

# PHARMACOGNOSY

## Tannin Containing Drugs

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(19.8.2007)

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### Keywords

Tannin, Hydrolysable tannin, Condensed tannin, Pseudotannin, Pale Catechu, *Uncaria gambier*, Catechin, Black Catechu, *Acacia catechu*, Myrobalan, *Terminalia chebula*, Nutgall, *Quercus infectoria*, Tannic acid, Kattha industry

## Introduction

Tannins are complex organic, non-nitrogenous plant products, which generally have astringent properties. These compounds comprise a large group of compounds that are widely distributed in the plant kingdom. The term 'tannin' was first used by Seguin in 1796 to denote substances which have the ability to combine with animal hides to convert them into leather which is known as tanning of the hide. According to this, tannins are substances which are detected by a tanning test due to its absorption on standard hide powder. The test is known as Goldbeaters skin test.

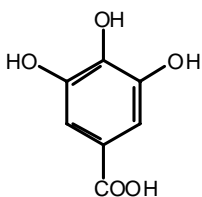
## Classification

The tannin compounds can be divided into two major groups based on Goldbeaters skin test. A group of tannins showing the positive tanning test may be regarded as true tannins while those, which are partly retained by the hide powder and fail to give the test, are called as pseudotannins.

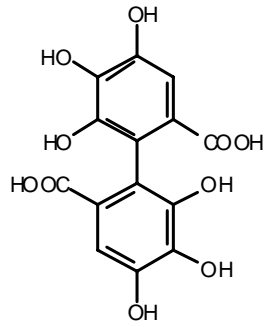
Most of the true tannins are high molecular weight compounds. These compounds are complex polyphenolics, which are produced by polymerization of simple polyphenols. They may form complex glycosides or remains as such which may be observed by their typical hydrolytic reaction with the mineral acids and enzymes. Two major chemical classes of tannins are usually recognized based on this hydrolytic reaction and nature of phenolic nuclei involved in the tannins structure. The first class is referred to as hydrolysable tannins while the other class is termed as condensed tannins.

**Hydrolysable Tannins:** As the name implies these tannins are hydrolysable by mineral acids or enzymes such as tannase. Their structures involve several molecules of polyphenolic acids such as gallic, hexahydrodiphenic or ellagic acids, bounded through ester linkages to a central glucose molecule. On the basis of the phenolic acids produced after the hydrolysis, they are further categorized under gallotannins composed of gallic acid or ellagitannins which contains hexahydrodiphenic acid which after intraesterification produces ellagic acid.

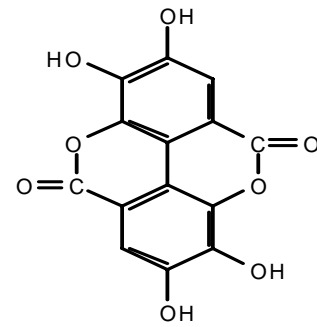
Hydrolysable tannins are sometimes referred to as pyrogallol tannins as the components of phenolic acids on dry distillation are converted to pyrogallol derivatives. The hydrolysable tannins are soluble in water and their solution produces blue color with ferric chloride.



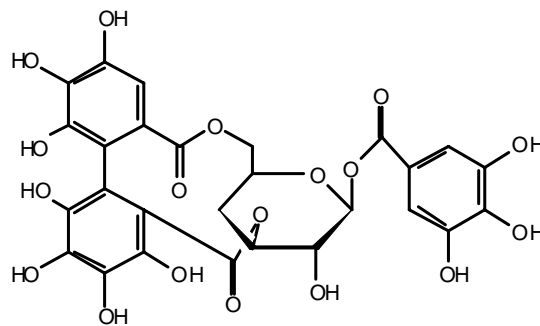
Gallic Acid



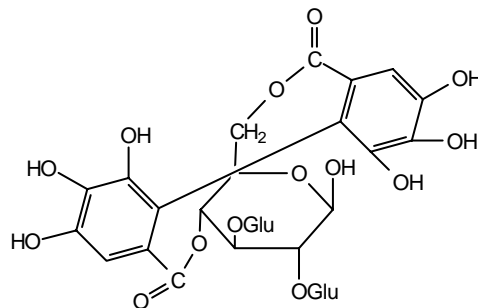
Hexahydroxydiphenic acid



Ellagic acid



Corilagin (Gallotamine)



