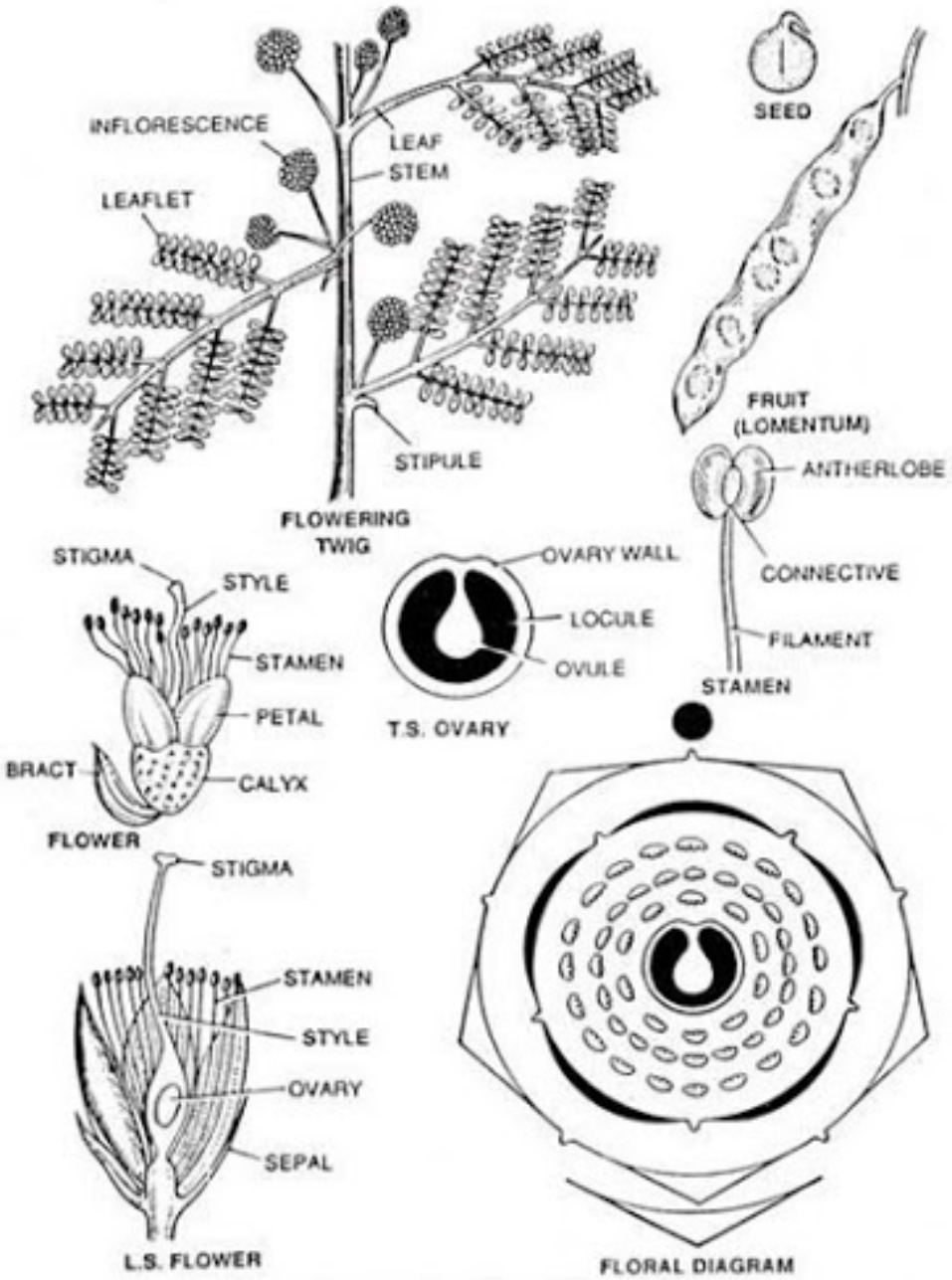
Lesson no. 32 Babul (Seyal)

Mimosaceae (Leguminosae) *Acacia nilotica*



Babul tree botanically is called as Vachellia nilotica; it old name was Acacia seyal and Acacia nilotica though may be different tree from same species; it is commonly known as gum Arabic tree, babul, thorn mimosa, Egyptian acacia or thorny acacia; it belongs to Fabaceae family. It is native to Africa, the Middle East and the Indian subcontinent. It is also a Weed of National Significance in Australia (an invasive species of significant concern in Australia,) as well as a Federal Noxious Weed in the United States. In part of its range small-stock consumes the pods and leaves, but elsewhere it is also very popular with cattle. Pods are used as a supplement to poultry rations in India. Dried pods are particularly sought out by animals on rangelands. In India branches are commonly lopped for fodder. In West Africa, the pods and leaves are considered to have anti-helminthic properties on small ruminants and this has been confirmed by in vitro experiments on nematodes. The tender twig of this plant is used as a toothbrush in south-east Africa, India etc. The exudate gum of this tree is known as gum Arabic and has been collected from the pharaonic times for the manufacture of medicines, dyes and paints. In the present commercial market, gum Arabic is defined as the dried exudate from the trunks and branches of Senegalia (Acacia) Senegal or Vachellia

(Acacia) seyal in the family Leguminosae (Fabaceae). The gum of A. nilotica is also referred to in India as Amaravati gum. The tree's wood is "very durable if water-seasoned" and its uses include tool handles and lumber for boats. The wood has a density of about 1170 kg/$m^{3.}$

For detail Islamic study on it please visit my website www.tib-e-nabi-for-you.com or direct link to lesson Babul on my website http://www.tib-e-nabi-for-you.com/sayal.html or read my English book Tibb e Nabawi part lesson no. page 164 onwards. Under its tree Nabi ﷺ took an oath, with his companions, and (this is mentioned is Quran chapter No. 24. as **"BAIT AL RIZWAN".**

- ***NAMES:-***

1. Its Arabic name is Seyyal.
2. Hindi name is Babul.
3. It is famous for its gum.
4. Latin name is Acacia seyal and Acacia nilotica; (new name Vachellia nilotica or same species).
5. It belongs to Fabaceae family
6. There are many types of it, some have thrones and are throne less.

- ***Basic encyclopedia of babul tree: -***





Vachellia nilotica is a tree 5–20 m high with a dense spheric crown, stems and branches usually dark to black coloured, fissured bark, grey-pinkish slash, exuding a reddish low quality gum. The tree has thin, straight, light, grey spines in axillary pairs, usually in 3 to 12 pairs, 5 to 7.5 cm (3 in) long in young trees, mature trees commonly without thorns.

- ***Stems: -***



Stems are whitish and either hairy or occasionally hairless when young and turn a darker color (i.e. grey to brown) as they age and become woody. They are usually covered in tiny whitish-colored raised spots (i.e.

lenticels). The trunks of mature trees are rough with fissured bark towards their base that is brown, reddish-brown or black in color. Pairs of stout greyish-colored spines (2-50 mm long, occasionally up to 10 cm in length) are borne at the base of each leaf (i.e. near the leaf axils). Sometimes these spines may be inconspicuous (i.e. they may occasionally appear to be absent from some branches), and they are usually absent from the trunks and older branches.

- ***Leaves: -***

Leaves are twice-compound (i.e. bipinnate) and are dark green in color and have a feathery appearance. They are borne on a relatively short leaf stalk (i.e. petiole) 4-20 mm long, which is finely hairy and sometimes has a small raised structure (i.e. gland) just below the lowest pair of leaf branchlets (i.e. pinnae). The extension of the leaf stalk (i.e. rachis) is 8-68 mm long and bears 2-10 pairs of small leaf branchlets (i.e. pinnae). A small raised gland is usually present on the rachis, at the junction of the uppermost one or two pairs of leaf branchlets (i.e. pinnae). Each of the leaf branchlets (1-5 cm long) bears numerous (7-30) pairs of small, oblong or narrowly oblong leaflets (i.e. pinnules). These leaflets (2-7 mm long and 0.5-2 mm wide) are usually hairless (i.e. glabrous), but sometimes have somewhat hairy (i.e. ciliate) margins, and have rounded tips.

- ***Flowers: -***

Flowers are small yellow or golden-yellow colored and are densely arranged into small globular clusters (6-15 mm across). Each individual flower has four or five relatively inconspicuous petals and sepals and numerous conspicuous stamens that give the flower clusters a very fluffy appearance. The globular flower clusters contain 30-50 of these flowers and are borne on hairy stalks (i.e. peduncles). These stalks (7-32 mm long) originate from the leaf forks and usually have some tiny bracts about half way along them. The flower clusters are borne in groups of two to six in each leaf fork (i.e. axil). Flowering occurs throughout the year, but is most abundant during autumn and winter (i.e. from March to July).

- ***Fruit: -***

The fruit is an elongated pod which is 6-25 cm long and 4-17 mm wide and is swollen around each seed and strongly constricted between the seeds, and thus resembles a string of pearls. These greyish-green pods are covered in tiny soft hairs, are somewhat flattened, and turn green to brown in color when mature. However, very old pods may turn dark brown or black in color after being shed from the plant. They contain about 8-15 seeds, do not split open at maturity (i.e. they are indehiscent), and are most

commonly present during late winter, spring and summer (i.e. from May to January). The brown or blackish-brown colored seeds (6-7 mm long and 4.5-6.5 mm wide) are sub-globular in shape and somewhat flattened. They are smooth in texture and have a hard seed coat.

Babul (Acacia nilotica (L.) Willd. ex Delile) is a medium sized, thorny, nearly evergreen tree that can reach a height of 20-25 m but may remain a shrub in poor growing conditions. The trunk is short, thick (1 m in diameter) and cylindrical, covered with grey bark. The crown may be flattened or rounded. The root system depends on the growing conditions and subspecies: a deep taproot in dry conditions and extensive lateral roots in flooded conditions. The leaves are 5-15 cm long, alternate and compound with 7 to 36 pairs of elliptical, 1.5-7 mm long x 0.5-2 mm broad, grey-green, hairy leaflets. Flowers are sweetly scented and bright to golden yellow in colour. The fruits are linear, flattened, narrow indehiscent pods, 4-22 cm long and 1-2 cm broad, dark-brown to grey in colour and glabrous or velvety. The pods contain 8 to 15 elliptical, flattened bean-shaped dark seeds. There are two groups of Acacia nilotica subspecies. The first group (nilotica, tomentosa, cupressiformis, indica) consists of tall riverine trees that grow in seasonally flooded areas. Their pods have a characteristic "necklace" shape with constrictions between the seeds. The second group (adstringens, kraussiana, leiocarpa, subalata) grows in drier areas and has straight-edged pods.
Acacia nilotica is a multipurpose tree: it provides timber, fuel, shade, food, fodder, honey, dye, gum and fences. It also impacts the environment through soil reclamation, soil enrichment, protection against fire and wind, and as a haven for biodiversity and ornament. It is widely used in ethno-medicine. However, it is considered a weed in some areas including Australia, the Galapagos Islands, and the Pacific Islands. It is a useful fodder source, and sometimes a very important one, particularly in dry regions. The foliage and the pods dropped during the dry season can be a fundamental source of nutrients in periods of feed scarcity. It is now commonly found or cultivated within 30°N and 20°S in almost all tropical and subtropical areas; it propagates by seeds carried in animal droppings or by direct seeding. The trees begin fruiting within 5-7 years and yield about 18 kg pods a year. Young leaves, young shoots, and young pods are consumed as vegetables. Seeds can also be sprouted and eaten as a vegetable. Further, it can also be fermented into an alcoholic beverage or roasted then made into flour. The flowers are made into fritters. The stem produces an edible gum. The gum from the bark is used for printing and dyeing calico, as a sizing material for cotton and silks, and for paper manufacturing. It is also used in making candles, inks, matches, and paints. The pods also yield gum, which is used for dyes and inks, and tannins. Fiber from the bark of slender branches are used to make coarse ropes and paper, and for toothbrushes. The wood is strong, heavy, hard, durable, and highly resistant to shock. It is used for agricultural implements, sugar and oil presses, boat handles, brake clocks, planks, etc. It is also used for fuel and charcoal.

