Determination of Nutritional and Anti-Nutrient Content of *Vitis vinifera* (Grapes) Grown in Bomo (Area C) Zaria, Nigeria

1V.O. Aina, 2Binta Sambo, 1Amina Zakari, 1M.S. Hauwa Haruna, 1Hauwa Umar, 1R.M. Akinboboye and 1Adama Mohammed

1Department of Applied Science, CST-Kaduna Polytechnic, P.M.B. 2021, Kaduna, Nigeria
2Department of Food Technology, Kaduna Polytechnic, Kaduna, Nigeria

**Abstract:** Various nutrients in *Vitis vinifera* (Grape) grown in Bomo village, Zaria were analyzed. These include carbohydrate, lipids, Moisture Fibre, Ash, proteins and Minerals such as Ca, Fe, Cd. The Macro-Kjeldhal method was used for protein determination, soxhlet extraction for fat and Atomic Absorption Spectrophotometer for mineral element determination. Anti-Nutrients determined were Oxalate, Phytic Acid and Cyanogenic Glycosides. The result showed that moisture content was 81.50%, lipid 0.18 and 0.44% ppm for calcium. The concentration of the anti-nutrient agreed with the WHO standard which was not harmful enough to prevent consumption of the fruit.

**Keywords:** Anti-nutrient, carbohydrate, cyanogenic glycosides, dietary fibre, polyphenol, *Vitis vinifera*

**INTRODUCTION**

Anti nutrients are substances that are damaging to health, they include metals such as lead, calcium and mercury, their presence in the body uses up large amount of nutrients such as Zinc, calcium, vitamin and other anti-oxidants to neutralize them. Phytic acid is an anti-nutrient that interferes with the absorption of minerals from the diet. Another particularly widespread form of anti-nutrient is the flavonoids which are a group of polyphenolic compounds that include Tannins (Beecher, 2003).

These compounds chelate metals such as iron and zinc and reduce the absorption of these nutrients. However, polyphenols such as Tannins have anti-cancer properties, so beverages such as green tea that contain large amount of these compounds might be good for the health of some people despite the anti-nutrient properties (Chung *et al.*, 1998).

**Aims and objectives of the research:**

- To investigate the nutritional content and mineral element composition of *Vitis vinifera* (grapes) grown in Bomo farm of Area C in Zaria-Nigeria and thus recommend its nutritional significance
- To investigate possible heavy metals and the anti-nutrient content in the samples

Most grapes come from cultivars of *Vitis vinifera*, the European grapevine native to the Mediterranean and Central Asia. Some fruits and wine comes from American and Asian species such as *Vitis labrusca*, *Vitis viparia*, *Vitis rolundifolia* and *Vitis amuresensis* (Shi *et al.*, 2003).

Nutrients are categorized as either Macronutrients (needed in relatively large amounts) or Micronutrients (needed in small quantities). The Macronutrients include carbohydrates, fats, fibre, proteins and water while Micronutrients are minerals and vitamins.

Dietary fibre consists mainly of cellulose, a large carbohydrate polymer that is indigestible because humans do not have the required enzymes to disassemble it. Dietary fibre helps to reduce the chance of gastrointestinal problems such as constipation and diarrhea by increasing the weight and size of stool and softening it.

Chemical substances present in food sample and which have been reported with some level of toxicity in mankind include aflatoxin (William, 2000), hemoglutiuin (Nelson *et al.*, 2005) and cyanogenic glycosides (Vetter, 2000). Toxicity is the result of interaction between three factors namely the type of organism, concentration of toxin and time of duration (Savage, 2000).

**MATERIALS AND METHODS**

**Sample source:** Fresh fruits of *Vitis vinifera* were collected from a farm plot located in Bomo village area C Zaria, Kaduna in May, 2010 and authenticated in the Herbarium of NARICT, Zaria.

**Sample preparation:** The samples collected was air dried at room temperature (25°C), pounded using a clean mortar and pestle and kept in air-tight containers until when needed.

**Corresponding Author:** V.O. Aina, Department of Applied Science, CST-Kaduna Polytechnic, P.M.B. 2021, Kaduna, Nigeria
Determination of moisture content: The method described by A.O.A.C (1980) was adopted, a clean crucible was dried to a constant weight in air oven at 110°C, cooled in a desiccator and weighed (W1). Two grams of finely ground sample was accurately weighed into the previously labeled crucible and reweighed (W2). The crucible containing the sample was dried in an oven to constant weight (W3). The percentage moisture content was calculated thus:

\[ \% \text{ Moisture content} = \frac{W2 - W3 \times 100}{W2 - W1} \]

Determination of ash content: The A.O.A.C (1980) method was used. The porcelain crucible was dried in an oven at 100°C for 10 min, cooled in a desiccator and weighed (W1). Two grams of the finely ground sample was placed into a previously weighed porcelain crucible and reweighed (W2). It was first ignited and then transferred into a furnace which was set at 550°C. The sample was left in the furnace for eight hours to ensure proper ashing. The crucible containing the ash was then removed; cooled in a desiccator and weighed (W3). The percentage ash content was calculated as follows:

\[ \% \text{ Ash Content} = \frac{W3 - W1 \times 100}{W2 - W1} \]