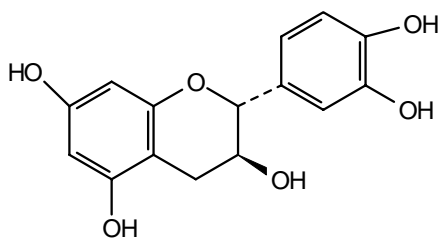
Tellimagradin (Ellagitannin)

**Nonhydrolysable or Condensed tannins:** Condensed tannins, unlike the previously explained group are not readily hydrolysable to simpler molecules with mineral acids and enzymes thus they are also referred to as nonhydrolysable tannins. The term proanthocyanidins is sometimes alternatively used for these tannins. The compounds containing condensed tannins contain only phenolic nuclei which are biosynthetically related to flavonoids. Catechin which is found in tannins is flavan-3-ol while leucoanthocyanidins are flavan-3,4-diol structures. These phenolics are frequently linked to carbohydrates or protein molecules to produce more complex tannin compounds.

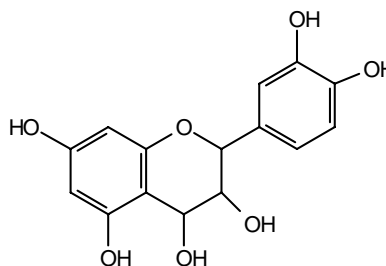
When treated with acids or enzymes, they tend to polymerise yielding insoluble red colored products known as phlobaphens. The phlobaphens give characteristic red color to many drugs such as cinchona and wild cherry bark. On dry distillation, they yield catechol derivatives. Condensed tannins are also soluble in water and produces green color with ferric chloride.

The families of the plants rich in both of the above groups of tannins include Rosaceae, Geraniaceae, Leguminosae, Combretaceae, Rubiaceae, Polygonaceae, Theaceae etc. The members of families Cruciferae and Papaveraceae on the other hand are totally devoid of tannins. In the plants in which tannins are present, they exert an inhibitory effect on many enzymes due to their nature of protein precipitation and therefore contribute a protective function in barks and heartwood.

**Pseudotannins :** Pseudotannins are simple phenolic compounds of lower molecular weight. They do not respond to the tanning reaction of Goldbeaters skin test. Gallic acid, Chlorogenic acid or the simple phenolics such as catechin are pseudotannins which are abundantly found in plants, especially in dead tissues and dying cells. Various crude drugs containing hydrolysable, condensed and pseudotannins are given in (Table 1).



Catechin



Leucoanthocyanidin

### Properties and Tests

Tannins are non-crystallizable, amorphous compounds. They are soluble in water, ethyl alcohol, glycerol, acetone and in dilute alkalies. Their aqueous solution shows an acidic reaction and a sharp astringent taste. Most of the tannin compounds cause precipitation of solutions of alkaloids, glycosides, gelatin and heavy metal salts of copper, lead and tin. Tannins produce a deep red color with potassium ferricyanide and ammonia. With freshly prepared ferric chloride solution hydrolysable tannins produce blue-black precipitate while condensed tannins show brownish green precipitate. Some other important and useful tests are mentioned as follows:

**Goldbeater's skin test:** Goldbeater's skin is a membrane produced from the intestine of Ox. It behaves just like untanned animal hide. A piece of goldbeaters skin previously soaked in 2% hydrochloric acid and washed with distilled water is placed in a solution of tannin for 5 minutes. It is then washed with distilled water and transferred to 1 % ferrous sulphate solution. A change of the color of the goldbeater's skin to brown or

black indicates the presence of tannin. Hydrolysable and condensed tannins both give the positive goldbeater's test while pseudotannins show very little color or negative test.