Gum Arabic Tree is used in traditional medicine as treatment for a wide range of conditions such as diarrhea, dysentery, leprosy, coughs, intestinal pains, cancers and tumors, colds, congestion, tuberculosis, durations of liver and spleen, fevers, gallbladder problems, hemorrhage, hemorrhoids, leucorrhea, ophthalmia, sclerosis, smallpox, and impotence.
The bark, gum, leaves and pods are used in various traditional medicines. Bark, leaves and pods are rich in tannins and so are astringent. Extracts of the plant have been shown to be inhibitory to at least four species of pathogenic fungi. The bark is used to treat a wide variety of ailments in traditional medicine, both internally in the form of a decoction, and externally as a wash. In particular, its astringency makes it an excellent treatment for diarrhea and dysentery, whilst it is also used as a nerve stimulant and in treating conditions such as leprosy, coughs, and intestinal pains. Both the gum and the bark have been used for treating cancers and/or tumours (of ear, eye, or testicles); chest problems including colds, congestion, coughs and tuberculosis; indurations of liver and spleen; fevers, gallbladder problems, hemorrhage,

haemorrhoids, leucorrhoea, ophthalmia, sclerosis and smallpox. The root has been used to treat tuberculosis and is also said to cure impotence. The bruised leaves are used as a poultice on ulcers. The wood has been used to treat smallpox.

- ***Part used: -***

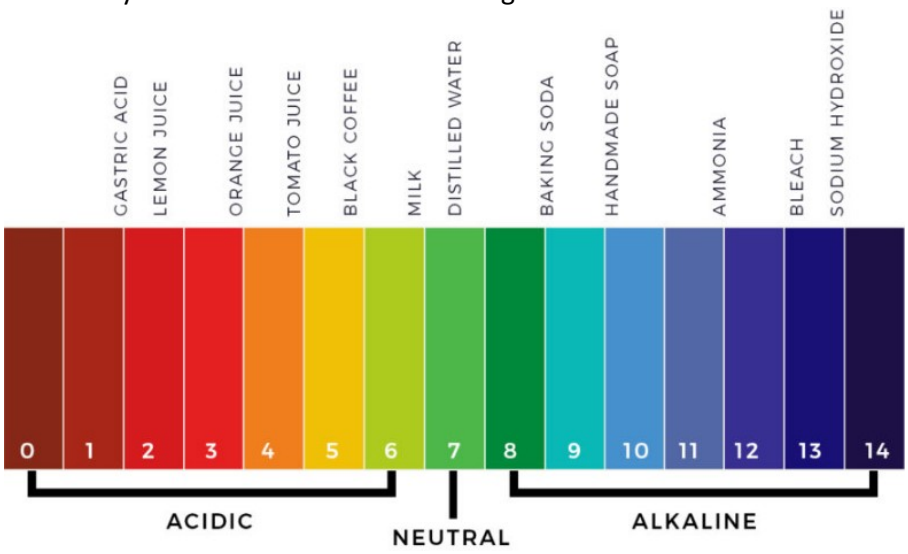
It is also known as "Healing tree" as all of its parts (bark, root, gum, leaves, pods, seeds) are used for various medicinal purposes.

- ***pH of it is: -***Not known; but it may be acidic because it has tannin as major component & Tannin solutions are acid and have an astringent taste.
- ***Calories of it: -***100 gram of it gives 59.67 calories.
- ***Glycemic index & Glycemic load: -*** It has low glycemic index & load due to tannin in it & is safe in diabetes though research is on. But exact sum is not able available because it is not eaten in bulk.

A food is considered to have a low Glycemic index (GI) if it is 55 or less; mid-range GI if 56 to 69 & high GI if 70 or more. *Glycemic index* is a number. It gives you an idea about how fast your body converts the carbs in a food into glucose.

A low Glycemic load (GL) is between 1 and 10; a moderate GL is 11 to 19; and a high GL is 20 or higher. For those with diabetes, you want your diet to have GL values as low as possible.

The *glycemic load* (GL) of food is a number that estimates how much the food will raise a person's blood glucose level after eating it. *Glycemic load* accounts for how much carbohydrate is in the food and how much each gram of carbohydrate in the food raises blood glucose levels.



- ***Babul is available in the market in following forms: -*** Gum, capsule, churan (powder)
- ***Recommended dosage of babul***

Babul Churan - ¼ - ½ teaspoon twice a day
Babul Capsule - 1-2 capsule twice a day
Babul Gum - ¼ - ½ teaspoon once a day

- ***Gross health benefits of it: -***

It is mostly used as the datum for cleaning the teeth and regular use of it strengthens the gums, teeth and reduces plaque and inflammation. The bark, gum, leaves, seeds and pods of babul tree possess potent medicinal properties -antibacterial, antihistaminic, anti-inflammatory, astringent and hemostatic. The bark of babul is cooling, aphrodisiac and expectorant in nature. The gum of babul is also a potent emollient, expectorant, detoxifier, aphrodisiac and antipyretic in nature. It is helpful in treating urinary problems such as UTI, pain and bleeding of the uterus. Babul is a great source of vital nutrients, vitamins and minerals. It is good in skin disease, hairfall, wounds, sexually weakness etc. It is helpful in the treatment of sore throat, cold, bronchitis, pneumonia, ophthalmia, diarrhea, dysentery, leprosy and venereal diseases.

- ***Clinical pharmacology of it: -***

Cancer is a multi-factorial disease and a major health problem worldwide. Earlier studies reported that plants and their constituents show inhibitory effects on the growth of malignant cells through modulation

of cellular proliferation, tumour suppressor gene, apoptosis, etc. It contains flavonoids and various other constituents that play an important function in the inhibition of cancer development. The experiment was made to evaluate the anticancer activity of aqueous extracts of gum, flower and leaves of *A. nilotica* in 7, 12-dimethylbenz(a) anthracene (DMBA) induced skin papallomegenesis in Swiss albino mice. The results showed a significant reduction in the values of tumour burden, tumour incidence and cumulative papillomas. A study finding revealed that methanolic pods extract showing anti-uveal melanoma activity.
Babul is considered as a rich source of phenolic compounds, tannins, sucrose, gallic acid, mucilage, saponins, stearic acid, chlorides etc. These constituents are responsible for its pharmacological properties.

Babul is a great source of vital nutrients, vitamins and minerals. The treasure trove of nutrients in babul include iron, manganese, protein, zinc and essential amino acids including valine, histidine, isoleucine, threonine, lysine and leucine. The bark and pod are rich in tannin and polyphenolic compounds. The gum contains a host of plant compounds including galactose, aldobio uronic acid and arabinobioses and minerals calcium and magnesium. The flowers are a good source of flavonoids like kaempferol 3- glucoside, iso-quercetin and leucocyanidin.

Prolactin release and milk production: -

Stem bark aqueous extract in the dose of 280-560 mg/b. w was proven to have the stimulation of milk production and mammary gland development in the female rats.

Sexual and urogenital: -

Traditionally, *A. nilotica* has been used to treat sexual dysfunctions. Pods are *Muqawwi-i-bah* (strong aphrodisiac) and useful to treat leucorrhoea. A douche of decoction of the bark is also useful in incontinence of urine. A douche of bark decoction with alum powder is useful in vaginal discharge. The oral intake of bark decoction is useful in abnormal uterine bleeding. Powdered pods are used in impotency, spermatorrhoea and effective in urogenital disorders. Recent scientific studies have also proven the same effect that the fresh pods extract are useful in the treatment of sexual disorders such as spermatorrhoea, loss of viscidity of semen, frequent night discharges and premature ejaculation.

In vitro study with ethanolic bark extract of *A. nilotica* 300 mg/kg b. w showed an increase in the volume of urine and concentrations of Na, K, and Cl ions proving its diuretic effect.

Smooth muscle relaxant property: -

An experiment was made to assess the smooth muscle relaxant activity of methanolic leaf extract against the acetylcholine and oxytocin-induced contractions in isolated Wistar rat uterus. The results showed excellent muscle relaxant activity of *A. nilotica*.

Antimalarial potential: -

A study was performed to investigate the anti-plasmodium activity of aqueous and methanolic root extract of *Babul* in *Plasmodium Berghei* infected mice. The results revealed significant activity against chloroquine-sensitive strains. Ethyl acetate extract of its root showed the highest activity against *P. falciparum.* Another *in vitro* study was made to evaluate the antimalarial activities of leaves, pods and bark extracts of *A. nilotica*. The results revealed that it had an antimalarial effect as all extracts inhibited the development of mature *schizont* indicating schizonticide activity against *P. falciparum.*

- ***Modern uses of it: -***

For wound: -

Babul gum is an excellent healer due to its healing and medicinal properties. As a result, babul gum is used to heal and checks bleeding when applied externally minor wound or skin injury. Apply its gum mixed with extra virgin olive oil.

For Skin disease: -

Babul bark powder cures skin problems like eczema and fungal infection due to its astringent quality. So its powder can be applied on eczema, fungal infection etc three times a day for 7 days followed by 2 times a day followed by once a day till complete relief.

For Bleeding Piles: -

Babul powder shows good result in pain or bleeding piles due to its active phyto-chemicals; apply it powder mixed in extra virgin olive oil, at piles three times a day till complete relief.

For Burn Injuries: -

Babul bark powder helps to cure burn injuries; apply it mixed with aloe vera gel 3 times a day

For Oral problems: -

Chewing small pieces of fresh bark of babul tree can be good for oral health. It not only helps strengthen the teeth but heals the gum.

- ***Contents/constituents of it: -***

All contents may not present in all types of it, because there are many varieties of it according to geographical regions & content may differ a lot as per cultivation, soil, seed, climate etc.

A good quality of it contains little amount of amino acids mentioned in table below: -

The above ingredients are based on scientific study, means these has been identified, known & learnt by modern science, it does not mean that it contains only these ingredients; there may be many more ingredients which are yet to be discovered, learnt & known by modern science.

The details given below are based on natural ingredients found in it and not synthetically prepared.

- ***Active components of it: -***

Bark & pod contain 12 to 20 % Tannin; Gum/resin contains galactose, aldobio uronic acid, arabinobioses, calcium 52% & magnesium 20%; flower contains kaempferol-3-glucoside, iso-quercitrin, leucocyanidin.

Table 1: Phytoconstituents of *Acacia nilotica* Linn

Composition	Bioactive constituents
Alkaloids	Dimethyltryptamine, N-methyltryptamine, tryptamines
Tannins	Methyl gallate Ethyl gallate Gallic acid, Egallic acid Gallocatechin-5-O-gallate, Dicatechin, Polygalloytannin
Proteins	Cysteine, Methionine, Threonine, Lysine, Tryptophan
Polysaccharides	D-pinitol T-Sitosterol
Terpenes	Acanilol Lupenone, Lupeol, Niloticane
Gums/Fatty acids	D-Galactose, L-Arabinose, L-Rhamnose 6-O-(β-D-glucopyranosyluronicacid)-D-galactose 4-O-(α-D-glucopyranosyluronicacid)-D-galactose Gallic acid, Tannic acid, Cresol
Flavonoids	Kaempferol kaempferol-3-glucoside, iso-quercitin, leucocyanidin, Catechin, Catechin-7-O-gallate,Quercetin, Quercetin-3-O-β-glucopyranoside, Naringenin, Naringenin-7-O-β-glucopyranoside, Chalconaringenin-4'-O-β-glucopyranoside.

It also contains crude fiber, crude protein, ash, iron, manganese, copper, zinc, sodium, potassium, selenium, calcium, saponins, valine, histidine, isoleucine, threonine, lysine and leucine. The bark and pod are rich in tannin and polyphenolic compounds. The gum contains a host of plant compounds including galactose, aldobio uronic acid and arabinobioses and minerals calcium and magnesium. The flowers are a good source of flavonoids like kaempferol 3- glucoside, iso-quercetin and leucocyanidin.

