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# BRIEF NOTES ON THE NUTS OF PAKISTAN

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**ABSTRACT**

In all, 41 types of useful nuts of Pakistan belonging to 32 genera and 25 families are described with reference to their distribution, trends of production (if known) or usefulness. Pistachio, almond, walnut, peanut, pine nut, coconut, apricot nut, water chestnut, coconut, earthnut, and candlenut are some widely known of them. Pecan is a promising new addition. Many of the nuts are unexploited or under-exploited at present such as Bonduc nut (Knicker nut), tiger nut, Candle nut, Chinese tallow nut, Jack nut, Ben nut, Jojoba nut, Sterculia nut (Samrong)., etc.

**Key words:** Nuts of Pakistan, Nuts Diversity, Nuts Distribution, Uses of nuts.

## INTRODUCTION

Any dry fruit whose kernel or seed is enclosed in an indehiscent hard woody shell or rind is nut (Howard, 1979). According to Jaynes (1993) the word nut may apply to both shell and the nutmeat or kernel inside or to the kernel alone. In popular usage, the term nut is applied to many fruits and seeds that are not necessarily nuts in strict botanical sense (a *simple dry indehiscent fruit with a bony shell, characteristically derived from a compound pistil, but 1-seeded by abortion***)** (Porter, 1967). Nuts like walnuts, pecans, chestnuts, acorns, and filberts (Hazel Nuts) are botanically true nuts. On the contrary**,** such fruits like coconuts, almonds and peanuts are not true nuts. Botanically, coconut and almond are drupe and peanut is a legume - pea type fruit. Earthnut of *Elwendia (formerly Bunium)* is a mericarp. According to Howard (1979) nuts may be classified into three categories.

**1. Food nuts:** Peanuts, walnuts, almond, cashews, pecans, pinons, and pistachio are widely used food nuts in temperate regions and Coconuts, Java almonds, Paradise nuts, pilinuts, breadnut, etc. are eaten in tropical regions. The nuts contain 50 - 70% fat and oil and 15 to 30% protein. They also contain some starch, thiamine, riboflavin, niacin and Vit. C. Few nuts like walnut contain Vit. A. Chestnuts are, however, rich in carbohydrate (starch). Preedy *et al.* (2011) described the role of nuts and seeds in health and disease prevention.

**2. Oil nuts:** Nuts provide two types of oils. English walnuts, candlenuts, and oiticicas provide drying oils (forming a thin film when exposed to air) and coconuts, peanuts, cashews, pecans, almonds, hazel nuts, etc. provide non-drying oils, which are liquid at room temperature and used for lighting and manufacture of margarine, soaps, etc. Jojoba nuts furnish valuable oil for lubrication of precision instruments. Peanut and walnut oils are edible. Tung oil is used in paints and varnishes. Nutmeg nut (Jaiphal - fruit kernel; Japatri-Aril of fruit) of *Myristica fragrans* Houtt. (Family Myristicaceae) contains a volatile oil (6 - 16% of the nut), which imparts it a strong aromatic odour. It is imported in Pakistan for its flavour used in several oriental foods and also for its therapeutic value. The alcoholic extract of nutmeg show antibacterial activity against *Micrococcus pyogenes* var. *aureus*. Nutmeg's aqueous decoctions are poisonous to cockroaches (NISC, 1998a).

**3. Other nuts:** This category includes nuts such as bitternut, acorns and pecan that provide tannins and also such nuts which are often used as feed for livestock (acorns and beech nuts). Betel nuts are chewed as stimulant. Coquilla nuts of Brazil (*Attalea funifera*) are used for making decorative articles and water clearing nuts (*Strychnos potatorum*) used in clearing muddy water in India and Ceylon.

### Export

Several nuts are commercially very important but most of the nuts in Pakistan are, however, unexploited or under-exploited. Pakistan exported almonds, walnuts and pistachio of worth of Rs.19.915 million only during the year 2000-2001 (FTS, 2001, p. 18). In Pakistan, nuts need attention to their fullest economic exploitation.

**DIVERSITY, PRODUCTION AND USE**

There are hundreds of diverse species of plants that produce nuts. Many nuts are edible; others yield oils and still others some valuable chemicals. Most of nuts are collected from wild plants. Only around 25 kinds of nuts are raised as crops in large fields or orchards (Jaynes, 1993). Some 41 types of nuts are found in Pakistan, which are important one way or the other. These nuts belong to 25 families and 32 genera. Known in botanical and / or commercial sense, these nuts are described in brief as under. Taxonomic references are from E. Nasir and S.I. Ali edited Flora of Pakistan (e.g., Abdulla, 1973; Ali, 1973, 1977; Ghafoor, 1985; Ghazanfar, 1975, 1976; Malik, 1984; Nasir, 1972 a & b, 1975 a & b, 1976, 1983; Nasir and Nasir, 1987; Qaiser, 1973, 1993; Qaiser and Qaiser, 1978; Radcliffe-Smith, 1986; Stewart, 1972; etc.).

**Family Anacardiaceae:**

**1.** *Pistacia vera* L.

**Pistachio Nut**, Pistache, Pista, Green Almond, a tree cultivated in Queetta, Zhob, and Kalat Divisions of Balochistan. It grows well above 900m.

According to Statistical Wing, Balochistan's Agricultural Directorate (1988-89) pistachio yield in Balochistan amounted to c. 3.9 tonnes/Ha. In 2003-04, Pakistan produced 3425 tonnes of Pistachio (Govt. of Pakistan, 2004).

A hard gray shell covers each nut. Under the shell the nut is covered by a thin purple skin. Pista kernel is fine-textured and very delicious. It has mild flavour and is used in ice creams and confectionaries. Also eaten salted and roasted as dessert. It is considered to be digestive, sedative and tonic. It contains 53.5% fat, 19.8% protein and 16.2% carbohydrates. Pista oil turns rancid easily (NISC, 1998b). Pistachio contains melatonin (N-acetyl-5-methoxytryptamine). It could be useful in insomnia, and scavenge radical species and enhance the immune system. It exhibits anti-ageing, anti-inflammatory, anti-cancer and neuro-protective activities. Moreover, it is beneficial in cardiovascular disease, diabetes and obesity. It is reported to regulate mood, sexual maturation and body temperature and useful in periodontology as described in a comprehensive review by Meng *et al*. (2012). Various cultivars of pistachio vary in Melatonin content Oladi *et al.* (2014) have reported melatonin contents in P. *vera* L. CV. Ahmad Aghaei to be 233,000 ng /g DW, in *P. vera* L. CV Akbari, kelle to be 226,900 ng / g DW, in *P. vera* L. CV Qouchi to be 231,400 ng / g DW and in *P. vera* L. CV Fandoghi to be 228,400 ng / g DW.

**2.** *Anacardium occidentale* **L.**

**Cashew nut,** Kaju**.** It is native of Brazil and said to be introduced in India by Turks in 1560-1565. Cashew is actually seed growing outside of fruit instead growing inside. The testa is poisonous due to a caustic resin so it is removed. The seed contains Vitamins A and K and boost up immunity. One tree is estimated to yield 20kg of fruits. Cashew is a sweet flavoured nut. .Leaves are fodder for sheep, goats and bullocks. The nut is good food in cardiovascular disorders. Kaju is greatly used in medicinal and neutraceutical purposes (Baptista *et al.*, 2018). *Anacardium* spp. exhibit anti-oxidant and antimicrobial effects and much used in food industry. Comprehensive details on chemical composition of Kaju is given by Bahare Salehi *et al.* (2019), a review with 117 bibliographic references. Its cultivation in Pakistan is in initial stages. It is said that where guava can grow, cashew can also grow successfully.

**Family Betulaceae:**

1. *Betula utilis* D. Don.

**Birch Nut**, Indian Birch, Bhojpatra, is a small tree commonly found at the upper limit of trees, from 3000 - 5000 m; usually gregarious at places. Its bark is smooth and sometimes used as a substitute for writing paper and roofing. Leaves are fodder for cattle. The use of nuts is not known.

2. *Alnus nitida* (Spach) Endl.

**Alder Nut,** Black Cedar, Kunis, Utis, Sharol, a tall tree commonly found along streams or cultivated as a roadside tree from Dir eastwards at 1900 - 2900 m elevation. The bark is used for dyeing and tanning purposes. The wood is light in weight and employed in rough agricultural works. The use of nuts is not known.

**Family Caeselpiniaceae:**

**1.** *Caesalpinia bonduc* (L.) Roxb.

**Knicker nut**, Bonduc Nut, Bengor Nut, Fever Nut, Katkaranj, Khayah-i-iblis, is a scandent or scrambling shrub cultivated in Sindh and the Punjab.

Seeds and leaves are used to relieve colic, fever, hydrocele, diarrhoea and rheumatism. Seeds (nuts) are diuretic and also used in asthma and chronic fever. Root is anthelmintic, febrifuge, astringent, and used in Leucorrhoea and blennorrhgia. The nuts are made into ointment to treat hydrocele. The oil of the nut is anti-rheumatic and compares favourably with phenylbutazone (PID, 1992).

**Family Combretaceae:**

**1.** *Terminalia Catappa,*

**Tavola Nut,** Tropical Nut, Myrobolan, Damerara almond, Desi Badam, a cultivated deciduous tree. Fruit a drupe, the kernel of which resembles almond or fresh filbert in flavour. The dried kernel has 52.02% fat, 25.4% protein, 14.6% fibre and 5.98% sugar (as glucose). The tavola nut oil may be a useful substitute for the oil of almond (PID, 1989).

**Family Corynaceae:**

**1.** *Corylus colurna* L.

**Constantinople Nut,** Turkish Hazel Nut, Urni, Thangi, Virin, a deciduous tree more common in the inner than the outer Himalaya from 1600 - 3300 m. Often gregarious. The plant yields nut crop annually from fourth year to twentieth year (CSIR, 1950). The nuts are edible.

**Family Cyperaceae**

1. *Cyperus esculentus* **L.**

**Tiger Nuts,** Chufa, yellow nut sedge, earth nut, etc. Wide spread invasive species across the World (Sánchez-Zapata *et al.*, 2012) including Pakistan (eflora of Pakistan). It is perennial plant up to 90 cm in height. It may often be found in wet areas like paddies, and irrigated land during warm weather. It is cultivated for edible tubers (tiger nuts) and used in snack food, and sweet milk beverages. It is actually the oldest cultivated plant in prehistoric and ancient Egypt. During olden times Chufa nuts were consumed either boiled in beer, roasted or as sweets made of ground tubers with honey, used also medicinally, taken orally, or as an ointment or as an enema, fumigant for sweet smell in home. In Egypt, tiger nuts are known as Hab-el-Aziz (wikipaedia.org). Dried tiger nuts are of two types) - Yellow variety and 2) Brown variety. Oladele and Aina (2007) have described the proximate composition of these varieties. Carbohydrates and lipid are the main constituents. Crude protein concentration (9.7%) is higher in brown tiger nuts.

Purple nut sedge (*Cyperus rotundus*) may be confused with *C. esculentus*. Some difference are, however, there that purple spikelets and tubers formed by *C. rotundus* are often multiple in number instead of just one at the tip in *C. esculentus*. Tubers are bitter in *C. rotundus* instead of wild almond like flavour in *C. esculentus* (USGS, 2003).

According to Zhang *et al.* (1996) the *C. esculentus* tubers contain 20-36% oil. It has been suggested as a crop for biodiesel. Drink made of chufa is popular in Spain (Horchata de chufa) and in Africa it is known as Kunnu in Nigeria and Mali. The tubers may be dried and ground into flour (Elias and Dykeman, 2009). Tiger nuts are regarded as digestive tonic that alleviates flatulence. These nuts promote urine production and menstruation. They are said to be aphrodisiac, carminative, diuretic, emmengogue, stimulant and tonic. They are used in Ayurvedic medicine (http://pfaf.org).

**Family Euphorbiaceae:**

1. *Aelurites moluccana* (L.) Willd.

**Candle Nut**, Indian Walnut, and Candle berry, Kukui, Varnish tree, a handsome tree native to Indo-Malayan region. Sparingly cultivated in Pakistan. Seeds are about the size of walnut and enclosed in a rough black shell motted with grey and white. The nuts contain 62.25% oil called 'lumbang oil'. The oil is colourless or yellowish transparent and has a pleasant odour. On account of its purging property, it can be used for edible purposes. It is used in making paints, varnish, and soaps and sometimes burned in lamps (Radcliffe-Smith, 1986, Usher, 1984). Painting boats with lumbang oil protects them against boring worms. It is considered substitute of linseed oil. Candles shaped from a paste of the kernels of the nuts are reported to be used for illumination. The fruit is tonic and considered useful in diseases of heart and blood. It is carminative, expectorant, and used in the piles, hydrophobia, and ringworm (Bhatia, 1983; PID, 1985).

2. *Jatropha curcas* L.

**Physic Nut**, Jamalghota, Japlota, widely cultivated as hedge plant and for its medicinal value. The seeds yield violently purgative oil (curcas oil). The oil is also used in making candles and soaps, as a lubricant, and in the woolen industry (Radcliffe-Smith, 1986; Usher, 1984).

3**.** *Sapium sebiferum* (L.) Roxb.

