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# Effect of cooking methods on mineral and anti nutrient composition of some green leafy vegetables

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**ABSTRACT**

*The human population in tropical Africa depends largely upon a large number of edible leaves to meet up with shortages in minerals and vitamins. Seven tropical leafy vegetable species (Talium triangulae, Amaranthus hydrides, Colocaisa esculenta, Telfairia occidentials, Solanum nigrum, Crassocephalum crepidiodes, and cindosculus aconitifolis) that are used as soup condiments in Nigeria either in the processed or unprocessed forms, were subjected to two cooking methods (cooking without blanching and cooking after blanching). Herein, we report the effect of these cooking methods on the mineral contents and anti nutritional components of the seven tropical leafy vegetables. There is varietal influence on the mineral and anti nutritional contents of the vegetables. All the mineral elements; Calcium, Phosphorus, Potassium, Magnesium, Iron, Manganese, Copper and Zinc, except Sodium (155.14mg/Kg to 4759.80mg/Kg) were reduced by the cooking methods. There was 45.96% to 69.33%, 39.22% to 64.42%, 76.71% to 87.88%, 68.10% to 98.33% and 78.78% to 88.02% reduction in phytate, oxalate, saponin, tannin and cyanide contents of the vegetables respectively due to cooking methods.*

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## INTRODUCTION

Most tropical countries are blessed with a diversity of foodstuffs which play a basic role in nutrition and healthy body development. The term vegetable include plants and their parts (leaves, roots, shoots, flours, seeds, fruits) other than ripe fruits and seeds that are eaten after cooking [1]. In a popular sense, the term vegetable applies to those plants or parts that are eaten with the main course of a meal and commonly salted and boiled or used for desert and salads. This food of plant origin contains many bioactive compounds and thus serves as an important source of minerals, vitamins and certain hormone precursors in addition to protein and energy sources [2]. However, the presence of inherent toxic factors or anti nutritional components in plants has been one major obstacle in harnessing the full benefits of nutritional value of plants foods, vegetable inclusive [3,4,5,6] However cooking and blanching have been highlighted as possible means reducing the antinutrient levels in plant food sources to innocuous level that can be tolerated by monogastric animal including man [7]. These not withstanding, leafy vegetables have continued to provide populations with limited access to meat or fish, a rich source of proteins and micronutrients essential for pregnant and lactating mothers, as well as young and growing children [8]

However, many of these inexpensive nutritive wild plants are yet to be adequately studies and their nutritional contribution to human diets has not been widely exploited. Nutritional information on these species of vegetables will be useful for the nutritional education of the public as a means to improve the nutritional status of the population. In this study, we determined the effect of cooking process on the mineral components and anti nutritional content of some of the green leafy vegetable consumed in Nigeria.

## MATERIALS AND METHODS

### SOURCES

The indigenous green leafy vegetables and other ingredients that were used in soup preparation were purchased from the local market in Ilaro, Ogun State, Nigeria. These vegetables were Amarranthus hybridus (Tete), Talium triangulae (Gbure), Colocasia esculentum (Cocoyam leaves), solanum nigrum (Igbo), Telifera occidentalis (Ugwu/ewe rook). Crassocephalum crepidioides (Ebolo), Cnidoscolus acontifolus [ipaja].

Each vegetables sample was destalked, cut into slices, and washed. Enough quantity of each vegetable was taken and kept as the control. Each vegetable was divided into two portions; one portion was subjected to blanching in hot water at 100$^{o}$C for 5 – 6mins, allowed to cool and further divided into two.

A portion was reserved as the blanched samples. The remaining blanched vegetables and the unblanched vegetables were used to prepare vegetables soup using standards ingredients [table 1] as described by [9], which was modified by not using any of the animal protein sources to prepare the vegetable soups. A common sauce was prepared for the vegetable soups. Out of which 500ml was taken, into which 250g of the blanched or unblanched vegetables were added and cooked for further 5mins. The soups were allowed to cool and stored using air tight plastic containers in a refrigerator pending chemical analysis.

