

## A Review on *Persea Americana* Mill. (Avocado) - Its Fruit and Oil

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**Abstract:** Avocado, also known as the 'Alligator pear' is a tropical fruit that has originated from America. The analysis of the fruit constituents reveals that it abounds in various fatty acids, vitamins, carotenoids and other phytochemicals. It is hence a very nutritious food. Avocado oil, extracted from the fruit pulp and seeds also retains most of the nutrients present in the fruit and can be used as an alternate dietary supplement. The extraction and composition of Avocado oil has been discussed.

Avocado and its oil possess several salutary properties and hence they have been traditionally used for the treatment of various ailments and disorders. This review highlights and focuses on the important pharmacological activities of this therapeutically important fruit and its oil.

**Key words:** *Persea americana* Mill., Avocado, Nutritive food, dietary supplement.

### Introduction

*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 earliest archeological evidence of this fruit dates back to 8<sup>th</sup> 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 ethnomedicine. 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. Today, it cultivated and harvested worldwide. The genus *Persea* constitutes of 150 species, out of which 70 are grown in the warmer regions of North of Central and South America. All its other species are cultivated in east and southeast Asia<sup>1,2,3,4</sup>. This review highlights the importance of the Avocado fruit and its oil. Their composition, extraction and pharmacological activities have been discussed.

### Composition of Avocado

The Avocado contains a significant amount of oil in comparison to other fruits<sup>5</sup>. Besides this, a lot of secondary metabolites have also been isolated from different parts of the Avocado plant. The predominant carotenoid in Avocado is Lutein.  $\alpha$ -carotene,  $\beta$ -carotene, zeaxanthin, neoxanthin and violaxanthin are the other carotenoids present in small quantities in it. Tocopherols have also been identified in its acetone extracts<sup>6,7</sup>. It has been reported that these lipophilic carotenoids may have potential anti-carcinogenic effects<sup>4</sup>.

A compound, persin, isolated from Avocado leaves has been used to carry out the induction of apoptosis in human breast cancer cells<sup>8</sup>. The hepatoprotective capacity of Avocado fruit due its flavonoid and phenolic content has been reported<sup>9</sup>. The growth of prostrate cells lines *in vitro*, was inhibited by Avocado extract which contained tocopherols and carotenoids<sup>10</sup>. Dietary supplementation of Avocado has also proven to be very useful. This is not only due to the nutritious aspect of the fruit but also due to its ability to enhance

absorption of nutrients from other foods. This hypothesis has been confirmed by a study which shows that the addition of Avocado to salads and salsa increases carotenoid absorption by the body<sup>11</sup>.

There are many varieties of Avocado. The most common commercial variety is the Hass Avocado<sup>[12]</sup>. The nutrients and phytochemicals present in one-half of Avocado (68g), according to the NHANES analysis is given in Table 1<sup>13,14</sup>.

**Table 1 Nutrients of Hass Avocado**<sup>13,14</sup>

| S.No. | Analyte                          | Quantity (g)      | S.No. | Analyte           | Quantity (g) |
|-------|----------------------------------|-------------------|-------|-------------------|--------------|
| 1.    | Total sugar                      | 0.2               | 11.   | Vitamin B-6       | 0.2 mg       |
| 2.    | High-monounsaturated fatty acids | 6.7 g or 114 kcal | 12.   | Niacin            | 1.3 mg       |
| 3.    | Sodium                           | 5.5 mg            | 13.   | Pantothenic acid  | 1.0 Mg       |
| 4.    | Potassium                        | 345 mg            | 14.   | Riboflavin        | 0.1 mg       |
| 5.    | Magnesium                        | 19.5 mg           | 15.   | Choline           | 10 mg        |
| 6.    | Vitamin A                        | 43 µg             | 16.   | Lutein/Zeaxanthin | 85 µg        |
| 7.    | Vitamin C                        | 6.0 mg            | 17.   | Phytosterols      | 57 mg        |
| 8.    | Vitamin E                        | 1.3 mg            | 18.   | Dietary fiber     | 4.6 g        |
| 9.    | Vitamin K1                       | 14 µg             |       |                   |              |
| 10.   | Folate                           | 60 mg             |       |                   |              |

### Extraction of Avocado Oil

Mechanical press or solvent extraction are the methods of choice by which vegetable oils are generally extracted from fruits, seeds, kernels and nuts<sup>15</sup>. Extraction of Avocado oil has been carried out using solvents like chloroform and petroleum ether<sup>15,16</sup>. The results of a study comparing the yield and quality of the oils extracted using three extraction methods revealed that highest percentage and best quality was extracted by the microwave drying method when compared to those extracted using two solvents, *viz.*, hexane and acetone<sup>17</sup>. Further, pressing Avocado pulp, dried under microwave is a promising alternative for its oil processing since the oil produced has a high oxidative stability and low acidity. This is suitable for human consumption<sup>18</sup>.

