



## Assessment of Proximate Composition, Minerals and Vitamins of Bush Buck (*Gongronema latifolia*) Leaf Meal and Leaf Extracts

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### ABSTRACT

In attempt to search for lesser-known vegetable leaf plants that are nutritionally beneficial to man and his animals, the proximate composition, minerals and vitamins content of bush buck (*Gongronema latifolia*) were analysed. Fresh leaves (6kg) of bush buck were after air-drying and grinding divided into three (3) samples. Sample 1 was left as dried *Gongronema latifolia* leaf meal, sample 2 was dissolved in de-ionized cold water (20°C) at 1kg/5L of water, while sample 3 was dissolved in de-ionized warm water (40°C) at same quantity. Both samples (2 and 3) were left to settle for 1 hour before decanting the supernatants. The dried leaf meal and the supernatants were thereafter analysed. The results revealed that ash, crude protein, fat and crude fibre were higher in the dried leaf meal except for moisture content and nitrogen free extracts (9.26, 17.84, 4.15, and 42.56% respectively). Values for warm water extract were least except for moisture and nitrogen free extracts (5.88, 12.48, 2.66, 20.25, and 39.33% respectively). All the analyzed minerals (K, Na, Fe, Zn, Mg, Mn, Ca, P, Cu and Co) were higher in the dried leaf meal except molybdenum (Mo) which was not detected across the three samples. Similarly, results for vitamins depict that the values for dried leaf meal were higher than those of cold and warm water extracts; 978.650, 1.003, 0.998, 0.144, 0.201, 87.311 and 0.400 mg/g respectively for vitamins A, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>12</sub>, C and E. These results have further confirmed the high nutrients composition of bush buck, but care must be taken in heat processing to avoid excessive loss of the nutrients.

**Key words:** Bush Buck, *Gongronema latifolia*, Proximate Composition, Vitamins and Minerals.

It is fundamental to understand why it is important to get acquainted with nature, as well as knowing the important nutritive and medicinal plants around us for our own benefits. Bush buck (*Gongronema latifolia*) is one of the plants that have not been fully explored and exploited as an active ingredient in human diets and animal feed formulation and feeding. *Gongronema latifolia* is a climbing shrub with broad, heart-shaped leaves that has a characteristic sharp, bitter and slightly sweet taste, especially when eaten fresh. The stems are soft, hairy and yields milky latex or exudates. It belongs to the family of plants known as “*Asclepiadaceae*” and it is widespread in tropical rainforest of West African countries. This vegetable is widely acceptable as human food supplement across West African countries. *Gongronema latifolia* commonly called “Utazi” by the Igbos, “Arokeke” by the Yorubas, and “Utasi” by the Efiks and Ibibios respectively, is one of the plants whose extracts (stem, roots and leaves) have been found to be beneficial to both human and animals. *Gongronema latifolia* is consumed fresh, cooked or dried and applied as powdery spice; whichever way, it carries a moderate bitter taste that contributes tremendously to its flavour. Locally and in

African countries, bitterness of plant materials is often strongly associated with anti-malaria potency and likely informs the local belief in the anti-malaria of the plant. The plant leaf extracts have been used as bitter spice or flavoring agent in many traditional dishes which acts as a stimulating tonic for the digestive system. It stimulates the flow of bile and appetite for food and enhances the activities of pancreas, regulates blood sugar and promotes detoxification of the liver [1]. Researchers agree that the fundamental ingredients used for medicinal purposes are stored in the various parts of the plant such as the fruits, leaves, stems, roots and bark. A researcher [2] reported that the leaf extract contains five phytochemical compounds including alkaloids, saponins, flavonoids, tannins and glycosides and suggested possible varied pharmacological effects. Leaf vegetables and their extracts are sources of macro and micro nutrients that play a major role in healthy living [3]. Also they are regular ingredients in the diets of the average Nigerian and provide appreciable amount of nutritive minerals and vitamins [3]. Though the bulk of the weight is water, leafy vegetables represent a veritable natural pharmacy of minerals, vitamins and phytochemicals [4]. Similarly, the leaf extracts have been shown to have anti-oxidative properties and are being

utilized in the management of diabetes mellitus and other tropical diseases of human [5 and 6]. The crop (Bush buck) was identified to be nutritionally high in iron, zinc, vitamins, proteins and amino acids and thus could complement the inadequacies of these substances in feed [6]. In Nigeria, local poultry farmers use *Gongronema latifolia* leaf for the treatment of common respiratory diseases. The development of the potential indigenous plants as sources of animal feedstuff might not only decrease dependency on the industry for expensive imported feed ingredients but relatively reduce the production cost thereby leading to the growers' economic efficiency.

