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Nutritional composition of fruits of *Alangium salviifolium*, ssp *Sundanum* (Miq.) Bloemp.: An underutilized edible fruit plant

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Abstract
The present investigation deals with the food and nutritional potential of the wild edible fruit, *Alangium salviifolium*, ssp *sundanum* (Miq.) Bloemp. consumed by *Kani*s, an indigenous tribal community residing in the Agasthyamalai Biosphere Reserve, Southern Western Ghats. Results indicated that the fruits have a high moisture content of 83.9 ± 1.49g /100g. while the mean carbohydrate content observed was 11.67g in 100g of edible portion. The energy value was 81 kcal/100 g. The ascorbic acid and Vitamin E composition noted were 62.46 mg and 0.71 mg/100g respectively. Potassium and sodium were the most abundant mineral elements analyzed. The current study emphasized the fact that the fruit of *Alangium salviifolium*, ssp *sundanum* is a potential source of the flavonoid pigments anthocyanin, and the mean value observed was 157.37 mg/100 g which is well comparable with many commercial anthocyanin-rich fruits.

Keywords: *Alangium salviifolium*, ssp *sundanum* (Miq.) bloemp, wild edible fruit, nutritional composition, *Kani*, agasthyamala biosphere reserve

Introduction
Fruits are the preeminent source of nutrition in human diet. They are an excellent source of both macro and micro nutrients and playing an important role in a nutritionally balanced diet, particularly contain carbohydrates, protein, vitamins, minerals and some other phytonutrients with major health benefits. Mostly fruits are rich in rapidly absorbed sugars which are very sweet and have relatively high calorific values. The nutritional value of fruits lies mostly in their micro nutrient content and dietary fibers. They supply several minerals including potassium, iron, calcium, manganese, phosphorous and magnesium. Fruits generally contain a large quantity of vitamins such as vitamin C, provitamin A in the form of β-carotenoids and to a lesser extend vitamin E and B group of vitamins. Fruits also act as an optimal mix of antioxidants as they contain the phenolic compounds, anthocyanins, carotenoids and other flavonoids along with antioxidant vitamins C and E, which can modify the metabolic activation of carcinogens (Wargovich, 2000) [1] and act as anti-aging compounds (Pandey & Rizvi, 2009) [2]. Scientific evidences indicate intake of fruits has been associated with a reduced risk of cardiovascular disease and cancer at several sites (Bazzano *et al.*, 2002; Liu *et al.*, 2000; Crawford *et al.*, 1994) [3, 4, 5]. They can also maintain the normal pH of the body as they are rich in precursors to bicarbonate ions which serve to buffer acidity.
From the time immemorial, wild fruits have played a vital role in supplementing the diet of various human populations. Being the rich source of macro and micronutrients, they can form an essential part of a healthy and balanced life style. Even though, fruits account for a substantial fraction of the world's agricultural output, many species of the fruit plants still remain unnoticed. Mainly depending on wild products for livelihood, the indigenous people inhabited in forests all over the planet hold immense range of knowledge on these plants. In recent years, a growing interest has emerged in the studies on finding new crops especially wild fruits and to evaluate their nutritional features. Increased consumption of fruits is promoted extensively as new reports frequently come out on the health benefits and nutrient potential provided by them. Recent researches have shown that a considerable range of indigenous fruits have the potential to provide rural households with a means to meet their nutritional needs (Ekesa *et al.*, 2009) [6].
The plant selected for the present study was *Alangium salviifolium*, ssp *sundanum* (Miq.) Bloemp belongs to the family Alangiaceae is an underutilized fruit plant widely consumed by *Kani*s, an indigenous tribal community residing in the Agasthyamalai Biosphere Reserve, Southern Western Ghats (Figure 1). Plant native to India and Malayan Archipelago is now distributed in India, Sri Lanka, China and Vietnam. This bushy liana bears fragrant white

flowers which have green buds and is commonly called, '*Thavittakka*' among *Kani*s (Raj & Appavoo, 2012) [7]. They also use its leaves for curing rheumatic pains and the fruit is used in the treatment of dental pain. In India, this is mostly found near sandy riparian tracts and road cuttings. The flowering and fruiting season is between December and June. The fruits are spherical berry like and they are green and hard initially, pale-red later and finally turn dark red to purple and fleshy. It is one seeded, matures within a period of 6 - 8 weeks and weighed 2 - 4.5 grams. Ripen fruits are sweet in taste with a mild aroma. The thick rind as well as the seed is discarded and reddish fleshy portion of seed eaten. Literature perusal reveals that there have been no systematic studies concerns with detailed evaluation of nutrient constituents of this lesser known fruit used by *Kani*s, the oldest tribe in south India, until now. The present ethno botanical study which deals with this aspects of wild edible fruits, therefore deserve a special attention.