**Table 1: Recipe for Vegetable Soups**

| Ingredients | Amount |
|---|---|
| Dried fish [kg] | 1.0 |
| Meat [kg] | 1.0 |
| Ground Crayfish | 90.0 |
| Onions [g] | 25 |
| Magi [g] | 15 |
| Pepper [g] | 15 |
| Salt [g] | 10 |
| Palm Oil [g] | 35 |
| Vegetables [g] | 250 |
| Water [ml] | 1000 |

*Adapted from Eboh, 2000*

### CHEMICAL ANALYSIS

The refrigerated samples of raw [R], blanched [B], unblanched cooked [UBC] and blanched cooked [BC] vegetables were analysed for their mineral composition using the standard methods. The sodium and potassium contents were determined by flame photometry, and phosphorous by the Vanodo-molybdate method [10]. The other mineral elements were determined after wet digestion with mixture of nitric, sulphuric and hydrochloric acid using Atomic Absorption Spectrophotometer (AAS Uniicam Analytical System, Model 919). The phytate content was determined by the method of Wheeler and Ferrel (1971)[11], based on the ability of standard ferric chloride to precipitate phylate in dilute HCI extracts of the vegetables. Oxalates were determined by the method of Day and Underwood (1986) [12], tannins was determined by Burns 1971[13]. The Saponin contents was analysed by adopting Spectrophotometric method of Brunner [14] The procedures of AOAC [15] was used to determine cyanide content. The nitrate and nitrite concentration were determined using standard procedure for determining nitrates in plants [16], and Montgomery and Dymock (1961)[17] procedures respectively.

### STASTISTICAL ANALYSIS

All the analysis were done using triplicate samples. Experimental results were subjected to univariate analysis of variance (ANOVA), and significant different of treatment means were compared by the methods of Duncan, using the statistical package for the social sciences (SPSS)[18] .

## RESULTS AND DISCUSSION

### MINERALS ELEMENTS

The result of mineral element composition of processed and unprocessed green leafy vegetables are shown in table 2 using the data obtained for raw vegetabes, the level of individual mineral in each of the vegetable samples varied with species. The values were close to those obtained by Aletor and Adeogun (1995)[19] on mineral analysis of some fresh leafy vegetables. The processing method effect the same change on the mineral composition of the vegetables. The result indicated that the concentration of all the mineral elements analyzed was reduced by blanching. This lost of nutrient is due to leaching of mineral salt into the blanching. This lost of nutrient is due to leaching of mineral slat into the blanching water. The result obtained in this study agrees with the findings of Mepha et al (2007)[20]. Similarly Oladunmoye et al (2005)[21] observed significant (P>0.05) reductions in K, Na, Ca, P, Fe, content of blanched and cooked tender and matured cassava leaves.

The result for minerals analysis of the vegetables showed that the adeqauency of each mineral element in the samples to meet the Recommended Daily Allowance (RDA) for minerals, varied in individual vegetable specie. Apart from potassium in *A. hybridus* and *C. crepidiodes*, its levels in other vegetables were grossly inadequate to meet the adult minimum potassium requirement for health (2000mg/day) set by the 1989 RDA[22]. The Na level in most of the samples except in *C. esculenta* and *C. aconifolis* meet the RDA (500mg/day) it should however be noted that excessive consumption of Na. increase calcium loss in urine and also contribute to hypertension in some people [23]. Therefore the low level of Na in *C esculenta* and *C aconitifolis* make them suitable for use in a Na restricted diets [20]

Ca content of *A hybridies, T. Occidentalis S. nigum and C. crepidodes* were adequate to meet the Recommended Daily Allowance (RDA) of 800mg/day for adults while they were inadequate in other vegetables species. Its low content in some leafy vegetables suggest a low intake by vegetarians that must seek alternative source to meet their needs for calcium [20]. *A hybridus* contained the highest magnesium content wjile moderate concentration in *T triangular, C esculenta, c crepidiodes and C aconitifolis* could be attributed to age of the plants and cultural practices [20]. The levels obtained in this studies for the four vegetables are low to meet the RDA of 400mg/day for men 19-30years old and 310mg/day for women 19-30 years old [24].

