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Economic Significance of Avocado Pear in Nigeria

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Abstract
Avocado, commonly referred to as the African pear is a well-known plant in West Africa. It has contributed immensely to the volume of local and communal trade during season. The plant has export potential and it is contributing positively to economics of countries such as Mexico, South Africa and Kenya through the export of its fruits. In 2015, Peru exported avocado fruits totalling US$282.75 to the Dutch market, Spain, UK, Chile and Costa-Rica. Although adequately available in Nigeria, this plant species is not yet well developed. However, in view of its industrial utilisation potential, it has become important that avocado pear be sustainably developed for industrial use. Avocado contains 30% oil and the lipid content varies from 5 – 25% depending on cultivar. The plant contains myristic acid level of about 0.1%, palmitic acid which varies from 7 – 12% and stearic acid of about 1 – 1.7%. The unsaturated fatty acid include palmitoleic acid, 5.5 to 11%; oleic acids, 52 – 81% and unsaponifiables 1.6 to 2.4%. The amino acid contents of the pulp are glutamic acid, 12.3%; aspartic acid, 22.6% and alanine 6%. Industrially, the oil can be used for hair cream, facial lotion and soap production. It is of great importance in the cosmetic industry in view of its photosterol content. It also has an array of vitamins, most especially, vitamins A, B and C which are useful against skin wrinkling. The fruit can also be used in the production of snacks.
Keywords: Vitamins, Photosterol, Guacamole, Oil, Senescence

1.0 Introduction

The Nigerian economy has transversed a variety of circumstances. From the dependence on the export of agricultural commodities in the 1960's, the country transmitted to a major crude oil exporter in the 70's and beyond. The high price commanded by oil and ease of availability of petro-dollars turned farming into a lack lustre activity and led to the neglect of the agricultural sector (Aribisala, 1993). However, crude oil prices are currently being affected by events that are disrupting the flow of oil to market, including geopolitical developments. These events have created uncertainty about the future of supply or demand, leading to volatility in prices (RMRDC, 2016). Between 2013 and 2016, the price of crude oil decreased significantly from $105.87 per barrel to $38.18 per barrel causing distortions in economies of countries such as Nigeria that rely solely on crude oil export for foreign exchange earnings (Statistic, 2016).

The agricultural sector remained stagnant during the oil boom decade of the 1970's and this accounted largely for the declining share of its contributions. According to NBS (2016), the trend in the share of agriculture in the Gross Domestic Product (GDP) shows a substantial variation and long term decline from 60% in the early 1960's through 48.8% in the 1970's and 22.2% in the 1980's. Unstable and other inappropriate economic policies, the neglect of the sector and negative impact of oil boom were responsible for the decline in its contributions (NBS, 2016).

In response to the distortions, the government of Nigeria had been planning to resuscitate activities in the agricultural sector. Emphases are being placed on the diversification of agriculture in order to boost its contributions to domestic production, employment and foreign exchange earnings. Recent government plans is to boost agricultural production through improve funding to enhance productivity, market linkages, and access to e-extension technology. The programmes aimed at accommodating well-known agricultural commodities such as cocoa, rice, maize, etc. with little or no emphasis on underutilised industrial plant species such as avocado which are fast contributing to the economic development of several countries despite the national endowment in avocado availability and its wide distribution in the country.

Avocado commonly referred to as the African Pear (*Dacryodes edulis*) is a well-known plant in West Africa. The fruits are edible, and the bark, leaves, stem and roots are used for local medicine against diseases (Neuwinger, 2000; Ji rovetz *et al.* 2003; Annabelle *et al.* 2004). In Nigeria the fruits are gathered for household use or for sale in local markets. Despite its increasing popularity as one of the most nutritious plants in the fruits family due to the rich presence of essential vitamins A, B and E in the fruits and are high demand in Europe, the plant species has remained largely underdeveloped in the country. As a matter of fact, the nation has continued to witness reduction on its non-timber forest products availability and utilisation. According to World Wildlife Foundation, the rate of deforestation in Nigeria has been put at 350,000 ha per annum (NEST, 1991). This has left in its wake the loss of endemic forest resources in different ecological zones as a result of destructive land use patterns and conversion of forest lands to other uses. The Federal Environmental Protection Agency reported that a total of 5,981 higher plants were identified in Nigeria. Out of these, 0.14% are threatened and 0.22% are endangered. Between 1980 – 1992, a total of 43 – 48% of the nation's forest ecosystem are lost through human activities and natural ecological disasters such as erosion, flooding and desertification (FAO, 2000).

