IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparative Analysis Of Nutritional Profiling Of Ten Wild And Ten Commercial Fruits

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Abstract: Abstract: Maintaining a nutritious diet is essential for human healthier life. Making poor food choices and consuming unhealthy meals are the main causes of non-communicable diseases (NCDs).Edible fruits including wild and commercially available fruits are rich source of nutritional contents. Most of the studies shows, rural people traditionally harvest wide range of leafy vegetables, roots, tubers, fruits from wild because of its taste, cultural uses, as food supplements or to tide over food shortage. The present study explored the nutritional status of the fruit of 10 wild and 10 commercial fruits by profiling their physical properties (color, taste and smell) and biochemical attributes such as carbohydrate, sugar, protein, and vitamins. The present work identified superior/identical nutritional status in terms in terms of color, odor, taste and Vitamin content in noncultivated indigenous forest species, i.e., *Annona muricata*, *Annona squiamosa*, *Elaeocarpus serratus*, *Mangifera indica*, *Anacardium occidentale* , *Phyllanthus emblica* , *Ixora coccinea* , *Averrhoa carambola* , *Zizipus oenopolia* and *Syzygium jambos* comparable to the cultivated fruits like *Carica papaya, Passiflora edulis, Hylocereus undatus, Citrullus lanatus, Vitis vinifera, Actinidia chinensis, Malus pumila* etc. The analysis indicate the scope of using wild edible fruits for dietary supplement since it has valuable ingredients as Iron, Sodium, Potassium and Calcium. Many other fruits of forest therefore need to be analyzed which could help in selecting promising species for inclusion in agro and farm-forestry and reforestation programme which have so far focused only on timber species. Wild fruit plantation not only improves food base for humans it helps in sustaining wild animals particularly herbivore and bird population. Further research on anti- nutrients and antioxidants of wild species would be useful in selecting nutritious fruits from wild resources of eastern India. Of particular importance are *Annona muricata*, *Annona squiamosa*, *Elaeocarpus serratus*, *Mangifera indica*, *Anacardium occidentale*, *Phyllanthus emblica*, *Averrhoa carambola* and *Syzygium jambos* that had significant level of micronutrient and minerals which are promising species for promotion as backyard planting especially farming systems suffering from crop loss, food shortage and chronic malnutrition.

***Index Terms*:** wild edible fruits, nutritional analysis, commercially cultivated fruits.

I. Introduction

Nearly one-third of the world is still battling with issues of hunger and starvations. The largest proportion of this phenomenon is in developing nations. This hunger and starvation lead to the nutrition deficiency. Rich nutrient foods are inevitable for childhood, children are the future resource of nation. Hence to full fill the condition, healthy diet is needed. A healthy body, and reduce the risk of chronic disease leading to overall health and well-being.

Knowledge about the nutritive value and antioxidant status of organic crops is one of the mandatory principle of nutrition. There is very limited information about the content of carotenoids (lycopene, alpha- and beta-carotene, lutein) and their interrelationship with vitamins (other than vitamin C) and secondary plants metabolites such as polyphenols (flavonoids, anthocyanins), which are of great health importance. Plants flavonoids, and especially these belonging the flavones group (quercitine, kaempferol and mercitine) have been reported to prevent some kinds of cancer. The consumption of raw fruit and vegetables has a protective effect in humans for some forms of cancer, especially when plants contain flavonoids together with vitamin C, β – carotene and lycopene (Crozier et al. 1997). Raw consumption of edible fruits are also gives the protective effects.

Edible fruits including wild and commercially available one. Most of the studies shows, rural people traditionally harvest wide range of leafy vegetables, roots, tubers, fruits from wild because of its taste, cultural uses, as food supplements or to tide over food shortage. Labelled as famine or hunger food, wild plants have been recognised to have potential to meet household food and income security (Guinand and Dechassa, 2000; Kebu and Fassil, 2006). Many wild fruits notably, Amla, Harida, Bel, Elephant apple have been exploited from wild for centuries across Indian subcontinent on account of its food and medicinal properties. Even today in Mediterranean Europe, gathering of wild fruits is a common practice; so is picking of wild mushroom in northern Europe (Pardo-de-Santayana et al., 2007). Non cereal plant foods from forests contribute significantly to the diets of local residents in Africa (Getachew et al., 2005). In rural countryside of many developing nations, wild fruits are often the only fruits consumed as people cannot afford cultivated commercial fruits as apple, grapes, pomegranate or orange. In India, the indigenous fruits collected from wild play significant role in the food and nutrient security of rural poor and tribal. Some wild fruits have been identified to have better nutritional value than cultivated fruits (Eromosele et al., 1991; Maikhuri et al., 1994). As a result, in recent years, a growing interest has emerged to evaluate various wild edible plants for their nutritional features (Nazarudeen, 2010; Aberoumand and Deokule, 2009; Musinguzi et al., 2007; Nkafamiya et al., 2007; Glew et al., 2005). Inventory of wild food resources, ethno-botanical information on its adaptability coupled with nutritional evaluation can only establish the non-cultivated variety as real substitute for domesticated or cultivated species. Scrutiny of plants of various tropical forest areas through constituent analysis may lead to selection of valuable wild species that can be taken through crop improvement and hybridization process to establish it as cultivated variety.

Of the estimated 2800 species of vascular plants of Orissa state (India), about 150 wild edible fruit species occurring in different parts of eastern India's deciduous forests are consumed in various quantities by rural communities (Mahapatra and Panda, 2009). The wild edible species are gathered mostly for home consumption and mainly by forest dwellers, tribal and marginalized rural communities. But some fruits as Chironji, Mahua, and Cashew are collected from forests for sale as well since it fetch good price. Most fruits in India are collected from wild in small quantity for consumption or at time during the festivals. But information on their nutritional and anti-nutritional properties are lacking. Since none of the indigenous fruit plants has been brought under farm cultivation yet, detail on their nutritional utility storage ability etc., are not known except its consumption value and taste.

Besides, there are many wild fruit relatives in forests that are underexploited, and their economic potential is yet to be tapped. In general information on edibility and therapeutic properties of wild fruits is scanty and data on their nutritional composition is negligible (FAO, 1984; Aloskar et al., 1992). A wide array of wild fruits are collected by forest dwellers; particularly tribal communities in eastern Indian states of Orissa, Jharkhand and Chattisgarh to supplement their food which necessitates scientific investigation of wild fruit plants nutritional and anti-nutritive properties.

In addition to these, during times of stress—such as crop failure, pest attack, and drought—edible wild plants serve as major sources of food. This implies that the consumption of wild plants is a necessary part of the strategies adopted by people in order to survive in harsh environments and periods (Bell 1995, Guinand & Lemessa 2001, Neudeck et al. 2012, Teketay et al. 2010). For instance, many pastoralists rely on the seasonal products of natural forests, woodlands, and bush lands. Hence, the consumption of wild plants seems more common and widespread in food insecure areas, including most dry land areas, where a wide range of species are consumed, leading to the notion of "famine-foods" or plants consumed only at times of food stress (namely drought, war, and other hardship periods) (Guinand & Lemessa 2001, Teketay et al. 2010).

Edible wild plants are an important component of coping strategies in times of severe food shortage. Furthermore, commercialization of fruits of edible wild plants is increasing because of increased demand for fruit in urban centres and as a result of limited alternative economic options for the rural people (Mithofer & Waibel 2003). An estimated 15 million people in sub-Saharan African countries earn cash income from forest-related activities (Oksanen et al. 2003). Ecologically, tree and shrub species that provide edible wild fruits can be used in restoration of degraded lands and in maintaining biodiversity, which, in turn, improves ecosystem productivity. Increasing the abundance of edible wild fruit trees and shrub species (EWFTSs) provides a food source to wild animals, such as birds and lemurs, which are agents of seed dispersal, thereby, enhancing regeneration of indigenous species

In general, EWFTSs play important roles in African countries, such as Ethiopia that are known for the diversity of their flora and fauna, and communities in such countries depend on these resources for various services and products (Getahun 1974). Several studies have demonstrated the roles of EWFTSs as sources of income and as supplementary food sources during times of crisis (Balemie & Kebebew 2006, Teketay & Eshete 2004, Teketay et al. 2010, Wondimu et al. 2006). The contributions of EWFTSs in poverty eradication by enhancing ecotourism, access to improved food, and nutritional security are also well recognized (Makonda et al. 2003, Styger et al. 1999, Teketay et al. 2010). Thus, it is not surprising that the need for systematic assessment and documentation of EWFTSs and other non-timber forest products of the country is emphasized in the Forestry Research Strategy of the Ethiopian Institute of Agricultural Research (Anonymous 2002).

In Ethiopia, EWFTSs have distinct merits that account for their preference over cultivated commercial fruits (CCF). Since EWFTSs are adapted to local environmental conditions, they may fill food availability gaps, acclimating well during seasons of unfavourable conditions. Several wild fruits serve as useful sources of minerals and vitamins. A recent nutritional study on three indigenous fruit trees of Ethiopia by Feyessa et al. (2011) has shown that *Ziziphus spina-christi* (L.) Desf., *Balanites aegyptiacus* (L.) Delile, and *Grewia flavescens* Juss. are important sources of carbohydrate, protein, energy, and minerals.