*A. hybridus* had the highest and more than adequate amount of phosphorus, but the amount of phosphorus in *C. aconitifolis and T. triangulae* are too low to meet the RDA of 800mg/day for adult men. Vegetables are generally poor sources of iron. However, Fe, contents of all the vegetables use in this study except *T. triangulae and C. aconitifolis*, can be considered adequate when viewed against an RDA of 8mg Fe/ day for men (19 years and older) and for women over 50 years, 18mg/day for girl and women (11 to 56years) [25]. The Food and Nutrition Board [26] recommends 10mg of iron per day for children between 1 to 10years. The levels of zinc in all the vegetable used in this study were adequate when compared with the RDA of 15mg/day for men and 12mg/day for women. Hence their consumption will correct zinc deficiency in developing countries which has been implicated for not decreased growth but also increased morbidity associated with ingestions in infants and children [27].

### ANTI NUTRIENTS

The results of the anti nutrient composition of both raw and cooked leafy vegetables were presented in Table 3. At a glance, it was observed that blanching and cooking caused significant reduction in the anti nutrient contents of leafy vegetables used in this study. The content of phytates in the raw vegetables was between 84.72mg/100g in *T.occidentalis* and 313.67mg/100g in *C. aconitifolis*. The values obtained in this study were close to phytate concentration reported by Aletor and Adeogun (1995)[19] for *T. occidentalis* [80mg/100g] and S.nigrum [100mg/100g] and A .hybridus [130mg/100g]. Also, Oboh, 2005 [28] reported a higher phytate content 479.4mg/100g] for *C.aconitifolis*. The difference in this report and reports of other authors confirmed the statement of Ruales, 1993 [29] that the composition of nutrients and antinutrients in food plants may vary depending on the variety and growing conditions. The 29.88% to 35.53% lost of phytate contents effected by blanching and a lost of 45.96% to 169.33% caused by cooking corroborated the finding of other workers that blanching and cooking reduces the phytate contents of plant foods.[28,30,31,32, 33].