Determination of crude lipid content by soxhlet method: A clean, dried 500 cm³ round bottom flask containing few anti-bumping granules was weighed (W1) with 300 cm³ petroleum ether (40-60°C) for extraction poured into the flask filled with soxhlet extraction unit. The extractor thimble weighing twenty grams was fixed into the Soxhlet unit. The round bottom flask and a condenser were connected to the Soxhlet extractor and cold water circulation was connected/put on. The heating mantle was switched on and the heating rate adjusted until the solvent was refluxing at a steady rate. Extraction was carried out for 6 h. The solvent was recovered and the oil dried in an oven set at 70°C for 1 h. The round bottom flask and oil was then weighed (W2). The lipid content was calculated thus:

\[ \% \text{ Crude Lipid content} = \frac{W2 - W1 \times 100}{\text{Weight of Sample}} \]

Determination of crude fibre: The sample (2 g) was weighed into a round bottom flask, 100 cm³ 0.25 M sulphuric acid solution was added and the mixture boiled under reflux for 30 min. The hot solution was quickly filtered under suction. The residue was washed with boiling water until it was base free, dried to constant weight in an oven at 100°C, cooled in a desiccator and weighed (C1). The weighed sample (C1) was then incinerated in a muffle furnace at 550°C for 2 h, cooled in a desiccator and reweighed (C2).

\[ \% \text{ Crude fibre} = \frac{C1 - C2 \times 100}{\text{Weight of original sample}} \]

Determination of nitrogen and crude protein: The ground defatted sample (91.5 g) in an ashless filter study was dropped into a 300 cm³ Kjeldahl flask. The flask was then transferred to the Kjeldahl digestion apparatus. The sample was digested unit a clear green colour was obtained. The digest was cooled and diluted with 100 cm³ with distilled water.

Distillation of the digest: Into 500 cm³ Kjeldahl flask containing antibumping chips and 40 cm³ of 40% NaOH was slowly added to the flask containing mixture of 50 cm³ 2% boric acid and 3 drops of mixed indicator was used to trap the ammonia being liberated. The conical flask and the Kjeldahl flask were then placed on Kjeldahl distillation apparatus with the tubes inserted into the conical flask, heat was applied to distill out the NH₃ evolved with the distillate collected into the boric acid solution. The distillate was then titrated with 0.1 M HCl.

\[ \% N2 = \frac{14 \times M \times V_{t} \times V_{100}}{\text{Weight of sample (mg)} \times V_{a}} \]

\[ \% \text{ Crude Protein} = \% N2 \times 6.35 \]

where, 
\( M = \) Actual Molarity of Acid 
\( V = \) Titre Value (Volume) of HCl used 
\( V_i = \) Total volume of diluted digest 
\( V_a = \) Aliquot volume distilled

Determination of carbohydrate by (difference): The total carbohydrate was determined by difference. The sum of the percentage moisture, ash, crude lipid, crude protein and crude fibre was subtracted from 100 (Muller and Tobin, 1980).

\[ \% \text{ Total carbohydrate} = 100 \times (\% \text{ moisture} + \% \text{ Ash} + \% \text{ fat} + \% \text{ Protein} + \% \text{ Fibre}) \]
Determination of the mineral elements and heavy metals: The ground sample (5.0 g) was put in a crucible and placed into a muffle furnace, ashed at 500°C and then cooled. Three mL concentrated HCl was added and evaporated to dryness. Twenty cm³ 25% HCl was then added to the residue to extract the mineral. The extract was qualitatively transferred to 100 cm³ volumetric flask and volume made up to the mark with distilled water with the digest used directly for the elemental determination using the Atomic Absorption Spectrophotometer.

Preparation of standard: For each mineral, standard ranging from 1-16 ppm were prepared from the stock solution and were used to calibrate the equipment in concentration mode.

Determination of oxalate: Oxalate was determined by using the method of Sanchez-Alonso and Lachica (1987). Exactly one gram of the sample was placed in 250 cm³ volumetric flask, 190 mL of distilled water and 10 cm³ of 6M HCl were added. The mixture was then warmed in a water bath at 90°C for 4 h and the digested sample centrifuged at 2,000 rpm for 5 min. The supernatant was then diluted to 250 cm³. Three 50 cm³ aliquots of the supernatant was evaporated to 25 cm³, the brown precipitate was filtered and washed. The combined solution and washings were then titrated with concentrated ammonia solution in drops until the pink colour of methyl orange changed to yellow. The solution was then heated in a water bath to 90°C and the oxalate was precipitated with 5% CaCl₂ solution was allowed to stand overnight and then centrifuged, precipitate was washed with hot 25% H₂SO₄, diluted to 125 mL with distilled water and titrated against 0.05 M KMnO₄.