**Table-1: Various types of Tannins and their sources**

<b>Tannins Type</b>	<b>Crude drug</b>	<b>Biological source</b>
<b>Hydrolysable Tannins</b>	Bearberry leaves	<i>Arctostaphyllum uva-ursi</i>
	Rhubarb	<i>Rheumofficinale</i>
Gallotannins	Clove	<i>Eugenia caryophyllus</i>
	Hammamelis	<i>Hammamelis virginiana</i>
	Turkish gall	<i>Quercus infectorea</i>
	Pomegranate bark and rind	<i>Punica granatum</i>
Ellagitannins	Myrobalam	<i>Terminalia chebula</i>
	Malabar kino	<i>Pterocarpus marsupium</i>
	Eucalyptus kino	<i>Eucalyptus rostrata</i>
	Chest nut	<i>Castanea</i> spp.
	Cinchona bark	<i>Cinchona</i> spp.
	Wild cherry bark	<i>Prunus serotina</i>
	Rhatany roots	<i>Krameria triandra</i>
<b>Condensed Tannins</b>	Kola seeds	<i>Cola acuminata</i>
	Areca seeds	<i>Areca catechu</i>
	Green tea leaves	<i>Camelia sinensis</i>
	Catechu	<i>Acacia catechu</i>
<b>Pseudotannins</b>		
Chlorogenic acid	Mangrove cutches	<i>Rhizophora</i> spp.
	Butea gum	<i>Butea frondosa</i>
Gallic acid	Coffee	<i>Coffee arabica</i>
Catechin	Mate	<i>Ilex paraguansis</i>
	Rhubarb	<i>Rheum officinale</i>
	Catechu	<i>Acacia catechu</i>
	Cocoa	<i>Theobroma cacao</i>
	Guarana	<i>Paullinia cupana</i>

**Phenazone Test:** To 5 ml of aqueous solution of tannin containing drug, add 0.5 g of sodium acid phosphate. Warm the solution, cool and filter. Add 2 % phenazone solution to the filtrate. All tannins are precipitated as bulky, colored precipitate.

**Gelatin Test:** To a 1 % gelatin solution, add little 10 % sodium chloride. If a 1 % solution of tannin is added to the gelatin solution, tannins cause precipitation of gelatin from solution.

**Test for Catechin:** Catechin test is the modification of the well known phloroglucinol test for lignin. Matchstick contains lignin. Dip a matchstick in the dilute extract of the drug, dry, moisten it with concentrated hydrochloric acid, and warm it near a flame. Catechin in the presence of acid produces phloroglucinol which stains the lignified wood pink or red.

**Test for chlorogenic acid:** A dilute solution of chlorogenic acid containing extract, if treated with aqueous ammonia and exposed to air, slowly turns green indicating the presence of chlorogenic acid.

### **Isolation**

Both hydrolysable and condensed tannins are highly soluble in water and alcohol but insoluble in organic solvents such as solvent ether, chloroform, and benzene. Tannin compounds can be easily extracted by water or alcohol. The general method for the extraction of tannic acid from various galls is either with water-saturated ether, or with mixture of water, alcohol, and ether. In such cases, free acids such as Gallic and ellagic acid go along with ether while true tannin gets extracted in water. If the drug consists of chlorophyll or pigment, it may be removed by ether. After extraction, the aqueous and ethereal layers are separately concentrated, dried, and subjected to further isolation and purification using various separation techniques of chromatography.

### **Medicinal properties and uses**

Tannins occur in crude drugs either as major active constituent as in oak bark, hamamelis leaves, and bearberry leaves etc. or as a subsidiary component as in clove, cinnamon, peppermint or garden sage. In many cases, they synergistically increase the effectiveness of active principles. Tannins are medicinally significant due to their astringent properties. They promote rapid healing and the formation of new tissues on wounds and inflamed mucosa. Tannins are used in the treatment of varicose ulcers, hemorrhoids, minor burns, frostbite as well as inflammation of gums. Internally tannins are administered in cases of diarrhoea, intestinal catarrh and in cases of heavy metal poisoning as an antidote. In recent years, these compounds have demonstrated their antiviral activities for treatment of viral diseases including AIDS. Tannins are used as mordant in dyeing, manufacture of ink, sizing paper and silk, and for printing fabrics. It is used along with gelatin and albumin for manufacture of imitation horn and tortoise shell. They are widely used in the leather industry for conversion of hide into leather, the process being known as tanning. Tannins are also used for clarifying beer or wine, in photography or as a coagulant in rubber manufacture. Tannins are used for the manufacture of gallic acid and pyrogallol, and sometimes as a reagent in analytical chemistry.

## 1. Pale Catechu

Synonym: Gambier, Pale Catechu, Catechu

**Biological Source:** Gambier or Pale catechu is a dried aqueous extract produced from the leaves and young twigs of *Uncaria gambier* Roxburgh., family Rubiaceae.

**Geographical Source:** *U. gambier* is a native of erstwhile Malaya. It is cultivated in Indonesia, Malaysia, Sumatra, Bornea and Singapore at elevation up to 150 m. The plant is used mostly for the production of the drug, which is marketed through Singapore.

