



NUTRITIONAL AND PHARMCEUTICAL BENIFITS OF AVOCADO PLANT

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ABSTRACT

Persea Americana Mill. or Avocado is a tropical native American fruit. It belongs to the *Lauraceae* family. The name 'Avocado' has been derived from the Aztec word 'ahucatl'. 'Alligator pear' and 'butter fruit' are its' alternative names. It has been traditionally cultivated for food and medicinal purposes due to its high nutrition content as well as for its therapeutic properties. The predominant carotenoid in Avocado is Lutein. α -carotene, β -carotene, zeaxanthin, neoxanthin and violaxanthin are the other carotenoids present in small quantities in it. Avocado plant and their seed, fruit, pulp, avocado oil part use for various type of activity as cosmetic, refined cooking oil, weight management program, heart disease, stroke and cancer.

Keywords: *Persea americana*, Avocado, amrican fruit, nutritional value

1. INTRODUCTION

The earliest archaeological evidence of this fruit dates back to 8th century BC, where its seeds were found buried with a mummy, in Peru. Since then it has been used for the treatment of scabies, dander and ergotism by Mexican folk and Saint Antonius, respectively, in ethno medicine. It was also used by women in the form of an ointment and also for treating skin eruptions. During the mid-1800's, the cultivation of *Persea Americana* spread across Asia. The genus *Persea* constitutes of 150 species, out of which 70 are grown in the warmer regions of North of Central and South America. Its other entire species are cultivated in east and Southeast Asia [1-4]. The predominant carotenoid in Avocado is Lutein. α -carotene, β -carotene, zeaxanthin, neoxanthin and violaxanthin are the other carotenoids present in small quantities in it. Tocopherols have also been identified in its acetone extracts [5, 6]. It has been reported that these lipophilic carotenoids may have potential anti-carcinogenic effects [4]. A compound, persin, isolated from Avocado leaves has been used to carry out the induction of apoptosis in human breast cancer cells [7]. The hepatoprotective capacity of Avocado fruit due its flavonoid and phenolic content has been reported [8]. The growth of prostrate cells lines *in vitro*, was inhibited by Avocado extract which contained tocopherols and carotenoids [9]. Addition of Avocado to salads and salsa increases carotenoid absorption by the body [10].

The most common commercial variety is the Hass Avocado [11]. The nutrients and phytochemicals present in one-half of Avocado (68g), according to the NHANES analysis is a given in Table 1 [12,13].

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2. BOTANICAL DESCRIPTION

The genus *Persea* avocado belongs to member of laurel family (*Lauraceae*). It is related to cinnamon tree, camphor & sassafras. Avocado cultivated in US consider representing single species *Persea Americana* study show it

derived from two species. *P. americana* Mill. & *P. Gracissima*, Gaerth. All of varieties classified horticulturally as belonging to West Indian & Guatemalan races are of this species. It is common avocado of tropical American lowlands. *P. drymifolia*, Cham & Schlecht. (*P. Americana* var. *Drymifolia* Mez). This includes small avocado of Mexican highland, now grown in California, Chile & in southern France, Italy & Algeria.

Kindom	:	Plantae
Unranked	:	Angiosperm
Unranked	:	Magnoliids
Order	:	Laurales
Family	:	Lauraceae
Genus	:	Persea
Species	:	<i>P. americana</i>
Synonym	:	<i>Lauruspersea</i> L.

Leaf : leaf blade are multiform shape, lanceolate, elliptic, lanceolate elliptic, oblong elliptic, oval, ovate & obovate. Base acute or truncate. Length of blade range between 3-4 inches. Botanically a large berry that contains a single seed. On shallow soil they may not reach more than 30 feet in height while on deep moist clay loams they reach 60 feet.

The two species from which cultivated avocado derived closely alike in many respects:

1. By smell of crushed leaf
2. *P. Drymifolia* possesses aromatic odor that of anise or saffron which *P. Americana* lack
3. Flower of *P. drymifolia* typically more pubescent & under leaf surface more glaucous than *P. americana*
4. Fruit also distinct having a thin almost membranous skin in former species & thick leathery or brittle skin in latter
5. *P. drymifolia* smaller leaves than *P. Americana* [14, 15].

There are three known varieties or horticultural races of avocado and these are the Mexican, Guatemalan and the West Indian Types. The Mexican types thrive in Mediterranean climate and are native to dry subtropical plateaus. The Guatemalan types are native to cool, high altitude tropics while the West Indian variety thrives in humid, tropical climates [16]. There are now many hybrids resulting from cross-breeding of these three varieties and also from the selection of certain favorable attributes. The three varieties can be differentiated from each other using various attributes as provided in Table 1.

