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Review Article

Introduction, Origin, History and Sustainability Perspective of Avocado as a Prosperous Crop: A Review

Sana Asghar[1], Mudassar Naseer[2], Samina Khalid[3], Bushra Zulfiqar[4], Hafiz Wasif Javaad[5], Muhammad Abdul Salaam Khan[6], Nafeesa Muslim[7], Muhammad Asad Saleem[2], Kiran Yousaf[8]

[1] *Hill Fruit Research Station, Sunny Bank Murree, Pakistan.*
[2] *Horticultural Research Station, Sahiwal, Pakistan.*
[3] *Department of Plant Protection, Pest warning and Quality Control of Pesticide Punjab Pakistan.*
[4] *Citrus Research Institute Sargodha, Pakistan.*
[5] *Horticultural Research Station Soon valley Khushab, Pakistan.*
[6] *Directorate of Floriculture T & R, Punjab, Lahore Pakistan.*
[7] *Soil and Water Testing Lab Sahiwal, Pakistan.*
[8] *Soil and Water Testing Laboratory Okara, Pakistan.*

ABSTRACT

Avocado owing to its great nutritional and medical benefits fetch higher price making it one of most economical important fruits. Avocado immense importance arouses the need of its evaluation to check its adaptability under different climatic conditions. The value addition of avocado fruit is necessary to keep it available for longer time period. Avocado Oil, Avocado Tea, Avocado Pickle, Avocado Marmalade and Avocado Jam is highly nutritious products and it importance as Vitamin E Powerhouse in addition to rich source of major essential vitamins and minerals make it an everyday choice for health conscious people. The growing of Avocado has huge potential in uplifting the rural economy, rural area agriculture based employment and reducing the poverty rate of growers. On the other hand, overall Avocado industry is highly criticized because of deforestation, massive water utilization, polluting the water bodies with insecticides and fertilizers, posing a threat to other plant species, and environmental pollution. Despite that huge benefits associated with avocado growing compensate for these losses. The review gives a glimpse of sustainability perspectives of growing avocado.

Keywords: Sustainability, Avocado, Origin, Value Addition, History, Sustainability Perspective

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Correspondence
Sana Asghar
horticulturist238@gmail.com

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INTRODUCTION

Tropical fruits are most cherished nutrient rich commodity owing to their health benefits and delicious taste (FAO, 2021-22: FAO 2022-23). The three most popular tropical fruits include Avocado, Mango and Pineapple. Among these avocado accounts for 50 % of World Trade owing to its high nutritional content, health benefits and a delicate flavor attributed to this fruit. The statistics of 2021 showed an 11 percent increase in avocado exports that is approximately 2.5 million tons. These statistics has contributed to motivate farmers to invest in increasing the production acreage of this fruit. Avocado is dicotyledonous fruit belonging to Lauraceae family (Marais, 2004, Elhadi, 2012). Avocado has received attention from customers owing to its taste, nutritional importance and increased number of unsaturated fats which are beneficial for health of heart and have few calories.

The edible flesh is around 80 % of avocado, composed of 72 percent water, 6.8 % fiber and compounds such as β-carotene, β-sitosterol and tocopherols etc which make it prominent among other fruit plants (Hausch et al., 2021).
Avocado commonly referred as alligator pear has also some local names like makhan phal (In Pakistan) or magas nashpaati. The fruit is climacteric in nature having green skin with large seed firmly embedded in the flesh. The plant is frost sensitive though mature trees can tolerate temperature as low as -4^{o}C for short period however prolonged frost may result in reduced yield causing economic losses. The young plants need frost protection in early three years of plantation. During flowering months i-e April to July night temperature of 5-10° C results in suppression of shoot growth and boost flowering (Anonymous, 2010). Avocado is termed as “Green Gold” and widely cherished owing to its commercial value.