In many cases the nutritional status of edible wild plants is comparable, and in some cases superior, to domesticated varieties (Maundu et al. 1997). Indigenous fruit trees may be less susceptible to disease and pest attack. If so, then they demand less production input in comparison with CCFs and are probably easier to integrate into the current farming system. Moreover, their food value is probably well understood with better acceptance by different categories of rural people. Nevertheless, efforts towards sustainable exploration of valuable tree and shrub species are very much limited because of lack of systematic approaches to manage and conserve natural resources (Tadesse & Mbogga 2004). The recognition of the role of indigenous knowledge in conservation and sustainable management of resources (Lulekal *et al*. 2011, Stave *et al*. 2007) has led to a growing emphasis to ethno botanical studies of different local communities. Traditional knowledge on EWFTSs and the extent of their use varies among different groups and individuals of the community (Mengistu & Hager 2008, 2010, Pfeiffer & Butz 2005).

Ethno botanical information on cultural, socio-economic, and nutritional values of wild plants is essential to assist the country's effort towards increasing food security (Lulekal et al. 2011, Teketay et al. 2010). Such information helps to better utilize its diverse fauna and flora, exploit their potential in sustaining food security and creating a healthy environment. However, the few earlier studies conducted in Ethiopia were focused on investigating medicinal plants (Balemie & Kebebew 2006), these limited studies addressed edible wild fruits together with other indigenous edible plants, and independent comprehensive studies are scarce. Nevertheless, site-specific identification and evaluation of people's preferences, analysing EWFTSs' potential for domestication, and assessing EWFTSs' contribution to product diversification are the primary tasks required for future conservation, expansion, and promotion of EWFTSs (Asfaw & Tadesse 2001).

From the above review noticed that wild and commercially available fruits possess high nutritional value. These fruits are good source of vitamins and minerals. Hence the present study aim to compare the nutritional status of the some selected wild and commercially available fruits.

OBJECTIVES OF THE STUDY

Raw consumption of edible fruits are also gives the protective effects. Literature survey point out that wild edible fruits are rich in vitamins and minerals. These fruits are good source of vitamins and minerals. Hence the present study aim to compare the nutritional status of the some selected wild and commercially available fruits. The main objectives are:

1. Collect the wild edible and commercially available fruits.
2. Compare the nutritive status of the ten wild edible and ten commercial fruits.

REVIEW OF LITERATURE

In many tropical countries, rural people traditionally harvest wide range of leafy vegetables, roots, tubers, fruits from wild because of its taste, cultural uses, as food supplements or to tide over food shortage, Wild plants have been recognized to have potential to meet household food and income security (Guinand and Dechassa,2000; Non cereal plant foods from forests contribute significantly to the diets of local residents in Africa (Getachew *et al*.,2005). Kebu and fassil,2006).Many wild fruits notably, Amla, Harida, Bel, Elephant apple have been exploited from wild for centuries across Indian subcontinent on account of its food and medical properties. Even today in Mediterranean Europe, gathering of wild fruits is a common practice; so is picking of wild mushroom in northern Europe (Pardo-de-santayana *et al*.,2007).

In rural countryside of many developing nations. Wild fruits are often the only fruits consumed as people cannot afford cultivated commercial fruits as apple, grapes, pomegranate or orange. In India, the indigenous fruits collected from wild play significant role in the food and nutrient security of rural poor and tribals. Some wild fruits have been identified to have better nutritional value than cultivated fruits (Eromosele *et al*., 1991; Maikhuri *et al*., 1994). As a result,in recent years, a growing interest has emerged to evaluate various wild edible plants for their nutritional features (Nazarudeen, 2010; Aberoumand and Deokule ,2009;Musinguzi *et al*.,2007;Nkafamiya *et al*.,2007; Glew *et al*.,2005). Inventory of wild food resources, ethno-botanical information on its adaptability coupled with nutritional evaluation can only establish the non-cultivated variety as real substitute for domesticated or cultivated species. Scrutiny of plants of various tropical forest areas through constituent analysis may lead to selection of valuable wild species that can be taken through crop improvement and hybridization process to establish it as cultivated variety (Mahapatra and Panda,2009).

The wild edible species are gathered mostly for home consumption and mainly by forest dwellers, tribal and marginalized rural communities. But some fruits as Chironji, Mahua, and Cashew are collected from forest for sale as well since it fetches good price. Most fruits in India are collected from wild in small quantity for consumption or at time during the festivals. But information on their nutritional and anti-nutritional properties are lacking, since none of the indigenous fruit plants has been brought under farm cultivation yet, detail on their nutritional utility storage ability etc., are not known except its consumption value and taste. Besides, there are many wild fruit relatives in forests that are underexploited, and their economic potential is yet to be tapped (FAO,1984; Aloskar *et al*.,1992). A wide array of wild fruits is collected by forest dwellers to supplement their food which necessitates scientific investigation of wild fruits plants nutritional and anti-nutritive properties.The present study explores the nutritional status of 10 wild edible fruits of deciduous forests of eastern India by profiling their biochemical attributes i.e., protein, carbohydrate, sugars, vitamin, anti-oxidants and micronutrient. Lots of phytochemicals are present in Annona muricata like alkaloids, flavonoids, carbohydrate, tannins, terpenoids and proteins.

Murray and Schoeninger (1999) reported the nutritional composition of commercial fruits like dragon fruit, apple, orange etc. which is compared to agricultural fruits , although they were higher in protein, carbohydrate, and energy and low in fat. Other researchers also studied about the moisture protein, fats, nonreducing and total sugar, fiber, total vitamins, and energy value were carried out and they compared their results with 10 common cultivated fruits (Nazarudeen , 2007).

Nkafamiya *et al* ., (2007) suggested the nutrient content of seed of some wild plants. He studies about the physicochemical characteristics of the Deterium microcarpum, Balani tesaegytiaca and Gemilin arbora oils. Proximate value of the protein oil and carbohydrate content of the seed may be adequate for the formulation of animal feed. They also found that the aglycone for all the glycoside detected was found to be in benzaldehyde.

Sathyavathi and Janardhanan (2011) studied about the wild edible fruits usd by Badgas of Nilgiri district, Western Ghats, Tamilnadu, India. They summaries Nilgiri was originally a tribal land, they also maintain the climate which is favorable for wild edible fruits. But the local people do not aware about the economic value of such wild fruits. Hence they desired to study and conserve those wild edible fruits and cultivate in large scale for to uplift their economic status near in future. (sathyavathi *et al* , (2011)

Mahadkar and Valvi(2012) studied about the Nutritional assessment of some wild edible plants as a good source of Minerals. They selected 10 plants for the study of anti- nutritional factors. They are Ensete superbum, Gmelina arborea Roxb, Oroscylum indicum Vent , Bauhini ceracemosa Lam , Carota urens L, Smilax zeylanical, Woodfordia fruticosa, Commelina benghalensis, Gaxinia indic, Zanthoxylum rhestsa. The result they concluded that the highest level of phytate in Ensete suoerbum, oxalate was highest in smilax zeylansea. Tannin was highest in Bauhinia racemose, saponin was absent in all plants. Finally they concluded that the values of anti-nutrients in all above plants are below the toxic levels of anti- nutrients. (Mahadkar *et al*, 2012).

Papaya is commonly known edible fruit and which has high nutritional value.it also has medicinal properties in traditional system of medicine. Krishna, paridhavi, jagruti (2008) worked in the nutritional medicinal and pharmacological properties of papaya. They concluded that fruits, leaves and leaves obtained from papaya plant are used as medicine and various other purposes. Papaya contains phytochemicals including polysaccharides, vitamins, minerals, enzymes, protein, fats, flavonoids etc. (krishna *et al*, Natural product Radiance, Vol 7(4), 2008)

Dragon fruit is an exotic plant that has high nutritional value and bringd multiple benefits. Luu T. T.H., studies about the health benefits, nutrients and its sustainable development under climate changes in Vietnam. They suggested that Dragon fruit has high biological activities against pathogenic microbes including bacteria, fungi and viruses and also they have cardiovascular and hepatoprotective properties as well as prebiotic potential. (Luu T.T.H., Le T.L., *et al*, Czech journal of food science,39, 2021)

Strawberry is a commercial edible fruit which contain carbohydrate, protein, vitamins and minerals. Yogesh kumar and other scientists studied about the enhancement in yield and nutritive qualities of strawberry fruits by the application of organic manures and biofertilizers. strawberry is a fresh fruit contain antioxidans including carotrnoids, vitamins, phenolics, flavonoids and also contain protein, carbohydrate and minerals and concluded that use of organic manure and bio fertilizers can be an effective and eco-friendly. This strategy may not use only enhance the crop production but also improve the soil quality and fertility. (Yogesh Kumar, *et al*, Scientia Horticulture, volume 283, 2021)

Nutrition is an important part of health and development of human being. Need better nutrition for to improved infant child and maternal health. Fruits and vegetables contain vitamins minerals and plant chemicals and also plant fibers. No single fruits can provide all of the nutrients we need to be healthy. Fruits and vegetables are very low in energy since they contain high amount of water and fiber. It can be consumed in a relatively larger amount contributing to increased and maintain normal weight. Additionally, fruits are very helpful to prevent obesity. High consumption of fructose in fruits and vegetables is related to obesity in rodents but no effect has been demonstrated in humans.

