

Tannins from Foods to Combat Diseases

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ABSTRACT

Tannins are a group of phytochemicals found to be present in various concentrations in many fruits and vegetables consumed by human. Studies reveal that the phytoconstituents belonging under the umbrella of tannins possess potent antioxidant activity; some exhibit radical scavenging activity as well. Studies also showed the presence of tannins in various pharmacologically potent leaves, barks and fruit extracts. Proper experimental and clinical evaluation of the protective activity of tannins from foods in various oxidative stress mediated pathological conditions can pave a new path for mankind in development of modern drugs and designing new and alternative pharmacological agents. On the other hand, inclusion of recommended fruits, beverages, leaves etc. containing tannins in one's daily diet can help to prevent and also combat various types of health ailments, the underlying mechanism being the radical scavenging and antioxidant potential of tannins.

Keywords: Tannins, antioxidant, radicals, phytoconstituents, oxidative stress

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INTRODUCTION

Antioxidants are substances that are capable of scavenging free radicals from within the body of living organisms. Plants, herbs, fruits and vegetables have been known to be rich sources of natural antioxidants. Those natural antioxidants are of various chemical nature and have varied molecular mechanism of action. Natural antioxidants have been revealed experimentally to possess potent capabilities to combat various diseased conditions in experimental animals [1] and humans [2]. Antioxidants have been reported to exert a wide range of pharmacological effects which includes anticancer, anti-inflammatory, antitoxic, antiallergic etc. and various other different types of medicinal activities [2-5]. Antioxidants are being investigated to possess antiteratogenicity and antimutagenicity [4, 5]. Tannins are a widely distributed phenolic antioxidant, present in various barks, leaves, fruits and vegetables and have been reported to possess medicinal and therapeutic

potentials [6]. Tannic acid is one such magic molecule with potent antioxidant activity.

Tannic acid in foods

Human consumption of fruits and vegetables and beverages rich in polyphenols have been found to be directly linked with inhibition of occurrence of deadly diseases like cancer [6], cardiovascular disorders [7], nephropathy [8] and also have been found to be related to detoxification of toxic effects of exposure to toxic heavy metals like lead [9] and cadmium [10].

Tannins have been reported to be present in fruits and vegetables like bananas, sorghum, grapes, raisins, spinach, red wine, persimmons, chocolate etc. Beverages like tea and coffee have also been recognised to be rich source of tannins [11]. The colour of tea also depends on the tannin content. Darker the tea, more is the content of tannin in it [11]. Tannic acid has a hydrophobic central 'core' containing glucose and a hydrophilic 'shell' is the structural specificity of the molecule responsible for the antioxidant property of tannic acid.

They have ten galloyl groups and tannins are soluble in water [12]. Phenolic compounds are known to exhibit antioxidant activity by virtue of their redox property because of which they can scavenge oxygen radicals and donate hydrogen to neutralise reactive oxygen species [12, 13]. Studies revealed protective ability of tannic acid against skin, lung and stomach tumors [14].

Both black and green tea, wine and chocolate and certain fruits and vegetables rich in tannin can be consumed in definite amount to maintain a healthy and disease free life and to restrict oxidative damages brought about due to generation of free radicals in animal and plant organisms. More than forty herbs have reported to contain tannin [15]. Curry leaves are one of the worth mentioning herbs containing tannins, which are available easily and consumed frequently and usually by the South East Asian countries as spice herb [15]. Several medicinal herbs also have been reported to contain tannin [15]. Besides, cinnamon, thyme, black cohosh and feverfew also contain tannin. Tannins are contributors of the particular flavour of wine. Tannins in wine come from from the

fruits like grape from which wine is manufactured. Tea is a rich and well known source of tannin and the quantitative content of tannin in a particular type of tea depends on the amount of tannin in the tea leaves or bark from which the tea has been derived [16].

Types of tannins

Tannins are classified into two classes. One group is comprised of hydrolysable polyhydric alcohol in which the hydroxyl groups are partially or completely esterified by gallic acid or similar kind of compounds [17]. The other group is composed of tannins which are formed by condensation of phenolic compounds. Those are non hydrolysable and are known as condensed tannins [18]. Condensed tannins are found in grapes, pomegranates etc., have high molecular weights and have been reported to possess therapeutic potentials¹⁸. The condensed tannins are more stable and are not easily decomposed. Condensed tannins are also not easily hydrolyzed by acids [18]. The basic component of condensed tannin is (epi) catechin. Several monomeric units of catechin condense to form the oligomeric or the polymer structure of condensed tannin [18].