**Cultivation, Collection and Preparation:** Propagation of *U. gambier* is done by seeds. Seeds are sown in the nursery to raise the seedlings, which after about 9 months are planted out in the clearing about 3 meters apart. Leaves and young shoots are collected as a first crop during second year's growth ( Fig. 1.). Later the crop is taken every year. The plant continues to give sufficient leaves and twigs up to twenty years but the maximum yield is obtained during eighth year of growth.

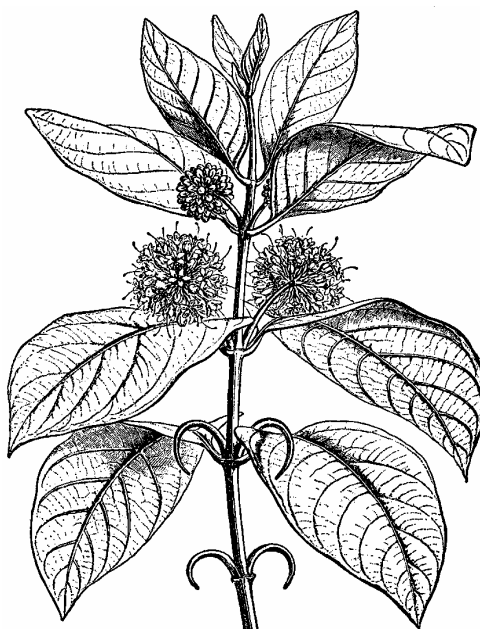


Fig.1. *Uncaria gambier* flowering branch

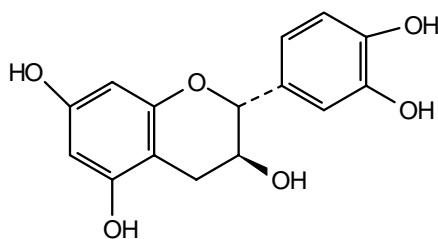
The collected leaves and twigs are transported to the factory as loose material. The material is put into large drums with about three quarters of boiling water. It is boiled for about three hours with intermittent stirring. The marc is subsequently removed by large wooden forks and lodged on surface to drain the liquor back to the vessels. It is pressed and washed. The washing are added to the extract. The combined total aqueous extract is then concentrated for one and half-hour till it becomes thick, yellowish-green paste. It is transferred from the vessels to wooden tubs, stirred while it is hot, and cooling in a stream of water to crystallize tannins. Semicrystallized paste is again transferred to wooden trays in which it sets. They are cut into cubes by wooden knife and dried in sun. The drug is also made into large blocks in kerosene tins.

**Characteristics:** Pale catechu comes in the form of cubes or rectangular blocks of 2 to 4 cm length. It is compact in constitution but lighter in weight. The color is dark brownish to dull brick red externally but pale brownish internally. The cubes may show small cavities due to the evaporation of entrapped water. The cubes can be broken easily and powdered. It is odorless with pleasant but bitter astringent taste. Its loss on drying should not be more than 15 % and water insoluble matter should not exceed 33%. It shows incompatibility with iron compounds, gelatin, limewater, mercuric chloride, zinc sulphate and alkalies.

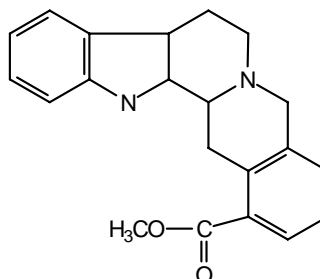
**Chemical tests:** Gambier fluorescin present in pale catechu gives the fluorescence. If to its alcohol extract, a little sodium hydroxide is added and shaken with petroleum ether. The petroleum ether layer shows green fluorescence.

**Microscopy:** The powdered drug, if mounted in the solution of lactophenol or water, shows the small circular crystals of catechu under microscope. The water insoluble part of the pale catechu under the microscope exhibits epidermal pieces, unicellular hairs, cork tissues, lignified fibers etc. Alcohol insoluble part shows the absence of starch. The pale catechu from Indonesia is reported to have minute starch grains.

**Chemical Constituents:** Pale catechu contain from about 7 % to 30 % of pseudotannin catechin and 22 % to 55 % of a phlobatannin catechutannic acid. Both of the about component constitute over 60 % of the drug. It also contains catechu red, and quercetin. It contains indole alkaloid up to 0.05 %, which includes gambirtannine and its derivatives. Gambirtannine gives a strong fuorescence under UV light. Catechin forms white, needle like crystals, which dissolves in alcohol and hot water. Catechutannic acid gives green color with ferric chloride.



