohemba, RL, Ajegi, JO, Mchihi, MM; Atsar, FS (2019). Effect of blanching time on oxalate and phylate content of non- conventional local vegetables in Benue State Nigeria. *FUW Trends. Sci. Technol. J.* 4 (2): 413 – 415

Udousoro, II; Akpan EB (2014). Anthropometric measurements, changes in anti-nutrients contents of edible vegetables under varied temperature and heating time. *Cur. Res. Nutri. Food. Sci.* 2(3) http://dx.doi.org/10.12944/CRNFSJ.2.3.06

Uusiku, NP, Oelofse A, Duodu, KG, Bester, MJ; Faber, M (2010). Nutritional value of leafy vegetables of sub-Saharan Africa and their potential contribution to human health: A review. *J. Food. Comp. Anal* 23(6):499-509.

Vishal, VN, Nirmala, SP, Vishal, TA; Baburao, AK (2014). Methodology in Determination of Oxalic Acid in Plant Tissue: A Comparative Approach. *J. Glo. Trends. Pharm. Sci* 5(2) 1662-1672

Yadav, SK; Sehgal, S, (2002). Effect of domestic processing and cooking methods on total, HCl extractable iron and in vitro availability of iron in spinach and amaranth leaves. *Nutri. Health* 16, *113-120.*