Phytochemicals in fruits and vegetables have been found to be act as anti- obesity agents that is why because they may play a role in suppressing growth of adipose tissue. Recent study by Vilaplana *et* al. demonstrated that *Carica papaya* and *morinda citrifolia* exhibited high lipase inhibition which can be considered as potential options for the management of obesity and maintaining body weight.

Eating a range of fruits provides the body with nutrients and antioxidants that can boost overall health and reduce the risk of disease. Good choices include oranges, apples, dragon fruit, papaya, kiwi, but there are many more to choose from. Eat a diet high in fruits and vegetables can reduce a person's risk of developing heart diseases, cancer, inflammation, and diabetes. Citrus fruits and berries may be especially powerful for preventing disease.

Foods of similar colures generally contain similar protective compounds. Try to eat a rainbow of colourful fruits and vegetables every day to get the full range of health benefits. Red foods like tomatoes and watermelon contain lycopene, which is thought to be important for fighting prostate cancer and heart diseases. Green vegetables contain lutein and zeaxanthin, which may help protect against age related eye diseases. Blue and purple foods contain anthocyanin and, which help to protect the body from cancer. White foods contain sulforaphane and may also help to protect against some cancers. To maximize nutrients and appeal buy and serve different types of fruits and vegetables. Try to buy fruits and vegetables that are in season and choose for freshness and quality.

Fruits and vegetables have also been suggested to prevent osteoporosis in adults mainly for their rich sources of calcium and other vitamins which are vital in bone health. The high fibre content of F&V may play a role in calcium absorption and reduce the 'acid load' of the diet. Enhancing bone formation and suppressing bone reabsorption which consequently result in greater bone strength. Moreover, Phyto ingredients in Fruits and vegetables such as gooseberry, curcumin, and soya isoflavones have shown to be protective against lens damage which occurs due to hyperglycaemia and certain flavonoids such as quercetin can prevent oxidative stress in the pathogenesis of glaucoma. Also, a high intake of fruits was inversely associated with the risk of COPD and respiratory symptoms. Higher total fruit and vegetable intake is also associated with lower risk of cognitive decline hence proved beneficial for mental health. Based on available evidence, a clear relationship between Fruits and vegetables and diseases has been well established however no protective effect of overall fruit and vegetable intake (FVI) against lung diseases were found. Green leafy vegetables, rather than fruit, were suggested to have a genuine protective effect against lung cancer. Risk of proximal colon cancer, rectal cancer and aggressive and non-aggressive urothelial cell carcinomas are not associated with FVI and no protective role were seen on the risk of endometrial cancer in post-menopausal women.

The accepted recommendation is to consume a variety of Fruits and vegetables because studies demonstrate that a combination of fruits and vegetables have more potential benefits rather than a single fruit or vegetable. However further studies are warranted. Interestingly, phytochemicals in F&V have been found to act as anti-obesity agents because they may play a role in suppressing growth of adipose tissue. Adiposity is closely related to biomarkers of oxidative stress and inflammation and a diet rich in F&V can modify these adiposity related metabolic biomarkers in overweight women. A recent study by Vilaplana *et al.* demonstrated that *Carica papaya* and *Morinda citrifolia* exhibited high lipase inhibition which can be considered as potential options for the management of obesity and maintaining body weight. To date, the red varieties of *Allium cepa*, *Lactuca sativa*, *Capsicum annum*, *Brassica oleracea var sabellica* and orange-fleshed type of *Ipomoea batatas* appear to be the richest vegetables sources of potential anti-obesity phytochemicals that can control the initiation and development of obesity.

It is also understood that fruits and non-starchy vegetables are very low in energy since they contain high amount of water and fiber and can be consumed in a relatively larger amount contributing to increased satiety to maintain normal weight. Fibers also form a gel-like environment in the small intestine, resulting in reduced activity of the enzymes involved in the digestion of fat, protein and carbohydrates (Hence an increased FVI can help to ease weight loss and this can be achieved when F&V displace high-energy-dense foods such as saturated fats, sugar so that the overall energy density of the diet is reduced. Additionally, fruits have been suggested to prevent obesity since they add up to dietary variety both between and within food groups and palatability to the diet which has been revealed to be an important predictor of body fat. However discrepancies exist with respect to F&V with high glycemic index carbohydrates that are related to a more immediate decrease in appetite and increase in food intake in the short term. High consumption of fructose in F&V is related to obesity in rodents but no effect has yet been demonstrated in humans. FVI in over-weight and obese people is much lower than the recommendation since they tend to restrict intake of these F&V when trying to lose weight.

A significant relationship was observed between BMI and vegetable intake whereby overweight participants had lower intake of vegetables. This finding is consistent to that) who also found a clear trend between prevalence of obesity and low FVI. Furthermore given that fruits are often eaten raw but vegetables are frequently prepared by adding fatty substances (e.g. oil while frying) which reduce the low energy dense uniqueness of vegetables, nutritionists should be careful when promoting FVI among population because the idea may not work with all target population. For instance, the intake of vegetables is associated with a higher risk of obesity in Chinese adults due to use of oil for stir frying vegetables and this highlights the importance of choosing the right cooking methods. Interestingly, many studies report a decrease in body weight with increased FVI. For instance, in a 10 year follow up study, high FVI reduced long-term risk of weight gain and obesity among Spanish adults demonstrated greater weight loss from high vegetable intake when a high vegetable diet was compared with a control diet comprised of 'usual intake'.

MATERIALS AND METHODS

Collection and authentication of plant materials

The present study explored the nutritional status of the fruit of 10 wild (*Table I)* and 10 commercial fruits (*Table II*) by profiling their physical properties (color, taste and smell) and biochemical attributes such as carbohydrate, sugar, protein, and vitamins.

Total carbohydrate:

The sample extract was prepared by hydrolyzing the sample in 2.5 N HCl for 3 hours in boiling water bath, followed by neutralizing it with sodium carbonate. Centrifuged the mixture, and, the supernatant collected was used for the analysis, following the method of Hedge and Hofreiter (1962).

Total sugar:

The total sugar was estimated using Anthrone's method (Rangana, 1979). 1 mL of alcoholic extract was taken in a test tube and chilled. After a while, 4 mL of anthrone's reagent was carefully added to the extract and the test tubes were immersed in ice water. The tubes were then brought to ambient temperature and then boiled in water bath for 10 min. After proper cooling, the absorbance was measured at 625 nm.

Protein:

The quantity of protein was estimated following the method of Lowery *et al.* (1951). 5 mL of fresh fruit juice along with 5mL buffer (2% Na_2CO_3 in 0.1 N NaOH) was taken in a centrifuge tube and allowed to centrifuge for 10 min at 10000 rpm. Pipetted out 0.1 mL and 0.2 mL of the supernatant separately in two test tubes and made up to 1mL by adding distilled water. Then 0.5mL of alkaline copper solution was added and mixed well and allowed to remain as such for 10 min. 0.5mL of Folin- Ciocalteu's reagent was added to the mixture and mixed well and kept at room temperature in dark for 30 min, till the blue color appeared. Then the reading was taken at 660nm and the standard graph was drawn, from which the amount of protein was calculated by the formula

20 x OD of Sample x Total Volume of Sample Total protein =
0.3 x Volume of Sample x Weight of Sample

Where,

20= Concentration of standard

0.03 = OD of the standards

Vitamins:

Estimation of vitamins like A, C, E, B1, B2, B3 and folic acid (B) in the fruits of ten wild and commercially available fruits were analyzed following the methods described below.