**Table 2: Effect of cooking methods on mineral contents [mg/Kg] wet weight of selected leafy vegetables**

| SAMPLE | TREATMENT | C3 | P | K | Na | Mg | Fe | Mu | CU | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | $106.86^{c}$ | $547.36^{c}$ | $367.04^{c}$ | $627.85^{b}$ | $148.21^{c}$ | $7.94^{c}$ | $1.21^{c}$ | $0.44^{c}$ | $18.45^{c}$ |
| | B | $99.72^{a}$ | $440.57^{a}$ | $287.31^{a}$ | $563.42^{a}$ | $130.98^{a}$ | $5.97^{a}$ | $0.81^{a}$ | $0.38^{a}$ | $12.76^{a}$ |
| *T.triangulae* | UBC | $114.54^{b}$ | $615.20^{d}$ | $447.44^{b}$ | $718.94^{d}$ | $162.90^{d}$ | $10.19^{d}$ | $1.41^{d}$ | $0.49^{d}$ | $23.13^{d}$ |
| | BC | $104.54^{b}$ | $506.75^{b}$ | $328.79^{b}$ | $641.38^{b}$ | $141.09^{b}$ | $7.31^{b}$ | $1.12^{b}$ | $0.42^{b}$ | $17.02^{b}$ |
| | R | $857.18^{c}$ | $1677.43^{c}$ | $3181.76^{c}$ | $3563.00^{c}$ | $1164.78^{c}$ | $81.18^{c}$ | $7.16^{c}$ | $3.53^{c}$ | $80.40^{c}$ |
| | B | $745.89^{a}$ | $1556.09^{a}$ | $2968.70^{a}$ | $3412.87^{a}$ | $1046.00^{a}$ | $66.68^{a}$ | $6.65^{b}$ | $2.89^{a}$ | $74.91^{b}$ |
| *A. hydrides* | UBC | $903.56^{a}$ | $1763.46^{a}$ | $3292.87^{d}$ | $3573.70^{b}$ | $1268.51^{d}$ | $91.31^{d}$ | $7.93^{d}$ | $4.17^{d}$ | $93.33^{e}$ |
| | BC | $798.03^{b}$ | $1618.30^{b}$ | $3048.93^{b}$ | $3489.21^{b}$ | $1103.66^{b}$ | $75.73^{b}$ | $6.99^{b}$ | $3.19^{b}$ | $7.89^{a}$ |
| | R | $139.39^{c}$ | $876.57^{c}$ | $548.84^{c}$ | $370.64^{b}$ | $150.83^{c}$ | $15.51^{c}$ | $4.07^{c}$ | $1.08^{b}$ | $86.12^{c}$ |
| | B | $120.97^{a}$ | $759.69^{a}$ | $437.74^{a}$ | $326.90^{a}$ | $136.62^{a}$ | $13.83^{a}$ | $3.35^{a}$ | $0.86^{a}$ | $71.24^{a}$ |
| *C.esculenta* | UBC | $148.50^{d}$ | $914.00^{d}$ | $598.88^{d}$ | $424.19^{d}$ | $168.47^{d}$ | $17.64^{d}$ | $6.41^{d}$ | $1.65^{d}$ | $91.50^{d}$ |
| | BC | $128.34^{b}$ | $832.10^{b}$ | $497.85^{b}$ | $387.41^{c}$ | $143.25^{b}$ | $14.35^{b}$ | $3.89^{d}$ | $1.29^{c}$ | $79.32^{b}$ |
| | R | $887.47^{c}$ | $1245.78^{c}$ | $680.84^{c}$ | $2457.00^{b}$ | $455.98^{c}$ | $95.90^{c}$ | $12.66^{b}$ | $2.49^{c}$ | $44.95^{c}$ |
| | B | $763.61^{a}$ | $1034.19^{a}$ | $569.15^{a}$ | $2171.45^{a}$ | $342.76^{a}$ | $73.82^{a}$ | $11.80^{a}$ | $2.34^{a}$ | $96.17^{a}$ |