Origin and History

Avocados originated in southern Mexico and Central America region, and local peoples have included this fruit for their diets from over 5000 years. The documentary record shows that avocado first described in book in Mexico in 1554 and first time sold in market in Mexican city Tenochtitlan (Lieu et al., 2024). Another literature shows that the past traces of Avocado were found as old as 10,000 years ago in Mexico (Galindo et al., 2007; Ayala and Ledesma, 2014) Avocados were cultivated from the Rio Grande to central Peru long before the arrival of Europeans. They were then carried to nearly all parts of the tropical and subtropical regions. It was first brought to Singapore between 1830 and 1840 and introduced into Florida in 1833 and into California in 1871 (Anonymous, 2023). It reached India in 1892 and Pakistan in 1955. Avocado is considered as ‘Green Gold’ and has a great value because of its commercial importance (Anonymous, 2021)
Currently avocados are commercially grown not only in the United States but throughout tropical America and the larger islands of the Caribbean. The tree of avocado is evergreen all over the year. Its height reaches about 40-80 feet from the ground and has a lot of long branches. The shape of leaves is round oval and ovate and about length in 3-10 inches. Avocado dates back to as old as 10,000 years, produced from tropical trees characterized by blackish-green colour with great nutritional value, buttery texture, and exceptional taste (Birnbaum et al., 2003; Cervantes-Paz and Yahia,2021).
Avocado can be grown in any type of soil however well drained loamy soil is best for cultivation of avocado. Moreover temperature range of 25-30 ^{o}C is ideal for avocado cultivation. In the initial years it needs protection from frost and hot weather. (Afzal et al., 2024)

Inflorescence

The size of the avocado flower is small and greenish. Flowers have both male and female parts. According to the Bergh (1974) opening and closing of flowers follows a regular pattern when the average night minimum and day maximum temperature is above 21°C. With fluctuation in minimum and maximum temperature flower opening is delayed. Irrigation scheduling is also a prerequisite for successful avocado cultivation. Water stress may result in delayed avocado flowering (Rodríguez, 2023).
Avocado produce millions of flowers during its flowering period but like citrus most of them drop without producing any fruit. Avocado flowers are bisexual in nature means each flower consists of both male and female flowers. It showed the phenomenon of protogynous dichogamy which means there is a twice opening of each bisexual flower with intermediate closing (stern et al., 2021). The opening of flowers is very interesting phenomenon first time it opens as female (receptive stigmas) and next day as male (anthers dehiscence). About 1 % flowers succeed in setting fruits (Alcaraz et al., 2013, Alcarez and Hormaza, 2019).

Fruit characteristics

The shape of avocado fruit may be round, ovate or pear-shaped and the skin of the fruit is different in color and appearance in all verities. The skin may have more flexibility, smooth to scratchy and yellow-green, purplish-red or black in appearance. The flesh color of the avocado fruit is yellow-greenish to bright-yellowish and it is oily in texture when ripped but the inner surface will be fibrous. Avocado fruit contains one large seed i.e. ovate or oval-shaped and it makes the weight of fruit about 10 to 25 percent of the total weight. The amount of oil and moisture content are different in all varieties of the avocado and about a maximum of 30 percent of oil is present in one fruit. Average ranges weighted from 450 g to 1.3 kg (Afzal et al., 2022).
Research showed that for best quality avocado fruit production and for better economic returns proper care and orchard management system is of prime importance. The major environmental factors influencing the fruit production include water stress, temperature, photosphere and amount of salt. Avocado is referred as berry fruit. From week 20-60 fruit growth in avocado is continuous and depends on cultivar, cultural practices and environmental conditions. (Afzal et al., 2022).

Composition, Nutritional and Medicinal Importance

Avocado has attracted consumers owing to its nutritional composition, taste and high degree of unsaturated fatty acids beneficial for improving heart health. The edible portion comprise of almost 80 percent of avocado primarily containing 72 % water, 6.8 percent fiber and compounds such as β-carotene, β-sitosterol and tocopherols (Figure 1) which makes it prominent as compared to other fruits (Anonymous, 2019). The antioxidants and vitamins present in avocado fruit oil may be helpful in curing and preventing dry skin i-e eczema and psoriasis. Keep in mind that while applying oil to skin first test at patch of skin to ensure it does not cause irritation issues (Afzal et al., 2022).