Retinol (Vitamin A)

For estimating the quantity of vitamin A, the method of Arnon (1949) was followed. 3 mL of fresh fruit juice was taken and added to 5 mL of 50% (w/v) potassium hydroxide solution and 50 mL of ethyl alcohol. The mixture was refluxed in a water condenser for 1 hr. Then cooled and transferred to a 500mL separator, to which 50 mL of hexane was added and shaken vigorously for 5 minutes that resulted in the formation of two separate layers. The upper organic layer was collected into another 200mL volumetric flask and added with15gm sodium sulphate anhydrous crystals, and allowed to dissolve very well and made it with 100mL hexane. The mixture was shaken and the flask was allowed to settle in a dark cool place. The absorbance was recorded at 325 nm by a UV spectrophotometer. Using the factor 1830, the vitamin A content was calculated and expressed in International units (IU).

$$\text{Vitamin A (IU)/100g sample} = \frac{\text{Sample absorbance x 200 x 1830}}{\text{Weight of the sample}} \times 100$$

Ascorbic acid (Vitamin C):

10mL of standard stock solution (0.05 g of L-ascorbic acid standard was added into 20 mL MPAA solution and diluted with 250 mL distilled water) and 5 mL of MPAA solution (15 g of Metaphosphoric Acetic Acid) were added into 40 mL of glacial acetic acid and diluted with 100 mLof distilled water and then added and titrated against 2,6, Dichloro-phenole indophenols solution (2,6-Dichlorophenol Indophenols salt (0.05g)These are diluted with 100 mL of distilled water and the solution was filtered till the appearance and persistence of pink color for 10 seconds. The titration was completed within 2 minutes. The titer value was noted. 100mL of sample solution (10 mL of fresh fruit juice was added in a 20 mL MPAA solution and diluted with 500mL distilled water. Subsequently the solution was filtered through a filter paper) was taken and the same procedure was repeated. Quantity of Ascorbic acid was calculated by the following formula:

$$\text{Ascorbic acid (mg)/100mg of sample} = \frac{\text{SAVx STVx10x500x1xSTP}}{\text{STWx250x1xSAWx100x100}} \times 100$$

Where,

SAV = sample titer value STV = standard titer value STW = standard weight SAW =sample weight STP = standard purity

Vitamin E (Tocoferol):

For the estimation of vitamin E,2 mL of the sample (fresh fruit juice) was refluxed with equal volume of acetone and ethanol for 5 minutes. 1 mL of 60% KOH was added and boiled for 3 minutes. The solution was then cooled and added in 25 mL of distilled water. Transferred that into a separating funnel and 50 mL diethyl ether was added and shaken well. The solution was kept for some time for the complete separation of ether. This process was repeated thrice and kept the mixture to allow the ether to evaporate completely. After that the dried up residue was dissolved in hexane: ethanol mixture (1:1) and then made the mixture to evaporate for the complete removal of ethanol. The dry extract was redissolved in 1mL hexane.

Read the absorbancy at 292nm against ethanol as blank. Using the factor 0.40, the quantity of Vitamin E was calculated as follows:

Absorbance of sample – (0.40 x absorbance of sample) Vitamin E (mg/100ml) = ___
Absorbance of standard

Vitamin B1 (Thiamin):

10 mL of fresh fruit juice and working standard solution (5 mL of 50mg thiamine hydrochloride in 500 mL distilled water + 100mL buffer (6.8 g of potassium dihydrogen phosphate +8mL of 1 M sodium hydroxide + 1000 mL H_2O) were taken in two different dry separating funnels and added with 10mL of chloroform and 10 mL of dye (0.06g bromothymol blue was dissolved in 10 mL chloroform) into the funnels and shook for 2 minutes continuously. That was kept for 5 minutes for separation. The bottom layer was discarded carefully and sodium sulphate anhydrous (1 spatula full) was directly added for the clearing of the extract. By using a Pasteur pipette the clear extract was collected into a dry test tube and read the absorbency at 420 nm against the blank (chloroform). The quantity of Thiamine was estimated as follows:

SAAxSTWx1x10x10x1xSTP
Thiamine HCl (mg)/100g of sample = ________________ x100 x 100
STAx100x100x1xSAWx10x10

Thiamine (mg)/1mL sample =Molecular weight of Thiamine /Molecular weight of thiamin HCl
Where,

SAA = Sample absorbance STA = Standard absorbance STW = Standard weight SAW =Sample weight

STP = Standard purity

Vitamin B2 (Riboflavin):

To determine the quantity of Vit. B2, 150 mL distilled water and 5mL glacial acetic acid were added to 5 mL of the fresh juice. The solution was boiled for 5 minutes and then cooled. After that, 30 mL of 1M Sodium hydroxide solution was added and diluted up to 550 mL

with distilled water. The solution was filtered and the absorbance was measured at 444nm in spectrophotometer. Distilled water was used as blank. The quantity of Riboflavin was estimated by the formula:

Riboflavin(mg)/100g of sample=
SAx500x1 328x SWx 100

x 100 x 100

Where,

328 = Molar extension coefficient SA = Sample absorbance

SW = The sample weight

Vitamin B3 (Niacin):

2 ml of fresh juice was mixed well with 10 ml of distilled water and centrifuged at 3000 rpm for 10 minutes. The supernatant was transferred into a conical flask for titration. Two or three drops of Phenolphthalein were added into the supernatant and titrated with 0.1N NaOH until the end point was reached.

Nicotinic acid/gm in the sample = Titer no. x 0.0123/1ml = Y gm Gm% = Y/sample weight x 100

Vitamin B9 (Folic acid):

Folic acid was estimated following the method of Hulching *et al*. (1947), with minor variations. 5mL of fresh juice was taken in a 100mL standard flask and added to 50mL of Dibasic Potassium Phosphate (K2HPO4) solution. Then the mixture was heated not above 60^0 C to disperse the sample properly. The mixture was cooled at room temperature and made up to 100 mL with Dibasic Potassium phosphate (K_2HPO_4) solution. Centrifuged the solution and four aliquots were taken from the supernatant and added with 1mL Sodium nitrate solution and 1 mL of 5N Hydrochloric acid into all the tubes. Mixed them and allowed to remain for 2 minutes and 1 mL of Ammonium sulphate was then added and mixed by swirling. Then, 1mL of N-(1- naphthyl) ethylene diamine dihydrochloride solution was mixed and kept for 10 minutes. Then

10gm Sodium chloride and 10mL of iso-butyl alcohol was added and shaken vigorously for 2-3 minutes. Then the isobutyl alcohol layer was separated by centrifugation. Took 9mL of the clear supernatant layer and read the absorbancy of the solution at 550 nm within 25minuts using iso- butyl alcohol as the blank. The quantity of Folic acid was estimated by the formula

$$\text{Folic acid} / 0.4C = \frac{A_1 - A_3}{A_2 + A_3 - (A_1 = A_4)}$$

Where,

C= concentrations of the working standard of folic acid in mg/ml A_1, A_2, A_3, A_4 = the absorbance of tubes 1,2,3,4 respectively.

Mineral analysis

Both macro, (Ca, P, K, Mg, Na, Cl, Fe, S) micro (B, Mn, Zn, Cu, Ni) and mineral elements of the samples were determined according to Walinga *et al.* (1989). 1mL of fresh fruit juice was digested with 4ml of a mixture of perchloric acid (HClO4, 60%) and concentrated sulfuric acid at the ratio 7:1 and 15ml of concentrated nitric acid. After complete digestion, the product was cooled, filtered and the volume was adjusted to 50 ml with distilled water except for Calcium where the filtered solution was diluted with 4.8 ml of lanthane (La2O3,1%). The quantity of Potassium was measured using a flame photometer (corning 400, Essex, England) and that of Phosphorus was determined with a Skalar auto analyzer (Skalar Breda, Netherlands) and all other minerals (Ca, Mg, Na, Cl, Fe, S, B, Mn, Zn,Cu, Ni) were quantified by an Atomic Absorption Spectrophotometer (Perkin Emer Analyst 100)

Data analysis

The collected data were standardized by determining mean values, and the values were statistically analyzed using the SPSS software. Single factor Analysis of Variance (ANOVA) with post hoc Duncan's test ($P<0.05$) was used to compare the mean values. The graph plotted using MS excel software.

Table No: 1 List of Wild Edible and Commercially Available Fruits.

Wild Edible Fruits		**Commercially Available Fruits**	
CODE	**Scientific Name**	**CODE**	**Scientific Name**
W 1	*Annona muricata L.*	C 1	*Carica papaya L.*
W 2	*Annona squamosa L.*	C 2	*Passiflora edulis sims*
W 3	*Elaeocarpus serratus L.*	C 3	*Hylocereus undatus (Haw.)Britton & Rose*
W 4	*Mangifera indica L.*	C 4	*Citrullus lanatus (Thunb.) Matsum.&Nakal variety*
W 5	*Anacardium occidentale L.*	C 5	*Vitis vinifera L.*
W 6	*Phyllanthus emblica L.*	C 6	*Actinidia chinensis Planch*
W 7	*Ixora coccinea L.*	C 7	*Fragaria x ananassa (Duchesne ex Weston) Duchesne ex Rozier*
W 8	*Averrhoa carambola L.*	C 8	*Malus pumila Kitam.*
W 9	*Zizipus oenopolia (L.) Mill.*	C 9	*Manilkara zapota (L.)P.Royen*
W 10	*Syzygium jambos (L.) Alston*	C10	*Citrus sinensis (l.)osbeck*

RESULTS AND DISCUSSIONS

In this study, a total of twenty (ten wild and ten commercial cultivar) edible fruits were taken and they are listed in Table II and Table III, along with their local name, Malayalam name, parts used, availability and uses. Table II contain the details of the wild edible fruits. They are *Annona muricata*, *Annona squamosa*, *Elaeocarpus serratus*, *Mangifera indica*, *Anacardium occidentale*, *Phyllanthus emblica*, *Ixora coccinea*, *Averrhoa carambola, Zizipus oenopolia and Syzygium jambos* , and its common names are Soursop, White sweetsop, Ceylon olive, Mango, Cashew Nut, Gooseberry, jungle flame, star fruit, Jackal fruit, and rose apple respectively. Commercially available cultivated fruits namely *Carica papaya, Passiflora edulis, Hylocereus undatus, Citrullus lanatus, Vitis vinifera, Actinidia chinensis, Fragaria ananassa, Malus pumila, Manilkara zapota and Citrus sinensis*, which are listed in Table III.

