Nutritional Analysis of Mature Unripen and Ripen Edible Fruits of *Aegle tamilnadensis* Abdul Kader (Rutaceae)

M. Chellakumar* and S. Abdul Kader

Department of Plant Biology & Plant Biotechnology, Presidency College (Autonomous), Chennai – 5, India

Abstract: Nutritive analysis of mature unripe and ripe fruits of *Aegle tamilnadensis* which is a close relative of *A. marmelos* (L) Correa was carried out at Presidency College, Chennai during 2016. Mature unripen fruits were plucked from the tree while ripen fruits were gathered from the ground after their natural fall during the month of December 2016 from the campus of Govt. Siddha Medical College, Arumbakkam, Chennai, Tamil Nadu, India. Seeds were removed; fresh fruit pulp was collected and weighed. Such pulp was used for the extraction of nutrients using methanol in Soxtron apparatus (Socs Plus - SCS 06 E). The moisture content was estimated by hot air oven method and expressed on dry weight basis [10]. The methanol fruit pulp extracts were used with standard methods for the estimation of protein, carbohydrate (sugar), energy, fat, vitamins, and minerals such as calcium, sodium and iron. The results showed that the mature unripe fruit contain high protein, sodium and calcium contents while cholesterol and fat contents were lower than those present in the ripe fruits. On the contrary in ripe fruit, vitamin C and iron contents were high. Therefore, both mature unripe and ripe fruits of *Aegle tamilnadensis* Abdul Kader can be used as a potential natural nutraceutical.

Keywords: *Aegle tamilnadensis*, Nutritional value, unripe fruit, ripe, nutraceutical.

INTRODUCTION

In developing countries like India as well as several developed countries in the world, many persons deprived from sufficient nutrients. Those who are fortunate to have food may not be able to meet the adequate protein and other nutritional requirement. As a result, they have poor health status and diseases. On the other hand, in developed countries such as Europe and America, excess food availability has increasing obesity and serious health problems. The food science is therefore facing a challenge niches to counter both the conditions. “Functional Food” is a solution for this problem. Food can be said to be functional if it contains a component that benefits one or more functions in the body in a targeted way that is relevant to the state of wellbeing or the reduction of the risk of the disease or has physiological or psychological effect beyond the basic nutrition.

International food Information Council Foundation (IFIC) in 1998 gave the definition of functional food as, “Food that provides health benefit beyond basic nutrition” [11]. A European commission consulted action program known as, “Functional Food Science in Europe (FUFOSE)” in 1998, reached a consensus known as the “European Consensus on Scientific Concepts of Functional Foods.” It says that, Functional food must remain food and must demonstrate its effect that normally be expected to be consumed in diet, it should not be a pill or capsule [15, 3].

Since ancient times, plants are known as a source of diverse biologically active chemicals, essential for maintaining health and useful for treating and preventing disease. It is only recently that several scientific investigations have been performed to discover potential health protective food compounds which might prevent the occurrence of disease and general health. It is because we are becoming increasingly aware that various nutrients play a crucial role in maintaining an optimum immune response. Optimal nutrition is a key factor in influencing the physiological functions of an individual, therefore, in Ayurveda also, the importance of several plant species in supplementary diet for maintaining good health has been very well emphasized. Nutrient estimation is considered as important procedure for collecting information on nutrient content of foods. The quantitative analysis of nutrient present is very important in food manufacturing industries. In most developing tropical countries, the food situation is worsening owing to increasing population, shortage of fertile land, high prices of available staples, and restrictions on the importation of food [19, 23]. This has resulted in a high incidence of hunger and malnutrition, a situation in which children and women, especially pregnant and lactating women, are most vulnerable [6,7] predictions of future food needs based on the current rates of population increase and food production emphasize the seriousness of this problem

*Address correspondence to this author at the Department of Plant Biology & Plant Biotechnology, Presidency College (Autonomous), Chennai – 5, India; Tel: 044-28544894; Fax: 044-28586401; E-mail: ckchella.kumar@gmail.com, sakfri@rediffmail.com

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[8]. There can be no immediate single solution to the problem of food insufficiency. An interdisciplinary approach is necessary [1]. All information on new sources of food will be of value in dealing with the food problem [13]. While every measure is being taken to boost food production by conventional agriculture, a lot of interest is currently being focused on the possibilities of exploiting the vast numbers of less familiar plant resources existing in the wild [18]. Many such plants have been identified, but the lack of data on their chemical composition has limited the prospects for their utilization [20, 21]. Most reports on some lesser-known and unconventional crops indicate that they could be good sources of nutrients, and many have the potential of broadening the present narrow food base of the human species [22, 16, 2, and 12].

METHODS

Fruits Collection

Unripe fruits were plucked from the tree while ripe fruits were gathered from the ground after nature fall during the month of December 2016 at the campus of Govt. Siddha Medical College, Arumbakkam, Chennai. Seeds were removed fresh fruit pulp was collected and weighed. Pulp extraction was obtained by using soxtron apparatus (Socs Plus - SCS 06 E) for nutritional analysis.

Nutritive Value Analysis

Moisture Content

The fully ripen and unripen fruit pulp of *Aegle tamilnadensis* Abdul Kader was cut into small pieces and moisture content was estimated [10]. The loss in weight was regarded as a measure of moisture content. (International Rules for Seed Testing. Seed Sci. & Technol.)

Fat Content

Accurately, 10 g of the material was weighed in a suitable thimble and dried for 2 h at 105±2ºC. The thimble was placed in the soxhlet extraction apparatus and extracted with the solvent for about 16 h. The extract contained in the Soxhlet flask was dried. The empty mass of the which was previously determined at 95 to 100 ºC for 1 h. It was cooled in a desiccator and weighed. The alternate drying and weighing were continued at 30 min intervals until the loss in mass between two successive weighing was not more than 1 mg. The lowest mass was recorded [14]. The fat obtained was preserved for the determination.

