



Phytochemical Screening and Antioxidant Potential of Selected Nigerian Vegetables

Yusuf Hassan, Magaji Ilu Barde

Department of Chemistry, Umaru Musa Yar'adua University, Katsina, Nigeria

* Corresponding author email: yusuf.hassan@umyu.edu.ng

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ABSTRACT

Reducing power activities of ten vegetables commonly consumed in Katsina State, Nigeria have been assessed with the view of establishing their antioxidant capacities. Preliminary, the phytochemicals of the individual plants were screened, and it was found that various constituents were present. In particular, flavonoids and anthraquinones were found in *Ficus glumosa* which also appeared to demonstrate the best reducing power activity (4.898 at 25 mg/L).

Keywords: Vegetables, Phytochemicals, Antioxidant, Reducing Power Assay.

1 Introduction

Consumption of fruits and vegetables is highly recommended in dietary guidance because of the health benefits of their fibers, vitamins, minerals, especially electrolytes, and phytochemicals, particularly antioxidants [1]. For instance, fibers found in fruits and vegetables prevent constipation as a result of reducing intestinal passage rates which lead to a gradual nutrients absorption [2]. Furthermore, available data, predominantly from adult studies, indicate significantly lower risks for obesity, diabetes, and constipation could be expected with higher dietary fiber consumption [2]. Of the various phytochemicals present in fruits and vegetables, much interest are focused on the vital role of antioxidants — a family of secondary metabolites referred to as flavonoids [3, 4]. Antioxidants are responsible for the bright colour of the fruits and vegetables and they act as scavengers by cleaning up free radicals before they cause detrimental health effects [4]. It is established that reactive oxygen species (ROS) such as $\cdot\text{OH}$ (hydroxyl radical), $\cdot\text{O}_2$ (superoxide anion), H_2O_2 (hydrogen peroxide) are closely involved in various human diseases such as cancer, inflammation, Alzheimer's disease, aging, rheumatoid arthritis

and atherosclerosis [5-7]. Hence, a number of methods for determining the antioxidant potential of fruits and vegetables have been reported [8]. In this study, reducing power assay has been employed to evaluate the antioxidant potential of ten green leafy vegetables commonly consumed in Nigeria. In this work, we chose to study the antioxidant capacity of leafy vegetables considering their nutritive value in terms of having high carbohydrate, protein, vitamins and minerals in comparison to that of exotic vegetables. [9].

2 Materials and Methods

All reagents used were purchased from BDH Labs (Cambridge, England) while the solvents were from Loba Chemic (Mumbai, India). UV-Vis spectrophotometer (PG Instruments Limited, T60U) was used to measure the absorbance.

2.1 Plant Collection and Authentication

The aerial parts of the plants were collected from the outskirts of Katsina City, Nigeria and authenticated at the Department of Biology, Umaru Musa Yar'adua University, Katsina, Nigeria.



2.2 Extraction

The leaves were carefully separated, washed with distilled water, and then dried under shade for three weeks. The dried leaves were crushed and ground to fine powder using a domestic blender. To obtain the ethanol extracts of the leaves, 25g of each powdered material was mixed with 150 mL of ethanol and allowed to stand for 48 hours with periodic shaking. The solvents were then evaporated *in vacuo* to obtain extracts as dried and oily materials.

2.3 Phytochemical Screening

Standard procedures for the determination of alkaloids [10], anthraquinones, flavonoids, saponins, and tannins [11] were adopted as follows.

2.3.1 Tests for Alkaloids

Approximately 3 mg of the ethanol extract was added to 3 ml of 1% HCl and heated for 20 min. The mixtures were then cooled and used to perform the following tests:

Mayer's test: 1 ml of Mayer's reagent was added drop by drop to a portion from above. The formation of a greenish coloured or cream precipitate indicated the presence of alkaloids.

Dragendorff's test: 1 ml of Dragendorff's reagent was added drop by drop to another portion from above. The formation of a reddish-brown precipitate indicated the presence of alkaloids.

2.3.2 Test for Anthraquinones

2 ml of benzene was added to 100 mg of each plant powder sample in a conical flask and soaked for 10 minutes and then filtered. Further 1 ml of 10% ammonia solution was added to the filtrate and shaken vigorously for 30 seconds. Formation of pink, violet, or red colour indicated the presence of anthraquinones in the ammonia phase.

2.3.3 Test for Flavonoids

2 ml of 2% NaOH was mixed with 100 mg of each plant extract; concentrated yellow color was produced, which became colorless when 2 drops of dilute acid was added to the mixture. This indicated the presence of flavonoids.

2.3.4 Test for Saponins

5 ml of distilled water was mixed with 100 mg of each plant extract in a test tube and it was mixed vigorously. The frothing was mixed with few drops of olive oil and mixed vigorously, and the foam appearance showed the presence of saponins.