Most of the wild fruits are collected from the families Annonaceae, Elaeocarpaceae, Anacardiaceae, Phyllanthaceae, Rubiaceae, Oxalidaceae Rhamnaceae and Myrtaceae. Fruits are the useful part. The fruits are eaten raw. *Mangifera indica Phyllanthus emblica and, Syzygium jambos are* not eaten raw only but is used to making juice too. The fruiting and flowering of the wild fruits started mostly from March onwards. Commercially available fruits are collected from the families like Caricaceae, Passifloraceae, Cactaceae, Cucurbitaceae, Vitaceae, Actinidiaceae, Rosaceae, Sapotaceae, Rutaceae. All the commercial fruits are available throughout the year. These fruits are eaten raw and used to making juices, puddings, squashes, jellies etc. The wild fruits are seasonal ie, not available all time of the year. But in the case of the commercially available fruits, its availability is any time in a year. Majority of these fruit are eaten in the ripen stage. Due to the lack of popularity and overexploitation of wild areas these plants are decreasing gradually and some are rarely found. To protect and popularize these wild edible fruits awareness should be needed among people (Tadesse *et al*, 2004).

Profiling of the Physical Properties and Biochemical Attributes of 10 Wild and 10 Commercial Edible Fruits are given in the Table III. Physical properties such as color, odor and taste were examined. Wild species like *Annona muricata ,Annona squiamosa* , *Anacardium occidentale* are white color, *Phyllanthus emblica* is cream color, *Mangifera indica* is yellow color, *Elaeocarpus serratus* is olive green, and *Averrhoa carambola, Zizipus oenopolia, Ixora coccineae, Syzygium jambos* are orange, brown, red and pink respectively. All the commercial available fruits are brightly coloured. *Carica papaya, Passiflora edulis, Hylocereus undatus,* and *Citrullus lanatus* are orange color. *Vitis vinifera, Actinidia chinensis, Malus pumila, Manilkara zapota , Citrus sinensis* are brightly coloured . It is clear from the above studies that wild edible fruits do not have attractive color or smell. All fruits pulp have a sour mixed taste. But commercial fruits have attractive color and the fruit pulp is very sweet and tasty (Fig.III). One of the most common interpretations regarding the color of the fruits is the disperser syndrome hypothesis, which is in flavour of a main role of biotic factors (bird and mammal frugivories, in particular) in selecting fruit colours according to specific visual perception abilities (Vishwakarma *et al*,2011). It is quite common that seed-dispersing birds prefer red and black fruits, whereas fruits with more cryptic colours, yellow, green, or brown, are preferred by mammals' frugivories (Crozier A. *et al*, 1997). Under this perspective, colour may represent a specific signal indicating precise messages, such as the degree of fruit maturity, to avoid premature fruit removal from the plant, and can facilitate recognition of specific food sources, such as certain carotenoids, as nutritional rewards (Seal, T. *et al*, 2011).

Another important characteristic of the fruit is the od of the fruits. Fruit aromas are crucial volatile organic compounds (VOCs) in plants. They are used in defense mechanisms, along with mechanisms to attract pollinators and seed dispersers. In addition, they are economically important for the quality of crops, as well as quality in the perfume, cosmetics, food, drink, and pharmaceutical industries. Fruit aromas share many volatile organic compounds in flowers and fruits. Volatile compounds are classified as terpenoids, phenylpropanoids/benzenoids, fatty acid derivatives, and amino acid derivatives. The wild edible like *Annona muricata, Annona squamosal, Elaeocarpus serratus, Mangifera indica, Anacardium occidentale,* are having pleasant smell, *Phyllanthus emblica*, is slightly acidic, *Averrhoa carambola* is sour fruit, *Zizipus oenopolia* is grape soda, *Syzygium jambos* is rose water smell and *Ixora coccineae* has no smell. In the case of commercial fruits, the smell is very important. Olfactory attractants can be used to develop effective, nontoxic traps for detection, monitoring, and control of fruit fly pests. Fruit aroma is a key contributor to fruit quality and acceptance by animal and human. Fruit aroma consists of various chemical compounds (e.g., aldehydes, alcohols, ketones, esters, lactones, and terpenes). (Saka, J. K, *et al*, 1994); the presence or absence of certain compounds determines differences among fruit aromas. In a wide range of fruits, the production of volatile compounds beginning from fruit-set to late-ripening is modulated by the accumulation of fruity esters, terpenes, and other compounds.

Many factors regulate aroma emission by fruits. Fruit genotype influences flavor. The final flavor profile is affected by environmental conditions such as climate, sunlight, soil, fruit ripening, harvesting time, and post-harvesting processes Environmental stresses (e.g., temperature and drought) influence fruit metabolism and aromatic compound content (Aloskar, *et al* 1992)). Terpenoids dominate the aroma profile in some fruits during ripening, such as apple (Feyessa *et al*, 2011). In grape, some phenyl propanoids increase with maturation (Saka, *et al* 1994). Therefore, maturation is vital for VOC emission in fruits and affects commercial production.

Carotenoids are important components of fruit aroma and important precursors of volatile norisoprenoids, which influence the aroma profile of fruits despite their presence at low levels. In some tomato and watermelon varieties, the degradation of carotenoids into lycopene pigment (red) produces geranial, a lemon-scented monoterpene aldehyde. Furthermore, the degradation of β-carotene and lycopene in "Sui hong" papaya fruit results in a pleasant aromatic odor. In cashew apple (*Anacardium occidentale* L.) juice, the thermal degradation of carotenoids produces an aroma profile of 33 active odor volatiles, such as 1,2,3,5-tetramethylbenzene, naphthalene, and p-xylene (van Dillen, *et al* 1996). Carotinoids, the tetraterpenoid compounds that are responsible for fruit colour are also rich source of antioxidants.

Vitamin analysis of 10 wild and commercially available fruits are given in the table 5.Amount of vitamin A, vitamin C, vitamin E, vitamin B1, vitamin B2, vitamin B3 and vitamin B9 are listed in the above-mentioned table. Vitamin A has significant role in normal vision, gene expression, growth, and immune functioning

(Buehler *et al*,2011). Its content ranged from 20±0.001 mg/100 g in *Manilkara zapota* to 120±0.001 mg/100 g in *Phyllanthus emblica*. For β-carotene (vitamin A) content, the highest (120±0.001 mg/100 g) was recorded in *Phyllanthus emblica* and the lowest (20±0.001 mg/100 g) was recorded in *Manilkara zapota*. From the Table III, we can notice that the value of Vitamin A of the each wild and commercially available fruits. The wild fruits having beta carotene is *Annona muricata, Annona squamosal, Elaeocarpus serratus, Mangifera indica, Anacardium occidentale, Phyllanthus emblica, Ixora coccineae, Averrhoa carambola, Zizipus oenopolia and Syzygium jambos*. Beta- carotene enhances the growth of cells and tissues, fortifies the immune system against diseases, and delays aging. Besides that, it helps keep the eye, skin, nails, and hair functioning effectively (Pinto *et al*,2011). The β-carotene values of the fruits serve as a great backup to their vitamin A levels, and therefore could be converted to vitamin A in the body to supplement it.

Another vital nutrient that is Vitamin C content (mg/100 g) varied significantly from 34.2±0.001mg/100 g in *Vitis vinifera* to 53.464±0.001mg/100 g in *Citrullus lanatus.* This vitamin is a crucial antioxidant that enhances non-heme iron transport and absorption, the reduction of folic acid intermediates, and the production of cortisol. Highest range of Vitamin C reported in *Citrullus lanatus* while vitamin C present low level in *Vitis vinifera.* Vitamin C is vital in the synthesis of collagen and other connective tissues. Its insufficiency in the body results in the fragility of blood capillaries, gum decay, and scurvy (Asfaw *et al*, 2001&Saito *et al* 2009).The study shows that all the wild edible fruits under investigation are good sources of vitamin C. *Mangifera indica, Phyllanthus emblica, Averrhoa carambola, Elaeocarpus serratus, Anacardium occidentale, Zizipus oenopolia* are comparable to contemporary cultivars such as papaya and strawberry and richer in Vit-C content than orange, apple, pomegranate and Kiwi. The comparative study also revealed wild edible fruits to be superior in respect of Vitamin composition.