It also contains terpenes, fluoroacetate, cyclitol, cyanogenic glysocide, ellagic, gallic, epicatechin, rutin, myricetin, (+)-catechin, (–)-epicatechin, myricetin 3-glucopyranoside, kaempferol, umbeliiferone, myricetin 3-rhamnopyranoside, methyl 3,4,5 tri hydroxyl benzoate, p-coumaroyl glucoside, p-coumaroyl quinic acid, Ferulic acid, isoferulic acid, epi catecine-3-gallate, ascorbic acid , quercetine 3-O- (4'-O-acetyl)-rhamnopyranoside, oleic acid, myristic acid, palmitic acid and steroidal sapogenin aglycons, stearic acid, kaempferol-3-glucoside, isoquercitrin, leucocyanidine.

Each & every constituent explained separately: -

- ***Tannin: -***

It is of astringent (dry & puckery feeling in mouth) taste, it is a polyphenol present in many plants, fruits, plant's wood, bark, leaves, skin, seeds etc. It is also called as Tannic acid; it is of 2 types hydrolysable & condensed. Hydrolysable is decomposable in water & reacts with water & form other substance. Condensed form is insoluble &precipitates; it is called as tanner's reds. But most of tannic acid is water soluble.

Main sources of tannin: -

It is present berries, apple, barley, nut, tea, legumes, grapes, pomegranate, quince, oak wood, lemons, squash etc.

Basic pharmacokinetics of tannin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research. After ingestion its bioavailability is poor due to its large size, high affinity to bound to plasma protein & low lipid solubility. It gets hydrolyzed in glucose & release gallic acid & other compounds upon decomposition.

Basic clinical pharmacology of tannin: -

It is used internally & externally. Externally it cures & heals the condition when applied on cold sores, fever blisters, diaper rashes, bleeding gums, tonsillitis, skin rashes, white discharge, yellow discharge, minor burn etc. It is used as douche for virginal disorders like white or yellow discharge.
In food it is used as flavoring agent & naturally present in fruits etc, it relieves & cures chronic diarrhea, dysentery, hematuria (blood in urine), pain in joints, persist cold, cancers etc, it reduces high blood pressure, high lipids in blood. It is anti-aging, anti-oxidant, anti-bacterial, anti-enzymatic. It is used in medicated ointments for piles.
If used excessive it can give toxic effects on skin & internally may reduce absorption of vitamin, cause stomach irritation, nausea, vomiting, liver damage, kidney damage. It should not be used in pregnancy, breast feeding & constipation.

- ***Galactose: -***

Galactose is a simple sugar, which belongs to simple carbohydrates. Galactose is composed of the same elements as glucose, but has a different arrangement of atoms; it is a source of energy for our body & related to many function & digestion.

- ***L-Arabinose: -***

L-Arabinose is the naturally occurring isomer and is a constituent of plant polysaccharides; Arabinose is an aldopentose a monosaccharide containing five carbon atoms, and including an aldehyde (CHO) functional group. L-arabinose is in fact more common than D-arabinose in nature and is found in nature as a component of biopolymers such as hemicellulose and pectin; arabinose is an inhibitor of sucrase, the enzyme that breaks down sucrose into glucose and fructose in the small intestine. This inhibitory effect has been validated both in rodents and humans. Therefore, arabinose could be used in foods to attenuate the peak of glycemic response (see: glycemic index) after the consumption of sucrose.

- ***L-Rhamnose: -***

L-Rhamnose is a deoxy sugar mainly found in gums and plant mucilages. It is one of the structural units of complex polysaccharides such as pectin and sterculia gum. L-Rhamnose may react with aqueous ammonia to form volatile flavor compounds such as alkyl pyrazines. Rhamnose occurs in nature in its L-form as L-rhamnose (6-deoxy-L-mannose). This is unusual, since most of the naturally occurring sugars are in D-form. Exceptions are the methyl pentoses L-fucose and L-rhamnose and the pentose L-arabinose. Rhamnose is commonly bound to other sugars in nature. It is a common glycone component of glycosides from many plants. Rhamnose is also a component of the outer cell membrane of acid-fast bacteria in the Mycobacterium genus, which includes the organism that causes tuberculosis.

- ***D-galactose: -***

It is a monosaccharide sugar that is about as sweet as glucose and about 65% as sweet as sucrose. It is a C-4 epimer of glucose. A galactose molecule linked with a glucose molecule forms a lactose molecule. Galactan is a polymeric form of galactose found in hemicellulose, and forming the core of the galactans, a class of natural polymeric carbohydrates.

- ***Aldobiouronic acid: -***

Aldobiouronic acid D3 is found in cereals and cereal products. Aldobiouronic acid D3 is isolated from partial acid hydrolysates of gum chagual (Puya species) and the hemicelluloses from corn hulls and wheat bran. Aldobiouronic acid D3, also known as aldobiouronate D3 or ga-2X, belongs to the class of organic compounds known as o-glucuronides. These are glucuronides in which the aglycone is linked to the carbohydrate unit through an O-glycosidic bond. Aldobiouronic acid D3 is an extremely weak basic (essentially neutral) compound (based on its pKa). Outside of the human body, Aldobiouronic acid D3 has been detected, but not quantified in, cereals and cereal products. This could make aldobiouronic acid D3 a potential biomarker for the consumption of these foods.

- ***Beta-D-glucuronic acid: -***

Beta-D-glucuronic acid is a D-glucopyranuronic acid in which the anomeric center has beta-configuration. It has a role as a metabolite. It is a conjugate acid of a beta-D-glucuronate.

- ***Isoquercetin: -***

Isoquercetin also called as isoquercitrin or isotrifoliin; it is a flavonoid, a type of chemical compound. It is the 3-*O*-glucoside of quercetin. Isoquercitrin can be isolated from various plant species

including *Mangifera indica* (mango) and Rheumnobile (the Noble rhubarb). It is also present in the leaves of *Annona squamosa* and *Camellia sinensis* (tea).Isoquercetin is presently being investigated for prevention of thromboembolism in selected cancer patients and as an anti-fatigue agent in kidney cancer patients treated with sunitinib. It is quercetin *O*-glucoside that is quercetin with a β-D-glucosyl residue attached at position 3. Isolated from *Lepisorus contortus*, it exhibits antineoplastic activity and has been found to decrease the rate of polymerization and sickling of red blood cells.

- ***Quercetin: -***

It is a plant flavonol from the flavonoid group of polyphenols; it is bitter in taste.

Main sources of quercetin: -

Red onion, green tea, apples, ginko biloba, grapes etc.

Basic pharmacokinetics of quercetin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research.

Basic clinical pharmacology of quercetin: -

It is good for heart diseases, coronary heart disease, prevents cancer, arthritis, bladder infection, diabetes; it is anti-oxidant, anti-inflammatory, reduces benign prostatic hyperplasia, cholesterol, blood pressure, asthma, symptoms of rheumatoid arthritis.

- ***Leucocyanidin: -***

Leucocyanidin, also known as 3,3',4,4',5,7-flavanhexol or 3,4-cyanidiol, belongs to the class of organic compounds known as catechins. Catechins are compounds containing a catechin moiety, which is a 3,4-dihydro-2-chromene-3,5.7-tiol. Thus, (2R,3S,4S)-leucocyanidin is considered to be a flavonoid lipid molecule (2R,3S,4S)-leucocyanidin is a very hydrophobic molecule, practically insoluble (in water), and relatively neutral (2R,3S,4S)-leucocyanidin may be a unique S. cerevisiae (yeast) metabolite.

- ***Catechin: -***

It is a natural polyphenol; it is a plant secondary metabolite.

Main sources of catechin: -

It is mainly present in tea, cocoa, berries, apples, grapes seeds, kiwi, strawberries, green tea etc.

Basic clinical pharmacology of catechin: -

It is antioxidant, prevents cell damage, anti-inflammatory, anti-cancer, promotes heart & brain health and reduces blood pressure & weight.

- ***Catechin 7-o-gallate: -***

It is also called as 7-Galloylcatechin, also known as arachidyl palmitate or catechin 7-O-gallate, belongs to the class of organic compounds known as flavonoid-7-o-glycosides. These are phenolic compounds containing a flavonoid moiety which is O-glycosidically linked to carbohydrate moiety at the C7-position. 7-Galloylcatechin is an extremely weak basic (essentially neutral) compound (based on its pKa). 7-Galloylcatechin has been detected, but not quantified in, herbs and spices and tea. This could make 7-galloylcatechin a potential biomarker for the consumption of these foods.

- ***Oleic acid: -***

Its short hand notation is C18:1, it is a non-essential (means it is produce naturally in the body) monounsaturated omega 9 fatty acids, it makes up 55% to 85% or more of extra virgin olive oil, it is insoluble in water & soluble in alcohol. It increases absorption of many drugs through skin by disrupting the lipids under the skin and penetration of the drugs, so olive oil is best to be used with other applications on skin and used in cosmetic formulas. It is advised in Hadith to eat it & massage with it just notice the importance of it.

Main sources of oleic acid: -

It is present in extra virgin olive oil is the best, also present in avocado oil, camellia oil, shea nut oil, apricot oil, sweet almond oil, whole egg, nuts, argan oil etc.

Basic pharmacokinetics of oleic acid (based on human intake in natural food products): -

It is believed that it is absorbed by different tissues mediated via passive diffusion to facilitate diffusion (this is under research) after taken up by the tissues it is stored in the form of natural triglycerides or oxidized, it is transported by lymphatic system; it is also believed to penetrate through skin (it is under research), its excretion is in stool. It is stored 98% in adipose tissues depots in form of triglycerides. Its metabolism & plasma half-life is yet not known.

Basic clinical pharmacology of oleic acid: -

It increases bioavailability of following medicines cortisol, hydrocortisone, betamethasone, 17 benzoate betamethasone, 17 valerate (betamethasone), ketarolac (anti-inflammatory), metronidazole, progesterone & estradiol. So I advised to mixed powder of prednisolone mixed in extra virgin olive oil and apply on eczema & psoriasis and get good results in cheaper rates.

Oleic acid prevents cardio vascular disease, blood pressure, skin disease, breast cancer, colon cancer, prostate cancer, stomach cancer, diabetes, gall stones, gastrointestinal disease and pancreatic disease. It reduces cholesterol, triglycerides, LDL, inflammation, swelling etc.

- ***Myristic acid: -***

It is a common nontoxic long-chain saturated fatty acid; it is also called as tetradecanoic acid; it is water soluble; its salt & esters are commonly referred as myristates.

Main sources of myristic acid: -

It is mainly present in pumpkin seed oil, butter fat, palm kernel oil, coconut water & oil, nutmeg oil etc.

Basic pharmacokinetics of myristic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of myristic acid: -

It cleans the skin & keeps the skin hydrate, plump & youthful; it is used in beauty products, shaving, soaps, creams, lotions, hair conditioner & personal care products manufacturing.

- ***Palmitic acid: -***

It is a common saturated fatty acid; it is the first fatty acid produced during lipogenesis (fatty acid synthesis) & from which longer fatty acids can be produced.

Main sources of palmitic acid: -

It is present in olive oil, flaxseed oil, soyabean oil, sunflower oil, palm oil, cocoa butter, meat, milk, pumpkin seed oil, grape seed oil etc.

Basic pharmacokinetics of palmitic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of palmitic acid: -

It softens the skin & keeps it moist thus good for psoriasis & eczema. It coats the skin, it is powerful anti-oxidant; it maintains the health of hair & skin from aging, cleans them from dirt, sweat, excessive sebum (main cause of acne and boil on face & other parts of the body).

- ***Stearic acid: -***

It is saturated fatty acid.

