Phytochemical and Vitamin Composition of *Cucumis metuliferus* Juice

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Authors’ contributions

This work was carried out in collaboration between both authors. Author CEA conceived the work, wrote the protocol and designed the study. Author ONA managed the literature searches, wrote the first draft of the manuscript, managed the analyses of the study and performed the statistical analysis. Both authors read and approved the final manuscript.

ABSTRACT

The pursuit of healthy lifestyle has led to increased demand for fruits and vegetables. Fruit juice in particular, is increasingly receiving attention because of the therapeutic benefits derived from its consumption. The bioactive compounds in fruit juice have various pharmacological applications. *Cucumis metuliferus* is a plant of the *Cucurbitaceae* family. The fruit has a high water content and sought after to quench thirst. The ethnomedicinal properties of the fruit requires investigation of all the parts in order to maximally utilize it. Therefore, in this study, the phytochemical and vitamin composition of the juice were investigated. The assays were conducted using standard methods. From the result, the phytochemicals present were phytate (0.33 ± 0.03%), alkaloids (0.48 ± 0.06%), saponins (0.19 ± 0.04%), cardiac glycosides (0.46 ± 0.16%), Oxalate (3.24 ± 0.38 mg/ml), tannins (108.79 ± 5.16 mg TAE/g) and phenols (0.06 ± 0.01 mg GAE/ml). The vitamin present were vitamin A (198.51 mg/kg), vitamin B$_1$ (0.09 mg/ml), Vitamin B$_2$ (0.11 mg/ml), Vitamin B$_3$ (0.07 mg/ml), vitamin B$_8$ (835.0 mg/ml), vitamin B$_9$ (2.089 mg/ml), vitamin B$_12$ (0.1 mg/ml), Vitamin C (682.0 mg/ml), vitamin D (5.28 mg/ml), vitamin E (4.42 mg/ml) and vitamin K (2.4336 mg/ml). These results have shown that *Cucumis metuliferus* juice have pharmacological properties and could also be utilized as an alternative source of vitamins.
Keywords: Cucumis; metuliferus; juice; phytochemical; vitamin; fruit.

1. INTRODUCTION

Fruits and their juices are said to be one of the most important foods for man, as their intake ensures healthy living and supplies lost nutrients in the body [1]. Fruit juice is full of nutrients and essential in a healthy diet as it supplies various micro-nutrients available on earth [2]. All over the world, especially in rural areas where fruits are mostly available, fresh fruits are seasonally consumed or in most areas throughout the year. In Nigeria, some fruits are seasonal while others are available all year round. These fruits are also carried from villages to cities or brought in from other countries when in season. Fruits can be eaten in different forms such as in slices, in combination with foods as well as expressed or prepared as natural juice. Some fruits are grossly underused due to lack of information about their nutritional and medicinal values. Fruits are sources of vitamins, minerals as well as fibre and digestible carbohydrate [3]. In fact, most fruits have low calorific value and so are suggested to be beneficial for management of weight. Studies show that fruits are about 85% water with very small varying amount of fats and protein, and a fair amount of carbohydrate (cellulose), vestigial amount of starch, vitamins and sugar [4]. Fruits and vegetables also have high fiber content which plays a vital role in the control of cholesterol in the blood and hence, prevents large bowel diseases. Therefore, consumption of diets which are rich in fruits and vegetables lowers the risk of cancers [5].

Cucumis metuliferus belongs to Cucurbitaceae family [6]; commonly called African horned cucumber, jelly melon or Kiwano. It is called ‘būrār za'àkì’, ‘nōnōn-kuùrā̀’ ‘gautar kaji’ in Nigeria (Hausa) [7,8]. It is mostly found in South Africa, Nigeria, Senegal, Namibia, Swaziland and Botswana where it naturally grows [9]. The plant grows at an altitude of between 210 m and 1800 m above sea level. It flowers from January and bears fruits from February to July. The fruit is brightly orange in colour when ripe with a bright green, gel-like flesh and tastes like banana and cucumber combined. It is consumed as snack in raw form as well as used in cooking [10]. The fruits occur in the bitter and non-bitter forms. The bitter forms are wild-growing plants and inedible, considered poisonous if eaten. This bitter form contains a highly poisonous compound called cucurbitacins [11] known to have cytotoxic, anti-tumour and anti-inflammatory effects [12]. The non-bitter form which is sweet, less toxic and cultivated widely [13,14]. This sweet form has been claimed to be used in the treatment of patients living with HIV/AIDS in and around Jos in Nigeria [6]. The fruit is highly sought after by people in Kalahari Desert as a source of water [15] and a good source of energy with low caloric value. From studies it was shown that the juice contains essential minerals and amino acids [16]. Therefore, in addition to studies done so far, the phytochemical and vitamin content of the juice were investigated in order to ascertain its therapeutic and nutritional usefulness.