| *T.occidentalis* | UBC | $993.06^{d}$ | $1355.32^{d}$ | $793.96^{b}$ | $2469.44^{c}$ | $526.21^{d}$ | $109.15^{d}$ | $13.32^{d}$ | $2.65^{d}$ | $48.47^{d}$ |
| | BC | $815.75^{b}$ | $1135.54^{b}$ | $642.32^{b}$ | $2485.64^{d}$ | $386.51^{b}$ | $86.64^{b}$ | $12.32^{b}$ | $2.40^{b}$ | $35.81^{b}$ |
| | R | $1870.56^{c}$ | $1064.62^{d}$ | $1901.63^{c}$ | $1277.87^{b}$ | $587.53^{c}$ | $63.36^{a}$ | $10.57^{c}$ | $5.79^{c}$ | $92.47^{c}$ |
| | B | $1655.67^{a}$ | $944.0^{a}$ | $1759.08^{a}$ | $1161.969^{a}$ | $513.49^{a}$ | $52.66^{a}$ | $8.73^{a}$ | $4.57^{a}$ | $84.90^{a}$ |
| *S.nigrum* | UBC | $2089.57^{d}$ | $1008.43^{c}$ | $2096.41^{d}$ | $1289.14^{d}$ | $623.21^{d}$ | $68.54^{d}$ | $11.20^{d}$ | $6.90^{d}$ | $109.74^{d}$ |
| | BC | $1735.98^{b}$ | $985.74^{b}$ | $1832.84^{b}$ | $1281.31^{c}$ | $569.04^{b}$ | $56.15^{b}$ | $9.37^{b}$ | $5.14^{b}$ | $90.10^{b}$ |
| | R | $965.79^{c}$ | $760.17^{c}$ | $4198.88^{c}$ | $4759.89^{b}$ | $232.27^{c}$ | $48.49^{c}$ | $9.73^{c}$ | $2.98^{c}$ | $131.16^{c}$ |
| | B | $849.31^{a}$ | $656.15^{a}$ | $3884.54^{a}$ | $4625.22^{a}$ | $188.47^{a}$ | $40.01^{a}$ | $7.86^{a}$ | $2.79^{a}$ | $122.45^{a}$ |
| *C.crepidiodes* | UBC | $1046.11^{d}$ | $873.46^{d}$ | $4280.49^{d}$ | $4883.44^{d}$ | $274.75^{d}$ | $52.91^{d}$ | $11.95^{d}$ | $3.12^{d}$ | $149.32^{b}$ |
| | BC | $921.02^{b}$ | $731.77^{b}$ | $4008.22^{b}$ | $4793.04^{c}$ | $221.40^{d}$ | $45.72^{b}$ | $8.83^{b}$ | $2.83^{b}$ | $129.43^{b}$ |
| | R | $294.41^{b}$ | $566.74^{c}$ | $185.02^{c}$ | $159.14^{b}$ | $117.79^{c}$ | $7.89^{c}$ | $1.82^{c}$ | $0.51^{c}$ | $15.46^{c}$ |
| *C.aconitifolis* | B | $265.02^{d}$ | $489.12^{a}$ | $159.34^{a}$ | $125.38^{a}$ | $103.63^{a}$ | $5.03^{a}$ | $1.26^{a}$ | $0.35^{a}$ | $10.52^{a}$ |
| | UBC | $310.31^{a}$ | $627.54^{d}$ | $194.00^{d}$ | $165.04^{d}$ | $129.85^{d}$ | $8.85^{d}$ | $2.12^{d}$ | $0.58^{d}$ | $17.23^{d}$ |
| | BC | $300.87^{c}$ | $523.67^{b}$ | $173.45^{b}$ | $160.12^{d}$ | $109.57^{d}$ | $6.19^{b}$ | $1.64^{b}$ | $0.43^{b}$ | $13.42^{b}$ |
| ±SEM | | 0.837 | .823 | 6.70 | 0.858 | 0.435 | 0.779 | 0.595 | 0.720 | 0.857 |