## **MATERIALS AND METHODS**

### **Sample Collection and Preparation:**

The fresh leaves (6kg) of bush buck (*Gongronema latifolia*) harvested from the Teaching and Research Farm of the Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo state, Nigeria were after rinsing with de-ionized water air-dried for ten (10) days under room temperature and were considered dried when they began to break or crumble. Thereafter, they were ground in a hammer mill to powder to pass through 0.5mm sieve and then divided into three (3) samples. Sample 1 was

left as dried *Gongronema latifolia* leaf meal, sample 2 was dissolved in de-ionized cold water (20°C) at 1kg per 5 litres of water while sample 3 was dissolved in de-ionized warm water (40°C) at same 1kg per 5 litres of water. Both samples (2 and 3) were left to settle for 1 hour. They were then sieved through muslin cloth [7] before decanting the supernatants. All samples were thereafter preserved in the refrigerator at 5°C until they were required for analysis.

### **Laboratory Analysis**

#### **Materials:**

All the reagents used for the analysis were of analytical grade and were products of Eagle Scientific Limited, England and BDH Limited, England. All glassware were thoroughly washed with detergent solution and rinsed with distilled de-ionized water and oven-dried before use.

#### **Analysis of the Samples:**

Determination of the proximate composition, vitamins and minerals were done in line with standard procedures [8].

#### **Determination of moisture content**

The moisture content was determined as follows [8]. A sample of 5g from each of the dried leaf meal, cold and worm water extracts of *Gongronema latifolia* were weighed into known

weights of clean empty petri dishes ( $W_1$ ). The weights of the petri dishes and each of the samples were taken and recorded as  $W_2$ . Each petri dish was placed into a preset oven of  $105^\circ\text{C}$  for 3hrs in order to reduce the moisture. After 3hrs, the petri dish was taken out and placed inside a desiccator for about 30 minutes so that it can cool. After cooling, the sample was brought out and weighed on a weighing balance.

The weight was recorded as  $W_3$ .

$$\% \text{ Moisture Content} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where:

$W_1$  = Weight of empty petri dish.

$W_2$  = Weight of the petri dish and the sample before moisture removal.

$W_3$  = Weight of the petri dish and sample after the removal of moisture.

### Determination of Fat

$$\% \text{ Fat content} = \frac{\text{Weight of fat extracted}}{\text{Weight of sample}} \times 100$$

### Determination of Ash

The ash content of the sample was determined as follows [8]. About 2g of the sample was weighed in a clean pre-weighed crucible and weight was recorded as  $W_2$ . The crucible with

The fat content was determined using soxhlet apparatus [8]. As was done in moisture content determination, a sample of 5g was weighed into a pre-weighed filter paper, weighed, dried in an oven and tied with thread. The filter paper containing the sample was placed in the receiver of the soxhlet apparatus. Normal hexane of boiling point range  $60 - 68^\circ\text{C}$  was used as solvent for the extraction; a 500ml round bottom flask was filled to  $3/4$  with the solvent. The flask was fitted to the soxhlet apparatus with a reflux condenser and placed in an electro mantle heater. Extraction began as the solvent refluxed several times and continued for 4 hours until the condenser was detached. The filter paper containing the defatted sample was removed and dried to a constant weight in an oven at  $50^\circ\text{C}$ . The difference in weight before extraction and after extraction was recorded in order to obtain the value for fat extracted.

the sample was placed in a muffle furnace and the temperature was increased to  $500^\circ\text{C}$  for 3 hours in order to allow the sample to burn (ash).

After ashing, the crucible with the ash was cooled in desiccators and then weighed.

$$\% \text{ Ash Content} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Where:

$W_1$  = weight of empty crucible.

