

## Biochemical Compositions of *Azadiracta indica* Fruit Juice

I.O. Igwenyi, N.O. Nwigbo, J.C. Nwokike and J.N. Awoke

Department of Biochemistry, Ebonyi State University,  
P.M.B. 053, Abakaliki, Ebonyi State, Nigeria

**Abstract:** *Azadiracta indica* is a plant widely used for its efficient medicinal value. Proximate composition and phytochemical analysis were carried out on fresh fruit juice of *Azadiracta indica* to ascertain possible nutritional essence and endowment of secondary metabolites. Investigation of the proximate composition revealed that the fruit juice was high in moisture 57.73±0.12%, protein 19.37±0.58% and carbohydrate 18.48±1.15%. The ash content, crude fiber and crude fat contents were lower with the values 2.73±0.31%, 1.05±0.05% and 0.80±0.20% respectively. The fruit juice was high in reducing sugar (114.97±13.78mg/100ml at 420nm and 68.00±5.67mg/100ml at 680nm), terpenoids 65.93±6.74mg/100ml, tannins 46.17±3.56mg/100ml and alkaloids 41.81±2.04mg/100ml. They were however lower in phenols 9.54±0.43, glycosides 1.39±0.132, flavonoids 11.19±2.61, carotenoids 0.21±0.04 and saponin 1.29±0.60mg/100ml. The high percentage composition of carbohydrate and protein shows that the juice is nutritious and can provide metabolizable energy for healthy growth and development. The presence of flavonoids and saponins indicates that the juice has antioxidant and antitumor properties. They can protect against heart diseases, cancer and other diseases. Alkaloids are powerful analgesics and can find useful applications in surgery and pain relief. The juice of *Azadiracta indica* has highest concentration in mg/100g of vitamin B<sub>3</sub> (15.75±0.21) while vitamin A and B<sub>2</sub> occurred at concentration of 8.28±0.35 and 4.67±0.19mg/100g while vitamins B<sub>1</sub>, B<sub>6</sub>, C and E were less than 1mg/100g of the fresh juice.

**Key words:** *Azadiracta indica* • Proximate • Phytochemicals • Fruit Juice • Antioxidant • Antitumor • Malaria

### INTRODUCTION

Green plants have become very useful resource for animals and humans. They accumulate both primary and secondary metabolites, which find useful applications in nutrition and health. Traditional medicine employs the use of leaves, bark, stem, roots, flowers, fruit and seeds of plants in the treatment of diseases [1]. Humans are able to discover medicinal plants by following animal instincts and by trial and error method. Indigenous medicine men claim to have learnt the use of plants in healing by observing that sick animals change their food preferences to nibble at bitter herbs which they normally reject in healthy state [2]. Dogs that are primarily carnivorous chew certain herbs when they have worms and expel such after consumption of the grass. In the same way, a lot of other animals unusually forage for specific herbs when sick.

*Azadiracta indica* is a fast growing tree that can reach a height of 15-20 meters. It is a popular plant (Also called Neem) in the Mahogany family Meliaceae and a native to India, Pakistan and Bangladesh. The tree also grows in tropical and semi-tropical regions. The fruit is smooth olive-like drupe and varies in shape from elongate oval to nearly roundish. The exocarp is thin and the bitter-sweet pulp (Mesocarp) is yellowish-white and fibrous. The white, hard endocarp (Inner shell) of the fruit encloses elongated seeds with brown seed coat. The plant parts are used to treat so many diseases [3-5].

One of the major uses of *Azadiracta indica* is in the treatment of malaria. Aqueous extract of the leaves is known to be very effective in the treatment of malaria in tropical Africa. Apart from the extensive work done in this area, not much has been documented in the usefulness of the fruit juice. It was observed that birds and bats enjoy the fruit of *Azadiracta indica*, discarding the epicarp and the seeds after consuming the mesocarp. This led to the

investigation of the proximate and phytochemical components of the fruit juice of *Azadiracta indica* as plants accumulate a large number of secondary metabolites [6], many of which exhibit a number of protective functions in human existence [7].

Fruits and vegetables form indispensable constituents of human diets supplying the body with minerals, vitamins and certain hormone precursors, in addition to small amounts of protein, carbohydrate, fiber and energy [8]. However, many of these fruits such as fruits of *Azadiracta indica* are yet to be adequately studied and utilized. It then becomes necessary to investigate the proximate, phytochemical and vitamin compositions of *Azadiracta indica* fruit juice to evaluate the nutritional essence and other possible and useful application as well as provide a nutritional and pharmacological database for useful scientific inquiry. This is because a lot of birds and bats spend much time on *neem* tree, feasting on the juice from the ripe fruits, which they suck and discard the hard seeds. This has become necessary as only few fruits are both nutritionally essential and medicinally important [9]. Proximate analysis is therefore employed to chemically evaluate the major constituents of food and to establish the proportion of some important food components such as carbohydrate, protein, lipids, fiber, ash and moisture while phytochemical analysis evaluates the pharmacologically active components of the material under investigation. Vitamins are organic components in food that are needed in very small amounts for growth and maintaining good health [10]. A chemical may be called vitamin (*vital amine*) when it cannot be synthesized in sufficient amount by an organism and must be obtained from diet.