**Chinese Tallow nut,** Pepli, , a small deciduous tree frequently planted in Pakistan for its pale yellow to deep red autumn tints in the NWFP, Punjab (salt range, Rawalpindi, Hazara), Gilgit and Jammu. It prefers riverine habitat up to 1220 m and is well naturalized on the islands in the River Jhelum. Seeds are ovoid (7mm x 6.5mm x 5 mm) with a white waxy exotesta surrounding a hard black endotesta. The wax around the seeds is used for making candles and soap in China.

**Family Fagaceae:**

1. *Quercus* Nut, **Acorn** (Nut of Oak), Aecern fruit of the field. There are six species of *Quercus* found in Pakistan all from hilly areas.
*Q. robur* L. (English Oak) up to 2000m;
*Q. glauca* Thunb (Banni, Barin) from 700 to 2000m;
*Q. semecarpifolia* Smith (Brown Oak, Banjar) from 2000m to 3900m;
*Q. incana* Roxb. (Ban, Rinji) from 1000m to 2700m;
*Q. baloot* Griff. (Breh) from 1800 to 3000m; and
*Q. dilatata* Royale (Holly Oak, Barungi, Moru), fairly common from 1600 to 2900m.

All these species are generally used for wood, charcoal, fodder and/or tannins from the bark. Acorns are the source of tannins. Usher (1984), however, reports that acorns of *Q. robur* are used as coffee substitute (Eichel Kaffee), as an emergency food and are an important food for pigs elsewhere.

2. *Castanea sativa* Mill.
**Spanish Nut** or Sweet Chestnut, sparsely cultivated at some hill stations of Pakistan (Abbotabad and Ghora Gali). The nut can be eaten raw or roasted. Bark yields tannins. Leaves and bark give a blackish brown dye and also oil, which is medicinal. The nuts are called marrons in Europe and are standard article of food. They are eaten raw, roasted or boiled like potatoes. They are stored in layers of sand or straw to retain their fresh taste and flavour. The dried or cured nuts boiled with water make acceptable meal with milk or sugar. They may also be made into jam. The plant has aphrodisiac property (PID, 1992; NISC, 2000).

**Family Gingkoaceae:**
1. *Ginkgo biloba* L.
**Ginkgo Nut**, Sal Nut, Maidenhair Tree, sparingly cultivated in Lahore and Abbotabad. Raw seeds are toxic. Roasted seeds (Sal nuts) are delicacy in China and Japan. They are also used medicinally as expectorant and sedative. The dry kernel contains sucrose 6%, starch 67.9%, protein 13.1% and fat 2.9% (CSIR, 1956; Stewart, 1972; Usher, 1984).

**Family Hippocastanaceae:**
1. *Aesculus indica* (Wall. ex Camb.) Hk.f.
**Horsechestnut,** Bankor, Hanudan, one of our largest trees grows wild and/or cultivated in Dir, Chitral, Swat, Hazara, Murree Hills, Loralai, Quetta, Ziarat, Poonch and Kashmir. The oil from the seeds used to cure rheumatism and to relieve stomach complaints in horses (Usher, 1984). The seeds contain dark brown oil, which is antifungal and moderately anti-bacterial against phytopathogenic fungi and human pathogenic bacteria. The seeds also show anti-inflammatory activity (NISC, 2000).

**Family Juglandaceae:**
1. *Carya illinoensis Koch*,
**Pecan,** introduced in Pakistan in 1972 from North America. Out of the nine varieties of pecan tested in Pakistan, variety Wichita is reported to give the highest yield of 13 Kg nuts per tree followed by Mohan, 12 Kg nuts per tree (not indicating whether on shelled or unshelled pecan basis (Rehman and Jan, 1998). Pecan trees are known to produce up to 230 Kg nuts each year. The trees fully bloom when they are 20 years old (Jaynes, 1993). The varieties such as Wichita and Mohan have been approved for commercial cultivation in the plains of NWFP (Charsada, Mardan, Nowshera, Peshawar, and Swabi) as this tree requires less number of cold hours, around 400 h below 7 $^{o}$C per year (Rehman and Jan, 1998).

Pecan nuts are eaten raw or used in ice cream and confectionary. Pecan oil is edible but is used mainly in the manufacture of cosmetics, and some drugs. Pecan is greatly consumed in the USA. The production estimate of pecan in shell in the USA for the year 2000 is reported to be around 72,824 tonnes with shelled to unshelled pecan ratio around 2.50: 1.0 (NASS, 2002).

2. *Juglans regia* L.
**Walnut** (Persian walnut), Akhrot, a beautiful tree wild and cultivated in Hazara, Murree, Gilgit, Chitral, etc. up to c. 3000m. Walnut tree yields good quality edible nuts. The wood is strong, hard, and even-textured. The best-cultivated variety is '**Kaghzi Akhrot**', with large nuts, easily breakable thin shell and whitish kernel. It is used in ice creams and confectionaries. Walnut kernel contains 15.6% protein, 11.0% carbohydrates and high amounts of fat. It contains Vit. A, B and C. Juglansin is the protein present in the kernel. The immature fruit is the richest source of Vit.C. Walnut oil is a pale greenish drying oil. It is edible and used in printing inks, varnishes and for making soap also. Oil cake is rich in protein. Bark is sold in the market by name '**Dundasa'** used to clean teeth and chewed for reddening lips (NISC, 1997). Walnut leaf and hull, broadly used in traditional medicine, have several

pharmacological effects. Girzu *et al*. (1998) have reported its sedative activity due to juglone, an active constituent. In 2003-04, Pakistan produced 13954 tonnes of walnut with a yield of 10.37 tonnes / Ha (Govt. of Pakistan, 2004).

Walnut also contains melatonin but in low concentration which slightly vary with cultivars. Tapia *et al.* (2013) have reported melatonin in *Juglans regia* L. CV Serr to be 1.2 ± 0.06 ng /g FW, in J. *regia* L. CV Hartley to be 1.77 ± 0.14 ng / g FW, in *J. regia* L. CV Chandler to be 1.37 ± 0.037 ng / g FW and in *J. regia* L. Cv. Howard to be 1.9 ± 0.04 ng / g FW, the maximum.

**Moraceae:**

**1.** *Artocarpus heterophyllum* Lam.

**Jack nut,** Kathal nuts (seeds), a large or medium-sized cross-pollinated tree (Singh *et al.,* 1963), native to the Western Ghats of India, cultivated in Sindh. There are at least 30 strains of jackfruit in Indo-Pakistan subcontinent and 30 more types in Malaysia. Sri Lankan varieties include Vela, varuka (Waraka), Peniwaraka, Kuruwaraka, Singapore or Ceylon jack (*Baliga et al..,* 2011).

All parts of the plant are usable in one way or the other. Based on 114 reference papers, the review by Rana Singhe *et al.* (2019) provides diverse and comprehensive information on uses of jackfruit plant on various aspects. The brown seeds called jack nuts are roasted or boiled and eaten. They are sweet starchy, have little sugar and about 5% protein. Jack nut has a flavour of chestnut. The jack fruit is said to be an indigestible fruit, but if the roasted seeds are eaten immediately after, they counteract any tendency towards indigestion (Norris, 1960). Several products from ripe as well as raw jackfruit, seeds and rind have been developed in Mysore, India (PID, 1985). A fruit may have 100-500 seeds. Seed coat is thin waxy and brown. A diversity of chemical, biological, nutritive and pharmacological and bioactivity of metabolites and trends in traditional use have been described in several papers – to cite a few e.g., Sreejadevi *et al.,* 2021; Sy Mohamad *et al.,* 2019; Ramasinghe *et al.,* 2019; Waghmare *et al.,* 2019; Mukhprasirt and Sajjaanantakul, 2004; Abedin *et al.,* 2012; Baliga *et al.,* 2011; Jagtap and Bapat (2010); Verheij and Colonel (1992). The health benefits of jackfruit seeds are on entire body of human (Prakash *et al.,* 2009). The seeds are reported to present no toxicity and are very effective against cancer cells lines (Berci *et al.,* 2019). However, Sy Mohamad *et al.* (2019) reported that seed extract to be lethal on zebra fish embryos during 96h exposure duration (the compound (s) responsible for toxicity are not known). Its leaves are antisyphilic and vermifuge and are used in ulcers and wound healing. The proximate composition of jack fruit seeds is described in Kumar *et al.* (1988). The seeds are edible and may be cooked, backed, roasted and sold as commercial alternative to chocolate aroma. Fruit pulp is cooked as vegetable in India. In isolated protein of seed flour, the essential amino acids are found in following *per cent* concentration in Bangladesh sample: Lysine 10.30; isoleucine 8.61; Leucine 6.73; Methionine 4.82; Threonine 3.90; Valine 1.73; Glycine 4.94; Arginine 2.44 and serine 4.46 (Sultana *et al.,* 2017). Ocloo *et al.* (2010) had reported jack seed flour to contain moisture 6.09%, Ash 2.70, fat 1.27, protein 13.50, fibre 3.198, carbohydrates 79.34% and Calcium 3087 mg /kg, Iron 130.74mg, Potassium 14781 mg, Sodium 60.66 mg, Copper 10.45 mg and manganese 1.12 mg / kg. The seed flour is good as thickener and binding agent in the food systems. Nutritive value of seed flour is well-established (Ahmed *et al.,* 1986). Seed cotyledons are very popular in Malaysia (Sy Mohamad *et al.,* 2019). Solid state fermentation using seed powder of jackfruit as substrate with a fungal culture (without adding any carbon source), *Monascus purpureus* produced pigments fairly stable at wide range of pH,. The nitrogenous compounds showed a positive impact on water-soluble pigments production (Babitha *et al.,* 2006).

Jackfruit peel can be used for the production of bio-oil which in turn can be used as an alternative for non-renewable fossil fuel (Soetardji *et al.,* 2014). Prakash *et al.* (2009) have presented the benefits of *Artocarpus* as follows:

1. Healthy skin, hair and eyes (Thiamine and Riboflavin). Stimulates hair growth. Keep skin hydrated, smooth and glowing.
2. Prevent asthma and respiratory disorders.
3. Prevent lungs and oral cavity cancer. Anticancer activity of saponins.
4. Decreases LDL and lowers risk of high cholesterol.
5. Prevent formation of plaque in arteries and their blockage.
6. Prevent toxic effects on colon and protect the body from colon cancer.
7. Maintain the electrolyte balance.
8. It is antioxidant and scavenge radicals.
9. Prevent wrinkles and delays ageing.
10. Increase red blood cells production (Iron).
11. Prevent anemia.
12. Prevent osteoporosis (Calcium).

13. Prevent and treat nervousness.
14. Promote blood circulation.
15. Promote thyroid metabolism (Copper).
16. Effective in hormone production and adsorption.
17. Lowers risks of heart disease.
18. It is good protein source.
19. Helps in muscle building.
20. Prevents constipation and indigestion (insoluble fibers).
21. Prevent obesity.
22. Used in treatment of diarrhea and dysentery.
23. Manages weight.
24. Regulate sugar by regulating insulin (Magnesium).
25. Increase blood sugar control as it contains resistant starch.
26. Limit the risks of blood clots (Flavonoids).
27. Antihypertensive.
28. Maintain proper BP (Potassium)
29. Metal ion chelating activity.

Jacalin, a compound in seed and jacalin-derived peptide have been found to prevent HIV-1 infection *in vitro*. However, mode of action is not well understood. Ajayi (2011) reported that jacalin has a potential against cancer. It has been used in benign and malignant lesions of the breast and thyroid.

**Moringaceae:**

1. *Moringa oleifera* Lam.

**Ben Nut**, Sohanjna (saijan), a commonly cultivated tree.

There are several vernacular names of the plant – Doctor Tree, Arenge Behan, Clarifier tree, Drumstick tree, Horseradish tree, benzoline tree, Ben oil tree, Super food tree, Miracle tree, Tree of life etc. Native to Indo-Pakistan subcontinent. Distributed in very many countries owing to nutritional and medicinal importance – Pakistan, Bangladesh, Afghanistan, South-East Asia, Philippines, Indonesia, Taiwan, Caribbean, Africa, Hawaii, cultivated in USA. It is highly useful plant and every part of the plant is used one way or the other. Ben nut is around 1cm in diameter, globular, with three superficial ridges and each ridge continuing in membranous white extension, the wings for dispersal with wind.

Flowers and immature fruits are eaten. Oil is extracted from nuts (seeds) - called 'Ben' or Behen' oil used as lubricant, in cosmetics and applied in rheumatism. The seeds are considered antipyretic. They are oleaginous and contain 38.4 % protein and 34.7 % fatty oil. The cake left after oil extraction is used as fertilizer (NISC, 1998). *M. oleifera* is a miracle plant. It is food and one of the best food supplements. *M. oleifera* is said to treat numerous diseases. It contains all essential amino acids (unusual for a plant) (*http://muneilla.wordpress.com/2012/04/16/moringa-global-warming-and you/*). *M. oleifera* is multipurpose tree rich in phytochemicals – 163 phytochemical compounds (Liu *et al.*, 2021) phenolics, flavonoids, steroids, tannins, alkaloids, carbohydrates, glycosides, saponins, terpenoids, triterpenes, Anthraquinones etc. Compounds like 4-(-L-rhamopyanosyloxy) benzyl iso-thiocyanate, 4-(-L- rhamopyanoxsyloxy) benzyl-glucosinolate and Pterygospermin are considered to be responsible for antibiotic activity.