$W_2$  = weight of sample and crucible before ashing.

$W_3$  = weight of crucible and the ashed sample.

### Determination of Crude fibre Content

Crude fibre was determined as follows [8]. A defatted sample of about 2g was weighed and transferred into a 500ml conical flask where 200ml of 1.25%  $H_2SO_4$  was added and the sample was boiled for 30minutes using cooling fingers to maintain constant temperature. After boiling, the mixture was poured into filter cloth under gentle suction using a butcher funnel, rinsed well with hot distilled water.

The material was transferred into a conical flask containing 200ml of 1.25% NaOH and

boiled for another 30minutes while shaking gently to avoid spillage. The sample solution was filtered, washed with hot distilled water and with 1% Hcl respectively. The washing was repeated twice with ethanol and trice with petroleum ether to remove any remaining fat. The residue was transferred into a clean dried crucible, oven dried, cooled in the desiccator and weighed ( $W_2$ ). The crucible was placed in the muffle furnace at  $450^\circ C$  for 2hours, cooled in a desiccator and re-weighed ( $W_3$ ).

$$\begin{aligned} \% \text{ Crude fibre} &= \frac{\text{Weight of Crude Fibre}}{\text{Weight of sample}} \times 100 \\ &= \frac{W_2 - W_3}{W_1} \times 100 \end{aligned}$$

Where:

$W_1$  = Weight of the sample

$W_2$  = Weight of sample + Crucible after oven-drying.

$W_3$  = Weight of the sample + Crucible after ashing.

### Determination of Crude Protein Content

The crude protein was determined using the standard method [8] which occurs in 3 stages;

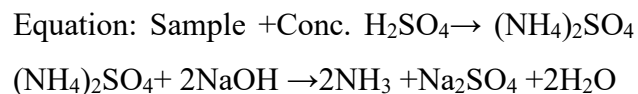
#### a) Digestion Stage:

This stage involves digestion of the sample. 2g of the sample was digested with 10ml H<sub>2</sub>SO<sub>4</sub> and 0.5g selenium was used as catalyst in a micro kjeldahl digestion flask and the mixture was heated on an electro-thermal heater until a clear solution was obtained. The flask was allowed to cool after which the digest was diluted with distilled water into a 100ml standard flask. The sample was transferred to the Kjeldahl distillation unit.

#### b) Distillation Stage:

It involved the steam distillation of the digest to which 10ml of 40% NaOH solution was added to release the ammonia. Three drops of mixed indicator were added to the

receiving flask containing 10ml of 2% boric acid solution to give a pink colour solution. The sample was distilled until about 50ml of the distillate was collected in the receiving flask. A colour change from red wine to green was observed indicating the presence of ammonia.



The collected ammonia forms a complex with the boric acid as  $\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow 2\text{NH}_4^+ + \text{BO}_3^-$

#### c) Titration Stage:

It involved the titration of the resulting solution in the conical flask against 0.1M HCl solution until a colour change from green to red wine was obtained indicating the end point.  $\text{NH}_4^+ + \text{HCl} + \text{H}_3\text{O}^+ \rightarrow \text{NH}_4\text{Cl} + 2\text{H}_2\text{O}$

$$\% \text{ Nitrogen} = \frac{\text{Titre value} \times \text{Molarity of acid used} \times 0.014 \times \text{Dilution factor}}{\text{Weight of the sample}} \times 100$$

$$\% \text{ Crude protein} = \% \text{ Nitrogen} \times 6.25.$$

### Determination of Nitrogen Free Extract

Nitrogen free extract was determined by difference. The summation of protein, fat, moisture content, ash, crude fibre subtracted from 100.

$$\% \text{ NFE} = 100 - (\text{moisture content} - \text{fat} - \text{crude fibre} - \text{ash} - \text{protein}).$$

## **Mineral Analysis**

The mineral content was in line with the standard procedure [8]. 1g of each sample was placed in a crucible and ashed in a muffle furnace at a high temperature of 550°C for 5hrs and then transferred to the desiccators to cool. The ashed sample was used by dissolving it with 1ml nitric acid and 1ml Hcl and then made up to 100ml. This was used to analyze for Magnesium (Mg), Sodium (Na), Iron(Fe), Zinc (Zn), Calcium (Ca), and Potassium (K).