(+) Catechin



Gambirtannin

**Uses:** Pale catechu is medicinally used as local astringent. In diarrhoea, it is used as general astringent. It is largely used in various countries of east for chewing with betel leaf. Large proportion of gambier is used in dyeing and tanning industries. It is used for tanning of animal hides to convert it to leather.

## 2. Black Catechu

Synonym: Cutch, Black catechu, Kattha

**Biological Source:** Black catechu is the dried aqueous extract prepared from the heartwood of *Acacia catechu* Willdenow, family, Leguminosae, subfamily, Mimosoideae.

**Geographical Source:** *A. catechu* is common throughout the tract from Punjab to Assam ascending to an altitude of 300 m. It is also quite common in drier regions of peninsula such as Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Bihar and Tamilnadu.



**Collection and preparation:** *A. catechu* is a medium size tree with thorns (Fig.2). For preparation of the drug the tree is cut off from the ground. The main trunk and branches are cleared of foliage and thorns. The bark is stripped off and the heartwood is made into chips. Heartwood is boiled in water in large earthen pots. The decoction is then strained and boiled in an iron pot with continuous stirring till it forms the syrupy mass. When the extract is cool enough, it is spread in the shallow wooden trays and kept for over night. When sufficiently dry, it is cut into pieces. Since the decoction is concentrated in iron vessels, the color of the catechu becomes darker due to its reaction with iron salts. If the syrupy extract is stirred during cooling, it develops the shining crystals of catechin and produces translucent black catechu. Nowadays stainless steel vessels are used for the manufacture of catechu that produces a lighter colored product.



**A**



**B**

Fig.2. *Acacia catechu*, (A) Full grown tree, (B) Fruiting branch

**Characteristics:** *A. catechu* heartwood is light, red, turning brownish red to nearly black with age and attached with whitish sapwood. The fracture is hard, odour, characteristic and taste is astringent.

Cutch is nearly shining black or brownish mass. It is hard and brittle, and breaks easily. The fractured surfaces show brownish color but dull gloss and small cavities. It gives dull brown fine powder, which is odourless but has a strong astringent taste. Black catechu forms a light brown magma in water, which shows the small crystals of catechin under microscope. It dissolves completely in boiling water but the content tends to form crystallized deposit on cooling.

**Microscopy:** A transverse section of *A. catechu* heartwood shows numerous uniseriate and biseriate medullary rays, with vessels occurring isolated or in small groups of two or four. Xylem fibres with narrow lumen occupy major portion of wood and xylem parenchyma is usually predominantly paratracheal, forming a sheath around vessels. Wood consists of crystal fibres having prismatic crystals of calcium oxalate. A few tracheids with scalariform thickening and some cells including vessels are also present.

**Chemical constituents:** Cutch or black catechu resembles pale catechu or gambier in its composition. It contains about 2 % -12 % of catechin and about 25 % to 33 % of phlobatannin catechutannic acid. The principle fraction of cutch has been identified as a mixture of catechin isomers which includes (-) epicatechin, acatechin, d l-acacatechin, l-acacatechin and d-iso acacatechin. It also contains 20 % - 30 % gummy matter, catechin red, quercetin and quercetin. It yields 2 % -3 % of ash.

**Uses:** Cutch is used in medicine as astringent. It cures troubles of mouth, diseases of the throat and diarrhoea. It also increases appetite. In India and eastern countries, it is used in betel leaves for chewing. In dyeing industries, cutch is used for dyeing fabrics brown or black. It is also used in calico printing.

### 3. Myrobalan

Synonym: Myrobalan

**Biological Sources:** Myrobalan is the mature dried fruits of *Terminalia chebula* family Combretaceae. The drug is popular in India as Harde or Haritaki.

**Geographical Source:** Myrobalan trees are found at an elevation of 300 to 900 m in North India, Satpura ranges of Madhya Pradesh, Maharashtra and Panchmahal district in Gujarat. It is also found in Myanmar and Srilanka.

**Collection and Preparation:** *T. chebula* is a moderate sized or large deciduous tree attaining a height of 25-30 m (Fig. 3.). The plant lacks natural regeneration. The plant requires direct overhead light and cannot tolerate shady situations. It is a frost and draught resistant tree. The fruits ripen from November to March depending upon the locality, and fall soon after ripening. The mature fruits are collected from January to April by shaking the trees, and then drying by spreading in thin layers preferably in shades. The dried myrobalan fruits are graded under different trade names. Gradation is done on the basis of fruits colour, solidness and freedom from insect attack.