Main sources of stearic acid: -

It is mainly present in olive oil, also present in butter, whole milk, yeast bread, egg, pumpkin seed oil, grape seed oil etc.

Basic pharmacokinetics of stearic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of stearic acid: -

It cleans the skin & removes dirt, sweat & excessive sebum from skin & hair.

- ***Ferulic acid: -***

It is a hydroxycinnamic acid, an organic phenolic compound; it is antioxidant & used in skin care products, it reduces spots, wrinkles; it is anti-ageing, anti-hypertensive, anti-diabetic, helpful in cardiovascular diseases, Alzheimer's etc. It is mainly present in bran, oats, rice, eggplant, citrus, apple seeds etc. It is also known as 4-Hydroxy-3-methoxycinnamic acid.

- ***Isoferulic acid: -***

Isoferulic acid, also known as hesperetic acid or hesperetate, belongs to the class of organic compounds known as hydroxycinnamic acids. Hydroxycinnamic acids are compounds containing a cinnamic acid where the benzene ring is hydroxylated. Isoferulic acid is an extremely weak basic (essentially neutral) compound (based on its pKa). Outside of the human body, Isoferulic acid is found, on average, in the highest concentration within a few different foods, such as sunflowers, common wheats, and vinegars and in a lower concentration in peanuts. Isoferulic acid has also been detected, but not quantified in, a few different foods, such as bilberries, german camomiles, and soy beans. This could make isoferulic acid a potential biomarker for the consumption of these foods. Isoferulic acid (CAS: 537-73-5) is a chlorogenic

acid (CGA). Isoferulic acid is present in normal human urine in concentrations of 0.05-2.07 umol/mmol creatinine at baseline, and reaches 0.2-9.6 umol/mmol creatinine in four hours after a cup of coffee, with a large inter-individual variation (PMID: 17884997). CGAs are abundant phenolic compounds in coffee, with caffeoylquinic (CQA), feruloylquinic (FQA), and dicaffeoylquinic (diCQA) acids being the major subclasses, and coffee is the most consumed food product in the world. CGAs are formed by the esterification of hydroxycinnamic acids (e.g. caffeic acid, ferulic acid, and p-coumaric acid) with quinic acid.

- ***Ellagic acid: -***

It is a natural phenol found in many fruits & vegetables. Plants produce ellagic acid from hydrolysis of tannins such as ellagitannin & geraniin.

Main sources of ellagic acid: -

White oak, red oak, walnut, grapes, strawberries, pomegranate, peach etc.

Basic pharmacokinetics of ellagic acid: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of ellagic acid: -

It is powerful anti-oxidant, prevents cancers & heart diseases.

- ***Gallic acid: -***

It is also known as Trihydroxybenzoic acid; it is a type of phenolic acid; it is a group of hydrolysable tannins. It is used in pharmaceutical industries for various purposes.

Main sources of gallic acid: -

Tea, oak bark, strawberries, grapes, banana, clove, vinegar, gallnuts etc.

Basic pharmacokinetics of gallic acid: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of gallic acid: -

It is anti-viral, anti-fungal, anti-oxidant, prevents cancers of colon, prostrate, leukemia without harming healthy cells, prevents neural disorders, anti-inflammatory, asthma, allergy, rhinitis, sinusitis etc.

- ***Naringenin: -***

It is bitter, colourless flavanone (a type of flavonoid); it is trihydroxy-flavanone; it is lipophilic, it is mainly present in grapes & other fruits & herbs.

Main sources of naringenin: -

It is present in grapes, tomato, cocoa, sour oranges, Greek oregano, beans, thyme, cherries, marjoram, bergamot etc.

Basic pharmacokinetics of naringenin (based on human intake in natural food products): -

It is lipophilic (tending to combine with or dissolve in lipids or fats), thus readily absorbed intestinal epithelium by passive diffusion into enterocytes; it reaches the blood circulation by multidrug resistance-associated protein (MRP1) or can be transported by active transport efflux protein carrier P-glycoprotein (P-gP) & with Mrp2 back to the intestine lumen out of the enterocytes, repeating the cycle; liver metabolism is via phase II conjugation by UDP-glucuronosyl transferase (UGT), sulotransferase & catechol-o-methyl-transferase.

Basic clinical pharmacology of naringenin: -

It is anti-inflammatory, antioxidant, it helps in controlling blood pressure, blood sugar, obesity, metabolic syndromes; it is anti-cancer, helpful in curing liver diseases; it is antiulcer, reduces gastric secretion by acting on H2 receptor thus it is antacid, estrogen antagonist, anti-inflammatory, antioxidant.

- ***Lupeol: -***

Lupeol is a pentacyclic triterpenoid that is lupane in which the hydrogen at the 3beta position is substituted by a hydroxy group. It occurs in the skin of lupin seeds, as well as in the latex of fig trees and of rubber plants. It is also found in many edible fruits and vegetables. It has a role as an anti-inflammatory drug and a plant metabolite.

- ***Beta-sitosterol: -***

It is among phytosterols & a main dietary phytosterol found in plants. It is anti-cancer, anti-inflammatory, it improves urine flow, reduces symptoms of heart diseases, reduces cholesterol, boost immune system, reliefs bronchitis, migraine, asthma, fatigue, rheumatoid arthritis, improve hairs quality, reliefs prostrate problems, improves erectile dysfunctioning, psoriasis, libido.

Main sources of beta-sitosterol: -

Canola oil, avocados, almond, soya bean oil, nuts, vegetable oil, dark chocolate, rice bran oil, wheat germ, corn oil, peanuts, grapes etc.

- ***Kaempferol: -***

It is a natural flavonol (a type of flavonoid) it is tetra-hydroxy-flavone.

Main sources of kaempferol: -

Fenugreek seeds, green tea, grapes, tomato, broccoli, spinach, raspberries, peaches, green beans, onion, potato etc.

Basic pharmacokinetics of kaempferol (based on human intake in natural food products): -

It is ingested as a glycoside, absorbed in small intestines usually by passive diffusion; it is metabolized in various parts of the body. In small intestine it is metabolized to glucuronide & sulfo-conjugate by intestinal enzymes & it is also metabolized by colon micro-flora (bacteria) which can hydrolyze the glycosides to aglycones or form simple phenolic compounds. It is mainly metabolized in liver to glucurono-conjugated & sulfo-conjugated form. It is mainly excreted in urine.

Basic clinical pharmacology of kaempferol: -

It is anti-oxidant, anti-inflammatory, anti-microbial, anti-cancer, cardio protective, neuro microbial, anti-diabetes, estrogenic, analgesic, anxiolytic, anti-allergic, anti-viral etc.

- ***Kaempherol-3-O-β-D-glucoside: -***

Kaempherol-3-O-β-D-glucoside, known as astragalin, is one oforally bioavailable flavonoids found in a variety of plants including *Cuscuta australis R.Br*. In recent studies, astragalin possesses many biological functions. Although astragalin is formed by linking glucose to kaempherol, its biological activity is not the same as kaempferol. In vivo, 17 β-estradiol (E2) is hydroxylated by cytochrome P450 (CYP) 1B1 to form 4-hydroxy-E2 (4-OH-E2). This metabolite 4-OH-E2 is highly expressed in tumor tissues and has a strong tumorigenic effect. It is anti-inflammatory.

- ***D-pinitol: -***

D-pinitol is a cyclitol present in several edible plant species and extensively investigated for the treatment of metabolic diseases in humans, as food supplement, and demonstrated protective effects in the cardiovascular system. It is a cyclitol present in several edible plants, including soybean and carob. The chemical similarity suggests that pinitol is a natural source of D-chiro-inositol *in vivo* Pinitol has been described as an antidiabetic drug, with insulin-like effect in an animal model of diabetes.

- ***Dimethyltryptamine: -***

Dimethyltryptamine is an N-methylated indoleamine derivative, a serotonergic hallucinogen found in several plants, especially Prestonia amazonica (Apocynaceae) and in mammalian brain, blood, and urine. It apparently acts as an agonist at some types of serotonin receptors and an antagonist at others.

- ***N-methyltryptamine: -***

N-methyltryptamine is a tryptamine alkaloid and a member of tryptamines. It has a role as a metabolite. It derives from a tryptamine.

Tryptamine is an aminoalkylindole consisting of indole having a 2-aminoethyl group at the 3-position. It has a role as a human metabolite, a plant metabolite and a mouse metabolite. It is an aminoalkylindole, an indole alkaloid, an aralkylamino compound and a member of tryptamines. It is a conjugate base of a tryptaminium.

- ***Methyl gallate: -***

Methylgallate is a phenolic compound. It is the methyl ester of gallic acid. It is also found in Terminaliamyriocarpa, Bergeniaciliata (hairy Bergenia) and Geraniumniveum; it is a plant polyphenol with antioxidant, anticancer, and anti-inflammatory activities. It is reported to reduce tumor growth.

- ***Rutin: -***

It is also called as Rutoside, it is a citrus flavonoid found in many plants including citrus fruits & it is soluble in water & alcohol.

Main sources of rutin: -

It is present in green tea, quince, apple, asparagus, black tea, citrus fruits, grapes, cherries, apricot, noni, leaves of eucalyptus, buck wheat, ginkgo biloba, raisins etc.

Basic pharmacokinetics of rutin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are in research.

Basic clinical pharmacology of rutin: -

It reduces high blood pressure, bleeding, bleeding piles, it strengthens the blood vessels, it reduces risk of cancers due to its anti-oxidant& anti-free radicals activity, reduces bruise, inflammation, protects heart, brain etc; it is chelator of metal ions.

- ***Myricetin: -***

It is among polyphenolic flavonoid. It is anticancer, anti-oxidant, anti-bacterial, anti-inflammatory, reduces weight, cholesterol, L.D.L & triglycerides.

Main sources of myricetin: -

Nuts, berries, grapes, tea, walnut, onion, herbs etc.

- ***Epicatechin: -***

It is a type of flavanol (a natural type of phenol) (please note flavanol & flavonols are different), flavonols is class flavonoids (phenol) that contains a ketone group & flavanol is a natural phenol.

Main sources of epicatechin: -

It is present in apple, quince, dark chocolate, cherries, guava, pear, black berry, green tea, cocoa etc.

Basic pharmacokinetics of epicatechin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are not yet known & are in research.

Basic clinical pharmacology of epicatechin: -

It is anti-oxidant, reduces myostatin (myostatin is inhibitor of muscles growth).

- ***Cresol: -***

Cresol is also called as *hydroxytoluene*; it is an organic compound which is methylphenols. It is widely occurring natural organic compounds; cresols can be solid or liquid because they have melting points not far from room temperature. Like other types of phenols, they are slowly oxidized by long exposure to air, and the impurities often give cresols a yellowish to brownish red tint. Cresols have an odor characteristic to that of other simple phenols, reminiscent to some of a "coal tar" smell. The name cresol reflects their structure being phenols, and their traditional source, creosote.

- ***Cyclitol: -***

Cyclitols, like alditols, are carbohydrates that contain only hydroxyl groups (that is, contain no carbonyl group). The difference is that cyclitols have cyclic (ring) structures.

- ***Umbelliferone: -***

Umbelliferone, also known as hydrangin or skimmetin, belongs to the class of organic compounds known as 7-hydroxycoumarins. These are coumarins that contain one or more hydroxyl groups attached to the C7 position the coumarin skeleton.

- ***Myricetin-3-rhamnopyranoside: -***

It is also called as Myricitrin is found in black walnut. Myricitrin is a chemical compound. It can be isolated from the root bark of Myrica cerifera (Bayberry, a small tree native to North America). It is antioxidant.

- ***Methyl 3 4 5-trihydroxybenzoate: -***

Methyl gallate, also known as methyl 3 or methyl galloic acid; it is a member of the class of compounds known as galloyl esters. Galloyl esters are organic compounds that contain an ester derivative of 3,4,5-trihydroxybenzoic acid. Methyl gallate is slightly soluble (in water) and a very weakly acidic compound (based on its pKa). Methyl gallate can be found in peach and pomegranate, which makes methyl gallate a potential biomarker for the consumption of these food products. Methyl gallate is a phenolic compound. It is the methyl ester of gallic acid.