### MATERIALS AND METHODS

**Proximate Analysis:** The method of Pearson [11] was employed for the determination of the proximate composition. The Soxhlet method was also employed in

the determination of the crude fat/oil in the sample using petroleum ether (40-60°C). The Kjeldhal method was used for protein estimation while the crude fiber and ash contents were also determined using official methods [12].

**Phytochemical Analysis:** Investigation of the secondary metabolites accumulated in the plant was carried out. The concentration of alkaloids was determined using the method of Haslam [13]. The methods of Harborne [14] were employed in the determination of flavonoids, glycosides, phenol, tannin, β-carotene, cyanogenic glycosides, steroids, saponins, reducing sugars and soluble carbohydrate.

**Vitamin Analysis:** Spectrophotometric methods as described by Pearson [11] were employed in the determination of vitamins A, C and E concentrations while the methods of Ball [15] were used for the determination of vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub> and B<sub>12</sub>.

### RESULTS AND DISCUSSION

The result of the proximate composition in Figure 1 revealed that the fruit juice is high in moisture, protein and carbohydrate. The values were moisture 57.73±0.12%, protein 19.37±0.58% and carbohydrate 18.48±1.15%. The ash content, crude fiber and crude fat contents were low with the values 2.73±0.31%, 1.05±0.05% and 0.80±0.20% respectively. It is quite clear from the result in Figure 1 above, that there is a good reason why birds and bats enjoy regular visits to the tree in search of ripe fruits. The juice has exceptional quality of very high amount of protein, especially as plants are not good sources of protein. The protein content showed that the fruit of *Azadiracta indica* is unique in protein content which is generally known to be low in plant materials especially in the fruit juice [15]. The protein content was higher than results obtained from analysis of popular fruits in Nigeria with protein values of 1.28±0.10%, 1.25±0.21%,

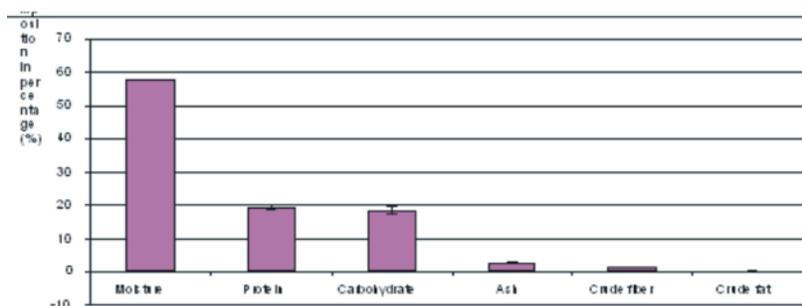


Fig 1: Proximate composition of fruit juice of *Azadiracta indica*.

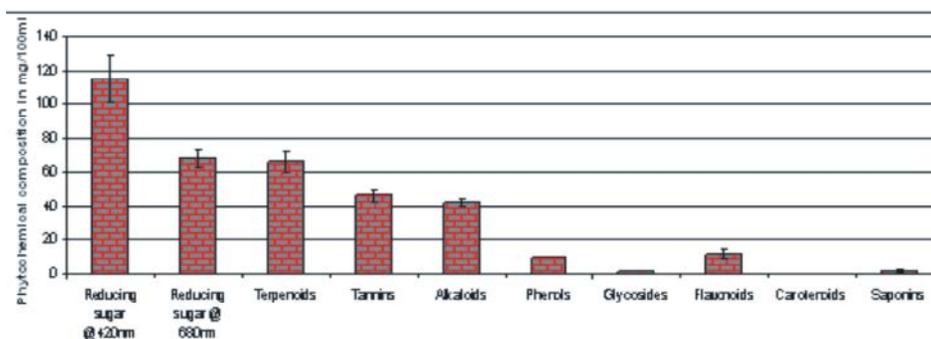


Fig 2: Phytochemical composition of *Azadiracta indica* fruit juice.

1.05±0.01% for *Psidium guajava*, *Musa paradisiaca* and *Citrus lanatus* respectively [15]. Thus, the fruit of *Azadiracta indica* is probably the plant part with the highest protein content in the plant kingdom.