From available statistics, the development of avocado in Nigeria for industrial utilization and for export has the capacity of generating about 5 billion naira on annual basis. The industrial use of avocado can lead to reduction of pressure on conventional raw materials such as groundnut, beniseed and other oil seeds used for vegetable oil production. It also has capacity for enhancing the development of pharmaceutical and cosmetic industries in the country. This paper examines the availability and industrial utilisation potential of avocado in Nigeria. Its contributory role to foreign exchange generation is also examined.

2.0 Global Trends of Avocado Production and Export

Intensive cultivation of avocados for commercial purposes began in California and Florida and later in Israel, South Africa and Chile. Although a range of avocado cultivars are grown, Hass is the world's most widely-grown and exported cultivar. Avocado fruit has shown good commercial perspectives and planted areas show a tendency to increase globally. World production of avocado increased by 4.3% (over 760,000 tonnes) between 1988 and 1998. The major producers of avocado are Mexico (34%), USA (8%), Dominican Republic (7%), Indonesia (6%), Brazil (4%), Israel (4%), Chile (2.4%), Spain (3%) and South Africa (2%). The countries together contributed to 70% of the world production in 1997.

Avocado world trade increased greatly from 57,576 tonnes in 1980 to 238,306 tonnes in 1997. In 1997, the main players in the export market were Israel, Mexico, South Africa, USA and Chile while the main importers of the fruit were in Europe. These include Belgium, France, The Netherlands, Sweden, Switzerland, the United Kingdom, Germany, Spain, and in America; the USA and Canada. In Asia, Japan has emerged as a strong market since 1995.

In New Zealand, avocados are mainly cultivated in the North Island, specifically, in the Bay of Plenty and Northland areas. The New Zealand avocado industry is based on the Hass cultivar. Avocado trees in New Zealand continued to be widely planted and with the entrance of new growers. Also, in Spain, avocado fruit is extensively cultivated on slopes and terraces at heights between 50 and 500m above the sea level. In 2014 approximately 9,000 ha of land were cultivated. About 60% of Spanish avocado are usually exported to the European market (Insider, 2014). Likewise, the decline of the sugarcane and pineapple industries in Hawaii resulted in an increased shift toward diversified agriculture (Chan-Halbrenat, 2007). Among the different tropical fruits, avocado make up to 27% of Hawaii market in fruits (Chan-Halbrenat, 2007). Avocado production increased from 500,000 pounds in 1995 to 800,000 pounds in 2005. There was also an increase in commercial value of the crop from $273,000 in 1995 to $600,000 in 2005. Despite this, local avocados currently contribute only 30% toward meeting this total demand, and their share of the market is also showing a decreasing trend compared to imports which was estimated at 2 million pounds in 2005 – 2006.

The United States of America is the world's second largest producer of avocado after Mexico. Since 1992, US produced approximately 8% of total world production. Total production in 1997 which amounted to 178,000 tonnes were produced in California, Florida and Hawaii. Todate, more than 30,000 ha of land are planted with avocado in the US. The value of the avocado industry in the US increased from $214 million in 1987 to $278 million in 1997 (NASS, 1998). Avocados constitute one of the 27 fruits sold in the United States. Avocado per capita consumption in the US grew to its maximum of 1.1kg in 1987. Avocados are sold fresh in the market and consumed fresh in salads, and especially in the preparation of guacamole.

The United States exports in 1997 totalled 5,819 tonnes accounting for 3% of total national production. One of the major reasons for this low export volume during the period were apparent low prices (on average of $1,300 per tonne), a strong American dollar and increasing domestic demand. The major export markets for US avocados are the European Union, most especially France and Netherlands and Japan and Canada (FAS, 1998b). A major feature of avocado production, sale and marketing showed that the United States, which being a large producer is also an imported of avocados, indicating a large internal demand. The main supply of avocado to America is Chile.

In 1996, avocados constitute 7.3% of the total Chilean orchard area, the fourth after table grapes, apples and pears (CIREN, 1996). The area of the land used in cultivating avocado in Chile grew from 8,000 ha in 1990 to 16,919 ha in 1999. This made Chile, the third most important avocado growing country in the world (after Mexico and USA) (Axxes, 1999). Chilean production is year round and mainly of the Hass cultivar which accounts for over 75% of the Chilean production. In 1997, Chile exported 30% of its total production to the US. Chile's avocado production has been increasing at the rate of 500 hectares per year. To absorb the large amounts produced, Chile is promoting internal consumption through intensive advertising.