- ***p-coumaroyl glucoside: -***

Petunidin 3-(6''-p-coumaroyl-glucoside) is a member of the class of compounds known as anthocyanidin 3-o-6-p-coumaroyl glycosides. Anthocyanidin 3-o-6-p-coumaroyl glycosides are anthocyanidin 3-O-glycosides where the carbohydrate moiety is esterified at the C6 position with a p-coumaric acid. P-coumaric acid is an organic derivative of cinnamic acid, that carries a hydroxyl group at the 4-position of the benzene ring. Petunidin 3-(6''-p-coumaroyl-glucoside) is practically insoluble (in water) and a very weakly acidic compound (based on its pKa). Petunidin 3-(6''-p-coumaroyl-glucoside) can be found in a number of food items such as black elderberry, redcurrant, highbush blueberry, and black chokeberry, which makes petunidin 3-(6''-p-coumaroyl-glucoside) a potential biomarker for the consumption of these food products.

- ***p-coumaroylquinic acid: -***

3-p-coumaroylquinic acid belongs to quinic acids and derivatives class of compounds. Those are compounds containing a quinic acid moiety (or a derivative thereof), which is a cyclitol made up of a cyclohexane ring that bears four hydroxyl groups at positions 1,3.4, and 5, as well as a carboxylic acid at position 1. 3-p-coumaroylquinic acid is slightly soluble (in water) and a weakly acidic compound (based on its pKa). 3-p-coumaroylquinic acid can be found in a number of food items such as redcurrant, highbush blueberry, sweet cherry, and blackcurrant, which makes 3-p-coumaroylquinic acid a potential biomarker for the consumption of these food products.

- ***Epi catechin-3-gallate: -***

(+)-Epicatechin-3-O-gallate is a gallate ester obtained by formal condensation of the carboxy group of gallic acid with the (3S)-hydroxy group of (+)-epicatechin. It has a role as a metabolite. It is a catechin, a gallate ester and a polyphenol. It derives from a gallic acid and a (+)-epicatechin.

- ***Saponin: -***

Saponins are glucosides with foaming characteristics. Saponins consist of a polycyclic aglycones attached to one or more sugar side chains. The aglycone part, which is also called sapogenin, is either steroid (C27) or a triterpene (C30). The foaming ability of saponins is caused by the combination of a hydrophobic (fat-soluble) sapogenin and a hydrophilic (water-soluble) sugar part. Saponins have a bitter taste. Some saponins are toxic and are known as sapotoxin.

Basic clinical pharmacology of saponin: -

It reduces cholesterol, LDL, increases testosterone, libido & muscle mass; it maintains balance between cellular proliferation & cell death the disturbances in the balance causes severe diseases like cancer etc; it is anti-bacterial, anti-oxidant, inhibit tumour growth.

- ***Steroid saponins: -***

It is natural glycosidic compounds of amphiphilic character. It is present in fenugreek, yucca, ginseng, asparagus, yams, alliums, legumes, beans, onion, garlic etc.

Basic pharmacokinetics of steroid saponin (based on human intake in natural food products): -

It is poorly absorbed in intestine due to large molecular mass, high hydrogen bonding capacity, unfavourable physicochemical traits, poor membrane permeability, rapid & extensive biliary (stool) excretion many saponins are excreted in urine also.

Basic clinical pharmacology of steroid saponin: -

It reduces cholesterol, LDL, increases testosterone, libido & muscle mass; it maintains balance between cellular proliferation & cell death the disturbances in the balance causes severe diseases like cancer etc; it is anti-bacterial, anti-oxidant, inhibit tumour growth.

- ***Glycosides: -***

Glycosides are organic compound present in plants & animal sources in which sugar group bounded to its carbon are bounded to another functional molecule. When it is hydrolyzed with enzymes give one or more sugar moiety & this is called as glycone. The word glycosides refer to any sugar or group of sugar (lactose, fructose, glucose etc) (please note glucose only is called as glucoside; please see the difference gly & glu).

Main sources of glycosides: -

It is present in many plants, fruits, vegetables & herbs & is called with different name as per present in which plant (example: - glycoside present in senna herb is called as sennosides).

Basic pharmacokinetics of glycosides (based on human intake in natural food products): -

Its absorption, metabolized & excretion are not yet known & are in research.

Basic clinical pharmacology of glycosides: -

It is anti-oxidant, anti-cancer, anti-tumour, anti-inflammatory, helpful to liver function, anti-viral, anti-bacterial, anti-fungal, helpful in heart diseases, cardiac arrhythmia, heart failure, congestive heart failure etc.

- ***Terpenes: -***

It is a group of volatile unsaturated hydrocarbons organic compound found in essential oils of plants; they have a strong odour & it protects the plant.

Main sources of terpenes: -

It is commonly present in mangoes, hops, lemon grass, thyme etc.

Basic pharmacokinetics of terpenes (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research. It is well absorbed in gastrointestinal tract & through skin.

Basic clinical pharmacology of terpenes: -

It is anti-inflammatory, analgesic, reduces migraine pain, headache, stimulates many brain chemicals which benefits in reducing pain, inflammation etc.

- ***Cyanogenic glycosides: -***

Cyanogenic glycosides are natural plant toxins that are present in several plants, most of which are consumed by humans. Cyanide is formed following the hydrolysis of cyanogenicglycosides that occur during crushing of the edible plant material either during consumption or during processing of the food crop.

- ***Fluoroacetate: -***

Fluoroacetate producing plants grow worldwide and it is believed they produce this toxic compound as a defense mechanism against grazing by herbivores.

- ***Crude fiber: -***

Crude fiber consists largely of cellulose (60-80%) and lignin (4-6%) plus some mineral matter. These Fibers are beneficial in treating or preventing constipation, hemorrhoids, diverticulosis, coronary heart diseases, and some type of cancer. Crude fiber is the insoluble residue of an acid hydrolysis followed by an alkaline one. This residue contains true cellulose and insoluble lignin.

- ***Lupenone: -***

Lupenone is a triterpenoid. It has a role as a metabolite. It derives from a hydride of a lupane. Pharmacological screening of lupenone revealed various pharmacological activities including anti-inflammatory, anti-virus, anti-diabetes, anti-cancer.

- ***Cysteine: -***

Cysteine is a semi-essential proteinogenic amino acid; 100 grams of a raw onion contains 0.004 g cysteine; It is helpful in respirative diseases, heart diseases, brain diseases, it is antioxidant, improves fertility in male & female. In onion 6 types of cysteine are present.

- ***Methionine: -***

It is a sulfur containing amino acid; it is essential; it plays a critical role in the metabolism & health; it act on normal cell functioning, growth & repair. It is also a chelating agent for heavy metals; due to its sulfur contain it is helpful in hair, nail health & growth & good for skin health; it reduces cholesterol by increase the production of lecithin in liver & reduces fats formation in liver, also protects kidneys, liver from hepatotoxins, it is an antioxidant. It is absorbed in lumen of small intestines into enterocytes by active transport & metabolized in liver.

Main sources of methionine: -

Meat, mutton, fish, chicken, cheese, egg, beans, milk, nuts, shellfish etc.

- ***Absorption & digestion of amino acid.***

When we eat high-protein foods, body breaks down protein into amino acids and peptides through digestive enzymes, such as pepsin & pancreas produces trypsin, chymotrypsin and other that aid in protein digestion.

Pepsin is the primary enzyme responsible for digesting protein; it acts on the protein molecules & breaks the bonds – called peptide bonds – that hold the protein molecules together. Next, these smaller chains of amino acids move in the stomach & then in small intestine where they're further broken down by enzymes released by the pancreas. Small intestine contains finger-like extensions called micro-villi. These structures enhance its ability to absorb dietary nutrients. Now the semi digested material pass through brush border and baso-lateral membranes of small intestine & di-tripeptides are absorbed by passive transport (facilitated or simple diffusion) or active transport (Na+ or H+ co-transporters) pathways. Di and tripeptides are more efficiently absorbed than free amino acids which in turns are better absorbed than oligopeptides. They're released into the bloodstream and used for various biochemical reactions.

Each amino acid has a different role in the human body. Upon absorption, some amino acids are incorporated into a new protein. Some fuel your muscles and support tissue repair. Others are used as a source of energy.

Tryptophan and tyrosine, for example, promote brain health. These amino acids support the production of neurotransmitters, leading to increased alertness and optimum nerve responses. Tryptophan also assists with serotonin production, lifting your mood and keeping depression at bay.

Phenylalanine serves as a precursor to melatonin, epinephrine, dopamine and other chemicals that regulate your mood and bodily functions. Methionine helps your body absorb selenium and zinc, two minerals that promote overall health. Some amino acids, such as isoleucine, play a vital role in hemoglobin production and glucose metabolism.

- ***Tryptophan: -***

It is an amino acids (protein) that is useful in bio-synthesis of protein; it is essential in human because body cannot make it); it is a precursor of neuro-transmitter serotonin, melatonin, vitamin B3; it is a sedative also.

Main sources of tryptophan: -

Salmon oil, egg, spinach, milk, seeds, fenugreek seed, soy products, nuts, fish, meat, wheat, banana etc.

Basic pharmacokinetics of tryptophan (based on human intake in natural food products): -

It is absorbed in small intestine & reached the blood circulation, it passes the blood brain barrier & in brain cells it is metabolized into indolamine neuro-transmitter, niacin, a common example of indolamine is serotonin derivative from tryptophan. Tryptophan is converted into serotonin in the brain & body; it is believed that tryptophan supplements should be taken with carbidopa, which blocks the blood brain barrier. (Serotonin (5HTP) 5 hydroxytryptamine, is a monoamine neuro-transmitter. It contributes in feelings of well-being, happiness, reward, learning, memory, many physiological functions).

In the pathway of tryptophan/serotonin, melatonin hormone is produced. Melatonin regulates sleep-wake cycle. It is primarily released by pineal gland in brain. It controls circadian (daily clock) rhythms.

Pineal gland releases it at night more & very little in day light. It improves immune system function.

Natural sources of melatonin are tomato, pomegranate, olive, grapes, broccoli, cucumber, barley, seeds, nuts etc.

Fructose malabsorption causes improper absorption of tryptophan in intestine thus leading to low level of it & may cause depression.

Basic clinical pharmacology of tryptophan: -

It is necessary for normal growth of infants; nitrogen balance in adults, it aids in sleep pattern, mood. It is necessary for melatonin & serotonin formation in body, it enhances mental & emotional wellbeing, manages pain tolerance, weight etc. it also helps in build muscle tissue, essential for vitamin B3 production, relives insomnia, reduces anxiety, depression, migraine, OCD, helps immune system, reduces cardiac spasms, improves sleep patter etc.

- ***Threonine: -***

It is an amino acid used in biosynthesis of proteins; it is an essential amino acid important for tooth enamel, collagen, elastin, nervous system, fats metabolism, it prevents fats buildup in liver, useful in intestinal disorders, anxiety, and depression.

Main sources of threonine: -

Cheese, chicken, fish, meat, lentil, black seed, nuts, soy etc.

Basic clinical pharmacology of threonine: -

It is useful in nervous system disorders, multiple sclerosis, spinal spasticity, makes bones, joints, tendons, ligament stronger, it helps the immune system, promotes heart health.

- ***Isoleucine: -***

It is an amino acid that is used in the biosynthesis of proteins, it is an essential amino acid means the body cannot make it & we depend on food sources, it plays & helps many functions of the body.

Main sources of isoleucine: -

Meat, mutton, fish, cheese, egg, seeds, nuts, soybeans, milk, legumes, fenugreek seed etc.

Basic pharmacokinetics of isoleucine (based on human intake in natural food products): -

It is absorbed in small intestine by sodium-dependent active transport. It is metabolized in liver.