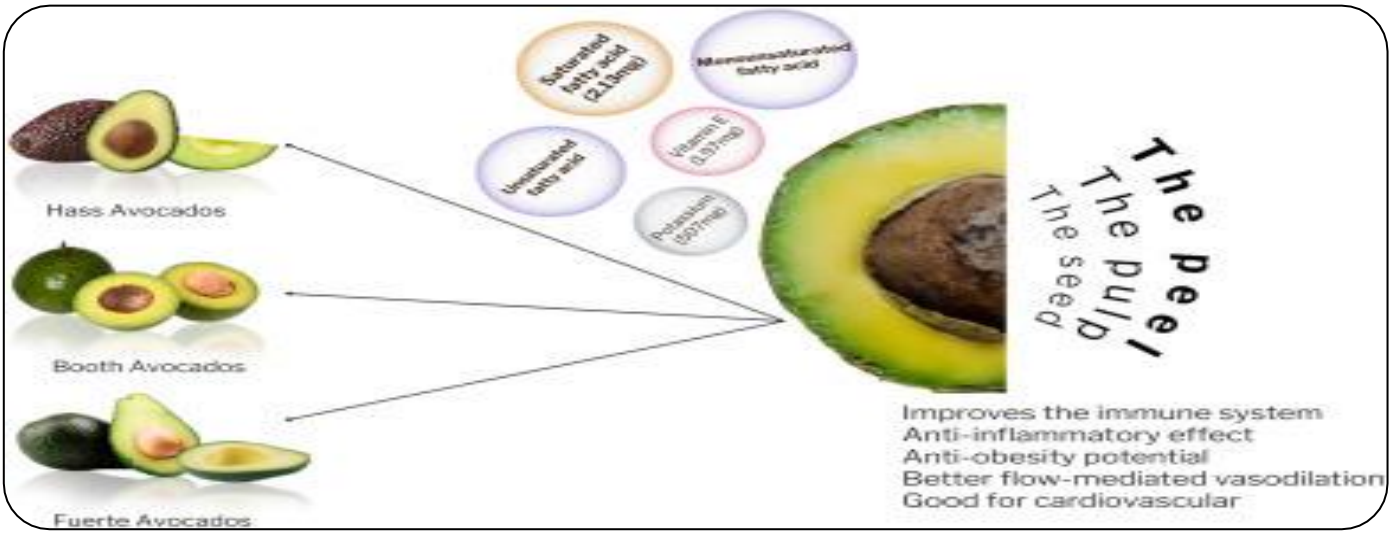

Figure 1. Characteristics of avocado (Adopted from Lieu et al., 2024).

Avocado oil is highly nutritious owing to presence fair amounts of triglycerides and unsaturated Fatty acids (Park et al., 2018: Machado et al., 2023). The consumption of avocado is helpful in improving the immune system and also protect from oxidative damage caused due to cellular metabolism. Oleic and Palmitic acid from avocado have been discovered to cause and anti-inflamatory effect on microphages (Raw 264.7) reducing TNF-α and IL-6 secretion in invite culture of intestine cell model. Moreover the palmitic and oleic acid from avocado oil fortified cheese has a potential of anti-obesity as found in invitro co-culture of intestine cell model (Machado et al., 2023). Wang et al. (2015) suggested that consumption of one avocado per day has beneficial effect on cardio –metabolic risk factors through non-HDL cholesterol lowering effect.

Consumer demand for the fruit is largely due to the health benefits associated with avocados, which have high amounts of monounsaturated fatty acids and antioxidants. Avocados provide thiamin, riboflavin, and vitamin A, and in some varieties the flesh contains as much as 25 percent unsaturated oil (Duarte et al., 2016). Avocados are not only helpful in antioxidants absorption from other foods, but they are also high in antioxidants (Gunnars, 2021; obah et al., 2016).

Ripening, Harvest and Post-Harvest Care

The unique characteristics of avocado as compared to other fruits are that it only ripens after harvest and the ripening process accelerates after harvest owing to vigorous respiration (Berry et al., 2015; Lieu et al., 2024).