Table 1: Different Varieties of Avocado with their properties

Main Attribute	Specific Attribute	Properties by Varieties		
		Mexican	Guatemala	West Indian
Oil	Scent	Nice	None	None
	Size	Small	Various	Various
Leaf	Skin	Thin	Warty	Leathery
	Size	Big	Small	Big
Seed	Cavity	Loose	Tight	Loose
	Cold	Yes	No	No
Tolerance	Salt	No	No	No
	Oil content	High	Medium	Low
Fruits	Maturity (Month)	6	9	6

3. AVOCADO PLANT IN COSMETICS

The avocado has various uses as a natural cosmetic, with advantages in rapid skin penetration, and as a superior natural sunscreen. Avocado oil has several culinary and health benefits. The greater use of whole fruit has important advantages: usefulness in human weight control, high nutritional density, source of major antioxidants, stroke prevention, fruit protein source, fiber source; as baby food, and other dietary benefits.

Increasing recognition of unhealthy consequences from additives, preservatives, processing, and artificial products generally gives the avocado a major advantage as

a food and also as a cosmetic. With increasing concern for the environment, an added plus for avocado cosmetics is that they are biodegradable. Consumers are beginning to favor basic, natural ingredients. Swisher (1988) discusses use of the avocado as a skin moisturizer, cleansing cream, makeup base, sunscreen, lipstick, bath oil, and hair conditioner. Toxicological tests of avocado oil products have provided an official health/safety assessment. In skin care, the two major advantages of the avocado are its marked softening and soothing nature and its notable absorption.

3.1. Avocado Oil

Avocado oil is predominantly monounsaturated, a property which is thought to confer distinct health benefits. The avocado as a refined cooking oil has additional advantages [17].

1. It is unusually light, so it mixes well with other foods.
2. It has a mild, delicate flavor, which enhances and brings out the flavor of other foods, instead of dominating them such as olive oil and other oils.
3. Avocado oil withstands a high cooking temperature before breaking down, i.e., its "smoke point" is about 255C (490F), which is much higher.

Fried foods presently have an undesirable health reputation, but use of avocado oil could change that.

3.2. Whole fruit pulp

This is by far the most important human use of the avocado and will constitute the remainder of this article. We will look at several nutritional qualities which sometimes overlap. Avocado can be a helpful part of a successful weight-management program. It brings several advantages.

1. Its monounsaturated fat speeds up the basal metabolic rate, as compared with saturated fat.
2. Its high fat content gives a quicker feeling of satiation ("fullness"), thus helping to reduce overeating.
3. Its high fat content makes an overall sound diet more palatable, reducing the temptation to binge on foods high in sugars or saturated fats.

Its rich supply of vitamins and minerals also makes the diet more wholesome and satisfying and thus more conducive to overall health and to moderation in consumption.

3.3. Avocado plant as Nutraceuticals

Avocado's role in weight control is its "rich supply of minerals and vitamins". More important than a food's calorie content is its total nutritional contribution to human needs. A good measure is nutrients per calorie. Different avocado analyses have given somewhat variable results. The most detailed publication is that of Slater *et al.* (1973) [18]. Their data indicate that one half of a 'Hass' avocado, about 80 g edible fruit, provides a substantial percentage of the daily nutritional needs of a child aged 7 to 10 (adult percentages are generally a little lower, especially iron for females) (Table 2).

The avocado contains little vitamin B 12 and calcium, limited zinc and modest phosphorus. Its half-a-fruit quota of riboflavin and thiamine for children is about 9.5 and 8%, respectively, hence about equal to its relative calorie

contribution. But the striking thing is that no less than eight essential nutrients are apparently present in about a 2:1 calorie ratio. All three additional nutrients, potassium, copper and pantothenic acid, are also estimated to be present in avocado at about twice the calorie content. Per calorie, the avocado is indeed remarkably nutritious.

Table 2: Percentage of daily nutritional need of a 7-10 year child supplied by half an avocado

Nutrient	% supplied
Calories	7
Vitamin A	18
Vitamin C	17
Vitamin E	13
Folacin	16
Niacin	13
Vitamin B6	15
Iron	15
Magnesium	20

Vitamin B6 (pyridoxine) is important for the nervous system, red blood cells, teeth and gums. Most of the Americans consume too little of vitamin B6, among good sources they list watermelon and banana (overlooking avocado). Polansky and Murphy (1966) [19] compared the 86 content per unit weight of 26 vegetables and fruits. For total chromatographed 86' banana and avocado had the highest amounts, the remaining 24 vegetables had from 1/5 to 1/25 of the amount of the avocado, with watermelon 1/6. A more recent report by William Sears, M.D., privately printed Nature's Guide to First Foods"(1988) [20] reports that avocado has three times as much B6 per g as banana.