2. MATERIALS AND METHODS

2.1 Sample Collection and Identification

Two (2) fresh fruits (the sweet form) of Cucumis metuliferus were purchased from a market in Gboko, Benue state, Nigeria and authenticated in the department of Applied Biology and Biotechnology, Enugu State University of Science and Technology, Enugu. Nigeria.

Fig. 1.

2.2 Sample Preparation

The fruits of Cucumis metuliferus were rinsed thoroughly with portable water and were cut into halves using kitchen knife. The pulp was scooped into a muslin cloth and the juice was squeezed out and used for the analysis. A total of 63.25 ml of the juice was produced.

2.3 Phytochemical Screening

2.3.1 Qualitative phytochemical screening

Quantitative phytochemical screening was done determine the various natural compounds in the extract. This was carried out according to the method of Sofowora [17,18,19].
2.3.2 Quantitative phytochemical screening

Quantitative phytochemical screening was done using standard methods. Thus; Total phenol and flavonoids were determined by method of Barros et al. [20], Saponin was determined using the method of Obadoni and Ochuko [21], tannin was determined according to method of AOAC [22]), phytate content was determined using the method of Young and Greaves [23], alkaloid was determined using the method of Harbone [24], oxalate was determined according to method of Osagie [25] and cardiac glycosides were determined by the alkaline titration method of the AOAC [22].

2.4 Vitamin Analysis

Vitamin A was determined by the calorimetric method of Kirk and Sawyer [26]. Vitamins B1, B2, B3, B6, B9 and B12 were spectrophotometrically determined according to the method of AOAC [27]. Vitamin C was determined by the titrimetric method according to Kirk and Sawyer [26]. Vitamin E was determined by the futter-mayer colorimetric method with association of vitamin chemist’s by Kirk and Sawyer [26]. Vitamins D and K were determined according to the method described by Zakara et al [28].

2.5 Statistical Analysis

Data analysis was done using the Statistical Package for Social Sciences (SPSS) software. All the data were expressed as Mean ± SD.

3. RESULTS

3.1 Phytochemical Composition of Cucumis metuliferus Juice

Table 1 shows the qualitative and quantitative phytochemical composition of Cucumis metuliferus juice. It revealed that Tannins was highly present, Oxalate was found to be moderately present; while Saponins, Alkaloids, Phytate and Cardiac glycosides were slightly present.

3.2 Vitamin Composition

The result of the vitamin analysis revealed that Cucumis metuliferus juice contains high amount of Vitamins B6, C and A. Vitamins D, K and B9 were present in moderate amount while vitamins B1, B2, B3, B12 and E were present in trace amounts (Table 2).

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### Table 1. Phytochemical Composition of Cucumis metuliferus juice

<table>
<thead>
<tr>
<th>Phytochemicals</th>
<th>Qualitative concentration</th>
<th>Quantitative concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phytate (%)</td>
<td>+</td>
<td>0.33 ± 0.03</td>
</tr>
<tr>
<td>Alkaloids (%)</td>
<td>+</td>
<td>0.48 ± 0.06</td>
</tr>
<tr>
<td>Saponins (%)</td>
<td>+</td>
<td>0.19 ± 0.04</td>
</tr>
<tr>
<td>Cardiac glycosides (%)</td>
<td>+</td>
<td>0.46± 0.16</td>
</tr>
<tr>
<td>Oxalate (mg/ml)</td>
<td>++</td>
<td>3.24 ± 0.38</td>
</tr>
<tr>
<td>Tannins (mg TAE/ml)</td>
<td>+++</td>
<td>108.79 ± 5.16</td>
</tr>
<tr>
<td>Total Phenols (mg GAE/ml)</td>
<td>+</td>
<td>0.06 ± 0.01</td>
</tr>
</tbody>
</table>

+= Slightly present, ++= moderately present, +++= highly present

### Table 2. Vitamin Composition of Cucumis metuliferus juice

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>Concentration (mg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>198.51</td>
</tr>
<tr>
<td>Vitamin B1</td>
<td>0.09</td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>0.11</td>
</tr>
<tr>
<td>Vitamin B3</td>
<td>0.07</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>835.00</td>
</tr>
<tr>
<td>Vitamin B9</td>
<td>2.09</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>0.10</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>682.00</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>5.28</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>0.42</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>2.43</td>
</tr>
</tbody>
</table>
4. DISCUSSION