Determination of Mg, Fe, Ca, Zn and P using Atomic absorption Spectrophotometer.

### **Procedure:**

The standard solutions were prepared separately for each of the elements and values determined on **Buck Scientific atomic absorption spectrophotometer Model 210VGP**. The values measured were then plotted against the strength of the solution. The values of the various digest were measured from the atomic absorption spectrophotometer and the strength traced on the respective standard curve to give the corresponding values which would give the original values of the element present in the digest.

### **Determination of Na and K using Flame Photometer**

#### **Procedure:**

The standard solutions were prepared separately using NaCl and KCl for sodium and potassium determinations respectively. The standard solutions were measured on the Jenway flame photometer and the values obtained were plotted against the strength of various solutions. The digest were determined from the flame photometer. The values were plotted in the respective standard curve to read the original values of the elements.

### **Vitamin Determination**

2g of each sample was mixed with 1g fat and 240 units of vitamin A with 30ml absolute alcohol and 3ml of 5% potassium hydroxide and boiled gently under reflux for 30 minutes in a stream of oxygen free nitrogen. This was cooled rapidly by adding 30ml water, then transferred to the separator, washed in with 3x50ml ether and the vitamin A extracted by shaking for 1min. After complete separation, the lower layer was discarded and the extract washed with 4x50ml water. Mixing was thoroughly done cautiously during the first two washes to avoid emulsion formation. Then the washed extract was evaporated down to about 5ml and the remaining ether removed in a stream of nitrogen at room temperature. The residue was then dissolved in sufficient isopropyl alcohol to give a solution containing 9 - 15 units per ml and

extinctions measured at 300, 310, 325 and 334nm and the wavelength of maximum absorption [9].

#### **Determination of Vitamin B<sub>2</sub> (Riboflavin)**

5g of each sample was extracted with 100ml of 50% ethanol and shaken for one hour. This was filtered into 100ml flask and 10ml of the extract was pipetted into 50ml volumetric flask. 10ml of 5% potassium permanganate and 10ml of 30% H<sub>2</sub>O<sub>2</sub> were added and allowed to stand over a hot water bath for 30 minutes, 2ml of 40% sodium sulphate was added. This was made up to 50ml mark and the absorbance measured at 510nm using spectrophotometer.

#### **Determination of Vitamin B<sub>3</sub> (Niacin)**

5g of each sample was treated with 50ml in H<sub>2</sub>SO<sub>4</sub> and shaken for 30 minutes, 3 drops of ammonia solution were added to the sample and filtered. The filtrate was pipetted into a 50ml volumetric flask and 5ml of potassium cyanide was added. This was acidified with 5ml of 0.02N H<sub>2</sub>SO<sub>4</sub> and absorbance was measured using spectrophotometer at 470nm.

#### **Determination of Vitamin B<sub>6</sub> (pyridoxine hydrochloride)**

0.5ml of each sample was pipetted into a test tube. Then 1.5ml of diazotized p-nitroaniline (5 mM) reagent solution and 3 ml of chlorothiophenoxy butanoic acid (CTAB) was added. The mixtures were shaken, then 3ml of

(0.1 N) sodium carbonate solution was added and the volume made up to the mark with distilled water 5ml. The mixture was shaken and the absorbance was measured at 480 nm against the corresponding reagent blank [10].

#### **Determination of Vitamin C**

The vitamin C content was determined using the ascorbic acid as the reference compound. 200µl of each extract was pipetted and mixed with 300µl of 13.3% of trichloroacetic acid (TCA) and 75µl of 2,4-dinitrophenylhydrazine (DNPH). The mixture was incubated at 37°C for 3hours and 500µl of 65% H<sub>2</sub>SO<sub>4</sub> was added, and the absorbance was read at 520nm [11].