Ganatra Tejas *et al.* (2012) have reviewed from various resources that *M. oleifera* have very many traditional and pharmacological properties. Its edible parts have:

Vitamin A – 4X of carrot and 13 x of Spinach.
Vitamin C – 7X of oranges.
Vitamin B – 4 X of meat.
Vitamin B3 – 50 x of Peanut.
Vitamin E – 6 X of Rapeseed.
Calcium – 4X 0f Milk.
Potassium – 63 X of Milk and 3X of Banana.
Magnesium - 36 X of Egg.
Iron – 25X of Spinach.
Protein – 2X of Yoghurt / Milk.
Polyphenol – 8X of red wine.
Amino acids - 2X of Black vinegar.

The traditional and pharmacological benefits of various morphological components of *M. oleifera* may be succinctly summarized as follows:

**Roots:** Roots are Cardiac tonic, and used in Toothache, Common cold, Ext. sores / ulcers, Fever and asthma. It is diuretic, aphrodisiac and used in gout, low back/ kidney pain, and scurvy. Roots are also reported to be antilithic, rubafacient, vesicant, carminative, antifertility, anti-inflammatory, stimulant in paralytic afflictions, treats rheumatism, inflammations, articular pains etc. (Swati *et al.,* 2018).

**Leaves**: Agbogidi and Ilondu (2012) described 75 therapeutic and prophylactic uses of *M. oleifera* from various references. Medical use of leaf in Nigeria included curing of fever, treatment of ear infections and blood pressure (Stevens *et al.,* 2013). It is applied as poultice to sores, rubbed on temples for headache, used in piles, etc. (Swati *et al.,* 2018). Leaves are anti-hypertensive, antibacterial, antiviral (Epstein Bar – virus (EPV), Herpes simplex virus, HIV-Aids) and used in many diseases. Leaves are lactation enhancer and contain anti-oxidants.

**Bark:** Dental caries / Toothache, Common cold, Ext. sores/ ulcer, anti-tumor, Snake bite, Scorpion bite, colitis, Digestive, Epilepsy, Hysteria, Headache, Anti-Nutritional factors, Abortifacient, Aphrodisiac, Birth control and scurvy.

**Flowers**: **Flowers**: Throat infection, common cold, external sores, Anthelmintic, Antitumor, Rheumatism, tonic, Diuretic, hysteria and Abortion (Makkar and Becker, 1996, 1997, 1999; Ganatra-Tejas *et al.,* 2012). Flowers of *M. oleifera* are cholagogue, tonic, anti-oxidant, prescribed in cold phlegmatic condition (Rizvi, 1998; Rizvi and Ali, 2016) and epilepsy (Fuglie, 1999).

**Seeds (Nuts**): Ganatra-Tejas *et al.,* (2012) described seed to be anthelmintic, useful in warts, Anti-tumor, Ulcers, Rheumatism, Arthritis, antispasmodic, Goitrogen, and minerals / Vitamins deficiency. Seeds of *Moringa* are known to contain Vitamin A that aids in avoiding eye issues in youngsters and night visual impairment. *Moringa* juice is also useful in conjunctivitis (Rao *et al.,* 1996). Seed extract of *M. oleifera* may be used as disinfectant (Bichi *et al.,* 1995). Seed extract of *M. oleifera* is antimicrobial (Eilert *et al.,* 1981). Frying quality of seed oil is said to be better in *M. oleifera* as compared to other vegetable oils (Abdulkarim *et al.,* 2007). Seeds are also used in perfume industry, cosmetics, lubricant, soap, oil and as body cream (Bhargave *et al.,* 2015). It is useful in pyodermia. It is anti-spasmodic, anti-schitosomes and antibacterial.

**Fruits**: Anthelmintic, Skin Cancer, Anti-hypertensive, Diabetes, Joint Pain.

**Exudates**: Dental Caries, Toothache, Syphilis, Typhoid, Earache, Fever, Asthma, Diuretic, Dysentery, Rheumatism, Headache, Abortifacient, Rubrafacient.

***In Vitro*:** Antibacterial and anti-fungal activity – *Bacillus cereus, B. subtilis, Escherichia coli, Pseudomonas aeruginosa, , Streptococcus faecalis, S. aureus, S. epidermidis, Shigella shinga, S. sonnei, Aspergillus niger, Candida albicans, Microspermum canis, Fusarium solani, Rhizopus solani, Yeast dermatophytes and Epidemophyton xoccosum. M. oleifera is active against helminths – Trichophyton rubrum, T. mentagraphytes.*

**Seed oil**: Bladder disorders, hepatomegaly, prostrate function, Lupus, antioxidant purgative, dermal application, fungal /mycoses.

*M. oleifera* is active against *Anopheles gambiens* and *Aedes aegyptii* larvae (Chuang *et al.,* 2007; Prabhu *et al.,* 2011). Pontual *et al.* (2012) reported Moringa activity against *A. aegyptii* owing to its contents of β-amyrin, β-Sitosterol, Kaempferol and quercitin. Heavy green flushes of the plant even in dry conditions is reported to act as good sink for $CO_2$ absorption and utilization. According to a study, the rate of $CO_2$ absorption by Moringa is 50 times higher than that of general vegetation (Villfuerte and Villfuerte-Abonal, 2009).

One person emits 320 kg of $CO_2$ per year; study on *Moringa* role in global warming revealed that it takes 23 Japanese cedar trees 50 years to absorb this amount of $CO_2$ but it takes two *Moringa* trees two years to absorb this amount. One family emits 2300 kg of $CO_2$ per year; it takes 160 Japanese cedar trees 50 years to absorb this amount of $CO_2$ but it takes 10 *Moringa* trees two years. Moringa is thus said to be a useful tool to sequester more $CO_2$ and fight global warming. Planting Moringa will mitigate the impacts of climate change (Muriel, 2010).

Seed powder with or without husk has coagulant, flocculant, water softening and disinfectant effects in surface water, shallow water and groundwater purification (Santos Bazanella *et al.,* 2008; Sanchez- Martin *et al.,* 2010; Pritchard *et al.,* 2010; Poumaye *et al.,* 2012; Teh and Wu, 2014; Velázquez – Zavala *et al.,* 2016). It removes Ca, Mg, Fe, Sr, Al (Bichi, 2013), Cd (Abedini and Alpour, 2015), nitrates (Rezende *et al.,* 2016), *textile dyes* (Beltran-Heredia *et al*., 2012b) and detergents (Beltran-Heredia *et al.,* 2012 a).

Indeed hundreds of research papers have so far been published on *M. oleifera* and likely it should be dealt with in detail, in form of a separate paper.

**Family Nelumbonaceae:**

1. *Nelumbo nucifera* Gaertn. **Lotus Seeds (Nuts)**, Sacred lotus, Indian Lotus, Chinese Water-lily, Kanwal, Kamal, Fox nut, Egyptian bean, Bean of India, Makhana, is an aquatic plant that grows well throughout Indo-Pak sub-continent but distributed in Asia-China, Vietnam, Russia (Caspian area), Sri Lanka, New Guinea, Northern and eastern Australia, Southern Himalaya and East Asia. It has been cultivated for 3000 years for its edible seeds (Zhang *et al.,* 2015).There are some reports that it was domesticated 7000 years ago in Asia and considered sacred in Hindus, Buddhists and Jains and has significance in their culture and arts. It grows up to 1400 m of elevation. It was considered to be a famine food of Chiu-Huang Pen-ts'ao (Reid, 1977). Bioprospecting of lotus seeds holds promising future as an alternate protein source (Sridhar and Bhat, 2007). The significance of lotus seeds has been highlighted by Zhu et al. (2016).

The plant has multiple uses. Rhizome (Kamal-Kakadi), young leaves, petiole and flowers are eaten as vegetable. Leaf extracts is anti-obesity (Ono *et al.,* 2006) and antidiabetic (Mukharjee *et al.,* 1997). Flowers and pedicels are used as cardiac and hepatic tonic. Seeds used in tissue inflammation, cancer and skin diseases, leprosy and snake antidote. Flowers have been used to treat diarrhea, cholera, fever, hyperdipsia (Paudel and Panth, 2015). Rhizomes are used in Chinese traditional medicine to treat live Cirrhosis, dyspepsia and dysentery (Menéndez-Perdomo and Facchini, 2018). (The fruits (torus) called Kamalgatta are seldom sold for the edible nuts (carpels) embedded in it. Hard dark coating of the nut is removed, and also the embryo inside which is bitter. The nut kernel is nutritious and eaten raw, roasted, boiled, candied or ground into flour. *Nelumbo* nuts are considered superior to cereals in nutritive value. Lotus seeds contain Vits. B1, B2, B6, C and E and phospholipids (Wu *et al.,* 2007). Dried nut contains: protein, 17.2; fat 2.4; carbohydrates 66.6; fibre 2.6; and ash 3.8 *per cent.* It also contains Vit. C (CSIR, 1966).

The plant is widely cultivated in Kashmir for its honey. The seeds are used in cutaneous diseases (Qaiser, 1993) and considered nourishing heart and kidneys with little fat and no cholesterol. They are rich in Ca, P, Zn, Mg, K and protein and kaemferol (Kaur *et al.,* 2009) and rich in essential amino acids (Zhang *et al.,* 2015).

From Southern Punjab (Pakistan), Shad *et al.* (2011) have reported the composition of rhizome flour as ash (1.10 ± 0.06g per 100g flour), Total nitrogen (1.36 ± 0.04 g per 100g, total protein (8.48 ± 0.25g per 100 g), total sugar (19.08 ± 0.01 g per 100g and free amino acids (0.78 ± 0.035g per 100g flour). The varieties of Thai lotus (Patoom, Boontric, Chatkow and catchompoo) seeds flours are reported to contain high amount of carbohydrate (62.90 ± 1.38 to 66.12 ± 0.36%), protein ( 17.16 ± 0.47 to 21.41 ± 0.15%), and amylose (21.27 ± 0.93 to 26.09 ± 2.64). Incorporating 10% Patoom seed flower in bread, both the quality and consumer acceptance were improved (Singthong and Meesit (2017).

*N. nucifera* has many medicinal uses and reviewed by several workers (Rajlakshmy, 2019; Limwachiranon, *et al.,* 2018; Zhu *et al.,* 2016; Paudel and Panth, 2015; Mukharjee *et al.,* 2009; Kaur *et al.,* 2009; Sridhar and Bhat, 2007; Indrayan *et al*., 2005; Facciola, 1990). It is used for the treatment of many diseases such as pharyngopathy, pectoralgia, spermatorrhoea, leucoderma, small pox, dysentery, cough, haematemesis, epistaxis, haemoptysis, haematuria, metrorrhagia, hyperlipidaemia, fever, cholera, hepatopathy and hyperdipsia, to cure mouth and nose bleeding and blood in urine. It is extensively used in Ayurvedic medicines. In popular medicine it is used in the treatment of tissue inflammation, cancer, skin diseases, leprosy and as a poison antidote. Several pharmacologically active constituents that are responsible for the medicinal values have been isolated from the leaf, rhizome, seed and flower. Seeds are also antiviral. The most important phytochemical classes of *N. nucifera* are alkaloids, steroids, triterpenoids, flavonoids, glycosides and polyphenols. Limwachiranon *et al.,* (2018) have reported some 12 phenolic acids and 89-90 flavonoids (47 flavanols, 25-26 flavono, 8 flvan-3-ols, 4 flavanons) and 5 anthocyanins from various parts of 154 cultivars of lotus.

According to Mukhrajee *et al.,* 2009) extracts of different parts of the plant have shown it to be anti-ischaemic, antioxidant, anticancer, antiviral, anti-obesity, lipolytic, hypocholesterolaemic, antipyretic, hepatoprotective, hypoglycaemic, antidiarrhoeal, anti-fungal, antibacterial, anti-inflammatory and diuretic activities (more details given in the comprehensive review of Mukhrajee *et al.* (2009).

Various alkaloids of seeds include nuciferine, neferine, lotusine, isolieusinine, quercitin and isoquercitin (Rajlakshmy, 2019). *N. nucifera* contains several Benzylisoquinoline alkaloids (Neferine and linesinne in majority). Seed embryo is green and bitter due to aporphines. Deng *et al.* (2016) have suggested that the alkaloids are synthesized in leaf and transported to the embryo (Deng *et al.*, 2016). Alkaloid liensinine extracted from rhizomes which is effective in Arrhythmia (Ling *et al.,* 2005), sunstroke fever, dysentery, diarrhea, dizziness and stomach problems (Lee *et al.*, 2005). Rajput *et al.* (2019) have reported anti-coagulant property of lotus.

Plumule and cotyledons of lotus seeds contain a large amount of Glutathione (Toyoda, 1966) which is related to the reduced germination of seeds (Mukharjee *et al.,* 1996a). The seeds may, however, remain viable for long time. It is reported that in 1994 a seed of lotus successfully germinated after 1300 ± 250 years of storage. An information

regarding its seed germination is also from Rams Bottom (1942) that 237 years old seeds, collected during 1705 from Hans Sloane of British museum, well germinated in 1942.