### Composition of Avocado Oil

This oil is rich in monounsaturated fatty acids with oleic acid content being the highest. The fatty acid distribution in the Avocado oil is listed in Table 2<sup>15</sup>.

**Table 2. Fatty acid composition of Avocado oil**

| Fatty acid       | Quantity (%) |
|------------------|--------------|
| Palmitic acid    | 28.21        |
| Palmitoleic acid | 5.69         |
| Stearic acid     | 0.69         |
| Oleic acid       | 50.95        |
| Linoleic acid    | 13.87        |
| Linolenic acid   | 0.58         |

The presence of other fatty acids such as lignoceric acid, arachidic acid, margaric acid, behenic acid, gadolenic acid, docosadienoic, myristic and eicosanoic acids in small amounts has been found in analyses of the oil<sup>19-21</sup>. The oil fortunately retains most of the phytochemicals and carotenoids present in the fruit. It also contains  $\beta$ -sitosterol, lecithin, minerals and vitamins. The oil has also been used for the treatment of skin wounds, stretch marks and psoriasis. It also possess hepatoprotective activity<sup>22-28</sup>.

## Pharmacological Activities of Avocado and its Oil

Use of Avocado in traditional herbal medicine can be attributed to its pharmacological activity <sup>4</sup>.

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. Anti-inflammatory activity of the extract was observed upon its 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<sup>29</sup>. The aqueous leaf extract of Avocado was found to possess anti-convulsant activity as it antagonized seizures induced in mice by administration of the drugs, viz., pentylenetetrazole (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<sup>30</sup>. 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<sup>31,32</sup>. 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<sup>33</sup>. 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<sup>34</sup>. 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 LD<sub>50</sub> 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<sup>35</sup>.

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 Ca<sup>2+</sup> influx through calcium channels<sup>36</sup>.

A mixture of unsaponifiables of soyabean and Avocado oils, which constitute a drug known as piascledine, 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 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<sup>37</sup>. Other studies have also confirmed the beneficial effects of Avocado unsaponifiables in the treatment of osteoarthritis<sup>5,37-42</sup>.

A compound- (E,Z,Z)-1-Acetoxy-2-hydroxy-4-oxo-heneicosa-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<sup>43</sup>. Seed extracts of Avocado have also shown to be toxic towards other fungal pathogens like *Candida* sp, *Cryptococcus neoformans*<sup>[44]</sup>. 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 *Malassezia pachydermatis* and could be used as an alternative for the commonly used antibiotic and anti-fungal agents<sup>[45]</sup>. 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*<sup>46</sup>.

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<sup>47</sup>). Avocado has acetogenin compounds which are responsible for

anti-platelet and anti-thrombic activity. Platelet aggregation and thrombus formation occur during ischemic diseases. 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<sup>48</sup>. Administration of Avocado oil attenuates the alteration in electron transfer in rat kidney mitochondria caused by type 1 diabetes. Antioxidants in the Avocado oil reduce the formation of ROS in the damaged mitochondria<sup>49</sup>. 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<sup>50</sup>.

## Conclusion

Avocado has long since been recognized as a fruit of therapeutic importance. Through the years, advancement in technology has enabled scientists to analyze the components present in the Avocado fruit. Analysis has revealed the high nutritional aspects of this tropical fruit. Fortunately, much of these nutrients are retained in the oil that may be used as an alternative for the fruit. Avocado oil has many beneficial effects on human health and forms an essential part of the human diet. Avocado and its oil play primary roles in the pharmaceutical industry as they are used as dietary supplements for humans. The oil also has applications in cosmetics in the form of topical creams to treat medical conditions.

The therapeutic use of Avocado and its oil can be attributed to the presence of a diverse array of bioactive compounds. Bioactive compounds are responsible for various pharmacological activities exhibited by the butter fruit and its oil. Therefore Avocado may play a significant role in many in the preparation of therapeutically and pharmacologically important products in the future.

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