Protein

Cultivars vary somewhat but the dominant 'Hass' is about 2.4% protein on a fresh weight basis [18]. This is unusually high for a fruit. The avocado is a "complete food" in terms of protein, containing all 9 essential amino acids, although not in the ideal proportions.

Fiber

Literature reveals that "fiber has emerged as a leading dietary component in chronic disease prevention [21]. High fiber intake lowers the risk for cardiovascular disease, some cancers, hypertension (high blood pressure), diabetes, and obesity. For some disorders, a mixture of both soluble and insoluble fiber appears to be

most beneficial. Another compared the fiber content the avocado had large amounts of both soluble and insoluble fiber (it had, respectively, 2.1 % and 2.7% by fresh weight).

The avocado is a mild-bland, oil-rich, nutrient-rich deliciously-flavored food. This combination gives it an exceptionally diverse range of dietary advantages. Just in terms of usage alone, the avocado can be served as an hors d'oeuvre, soup, salad, dip, sandwich spread, garnish, half-shell spoon-out, entree, dessert, or beverage with various kinds of use in each category. Such eating versatility makes it easy to increase consumption in order to gain greater benefit from its numerous advantages to the human diet. Our analyses (unpublished) indicate that the linolenic oil content of the 'Hass' avocado averages just over 21 %, only the content of the mono unsaturated fat oleic acid was higher.

3.4. Avocado plant as Anti-Ageing agent

The University of California at Berkeley *Wellness Letter* for October, 1991 [22], discusses the basic role of oxygen for human cellular energy and for life, but notes that an inevitable by-product of this activity is the formation of highly reactive "free radicals." These unstable troublemakers can affect various cell constituents: perhaps artery walls or LDL cholesterol advancing coronary heart disease; eye lens tissue causing cataracts; a critical gene leading to cancer; perhaps arthritis; or DNA (the genetic material) causing gradual deterioration and aging. The human body has two main defences against these free radicals: enzymes and other blood compounds that depend on trace minerals and good general nutrition and three potent antioxidants vitamins C, E, and beta carotene (vitamin A precursor). An article in the June, 1991, issue of the *American Journal of Clinical Nutrition* indicates that only about 57% of non-smokers may be getting enough vitamin C daily (for smokers the deficit is much greater). *All above* concluded that most of us are not getting enough vitamin E. A number of nutritionists have called for greater consumption of beta carotene [23].

As we have discussed, the avocado provides about twice as high a proportion of our daily needs for the above three antioxidant vitamins as its calorie proportion. Recall also that the avocado is rich in copper and iron, two mineral constituents of antioxidant enzymes. Nutritionists usually recommend that we get our needs met from basic food rather than from supplements. And while the risk of colon cancer, for example, has been

associated with fat consumption, the *Harvard Health Letter* for March, 1991, reported that while meat indeed increased that risk sharply, there was no association with plant fat. Thus, eating avocados could be an enjoyable way to help protect ourselves against cancer, heart disease, arthritis, and eye cataracts; it may even delay the processes of aging.

3.5. Avocado plant in Stroke prevention

Heart disease, cancer and stroke are the three leading causes of death in the United States. Dr. Tobi is quoted as suggesting that bachelors may die earlier than married men because they have fewer balanced diets, specifically insufficient in potassium. *Prevention* magazine for August, 1987, reported the results of a 12 year study of stroke entitled "*Potassium was the key.*", conducted jointly by the Schools of Medicine of the University of California San Diego and Cambridge University in England. A 40% reduction in stroke risk was associated with an average daily increase in potassium consumption of about 400 mg, the amount supplied by less than half an avocado! Moreover, blood pressure, a stroke factor, was linked in the same article to potassium-sodium imbalance, namely to a sodium excess. The avocado has about 52 times as much potassium as sodium.

Finally, avocado chief foods that are very high in monounsaturated fats, while being comparatively low in both polyunsaturated and saturated fats. An Italian epidemiological survey of 4,903 people found that while both monounsaturated and polyunsaturated fat were associated with lower blood cholesterol as compared with saturated, only monounsaturated fat was also associated with lower blood pressure [23].