Protein Content

The material (1-2 g) was transferred to the Kjeldahl flask. Precaution was taken to see that particles of the material do not stick on to the neck of the flask. Anhydrous sodium sulphate (10) added to 0.2 to 0.3 g of copper sulphate and 20 mL of concentrated sulfuric acid [5]. The flask was placed in an inclined position. It was heated below the boiling point of the acid until frothing. The heat was increased until the acid boil vigorously and digest for 30 min after the mixture becomes clear and pale green or colourless. The content of the flask was cooled and transferred to the round bottomed flask with water (200 mL). Pieces of pumice stone added to prevent bumping. Sodium hydroxide solution (50 mL) was added carefully through the side of the flask so that it does not mix at once with the acid solution but forms a layer below the layer. The apparatus was assembled taking care that the dip tube extends below the surface of the standard sulphuric acid contained in the beaker. The contents of the flask were mixed until all ammonia was passed over into the standard sulphuric acid. The burner was shut off and immediately the flask was detached from the container. The condenser was rinsed thoroughly with water into the beaker. The dip tube was washed carefully so that all traces of the condensate were drained into the beaker. Two or three drops of methyl red indicator solution were added and titrated with the standard sodium hydroxide solution.

Estimation of Carbohydrate

100mg of the sample was weighed into a boiling tube which was then hydrolyzed by keeping it in a boiling water bath for three hours with 5.0 ml of 2.5 N HCl to room temperature. The standards were prepared by taking 0.2-1.0 ml of the working standards. 1.0 ml of water as a blank. 1.0 ml in all the test-tubes with distilled water, then 4.0 ml of Anthrone reagent was added and heated for eight minutes in a boiling water bath, cooled rapidly and the green to dark green colour at 630 nm [9].

Determination of Minerals

Mineral contents of were determined by atomic absorption spectrometry, flame photometry and spectrometry according to the methods of AOAC [4]. A 1.0g of the powdered sample was added 12ml of HNO3 and the mixture was left overnight at room temperature. Then 4.0 ml HClO4 was added to the mixture and the mixture was evaporated on a hot plate in a fume cupboard until the appearance of white fumes. The digest was then filtered and kept for Flame Photometry and Flame Atomic Absorption

Table 1: Nutritional Analysis of Ripen and Unripen Fruit Pulp of *Aegle tamilnadensis* Abdul Kader

S. No.	Nutritional characteristics (DW)	Results	
		Ripen	Unripen
1	Moisture (g/100g)	04.36 gm	02.30 gm
2	Protein (g/100g)	10.09 gm	13.00 gm
3	Fat (g/100g)	05.12 gm	01.09 gm
4	Carbohydrate (g/100g)	02.50 gm	02.40 gm
5	Iron (mg/100g)	03.14 gm	14.22 mg
6	Vitamin c (mg/100g)	08.00 gm	00.17 mg
7	calories (kcal/100g)	96.44 kcal	71.41 kcal
8	Cholesterol (g/100g)	00.19 gm	00.07 gm
9	Calcium (mg/100g)	07.93 gm	12.00 gm
10	Sodium (g/100g)	0272 gm	0300 gm

Spectrophotometer (FAAS) analysis using PerkinElmer Atomic Absorption Spectrometer, model (AA200).

Estimation of Iron by Wong's (KCNS) Method

The ferrous ions present in the sample are oxidized to ferric ions by K2S2O8 solution. The ferric ions give a red coloured 'ferro-sulphocyanide complex' with KCNS. The intensity of the coloured complex so formed is then estimated calorimetrically at 425 nm [24].

Estimation of Cholesterol Zak's Method (Zak, 1977)

To 0.1ml of sample and standard cholesterol, chloroform in the ratio 1:10 was added and evaporated to dryness in water bath at 50˚C. 3ml glacial acetic acid and 3ml of coloring reagent were added to all tubes and then shaken vigorously. Distilled water was set as blank. It was then incubated at room temperature for 30 minutes and the absorbance read at 560nm [25].

Estimation of Energy

The energy was calculated by grams of carbohydrate in the extract by 4 calories per gram. Grams of protein in the extract were also multiplied by 4 calories per gram. Whereas, grams of fat by 9 calories per gram. The total energy was the addition of carbohydrate, protein and fat.

Estimation of Ascorbic Acid (Vitamin C) by DNPH Method

Ascorbic acid is first dehydrated by bromination. The dehydroascorbic acid is then reacted with 2, 4-Dinitriphenyl hydrazine to form osazones and then in sulphuric acid to give an orange- red color solution which is measured calorimetrically at 540nm.

RESULTS

Nutritional Analysis

The results (Table **1**) showed that the mature unripe fruit contains high protein, sodium and calcium contents while cholesterol and fat contents were lower than the ripe fruit. On the contrary in ripe fruit, vitamin C and iron contents were high. Therefore, both mature unripe and ripe fruits of *Aegle tamilnadensis* Abdul Kader can be used as a potential natural nutraceutical.

CONCLUSION

The result indicates that both the ripen and unripe fruit of *Aegle tamilnadensis* Abdul Kader as a good and cheap source of nutrient for the rural and tribal people. The protein, vitamin, iron and mineral analysis indicates the scope of using the edible fruit for the dietary supplement. Plantation of wild fruit helps to sustain the wild animals. Rich nutritional composition of the fruit is an alternative source of bio-nutrition.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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