Generally, seeds of the lotus are rich in amino acids, minerals, proteins, and unsaturated fatty acids (Mukharjee *et al.,* 1996a). *N. nucifera* seeds are rich in minerals and several metabolites (nuciferine, dauricine, liensinine, lotusine, pronuciferine, roemerine, armepavine, and neferine, etc. (Mehta *et al*., 2013; Mukharjee *et al.,* 1996 b and C; 1997, Huralikuppi *et al.,* 1991; Lee *et al.,* 2001: Shinha *et al.,* 2000; Rakesh *et al.,* 2011). Wu *et al.* (2007) extracted procyanidin from lotus seed pod. It has also rich in compounds like isoliensinine, dimethylocrypalline, flavonoids like (rutin, galuteolin, hyperine) and some other microelements like zinc, magnesium, iron, and calcium (Zn, Mg, Fe, Ca) (Acharya and Srikanth, 2014). Seeds are rich in phosphorus also (Chowdary, 2013).

**Family Nyctaginaceae:**

1**.** *Mirabilis jalapa* L.

**Jalapa Nut,** Four O'clock Plant, Gul-e-Abbas, a cultivated ornamental herb. Nuts small subglobose and black; used as an adulterant of black pepper (NISC, 1998). Powdered nuts are used as a cosmetic in Japan (Usher, 1984).

**Family Palmae (Palmaceae):**

1**.** *Cocos nucifera* L., **Coconut**

Narial (Khopra, copra), cultivated in coastal areas of Pakistan mainly for its nut. The kernel (endosperm) is oily and edible. The copra contains 60-65% oil suitable for manufacture of quick lathering soaps, margarine, cosmetics and synthetic rubber. The kernel is also eaten raw. Coconut water is a delicacy. Pakistan produced 8526 tonnes of coconut in 2003-04 with yield around 5.44 tonnes / Ha (Govt. of Pakistan, 2004). Since production of coconut is not sufficient in Pakistan, coconut and coconut oil are imported from Southeastern countries.

2. *Areca catechu* L.

**Betelnut,** Supari, Chhaliya, cultivated as ornamental plant in Pakistan. Betel nuts are imported in Pakistan and they are chewed as a mild stimulant. The nuts, cut into pieces and wrapped in leaves from betel pepper plant (*Piper betle*) along with lime with or without tobacco, are chewed for mild narcotic effect. Chewing betel stains the saliva and mouth red and blackens and decays teeth (Howard, 1979). Betal nut contains alkaloids, arecoline and arecaidine. Arecoline is a mild stimulant of the central nervous system. It can improve learning and memory as well as counteract intestinal parasites. Excessive use can, however, cause inebriation and dizziness. Long-term use may damage teeth and soft tissues of mouth and may cause cancer (http://www.druscope.org.uk.druginfo/drug search/ds; NISC, 2000).

Arecoline of *A. catechu* increases respiration (http://www.erowid.org/plants/betel/betel.Shtml). Aqueous extract of *Areca* nut as well as arecoline have shown genotoxic effects in Chinese hamster ovary cells *in vitro*. Arecoline shows hypoglycaemic activity. NISC (2000) have reiterated that betel nut when harvested prematurely and allowed to dry in heaps, get infected with fungus, *Aspergillus flavus*, which spread up to the interior of the nuts. Such nuts when consumed cause cancer due to the presence of aflatoxins secreted by *A. flavus*. The use of pan (*P. betle*) and *Areca* nuts should be discouraged.

**Family Papilionaceae:**

1. *Arachis hypogaea* L.

**Peanut** (Groundnut), Goober, Pindar, Mungphali, cultivated in Sindh, Punjab and NWFP. Cultivar "Golden" has been approved as a commercial variety of groundnut for general cultivation in Punjab. It has resistance against Cercospora leaf spot. It was originated at Barani Agricultural Research Institute (BARI) Chakwal. Average and potential pod yield of variety "Golden" is 2413 and 4100 kg / Ha (Naeemuddin *et al.* (2009).

Although some decline has taken place in recent years, the area of cultivation as well as the production of peanut have gradually increased in Pakistan. In 1997-98, total peanut production amounted to 112.3 thousand tonnes; nearly double to that in 1980-81 (57.4 thousand tonnes) and only slightly lower than that in 1996-97 (117.4 thousand tonnes; ever maximum). However, this rise in peanut production appears to be largely the function of the increase in the area under peanut crop. Average production per hectare for last 44 years of peanut cultivation since 1957-58, has been quite low averaging to 1.223 ± 0.0262 tonnes/Ha; range: 0.78 - 1.563; CV, 14.04%). The data of Federal Bureau of Statistics (FBS, 1998 a & b and 2002) indicates that peanut yield/Ha has been much higher in Sindh and NWFP than that in the Punjab. One-way ANOVA of the yield-data, partitioned decade-wise into various temporal segments, indicates that significant increase in yield on Pakistan basis took place during 1967-68 to 1976-77 (12.83% over previous decade). The yield, then, began declining gradually and significantly over the years with no recovery (Table 1). Peanut cultivation in Pakistan needs more judicious and scientific approach so that its yield

may increase to its fullest potential. Yield/Ha of peanuts for nuts in USA for the period of 1992 - 2000 has averaged around 2.796 ± 0.084 tonnes/Ha (CV = 9.01%), which is much higher, comparatively (NASS, 2002).

The yield of pods varies with the cultivars. Ahmad *et al.* (2007) have investigated three genotypes of peanut (Sp 2002, Sp 2000 and Sp 96) under three rates of sowing (20, 40 and 60 kg / acre). They reported that the yield varied with the pattern of sowing and the higher seed rate and spacing of 30 cm gave higher yield particularly in in case of genotype SP 2000. Pod yield from bunch type of peanut is reported to be higher (c 16%) (Norden and Lipscomb, 1974). Duke and Alexander (1964) reported pod yield that was higher by 14% in narrow row planting as compared to traditional wider planting in case of large-seeded Virginia bunch-forming type peanut. The inter spacing of 30 cm gave higher pod yield by bunch-forming peanut with seed rate of 60 kg/ acre (Khushik and Chaubey, 2000).

Table 1. One way ANOVA of yield (tonnes / ha) of **peanut** for 44 years of cultivation until 2000-2001 partitioned into five period viz. Period I, 1957-58 to 1966-67; Period II, 1967-68 to 1976-77; Period III, 1977-78 to 1986-87; Period IV, 1986-87 to 1996-97; and Period V 1997-98 to 2000-2001.

| Period | Mean | SE | N | CV (%) |
|---|---|---|---|---|
| I | 1.255 a | 0.06092 | 10 | 14.57 |
| II | 1.416 b | 0.02408 | 10 | 5.10 |
| III | 1.229 a | 0.02404 | 10 | 5.87 |
| IV | 1.051 c | 0.03126 | 10 | 8.93 |
| V | 1.057 c | 0.01688 | 4 | 2.72 |
| Grand Mean: | 1.223 | 0.02617 | 44 | 14.04 |

| SOURCE | SS | df | MS | F | Prob. |
|---|---|---|---|---|---|
| Between | 0.767 | 04 | 0.192 | 14.114 | 0.001 |
| Within | 0.530 | 39 | 0.014 | | |
| Total | 1.296 | 43 | | | |

Means followed by the different letters are statistically different at least at $p < 0.05$.

Table 2. Fatty acid composition of peanut oil.

% Fatty acids of groundnut

Myristic acid = 0.05-0.09
Palmitic acid = 6.4-7.6
Palmitiolic acid = 0.1-0.2
Stearic acid = 2.2-2.8
Oleic acid = 49.6-62.1
Linoleic acid = 27.2-37.7
Linolenic acid =1.4-1.9
Archidic acid = 0.34

The data presented by Fernandes *et al.* (2017) based on several bibliographic references.

The peanuts are roasted and eaten as snacks. The peanut oil yield varies with the cultivars. The pale yellow oil of peanuts is a non-drying oil belonging to the oleo-linolein group (Table 2). It has nutty odour and bland taste and is completely digestible. It is hydrogenated to produce 'Vanaspati Ghee'. It contains 47.5% fats and 28.5% protein. Arachin is the dominant protein in its kernel. Twenty ground nut varieties are grown in Ghana of which 7 belong to subspecies Hypogeae and 13 belong to subspecies Fastiata. Significant variation in phytochemicals concentration exists between the varieties (Asibuo *et al.* (2008). Virginia cultivar of subspecies hypogeae had higher oil content (49.7%) than Spanish and Valencia market types belonging to subspecies fastiata (47.3%). Mean protein content is reported to be higher in subsp. Fastiata (25.69%) than subsp. Hypogeae (22.78%). Brohi fufuo, a Spanish market type had the highest crude protein content (30.53%) but least oil content (33.60%). There was, however, no significant difference between the two subspecies with respect to the mineral content (Zn, Cu, Fe and Mn) (Table 3) (Asibuo *et al.*, 2008). Ground nut is rich source of Vit. C.

Embryo of groundnut, however, contains bitter principles, the saponins. Groundnut is used in multiple ways e.g., in desserts, confectionary products and preparation of edible groundnut flour, which is used in some formulations of food for infants and adults. Groundnut milk is reported to be as good as Cow's milk. Groundnut oil cake is extensively used in livestock feed and also as fertlizer, in preparation of glues for binding plywood. Wool like fibres (Ardil in UK and Sarelon in USA) has been prepared from protein extracted from groundnut oil cake. The fibre is said to be light cream in colour with soft handle and warmth similar to that of wool. The shells of fruit form low-grade fertilizer (PID, 1985).

George Washington Carver of USA (1864 - 1943) extensively studied peanut and he is credited with having found more than 300 uses for peanut plant and its seeds (Kitchens, 1993).

Table 3. Minerals contents (mg / 100g) of 20 cultivars of Hypogeae and Fastiata group of peanut.*

| Mineral | Hypogeae (N = 7) | Fastiata (N + 13). | Student t - Test |
|---|---|---|---|
| Zinc | 5.47 ± 0.30 | 5.060 ± 0.438 | 0.7238 (NS) |
| Copper | 2.11 ± 0.498 | 1.823 ± 0.173 | 1.4656 (NS) |
| Iron | 2.71 ± 0.223 | 2.890 ± 0.251 | 0.6245 (NS) |
| Manganese | 2.10 ± 0.162 | 2.085 ± 0.079 | 0.0289 (NS) |

*, calculated from the data of Asibuo *et al.,* 2008) for varieties of Ghana.
Zinc and Copper were not detected in variety Kintampo local.

**Family Pinaceae:**

1**.** *Pinus gerardiana* Wall. Ex Lamb.

**Pine nut**, Chilghoza**,** Neosia Pine, is cultivated in Balochistan, Kurram valley, Chitral, upper Swat, Astor, Naga Parbat and Kishtwar areas. Roasted seeds are eaten in winter. The kernel of the seeds is oleaginous and possesses a delicate terebinthine flavour. It is carminative, stimulant and expectorant. The kernel has 15.9% protein, 49.9% fat, 21.6% carbohydrates and fair amount of calcium and phosphorus (NISC, 1998).

**Family Proteacae:**

1**.** *Macadamia ternifolia* F. Muell.

**Macadamia Nut**, Queensland Nut, Bush nut, marroochinut and Hawaii nut, a native of Australia. It was introduced in Hawaii in 1880sIn aboriginal language it is called Bouple, Gyndi, Jindill and Boomberra. Aborigines called it Kindal Kindal also. British colonizers of Australia named it Macadamia after Dr. John Macadam. It is cultivated in Lahore (Stewart, 1972). It is usually planted by grafting. It provide 3080kJ /100 g energy. The seeds are edible and have creamy texture and delicious butter like flavour when roasted and salted. Economically unexploited in Pakistan. Three species of *Macadamia* are commercially important- *M. ternifolia, M. integrifolia* and *M. tetraphylla*. It is one of the expensive nut of the World. It contains carbohydrates 13.8g; Sugar: 4.57g, Dietary fiber: 8.6g, Fat: 75.8g (saturated fat: 12g, monounsaturated fat: 59g, polyunsaturated fat: 1.5g) and protein: 7.9g per 100 g raw. The nut is ideal for many healthy eating and weight-loss. It is included in Keto diet programmes (Macadamia Wikipedia).

**F*a*mily Rosaceae:**

1. *Prunus amygdalus* Batsch:

**Almond,** Badam, cultivated and wild in Balochistan, Chitral, Gilgit and Astor. According Javed et al. (2020) around 95% of almond is cultivated in Balochistan. They identified Western Balochistan, Loralai, Zhob and Killa Saifullah as the main almond growing clusters (Javed *et al.,* 2020). It does not do well in the Punjab.

Table 4. One-way ANOVA of yield (tones / Ha) of almonds for 30 years of cultivation until 2000-2001 partitioned into three periods viz. Period I, 1971-72 to 1980-81; Period II, 1981-82 to 1990-91; Period III, 1991-92 to 2000-2001.

| Period | Mean | | SE | N | CV (%) |
|---|---|---|---|---|---|
| I | 3.385 | a | 0. 32466 | 10 | 28.77 |
| II | 4.084 | b | 0.06125 | 10 | 4.50 |
| III | 4.258 | b | 0.21038 | 10 | 14.87 |
| Grand Mean: | 3.909 | | 0.14423 | 30 | 19.87 |

| SOURCE | SS | df | MS | F | Prob. |
|---|---|---|---|---|---|
| Between | 4.265 | 02 | 2.133 | 4.163 | 0.026 |
| Within | 13.833 | 27 | 0.512 | | |
| Total | 18.098 | 29 | | | |

Means followed by different letters are statistically different at least at $p < 0.05$.