The most important vitamin in fruits and vegetables for human nutrition is vitamin C. More than 90%of the vitamin C human diet is supplied by fruits and vegetables (Fenech *et al*,2019). Vitamin C is required for the prevention of scurvy and maintenance of healthy skin, gums and blood vessels. Vitamin C also known to have many biological functions in collagen formation, absorption of inorganic iron, reduction of plasma cholesterol level, inhibition of nitrosamine formation, enhancement of the immune system, and reaction with singlet oxygen and other free radicals (Lee *et al*, 2000). Vitamin C, as an antioxidant, reportedly reduces the risk of arteriosclerosis, cardiovascular diseases and some forms of cancer (Agius *et al*,2003).

Next important vitamin studied in the 10 wild edible and 10 cultivated fruits are Vitamin E or Tocoferol. Vitamin E is a fat-soluble vitamin, essential for health. The amount of content ranged from 0.01±0.001 to 0.32±0.003. Maximum content was observed in Annona muricata (0.32±0.003) and *Annona squamosa* (0.32±0.003) and the least amount observed in Manilkara zapota. The remaining species of the 10 wild (*Elaeocarpus serratus, Mangifera indica, Anacardium occidentale, Phyllanthus emblica, Ixora coccinea, Averrhoa carambola, Zizipus oenopolia and Syzygium jambos*) and 10 cultivated species (*Carica papaya, Passiflora edulis, Hylocereus undatus, Citrullus lanatus, Vitis vinifera, Actinidia chinensis, Fragaria* *ananassa, Malus pumila, and Citrus sinensis,*) were arranged in between the range. Vitamin E possesses powerful neuroprotective, anticancer and cholesterol-lowering properties that are often not exhibited by tocopherols. Vitamin E able to exert many and different biological activity in plant, animal and human cell. Vitamin E deficiency is developed in premature infants and in persons with a chronic malabsorption of fats, as well as mild anemia, ataxia and pigmentary changes in the retina (Rickman *et al,*2007).

Another important vitamin, Vitamin B1, (Riboflavin) is the universal precursor of the coenzymes flavin mononucleotide and flavin adenine dinucleotide- cofactors that are essential for the activity of a wide variety of metabolic enzymes in animals, plants, and microbes. Table 3.4 shows the range of Riboflavin (Vitamin B2) too. It varies from 0.1±0.001 mg/100ml to 0.4±0.004 mg/100ml. High amount of Riboflavin shows in *Averrhoa carambola* and the lowest in *Passiflora edulis. Annona squamosal,* and *Hylocereus undatus*, shows similar range of riboflavin. A balanced diet meets the riboflavin recommended daily Allowance (RDA) corresponding to 1.4 mg/day for an adult man (Goodrich *et al,* 2000) as well as human gut icrobiota act as riboflavin supplier through insitu production (Garcia-Angulo *et al* 2017). Riboflavin deficiency is one of the most common vitamin deficiencies in developing countries especially those with rice as the staple food coupled with insufficient milk and meat intake (Buehler *et al,* 2011). It is usually due to dietary inadequacy but also occurs most frequently in people with long-standing infections, liver disease and alcoholism (Pinto *et al,*2016). Consequences of ariboflavinosis in humans includes sore throat, hyperaemia, oedema of oral and mucous membranes, cheilosis and glossitis which further leads to loss of hair, inflammation of skin, cataract development, migrane prophylaxix and decrease in haemoglobin status. Worsening symptoms include a swollen tongue, seborrheic dermatitis, anemia and impaired nerve function (Thakur *et al,*2017).

In the current study, Niacin, a water-soluble vitamin calculated. This vitamin is essential for the metabolism of carbohydrates, protein ad fats and also serves as a building block for nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate. The amount of niacin ranged from 0.12±0.001 to 1.72±0.003. The highest value was observed in *Citrullus lanatus* and smallest value observed in *Anacardium occidental.* Previous studies have shown niacin has neuroprotective effects on the central nervous system. Niacin has antiapoptotic, anti-inflammatory, antioxidant and neroprotective effects at least equal to methylprednisolone in ischemia/reperfusion injury of the spinal cord. Niacin has varied effects on body tissues including the central nervous system. It has been demonstrated that niacin has beneficial effects in the treatments of dyslipidemia, hypercholesterolemia, type 2 diabetes mellitus, obesity, atherosclerosis, hyperalgesia, lung and kidney damage, nerodegerative disorders, and psychological disorders (Shen *et al,*2023).

Folate refers to Vitamin b9, a water-soluble B vitamin that occurs in many chemical forms, including naturally in foods such as leafy greens, fruits, nuts, peas, seafood, eggs, dairy products, meat and poultry. In the present study the amount of folic acid ranged from 17.08±0.003 to 34±0.003. The highest amount was observed in *Annona squamosal* and *Hylocereus undatus* and the lowest level observed in *Citrus sinensis*. Folic acid supplementation for persons in the periconceptional period has been found to reduce the risk of neural tube defects in offspring. Despite folic acid fortification of food and supplementation guidelines, folic acid fortification o food and supplementation guidelines, folic acid deficiency remains a concern in the US. Low levels of maternal folate may be due to inadequate dietary intake, poor intestinal absorption, medication use that interferes with folic acid function and impaired folate metabolism. Survey data from 1998 to 2016 found that approximately 20% to 40% of women who were recently pregnant or trying to get pregnant reported taking periconceptional folic acid supplement.

The mineral composition of the eleven taxa of *Passiflora* species is given in Table 6. Potassium (K) content was observed to be the highest (182-410 mg/100 ml) compared to the other minerals. *Elaeocarpus serratus* showed higher quantity of

Potassium (410mg/100 ml) and Sodium (68mg/100ml), whereas the lowest was found in the fruits of *Averrhoa carambola* (101 mg/100ml, 38mg/100ml). The other species showed an intermediate range. Calcium (Ca) content of the fruit juice ranged from 9mg/100 ml to 12.3mg/100 ml. Among all the trace minerals analyzed, Zink (Zn) and Copper (Cu) were found in the least quantity. However, presence of Cobalt (C0), Boron (Br) and Nickel (Ni) were not detected in any of the sample. It was observed that the presence of Mn and Se were negligible in quantity.

Plants requires seventeen essential mineral elements for proper growth and functioning. The analysis of mineral composition of 10 wild edible and 10 commercially available fruits revealed high amount of calcium, potassium, phosphorus and sodium as compared to other minerals. This suggests the high nutritive value of 10 wild and commercially available fruits and its role in various physiological functions. Tang *et al*. and Han had suggested the significance of microelements in diverse physiological and biochemical functions of the human body. Na and K together with Cl are helpful in maintain normal fluid balance in cells as well as proper acid-base balance in the body. However, the lower sodium content of *Anacardium occidentale* and *Phyllanthus emblica* varieties might be an added advantage to human beings due to the direct relationship of sodium intake related to hypertension. The study revealed that the species of wild edible fruits are good sources of iron and phosphorus in addition to calcium, than commercially cultivated fruit. Farid *et al.*, Silva *et al*. , and Zucolotto *et al.* had also reported high amount of iron, calcium, and phosphorous in *10 wild edible fruits*.

From the literature noticed that the antinutrient contents of the fruits were relatively low, and might not pose any serious health problems, especially with their high concentration of mineral absorption enhancers such as β-carotene and vitamins A and C. Therefore, with the nutritional and antinutritional information from the literature provided in this study, it is evident that these forest fruits, which lack public patronage and consumption in the Ghanaian community despite their availability, could be relied on to fight hunger and some nutrient deficiencies. However, due to the seasonality and perishability of the fruits, it would be very expedient to process them into finished and novel food products such as beverages, bakeries, or cookies to ensure extended consumption.

Table No: 2 List of Wild Edible Fruits.

CODE	COMMON NAME	SCIENTIFIC NAME	LOCAL NAME	FAMILY	PARTS USED	AVAILABILITY	USES
W 1	Soursop	*Annona muricata* L.	മുള്ളാത്തി	Annonaceae	Fruit	March-October	Fruits are eaten raw when ripe
W 2	White sweetsop	*Annona squamosa* L.	സീതപ്പഴം	Annonaceae	Fruit	March-June	Fruits are eaten raw when ripe
W 3	Ceylon olive	*Elaeocarpus serratus* L.	കാരക്ക	Elaeocarpaceae	Fruit	March-September	Fruits are eaten raw when ripe
W 4	Mango	*Mangifera indica* L.	മാമ്പഴം	Anacardiaceae	Fruit	March-September	Fruits are eaten raw when ripe
W 5	Cashew Nut	*Anacardium occidentale* L.	പറങ്കി മാവ്	Anacardiaceae	Fruit	November- June	Fruits are eaten raw when ripe
W 6	Gooseberry	*Phyllanthus emblica* L.	നെല്ലിക്ക	Phyllanthaceae	Fruit	March-April	Fruits are eaten raw when ripe
W 7	Jungle flame	*Ixora coccineae* L.	തെറ്റിപ്പഴം	Rubiaceae	Fruit	March-April	Fruits are eaten raw when ripe
W 8	Star fruit	*Averrhoa carambola* L.	ചതുരപ്പുളി	Oxalidaceae	Fruit	April-September	Fruits are eaten raw when ripe
W 9	Jackal fruit	*Zizipus oenopolia* (L.) Mill.	തുടലി പഴം	Rhamnaceae	Fruit	March-April	Fruits are eaten raw when ripe
W 10	Rose apple	*Syzygium jambos* (L.) Alston	ജാംബക്ക	Myrtaceae	Fruit	December-May	Fruits are eaten raw when ripe

Table No: 3 List of Commercial Fruits.