2.3.5 Test for Tannins

10 ml of bromine water was added to 500 mg of each plant extract. Decoloration of bromine water showed the presence of tannins.

2.4 Reducing Power Assay

Antioxidant potential as per reducing power assay was measured according to a method reported by El-Jemli *et al.*, [12] with modification. Briefly, a set of 5 dilutions of each plant extract was prepared in 50% aqueous methanol in the range 5 - 25 mg/L. Subsequently, 2.5 mL plant extract, 2.5 mL sodium phosphate buffer (0.2 M, pH 6.6) and 2.5 mL potassium ferricyanide (1% w/v in distilled water) were mixed in a test tube. The mixture was incubated in a water bath for 20 min at 50 °C. Then, 2.5 mL trifluoroacetic acid (10% w/v in distilled water) was added, and the mixture was centrifuged at 650 rpm for 10 min. The supernatant (5 mL) was taken into a test tube and 5 mL distilled water and 1 mL ferric chloride (0.1% w/v in distilled water) solution was added and mixed well. Absorbance was then measured at 700 nm. By replacing the plant extract with an equal volume of solvent, blank was run using the same procedure.

3 Results and Discussion

Phytochemical screening of the ethanol extracts of the plants (Table 1) revealed that alkaloids and flavonoids are present in all the plants. Whereas fruits and vegetables are characteristically associated with the flavonoids [1], it appeared quite interesting to find that alkaloids are also present in these plants. This is due to the fact that the families of these plants are not often reported to possess such class of compounds [3]. Moreover, anthraquinones were found to be distributed in only four of the plants. This also agreed with the literature reports on the most usual families of higher plants that are found to

contain anthraquinones [13]. But overall, it could be seen that the essential phytoconstituents that gives vegetables their nutritional as well as health benefits are well distributed in the plants investigated. It is particularly interesting to have detected the presence of alkaloids, saponins, and tannins because these secondary metabolites act in plant defence mechanism, and it turn confers health benefits to humans [14].

Reducing power assay is a widely adopted method for evaluating the antioxidant capacity of plant materials. It deals with the conversion of Fe^{3+} in ferric chloride to ferrous (Fe^{2+}) ion [12]. This conversion is normally monitored using UV-visible spectroscopy by the absorbance of the sample at 700 nm. The results (Table 2, Figure 1) revealed that the absorbance of the ethanol extracts of the plant materials is concentration dependent. It indicated that *Ficus glumosa* possess

the best reducing power capacity (4.898 at 25 mg/L). This agrees well with the phytochemical constituents of this plant (Table 1) where it is shown to be rich in flavonoids and anthraquinone. Furthermore, it supports the use of the leaves and bark of the plant in northern Cameroon and southern Chad as a stimulant for milk production in both women and animals [15]. On the other hand, *Euphorbia balsamifera*, *Senna tora*, *Tapinanthus dodoneifolius*, *Hibiscus cannibinus*, *Boscia salicifolia*, *Leptadenia hastata*, and *Moringa oleifera* exhibited some closely related values of 4.800, 4.562, 4.543, 4.311, 4.288, 4.107, and 4.103 respectively. Apparently, the plants with the lowest activities of 3.583 and 3.206 appeared to be *Cratava adansonii* and *Hibiscus sabdariffa* respectively. But generally, the plants investigated here showed better reducing power activities than some well-known medicinal plants [16-18].

Table 1: Results of phytochemical screening of the ethanol extracts of the plants

| Plants | Phytochemicals | | | | |
|----------------------------------|----------------|------------|----------|---------|----------------|
| | Alkaloids | Flavonoids | Saponins | Tannins | Anthraquinones |
| <i>Boscia salicifolia</i> | + | + | + | + | + |
| <i>Cratava adansonii</i> | + | + | + | + | + |
| <i>Euphorbia balsamifera</i> | + | + | + | + | - |
| <i>Ficus glumosa</i> | + | + | + | + | + |
| <i>Hibiscus cannibinus</i> | + | + | + | - | - |
| <i>Hibiscus sabdariffa</i> | + | + | + | - | - |
| <i>Leptadenia hastata</i> | + | + | + | + | - |
| <i>Moringa oleifera</i> | + | + | - | + | - |
| <i>Senna tora</i> | + | + | + | + | - |
| <i>Tapinanthus dodoneifolius</i> | + | + | + | + | + |