Table 5. Fatty acid composition of almond oil.

Myristic acid = 0.0-0.07
Palmitic acid = 4.7-15.8
Palmitiolic acid = 0.1-2.5
Stearic acid = 0.3-2.5
Oleic acid = 50.04 – 81.2
Linoleic acid = 6.21 - 37.1
Linolenic acid =0 -11.1
Archidic acid = 0.4 – 0.2

The data presented by Fernandes *et al.* (2017) based on several bibliographic references.

It is said that this species has three varieties, viz. var. *amygdalus*, var. *amara* (DC.) Focke and var. *sativa* (Ludw.) Focke. The first one includes wild types found in West Asia, Greece and N. Africa; the second and third varieties include a large number of types; var. *amara* comprises mostly the Bitter Almond and var. *sativa* the Sweet Almond. The drupe has tough fibrous rind surrounding a hard oval-shaped pit that contains the edible seed. It is most widely used of all nuts. It is eaten ripe, dried, or green and even salted or roasted. Almond is added in desserts and pressed to obtain oil, Badam oil. The sweet almond kernel contains around 58% fat, 20.8% protein, and 10.5% carbohydrates besides calcium, phosphorus, iron, thiamine, nicotinic acid, riboflavin, folic acid, and tocopherols. Amond lacks Vitamins A and C. The chief protein of almond is a globulin, amandin, which has high arginine content. Albumin is also present. The inedible bitter almond is used only for oil. The sweet almond oil (Oleum Amygdalae Expressum) is non-drying oil and used to soften tissues and relieve congestion. The bitter almond oil (Oleum Amygdalae Amarae) is also non-drying oil but it contains a glucoside that form hydrocyanic (prussic) acid, a poison. Under the influence of the enzyme emulsin, which is present in the kernels and freed by crushing of the kernels, the glucoside gets hydrolysed into benzaldehyde, hydrocyanic acid and glucose. With Prussic acid removed, the oil is used in making cough syrups and other medicines and for making almond extract, a flavoring for food. The crushed material remaining after the oil has been extracted is used for soaps, cosmetics, and bases for perfumes. Badam oil is a mild laxative (NISC, 1998; Usher, 1984).

The area under almond cultivation in Pakistan has more or less doubled during last 30 years and so its total production. The production during last two years has, however, substantially declined due to drought prevalent in the country in general and Balochistan in particular. Average yield per hectare, for last 30 years since 1971-72, amounts to 3.908 ± 0.144 tonnes/Ha. One-way ANOVA of yield data from FBS (1981 & b and 2002), partitioned decade-wise into three temporal segments, indicates that significant increase in yield occurred during 1980-81 to 1990-91 only. It remained stagnant thereafter (Table 4).

Almond production, in Pakistan is found to be in serious crisis. During 2001-2016 almond production has plummeted at a rate of 1.6 per annum. There is a need to address for competitiveness of almond in domestic and international market (Javed *et al.,* 2020). Almond is a high value stone nut. With the introduction of early ripening varieties, it is now grown in Pothwar region also. The almond oil is predominantly composed of monounsaturated fatty acid (oleic acid) (Edu.par.com.pk) and resembles to hazel nut oil in fatty acid composition (Fernandes *et al.* (2017) (Table 5). Almond is good for health in many respects. It cures diabetes. It is a fantastic source of Vitamin E. It reduces risk of cancer, relief from constipation, respiratory disorders, cough, heart disorder, anemia, and impotency. It makes hair and skin (Psoriasis) healthy, increases brain activity, decreases the occurrence of Alzheimer's disease, normalizes functioning of nervous system, its P content maintain durability of bones and teeth. It is a source of Folic acid. It protects from artery wall damage and regulates blood pressure. Almonds, however, do contain oxalates, and excessive oxalates can cause crystallization, which can lead to a host of different issues. People that have kidney or gallbladder problems should avoid eating almonds (*Edu.par.com.pk*).

2. *Prunus armeniaca* L.

**Apricot Nut,** Khubani, Khurmani, Zardalu, cultivated in Kurram, Hunza, Gilgit and Chitral but mostly in the mountainous region of Balochistan. There are some 50 varieties of apricot available in the country. Apricot's cultivation in Pakistan, occupies an area slightly more than 12,000 Ha with magnitude of fruit production around 190800 tonnes (Yield: c 15 tonnes / Ha) (FBS, 2000). Around 90% of the produce comes from Balochistan.

It is a greatly promising fruit crop of Pakistan, however, needs improvement in culturing of the plant and processing of the produce. At present, it is said that during apricot season 60% of the fruits go in waste. The collection and conservation of local germplasm is required since emphasis on apricot improvement has mainly been restricted to the selection of exotic germplasm (Laghari, 1998).

The production estimate for apricot nut is not available. Apricot-nut-kernel is used as substitute of almond or eaten raw along the fruit pulp. Locals opine that eating kernel along the pulp saves from gastric upset, which may occur on eating the pulp alone. The oil extracted from the kernels is used for cooking and burning and as substitute of almond oil. Apricots are good source of sugars and Vit. A. A number of products are prepared from apricots (NISC, 1998). Dried apricots are also sold in the market. In Gilgit, Kilaoo, a delicious sweet snacks, is prepared by layering the apricot, almond or walnut kernels with thick mulberry or grape juice and then drying.

**Family Sapindaceae:**

*Litchi sinensis* Sonn.

**Litchi Nuts**, Licche, Leechee. For last few years cultivation of Litchi has been undertaken in Punjab, which being successful is gradually increasing. Litchi fruits may be eaten fresh or dried like raisins. When dried, they are called Litchi Nuts (Ito, 1993). The seed kernel is, however, not eaten. China exports large quantities of Litchi nuts (Usher,

1984). Litchi seed extract has been used in Chinese and Indian medicines since ancient times to relieve neural pain, swelling and other hernia-like conditions. It is hypoglycemic, anticancer, antibacterial and antiviral which may be attributed to phenolics, fatty acids, triterpenes and proteins in seeds. Ethanolic extract from Litchi seeds has strong DPPH radical scavenging and good anti-tyrosinase activity. Seed oil is a source of cyclopropanoic fatty acid. The litchi contains Di-hydrosterculic acid, Cis -7, 8 methylenehexadecanoic acid, Cis -5, 6 methylenetetradecanoic acid and Cis- 3, 4 methylenedecanoic acid. All these compounds exhibit great medicinal activity (Yang *et al.,* 2011).

2. *Sapindus mukorossi* Gaertn.

**Soapnut,** Chinese soapberry, Ritha. Soapnut trees grow in valleys of Himalaya up to 1219m. Ocassionally cultivated in Pakistan. The fruit shell is used as soap substitute for washing fabrics and bathing owing to the presence of saponins. Other substances in fruit include mucorosin, glucose, and pectin. Other species of genus *Sapindus* e.g., *S. trifoliatus* L. is also used for similar purpose (Usher, 1984; Kaushik and Dhiman, 2000).

**Family Simmondsiaceae:**

1. *Simmondsia chinensis* (Link) C.K. Schneider

**Jojoba Nut**, Goatnut, native to USA, introduced in Pakistan and cultivated experimentally in Sindh with success. Jojoba nuts are about the size of acorns containing one or sometimes two seeds, which yield Jojoba oil. This oil contains no glycerides or glycerol. It is composed of fatty acids connected directly to fatty alcohols. The seeds contain about 50% oil. The oil can easily be hydrogenated into Jojoba wax, which resembles to beeswax, candelilla, carnauba and spermaceti. NRC (1985) opined that Jojoba oil and its derivatives have great potential in diverse products such as cosmetics, pharmaceuticals, lubricants, foods, electrical insulators, foam-control agents, plasticizers, fire retardants, transformer oils, etc.

**Family Sterculiaceae**

*1. Sterculia foetida L.*

**Samrong, Sterculia nut,** Hamrong, Marong, Chammahong, Java Olive, Jangli Badam (wild almond), Pinari, peon, Poon tree, Bastard poon tree, Skunk tree, Chichá, Hazel Sterculia, Pranajiwa etc. The name *Sterculia* is based on word "Stercus" meaning manure due to malodromous nature of flowers. Plant is dioecious and may grow to 40m in height. Bark is smooth and gray. Canopy spreading like umbrella. The leaf palmate with several elliptical, lanceolate leaflets with small Petiolule (Chanywiwatkul *et al,* 2018). It is distributed in many countries of the World. The different parts of the plant may be used as food or medicine (Orwa *et al.,* 2009).

The environment of 50% shade is the most suitable to produce hazel *Sterculia* seedlings even under salinity (5.1 $dS.m^{-1}$). Increase in salinity negatively affects its growth (Lima *et al.,* 2018). Lustosa *et al.* (2017) has shown high concentration of K in leaves of this plant but Na / K ratio remained unchanged under salinity stress as compared to the control when treated with 100mM NaCl solution for 23 days.

Seeds are ovate in shape, black in colour and 2 to 4g in weight. Mechanical scarification and soaking for 24 h improves germination (Santos *et al.,* 2004).

Ethanolic extract of *S. foetida* seeds contains flavonoids, saponins and alkaloids (Shamsunder and Paramjyothi (2010). Its leaf is reported to contain glucuronyl derivatives of Procyanidin, scutellarein and Luteolin and also taraxerol, n-octacosanol and beta-Sitostero (Kavitha *et al.,* 2015). Samrong seed kernel consists of moisture 5.91 ± 0.12%, ash 2.80 ± 0.17%, oil 46.09 ± 0.44% protein 11.68 ± 0.16% and carbohydrate 33.52 ± 0.07%. In Samrong oil, saturated fatty acids are 29.34%, monounsaturated fatty acids 5.30% and polyunsaturated fatty acid 55.95%. The linoleic acid constitute 47.80%, Palmitic acid 16.49% and Stearic acid 10.45%. The oil content *in S. foetida* seeds is reported to be 25.5% (Sudrajat *et al.,* 2010). Its oil may be used as potential source of edible oil for food industry (Chanywiwatkul *et al,* 2018). Substantially varying fatty acid composition of seed oil is presented by Kale *et al.,* (2011) which is given below.

Oil content of seed = 32.44%; Myristic acid = 1.65%, Palmitic acid = 11.87%, Heptadecanoic acid & Margaric acid = 2.28%, Oleic acid = 20.50%, Linoleic acid 12.86% and Sterculic acid = 6.67%.

Significant variations in seed morpho-physiological and biochemical characters for the populations of *S. foetida* have been reported by Sudrajat *et al.* (2018) for Indonesian islands are reported due to different degree of environmental constraints and possible genetic reasons. The nutritive value of *S. foetida* nuts peeled kernels is reported by Bhattacharyya and Mazumdar (1989). The seeds are edible but they should be roasted prior to eating them (www.ntbg.org/plants /plant_ details). There are some reports of anti-hyperglycemic and insulin resistant activity and also hypolipidemic effect of ethyl alcohol solution fraction of seeds of *S. foetida* (Dange, H. and P. Ingale, ND) – hemalatadange.99@ gmail.com). Acetone extract of seeds of *S. foetida* showed toxicity to the *Spodoptera litura* and feeding deterrence to the *Achaea janata* on castor. The activity was dose dependent (Rani and

Rajasekharredy, 2009). According to Amuthavalli *et al.* (2020) the seed powder extract with ethyl acetate, 98% Methanol and water appeared to be antibacterial against *Staphylococcus aureus* and *Proteus mirabilis* at 30 µg concentration and showed anti-termite activity against white termite *Odontotermes obesus*. This activity may be due the presence of carbohydrates, amino acids, fats and oils, saponins, alkaloids, flavonoids and terpenoids (Amuthavalli *et al.*, 2020) in this plant.

It is important source of timber and non-timber resources. It is valuable in cosmetics, medicines, pesticides, bio-oil, and beverage and furniture industry. Grows well in degraded soils (Nhan *et al.*, 2019).

Active pyrolysis of empty hard fruits of *S. foetida* and seeds showed mass loss of 59.82 and 51.32%, respectively. They were rated as excellent source for thermal energy conversion (Vaishnavi and Pugazhvadivu (2017). *Sterculia villosa* is a closely related species also in cultivation in Pakistan.

**Family Trapaceae:**

1. *Trapa bispinosa* Roxb.

**Water Chestnut**, Singhara, cultivated in permanent and rain-fed ponds. It grows wild also. Peeled nuts are eaten raw or boiled. Fresh kernel of fruit has 20% carbohydrates, 5% proteins, and fair amounts of vitamins (A, B and C) (Mirza and Bokhari, 1996).

2. *T. natans* L. is a four-horned Singhara of Kashmir lakes (Stewart, 1972).