Calculation:

\[ 1 \text{ mL} 0.05 \text{ M KMnO}_4 = 2.2 \text{ mg Oxalate} \]

Determination of phytic acid: Phytic acid was determined by the procedure of Lucas and Markakas (1975) 2.0 g of the sample was weighed into a 250 mL conical flask. One hundred mL 2% concentrated HCl was used to soak sample for 3 h and then filtered with a WhatmanNo. 1 filter paper. Fifty cm³ of the filtrate and 10 cm³ of distilled water were added in each case to give proper acidity. Ten mL 0.3% ammonium thiocyanate solution was added into the solution as indicated and titrated with standard Iron II Chloride solution containing 0.00195 g Iron/mL, end point observed to be yellow which persisted for 5 min. The percentage phytic acid was calculated thus:

\[ % \text{ Phytic acid} = y \times 1.19 \times 100 \]

where,
\[ y = \text{titre value} \times 0.00195 \text{ g} \]

Determination of cyanogenic glycoside: Cyanogenic glycoside was determined using alkaline picrate method of Onwuka and Olopade (2005). Ground sample (5.0 g) was weighed and dissolved in 50 cm³ distilled water. The cyanide extraction was allowed to stay overnight and then filtered (Inuwa et al., 2011).

Preparation of cyanide standard curve: Different concentrations of KCN solution containing 0.1 to 1.0 mg/mL cyanide were prepared. To 1 mL of the sample filtrate and standard cyanide solution in test tubes, 4 mL of alkaline picrate solution (1 g of picrate and 5 g of Na₂CO₃ in 200 cm³ distilled water) was added and incubated in water bath for 15 min.

After color development, the absorbance was read at 490 nm against a blank containing only 1 mL distilled water and 4 cm³ alkaline picrate solution. The cyanide content was extrapolated from the cyanide standard curve.

Calculation:

\[ \text{Cyanogenic glycoside (mg/100 g)} = \frac{C \text{ (mg)}}{\text{Weight of sample}} \times 10 \]

where, 
\[ C \text{ (mg)} = \text{Concentration of cyanide content read off the graph} \]

RESULTS AND DISCUSSION

From the results of this research which include analysis of different types of nutrients in Vitis vinifera (Grapes) grown in Bomo Village. The sample contained

Table 1: Showing the percentage of the nutrient content of Vitis vinifera

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>81.50</td>
</tr>
<tr>
<td>Ash</td>
<td>0.100</td>
</tr>
<tr>
<td>Crude lipid</td>
<td>0.180</td>
</tr>
<tr>
<td>Crude protein</td>
<td>0.820</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>0.720</td>
</tr>
<tr>
<td>Solution carbohydrate</td>
<td>16.72</td>
</tr>
</tbody>
</table>

Table 2: Showing the concentration of some heavy metals and mineral elements of Vitis vinifera

<table>
<thead>
<tr>
<th>Elements</th>
<th>Concentration (mg/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead (Pb)</td>
<td>0.0107</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0100</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>0.4454</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.4312</td>
</tr>
</tbody>
</table>

Table 3: Showing the concentrations (mg/100) of the Ant nutrient content of the sample

<table>
<thead>
<tr>
<th>Anti-nutrient</th>
<th>Concentration (mg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxalate</td>
<td>99.00</td>
</tr>
<tr>
<td>Phytate</td>
<td>0.280</td>
</tr>
<tr>
<td>Cyanogenic glycosides</td>
<td>0.033</td>
</tr>
</tbody>
</table>
high moisture content. This is not surprising as many fleshy fruits have high percentage of moisture. The carbohydrate content which is the soluble sugar of the grape was found to be 16.50%. This percentage is desirable for people who want to lose weight as many other fruits contain higher percentage of sugar. The fibre content of grape is 0.70% which is higher than that of protein and fat. This is not surprising as fruits generally are not good sources of proteins and fats. The concentration of calcium (0.4454) in the sample is higher than that of Iron (0.4312), however results show that the fruit (grape) is a good source of these two mineral elements. Lead content was found to be 0.0107 and this indicated that as far as lead poisoning was concerned, the fruit is safe for human consumption since the acceptable WHO standard/level is 15.0 mg. From the foregoing results, from Table 1, the moisture content was quite high (81.5%) followed by carbohydrate (a good source) and crude protein (0.8%). Table 2 indicated that for elemental concentration Ca was the highest followed by the Fe, Pb and Cd. From Table 3, Oxalate was the highest in concentration in (99 mg/100 g), followed by phytate, then cyanogenic glycosides.

For the anti-nutrient factors, oxalate was found to be 99 mg/100 g compared to the range given by Munro and Bassir (1969) which is 2-5 g. The level of phytic acid was found to be 0.46 which is low. The low level of phytic acid could be attributed to the presence of an enzyme phytase which degrade phytic acid in fruits (NRC, 1989). The level of cyanogenic glycoside was found to be infinitesimally low. The knowledge of the cyanogenic glycoside content of food is vital because cyanide being an effective cytochrome oxidase inhibitor interferes with aerobic respiratory system.

ACKNOWLEDGMENT

The Co-authors wish to thank the Head of Department of Applied Sciences Department, Kaduna Polytechnic, Kaduna-Nigeria for allowing access to the laboratories and reagents.

REFERENCES


