



Review Article

Phytochemistry and Medicinal Uses of *Tamarindus indica* and *Persea Americana* as Sources of Plant Nutrients

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Abstract: *Tamarindus indica* (tamarind) and *Persea Americana* (avocado) are tropical fruits. They are very nutritious foods contain fatty acids, vitamins, phytosterols and other phytochemicals. The extracts from fruit pulp and seeds can be used as an alternative dietary supplement. In addition, they have been extensively used in traditional medicine for the treatment of various diseases. Thus, the present study review the phytochemicals and medicinal uses of tamarind and avocado as sources of plant nutrients.

Keywords: Tamarind, Avocado, Phytochemistry, Medicinal Properties

1. Introduction

Dietary manipulation through the consumption of specific plant materials containing phytochemicals have been proved to be effective treatment methods for the regulation of glucose and lipids in the blood [1]. Studies have shown that plants containing sterols such as the aloe-vera can be used to reduce visceral fat accumulation and improve hyperlipidemia and hyperglycemia in rat [2]. *In-vitro* studies have also shown that phytosterols (PS) dissolved in diacylglycerol (DAG) oil (PS/DAG) was very effective at a relatively low dose to lower the blood cholesterol and lipoprotein concentrations for hypercholesterolemia patients with a low response to pravastatin [3].

Tamarind and avocado contain phytosterols such as beta-sitosterol, campesterol and stigmasterol [4]. Avocado also contains fatty acids with olefinic, acetylenic bonds, furanoic acids, dimers of flavanol [5] and oligomeric proanthocyanidins [6] which could account for other nutritional importance. To date, there are intensive bioactivity studies on the tamarind and avocado. The present study review the phytochemicals and medicinal uses of tamarind and avocado as sources of plant nutrients.

2. Tamarind

Tamarind (*Tamarindus indica* L.) is a plant in the family of Fabaceae under the genus *Tamarindus*. Common names of tamarind are tamarind, tamarindo, tamarin and sampalok. Tamarind is native to tropical Africa but is extensively cultivated in India, North America and many tropical areas of the world [7].

2.1. Cultivation

Tamarind is well adapted to semi-arid tropical conditions, although it does well in many humid tropical areas of the world with seasonal high rainfall. Tamarinds can grow 80 feet high with a spread of 20 to 35 ft [8]. The leaves are normally evergreen but may be shed briefly in very dry areas during the hot season [9]. The five-petal tamarind flowers are borne in small racemes and are yellow with orange or red streaks. The flower buds are pink due to the outer colour of the 4 sepals which are shed when the flower opens [10]. Tamarind fruits are 3-8 inch long, brown, irregularly curved as pods and are borne in abundance along the new branches. As the pods mature, they fill out and the juicy acidulous pulp turns brown

or reddish-brown. When fully ripened, the shells are brittle and easily broken.

The pulp dehydrates to a sticky paste enclosed by a few coarse strands of fibre. The pods may contain from 1 to 12 large, flat, glossy brown, obvoid seeds embedded in the brown, edible pulp. The pulp has a pleasing sweet/sour flavour and is high in both acid and sugar. It is also rich in vitamin B and high in calcium [8].

Tamarinds grow best in well drained soils which are slightly acid but do not tolerate cold wet soils [9]. The young tamarind trees require adequate soil moisture until they become established, but the mature ones do quite well without supplemental irrigation [10]. The tamarind is not very demanding in its nutritional requirements. Young trees are fertilized every 2-3 months with a 6-6-3 NPK or similar analysis fertilizer. Microelements, particularly iron may be required for trees in alkaline soils [8].

Tamarind fruits mature in late spring to early summer. They may be left on the tree for as long as 6 months after maturity so that the moisture content will be reduced to 20% or lower. Fruits for immediate processing are often harvested by pulling the pod away from the stalk. Mature trees are capable of producing 350 lb. of fruit/year. Ripe fruit in humid climates is readily attacked by beetles and fungi, so mature fruit should be harvested and stored under refrigeration [10]. Tamarinds may be eaten fresh, but they are most commonly used with sugar and water in the American tropics to prepare a cooling drink. The pulp is used to flavour preserves and chutney to make meat sauce. Candy can be made by mixing the pulp with dry sugar and moulding it into desired shapes [11].