**Family Umbelliferae:**

1**.** *Elwendia persica* (Boiss.) Pimenov & Kljuykov (syn. Bunium persicum (Boiss.) Fedtsch.): **Earthnut, Arnut,** Yer-nut, Earth Chestnut**,** Hawknut, Lousy-nut, Kala Zira, Syahi zeera, Zeera kuhi (mountain wild) is a common plant in dry arid regions of Gilgit, Baltistan, Chitral, Swat, Hazara, NWFP, and Balochistan. Earthnut is highly valued as spice. It has high potential in medicine. A comprehensive review on the photochemistry of this plant is presented by Hassanzadazar *et al.* (2018) with large number of phytochemicals - cumanaldehyde, γ-Terpenene, limonene, Carvone, p-Cymone and β- Pinene as the main constituents. There are many therapeutic uses of the plant in gastro-intestinal disorders, urinary tract disorders, as diuretic, geneocologic, anti-convulsions, anti-helminthic, anti-asthma, and dyspnea. The seeds are anti-spasmodic, carminative, emmehagogue, expectorant, galactogogue, stomachic and tonic, useful in diarrhea, and dyspepsia as reviewed by Hassanzadazar *et al.* (2018). Antifungal and antibacterial properties of the essential oils have been reported. It inhibits aflatoxin production of *Aspergillus parasiticus* (Razzaghi-Abyanch *et al.*, 2009). It has anti-oxidative property (Abdalaziz *et al.*, 2017).

## REFERENCES


Abdalaziz, M.N., M.M. Ali, M.I. Garbi, M.A. Dafalla and A.S. Kabbashi (2017). In vitro antimicrobial, anti-oxidant activities and cytotoxicity of *Carum carvi* L. *Am. J. Heterocycl. Chem*., 3(3): 23-27.

Abdulla, P. (1973). Sapindaceae. Fl. W. Pakistan # 39.

Abedin, M.S., M.M. Nuruddin, K.U. Ahmed and A. Hossain (2012). Nutritive compositions of locally available jackfruit seeds (*Artocarpus heterophyllus*) in Bangladesh. *Int. J. BioSci.* (IJB), 2 (8): 1-7.

Abedini, S. and V. Alpour (2015). Cadmium removal from synthetic waste water by using *Moringa oleifera* seed powder. *Environmental Health Engineering Management Journal*, 2(4): 157-163. (Seen in Velázquez-Zavala *et al.*, 2016).

Abdulkarim, S.M., K. Long, O.M. Lai, S.K.S. Mohammad and H.M. Ghazali (2007). Frying quality and stability of high-oleic *Moringa oleifera* seed oil in comparison with other vegetable oils. *Food Chem.*, 105: 1382-1389.

Acharya CVK, and K. Srikanth (2014). Second Generation Biofuels from *Nelumbo nucifera* (Lotus) Seeds. IJEDR, 2(4): 3693-3696.

Agbogidi, O.M. and E.M. Ilondu (2012). *Moringa oleifera* Lam.: Its potential as a food security and rural medicinal item. *J. Bio. Innov.* 16: 156-167.

Ahmad, N., M. Rahim and Ulas Khan (2007). Evaluation of different varieties, seed rates and row spacing of groundnut planted under Agro-ecological conditions of Malakand Division. *J. of Agronomy* 6(2): 385-387

Ahmed, K., M. Malik, K. Jahan and K. Salamatullah (1986). *Nutritive value of food stuff.* Third Edn. Institute of Nutrition and Food Sci., Univ. Dhaka, Bangladesh.

Ajayi, I.A. (2011). Chapter 79- Use of jackfruit (Artocarpus heterophyllus) seed in health. In: *Nuts and Seeds in Health and Disease Prevention.* .Pp. 677-683. Academic Press. (http: doi.org/10.1016/B978-0-12-375688-6.10079-9).

Ali, S.I. (1973). Caeselpiniaceae. Fl. W. Pak. # 54.

Ali, S.I. (1977). Papilionaceae. Fl. W. Pak. # 100.

Amuthavalli, A., T. Ramesh and R. Eswalakshami (2020). Anti-termite activity of *Sterculia foetida* L. seed extracts against Indian white termite, *Odontotermes obesus*. *Int. J. Res. Trends & Innovation*, 5(5): 48-53.

Anyasor, G.N., K.O. Ogunwenmo, O.A. Oleyana, D. Ajayi and Dangama (2009). Chemical analysis of groundnut (Arachis hypogaea) oil. *Pak. J. Nutrition* 8 (3): 269-272.

Asibuo, J.Y., R. Acromah, O. Safe-Kantanka, H.K. Adu-Dapaah, S. Ohemeng-Dapaah and A. Agyeman (2008).Chemical composition of groundnut, *Arachis hypogaea* (L.) landraces. *Afr. J. Biotech*. 7(13): 2203-2208.

Babitha, S., C.R. Soccol and A. Pandey (2006). Jack fruit seed – A noel substrate for the production of *Monascus* pigments through solid-state fermentation. *Food Technol. Biotechnology*, 44 (4): 465-471.

Bahare Salehi, Mine Gültekin-Özgüven, Celale Kırkın, Beraat Özçelik, Maria Flaviana Bezerra Morais-Braga, Joara Nalyda Pereira Carneiro , Camila Fonseca Bezerra, Teresinha Gonçalves da Silva , Henrique Douglas Melo Coutinho, Benabdallah Amina, Lorene Armstrong , Zeliha Selamoglu , Mustafa Sevindik , Zubaida Yousaf , Javad Sharifi-Rad, Ali Mahmoud Muddathir , Hari Prasad Devkota, Miquel Martorell, Arun Kumar Jugran, Natália Martins and William C. Cho (2019). *Anacardium* plants: Chemical, nutritional composition and biotechnological applications. *Biomolecules* 9: 463. Doi: 10.3390/biom9090465. 34 pages (www.mdpi.com/journal/biomolecules).

Baliga, M.S., A.R. Shivashankara, M. R. Haniadka, J. Dsouza and H.P. Bhat (2011). Phytochemistry, nutritional and pharmacological properties of *Artocarpus heterophyllus* Lam. (Jackfruit): A review. *Food Res. International* 44 (9):1800-1811.

Baptista, A., R.V. Gonclaves, J. Bressen, M. Peluzio (2018). Antioxidant and antimicrobial activities of crude extracts and fractions of Cashew (*Anacardium occidentale* L.), Cajui (*Anacardium microcarpium* L.) and Pequi (*Caryocar braasiliensec*): A Systematic Review. *Oxid. Med. Cell Longev*. 3753562 (13 pages) Hindawi. (http://doi.10.1155/2018/3753562).

Beltran-Heredia, J., J. Sánchez-Martin, A. Muñoz-Serrano, J.A. Peres (2012 b). Towards overcoming TOC increase in wastewater treated with *Moringa oleifera* seed extract. *Chemical Engg. Journal.* 188: 40—46.

Beltran-Heredia, J., J. Sánchez-Martin, A. Muñoz-Serrano, J.A. Peres (2012 a). Long-chain anionic surfactants in aqueous solution. Removal by *Moringa oleifera* coagulant. *Chem. Engg. Journal.* 180 (15): 128-136.

Berci, L.M., C.B. Da Silva, J. N. Redon, L.M. da Silva, S.F. de Andrade, O.G. Miguel, J.de F.G. Dias and S.D. Miguel (2019). *Toxicology Reports* 6: 1304-1308.

Bhargave, A., J. Pandey, K. Singh, Nama and M. Pandey (2015). *Moringa oleifera* Lam.- Sanjana (Horseradish tree) – A miracle food plant with multipurpose uses in Rajasthan, India – An overview. *Int. J. Pure Appl. Bioscience.* 3(6): 239-248.

Bhatia, S.C. (1983). *A Concise Encyclopedia of Oils. I. Vegetable and Animal Oils*. Shree Publ. House, N, Delhi. IV + 220 pp.

Bhattachayya, A.K. and B.C. Mazumdar (1989). Nutritive value of the *Sterculia foetida* nuts. *Science & Culture* 55: 220.

Bichi, M.H. (2013). A review of the applications of *Moringa oleifera* seed extracts in water treatment. *Civil and Environmental Researc*h 3(8): 1-11. (Seen in Velázquez-Zavala *et al.*, 2016).

Bichi, M.H., J.C. Agunwamba, S.A. Muyibi and M.I. Abdul Karim (1995). Effect of extraction method on the antimicrobial activity of *Moringa oleifera* seeds extract. *J. Am Sci.* 8: 450-458.

Chanywiwatkul, J. S .Supapavnich, and S. Takeugwogtrakul (2018). Physico-chemical properties and oxidative stability of oils from Samrong (*Sterculia foetida*) seeds. *Int. J. Agricultural Technology* 14(7): 1097-1106.

Chowdary S. (2013). Neuropharmacological Screening of ethanolic extract of *Nelumbo nucifera* Gaertner seeds, *Indian J. Res. Pharm. & Biotech (IJRPB).*, 1(5):635-642.

Chuang, P.H., C.W Lee, J.Y. Chou, M. Murugan, B.J. Sheikh, H.M. Chen (2007). Anti-fungal activity of crude extracts and essential oil of *Moringa oleifera* Lam. *Bioresource Technology* 98: 232-236. (Doi: 10.1016/biotech).

CSIR (Council of Scientific and Industrial Research). (1950). *The Wealth of India*. Raw Materials. Vol. II. New Delhi, India.

CSIR, (1956). *The Wealth of India*. Raw Materials. vol. 4 (F - G). New Delhi, India.

CSIR, (1966). *The Wealth of India*. Raw Materials. vol. 7 (N - Pe). New Delhi, India. Reprinted NISC (1992).

Deng, X., L. Zhu, T. Fang, S. Vimolmangkang, D. Yang, C. Oguto, Y. Liu, Y. Han (2016). Analysis of isoquinoline alkaloid composition and wound-induced variation in Nelumbo using HPLC-MS/MS. *J. Agric. Food Chem*., 64: 1130-1136.

Duke, G.B. and M. Alexander (1964). Effects of close row spacing on peanut yield and peanut production requirements. *USDA Prod Res. Bull*. Pp. 77.

Eilert, U., B. Walters and A. Nahrstedt (1981). The antibiotic principle of seeds of *Moringa oleifera* and *M. stenoptela*. *Planta Med.* 42: 55-61.

Elias, T.S., and P.A. Dykeman (2009). *Edible wild plants: A North America. Field Guide to over 200 Natural Foods*. New York.

Facciola, S. (1990). *Cornucopia. A Source Book of Edible plants*. Kampong Publications, California.

FBS (Federal Bureau of Statistics). (1998a). *Compendium on Environment Statistics of Pakistan*. Statistics Div., Govt. Pakistan.

FBS, (1998b). *Fifty years of Pakistan in Statistics*. Vol. III. Statistics Div., Govt. of Pakistan.

FBS, (2002). *Pakistan Statistical Year Book*. 2002. Statistics Div., Govt. of Pakistan.

Fernandez, G.D., R.B. Gómez-Cola, M. D. C. Párez-Camino, W. Moreda and D. Barrera-Arellano (2017). Chemical characterization of major and minor compounds of nut oils: Almond, Hazelnut and Pecan nut. *J. Chemistry* (Hidawi). Article ID- 2609549, 11 pages. Http: // doi.org /10.1155/2017/26095-19.

FTS (Foreign Trade Statistics of Pakistan). (2001). Federal Bureau of Statistics. Govt. of Pakistan.

Fuglie, L.J. (1999). Miracle tree, *Moringa oleifera*, natural nutrition for the tropics. Dakar: Church World Service. P 68.

Gambo, A. and A. Da'u (2014). Tiger nut (*Cyperus esculentus*): composition, products, uses and health benefits – A review. *BAJOPAS* (*Bayero Journal of Pure and Applied Sciences*) 7(1): 56-61.

Ganatra-Tejas, H., U.H. Joshi, P.N. Bhalodia, T.R. Desai and Tirgar (2012). A panoramic view on pharmacognostical, nutritional, therapeutic and prophylactic values of *Moringa oleifera* Lam. *Int. Res. J. Pharmacy*, 3 (6): 1-17.

Ghafoor, A. (1985). Moraceae. Fl. Pak. # 171.

Ghazanfar, S. (1975). Cornaceae. Fl. W. Pak. # 88.

Ghazanfar, S. (1976). Trapaceae. Fl. Pak. # 97.

Girzu, M., A. Carnat, A.-M. Privat, J. Fialip, A.-P. Carnat and J.-L. Lamaison. (1998). Sedative effect of walnut leaf extract and juglone, an isolated constituent. *Pharmaceutical Biol*. 36 (4): 280 - 286.

Govt. of Pakistan. (2004). *Fruit, Vegetables and Condiments Statistics of Pakistan* (2003-2004). MINFAL (Economic Wing), Islamabad. Pp. iv + 46.

Hassanzadazar, H., B. Taami, M. Aminazare, and S. Daneshamooz (2048). Bunium persicum (Boiss.) B. Fedtsch: An overview on photochemistry, therapeutic uses and its application in the food industry. *J. Appl. Pharmaceuticals Science* 8(10): 150-158.

Howard, R.A. (1979). Nut (p. 591 - 593). (In: *Merit Students Encyclopedia.* (vol. 13) (Eds. W.D. Hulsey (Edit. Director) & E. Friedman (Ed. in Chief). Macmillan Educational Corporation, N.Y.

Huralikuppi JC, Christopher AB, Stephen P. (1991). Antidiabetic effect of *Nelumbo nucifera* (Gaertn): Part I Preliminary studies in rabbits. *Phytother. Res*. 5:54-58.

Indrayan, A.K., S. Sharma, D. Durgapal, N. Kumar and M. Kumar (2005). Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttranchal. *Current Sci.* 89: 1252-1255.

Ito, P.J. (1993). Litchi (p. 350). *World Book Encyclop*. (vol. 14). World Book Inc., Chicago.

Jagtap, U.B. and V.A. Bapat (2010). *Artocarpus*: A review of its traditional uses, phytochemistry and pharmacology. *J. of Ethnopharmacology* 129: 142-166.