#### **Determination of Vitamin E**

1.0g of each sample was put in a 100ml flask fitted with a reflux condenser, and then 10ml of absolute alcohol and 20ml of 1M alcoholic sulphuric acid were added. It was refluxed for 45minutes and allowed to cool. 50ml water was added and then transferred to a separating funnel of low actinic glass with the addition of a further 50ml of water. The unsaponifiable matter was extracted with 5x30ml diethyl ether. The combined ether extract was washed free from acid and dried over anhydrous sodium sulphate. The extract was evaporated at low temperature. Protecting it from sunlight, the residue was dissolved in 10ml absolute alcohol, thereafter, both the standard and the sample



were transferred to a 20ml volumetric flask and 5ml of absolute alcohol was added followed by 1ml concentrated nitric acid. The flask was placed on a water bath at 90°C for 3 minutes and allowed to cool under running water made up of 20ml absolute alcohol. The absorbance was measured at 470nm against blank containing absolute alcohol as reported by Pearson [9].

## STATISTICAL ANALYSIS

Results obtained were subjected to statistical analysis using tools such as percentages, standard deviation, coefficient of variation etc.

## RESULTS

### Proximate composition

The proximate nutrients compositions of bush buck (*Gongronema latifolia*) under different conditions evaluated namely, moisture, ash, crude protein, fat, crude fibre and nitrogen free extract (NFE) are shown in Table 1. It is evident in Table 1, that Bush buck contained good amount of nutrients in the leaf meal more than the cold (20°C) and warm (40°C) water extracts. Moisture was however lower in dried leaf meal with the value 11.54% as against 21.27% and 19.40% for cold water extract and warm water extracts respectively. The level of ash (9.26%) detected was also more in the dried leaf meal sample as against what was recorded for cold

and warm water extracts (8.78 and 5.88%). The ash values in these results are lower than 11.6% reported for *Gongronema latifolia* [12]. This nutrient dominance in leaf meal ran through with crude protein and fat having 17.84 and 4.15%. This was followed by the cold-water extract with values 16.72% for crude protein, and 3.80% for fat. The crude protein in this study ranged from 12.48 - 17.84%. This is at variance with the reported values of 26.99% and 27.2% [12]. It was observed that nitrogen free extract was highest in warm water extract and least in the dried leaf meal with values; 39.33, 29.13 and 14.65% respectively.

The range of crude fibre (20.25 - 42.56%) in this research is comparatively higher than the reported value of 10.8% [12] but within the ranges earlier reported [13 - 15]. The highest level of nitrogen free extract (39.33%) in *Gongronema latifolia* warm water extract of this study is comparable to the reported value of 44.3% [12]. Comparatively, the extracts of *Ocimum gratissimum* had a close nutritional value with bush buck (*Gongronema latifolia*) [16]. The above was corroborated and noted that some plant feed ingredients could serve as a viable alternative to the conventional feed ingredients for compounding animal feed [14 and 15].

Table 1. Proximate nutrient composition of *Gongronema latifolia* dried leaf meal and *Gongronema latifolia* cold and warm water extracts.

| Ingredients | Nutrients (%) |       |       |       |       |       |
|-------------|---------------|-------|-------|-------|-------|-------|
|             | M.C           | Ash   | CP    | Fat   | CF    | NFE   |
| DLM         | 11.54         | 9.26  | 17.84 | 4.15  | 42.56 | 14.65 |
| CWE         | 21.27         | 8.78  | 16.72 | 3.80  | 20.30 | 29.13 |
| WWE         | 19.40         | 5.88  | 12.48 | 2.66  | 20.25 | 39.33 |
| Mean        | 17.40         | 7.97  | 15.68 | 3.54  | 27.70 | 27.70 |
| SD          | 4.14          | 2.23  | 2.31  | 0.63  | 10.51 | 10.13 |
| SEM(±)      | 0.46          | 0.17  | 0.26  | 0.07  | 1.17  | 1.13  |
| CV (%)      | 23.80         | 27.98 | 14.73 | 17.80 | 37.94 | 36.57 |

MC = Moisture Content, CP = Crude Protein, NFE = Nitrogen free extract, SEM = Standard error mean, CV = Co-efficient of variance, DLM = Leaf Meal, CWE = Cold Water Extract (20oc) and WWE = Warm Water Extract (40oc).