_Cucumis metuliferus_ fruit is a versatile fruit with numerous nutritional importance. This study on the juice revealed the presence of phytochemicals which are active medicinal compounds. From the result it was shown that tannin was the most abundant phytochemical at the concentration of 108.79 ± 5.16 mg/ml. Tannins are oligomers of flavan-3, 4-diols and flavan-3-ols which are mainly found in the bran of legumes [29]. They are a major group of polyphenol antioxidants present in food with multifunctional properties to human health and have been shown to have medicinal effects [30]. It has wound healing effects such as anti-inflammatory and analgesic effects [31] which have been well documented [32]. Its anti-nutritional properties are displayed through impairment of digestion of various nutrients and prevention of absorption of bioavailable substances in the body [33]. Tannins also bind and form complexes with proteins which may cause inactivation of digestive enzymes and reduction in digestion of protein brought about by ionisable iron and protein substrate interaction [34]. The high composition of Tannin in _Cucumis metuliferus_ juice shows that the juice could be useful therapeutically for wound treatment. The second most abundant phytochemical in the _Cucumis metuliferus_ juice was oxalate (3.24 ± 0.38 mg/ml). Oxalate is also an anti-nutrient. Oxalic acids form oxalates which are soluble (with potassium and sodium) or insoluble (with calcium, magnesium, and iron) salts or esters and are present commonly in plants or synthesized in the body [35]. These insoluble salts cannot be eliminated from the urinary tract once processed through the digestive system. Calcium oxalate accumulates as kidney stones and so can be harmful to health and human nutrition [36]. Other phytochemicals present in the juice were phytate, alkaloids, saponin, cardiac glycoside and phenol. Phytate is said to be the main storage form of phosphorus especially in leafy vegetables [37]. However, phytase can unlock the phosphorus stored as phytic acid. But phytic acid hinders the uptake of minerals such as calcium, zinc, magnesium and iron by binding and forming complexes with them when phytase is absent [38]. This gives rise to salts which are highly insoluble and hence, absorbed poorly by the GIT leading to less minerals being bio-available. However, it acts as an antioxidant through inhibition of iron-mediated free radical generation [39]. Alkaloids have medicinal properties which include antiarrhythmic, antihypertensive, anticancer and antimalarial properties [40]. Both synthetic and pure forms of alkaloids have been useful as bactericidal, analgesic and antispasmodic agents [41] and alkaloid-containing plants are used for treatment of fever and headache [42]. These abilities are associated to their antibacterial and analgesic properties [43]. From reports, alkaloids have been shown to act as anti-depressant in the central nervous system [44]. Saponins are also anti-nutrients with a bitter taste and toxic in high amount. They can hinder absorption of nutrients through enzyme inhibition as well as by binding with nutrients such as zinc. Saponins occur naturally and possess various biological effects such as hypocholesterolemic and hypoglycemic effects [45,46]. They also impair digestion of protein, minerals and vitamins uptake in the gut, as well as cause leakage of the gut [47]. Cardiac glycosides inhibits the membrane-bound Na⁺-K⁺-ATPase pump which is responsible for Na⁺-K⁺ exchange, and are used as heart drugs [48]. The phenol content was very low in the concentration of 0.06 ± 0.01 mg/ml. Phenolic compounds are metabolites with antioxidant activity and act as free radical scavengers [49].

From the result of vitamin analysis in Table 2, it was shown that the juice contains very high amount of vitamins B6 (835.00 mg/ml), C (682.00 mg/ml) and A (198.51 mg/ml). Vitamins B6 and C contents are higher than the recommended daily allowances of 1.3 and 45 mg per day respectively for an adult [50]. Vitamin A, although below the recommended daily allowance of 300 mg per day [50], can be a good source when combined with other sources. Others were present in moderate amounts. These vitamins are important in human health, playing protective roles and participate in energy production. The B vitamins are coenzymes which aid in macromolecule metabolism. Vitamins C and E are antioxidants which protect the cell membranes from oxidative damages by free radicals [51]. Vitamin C in addition to its antioxidant role, possesses several health benefits [52]. Vitamin C is also required for maintenance of normal connective tissues, wound healing and as well as facilitate the absorption of dietary iron from the intestine [53]. Vitamin E is known as anti-sterility vitamin and important in reproduction, in the development and normal functioning of the red blood cell and muscles [54,55]. Vitamin D is needed for increase intestinal uptake of calcium, phosphate and magnesium [56].
5. CONCLUSION

From this study, it has been shown that *Cucumis metuliferus* juice contains important secondary metabolites which are of great health benefits. This finding suggests that the juice could be utilized as nutraceutics and it is a good source of vitamins being high in a number of them. Nevertheless, precautions in consumption should be taken as the juice richly contains some anti-nutrients which are potentially harmful. Therefore, toxicity studies are required to ensure consumer’s dietary safety.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


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