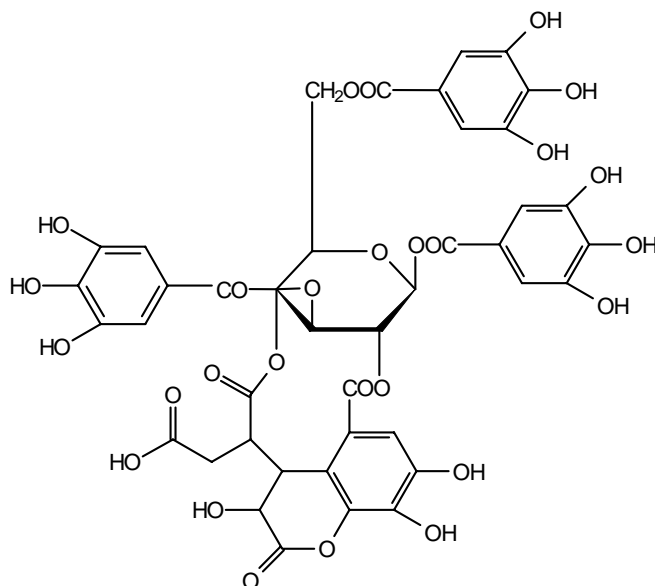


Fig. 3. *Terminalia chebula*, (A) Full grown tree, (B) Fruiting branch

**Characteristics:** Mature myrobalan fruits are drupes which are ovate and longitudinally wrinkled. The fruits are 2-3.5 cm long, and 1.3 - 2.5 cm broad. It is hard and stony. The pulp is 3 to 4 mm thick, which is not attached to seeds. It has slight odour and slightly bitter, astringent taste. The small immature fruits are known as 'Himaj'. These fruits are

pale brownish to black, compressed, ovate and tapering on both ends. Fruits show a scar of pedicel at one side.

**Chemical Constituents:** Myrobalan contains about 30 % of the hydrolysable tannins, which consists of chebulinic acid, chubulagic acid and D- galloyl glucose. It contains free tannic acid, gallic acid, ellagic acid and resin myrobalanin. Anthraquinone glycosides, sennosides have been reported in myrobalan.



Chebulinic acid

**Uses:** Myrobalan is reputed in Indian system of medicine as a drug for various types of diseases. Because of antiseptic and healing properties of tannins, it is used externally in chronic ulcers, wounds, piles and as stomachic. It is one of the drugs of the well-known preparation 'Triphala'. It has purgative properties. Fine powder of myrobalan is used in dental preparations.

#### 4. Nutgalls

**Synonym:** Nutgalls, Blue Galls, Turkish galls

**Biological Source:** Nutgall consists of the excrescence obtained from the young twigs of the dyers oak, *Quercus infectoria* Olivier family Fagaceae. Excrescence is caused by the puncture of ovums of insect *Cynips tinctoria* or *Adleria gallaetinctoriae* Olivier Family Cynipidae.

**Geographical Source:** Oak galls are obtained principally from Asiatic Turkey. Dyers oak is found in Turkey, Syria, Iran, Cyprus and Greece.

**Collection and Preparation:** Larvae of the insect *C. tinctoria* after emerging from the eggs, pierces the delicate epidermis near the growing point of the twigs where the eggs are deposited by the insect (Fig. 4.). The gall begins to enlarge, when the chrysalis stage is reached, starch disappears from the neighbourhood of insect and is replaced by gallic acid while central cells consist of tannic acid. The insect passes through the larval and pupal stages. If the galls are not collected and dried at this stage the mature insect comes out of the gall and escapes, and during this stage galls changes the color from a bluish gray, through olive-green to almost white. After the escape of the insect, a central cavity is formed and the tannic acid is oxidized in the presence of moisture and air. The more porous gall is the white gall of commerce.

In Asiatic Turkey, galls are collected before the escape of the insect in the months of August and September. After drying, they are sorted out according to color into three grades i.e. blue, green and white and exported.



Fig. 4: Nutgalls on a branch of *Quercus infectoria*

**Characteristics:** Nutgalls are subspherical about 12-25 mm in diameter with short basal stalk and number of projections on the outer surface. Galls are hard, heavy, and sink in water. Blue galls generally have grayish color while the green galls are olive green in color. Both of these galls are preferred to the white galls as in white galls the tannins are decomposed to certain extent. They have no odor but characteristic astringent, sweet taste.