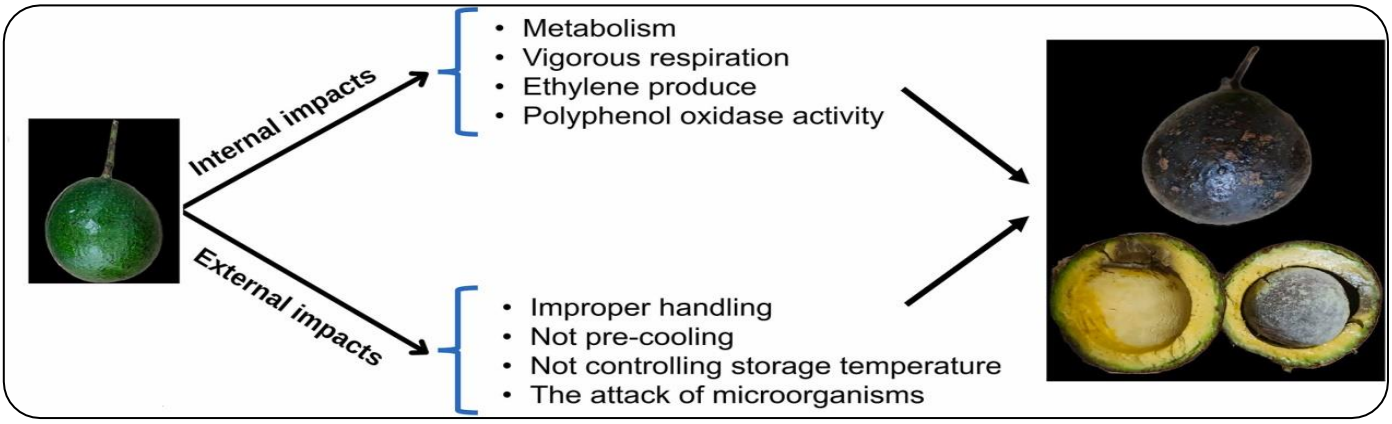

Figure 2. Adverse impacts on avocado (adopted from Lieu et al., 2024)

The biochemical changes like ethylene production, accelerated respiration rates and changes in physical characteristics determine the ripeness in avocado (Defilippi et al., 2018). Moreover the presence of unsaturated fatty may also cause quick decay (Anonymous, 2019) however the physiological nature of avocado in causing spoilage is only a minor part. The major loss occurs due to fungi and microorganisms (Figure 2) who took advantage of nutritional characteristics for proliferation and increasing the decay rate (Perez et al., 2021, Lopez et al., 2022).

Avocado being climacteric fruit and one of the fastest ripening fruit continue to respire after harvest and its start ripening process immediately after leaving the tree (Berry et al., 2015). Fruit is harvested upon horticulture maturity and not allowed to ripe on tree. After harvesting fruits are washed, graded, waxed and packed in 4-6 kg cartons. According to Timberlake (2021) Cool and dark conditions are best for storing avocado and ideal temperature is around 20 °C (68 ^{o}F). The quantitative and qualitative perishability of commodities such as avocado pose challenging conditions for supply chain management. This deterioration warrants the cold chain management complex resulting in more emphasis driven toward regulation and controlling storage condition at optimal level (Aiello et al., 2011).

Post-harvest operations must be focused on the extended range of fruit storage by slowing down the process of senescence and also control the ripening of fruit when it is harvested at a mature stage or in the unripe stage. All the harvesting, handling, and transportation to the packing houses and all other operations are needed to be done carefully i.e. no chance of mechanical loss. Damages or injuries can accelerate the ripening of fruit and can affect negatively the appearance of fruit peeling cause browning and blemishes after and before storage. Commonly, avocados are very sensitive to spoiling during softening (Arpaia et al. 1988, Afzal et al., 2022), and then they should be transported carefully for displaying in the markets.

Avocado value addition

The global activities to fight the hunger aim at increase in fruit production through reduction in food wastage worldwide (Dora et al., 2019). The major concern for sustainable development and addressing environmental concerns drive the researchers focus on developing value added products from by-products of fruit processing industry. However the most organic wastes that are generated from processing industries are either underutilized or discarded (Vandyk et al., 2013, Khan et al., 2015).