Fig 1: Habit of *Alangium salviifolium*, ssp *sundanum* (Miq.) Bloemp

Materials and Methods

Fruit collection and documentation

The participatory rural appraisal (PRA) method (Martin, 1995) [8] was used for gathering ethno botanical information regarding the plant. During the field study, informants from the *Kani* settlements were accompanied to identify and gather the fruit samples. Length and diameter were measured as an average of randomly selected 10 fruits with the help of a vernier calliper and expressed in centimetres. Ten randomly selected fruits were also weighed using an electronic weighing balance; range and the average of weights are expressed in grams. Unblemished fully ripened fruits collected were cleanly washed and taken immediately to the laboratory and stored at 4ºC for for further analysis. Approximately 200 gram of fruit was collected and the edible portions were separated for the evaluation of total carbohydrate, total protein, and vitamins. One portion was dried in a hot air oven for 24 hours at 45ºC. Then the dried fruits were ground well and kept in an air tight bottle for the evaluation of mineral profiling.

Nutritional profiling

Nutritional composition of fruits samples was determined on fresh weight basis. The sample was scrutinized for a total of 15 parameters which include proximates, vitamins, minerals and other phytonutrients. The proximate composition including the moisture content was estimated as per the gravimetric method (AOAC, 2000) [9]. Total carbohydrates were estimated by the method given by Hedge & Hofreiter (1962) [10]. Total protein content was quantified using the method by Hartree - Lowry assay (Hartree, 1972) [11]. Crude fat (Total lipids) was determined by Bligh and Dyer's method (Bligh & Dyer, 1959) [12]. Total energy was estimated by Atwater specific factor (ASF) system (FAO, 2003a) [13], a more refined energy conversion system based on the Atwater general factor (Atwater & Woods, 1896) [14]. The vitamins C, E and the pigment, anthocyanin were evaluated by as per various methods given by Association of Analytical Chemists (AOAC, 2000; 2005) [15, 16]. The minerals; Potassium (K), Magnesium (Mg), Calcium (Ca), Iron (Fe), Copper (Cu) and Manganese (Mn) in the sample prepared by either dry ashing or wet digestion, are quantitatively measured by atomic absorption spectrophotometer (AAS) at specific wavelengths.

Results and Discussion

Ethnic societies across the globe are well aware of seasonal availability of the wild edible fruits they use. Since these fruits are freely accessible within natural habitats, *Kani*s in ABR also have acquired knowledge from practical experience on how to gather fruits and where to collect a particular species from. Apart from *Kani*s, many ethnic tribal communities in India also consume the fruit of *A. salviifolium*, ssp *sundanum*. There are reports on its edibility from the tribal groups such as *Todas*, *Kotas*, *Kurumbas*, *Paniyas* and *Irulas* of Nilgiri district of Tamil Nadu (Sasi & Rajendran, 2012) [17], *Bhils*, *Pawaras* and *Vanjaras* of Maharashtra, *Malampandarangal* and *Kattunaykkar* of Kerala (Nazarudeen, 2010) [18].

Nutritional composition

The nutritional analysis results of *A. salviifolium*, ssp *sundanum* (Miq.) Bloemp were presented in Table 1. The moisture content in fresh fruits was relatively high with value of 83.9g/100g. The high content of moisture in fruits suggested that they require to be preserved well as they are highly perishable in nature (Lim & Rabeta, 2013) [19]. Carbohydrates are one of the most important components in many fruits. The total carbohydrate was noted in the fruit was 11.67 g/100g of edible portion. The result suggested that carbohydrate content of this fruit is higher than that of the values observed in commercial fruits like strawberry (7.68 g) and water melon (8.16 g) (USDA, 2013) [20]. The fruit showed the protein content of 2.07 g/100 g. Compared to some popularized fruits in tropics, this value is much closer and well comparable to the domesticated counterparts such as guava (2.55 g) and dates (2.45 g). The fat content of the fruit was very low (0.12 g/100g) as generally observed in most of the popular cultivated fruits (FAO, 2003b) [21]. The results showed that total ash, which is an index of mineral contents (Coimbra & Jorge, 2011) [22], for the fruit was 1.61g/100g.