3.6. Diabetes

A report shows a 4-week comparison of individuals on the traditional type II diabetic's diet of low fat-high carbohydrate with those on a diet lower in carbohydrates and higher in monounsaturated fat (the dominant kind in avocados). The monounsaturated diet offered better control of blood sugar levels, accompanied by lower triglycerides and higher HDL ("good" cholesterol). However, this needs confirmation, including more careful monitoring. Moreover, there is a report that avocado has an odd sugar type that depresses insulin production. Diabetics probably should consume avocados cautiously [24, 25].

3.7. Avocado plant as Baby food

Dr. William Sears notes that avocado is "one of the first fresh fruits a baby can enjoy." It is a time-saver, served raw. "Low in sodium and cholesterol-free, avocados contain [many] valuable nutrients". For example, "Ounce for ounce, avocados contain more potassium than 45 other fruits, juices or vegetables... and they are one of the only fruits or vegetables which contain monounsaturated fats, essential for baby's development." In an interview with the *California Grower*, Dr. Sears stated, "When you think about it ...avocados are an ideal first food for infants. Avocados have a delicate flavor and a smooth, creamy consistency which makes them a perfect food for babies. Avocados provide infants with more vitamin B1, B2, niacin, folacin, potassium and magnesium per 15 gram serving than any of the other frequently recommended fruits and vegetables [and are second to the highest in several other vitamins and minerals.]" [20].

Seventy years earlier, long before these dietary details were understood, Pasadena nurseryman D. W. Coolidge addressed the annual meeting of what was then the California Avocado Association: "The fruit of the avocado is about the most tasteful and nourishing that grows out of the ground The strongest people physically and mentally, the happiest and most beautiful children, will

be those who make the avocado, instead of meat, their daily diet. I have often marvelled how babies and very young children take [26, 27].

4. PHARMACOLOGICAL ACTIVITIES OF AVOCADO PLANT AND ITS PARTS

Use of Avocado in traditional herbal medicine can be attributed to its pharmacological activity [28]. The summary of the Pharmacological activities is described in Table no. 3.

4.1. Analgesic effect

It has been reported that administration of 1600 mg/kg an aqueous leaf extract of Avocado was able to reduce the writhing in mice induced by administration of acetic acid, by 57%. It could also increase the threshold of pain by 87.2% upon administration of 800mg/kg as noted by the hot plate test and inhibit both phases of formalin induced pain in a dose-dependent manner. These results were similar to those obtained after administration of drugs like acetylsalicylic acid and morphine for the mouse writhing assay and hot plate test respectively. The results along with the inhibition of formalin induced pain indicated the analgesic effect of the extract on mice.

Table 3: Pharmacological Activities of Avocado plant and its parts

Plant Part	Disease		Reference
Leaf	Anti Inflammatory	Aqueous Extract	29
	Analgesic	Aqueous Extract	29
	Anti convulsant	Aqueous Extract	30
	Anti Diabetic	Hydroalcoholic extract	31,32
	Hypercholesterolemia	Aqueous Extract	33
	Vaso relaxant	Aqueous Extract	34
	Anti-ulcer activity	Aqueous Extract	35
Seed	reduces the very-low density lipids	Oil	36
	Anti-Diarrheal	chloroform-methanolic extracts	37
	Osteoarthritis.	Avocado oils with unsaponified soyabeens	38-42
Fruit	Anti-Fungal	(E,Z,Z)-1-Acetoxy-2-hydroxy-4-oxo-heneicosa-5,12,15-triene	43,44
	Wound Healing	Fruit Extract	43
Pulp	Inhibit Platelet Aggregation and Prevents Thrombus Formation	Bioactive Compounds	44
Oil	Type 1 Diabetes	Oral Administration	45
	Liver Regenerant	As dietary supplement	46

4.2. Anti-inflammatory activity

Anti-inflammatory activity of the extract was observed upon its use in mice with Carrageenan induced edema, as it resulted in reduction of swelling. Moreover, no toxicity symptoms in mice were found even after administration of 10g/kg of extract [27].

4.3. Anticonvulsant Activity

Avocado was found to possess anticonvulsant Activity as it antagonized seizures induced in mice by administration of the drugs, viz. pentylentetrazole (PTZ) and picrotoxin (PCT). The anti-convulsant property of the extract can be attributed to its ability to enhance the neurotransmission and/or action of GABA in the brain [30].

4.4. Anti-Diabetic Activity

The anti-diabetic activity of hydroalcoholic extract of Avocado leaves on streptozotocin-induced diabetic rats has been reported. Upon administration of the extract, reduction in blood glucose levels (hypoglycemia) has been observed. In addition, treatment of rats with the extract of *Persea Americana* resulted in an increase in the phospho-PKB expression in the soleus muscle. The activation of this enzyme leads to the translocation of the GLUT-2 molecule from the cytoplasm to the cell membrane in the uptake of glucose [31, 32].