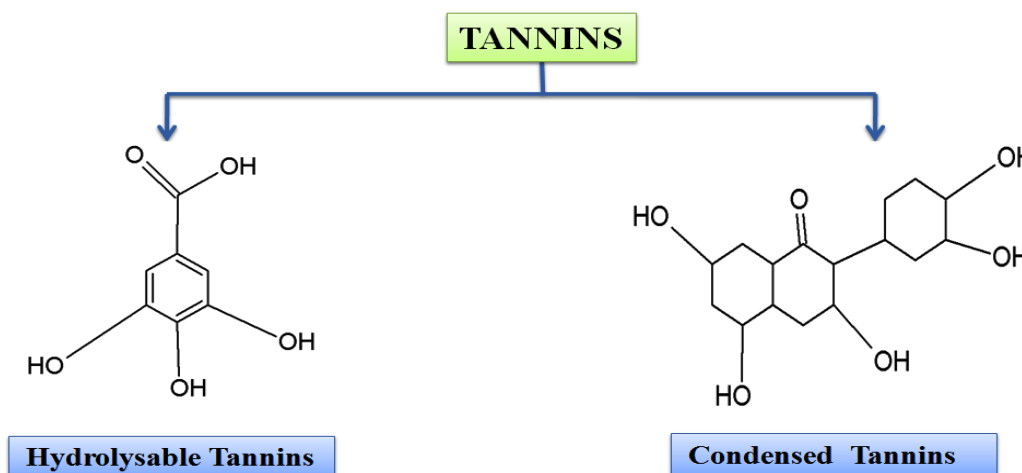


Figure1: Types of tannins and their basic structures

Tannins in therapeutics

Researchers around the world are in search of potent molecules from plants for developing useful drugs with least or no side effects and cytotoxicity. Tannic acid from herbs and fruits can thus be of immense use in endeavours of drug development from natural sources.

According to a report by WHO, almost 80% of the total population of the world are dependent on medicines derived from natural sources. Tannic acid imparts the astringent taste to unripe fruits.

During the late 19th and beginning of the 20th century, tannic acid has been reported to be in use for treating toxicity due to

substances like strychnine, mushroom etc. Condensed tannins have been reported to be effective against allergies, tumours, cardiovascular disorders etc. Besides, studies reveal that condensed tannin has the potency to treat tumours, platelet aggregation and also can reduce the risk of cancer [19, 20].

Use of tannic acid for treating burn injuries reduced the number of deaths occurring due to burn [21]. Strong, luke warm tea in place of tannic acid can be used for treating burn injuries [21]. During the second World War, burn injuries due to bombs, lewisite or mustard gas were treated with tannic acid. Tannic acid was used for dressing such burn injuries [22].

Tannins from various plants and fruits are of diverse type and this variation is due to their degree of polymerization and concentration in respective plant which in turn decides their biological activity. Tannin has been reported in many plant species including *R. apiculata* and *R. Mangle* [22]. We have also found presence of tannic acid in *Murraya koenigii* [15]. It is difficult to isolate and characterize tannins from plants and fruits due to the complex structure of highly polymerized tannins. The tannins from *R. apiculata* and *R. Mangle* has been reported to possess antibacterial and antiviral activity [23]. Whereas tannins from *Murraya koenigii* have been found to be one of the important components of the leaves of the plant which are responsible for imparting the antioxidant capacity of the same [22]. *Murraya koenigii* has been found to be effective in combating heavy metal induced oxidative stress mediated damages in heart [23], liver [23], kidneys [9, 23] and blood tissues [24] in experimental rats. Tannic acid being a recognized antioxidant component of the leaves of *Murraya koenigii* can be considered to have contributions to the protective effect of the leaves against heavy metal induced cardio toxicity, hepatotoxicity, nephrotoxicity and hematotoxicity.

Studies reveal the use of tannic acid in healing wounds and various other different types of ailments in human beings. Tannins have been reported to be used in treating gastric ulcers, diarrhoea, snake bites, inflammations [25] etc. Hydrolyzable

tannins are found in high concentrations in nutgalls growing on *Rhus semialata*, *Quercus infectoria*, the seedpods of *Caesalpinia spinosa* and the fruits of *Terminalia chebula* [26]. Well known sources of condensed tannins are the heartwood of *Schinopsis lorentzii* and *S. balansa*, the bark and/or heartwood of *Acacia catechu* and *A. mollissima*, and the bark of *Rhizophora* and *Eucalyptus* species [27].

The hydrolysable form of tannin is extensively used in medicine and is called as "acidum tannicum" or tannic acid. Though studies suggest that both the types of tannins i.e., condensed tannin and the hydrolysable one have potent therapeutic potentials in various kind of diseases and ailments, yet the hydrolysable one is considered as a ready to use drug in the European and American countries [28, 29]. Whereas, the condensed form of tannin is considered and has been reported to be extensively used in countries like China [30, 31].

Tannic acid has been reported to be used in cold sores and fever blisters, prickly heat, sore throat, inflamed tonsils, acute dermatitis etc. Tannic acid is also used for bleeding, chronic diarrhoea, dysentery, hematuria, painful joints, persistent coughs [32] etc.

Tannins have been reported to have synergistic therapeutic activity [33]. We also have observed that use of *Murraya koenigii* leaves containing tannins have enhanced the protective activity of melatonin against lead induced toxic effects in various organs in rats [24,34,35].

CONCLUSION

Tannins thus form a large group of natural product and they are biologically active entities easily available from our foods. Tannins have extensive health benefits and have therapeutic potentials for treating various disease conditions. We may take care of including components containing tannins in our daily diet and thus can simply step away from many diseases. Continuous administration of purified tannins in experimental animals has been reported to be detrimental for hepatic and renal tissues of the animal but on the other hand studies reveal that intake of tannins present in food is safe [36,37]. Till date

there is no adverse effect reported in humans or experimental animals for consuming tannin containing foods. So, purified tannins when used for therapeutic purpose must be extensively experimentally verified and checked and should be used at permissible, safe and recommended doses only. Whereas, foods containing tannins, like tea, wine, fruits, herbs and chocolates can be consumed without worries and the beneficial effects of tannins can be thus extracted and enjoyed for a healthy life with reduced load of diseases and ailments.

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