Basic clinical pharmacology of isoleucine: -

It promotes glucose consumption & uptake, it is anti-catabolic, enhances athletic performance & best for pre-workout, it acts on wound healing, detox of nitrogenous waste in the body, stimulates immune system, promotes secretion of many hormones, helps in heamoglobin formation, regulating blood glucose, energy in the body, built muscles, helpful to brain for its function.

- ***Leucine: -***

It is branched chain amino acid (BCAA) it is ketogenic amino acid; it is necessary when we do exercise, it stimulates protein synthesis & assists in muscle building.

Main sources of leucine: -

Cheese, soyabean, meat, nuts, chicken, seeds, fish, seafood, beans.

Basic clinical pharmacology of leucine: -

It helps regulate blood glucose, promotes growth, recovers the muscles & bone tissues, acts on production of growth hormones, repairs the tissues, essential for muscle building, it burns fats, controls obesity, promotes lean muscles growth.

- ***Lysine: -***

It is an essential amino acid, which our body cannot prepare and we need to eat it from food sources. It necessary for many body functions, acts in building blocks of protein (muscles).

Main sources of lysine: -

Red meat, chicken, egg, fish, beans, lentils, wheat germ, nuts, soybeans, spirulina, fenugreek seed, shrimp, pumpkin seed, tuna, cheese, milk etc.

Basic pharmacokinetics of lysine (based on human intake in natural food products): -

It is absorbed from the lumen of the small intestine into the enterocytes by active transport, it undergoes first pass metabolism in liver & is metabolized in liver.

Basic clinical pharmacology of lysine: -

It helps the body in tissue growth, repair muscles injury, promote collagen formation, help the body to produce enzymes, antibodies, hormones, supports immune system, its deficiency causes fatigue, irritability, nausea, hair loss, anorexia, inhibited growth, anemia, problems with reproductive system, it is very helpful in treating cold sores (herpes), control blood pressure, diabetes, osteoporosis, helps athletes performance, helpful in treating cancers, reduces anxiety, increase absorption of calcium, improves digestion & prevent leaky gut, helpful in pancreatitis.

- ***Methionine: -***

It is a sulfur containing amino acid; it is essential; it plays a critical role in the metabolism & health; it act on normal cell functioning, growth & repair. It is also a chelating agent for heavy metals; due to its sulfur contain it is helpful in hair, nail health & growth & good for skin health; it reduces cholesterol by increase the production of lecithin in liver & reduces fats formation in liver, also protects kidneys, liver from hepatotoxins, it is an antioxidant. It is absorbed in lumen of small intestines into enterocytes by active transport & metabolized in liver.

Main sources of methionine: -

Meat, mutton, fish, chicken, cheese, egg, beans, milk, nuts, shellfish etc.

- ***Cystine: -***

It is the oxidized dimer form of amino acid, it is nonessential; the body uses it to produce taurine & other amino acids; it is a sulfur containing amino acid; our body uses vitamin B6 with the help of cystine; it heals burns, wounds, bronchitis, assist in supply of insulin, it increases level of glutathione in liver, lungs, kidneys & bone marrow. It is anti-aging, anti-inflammatory, anti-arthritis, anti-rheumatoid arthritis.

Main sources of cystine: -

Meat, egg, milk, garlic, onion, broccoli, oats, wheat germ, lentils etc.

- ***Phenylalanine: -***

It is an aromatic essential amino acid in human; it plays a key role in biosynthesis of other amino acids; it is important in the structure & function of many proteins & enzymes. It is precursor of melanin, dopamine, noradrenalin hormone, thyroxin hormone. It is converted in tyrosine & used in biosynthesis of dopamine & noradrenalin. It improves memory, reduces pain of hunger; it is anti-depressant; it is also a building block

protein; it is useful in vitiligo, depression, ADHA, parkinson's, multiple sclerosis, pain, osteoarthritis, rheumatoid arthritis, fat burn & helpful in alcohol withdrawal symptoms.

Main sources of phenylalanine: -

Pumpkin seed, nuts, seeds, soy, meat, fish, chicken, egg, beans, milk etc.

- ***Tyrosine: -***

It is a nonessential amino acid; it is also called as 4-hydroxyphenylalanine; it is useful in cell synthesis of protein; it is a building block protein; body prepares it from phenylalanine. It is a precursor & used to produce noradrenalin, dopamine, & thyroxin & melanin hormones. It reduces stress, improves memory, it promotes growth, mental health, skin health, fat burn. It acts as a mood elevator, anti-depressant, improves memory, mental alertness, its deficiency can cause hypothyroidism leading to low blood pressure, low body temperature (hypothermia), stress, fatigue, narcolepsy; it helps thyroid gland, adrenal gland, pituitary gland to function properly. It is absorbed in small intestine by sodium-dependent active transport; after absorption it reaches the blood & crosses the blood brain barrier (BBB) & enters the brain cells & gets metabolized into catecholamine (noradrenalin). Human body regulates it amount by eating it by food sources & making inside the body (nonessential). The body does not store it much for later uses.

Main sources of tyrosine: -

Meat, fish, egg, milk, nuts, beans, oats, wheat, black seeds etc.

Dopamine: -

It regulates reward & pleasure centers in brain; it is a chemical important for memory, motor skills & etc.

Nor-adrenaline & adrenaline: -

These hormones are responsible for fight & flight response in stressful situation & also controls many functions of the body; it is secreted by adrenal glands.

Thyroxin: -

It is secreted by thyroid gland; it regulates metabolism, blood pressure, digestion, energy etc.

Melanin: -

It is pigmented hormone, gives our skin, hair, eye their colour; dark skinned people have more melanin in their skin than light skin people (depend on exposure to sunlight).

- ***Valine: -***

It is an essential nutrient for vertebrates, biosynthesis of protein; it is an aliphatic & extremely hydrophobic essential amino acid; it is branched chain of amino acid (BCAA); it is important for growth, repair, blood glucose regulation, for energy; it stimulates CNS, proper mental function.

Main sources of valine: -

Cheese, soy, beans, nuts, fish, meat, chicken, mushroom, seeds, nuts, whole grains etc.

- ***Histidine: -***

It is an amino acid used in biosynthesis of protein; it is semi essential amino acid, needed by human for production of histamine & also for growth & tissue repair, it is helpful in maintaining myelin sheaths that covers the nerves & protects the nerves.

Main sources of histidine: -

Meat, mutton, fish, milk, egg, seeds, nuts, chicken, cheese, soy, beans, whole grains, fenugreek seeds.

Basic pharmacokinetics of histidine (based on human intake in natural food products): -

It is absorbed in small intestine via active transport requiring the presence of sodium.

Basic clinical pharmacology of histidine: -

It plays many roles in immunity, gastric secretion & sexual functions. It is also required for blood cell formation & protects tissues against damage of radiation & heavy metals. It keeps normal pH of 7 in the body, useful in rheumatoid arthritis, allergy, ulcer & anemia caused by kidney failure or dialysis. It is an antioxidant, anti-inflammatory, reduces cholesterol.

- ***Arginine: -***

It is among conditional essential amino acid the body needs to function properly; it is made in liver; it plays an important role in building protein thus helpful in body building.

Main sources of arginine: -

Chicken, pumpkin seeds, spirulina, dairy products, red meat, fish, egg etc.

Basic pharmacokinetics of arginine (based on human intake in natural food products): -

It is absorbed in jejunum mainly from oral diet.

Basic clinical pharmacology of arginine: -

It releases nitric oxide in the blood & nitric oxide dilates the blood vessels thus increases the blood supply & controls high blood pressure, it improves erection, builds muscles etc. it also act on release of growth hormone, insulin & other substances in the body. It also improves heart health, athletes performance, stimulates immune system; citrulline present in watermelon is converted into arginine in kidneys, please refer lesson on watermelon.

- ***Alanine: -***

It is a non-essential amino acid that is present in blood plasma in its free state in high levels; it is involved in sugar & acid metabolism, protein synthesis, it increases immunity, provides energy for muscles tissues, brain & CNS, it acts on tryptophan, vitamin B6 metabolism; it is an important sources of energy for muscles; it helps the body to convert simple sugar (glucose) into energy; it is produced in the body. It increases exercise capacity; reduces muscle fatigue, boost immunity, it is antioxidant; anti-aging; increases muscle growth; ideal pre & post workout, reduce blood sugar, prevent liver disease, helps the liver to eliminate toxins, improves CNS functioning, helpful in benign prostate hypertrophy. It is digested in small intestine; it is converted into pyruvic acid by alanine aminotransferase-1; during fasting condition alanine derived from protein breakdown is converted into pyruvate & used to synthesis glucose by gluconeogenesis in liver, it is excreted in urine via urea cycle. It is stored little in skeletal muscles.

Main sources of alanine: -

Meat, fish, egg, milk, aleovera, honey, black seeds, nuts etc.

- ***Aspartic acid: -***

It is a non-essential amino acid; it is over all negatively charged & plays an important role in synthesis of other amino acid, citric acid & urea cycles; it is found in animals, plants, sugarcane, sugarbeet. It may be a neurotransmitter; it strengthens the muscles, improves heart function, helps in maintaining mental health, reduces tiredness, improves athletic performance, increases muscle size, reduces depression & fatigue. It is absorbed in small intestine by active transport.

Main sources of aspartic acid: -

Meat, oysters, seeds, oats, avocado, sugar beet, milk, egg, nuts, cereals etc.

- ***Glutamic acid: -***

It is a nonessential amino acid. It is an excitatory neuro-transmitter; it is necessary for biosynthesis of proteins; body uses it for several key functions within the body like making other neuro-transmitters such as GABA; it promotes brain health, muscles health, intelligence, mood & mental alertness. It is called as chemical messenger. It plays an important role in body's disposal of excessive waste like nitrogen. It is absorbed in lumen of small intestine into enterocytes by active transport & excreted in urine mainly. It is almost about 2 kgs, storage in natural form in brain, kidneys, liver, muscles etc.

Main sources of glutamic acid: -

Meat, chicken, fish, egg, milk, wheat, mushroom, soy, broccoli, walnut, peas etc.

- ***Glycine: -***

It is a nonessential amino acid that body needs for growth &maintenance of tissue & need to prepare hormones & enzymes. It is inhibitory neurotransmitter. It helps in preparing glutathione (a powerful antioxidant & reduces free radicals, delay aging). It is helpful in preparing of creatine (provides energy to muscles to perform exercise etc & acts on muscle contraction), beneficial for brain health, bone health, alzheimer's, schizophrenia, sleep disorder, stroke, burns, protects kidney & liver from harmful side effects of drugs used after organ transplant, heals wound & ulcers, it is anti-inflammatory, improves skin health.

Main sources of glycine: -

Meat, fish, milk, legumes etc.

- ***Proline: -***

It is a protein-genic amino acid used in biosynthesis of proteins. It heals cartilages, cushion joints, tendons, ligament, heart muscles, connective tissues & helps in formation of collagen.

Main sources of proline: -

Soy, pumpkin seed, lentils, black beans, quinoa etc.

- ***Serine:-***

It is a nonessential amino acid, important for synthesis of protein, fats metabolism, muscle growth, immune system; it is a precursor of many amino acids, helpful in enzyme catalyze its reaction, overall health, physical & mental health.

Main sources of serine: -

Soybean, egg, lentils, meat, fish, nuts, almonds, walnut etc.

- ***Asparagine: -***

It is a non-essential amino acid; it acts on biosynthesis of proteins; it is a nontoxic carrier of residual ammonia to be eliminated from the body; it acts as diuretic also; it helps cell, nerve, brain to function. It is helpful to nervous system, reduces fatigue, helps in building muscles, improves liver function, protects liver, beneficial for nerve cells & brain; increases stamina, help in synthesis of various enzymes, proteins, glycoprotein etc.

- ***Main sources of asparagine: -***

Milk, meat, egg, fish, soy, potato, legumes, nuts, seeds etc.