4.5. Hypercholesterolemia

It has also been found that administration of aqueous leaf extracts to rats with hypercholesterolemia caused a decrease in the levels of plasma glucose, total cholesterol and LDL and a significant increase in the HDL levels [33].

4.6. Vasorelaxant properties

The vasorelaxant properties of aqueous leaf extract of Avocado on isolated rat aorta has been investigated. A significant vasorelaxation in aorta has been observed due the synthesis of endothelium derived relaxing factors (EDRF's) and the release of prostanoid. The treatment of the aorta with the extract also reduces vasoconstriction, the probable reason for it being the inhibition of Ca²⁺ influx through calcium channels [34].

4.7. Anti-ulcer activity

Aqueous leaf extract of Avocado consisting of alkaloids, flavonoids, saponins and tannins produced significant dose-dependent anti-ulcer activity when administered orally to sick rats (rats pre-treated with ulcerogenic drugs- indomethacin and ethanol [35].

4.8. Anti-platelet and Anti-thrombic activity:

Avocado has acetogenin compounds which are responsible for anti-platelet and anti-thrombic activity. Platelet aggregation and thrombus formation occur during ischemic diseases.

4.9. Lowers LDL

Avocado oil also reduces the very-low density lipids (VLDL), low density lipids (LDL) levels without affecting the high density lipids (HDL) levels in sick mice [36].

4.10. Anti-diarrheal property

The anti-diarrheal property of bioactive compounds present in Avocado seeds has been reported. Administration of chloroform-methanolic extracts of these seeds to castor oil induced diarrheal rats caused significant reduction in wetness of feces in a dose-dependent manner. Also, the LD50 values of the extracts were found to be lower than 5000mg/kg body weight of the rats. This attested the safety of the extracts with only a remote chance of acute toxicity [37].

4.11. Osteoarthritis

A mixture of unsaponifiables of soyabean and Avocado oils, which constitute a 4rug known as piacledine, has been used to effectively treat osteoarthritis. The drug enhanced the synthesis of collagen and proteoglycan and decreased the synthesis of fibronectin. The drug also the inhibited the release and activity of metalloproteinases and pro-inflammatory cytokines which play a major role in the development of osteoarthritis. Within two years of drug administration, reduction in pain and analgesic drug demands in patients was found. Also, radiological evaluation of patients revealed delayed joint destruction. Other studies have also confirmed the beneficial effects of Avocado unsaponifiables in the treatment of osteoarthritis [38-42].

4.12. Anti-Fungal Property

A compound- (E,Z,Z)-1-Acetoxy-2-hydroxy-4-oxoheneicosa-5,12,15-triene has been isolated from Avocado fruit. This compound was found to exhibit anti-fungal property against the fungal pathogen *Colletotrichum gloeosporioides* by inhibiting spore germination. Seed extracts of Avocado have also shown to be toxic towards other fungal pathogens like *Candida* sp, *Cryptococcus neoformans*. Another study has shown that a topical cream consisting of mixture of Avocado oil, tea tree oil, emu oil and jojoba oil inhibited the growth of the canine skin pathogens - *Staphylococcus pseudintermedius* and *Malasseziapachy dermatis* and could be used as an

alternative for the commonly used antibiotic and anti-fungal agents [43, 44].

4.13. Wound Healing Properties

The wound healing properties of the Avocado fruit extract has been confirmed. The topical or oral administration of the fruit extract in wounded rats resulted in the complete epithelialization of the wound. Other parameters like rate of wound contraction and hydroxyproline content of tissues along healing with histological observations also indicated the wound healing property of *Persea Americana* [43].

4.14. Platelet Aggregation

Avocado pulp contains bioactive compounds which inhibit platelet aggregation and prevents thrombus formation. Thus a diet supplemented with Avocado pulp can be beneficial for patients suffering with ischemic diseases. The anti-platelet and anti-thrombic activity of Avocado has been confirmed [44].

4.15. Type 1 Diabetes

Administration of Avocado oil attenuates the alteration in electron transfer in rat kidney mitochondria caused by type 1 diabetes [45].

4.16. Antioxidants

Antioxidants in the Avocado oil reduce the formation of ROS in the damaged mitochondria. The beneficial effects of Avocado oil as a dietary supplement, over control of metabolic illnesses, based on the evidence that the oil positively affected hepatic markers in sucrose fed rats (which had altered hepatic markers) has been reported. It also results in liver regeneration [46].

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