**Microscopy:** A transverse section through a nutgall show thin walled parenchymatous outer zone, which is quite larger as compared to inner zone. Parenchyma is followed by a ring of sclerenchyma composed of one or two layers of suberised cells. Inner zone is made up of thick walled parenchyma, which surrounds central cavity. Cells of parenchyma show the presence of numerous starch grains, calcium oxalate clusters and rosettes and tannins. Parenchyma also shows the bodies of lignified tissues, which stains with phloroglucinol and hydrochloric acid.

**Chemical Constituents:** Nutgalls contains about 50 %-70% tannin mainly gallotannic acid which is official tannic acid. It also consists of 2 % - 4 % gallic acid, ellagic acid, sitosterol, methyl belulate and methyl oleanolate which are methyl esters of betulic and

oleanolic acid. Recently few more compounds such as Nyctanthic acid, roburic acid and syringic acids have been reported from galls. It contains abundant starch.

Tannic acid of commerce is a hydrolyzable tannin which yields gallic acid and glucose. The molecule of tannic acid may contain the gallic acid up to pentagalloyl glucose. It is isolated by fermentation and subsequent extraction of galls with water-saturated ether.

**Uses:** Nutgall is the major source of tannic acid, which is largely used in tanning and dyeing industry and for the manufacture of ink. It is used medicinally as a local astringent in ointments and suppositories.

**Allied Drugs:** Various types of galls are produced on plants by insects of the genera *Cynips* and *Aphis*. Chinese and Japanese galls are of commercial interest. These galls are formed on *Rhus chinensis* Mill, family Anacardiaceae by an aphid, *Schlectendalia chinensis*. These galls are knotty, gray, irregular and breaks easily to show irregular cavities. They contain 57 %-77 % of tannins. These drugs have been used in China and Japan since time immemorial as astringent and styptic.

### **Tannic acid**

Tannic acid is not a single constituent but a type of hydrolyzable tannin that contains several units of gallic or ellagic acids esterified with the glucosyl OH to produce complex tannin compounds. Its exact composition varies according to its source. Turkish galls have a maximum complexity of hexa or heptagalloyl glucose while Chinese galls are octa or nonagalloyl glucose, which affords methylgallate, and pentagalloyl glucose on hydrolysis.

Tannic acid is extracted with a mixture of water, alcohol, and ether. The extracted liquid separates into two layers. The aqueous lower layer contains gallotannins while the ethereal layer contains free gallic acid and other similar compounds. Aqueous and ethereal extracts are treated separately for further purification.

Tannic acid occurs as amorphous powder containing brownish spongy masses. It has a faint odor and strong astringent taste. It is soluble in water, alcohol, and acetone but insoluble in organic solvents.

Tannic acid has strong astringent properties. It is used as an antidote in cases of alkaloidal poisoning as it precipitates alkaloids as tannate salts. It finds its uses in tanning, dyeing industries and for ink manufacture. Its preparation can be used topically for the treatment of bedsores and minor ulcerations. It is utilized in the laboratory as a reagent for detection of gelatin and proteins.

### **Kattha Industry in India**

Kattha or cutch is extracted from wood of khair tree, *Acacia catechu* subfamily; Mimosoidae, Family Leguminosae. Khair tree is found abundantly in Uttar Pradesh, Bihar, Rajasthan, Gujarat and Himachal Pradesh. Though manufacture of kattha is an important forest-based traditional industry in India, it is a little known industry unlike

other industries. However it is a very high revenue yielding industry to the forest and provides employment to thousands of workers both in the factories and forests.

**Manufacture:** The manufacture of kattha has developed gradually from ancient times and even today it is largely carried on in the same way as it was done centuries ago. This traditional method is given bellow.

**Traditional Method:** Large quantities of kattha are produced by the conventional method in the forest. Winter season is preferred for the kattha manufacture. Mature tree is felled, the bark and sap wood is peeled off. The heart wood is reduced to fairly uniform chips of 2 to 4 cm length and 0.5 to 1.5 cm thickness. Large egg shaped earthen pots of 6 to 9 kg holding capacity, are placed in rows over a tunnel like hearth or bhatthi which is fired by the sapwood, khair bark and extracted chi

The chips in the pots are covered with water and boiled several times till exhaustion. Generally chips are extracted carrying three to five changes of water with heating time of 3 to 4 hours. The extract is strained through muslin cloth and further concentrated in the earthen pots to a particular consistency. The concentrated extract is set aside for several days for natural cooling. The consistency and colour of liquid extract changes with the separation of lesser soluble components. The separated solid mass containing kattha or cutch is processed further to separate kattha. In one of the procedure solid mass is transferred to baskets strewn with ash. In another method the mass is transferred to rectangular pits with bed of sand and clay covered with jute hessian or muslin. The soluble cutch portion is removed in this operation, leaving behind the solid mass of kattha. The solid is scooped out and made into blocks of 30cm X 30cmX 22.5cm. The blocks are dried in the shade. The size of the mass reduces with loss 20 to 25% moisture and requires further drying for 20 to 30 days.