- ***Calcium: -***

It is natural essential mineral for the body, it is among the electrolytes of the body; its symbol is Ca & atomic no. 20.

Main sources of calcium: -

It is present in watermelon, quince, milk, banana, cheese, green leafy vegetables, soya beans, nuts, fish, meat, egg, bread, flour, yogurt, almonds, kale, soybean, spinach, cucumber etc.

Basic pharmacokinetics of calcium (based on human intake in natural food products): -

Calcium is absorbed in duodenum & upper jejunum (when calcium intake is low) by transcellular active transport process, this depends on action of calcitriol & intestinal vitamin D receptors & when calcium intake is high, absorbed by paracellular passive process throughout the length of small intestine by 3 major steps, entry across the brush border, intracellular diffusion via calcium-binding protein & extrusion; Vitamin D is necessary for absorption of calcium, also vitamin C, E, k, magnesium & exercise increases the absorption of calcium. Also the level of calcium is regulated by calcitonin released by thyroid gland it reduces calcium level in blood when it is excessive & increases the excretion of calcium via kidneys; Parathyroid hormones (PTH) released by parathyroid gland increases the blood level of calcium when body need it or calcium is less in blood & promotes reabsorption of it in kidneys (calcitonin & PTH both have opposite function). Intestines can absorb 500 to 600 mg of calcium at a time; it is mostly stored in bone tissues & teeth & excreted in stool & sweat & little in urine depended upon the level of it in blood. Also estrogen act on transport of blood calcium in bones thus women mostly suffer from osteoporosis after menopause.

Basic clinical pharmacology of calcium: -

Calcium acts on bone health, communication between brain & other parts of the body, muscles contraction, blood clotting; it is a co-factor for many enzymes, it relaxes the smooth muscles & blood vessels; it maintains heart rhythm, muscles function; it is more needed in childhood & deficiency of it in childhood may cause convulsions (seizure); Excessive level of it in blood is called as hypercalcemia & may lead to kidney stone formation, heart attack, stroke, loss of appetite, excessive urination, memory loss etc; its low level in blood is called as hypocalcemia & may lead to cramps in the body, weak bones, weak teeth, numbness, tingling etc.

Contraindication: -

Sarcoidosis, excessive level of calcium in blood, very severe constipation, kidney stones, increased activity of parathyroid gland etc. Hypersensitivity of calcium, severe cardiac diseases, hypercalcemia, hypercalciuria, severe kidney stones etc.

- ***Iron: -***

It is an essential mineral for our body; its symbol is Fe & atomic no. 26; it is an important component of heamoglobin (heamoglobin binds oxygen in lungs & supply it to whole body, it is oxygen carrier).

Main sources of iron: -

It is present in watermelon, quince, meat, dates, spinach, egg, nuts, dark leafy green vegetables, broccoli, pumpkin seeds, chicken, legumes, fish, banana, cabbage, kidney, almonds, cucumber etc.

Meat is the best source of iron; it provides Fe+2 directly which can be transported from intestine to blood steam through Fe+2 transporter ferroportin (this binds with transferring & delivered into tissues).

Basic pharmacokinetics of iron (based on human intake in natural food products): -

The absorption of iron is not known fully; about only 10% of iron taken in food is absorbed; it is absorbed in duodenum & upper jejunum mainly & at the end part of ileum; low pH is needed for its absorption, after absorption it get bind to transferring (each transferring can carry 2 atoms of iron); ceruloplasmin (protein) also helps in binding of iron; Hepcidin a hormone produced by liver is released when iron stores are full & inhibits iron transport & binding, thus reduces the absorption of iron; vitamin C & copper enhances iron absorption.

Storage of iron: -

Iron is stored in liver (in hepatocytes & kupffer's cells) kupffer's cells play an important role in recycling body iron, they ingest aged RBC liberate iron for it & reuse by breaking down heamoglobin. Little iron is stored in liver, heart, & kidneys in form of ferritin also little in bone marrow, spleen.

Excretion of iron: -

The body does not possess a physiological mechanism for regularly eliminating iron from the body because most of it is recycled by liver cells; iron is lost within cells, from skin & interior surface of the body (intestines, urine, breathe).

Basic clinical pharmacology of iron: -

It is an important component of Haemoglobin (heamoglobin bind oxygen in lungs & supply it to whole body); iron is beneficial for nails, hair, skin etc; it acts on blood production, its deficiency causes Anaemia (low haemoglobin level in blood) (this causes reduced in oxygen carrying capacity & supply of it); most of the iron is present in haemoglobin, it consists of one heme (iron), one protein chain (globin) this allows it to bind & load oxygen from the lungs & supply it to whole body.

Unbounded or free iron is highly destructive & dangerous it can trigger free radical activity which can cause cell death & destroy DNA.

- ***Copper: -***

It is an essential micronutrient mineral; its symbol is Cu & atomic no. 29; there are lot of health benefits of it; it is needed in little amount in the body.

Main sources of copper: -

It is present in watermelon, quince, spirulina (water-plant), nuts, seeds, lobster, leafy green vegetables, guava, grapes, green olive, kiwi, mango, pineapple, pomegranate, egg etc.

Basic pharmacokinetics of copper (based on human intake in natural food products): -

It is absorbed 30 to 50%; it is absorbed easily than other minerals, its absorption depends on the copper present in the body, when the intake of it is less, absorption is increased & when intake is more absorption is less, it is mainly absorbed in small intestines & little in stomach via carrier-mediated process; its absorption is influenced by amino acids, vitamin C & other dietary factors. After absorption it is bound primarily to albumin, peptide & amino acids & transported to liver. Copper is secreted into plasma as a complex with ceruloplasmin. It is mainly stored in liver little in brain, heart & kidneys; it is excreted mainly in bile & little in urine.

Basic clinical pharmacology of copper: -

Together with iron it enables the body to form RBC; it helps to maintain health of bones, blood vessels, nerves & immune system; it also acts on iron absorption, protein metabolism, growth of body, it acts also on development of brain, heart & other organ; it is needed by the body for making ATP, collagen. Excessive of it may cause Wilson's disease.

Deficiency of copper: -

It is very rare; but may cause cardiovascular disease, genetic defects, inflammation of optic nerve etc.

- ***Selenium: -***

It is an essential trace mineral; it is micro nutrient helpful to our body; its symbol is Se & atomic no. 34.

Main sources of selenium: -

It is present in watermelon, fish, nuts, beef, chicken, mushroom, egg, grains, garlic, grapes etc.

Basic pharmacokinetics of selenium (based on human intake in natural food products): -

It is mainly absorbed in duodenum & proximal jejunum by active transport process; Dietary selenium is in 2 forms organic (selenoimethionine) it is 90% absorbed & inorganic (selenite) it is 50% absorbed; after absorption it is send in liver via portal veins, liver turns it into selenite & then is bound with selenoproteins & send into blood stream, gets in RBC, muscles, tissues etc; it is not distributed evenly in the body, liver has more of it; Vitamin E & other vitamins increases its absorption & both work as an anti-oxidant. Natural selenium remains in the body for less than 24 hours;

it is stored in amino acid in skeletal muscles, little in liver, kidneys & pancreas; it is primarily excreted in urine, stool & expired in air via lungs very little in sweat & semen.

Basic clinical pharmacology of selenium: -

It is important for many body functions, immune system, fertility (both male & female); it contributes in thyroid hormone metabolism, DNA synthesis; it protects the body from oxidative damages & infection, it is found in tissues, skeletal muscles; it helps testies & seminal vesicles in their function; it reduces the risk of miscarriages, liver disease, cancer, asthma, cardio vascular disease; deficiency of it causes pain in muscles & joints, weaken the hair, nails, white spots on nails are found etc.

- ***Magnesium: -***

It is an important essential mineral; its symbol is Mg & atomic no. 12; it is a co-factor for more than 300 enzymes that regulates functions in the body. Its normal range in blood is 0.75 to 0.95 millimoles (mmol)/L.

Main sources of magnesium: -

It is present in watermelon, quince, spinach, meat, egg, nuts, dark leafy green vegetables, broccoli, pumpkin seeds, dates, chicken, fish, legumes, cucumber etc.

Basic pharmacokinetics of magnesium (based on human intake in natural food products): -

It is absorbed about 20 to 50% only; it is absorbed about 40% in distal intestine when the level of it is low via passive paracellular transport & about 5% in descending colon when the level of it is high via active transcellular transport. Vitamin D increases its absorption & also acts on its excretion in urine. It is excreted in urine & stool; it is stored in bones.

Basic clinical pharmacology of magnesium: -

It is a co-factor for more than 300 enzymes that regulates functions in the body. It acts on protein synthesis, muscles & nerve function, blood glucose, control blood pressure; it is required for energy production, bone development, synthesis of DNA & RNA. It also plays a role in active transport of calcium & potassium ions, muscles contraction, normal heart rhythm etc.

- ***Zinc: -***

It is a trace mineral; symbol is Zn & atomic no. 30; it is necessary for human body as it plays vital role in health.

Main sources of zinc: -

It is present in watermelon, quince, meat, fish, legumes, beans, egg, dairy products, seeds, nuts, whole grains, cucumber etc.

Basic pharmacokinetics of zinc (based on human intake in natural food products): -

It is absorbed 20 to 40%, its absorption depends on its concentration & is absorbed in whole intestines (jejunum has high rate of its absorption) via carrier-mediated mechanism, it is released from food as free ions during digestion. Zinc from animal sources is easily absorbed comparing to plants sources. It is present in bile & pancreatic juices which is released in duodenum & is reused by the body this is called as endogenous zinc & zinc present is food sources is called as exogenous zinc. Its absorption depends on 2 proteins- Albumin & metallophinonein. Albumin enables zinc to be transported from plasma into enterocytes. It is stored in muscles, bones mainly & little in prostate, liver, kidneys, skin, brain, lungs, heart & pancreas. It is excreted in stools 80% & rest in urine & sweat. Metallophinonein binds to zinc to make it unavailable & excrete it in stools when zinc is excess in the body, & production of metallophinonein is reduced when zinc is less in the body to make zinc available for the body.

Basic clinical pharmacology of zinc: -

It is necessary for immune system, prevents skin diseases, heal skin diseases, helps stimulate activity of at least 100 different enzymes in the body; it is required in little amount in the body, but children, pregnant & old aged need it more. It promotes growth in children, synthesize DNA & acts on wound healing, it is best in treating initial diarrhea & cold cough. It improves learning, memory, fertility etc. It heals acne, attention deficit hyper activity disorder (ADHD), osteoporosis, pneumonia etc.

- ***Vitamin C: -***

It is also called as Ascorbic acid; it is an essential water soluble vitamin; it is very much needed by the body for many functions & absorption etc.

Main sources of vitamin C: -

It is present in watermelon, citrus fruit, broccoli, cauliflower, sprouts, capsicums, papaya, strawberry, spinach, green & red chillies, cabbage, leafy vegetables, tomato, cereals etc.

Basic pharmacokinetic of vitamin C (based on human intake in natural food products): -

It does not need to undergo digestion, 80 to 90% of it eaten is absorbed by intestine cell border by active transport & passive diffusion & through ion channels it enters the plasma via capillaries. It is very little stored in adrenal glands,

pituitary gland, brain, eyes, ovaries, testes, liver, spleen, heart, kidneys, lungs, pancreas & muscles. All together body can store 5 grams of it & we need 200mg/day in order to maintain its normal level & uses, but old, disease person, smokers & alcoholic need more daily value. It is excreted in urine in the form of dehydroascorbic acid changed by liver & kidneys both, but unused vitamin C is excreted intact.