2.2. Phytochemistry

The tamarind seed contains crude proteins, crude fibre, crude fat and tannins in various weights 131.3, 67.1, 48.2 and 56.2g/kg-1 respectively with trypsin inhibitor activity of 0.8 where most tannin being located in the testa [12]. It contains fifteen fatty acids mainly palmitic (14–20%), stearic (6–7%), oleic (15–27%), linoleic (36–49%), arachidic (2–4%), behenic (3–5%) and lignoceric (3–8%) acids and phytosterols such as β -sitosterol (66–72%), campesterol (16–19%) and stigmasterol (11–14%) [13]. The seed contains flavonoids such as the anthocyanidins and oligomeric proanthocyanidins [14]. The seeds also contain phenolic antioxidants such as 2-hydroxy-30, 40-dihydroxyacetophenone, methyl 3, 4-dihydroxy-benzoate, 3,4-dihydroxyphenyl acetate and epicatechin [15]. The organic content is 975.4 g/kg DM, neutral detergent fibre (NDF) 755.2g/kg DM, acid detergent fibre (ADF) 725.4g/kg DM, acid detergent lignin 421.9g/kg DM, ash in ADF 2.1g/kg DM, total phenol content 155g/kg DM [12].

2.3. Medicinal Uses

Tamarind fruits are used traditionally as cathartic, astringent, febrifuge, antiseptic and refrigerant purposes [7] while tamarind seed husk act as a source of tannin to manipulate fermentation or nutrient digestion to the advantage of lactating cows instead of the cost additive efforts in

detannifying it [12]. The xyloglucan polysaccharide derived from tamarind seeds are used as a potential gel (formed by *in situ* gelation of the xyloglucan gel) for percutaneous administration of non-steroid anti-inflammatory drugs [16] otherwise a vehicle for oral drug delivery [17]. Recent studies have also revealed that tamarind fruit is a good source of compounds active on complement system [18] and was also showed that the xyloglucan gel formed from tamarind seed can be used as a sustained vehicle for intraperitoneal administration of Mytomycin C, a chemotherapeutic agent [19]. Tamarind intake appears to have beneficial effects on the mobilization of deposited fluoride from bone by enhancing urinary excretion of fluoride [20].

Tamarind is also used as a raw material for the microbial production of citric acid [21]. The Malabar tamarind may be effective in the treatment of obesity [22], but the mechanism is not fully understood. Tamarind has also been used to reduce the calculogenic properties in urine [23]. The seed extract has been used as a replacement for phosphoric acid citric acid and other acids that are added to soft drink as a result of its high pH and flavor profile equivalent to or better than beverages sweetened with aspartame [24]. The seed extract also exhibits antioxidant potentials by reducing lipid peroxidation *in vitro* and anti-microbial activity [15].

3. Avocado

Avocado belongs to the flowering plant family of *Lauraceae*, genus *Persea* and specie *Persea americana*. It is commonly called avocado, alligator pear (English); aguacate, palta (Spanish). Avocado probably originated in southern Mexico but was cultivated from the Rio Grande to central Peru before the arrival of Europeans [25].

3.1. Cultivation

Avocados do well in the mild-winter areas. Some hardier varieties can be grown in the cooler parts and along the Gulf Coast. Avocados do best some distance from ocean influence but are not adapted to the desert interior [26]. Avocado is a dense, evergreen tree, shedding many leaves in early spring. It is fast growing and can with age reach 80 feet, although usually less and generally branches to form a broad tree. [27]. Avocado leaves are alternate, glossy, elliptic and dark green with paler veins. They normally remain on the tree for 2 to 3 years [25]. The flowers of Avocado appear in January-March before the first seasonal growth, in terminal panicles of 200-300 small yellow-green blooms. Each panicle will produce only one to three fruits.

The flowers are perfect, but are either receptive to pollen in the morning or shed pollen the following afternoon (type A), or are receptive to pollen in the afternoon, and shed pollen the following morning (type B). About 5% of flowers are defective in form and sterile. Production is best with cross-pollination between types A and B. The flowers attract bees and hoverflies and pollination usually good except during cool weather. Off-season blooms may appear during the year and often set fruit. Some cultivars bloom and set fruit

in alternate years [28]. The flesh of avocados is deep green near the skin, becoming yellowish nearer the single large, inedible ovoid seed.