In sub-Saharan Africa, Kenya is a promising avocado producer with an estimated annual production of 115,000 tonnes in 2005. Kenyan avocado subsector is experiencing new investments as the sector opens up (AFFP, 2016). Each year, more than 1,000 containers are shipped to Europe, Middle East, Russia and Asia (AFFP, 2016). Kenya has about 7,500 ha of land under the crop with 70% of total production coming from smallholder farmers. Among the incentives that assisted in the development of avocado farming in Kenya are increased interest and investment in the sector by the government, contract farming and replacement of old trees with improved varieties

(AFFP, 2016).

One major countries that benefited most in avocado export more recently is Peru. Peruvian total avocado exports totalled $282.75 million between January and November, 2015 (Fresh Plaza, 2016). The Dutch market top the ranking importers of Peruvian avocados by importing a total 105.85 million US dollars worth of the fruit. This was followed by US (78.25 million dollars), Spain (46.53 million dollars), the UK (29.8 million dollars), Chile (12.74 million dollars) and Costa Rica (12.18 million dollars) (Fresh Plaza, 2016).

3.0 Avocado Availability in Nigeria

3.1 Occurrence

The time and mode of introduction of avocado to Nigeria is uncertain. However, avocado was noticed in Nigeria as far back as early 1920's (RMRDC, 2012). Despite its long occurrence, little or no effort has been made to study the origin and the varieties that are locally available. Nevertheless, available information indicated that the natives of South America introduced the fruit as far as to Peru, and the Spanish continued its spread into their colonies in Chile, West Africa, Madeira and Canaries (Hamilton, 1987). From these places, avocado spread to all regions where the climate and soil suited it. In recent times, avocado varieties has spread from California in United States to Australia, New Zealand and South Africa (Hamilton and Evans, 1999).

Avocado is found in the forest, farmlands and homesteads in Nigeria. Apart from these, avocado is also grown to some extent in the Central part of the country (RMRDC, 2012).

3.2 Distribution

RMRDC (2012) indicated that avocado is predominantly available in the Southern and Central parts of Nigeria. The distribution in terms of abundance is closely related to vegetation conditions with the rainforest having the most abundant distribution. In terms of abundance, economic/marketing potential and current level of production and sustainability of supply, four levels of avocado availability was reported in Nigeria (Table 1). According to RMRDC (2012), avocado can be considered abundant in States where it constitutes more than 10% of the volume of non-wood forest species marketed and traded for economic benefits. It also show States where avocado constitutes 10% of natural vegetation and where it is grown in copious quantities in farms and backyard gardens.

It is however considered less abundant in States where avocado constitute about 6.0 to 9.9% of the natural vegetation. In these States, the planting of avocado is not extensive, although stands are found in gardens, farmlands and as part of road side plantings. In States where avocado constitute about 3.0 to 5.9% of the natural vegetation, RMRDC (2012), considered its availability as frequent. In these States, planting of avocado in backyard farms and gardens is not a very common activity, although, one comes across the plant once in a while in farmsteads and backyard gardens. It is considered rare in States where avocado constitute about 3% of the natural vegetation or where the plant species is virtually absent (Table 1).

Based on these categorisation, RMRDC (2012) considered avocado to be abundant in all the States in Eastern Nigeria and parts of South-South Zone. The plant is found in Imo, Abia, Anambra, Enugu, Ebonyi, Edo, Akwa-Ibom, Delta, and Cross River States. Although, marketed to a reasonable extent, avocado is less abundant in Lagos, Ogun, Ondo, Bayelsa, Taraba and Rivers States when compared with the States indicated above.

In most of the Central part, it constitutes about 3.0 to 5.9% of the natural vegetation. Although, the fruits are sold in the markets across the States within this zone, the period of time avocado is available is not only short, the quantity available cannot support major industrial enterprise. The States included in this category are Kwara, Kogi, Benue, Niger and Nasarawa States. It is also found to a less extent in Plateau and Kaduna States.

There are 12 States where avocado is rare. These are Borno, Bauchi, Gombe, Kano, Kaduna, Katsina, Kebbi, Sokoto, Jigawa, Yobe, Adamawa and Zamfara. From available statistics, sustainable development of avocado processing facilities can take place in all the South Eastern States and in Edo, Akwa-Ibom, Delta and Cross River States. These States can support intensive and profitable plantation establishment of avocado species for use as an industrial raw material in the country. Although, the situation in less endowed States that is, Lagos, Ogun, Ondo, Bayelsa and Rivers States is similar, there will be need for more intensive research on agronomic properties of the plant species for large scale plantation establishment in these States. In the States where avocado is abundantly available, processing activities may only support cottage and small scale processing activities to eliminate the problems of raw materials shortages and the need for long distance travels to obtain the raw material.