Javed, T.M., A. Mubarak, F. Umar, Y. Aqsa and Y.S. Khan (2020). Almond cluster feasibility and transformation study. In: Ali Mubarak (2020). *Cluster Development Based Agriculture Transformation plan Vision – 2025*. Planning Commission of Pakistan and Centre for Agriculture Bioscience International. (CABI) Project # 131 (434) PC/AGR/CDBAT120/2018.

Jaynes, R.A. (1993). Nut (p. 627 - 628). *World Book Encyclopedia* (vol. 14). World Book Inc., Chicago.

Jaynes, R.A. (1993). Pecan (p. 225 - 226). *World Book Encyclopedia* (vol. 15). World Book Inc., Chicago.

Kale, S.S., D. Vijaya and H.A. Thakur (2011). Analysis of fixed oil from *Sterculia foetida* Linn. *Int. J. Pharmaceutical Sciences Res.* 2(11): 2908-2914.

Kaur, P., L. Kaur, N. Kaur, A. Singh, J. Kaur, H. Kaur, N. Kaur, M. Kaur (2019). A brief review on pharmaceutical uses of *Nelumbo nucifera*. *J. Pharmacognosy and Phytochemistry* 8(3): 3966-3972.

Kaushik, M.K. and A.K. Chaubey (1974). Response of rainy season bunch groundnut (*Arachis hypogaea* L.) to row spacing and seed rate. *Crops Res*. 20: 407-410.

Kaushik, P. and A.K. Dhiman. (2000). *Medicinal Plants and Raw Drugs of India*. Bishen Singh Mahendra Pal Singh. Dehra Dun, India. Xi + 623 pp.

Kavitha, M., R. Vadiva and R. Radha (2015). A review on Sterculia foetida L. *Res. J. Pharmacognosy and Photochemistry* 7 (4): 239-244.

Kitchens, J.W. (1993). Carver, George Washington (p. 268 - 269). *World Book Encyclopedia*. vol. 3. World Book Inc., Chicago.

Kumar, S., A. B. Singh, A.B. Abidi, R. G. Upadhaya and A. Singh (1988). Proximate composition of Jack fruit seeds. *J. Food Sci. & Tech.* 25: 300-309.

Laghari, M.H. (1998). Apricot- An underutilized fruit of Pakistan (pp. 89 - 94). In: *Underutilized Crops of Pakistan* (Eds. Haq, N., K. Anthony, M. Sarwar, and Z. Ahmad). Proc. Symp. Plant Genetic Resource. Inst., PARC, Islamabad, Pakistan (May 28 - 29, 1997). 122 pp.

Lee M.W., Kim JS, Cho S. M, Kim JH, Lee JS. (2001). Antidiabetic constituent from the nodes of lotus rhizome (Nelumbo nucifera Gaertn). *Nat Prod Sci.* 7:107-109.

Lee, H.K., Y.M. Choi, D.O. Noh and H.J. Suh (2005). Anti-oxidant effect of Korean traditional lotus liquor (Yum YuPjn). *Int. J. Food Sci. and Tech.* 40: 709-715.

Lima, B.L. de Carvalho, C.F. de Lacerda, M.F. Neto, D. de Holando Compello, J.A. de Silva, P.F. S. Ortiz and A.M. E. Bezerra (2018). Light availability and salt stress on hazel *Sterculia* seedlings. *Florista Ambiente* 25 (4): e20170567. (http://doi.org/10.1590/2179-8087.056717)

Limwachiranon, J., H. Huang, Z. Shio, Li Li, and Z. Luo (2018). Lotus flavonoids and phenolic acids: Health promotion and safe consumption dosages. *Comprehensive review in Food sci. and Food safety*. 17: 458-471. Doi: 10.1111/1541-4337.12333.

Ling, Z.Q., B.J. Xio and E.L. Yang (2005). Isolation, characterization and determination of anti-oxidative activity of oligomeric procyanidins from the seed pod of *Nelumbo nucifera* Gaertn. *J. Agricultural & Food Chemistry* 53: 2441-2445.

Lui, R., J. Lui, Q. Huang, S. Lui, and Yueping Jiang (2021). *Moringa oleifera*: a systematic review of its botany, traditional uses, phytochemistry, pharmacology and toxicity. *J. Pharmacy and Pharmacology*: rgrab 131. (http://doi.org/10.1093/jpp/rgrab131).

Lustosa, B.M. L. G. F. de Souza, G. Frosi, H.M. Falcao, S. Pereira, M.T. Oliveira and M. G. Santos. (2017). Strategies of two tropical woody species to tolerate salt stress. *Pesq. For. Bras. Colombo.* V37 n 89 PP. 63-73.

Makkar, H.P.S. and K. Becker (1996). Nutritional value and whole and ethanol anti-nutritional components of extracted *Moringa oleifera* leaves. *Animal Feed Science and Technology*. 63:211.

Makkar, H.P.S. and K. Becker (1997). Nutrients and anti-quality factors in different morphological parts of the *Moringa* tree. *J. Agricultural Sci.* 128(3): 311-322.

Makkar, H.P.S. and K. Becker (1999). Plant toxins and detoxification methods to improve feed quality of tropical seeds. *Asian Australasian J. of Animal Science* 12(3): 467-480.

Malik, K.A. 1984. Palmae. Fl. Pak. # 153.

Mehta NR, E. P. Patel P.V. Patani, B. Shah. (2013). *Nelumbo nucifera* (Lotus): A Review on Ethanobotany, Phytochemistry and Pharmacology. *Indian J Pharm Biol Res.* 2013; 1(4):152-167.

Menéndez-Perdomo, I.M. and P.J. Facchini (2018). Benzylisoquinoline alkaloids biosynthesis in sacred lotus. *Molecules*, 23: 2899. Doi: 10.3390/molecules 23112899). www. mdpi.com/journal/molecules. PP. 1-17.

Meng, X., Ya Li,, Li Sha, Y. Zhou, G. Ren-you, Xu Dong-Ping, Li Hua-Bin (2017). Dietary sources and bioactivities of melatonin. License (Http://creative commons. Org/licenses/by/4.0/) License MDPI, Basal, Switzerland.

Mirza, J.I. and M.H. Bokhari. (1996). *Fruits and Vegetables of Pakistan*. Ferozesons (PVT.) Ltd. Karachi.

Mukherjee K., K. Saha, M. Pal, B. Saha (1997). Effect of *Nelumbo nucifera* rhizome extract on blood sugar level in rats. *Journal of Ethnopharmacology*. 58:207-213.

Mukherjee PK, J. Das, K. Saha, M. Pal and B.P. Saha. (1996b). Diuretic activity of the rhizomes of *Nelumbo nucifera* Gaertn. *Phytother Res.* 10:424-425.

Mukherjee PK, K. Saha K, R. Balasubramanian, M. Pal B.P. Saha BP. (1996a). Studies on psychopharmacological effects of *Nelumbo nucifera* Gaertn. Rhizome extract. *J. Ethnopharmacology*, 54(2):63-67.

Mukherjee, P.K., D. Mukherjee, A.K. Maji, S. Rai and M. Heinrich (2009). The sacred lotus (*Nelumbo nucifera*) – phytochemical and therapeutic profile. *J. Pharmacy and Pharmacology* 61: 407-422.

Mukhprasirt, A. and K. Sajjaanantakul (2004). Physico-chemical properties of flour and starch from jackfruit seeds (*Artocarpus heterophyllus* Lam.) compared with modified starches. *Int. J. Food Sci. & Tech.* 39: 271-276.

Muriel, G. (2010). Moringa and global warming. (muriella.wordpress.com/2012/04/16/Moringa-global warming-and you-murriell'a corner).

Naeemuddin, A. Mehmood, G.S.S. Khattak, I Saeed and M.F. Hassan (2009). High yielding groundnut (*Arachis hypogaea* L.) variety, "Golden" *Pak. J. Bot.* 41 (5):2217 – 2222.

Nasir, E. and Y.J. Nasir. (1987). Gymnospermae. *Fl. Pak.* # 178 - 186.

Nasir, Y. (1972a). Corylaceae. *Fl. W. Pak*. # 22.

Nasir, Y. (1972b). Juglandaceae. *Fl. W. Pak.* #14.
Nasir, Y. (1975a). Betulaceae. *Fl. Pak*. # 95.
Nasir, Y. (1975b). Hippocastanceae. *Fl. W. Pak.* # 82.
Nasir, Y. (1976). Fagaceae. *Fl. Pak.* # 104.
Nasir, Y.J. (1983). Anacardiaceae. *Fl. Pak.* # 152.
NASS (National Agricultural Statistics Service). (2002). *Agricultural Statistics 2002*. USDA, US Govt. Printing Office, Washington, USA.
Nhan, P.T., Le H. En, H. T.K. Trinh (2019). A review on *Sterculia foetida* L. and its potential for development in the dry areas of Vietnam. *Dalat Univ. J. of Science 9*(2): 81-93.
NISC (National Institute of Science Communication) (1992). *The Wealth of India.* Raw Materials. Vol. VII (N - Pe). First printed, 1966. CSIR, New Delhi, India.
NISC, (1997).*The Wealth of India*. Raw Materials. Vol. V (H - K). First printed, 1959. CSIR, New Delhi, India.
NISC, (1998a).*The Wealth of India.* Raw Materials. Vol. VI (L - M). Raw Materials. CSIR, New Delhi, India.
NISC, (1998b).The Wealth of India. Raw Materials. Vol. VIII (Ph - Re). Raw Materials. CSIR, New Delhi, India.
NISC, (2000).*The Wealth of India.* Raw Materials. First Suppl. Ser. vol. 1 (A - Ci). CSIR, New Delhi, India.
Norden, A.J. and R.W. Lipscomb (1974). Influence of plant growth habit on peanut production in narrow rows. *Crop Sci.* 14: 454-457.
Norris, P.E. 1960. *About Nuts and Dried fruits.* Thosons Publishers Ltd., London 64pp.
NRC (National Research Council). 1985. *Jojoba:* New Crop for Arid Lands, Nre Raw Material for Industry. National Academy Press, Washington, USA. x + 102 pp.
Ocloo, F.C.K, D. Bansa, R. Boatin, T. Adom and W.s Agbemavor (2010). Physico-chemical, functional and passing characteristics of flour produced from jackfruit (*Artocarpus heterophyllus* Lam.) seeds. *Agriculture & Biology Journal of North America.* (Doi.10.5251/abjna2010.15.903.908)
Oladele, A.K. and J.O. Aina (2007). Chemical composition and functional properties of flour produced from two varieties of tiger nuts. *African J. Biotechnology* 6: 2473-2476.
Oladi, E., M. Mohammadi, T. Shamspur and A. Mustafavi (2014).Spectrofluorimetric determination of melatonin in kernels of four different varieties after ultrasound- assisted soli-liquid extraction. *Spectro-Chim Acta A. Mol. Biomol. Spectrose.* 132: 326-327. (Seen in Meng *et al.*, 2017)
Ono, Y., F. Hattori, Y. Fukaya, S. Imai and Y. Ohizumi (2006). Anti-obesity effect of *Nelumbo nucifera* leaves extract in mice and rats. *J. Ethnopharmacology* 106: 238-244.
Orwa, C., A. Mutua, R. Kindt, R. Jamnadass and A. Simons (2009). *Agroforestry database: a tree species reference and selection guide version 4.0.* World Agroforestry Centre ICRAF, Nairobi, KE.
Paudel, K.R. and N. Panth (2015). Phytochemical profile and biological activity of Nelumbo nucifera. Review article. *Evidence-based Complementary and Alternative Medicine*. Vol. 2015. Article ID 789124. 16 pages, Hindawi Publ. Corporation.
PID (Publications & Information Directorate). (1985). *The Wealth of India*. Raw Materials. Vol. I A (Revised). CSIR, New Delhi, India.
PID, (1989). *The Wealth of India.* Raw Materials. Vol. X (Sp - W). CSIR, New Delhi, India.
PID, (1992).*The Wealth of India.* Raw Materials (Revised). Vol. III (Ca - Ci). CSIR, New Delhi, India.
Pontual, E.V., B.F. Carvalho, R.S. Bezerra, L.L. Coelho, T.H. Napoleão and P.M. Paiva (2012). Caseinolytic and milk-clotting activities from *Moringa oleifera* flowers. *Food Chem.* 135(3): 1848-1854 (Doi: 10.1016/jfoodchem.2012.06.087)
Porter, C.L. (1967). *Taxonomy of Flowering Plants*. W.H. Freeman & Co. San Francisco.
Poumaye, N., J. Ma Bingui, P. Lutgen and L.M. Bigan (2012). Contribution to the clarification of surface water from *Moringa oleifera*: Case of M'Poko River to Bangui, Central African Republic. *Chem. Engg. Res. Des.* 90: 2346-2352.
Prabhu, K., K. Murugan, A. Nareshkumar, W. Ramasubramanian and S. Bragadeeswaran (2011). Larvicidal and repellant potential of *Moringa oleifera* against malarial vector *Anopheles stephensi* Liston (Insecta: Diptera. Culidae). *Asian Pacific J. Tropical Biomedicine* 1-12: 124-129. (Doi: 10.1016/s2221-1691(11)60009-9).
Prakash, O., R. Kumar, A. Misra and R. Gupta (2009). *Artocarpus heterophyllus* (Jackfruit): An Overview. *Pharmacognosy Reviews* 3(6): 353-358.
Preedy, P.R., P.R. Watson and P. Vinod (2011). Eds. *Nuts and seeds in Health and diseases prevention* (First edition). Burlington.14A, Acad. Press. Pp. 678. ISBN 978-0-12-375689-3.
Pritchard, M., T. Craven, T. Mkanawire, A. S. Edmosnon and J.G. O'Neil (2010). A comparison between *Moringa oleifera* and chemical coagulants in the purification of drinking water- An alternative sustainable solution for developing countries. *Physics and Chemistry of the Earth* 35: 798-805. (DOI: 10.1016/jpee.2010.07.014)