CODE	COMMON NAME	SCIENTIFIC NAME	LOCAL NAME	FAMILY	PARTS USED	AVAILABILITY	USES
C 1	Papaya	*Carica papaya* L.	ഓമക്ക	Caricaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 2	Passion fruit	*Passiflora edulis* sims	ബ[illegible]ോഞ്ചിക്ക	Passifloraceae	Fruit	March-June	Fruits are eaten raw when ripe.
C 3	Dragon fruit	*Hylocereus undatus* (Haw.)Britton & Rose	ഡ്രാഗൺ ഡ്രൂട്ട്	Cactaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 4	Water melon	*Citrullus lanatus* (Thunb.) Matsum.&Nakal variety	തണ്ണിമത്തൻ	Cucurbitaceae	Fruit	December-April	Fruits are eaten raw when ripe.
C 5	Grapes	*Vitis vinifera* L.	മുന്തിരി	Vitaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 6	Kiwi	*Actinidia chinensis* Planch	കിവി	Actinidiaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 7	Strawberry	*Fragaria x ananassa* (Duchesne ex Weston) Duchesne ex Rozier	സ്ബ്രോ[illegible]രി	Rosaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 8	Apple	*Malus pumila* Kitam.	ആപ്പിൾ	Rosaceae	Fruit	All time	Fruits are eaten raw when ripe.
C 9	Sapota	*Manilkara zapota*(L.)P.Royen	സപ്പ്പാട്ട	Sapotaceae	Fruit	All time	Fruits are eaten raw when ripe.
C10	Orange	*Citrus sinensis* (l.)osbeck	ഓറഞ്ച്	Rutaceae	Fruit	All time	Fruits are eaten raw when ripe.

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Table No: 4 Profiling the Physical Properties and Biochemical Attributes

of 10 Wild and 10 Commercial Edible Fruits.

CODE	SCIENTIFIC NAME	COLOUR	ODOUR	TASTE	VitaminA/Retinol (mcg/160g fresh fruit)	VitaminC/ Ascorbic acid (mg/100ml)
W 1	*Annona muricata* L.	white	Pleasant	Soursop	20±0.001	53.08±0.001
W 2	*Annona squiamosa* L.	Creamy white	Pleasant	Sweet	20.2±0.002	50.2±0.003
W 3	*Elaeocarpus serratus* L.	Green olive	Pleasant	Slightly sour	40±0.002	56.464±0.001
W 4	*Mangifera indica* L.	yellow	Pleasant	Sweet	89±0.003	44.2±0.001
W 5	*Anacardium occidentale* L.	Yellow to orange	Pleasant	Sweet	49±0.003	40.24±0.002
W 6	*Phyllanthus emblica* L.	Light green	Slightly acidic	Sour	42±0.001	43.16±0.003
W 7	*Ixora coccineae* L.	red	No smell	Sweet	22±0.001	44.34±0.003
W 8	*Averrhoa carambola* L	yellow	Sour fruity	Slightly tart	53±0.001	45.14±0.001
W 9	*Zizipus oenopolia*(L.)Mill.	purple	Grape soda	Sour taste	33±0.001	44.66±0.002
W 10	*Syzygium jambos*(L.)Alston	Dark red	Rose water	Sweet	36±0.001	43.322±0.002
C 1	*Carica papaya* L.	yellow	Pleasant	Sweet	78±0.002	42.02±0.001
C 2	*Passiflora edulis* sims	yellow	Sweet aroma	Sweet	180±0.001	53.08±0.001
C 3	*Hylocereus undatus* (Haw.)Britton & Rose	majentha	Fruity	Sweet	126.2±0.002	50.2±0.003
C 4	*Citrullus lanatus* (Thunb.) Matsum.&Nakal variety	Pink red	No smell	Sweet	149±0.002	53.464±0.001
C 5	*Vitis vinifera* L.	purple	Pleasant	Sour	89±0.003	34.2±0.001
C 6	*Actinidia chinensis* Planch	Green	Citrusy	Sweet	71.48±0.003	40.24±0.002
C 7	*Fragaria* x *ananassa*(Duchesne ex Weston)Duchesne ex Rozier	Bright red	Sweet caramel-like	Sweet	64.6±0.001	33.16±0.003
C 8	*Malus pumila* Kitam	Red	Pleasant	Sweet	45±0.001	24.34±0.003
C 9	*Manilkara zapota*(L.)P.Royen	Pale yellow	Minty	Caramel	36±0.001	25.14±0.001
C 10	*Citrus sinensis* (l.)osbeck	orange	Pleasant	Sour	143.6±0.001	53.08±0.001

Table 5: Vitamin Analysis of 10 wild edible and commercial fruit Juice

Accessions	**VitaminA/Retinol (mcg/160g fresh fruit)**	**VitaminC/ Ascorbic acid (mg/100ml)**	**VitaminE/ Tocoferol (mg/100ml)**	**Vitamin B1/ Thiamin**	**VitaminB2/ Riboflavin (mg/100ml)**	**VitaminB3/ Niacin (mg/100ml)**	**VitaminB9/ Folic acid (mcg/100ml)**
Annona muricataL.(W 1)	20±0.001	53.08±0.001	**0.32±0.001**	0	**0.28±0.001**	1.6±0.002	33±0.002
Annona squamosal L.(W 2)	20.2±0.002	50.2±0.003	**0.32±0.003**	0	0.13±0.002	1.48±0.001	**34±0.003**
Elaeocarus serratus L. (W 3)	40±0.002	**53.464±0.001**	0.291±0.001	0	0.11±0.001	**1.72±0.003**	33.2±0.003
Mangifera indica L.(W4)	89±0.003	44.2±0.001	0.13±0.003	0.002±0.001	0.092±0.002	0.12±0.002	26.7±0.002
Anacardium occidentale L.(W5)	49±0.003	40.24±0.002	0.13±0.002	0.001±0.001	0.083±0.003	0.12±0.001	20±0.002
Phyllanthus emblica L.(W6)	42±0.001	43.16±0.003	0.12±0.002	0.0012±0.001	0.09±0.001	0.1±0.001	17.18±0.003
Ixora coccinea L.(W7)	22±0.001	44.34±0.003	0.14±0.001	0	0.033±0.003	0.37±0.003	19.16±0.003
Averrhoa carambola L.(W 8)	53±0.001	45.14±0.001	0.11±0.001	0	**0.4±0.004**	0.29±0.002	18.92±0.002
Zizipus oenopolia(L.)Mill(W 9)	33±0.001	44.66±0.002	0.15±0.002	0	0.12±0.002	0.36±0.003	17.08±0.003
Syzygium jambos(L.)Alston(W10)	36±0.001	43.322±0.002	0.11±0.003	0	0.031±0.001	0.27±0.001	14.24±0.002
Carica papaya L.(C1)	78±0.002	42.02±0.001	0.11±0.001	0	0.031±0.003	0.27±0.002	12.23±0.001
Pasiflora edulis sims(C2)	180±0.001	53.08±0.001	0.12±0.001	0	**0.1±0.001**	1.6±0.002	33±0.002
Hylocereus undatus(Haw.)Britton&Rose (C3)	126.2±0.002	50.2±0.003	0.02±0.003	0.002±0.001	0.13±0.002	1.48±0.001	**34±0.003**
Citrullus lanatus(C4)	149±0.002	**53.464±0.001**	0.05±0.001	0.001±0.001	0.11±0.001	**1.72±0.003**	33.2±0.003
Vitis vinifera(5)	89±0.003	**34.2±0.001**	0.09±0.003	0.0012±0.00	1.5±0.002	0.12±0.002	26.7±0.002

				1			
Actinidia chinensis Planch.(C6)	71.48±0.003	40.24±0.002	0.03±0.002	0.002±0.001	0.83±0.003	0.12±0.001	20±0.002

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Fragaria x ananassa(Duchesneex Weston) Duchesne ex Rozier(C7)	64.6±0.001	33.16±0.003	0.05±0.002	0.001±0.001	0.9±0.001	
Malus pumila (C8)	45±0.001	24.34±0.003	0.02±0.001	0.0012±0.001	0.2±0.003	
Manilkara zapota(L.) P.Royen(C9)	36±0.001	25.14±0.001	**0.01±0.001**	0.002±0.001	**0.2±0.004**	
Citrus sinensis(L.)Osbeck(C10)	143.6±0.001	53.08±0.001	0.05±0.002	0.001±0.001	0.12±0.002	