Basic clinical pharmacology of vitamin C: -

It prevent cough & cold, repairs tissue, acts as an enzyme for curtain neurotransmitter, important for immune function, it is a powerful antioxidant (donates electron to various enzymatic & non-enzymatic reactions); body prepares collagen with the help of vitamin c; it is also helpful in Alzheimer's, dementia, acts on iron absorption, it protects the body from oxidative damages, reduces stiffness of arteries, reduces tendency of platelets to clump each other, improves nitric oxide activity (dilatation of blood vessels) thus prevents high blood pressure & heart disease, also prevent eye disease, reduces risk of cataract, prevents the lining of lungs & prevents lung disease, it is a natural antihistamine (anti-allergy), eliminates toxins from the body etc. Deficiency of it causes Scurvy disease (brown spots on skin occurs, swelling of gums, bleeding from all mucous membrane, spots are more on thighs & legs, the person looks pale, feel depressed, cannot move, loss of teeth, suppurative wounds occur.

- ***Potassium: -***

It is a mineral with symbol K & atomic number 19, it is an essential mineral which body cannot prepare; it is necessary for heart, kidney & other organs to function, its low level in body is called as hypokalemia & high level is called as hyperkalemia; it is mostly present inside the cells (intracellular); normal blood range is 3.5 to 5.0 milli equivalents per/liter (mEq/L).

Main sources of potassium: -

Potassium is naturally present in Banana, orange, dates, raisin, broccoli, milk, chicken, sweet potato, pumpkin, spinach, watermelon, coconut water, white & black beans, potato, dried apricot, beetroot, pomegranate, almond etc.

Basic pharmacokinetics of potassium (bases on human intake in natural food products): -

It is absorbed in small intestines by passive diffusion; it is stored mostly inside the cell, little in liver, bones & red blood cells. 80 to 90% potassium is excreted in urine & 5 to 20% is excreted in stools, sweat.

Basic clinical pharmacology of potassium: -

It is a mineral which belongs to electrolytes of the body; it conducts electrical impulses throughout the body & assists blood pressure, normal water balance, muscle contraction, nerves impulse, digestion, heart rhythm, maintain pH balance. It is not produced in our body so we need to consume it through eating; Kidneys maintain normal level of it in the body by excreting excessive amount of it in urine or reabsorb it if the amount is less in the body so that the body may reuse it. Its deficiency may cause weakness, low blood pressure, constipation, nausea, vomiting etc.
Its normal amount in body keeps blood pressure normal; water balance in body normal; prevents heart disease, stroke, osteoporosis, kidney stone etc.

- ***Sodium: -***

Here we are learning natural sodium, its symbol is Na & atomic no. 11; it is not produced in the body we need to take it in food sources; it is an important & essential mineral on which our body functions; it regulates blood pressure, blood volume etc.

Main sources of sodium: -

Excessive intake of sodium should be avoided; beetroot has very less amount of sodium in it; also vegetables & fruits have less sodium in them which is good for the body. It is present in beans, meat, fish, chicken, chili, bread, rolls, milk, celery, beetroot etc.

Basic pharmacokinetic of sodium (based on human intake in natural food products): -

It is absorbed in ileum by active sodium transport because it is impermeable & in jejunum absorption takes place via mediated active transport & depends on levels of water, bicarbonate, glucose, amino acids etc; its absorption plays an important role in the absorption of chloride, amino acids, glucose & water; similar mechanism are involved in the reabsorption of it in kidneys when its level in the body falls. It is excreted mainly in urine, little in sweat & stools. It is stores in bones & dissolved in various body fluids.

Basic clinical pharmacology of sodium: -

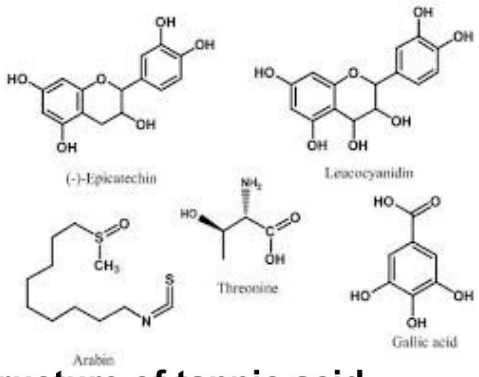
It is amongst the essential electrolyte within the body, it remains in extracellular fluid (outside the cell) mainly, it carries electrical charges within the body, kidney maintain its normal level in the body, normal level is 135-145 milli-equivalent per liter (mEq/L), it is not produce in the body, it acts on muscles contraction, nerve cells, regulates blood pressure, blood volume; it takes part in every function of the body mostly, its low level in body is called as hyponatremia, it is found more in older aged, kidney disease, heart disease, hospitalized patient, this condition may

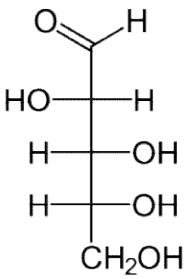
cause brain edema, low blood pressure, fatigue, tiredness etc; its high level in the body is called as hypernatremia may cause increase in blood pressure, thirst, confusion, muscle twitching or spasm, seizures, weakness, nausea, loss of appetite, swelling in body etc.

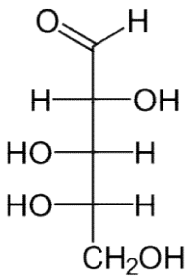
Nutritional value of Babul leaf and fruit
Serving Size: 100 g
Calories from Fat 59.67Kcal.

Proximity	Amount	% DV
Protein	13.92 g	27.84%
Total Fat (lipid)	6.63 g	18.94%
Ash	9.29 g	N/D
Minerals	Amount	% DV
Calcium, Ca	2.53 mg	0.25%
Iron, Fe	4.28 mg	53.50%
Magnesium, Mg	0.18 mg	0.04%
Phosphorus, P	0.23 mg	0.03%
Potassium, K	1.25 mg	0.03%
Zinc, Zn	0.256 mg	2.33%
Manganese, Mn	0.902 mg	39.22%
Amino acids	Amount	% DV
Threonine	3.2 g	181.82%
Isoleucine	3.06 g	183.01%
Leucine	3.06 g	82.79%
Lysine	4.98 g	148.92%
Cystine	2.35 g	N/D
Phenylalanine	3.23 g	N/D
Tyrosine	2.34 g	N/D
Valine	5 g	236.74%
Arginine	5.07 g	N/D
Histidine	2.63 g	213.47%
Alanine	4.59 g	N/D
Aspartic acid	28.69 g	N/D
Glutamic acid	8.97 g	N/D
Glycine	4.05 g	N/D
Proline	11.81 g	N/D
Serine	4.58 g	N/D

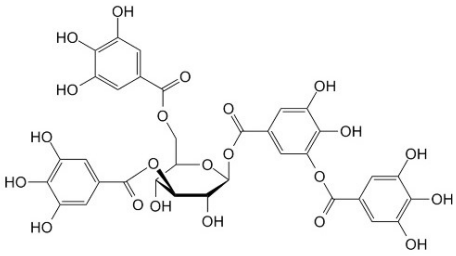
- ***Main chemical structures of Babul: -***

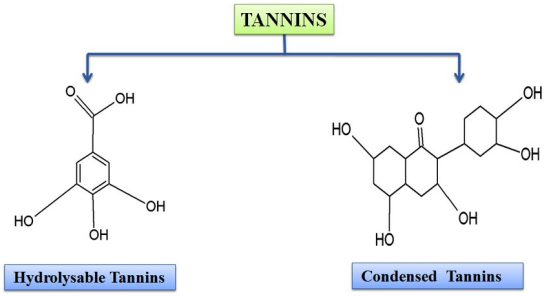


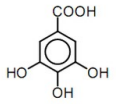




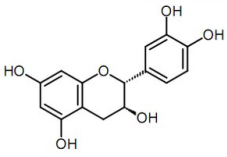
Structure of tannic acid



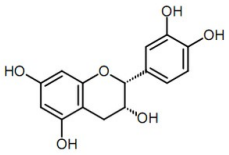




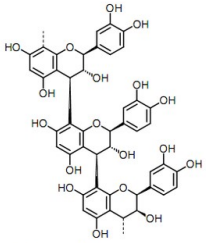
3,4,5-trihydroxybenzoic acid
Gallic acid (GA)



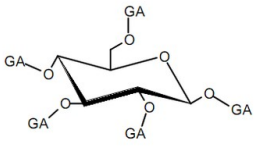
Catechin



Epicatechin



Procyanidin (condensed tannin)
Epicatechin-(4→8)-epicatechin-(4→8)-catechin



Hydrolyzable tannin
ß-1,2,3,4,6-pentagallolyl-O-D-Glucose
GA = Gallic acid

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- ***Research: -***

A study was conducted to investigate the *in vitro* antibacterial activity of *Acacia nilotica* methanolic fruits extract against clinical isolates performed by cup-plate agar diffusion method against five gram-negative bacteria (*E. coli, S. flexneri, Salmonella typhi, Pseudomonas aeruginosa,* and *Klebsiella pneumonia*) and 2 gram-positive bacteria i.e., *Listeria monocytogenes* and *Bacillus cereus*. Out of 7 cultures tested, it showed good activity against *Salmonella typhi* and *Bacillus cereus*. The authors concluded that the methanolic fruit extract of *A. nilotica* showed significant inhibition against gram-positive and gram-negative species. One of the studies found that the methanolic extracts of *A. nilotica* pods were most active against different bacterial and fungal strains. The methanolic extract of pods showed the highest activity against *E. coli, S. aureus* and *A. niger*. The antimicrobial property of 50 percent aqueous ethanolic leaf extract of *A. nilotica* (L.) exhibited antifungal property against *Rhizoctonia solani*. *A. nilotica* demonstrated the highest activity against three bacterial strains (*E. coli*, *S. aureus and Salmonella typhi*) and two fungal strains (*Candida albicans* and *Aspergillus niger*). Pods and leaf extracts exhibited the anti-viral effect. Pods of *A. nilotica* were reported to inhibit HIV-1 induced cytopathogenicity.

Cancer is a multifactorial disease and a major health problem worldwide. Earlier studies reported that plants and their constituents show inhibitory effects on the growth of malignant cells through modulation of cellular proliferation, tumour suppressor gene, apoptosis, etc. It contains flavonoids and various other constituents that play an important function in the inhibition of cancer development. The experiment was made to evaluate the anticancer activity of aqueous extracts of gum, flower and leaves of *A. nilotica* in 7, 12-dimethylbenz(a) anthracene (DMBA) induced skin papallomegenesis in Swiss albino mice. The results showed a significant reduction in the values of tumour burden, tumour incidence and cumulative papillomas. A study finding revealed that methanolic pods extract showing anti-uveal melanoma activity

Plants or their isolated derivatives are in practice to treat/act as anti-inflammatory agents. Study results had confirmed that ethyl extract of *A. nilotica* bark showed significant anti-inflammatory activity in 12-O-tetradecanoyphorbol-13-acetate (TPA) induced mouse ear oedema. Other study results revealed that its pod aqueous extract at a dose of 50 and 100 mg/kg b.w. showed significant anti-inflammatory activity in cotton pellet granuloma assay in rats. Another study investigated the anti-inflammatory effect of *A. nilotica* on albino rats using carrageenan-induced paw oedema and yeast induced pyrexia at a dose of 100 mg/Kg b.w. The results exhibited an increased inhibition of paw oedema and pyrexia (20%).

- ***Conclusion***

The nutritive value of *A. Nilotica* was determined and results revealed that it is so rich in crude protein and some trace and essential mineral elements especially Iron, Zinc, Copper and Potassium. Traditionally the plant used widely for the treatment of various ailments, but scientifically few of them was screened out. Therefore, the scientific studies should be conducted to investigate the unexploited potential of *Acacia Nilotica* (L.).Our results revealed that it could be recommended as a dietary supplement for people who need essential mineral elements. In conclusion the present study revealed that the seed oil of *A. Nilotica* growing in south of Iran could be a new source of high protein and mineral elements and its full potential should be exploited. The use of this seed is of potential economic benefit to the poor native population of the areas where it is cultivated. Hence the seed protein and minerals of *A. Nilotica* could be a new source of edible vegetable after the future toxicological studies.