Avocado flesh is hard when harvested but softens to a buttery texture. Wind-caused abrasion can scar the skin, forming cracks which extend into the flesh. Seeds may sprout within an avocado when it is over-matured, causing internal moulds and breakdown. High in monounsaturated fat, the oil content of avocados is second only to olives among fruits, and sometimes greater [25]. Avocado trees flourish in decomposed granite or sandy loam soil. They do not survive in locations with poor drainage. The trees grow well on hillsides and should never be planted in stream beds [28]. Over irrigation can induce root which is the most common cause of avocado failure. Avocados tolerate some salts, though they will show leaf tip burn and stunting of leaves. Deep irrigation will leach salt accumulation [25]. Avocado seeds may be needed to be fertilized using a balanced fertilizer, four times yearly. Older trees need nitrogenous fertilizer applied to them. Yellowed leaves (chlorosis) indicate iron deficiency. This can usually be corrected by a chelated foliar spray of trace elements containing iron. Mature trees sometimes suffer from zinc deficiency [29]. The time of harvest depends upon the variety. Some are ripe in 6-8 months from bloom while others can take up to 12-18 months. Fruits continue to enlarge on the tree even after maturity. Avocados are allowed to colour fully before harvest. Avocado fruits can be stored at 40-50° F for up to six weeks but some avocado discolour quickly and require immediate consumption [29].

3.2. Phytochemistry

The avocado fruit has a lot of nutrients. This includes its high content of essential minerals, potassium, vitamin E and B complex. The avocado seed also contains various classes of natural products such as phytosterols and triterpenes [30], fatty acids with olefinic, acetylenic bonds, furanoic acid, dimmers of flavonols and oligomeric proanthocyanidins, β -D-glucoside of 8-hydroxyabscisic acid and epi-dihydrophaseic acid β -d-glucoside [31]. The proximate analyses of the fruit on dry basis shows 4.2%, ash 8.1% protein 70%, oil 7.2% fiber and 10.5% carbohydrate. It also contains tannins 2.45g/kg wt of the seed [28]. Oil content was found to change in terms of maturity from 49.5% after harvest to 70% (dry basis) after 13 days of storage. Thus, ripe avocados afford the maximum amount of oil from the raw material [32].

3.3. Medicinal Uses

Leaf and seed extracts have been used for a variety of medical application including treatment of diarrhoea, dysentery and as an antibiotic. [28]. It contains nutrients which are beneficial in the synthesis of skin protein called collagen [33]. The fruit is considered one of the most potent anti-oxidant fruit in the world because of its high content of mono unsaturated fats [34], thus people consuming a special avocado based diets showed lower cholesterol levels. It is noteworthy that ethnopharmacology of Aztec and Maya

cultures used decocts of avocado seeds as a potent agent to treat mycotic and parasitic infections [35].

Avocado seeds preparations are traditionally used as anti-inflammatory [36]. The avocado leaves aqueous extract can be very toxic to horses but not for cows, while the lipophilic extract is toxic [37]. Some lipids isolated from the avocado fruits have shown a selective activity against human prostate Aden carcinoma [35]. Avocado fruit has a skin healing effects which may be due to the positive influence on fatty acid [38]. The non-toxic ACC-inhibiting substance could be a beneficial tool to suppress fat accumulation and hence to avoid obesity [39].

It is reported that the aqueous leaves extract of the avocado has some vaso-relaxant effect on isolated rats and this effect is dependent on the synthesis or release of endothelium-derived relaxing factors as well as the release of the prostanoid, thus inhibiting Ca^{2+} influx through calcium channels [40]. The presence of two glycosylated abscisic acid derivate in avocado seed [31] could ameliorate the symptoms of type 2 diabetes, targeting peroxisome proliferator-activated receptor gamma in a similar manner as the thiazolidinediones class anti-diabetic drugs [41].

4. Conclusion

Tamarind and avocado have known as fruits of therapeutic importance. This is attributed to the presence of bioactive compounds that responsible for many pharmacological activities. Therefore, Tamarind and avocado can play an important role in the preparation of a wide range of pharmacology and therapeutic applications.

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