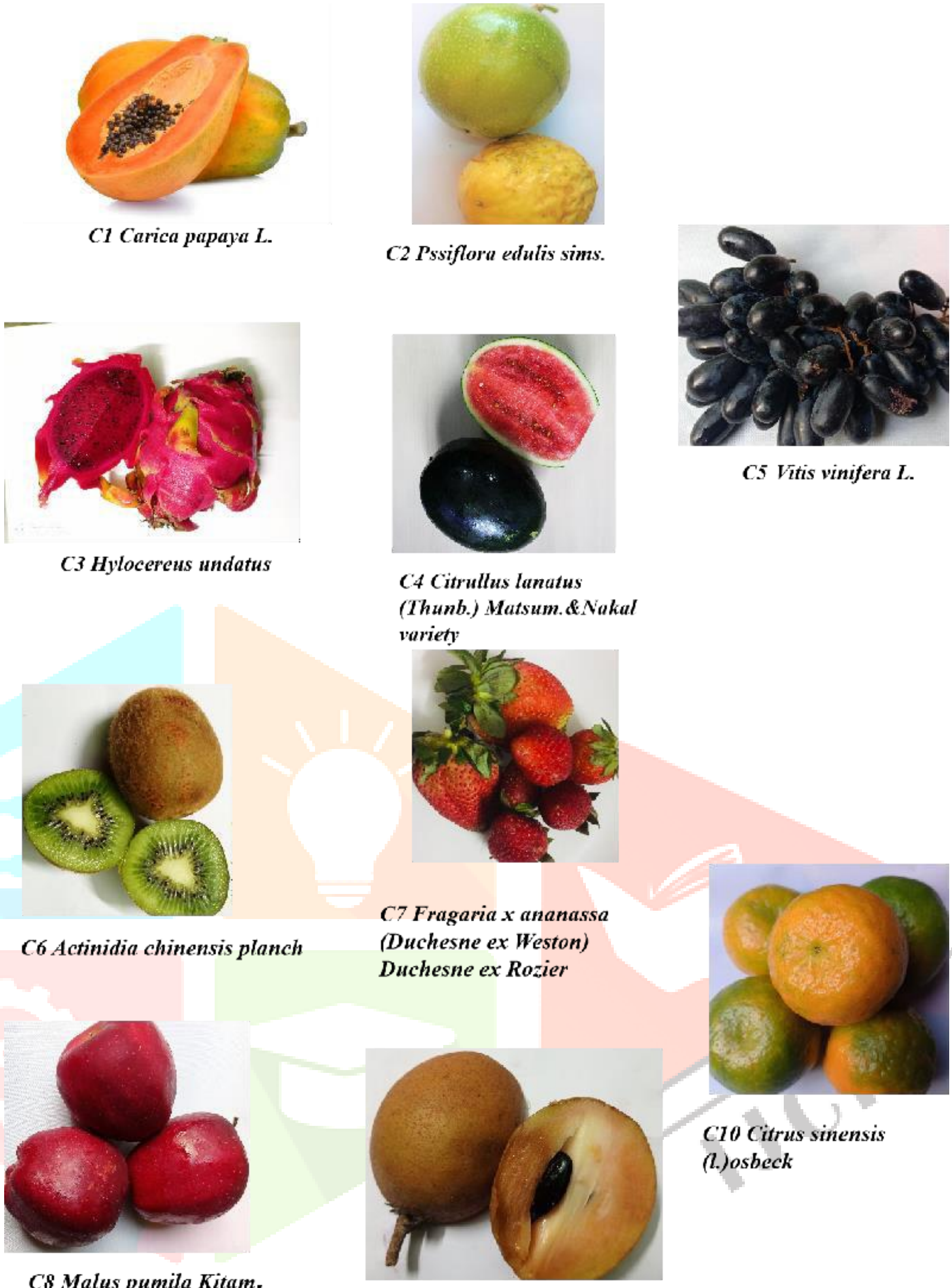
Table 6: Mineral Analysis of 10 wild and cultivated fruits

Minarals / **Accessions**	**Ca/ mg**	**K/mg**	**Ph/mg**	**Mg/mg**	**Na/mg**	**Fe/mg**	**Se/µg**	**Cu/ mg**	**Z**
Annona muricata L.	12	348	68	28	66	2	0.6	0.203	
Annona squamosa L	11	320	68.2	28.4	64	1.8	0.6	0.204	
Elaeocarpus serratus L	12.3	**410**	62.2	32	**68**	2	0.7	0.205	
Mangifera indica L.	10.1	210	50.1	12	48	1.1	0.3	0.121	
Anacardium occidentale L.	10.3	215	50.6	13	42	0.98	0.4	0.098	
Phyllanthus emblica L.	10.6	243	51	16	44	1	0.3	0.1	
Ixora coccineae L.	12.3	123	68.2	28	66	2	0.6	0.203	
Averrhoa carambola L.	10.1	101	62.2	28.4	64	1.8	0.6	0.204	
Zizipus oenopolia (L.) Mill.	10.3	103	50.1	32	**68**	2	0.7	0.205	
Syzygium jambos (L.) Alston	10.6	106		28	48	1.1	0.3	0.121	
Carica papaya L.	12.1	321	49	22.23	54	0.98	0.4	0.098	
Passiflora edulis sims	9	200	40	20	43	1	0.1	0.1	
Hylocereus undatus (Haw.)Britton & Rose	12.1	321	49	22.23	54	1.5	0.4	0.2	
Citrullus lanatus (Thunb.)	13	211	50.87	19	57	0.1	0.3	0.08	
Matsum.&Nakal variety									
Vitis vinifera L.	10.8	**182**	53.76	18	**38**	0.97	0.2	0.087	
Actinidia chinensis Planch	9	200	40	20	43	1	0.1	0.1	

Fragaria x ananassa (Duchesne ex Weston) Duchesne ex Rozier	9	200	40	20	43	1	0.1	0.1
Malus pumila Kitam.	12.1	321	49	22.23	54	1.5	0.4	0.2
Manilkara zapota(L.)P.Royen	13	211	50.87	19	57	0.1	0.3	0.08
Citrus sinensis (l.)osbeck	10.8	**182**	53.76	18	**38**	0.97	0.2	0.087

Ca-calcium; K-Potassium; Ph-Phospherous; Mg-Megnesium; Na- Sodium; Fe- Iron; Se- Selenium; Cu- Copper; Zn- Zink; Co- Cobalt; Mn- M
Boron; Ni- Nickel.

Fig I: Ten Wild Edible fruits.



C1 Carica papaya L.

C2 Pssiflora edulis sims.

C5 Vitis vinifera L.

C3 Hylocereus undatus

C4 Citrullus lanatus (Thunb.) Matsum.&Nakal variety

C6 Actinidia chinensis planch

C7 Fragaria x ananassa (Duchesne ex Weston) Duchesne ex Rozier

C10 Citrus sinensis (l.)osbeck

C8 Malus pumila Kitam.

C9 Manilkara zapota(L.)P.Royen

Fig II: Ten Commercial Fruits

Fig III: Fruit Juice of Wild and Commercial Fruits

SUMMARY AND CONCLUSION

The result highlighted significance of wild fruit species as cheap source of nutrient for rural poor. The food value of many wild fruits compared well with commercially available popular fruits as *Carica papaya, Passiflora edulis, Hylocereus undatus, Citrullus lanatus, Vitis vinifera, Actinidia chinensis, Malus pumila* etc. in terms of color, odor, taste and Vitamin content. The analysis of 10 wild edible fruits bring into focus the rich nutritional composition of indigenous fruits and the scope for their use as an alternative source of bio-nutrition. The present work identified superior/identical nutritional status in terms in terms of color, odor, taste and Vitamin content in noncultivated indigenous forest species, i.e., *Annona muricata, Annona squiamosa, Elaeocarpus serratus, Mangifera indica, Anacardium occidentale* , *Phyllanthus emblica* , *Ixora coccinea* , *Averrhoa carambola* , *Zizipus oenopolia* and *Syzygium jambos* comparable to the cultivated fruits like *Carica papaya, Passiflora edulis, Hylocereus undatus, Citrullus lanatus, Vitis vinifera, Actinidia chinensis, Malus pumila* etc. The analysis indicate the scope of using wild edible fruits for dietary supplement since it has valuable ingredients as Iron, Sodium, Potassium and Calcium. Many other fruits of forest therefore need to be analyzed which could help in selecting promising species for inclusion in agro and farm- forestry and reforestation programme which have so far focused only on timber species. Wild fruit plantation not only improves food base for humans it helps in sustaining wild animals particularly herbivore and bird population. Further research on anti- nutrients and antioxidants of wild species would be useful in selecting nutritious fruits from wild resources of eastern India. Of particular importance are *Annona muricata*, *Annona squiamosa*, *Elaeocarpus serratus*, *Mangifera indica*, *Anacardium occidentale*, *Phyllanthus emblica*, *Averrhoa carambola* and *Syzygium jambos* that had significant level of micronutrient and minerals which are promising species for promotion as backyard planting especially farming systems suffering from crop loss, food shortage and chronic malnutrition.

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