In this traditional method final yield of kattha is 6 to 7% of the heartwood. The total recovery of the kattha is about 50%.

**Factory Method:** Factory method utilizes various mechanical appliances for the production of kattha or cutch. In 1920, Indian Wood Product Ltd., Izatnagar, first started industrial production of kattha from khair wood in Uttar Pradesh. The various unit operations involved in the factory method have been illustrated below:

- i) Debarking or Desapping
- ii) Chipping
- iii) Extraction
- iv) Evaporation
- v) Crystallization
- vi) Filtration
- vii) Pressing of cake
- viii) Cake cutting
- ix) Drying
- x) Sorting and packing and
- xi) Filtrate processing

All the above unit operation used in the factory method are exactly similar as those in the traditional method except that each operation is mechanical in nature with a scientific basis for better reliable and reproducible results.

The brief idea about the factory method is as follows:

After receiving the logs of woods from the forests, their bark and sapwood is removed by manual labour. The logs of heartwood are converted to chips by machines. The extraction of the chips is done in large extractors using steam. The extract obtained is concentrated in evaporators under vacuum. The concentrated extract is then cooled to desired temperature by refrigeration. The cooled extract containing separated kattha is centrifuged to remove the liquor of soluble cutch. The cakes obtained after centrifugation are pressed in hydraulic presses. Large cakes are cut into tablets of suitable size by machines. The tablets are dried in the room of controlled temperature for a long period till complete drying.

The mother liquor also contains about 15 - 20% total solids. It is concentrated to 85 to 90% to get further yields of kattha.

### Standards

The ISI standards recognize two grades of kattha on the basis of the values given in table 2.

Table 2: ISI standards of two grades of kattha

Standards	Grade I	Grade II
Loss on drying	15	15
Catechin content ( % weight )	55	40
Cold water extractive ( dry weight )	45	60
Insoluble matter in rectified spirit	25	25
Insoluble matter in boiling water	3	6
Total ash ( %wt )	1.5	4

Indian pharmacopoeial standards for black catechu are given in Table 3.

Table 3: Indian pharmacopoeial standards for black catechu

Water insoluble residue	Not more than 25%
Alcohol insoluble residue	Not more than 30%
Loss on drying	Not more than 12%
Ash	Not more than 6%

A 10% solution of black catechu should produce dark green colour with addition of ferric chloride (5%).

The kattha industries are mostly found in Uttar Pradesh where the khair tree is abundantly found in river tracts of Terai and Bhabar. The factories under operation in various states of India are mentioned in Table 4. Many other state of India do have large plantation of khair tree but production is done at small scale either under the forest department of the state government or by number of traditional manufactures of kattha in different states.

Table 4: Kattha factories under operation in various states of India

S. No.	State	Industry
1	Uttar Pradesh	The Indian Wood Industries Ltd., Izatnagar Goel Kattha Industries, Bareilly Bareilly Kattha Factory, Bareilly Chandra Kattha Industry, Najibabad Laxmi Kattha Factory, Najibabad Vijay Kattha Factory, Najibabad Ganesh Kattha Factory, Haldwani Amar Sika Wood Product, Agra
2	Gujarat	Narbada Valley Chemical Industries Pvt. Ltd., Rajpipla, New Laxmi oil and chemical works, Derol, Bekay Kattha Manufacturing Co., Vyara,
3	Maharashtra	Swastik Kattha Factory, Dahanu Road. Maharashtra Kattha and Allied Industries Ltd.  Chandrapur
4	Madhya Pradesh	Gwalior Forest Product Ltd., Shivapuri
5	Haryana	Mahesh Wood Product Bahalgarh
6	Himachal Pradesh	Mahesh Kattha Udyog, Oel

### Suggested Reading

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2. Evens W. C. and Trease G. E., Pharmacognosy, 12<sup>th</sup> ed., ELBS / Belliere Tindall, Eastbourne, U.K., 1985