Qaiser, M. (1973). Moringaceae. Fl. W. Pak. # 38.
Qaiser, M. (1993). Nelumbonaceae. Fl. Pak. # 194.
Qaiser, S. and M. Qaiser. (1978). Combretaceae. Fl. W. Pak. # 122.
Radcliffe-Smith, A. (1986). Euphorbiaceae. Fl. Pak. # 172.
Rai, Y. (2014). Growth and development of rare tree species *Sterculia foetida* Linn. In District Meerut (U.P.) India. *Int. J. Sci. & Res*. 3 (6):324-327.
Rajlakshmy, P. (2019). Lotus seeds: A Review. *Acta Scientific Nutritional Health* 3(9): 93-95.
Rajput, M.A., R.A. Khan, S. Zafar, A. Riaz and R. Ikram (2019). Assessment of anti-coagulant activity of *Nelumbo nucifera* fruit. *Pak. J. Pharm. Sci.* 32(6): 2561-2564.
Rakesh, P.D., S. Sekar and K.L.S. Kumar (2011). A comparative study on the antidiabetic effect of *Nelumbo nucifera* and glimepiride in streptozotocin induced diabetic rats. *International Journal of Pharma and Bio Sciences.* 2011; 2(2).
Ramasinghe, R.A.S.N, S.D.T. Maduwanthi and R.A.U.J. Marapana (2019). Nutritional and health benefits of jackfruit (*Artocarpus heterophyllus Lam*.): A Review. *Int. J. Food Sci.* Article ID 4327183, 12 pages. Hindawi (http://doi.10.1155/2019/4327183).
Rams Bottom, J. (1942). Recent work on germination. *Nature* 149: 658.
Rani, P.U., and P. Rajasekharredy (2009). Toxic and antifeedant activities of *Sterculia foetida* (L.) seed crude extract against *Spodoptera litura* (F.) and *Achaea janata* (L.). *J. Biopesticides* 2(2): 161-164.
Rao, M.V., G. Paliyadh and D.P. Ormarod (1996). Ultraviolet-B and ozone-induced biochemical changes in antioxidant enzymes of *Arabidopsis thaliana*. *Plant Physiol.* 110: 125-136.
Razzaghi-Abyanch, M., M. Shams-Ghahfarokhi, M-B. Rezace, K. Jaimand, S. Alinezhad, R. Saberi *et al.* (2009). Chemical composition and anti-aflatoxigenic activity off *Carum carvi* L., *Thymus vulgaris*, *Citrus aurantifolia* essential oils. Food Control 20(11): 1018-1024.
Rehman, N. and T. Jan. (1998). Pecan-an emerging nut crop of Pakistan. (p. 95 -97). In. Haq *et al.*, 1998 (eds.) - Underutilized Crops of Pakistan. Proc. Symposium (May 28 - 29, 1997). Pt. Genetic Resource Inst., PARC, Islamabad, Pakistan. pp 122.
Reid, B.E. (1977). *Famine Foods of the Chiu-Huang pen-ts'ao.* Southern Materials Centre, Taipei.
Rezende, D., L. Nishi, P.F. Coldebella, M.F. Silva, M. F. Viera, A.M.S Vieira, R. Borgamasco and M. R. Fagundes-klen (2016). Groundwater nitrate Contamination: Assessment and treatment using *Moringa oleifera* Lam. seed extracts and activated carbon filtration. *The Canadian J. Chemical Engineering* 94 (4): 725-732. (Doi: 10.1002/cjce.22442).
Rizvi, M. A. and S. Abid Ali (2016). Medicinal flowers of Pakistan. *Int. Journal of Advanced Research* 4(2); 1313-1341.
Rizvi, M.A. (1998). *Medicinal flowers of Pakistan.* Part III. Horticultural Society of Pakistan, Karachi. 48-52.
Sanchez-Martin, J., K. Ghebremichael and J. Beltian-Heredia (2010). Comparison of single step and two step purified coagulants from *Moringa oleifera* seed for turbidity and DOC removal. *Bioresource Technology* 101(15):6259-6261 (Doi: 10.1016/j.biotech, 2010.02.072).
Sánchez-Zapata, E., J. Fernándes – Lopez, J.A. Pérez-Alvarez (2012). Tiger Nut (*Cyperus esculentus*) commercialization: Health Aspects, composition, properties and food applications. *Comprehensive Review in Food Science and Food Safety* 11 (4); 366-377.
Santos Bazanella, G.C., G.F. Silva, A.M.S. Viera and F. Bergamesco (2008). Fluoride removal from water using combined *Moringa oleifera* / ultrafiltration process. *Water Air Soil Pollution* 223: 6083-6093.
Santos, T. O. dos, T.G. de O. Morais and V.P. Matos (2004). Mechanical scarification of seeds of *Sterculia foetida* L. *R. Árvore Viçosa* – M.G., 28 (1): 1-6.
Shad, M.A., H. Nawaz, M. Hussain and B. Yousuf (2011). Proximate composition and functional properties of rhizomes of lotus (*Nelumbo nucifera*) from Punjab, Pakistan. *Pak. J. Bot.* 43(2): 895-904.
Shamsunder. S.G. and S. Paramjyothi (2010). Preliminary pharmacognostical and phytochemical investigation of ethyl alcohol fraction of seeds of *Sterculia foetida* Linn. Seeds. *Afr. J. Biotech.* 9(3): 1987-1989.
Shinha S, P.K. Mukherjee, K. Mukherjee,, M. Pal, S. C. Mandal and B.P. Saha. (2000). Evaluations of antipyretic potential of *Nelumbo nucifera* stalk extract. *Phytother Res.* 2000; 14:272-274.
Singh, S., S. Krishnamurthi and S. Kotyal (1963). *Fruit culture in India.* ICAR, New Delhi, India.
Singthong, J. and U. Meesit (2017). Characteristics and functional properties of Thai lotus seed (*Nelumbo nucifera*) flours. *Int. Food Res. Journal* 24 (4): 1414-1421.
Soetardji, J.P., C. Widjaja, Y. Djejorrahardja, F.E. Soetaredjo and S. Ismadji (2014). Bio-oil from Jackfruit peel waste. *Procedia Chemistry* 9:158-164.

Sreejadevi, P.S., N.S. Kumar and K.K. Sabu (2021). Phytochemical profiling and antioxidant activities of different parts of *Artocarpus heterophyllus* Lam. (Moraceae): A review on current status of knowledge, *Future J. of Pharmaceutical Sciences* 7-30. (http://doi.org/10.1186/s43094-021-00178-7).

Sridhar, K.R. and R. Bhat (2007). *Lotus- A potential neutraceutical source. J. Agricultural Tech.* 3(1): 143-155.

Statistical Wing. (1988-89). *Agricultural Statistics Balochistan (1988-89).* Directorate General of Agriculral Dept. Quetta, Balochistan. 136pp.

Stevens, G.C., K.P. Baiyeri and O. Akinnnagbe (2013). Ethno-medicinal and culinary uses of *Moringa oleifera* Lam. in Nigeria. *J. Medic. Plant. Res.* 7(13): 799-804.

Stewart, R.R. (1972). *An annotated catalogue of the Vascular Plants of West Pakistan and Kashmir.* Fl. W. Pak. (Eds. E. Nasir & S.I. Ali). Fakhri Printing Press.

Sudrajat, D.J., I. Suwandhi, I.Z. Siregar and U.J. Siregar (2018). Variation in seed morpho-physiological traits of Java Olives populations originated from Java, Bali, Lombok and Timor Islands, Indonesia. *Biodiversitas* 19(3): 1001-1012.

Sudrajat, R., S. Yogie, D. Hendra and D. Setiawan (2010). Transesterification process for manufacturing Kepuh seed biodiesel. *J. Penelitian Hasil Hutan* 28(2); 145-155. (Indonesian).

Sultana, A., M.N. Amin, M.Y. Miah, A.K. Sarker. Md. M.A. Rasel, M.T. Aziz, F. Sharmin, Md. A. Hakim, H. Shiddika, S.H. Emon, T.P. Tuli and Mst. M. Khanom (2017). Determination of proximate composition and amino acid profile of jackfruit seed and utilization of its seed flour for development of protein-enriched supplementary food. *Cell Biology* 5(6): 57-65. (Doi: 10.11648/j.cb.20170506.11)

Swati, A.K. Virk, C. Kumari, A Ali, P. Garg, P. Thakur, C. Attri and S. Kulshrestha (2018). *Moringa oleifera* – A never die tree: A Overview. *Asian J. of Pharmaceutical and clinical Research* 11 (12): 57-65.

Sy Mohanad, S.F., F. Mohd Said, M.S. Abdul Munaim, S. Mohamad and W.M.A Wansulaiman (2019). Proximate composition, mineral contents, functional properties of Mastura variety jackfruit (*Artocarpus heterophyllum*). Seeds and lethal effects of its crude extract on zebra fish (*Danio rerio*) embryos. *Food Research* 3(5): 546-555.

Tapia, M.J., J.R. Sanchez-Morgado, J. Garcia-Perra, R. Remirez, T. Hernández and D. González-Gómez (2013). Comparative study of the nutritional and bioactive compounds content of walnut (*Juglans regia* L.) cultivars. *J. Food composition. Anal.* 31: 232-237. (Seen in Meng *et al.,* 2017).

Teh, C.Y. and T.Y. Wu (2014). The potential use of natural coagulants and flocculants in the treatment of urban waters, *Chem. Engg. Transactions* 39. (Doi: 10.3303/CET1439268). A publication of AIDIC. *The Italian Association of Chemical Engineering*-www.aidic.it/cet.

Toyoda, K. (1966). Glutathione in the seeds of *Nelumbo nucifera*. *Chem. Abstr*. 65: 10959.

USGS (2003). *Weeds in the West Project Status of Introduced Plants in Southern Arizona Parks*. Factsheets for *Cyperus esculentus* L. Tucson, Arizona.

Usher, G. (1984). *A Dictionary of Plants Used By Man.* CBS Publ. and Distributors, Delhi, India.

Vaishnavi, N. and M. Pugazhvadivu (2017). Studies on the fuel characteristics of empty fruits and seed of *Sterculia foetida*. *Int. J. Latest Technology in Engineering Management. Applied. Science* 6 (8): 98-101.

Velázquez-Zavala, M.V. and T.E. Peón-Escalante, R.Z. Baupista and M.A. Jiménez-Arellanes (2016). Moringa (Moringa oleifera Lam.): Potential uses in agriculture, industry and medicine, *Revista Chapingo serie horticultura* vol. XXII (No. 2). (Doi:10.5154/r.rehsch.2015.07.018).

Verheij, E.N. and R.E. Colonel (1992). *Plant Resources of South-East* Asia. No. 2. Edible fruits and Nuts. Prosea, Bogor, Indonesia.

Villafuerte, L.R. and L. Villafuerte-Abonal (2009). *Data taken from the forestry agency of Japan in Moringa*. Malunggay Philippines. Apples of gold publishing, Singapore, p. 240.

Waghmare, R., N. Memon, Y. Gat, S. Gandhi, V. Kumar and A. Panghal (2019). Jackfruit seed: an accompaniment to functional foods. *Brazilian J. Food Technology*. 22 e 2018207. (http://doi.org/10.1590/1981-6723.20718)

Wu J.Z., Y.B., Zheng, T.Q Chen, J. Yi, L. Qin, K. Rahman and W. Lin (2007). Evaluation of the quality of lotus seed of *Nelumbo nucifera* Gaertn. from outer space mutation. *Food Chem*. 2007; 105:540-547.

Yang, B., H. Wang, N. Prasad, Y. Pan and Y. Jiang (2011). Chapter 82 – Use of litchi (*Litchi sinensis* Sonn.) seeds in health pp. 699-703). *Nuts and Seeds in Health and Disease Prevention.* Academic Press.

Zhang, He Yuan, Hanna, Milford A., Ali Yusuf and Nan, Lu (1996). Yellow nut sedge oil as a fuel. *Industrial Crops and Products* 5(3): 177-181.

Zhang, Yi, Xu Lu, S. Zeng, X. Huang, Z. Guo, Y. Zhang, Y. Tan and B. Zheng (2015). Nutritional composition, physiological functions and processing of lotus (*Nelumbo nucifera* Gaertn). Seeds: a review. *Phytochem. Rev.* 14:321-334. (Doi. 10.1007/s11101-015-09401-9).

Zhu, M., T. Liu and M. Guo (2016). Current advances in the metabolomics study on lotus seeds. *Frontiers in Plant Sci.* Vol. 7, Article 891. Doi: 10.3389/flpls.2016.00891.