**Mean values in a column within a group denoted by different superscripts differ significantly at $P < 0.05$*
***±SEM Standard Error of the mean*

**Table 3: Effect of cooking methods on anti nutrient content (mg/100g) wet weight of selected leafy vegetables**

| SAMPLE | TREAMENT | Phytate | Oxalate | Saponin | Tannin | Cynide | Nitrate | Nitrite |
|---|---|---|---|---|---|---|---|---|
| | R | $210.54^{d}$ | $28.93^{d}$ | $2.64^{d}$ | $1.01^{d}$ | $23.81^{d}$ | $5.51^{d}$ | $0.23^{d}$ |
| | B | $106.20^{b}$ | $15.84^{b}$ | $0.58^{b}$ | $0.33^{b}$ | $8.52^{b}$ | $2.97^{b}$ | $0.08^{b}$ |
| *T. triangulae* | UBC | $179.41^{c}$ | $26.92^{c}$ | $1.89^{c}$ | $0.66^{c}$ | $11.34^{c}$ | $4.44^{c}$ | $0.13^{c}$ |
| | BC | $84.23^{a}$ | $14.93^{a}$ | $0.32^{a}$ | $0.18^{a}$ | $3.21^{a}$ | $1.92^{a}$ | $0.03^{a}$ |
| | R | $155.00^{d}$ | $47.35^{d}$ | $4.52^{d}$ | $0.67^{d}$ | $24.36^{b}$ | $4.99^{d}$ | $0.24^{d}$ |
| | B | $78.31^{b}$ | $32.55^{b}$ | $1.41^{b}$ | $0.28^{b}$ | $9.02^{b}$ | $3.41^{b}$ | $0.08^{b}$ |
| *A. hydridus* | UBC | $84.78^{c}$ | $40.64^{c}$ | $3.89^{c}$ | $0.57^{c}$ | $14.58^{c}$ | $3.95^{c}$ | $0.24^{d}$ |
| | BC | $56.67^{a}$ | $28.78^{a}$ | $1.06^{a}$ | $0.11^{a}$ | $4.69^{a}$ | $2.78^{a}$ | $0.08^{a}$ |
| | R | $191.25^{d}$ | $15.74^{d}$ | $4.09^{d}$ | $0.65^{d}$ | $25.69^{d}$ | $3.58^{d}$ | $0.12^{c}$ |
| | B | $81.65^{b}$ | $9.49^{b}$ | $1.51^{b}$ | $0.27^{b}$ | $9.23^{b}$ | $2.02^{b}$ | $0.05^{a}$ |
| *C. esculenta* | UBC | $121.79^{c}$ | $11.35^{c}$ | $3.03^{c}$ | $0.44^{c}$ | $16.3^{c}$ | $2.77^{c}$ | $0.19^{c}$ |
| | BC | $62.48^{a}$ | $5.60^{a}$ | $0.94^{a}$ | $0.14^{a}$ | $3.08^{a}$ | $1.84^{a}$ | $0.06^{b}$ |
| | R | $84.72^{d}$ | $48.17^{d}$ | $5.61^{d}$ | $0.89^{d}$ | $25.40^{d}$ | $7.88^{d}$ | $0.09^{c}$ |
| | B | $59.41^{b}$ | $30.13^{b}$ | $1.25^{b}$ | $0.36^{b}$ | $9.51^{b}$ | $4.39^{b}$ | $0.03^{a}$ |
| *T. occiedetails* | UBC | $73.37^{c}$ | $26.29^{a}$ | $4.39^{c}$ | $0.61^{c}$ | $12.94^{c}$ | $6.34^{c}$ | $0.30^{d}$ |
| | BC | $42.37^{a}$ | $5.89^{d}$ | $0.87^{a}$ | $0.21^{a}$ | $5.39^{a}$ | $2.51^{a}$ | $0.10^{b}$ |
| | R | $97.21^{d}$ | $2.99^{b}$ | $7.17^{d}$ | $0.16^{d}$ | $24.18^{d}$ | $4.08^{d}$ | $0.15^{c}$ |
| | B | $92.67^{b}$ | $4.18^{c}$ | $2.45^{b}$ | $0.50^{b}$ | $9.45^{b}$ | $2.64^{b}$ | $0.06^{a}$ |
| *S. nigrum* | UBC | $83.98^{c}$ | $3.14^{a}$ | $5.05^{c}$ | $0.87^{c}$ | $13.79^{c}$ | $3.53^{c}$ | $0.26^{d}$ |
| | BC | $49.62^{a}$ | $21.49^{d}$ | $1.67^{a}$ | $0.37^{a}$ | $4.47^{a}$ | $1.82^{c}$ | $0.09^{b}$ |
| | R | $249.16^{d}$ | $13.20^{b}$ | $3.33^{d}$ | $9.58^{d}$ | $24.00^{d}$ | $3.93^{d}$ | $0.11^{c}$ |
| | B | $161.93^{b}$ | $17.17^{c}$ | $0.97^{b}$ | $0.23^{b}$ | $8.66^{b}$ | $1.94^{b}$ | $0.06^{a}$ |
| *C. crepidiodes* | UBC | $187.54^{c}$ | $11.88^{a}$ | $2.68^{c}$ | $0.38^{c}$ | $18.03^{c}$ | $3.17^{c}$ | $0.22^{d}$ |
| | BC | $113.61^{a}$ | $37.08^{d}$ | $0.73^{a}$ | $0.16^{a}$ | $3.25^{a}$ | $1.35^{a}$ | $0.08^{b}$ |
| | R | $313.67^{d}$ | $23.11^{b}$ | $4.66^{d}$ | $0.76^{d}$ | $28.71^{d}$ | $5.10^{d}$ | $0.12^{c}$ |
| *C. aconitifolis* | B | $209.21^{b}$ | $30.87^{c}$ | $1.32^{b}$ | $0.33^{b}$ | $19.31^{b}$ | $3.21^{b}$ | $0.05^{a}$ |
| | UBC | $298.93^{c}$ | $13.40^{a}$ | $3.35^{c}$ | $0.51^{c}$ | $23.41^{c}$ | $4.24^{c}$ | $0.21^{d}$ |
| | BC | $193.54^{a}$ | $20.42^{b}$ | $1.02^{a}$ | $0.23^{a}$ | $4.37^{a}$ | $2.33^{a}$ | $0.11^{c}$ |
| ±SEM | | 0.073 | 0.148 | 0.075 | 0.027 | 0.025 | 0.116 | 0.039 |

**Mean values in a column within a group denoted by different superscripts differ significantly at $P<0.05$*
***±SEM Standard Error of the mean*