An avocado seed comprised of different extracts which can be utilized for various applications. Starch (Figure 3), lipid, oil, protein, antioxidants, crude fibre, minerals and vitamins are included in most known extracts that can be extracted from avocado seed (Tesfaye et al., 2022). Avocado is nutrient rich fruit and is cherished for substantial level of compounds like Vitamin E, ascorbic acid, soluble phenols, carotenoids and great health benefits (Saavedra et al., 2013, Fernandez et al., 2018).Valorization of this waste material can be done by extraction of vital components like starch, phytochemicals, protein which has various industrial applications (Tesfaye et al., 2017).

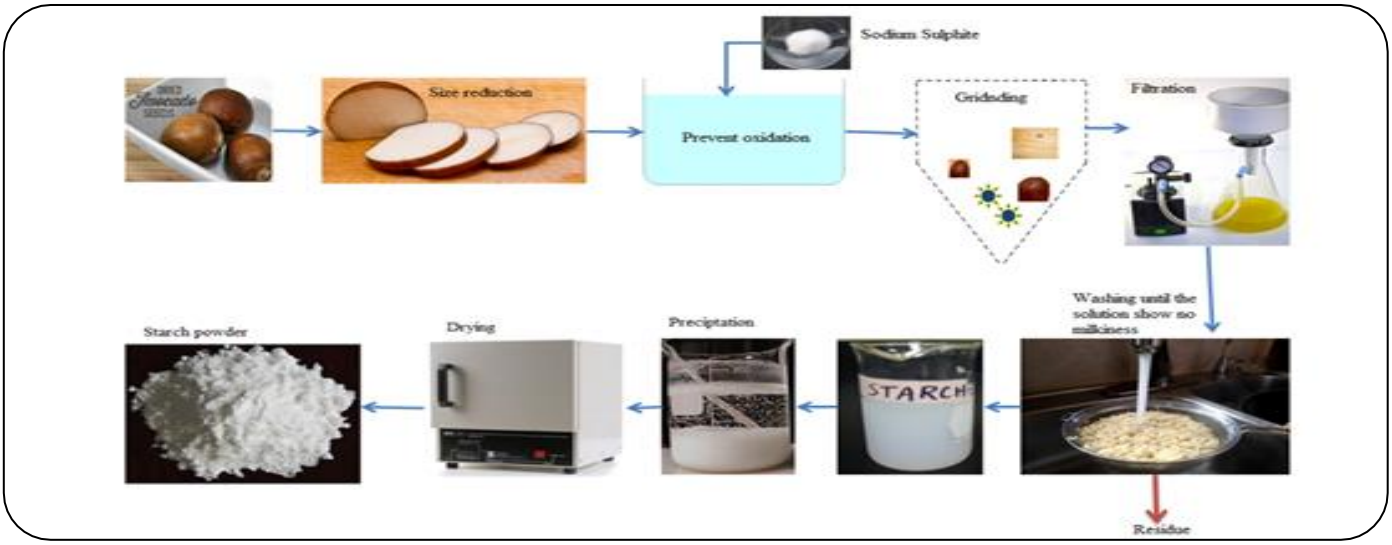

Figure 3. Schematic illustration of a process flow for the starch extraction from waste avocado seeds (Tesfaye et al., 2022).

Avocado oil is highly nutritious owing to its composition of triglycerides and unsaturated fatty acids (Park et al., 2018, Machado et al., 2023). Avocado is widely included nowadays in various dietary patterns (Marra et al., 2024). In Pakistan avocado was first cultivated at Hill Fruit Research Substation Tret in 1955. Thereafter various trials were

conducted and now Hill Fruit Research Station Sunny Bank is serving premier research station working on avocado fruit (Afzal et al., 2024)

Avocado Global Market Scenario and Future prospects

There is a rising trend in avocado consumption worldwide owing to its favorable effects on vision, digestion and heart health. The rising demand has also influenced the production which has increased on global scale. Mexico is the leading producer with 224, 422 million acres production area and over 2.3 million tonnes fruit production (Figure 4). In terms of form of consumption there was 78.2 % revenue share in fresh form which was termed as highest. The increasing demand of raw fruit has resulted in use of innovative technologies from international producers in the manufacturing processing.