+ = Present - = Absent

Table 2: Absorbance of the ethanol extracts of the plants at 700 nm^a

| Plants | Concentration (mg/L) | | | | |
|----------------------------------|----------------------|-------|-------|-------|-------|
| | 5 | 10 | 15 | 20 | 25 |
| <i>Boscia salicifolia</i> | 4.109 | 4.149 | 4.201 | 4.222 | 4.288 |
| <i>Cratava adansonii</i> | 2.523 | 3.196 | 3.384 | 3.558 | 3.583 |
| <i>Euphorbia balsamifera</i> | 2.439 | 2.536 | 4.252 | 4.309 | 4.800 |
| <i>Ficus glumosa</i> | 3.361 | 3.461 | 4.450 | 4.628 | 4.898 |
| <i>Hibiscus cannibinus</i> | 3.678 | 3.886 | 4.095 | 4.273 | 4.311 |
| <i>Hibiscus sabdariffa</i> | 2.160 | 2.622 | 2.833 | 3.146 | 3.206 |
| <i>Leptadenia hastata</i> | 2.880 | 2.950 | 3.486 | 3.828 | 4.107 |
| <i>Moringa oleifera</i> | 3.019 | 3.164 | 3.213 | 3.617 | 4.103 |
| <i>Senna tora</i> | 3.215 | 3.596 | 4.191 | 4.236 | 4.562 |
| <i>Tapinanthus dodoneifolius</i> | 3.214 | 3.376 | 3.546 | 3.947 | 4.543 |

^aAbsorbance is the average of three runs for each plant

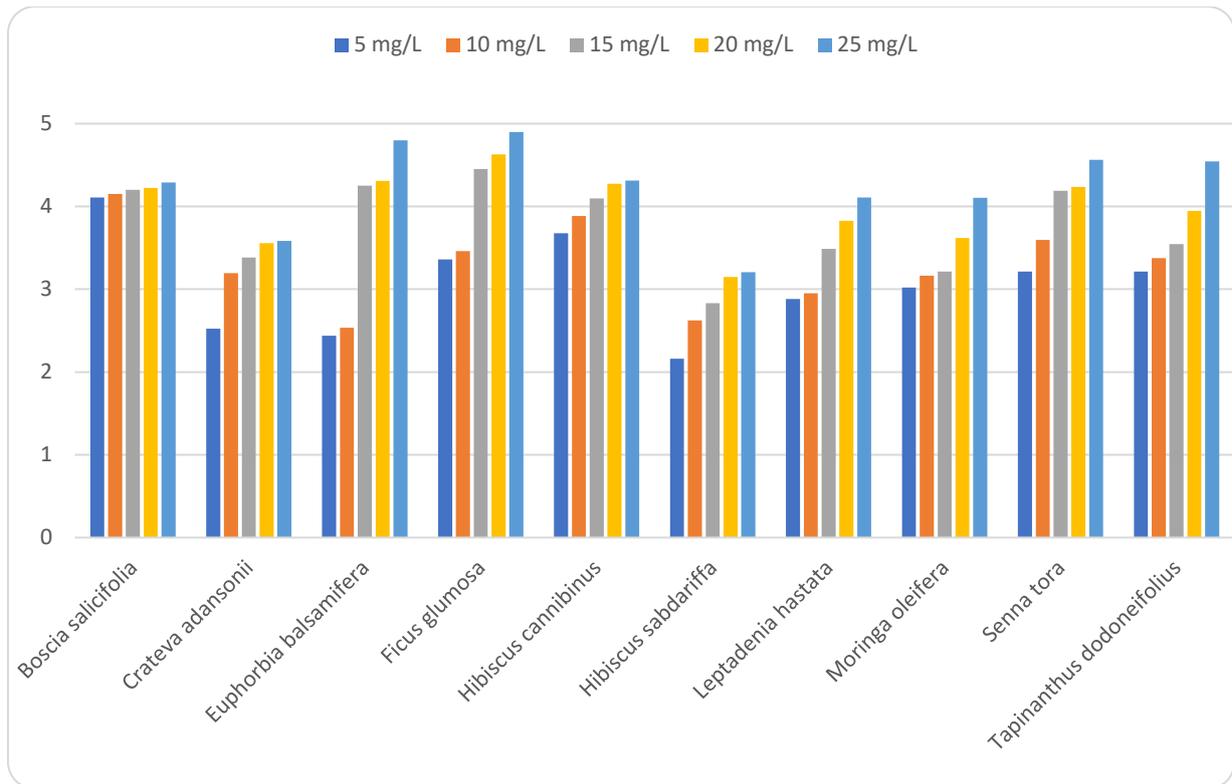


Figure 1: Reducing power capacity of the ethanol extract of the plants

4 Conclusions

The capacities of ten commonly consumed vegetables in Katsina State, Nigeria have been investigated using reducing power assay. And it was found that all the plants under study possessed reasonable reducing capacities of Fe^{3+} to Fe^{2+} in ferric chloride due to the presence of antioxidant compounds in the plants. This information provides further supportive information on the health benefits of vegetables, particularly their ability to clean up free radicals which are commonly associated with deadly diseases like cancers. Moreover, this study calls for improvement in the vegetables intake to maintain our balance diet.

5 Declarations

5.1 Acknowledgements

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5.2 Competing Interests

The authors declared that no conflict of interest exist in the publication of this work.

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