Oxalate is found in nature in some plants in the form of soluble and insoluble salts and as oxalic acid, the simplest organic acid. The composition of oxalate in the selected raw leafy vegetable range 5.89mg/100g in S. nigrum and 48.17mg/100 in T.occidentalis. There is variation in the amount of oxalate obtained in this and those obtained by other authors on similar leafy vegetables. Sources of variation in oxalate content of fresh fruits and vegetables include genetic pre-harvest conditions of the plant, maturity of the edible product at harvest, post havest handling, storage and processing [34]. Blanching caused a significant (P>0.05) reduction of 31.26% to 49.24% in the oxalate and further reduction [39.22%g to 54.42%] was achieved when the blanched vegetables were processed to vegetables' soups. The trend observed in this study is in conformity with the findings of Badifu and Okeke, 1992 [35].

The results of crude saponin in the cooked and uncooked leaves are presented in table 3. the quantity of saponin in the leaves differ in proportion with the species. The saponin in all the raw samples was in the ranges of 2.64g/100g to 7.17g/100g with the highest levels occurring in S.nigrum and lowest level in T.triangulae. the cooking methods effected a significant reduction in saponin contents of the vegetables and this was in agreement with the findings of Badifu and Okeke, 1992[35]. Saponin a natural detergents [36] is of interest from the pharmacoligcla point of view as they have been shown to modify the permeability of the small intestine which may help the absorption of specific drugs.

Table 3 shown that blanching and cooking significantly [P>0.05] reduced the tannin contents of green vegetables. This results is in conformity with the findings of previous works carried out on some legume seeds such as faba beans, mung beans, *vigna acconitififolia P. angluaris* and *Pinium satirin*, and it also indicated that blanching and cooking significantly decreased the levels of tannin, [31,33,37,38,39]. Since the phenolic compounds are water soluble in nature, the loss may be due to leaching out in the cooking medium [40,41]. The levels of tannin in the vegetables are species dependent. *C. crepidiodes* contained he highest tannin [0.18g/100g to 3.58%g/100g] and the lowest tannin levels [0.14g/100g to 0.65g/100g] was found in *C.esculenta*.

Cyanide either in inorganic forms as in HCN of NaCN, or organic forms as in cyanogenic glycosides is a potential inhibitor of cytochrome oxidase [terminal oxidase] of electron transport chain [42]. This study revealed that the cyanide contents of the raw vegetables range between 28.71mg/100g in *C.aconitifolis* and 23.81 in *T. triangulae*. These values are close to those obtained by Badifu and Okeke 1992, but higher than cyanide contents reported by Oboh, 2005[28] for *C.aconitifolis* [1.8mg/kg] *T. occidentalis* [0.86mg/kg], while sweet potatoes leaves contain high cyanide value [30.24mg/100g] than all the vegetables investigated [43]. Blanching effected 60.90% reduction in the cyanide levels of the leaves and 78.78% to 88.02% reduction was observed when the blanched leaves were further cooked.

Nitrates are fairly stable nitrogen component that can be degraded into nitrites. Nitrites are unstable and can combine readily with other compounds in the digestive tract to form carcinogenic nitrosammes [44]. The amount of nitrate and nitrite in the selected leafy vegetables as depicted in table 3 revealed that cooking methods had significant (P>0.05) effect on their nitrates and nitrites levels. Blanching caused 31.70% to 50.76% reduction in nitrates and 64.105 to 67.67% in nitrite contents of the vegetables. The reduction in nitrate and nitrite levels of the vegetables as a result of cooking methods support the claim that blanching and cooking significantly (P>0.05) reduced nitrate and nitrite contents of the leafy vegetables.

## CONCLUSION

The result of the study revealed that the different species of green leafy vegetable contain appreciable quantity of minerals, and antinutrients. Cooking and blanching have inevitable consequences on the nutritional values of the vegetables. The minerals contained within the vegetables show varying degree s of stability when the vegetables are cooked. These vegetable species also contain high level of anti nutritional factors, like phytate, oxalate, tannin, cyanide and saponin, but however cooking and blanching have been highlighted as possible means of reducing the anti nutrient levels in plant food source to innocuous level that can be tolerated by monogastric animal including man..

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