### Mineral composition

Table 2 shows the mineral composition of *Gongronema latifolia* leaf meal and *Gongronema latifolia* cold and warm water extracts. All the minerals assayed were higher in leaf meal. The evaluated minerals; potassium (K), sodium (Na), iron (Fe), zinc (Zn), magnesium (Mg), molydenium (Mo), manganese (Mn), calcium (Ca), phosphorus (P), copper (Cu) and cobalt (Co) with corresponding values in the leaf meal as; 49.09, 126.36, 118.18, 131.82, 98.45, 0.0 (ND), 250.00, 121.23, 236.55, 24.11 and 112.60ppm in that

order. This was followed by values obtained in cold water extract (20°C) with 44.29 for potassium, 122.89 for sodium, 107.62 for iron, 128.23 for zinc, 88.00 for magnesium, 0.0 (ND) for molydenium, 199.88 for manganese, 106.77 for calcium, 196.11 for phosphorus, 23.22 for copper and 97.20ppm for cobalt. It was evident from the table (2) that warm water extract showed least values across the tested minerals. The values were 26.00 (K), 64.44 (Na), 63.82 (Fe), 54.05 (Zc), 43.32 (Mg), 0.0 ND (Mo), 147.50 (Mn), 72.60 (Ca), 141.93 (P), 10.85 (Cu)

and 67.20ppm (Co). Molybdenum (Mo) was not detected in all the samples.

It is clear from above compendium that the leaves of bush buck (*Gongronema latifolia*) contained substantial concentration of most minerals necessary for the health of the animal. Of all these minerals, molybdenum was conspicuously not detected in all the three forms of assessment. A similar range of concentration in magnesium and calcium was earlier reported [17] but the concentration of other minerals was at variance with the findings of this research. Most green vegetables, legume seeds, peas, beans and nuts are rich in magnesium and this finding has proved that *Gongronema latifolium*

is no exception. The hypoglycemic potential of *Blighia unijugata* and some other leafy vegetables might be due to the presence of fair amounts of trace elements including manganese [18]. The earlier report [19] on the concentration of the minerals of *Gongronema latifolium* do support the findings of this research as the elements are present in appreciable amounts that can be considered good in concentration. Minerals and vitamins have been well known as active catalyst for many body functions and biological activities in animals and these are embedded in *Gongronema latifolium*.

**Table 2 Mineral composition of *Gongronema latifolia* dried leaf meal and *Gongronema latifolia* cold and warm water extracts**

| Ingredients |       | Parameters (ppm) |        |        |       |    |        |        |        |       |       |
|-------------|-------|------------------|--------|--------|-------|----|--------|--------|--------|-------|-------|
|             | K     | Na               | Fe     | Zn     | Mg    | Mo | Mn     | Ca     | P      | Cu    | Co    |
| DLM         | 49.09 | 126.38           | 118.18 | 131.82 | 98.45 | ND | 250.00 | 121.23 | 236.55 | 24.11 |       |
| 112.20      |       |                  |        |        |       |    |        |        |        |       |       |
| CWE         | 44.29 | 122.89           | 107.62 | 128.33 | 88.00 | ND | 199.88 | 106.77 | 196.11 | 23.22 | 97.20 |
| WWE         | 26.00 | 64.44            | 63.84  | 54.05  | 43.32 | ND | 147.50 | 72.60  | 141.93 | 10.85 | 67.20 |
| Mean        | 39.79 | 104.56           | 96.55  | 104.73 | 76.59 | ND | 199.13 | 100.20 | 191.53 | 9.39  | 92.20 |
| SD          | 9.95  | 28.41            | 23.53  | 35.87  | 23.91 | ND | 41.85  | 20.39  | 38.76  | 6.05  | 18.71 |
| SEM(±)      | 1.11  | 3.16             | 2.61   | 3.99   | 2.66  | ND | 4.65   | 2.27   | 4.31   | 0.67  | 2.08  |

SEM=Standard error mean, CV=Co-efficient of variance, DLM=Leaf Meal, CWE=Cold Water Extract (20°C) and WWE=Warm Water Extract (40°C).