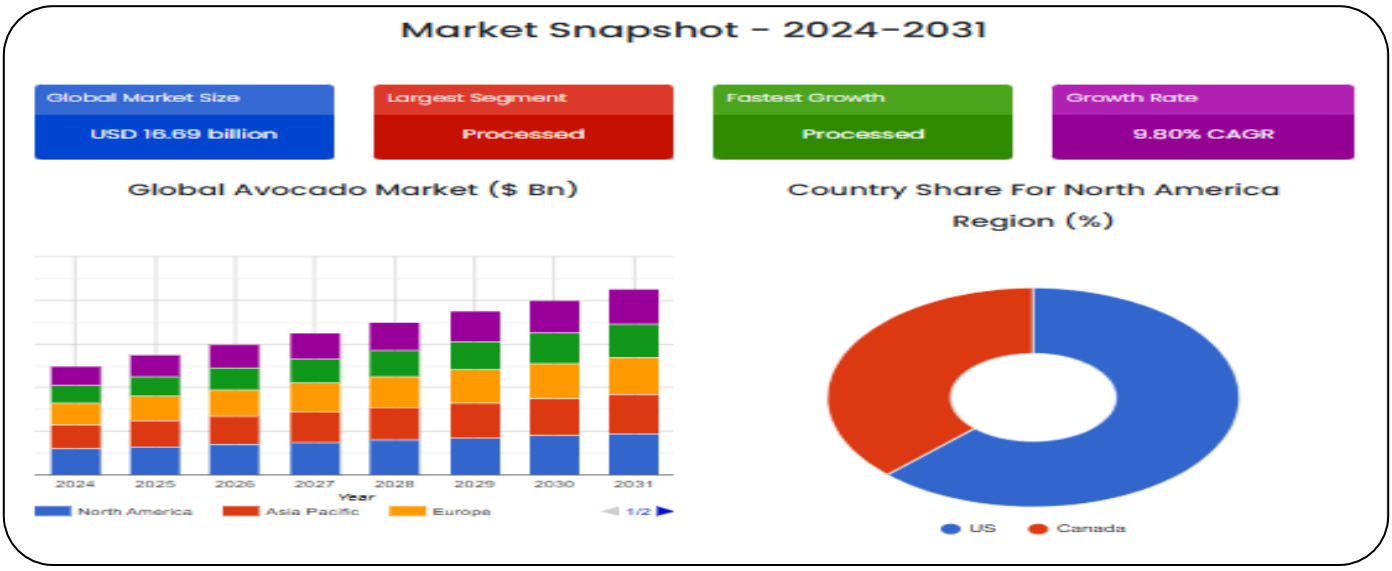

Figure 4. Market Snapshot- 2024-2031 (Adopted from Anonymous (2024).

The rising popularity is due to customer's preference for fresh avocado. The high fiber content of avocado in fresh form prevents constipation, promotes efficient gastrointestinal function, minimizing colon cancer risks and aid in digestion process (Anonymous, 2024).The price variation of avocado is linked with labor, pesticides, fertilizer etc. USA is leading the avocado production. The value of avocado market was 11020 million dollars in 2020 and expected to grow to 13860 million dollars by the year 2027 (Afzal et al., 2022).

CONCLUSION

The purpose of evaluating the quality characteristics of Avocado is to create awareness regarding the worth of this economically important high value fruit crop in the area. Avocado being the rich source of cholesterol free fat from plant origin and its other attributes make it one of the most demanding fruit. The origin, climate and plant nutrition are the factors determining the avocado growth and quality. The value addition of Avocado is necessary to keep it for longer time period. Avocado Oil and Jam is highly nutritious product and it is also regarded as Vitamin E Powerhouse in addition to source of major vitamins and minerals. There is a dire need to produce Avocado on the large scale and it may be helpful in increasing export potential of the country.

AUTHOR CONTRIBUTIONS

All authors of this research paper have directly participated in the planning, execution, or analysis of this study;

COMPETING OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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