This means that as bats are nocturnal, they derive most of their protein need from high protein sources such as the fruit juice of *Azadiracta indica*. However, the net protein utilization of human and animals eating only one source of protein source is affected by the limiting amino acid content of that source. Adequate protein utilization will readily be obtained if a balanced variety of protein sources is eaten [8].

Phytochemical analysis in Figure 2 showed that they were made up of some bioactive compounds. Nutrition studies also focuses on secondary metabolites commonly found in food sources and beverages due to their medicinal and therapeutic value. The investigation into the phytochemical components has shown that the fruit juice of *Azadiracta indica* fruit juice was high in reducing sugar (114.97±13.78mg/100ml at 420nm and 68.00±5.67mg/100ml at 680nm), terpenoids 65.93±6.74mg/100ml, tannins 46.17±3.56mg/100l and alkaloids 41.81±2.04mg/100ml. They were however low in phenols 9.54±0.43, glycosides 1.39±0.132, flavonoids 11.19±2.61, carotenoids 0.21±0.04 and saponin 1.29±0.60mg/100ml.

The high level of reducing sugar indicates high energy store while the analgesic effect of alkaloids are very important in the strenuous exercise of flight and fight for survival. These values were higher than 1.28-1.64mg/100g reported in the phytochemical composition and nutritional quality of *Glycine max* and *Vigna unguiculata* (L) [16] and 4.32% by [8]. Alkaloids are famous analgesics [17] and have been utilized in a variety of ways in the treatment of diseases and during surgery due to their medicinal and pharmacological efficacy. Flavonoids are most commonly known for their antioxidant activity. However, it is now

known that the health benefits they provide against cancer and heart disease are the result of other mechanisms [18].

Flavonoids have been referred to as "nature's biological response modifiers" because of strong experimental evidence of their inherent ability to modify the body's reaction to allergens, viruses and carcinogens. They show anti-allergic, anti-inflammatory [19], anti-microbial [20] and anti-cancer activity. Tannins are astringent, bitter plant polyphenols that either bind and precipitate or shrink proteins. Tannins have traditionally been considered antinutritional but it is now known that their beneficial or antinutritional properties depend upon their chemical structure and dosage [21]. Recent studies have demonstrated that products containing chestnut tannins included at low dosages (0.15-0.2 %) in the diet can improve wellbeing [22].

The result of this investigation revealed that *Azadiracta indica* accumulates a large number of both primary and secondary metabolites. The fruit juice is very rich in plant protein and carbohydrate and as such, can serve as a good source of nutrients especially of scarce plant proteins. Many of the phytochemicals exhibit a number of protective functions in animal and human existence. The juice can be said to be medicinal as according to Iwu, most medicinal plants were often rich in alkaloids and this can be physically observed by their stiff nature [7]. Strong antioxidant activities have been reported for flavonoids and saponins have been reported to elicit antitumor activities in leukemia cells [23].

The analysis of the vitamin content as shown in Table 1 revealed that they occurred in varied amounts. The juice of *Azadiracta indica* has highest content of vitamin B3 at a concentration of 15.75±0.21mg/100g while vitamin A and B<sub>2</sub> occurred at concentration of 8.28±0.35 and 4.67±0.19mg/100g. However, vitamins B<sub>1</sub>, B<sub>6</sub>, C and E were less than 1mg/100g of the fresh juice. Vitamins play very important roles in maintaining the proper functioning

Table 1: Vitamin Composition of Fresh Fruit Juice of *Azadiracta indica* in Mg/100ml

Parameter	Mean Value $\pm$ SD
Vitamin A	8.3531 $\pm$ 6.4024
Vitamin B <sub>1</sub>	0.4727 $\pm$ 0.0283
Vitamin B <sub>2</sub>	4.6667 $\pm$ 0.1900
Vitamin B <sub>3</sub>	15.7447 $\pm$ 0.2128
Vitamin B <sub>6</sub>	0.0036 $\pm$ 0.0009
Vitamin B <sub>12</sub> (KH <sub>2</sub> P supernatant)	0.560 $\pm$ 0.0200
Vitamin B <sub>12</sub> (KH <sub>2</sub> P sediment)	0.0012 $\pm$ 0.0005
Vitamin B <sub>12</sub> (KCN supernatant)	0.0096 $\pm$ 0.0042
Vitamin B <sub>12</sub> (KCN sediment)	0.0403 $\pm$ 0.0026
Vitamin C	0.9015 $\pm$ 0.0054
Vitamin E	0.0244 $\pm$ 0.0141

of the system, even in very minute quantity. Vitamins A and C have strong antioxidant activity. This point to the fact that though every part of *Azadiracta indica* plant is highly medicinal, the fruit juice is both medicinal and nutritious, just justifying the reason why bats and birds use it as food and medicine.

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