The total energy provided by this wild edible fruit was 50kcal per 100 gram of edible portion. As per the Atwater specific factor (ASF) system, an increase in any of the three proximate principles, carbohydrate, protein and fat or these factors together proportionately increases the energy value.

Table 1: Nutritional Composition of *Alangium salviifolium*, ssp *sundanum* (Miq.) Bloemp

Nutrient	Unit	Value/100 g
Proximates		
Energy	kcal/kJ	50/209
Protein	g	2.07 ±0.15
Total lipid (fat)	g	0.12 ±0.004
Carbohydrate	g	11.67 ±0.14
Moisture	g	83.9 ±1.49
Ash	g	1.61
Minerals		
Potassium	mg	168
Calcium	mg	12
Magnesium	mg	19
Iron	mg	1.37
Copper	mg	0.302
Manganese	mg	0.064
Vitamins		
Vitamin C (Ascorbic acid)	mg	62.46 ±1.64
Vitamin E (α-tocopherol)	mg	0.71 ±0.05
Others		
Anthocyanin (CGE)	mg	157.37±1.04

The amount of mineral elements present in a plant depends to a large extend on the genetics, climate, soil nutrient content, time of harvest and growing location (Kruczek, 2005) [23]. The present study estimated the composition of six mineral nutrients; three macro elements (K, Ca and Mg) and three microelements (Cu, Mn and Fe) present in the fruit. The level of K was 168 mg/100 g which is well comparable to the concentration observed in commercial fruits like mango (168 mg), orange (169 mg), grapes (203 mg) and pomegranate (236 mg/100 g). In the tissue of many fruits, Ca is one of the minerals believed to be an important factor governing fruit storage quality (Lechaudel *et al.* 2005) [24]. Ca content recorded for the fruit was 12 mg/100 g, which is relatively a common concentration in most of the domesticated fruits. Mg concentration observed was 19 mg/100 g. This result is at par with the Mg concentration of most of the commercial fruits. Iron is an important trace element required in numerous essential proteins (Arredondo & Nuñez, 2005) [25]. Iron, Manganese and Copper composition noted for the fruit was 1.37 mg, 0.064 mg and 0.302 mg/100 g respectively per 100 gram of edible tissue.

The vitamins present in fruits make an important contribution to human nutrition, as they have specific functions in normal body performance. Fruits, particularly tropical species, are the main dietary sources of vitamin C with value normally ranged 20-60 mg/100 g of edible portion (FAO, 2003a) [13]. The ascorbic acid composition noted was 62.46 mg/100 g which is almost in agreement with this observation. Vitamin E content registered in the fruit was 0.71 mg/100g which is well comparable to the values observed in some popular commercial fruits, guava (0.73 mg/100 g), peaches (0.73 mg/100 g) and pomegranates (0.60 mg/100 g) known to be rich source of tocopherol (USDA, 2013) [20].

Apart from major constituents like proximates, minerals and vitamins, fruits contain several health beneficiary phytonutrients. The current study emphasized the fact that the fruit of *A. salviifolium*, ssp *sundanum* is one of the highest sources of anthocyanin, the water soluble, flavonoid pigments with great relevance due to their contribution to the strong antioxidant capacity of fruits (Blando *et al.*, 2004) [26]. The value observed was 157.37 mg/100 g which is well comparable with the fruits of raspberry (214-589 mg/100 g), known to be a rich sources of this pigment (Oancea *et al.*, 2011) [27].

Conclusion

The result of the nutritional evaluation of the fruit of *A. salviifolium*, ssp *sundanum*, eaten as raw by *Kani* tribals in ABR, indicates that this fruits is either superior or have identical status to the popular commercial fruits. The study expands the knowledge on the macro and micronutrients present in this wild edible fruit. It was also observed that, compared to the large sized cultivated fruits, this small minor fruit, even though not much tasty, were more nutritional in term of biologically active substances such as ascorbic acid, tocopherol, and anthocyanin (CGE). It shows that, consumption of small fruits, which are often referred to as "natural functional products" (Kondakova, 2009; Joseph *et al.*, 2000) [28, 29], has been associated with diverse health benefits such as prevention of heart disease, hypertension, certain forms of cancer and other degenerative or age-related diseases (Viskelis *et al.*, 2012) [30]. The present study showed that the underutilized fruit of *A. salviifolium*, ssp *sundanum* fruits could also be used as a potential source of protein, vitamin, minerals and monomeric anthocyanins. This information is also pertinent to help underutilized and neglected species for better health and nutritional status of the rural communities of the country.

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