Table 3. Vitamin composition of *Gongronema latifolia* dried leaf meal and *Gongronema latifolia* cold and warm water extracts

| Ingredients | Vitamins (mg/g) |       |       |        |        |        |       |
|-------------|-----------------|-------|-------|--------|--------|--------|-------|
|             | A               | B2    | B3    | B6     | B12    | C      | E     |
| LM          | 978.650         | 1.003 | 0.998 | 0.144  | 0.201  | 87.311 | 0.400 |
| CWE         | 973.710         | 0.748 | 0.677 | 0.012  | 0.000  | 46.217 | 0.331 |
| WWE         | 677.890         | 0.497 | 0.405 | 0.009  | 0.000  | 26.458 | 0.316 |
| Mean        | 876.75          | 0.75  | 0.69  | 0.055  | 0.067  | 53.33  | 0.349 |
| SD          | 140.63          | 0.21  | 0.06  | 0.06   | 0.095  | 25.35  | 0.036 |
| SEM(±)      | 15.62           | 0.02  | 0.01  | 0.01   | 0.011  | 2.82   | 0.004 |
| CV (%)      | 16.00           | 28.00 | 8.70  | 109.00 | 141.80 | 47.53  | 10.32 |

SEM = Standard error mean, CV = Co-efficient of variance, DLM = Leaf Meal, CWE = Cold Water Extract (20°C) and WWE = Warm Water Extract (40°C).

### Vitamins

The evaluated vitamins; A, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>12</sub>, C and E. (Table 3) show that leaf meal values were *overwhelmingly higher than other two samples assessed. The values for dried leaf meal were*; 978.650, 1.003, 0.998, 0.144, 0.201, 87.311 and 0.400 mg/g for vitamins A, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>12</sub>, C and E respectively. In the same order, the values recorded for cold extract proved superior to those obtained for warm water extract. Cold water extract values were; 973.710, 0.748, 0.677, 0.012, 46.217 and 0.331mg/g respectively for vitamins A, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, C and

E while values for warm water extract were; 677.890mg/g for vitamin A, 0.0497mg/g for vitamin B<sub>2</sub>, 0.405mg/g for vitamin B<sub>3</sub>, 0.009mg/g for vitamin B<sub>6</sub>, 26.458mg/g for vitamin C and 0.316mg/g for vitamin E. It should be noted that vitamin B<sub>12</sub> was not detected in both cold water extract and warm water extracts.

It is clear from above that *Gongronema latifolia* contains substantial concentration of vitamins, minerals and other nutrients necessary for well-being and production in humans and farm animals [20]. The various vitamin compositions

in this research as contained in table 3 show that the concentrations were highest in leaf meal as against those in cold water extract (20 - 25°C) and warm water extracts (40°C). Ascoric acid (vitamin C) has been reported to be a major natural antioxidant and also possesses anti-carcinogenic properties. This was observed to be high in *Gongronema latifolium* and can therefore be taken as a good antioxidant vegetable. A similar range of concentration of vitamin A (carotenoid) as was observed in this study for *G. latifolia* had been reported [15]. Low concentration of vitamin E (0.431mg/g) was also reported [15]. The vitamin E is well known for its antioxidant ability that can mitigate lipid oxidation and thus help reduce the occurrence of atherosclerosis which predisposes animals to increased risk of heart disease [15].

## CONCLUSION

The bush buck (*Gongronema latifolium*) as shown in this study is a rich source of some vital nutrients; protein, minerals and vitamins, but in processing for human and animal use care must be taken to avoid the loss of these nutrients.

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## REFERENCES

1. Iheise, G. C. (2015). Health Benefits of *Gongronema latifolia* (Utazi). The Guardian Nigeria Newspaper, 5<sup>th</sup> September, 2015.
2. Gamaniel, K.S. and Akah, P.A. (1996). Analysis of the gastrointestinal relaxing effect of the stem extract of *Gongronema latifolia*. *Phytomed*, 2(4): 293-296.
3. Ajewole, K. (1999). Analysis of nutritive elements in some Nigerian leafy vegetables. Proceedings of 23<sup>rd</sup> Annual Institute of Food Science and Technology (NIFST) Conference, 25-27 October, 2015.
4. Gorge, P. M. (2003). Compositional analysis methods: In manuals of food quality control. *Encyclopedia of Foods*, 7(1): 203-232.
5. Ugochukwu, N.H., Babady, N.E., Cobourne, M. and Gasset, S. R. (2003).

- The effect of *Gongronema latifolia* Extract on serum lipid profile and oxidative stress of hepatocytes of diabetic rats. *Journal of Biology Sciences*, 28: 1-5.
6. Agbo, C.U., Baiyeri, K. P. and Obi, I. U. (2005). Indigenous Knowledge and Utilization of *Gongronema latifolia* Benth: a case study of women in the University of Nigeria, Nsukka. *Bio-Research Journal*, 3(2) 66-69.
  7. Garima G., Gagandeep K., Rachna Y. and Neelima R. K. (2021). Repellent effect of aqueous extract of mustard seeds *Brassica juncea* on three major pests of horticultural crops. *Canadian Journal of Agricultural and Applied Sciences* (CJAAS), 1 (1): 16 – 24.
  8. AOAC (Association of Official Analytical Chemists, 2005). Official Methods of Analysis of the AOAC (W.Horwitz Editor, Eighteen Edition, Washington, D.C., AOAC).
  9. Pearson, D (1975). Chemical analysis of foods. 6<sup>th</sup> edition. Churchill Livingstone, Edinburgh pp.451.
  10. Asma, N. Abdul-Kadir (2010). Spectrophotometric Determination of Vitamin B<sub>6</sub> by Coupling with Diazotized p-Ntroaniline, *Journal Rafidain of Science*, Vol. 21 (4); pp 49-59.
  11. Benderitter, M., Maupoil, V., Vergely, C., Dalloz, F., Briot, F and Rochette, L (1998). Studies by electron paramagnetic resonance of the importance of iron in the hydroxyl scavenging properties of ascorbic acid in the plasma: effect on iron chelators. *Fundamentals and Clinical Pharmacology*, 12 (5): 510-516.
  12. Afolabi, F. E. (2007). Chemical Composition and anti-bacterial activity of *gongronema latifolia*. *Journal Zhejiang University Science Book*, 8(5):352-358.
  13. Machebe N. S., Agbo, C. U and Onuaguluchi, C. C. (2011). Oral administration of *Gongronema latifolia* leaf meal: Implications on carcass and haematological profile of broiler finishers raised in the humid

- tropics. *African Journal of Biotechnology*, 10 (30): 1-7.
14. *Gongronema latifolia* leaf meal: Implication on carcass and haematological profile of broiler finishers raised in the humid tropics. *African Journal of Biotechnology*; vol. 10 (30): 5800-5805.
  15. Mohammed, A., Tanko, Y., Okasha, M. A., Magaji, R. A and Yaro, A. H. (2007). Effects of aqueous leave extracts of *Ocimum gratissimum* on blood glucose levels of streptozocin-induced diabetic wister rats. *African Journal of Biotechnology*, 6: 2087-2090.
  16. Ekenyem, B. U., Obi, T. K.O., Odo, B.T and Mba, F. I. A.(2010). Performance of Finisher Broiler Chicks Fed Varying Replacement Levels of *Chromolaena odorata* for Soyabean meal. *Pakistan Journal of Nutrition*; Volume 9 (6): 558-561.
  17. Ekwe, O. C., Uzoma, C. C., Ede, V.O. and Nneji, C. P. (2017). Effect of *Eupatorium odoratum* and *Ocimum gratissimum* Leaf Extracts on Growth, Haematology and Cost Benefit of Broiler Chichens. *Asian Journal of Poultry Science*, Vol. 11(2): 90-95
  18. Offor, C. E., Agidi, J. U., Egwu, C. O., Ezeani N. and Ugwu, P. C. (2015). Vitamins and Mineral Contents of *Gongronema latifolia* leaves. *World Journal of Medical Science*; 12 (2): 189-191.
  19. Ibrar, M., Ilahi I. and Hussan F. (2003). Hypoglycemic Activity of *Hedera helix* L. Leaves and Possible Mechanism of Action. *Pakistan Journal of Botany*; 35 (5): 805-809.
  20. Enemor, V. H. A., Nnaemeka, O .J. and Okonkwo, C. J. (2014). Minerals, Vitamins and Phytochemical Profile of *Gongronema latifolium*: Indices for Assessment of Free Radical Scavenging Nutritional and Anti-nutritional Qualities. *International Research Journal of Biological Sciences*, Vol. 3 (1); 17-21.