Table 1: Levels of Avocado Occurrence in Nigeria

S/N	AVAILABILITY LEVELS	STATES INVOLVED
1.	Abundant	Imo, Abia, Anambra, Enugu, Ebonyi, Edo, Akwa-Ibom, Delta, Cross Rive, Osun and Oyo
2.	Less abundant	Lagos, Ogun, Ondo, Taraba, Bayelsa and Rivers
3.	Frequent	Kwara, Kogi, Benue, Niger, Nasarawa, Plateau and Kaduna
4.	Rare	Borno, Bauchi, Gombe, Kano, Kaduna, Kebbi, Sokoto, Jigawa, Yobe, Adamawa and Zamfara.

4.0 Properties and Utilization Potential of Avocado Species

The major current pattern of avocado utilisation is for human consumption as food. Avocado industries are still relatively young. However, with increasing realisation of its beneficial chemical composition and nutritive values, avocado is gradually becoming a plant of high industrial value. It is currently used for oil production, as an anti-inflammatory agent, anti-aging, cell regenation and in nutritive food formulation in view of the vitamins A, B1, B2, B5, lecithin, squalene and fatty acids that are present in the avocado flesh. Some of the current efforts directed towards promoting the industrial utilisation of the mesocarp and other parts of the plant are subsequently discussed.

4.1 Properties of Avocado Species

The oil, food and medicinal properties of avocado have been subjects of intensive research in view of their economic and industrial potential (RMRDC, 2012; Miller, 2012; Chin and Yokohoma, 2013; Ikhuoria and Maliki, 2007; Onuegbu *et al.,* 2011). Avocado contains about 30% oil (Chia and Yokohoma, 2012; RMRDC, 2012). The increasing popularity of avocado as an alternative raw material for oil production is induced by its high digestibility coefficient, excellent keeping quality and availability of high values of palmitic, oleic and stearic acids as constituents of the oil. These made the oil, a very important raw material for the production of cosmetics such as soap, facial creams, hand lotions and allergic skin softening cream. The lipid content varies from 5 – 25% depending on cultivar (Mortion, 1987). The variations in the saturated and unsaturated fatty acids contents are shown in Table 2 and 3. The plant contains myristic acid level of 0.1%, palmitic acid which varies from 7 – 12% and stearic acid which ranged from 1 – 1.7%. The unsaturated fatty acids (Table 3) include palmitoleic acid 5.5 to 11%, oleic acids 52 – 81% and non-saponifiables 1.6 to 2.4%. The amino acid contents are also shown in Table 4. The major amino acid contents of the pulp are glutamic acid, 12.3%; Aspartic acid, 22.6%; and alanine, 6.0%. Research and development have shown avocado fruits as a dream fruit for human consumption in view of its heavy bearing, high rate of digestibility and high calorific values.

The nutritional component of Avocado fruit is presented in Table 5. The fruit consists essentially of 74.9% of water, 19.8% of fat and 11.3% ascorbic acid. The average fatty acid contents of the flesh and seeds are shown in Table 6. The palmitic acid content of the flesh is 12.3% while those of the seed is 20.2% (Table 6).

4.2 Industrial Potential of Avocado Species

The objectives of Vision 20:2020 seeks to place Nigeria among the largest 20 global economies by year 2020. The Vision is hung on three pillars, namely guaranteeing the productivity and wellbeing of Nigerians, optimising key sources of economic growth and fostering sustainable social development. One of the major raw materials that can be developed for sustainable industrial growth and for export is avocado. Among all fruits, only the olive (*Oleo europa*) and the oil palm fruit (*Elaeis guineensis*) can rival avocado oil in content (Lewis, 1979). The lipid content is high and confer high industrial utilisation potential on the plant.

4.2.1 Production of Oil for Industrial Use

The oil is used for hair dressing and is also employed in facial lotions and soap production. It is of great importance to the cosmetic industry as it contains sterol called photosterol which has high penetrating abilities. Avocado oil is easy to emulsify, its low surface tension produces smoothening creams and makes a superior cosmetic oil. The impressive list of vitamins found in avocado oil is of benefit to the cosmetic industry as vitamin A helps to prevent the dry skin and vitamin E (Tocopherol) and vitamin B are effective against skin wrinkling. Also avocado oil is usually categorised as vegetable oil (Oldrichs, 1995). Vegetables constitute the most important source of edible fats and oil (Kirk and Othmer, 1995). It produces one of the healthiest oils as it contains mostly unsaturated fatty acids (Horace, 1956). It is the filth in the list of the most desirable oils known as anti-cholesterol agents.

Traditionally, the commercial process for avocado oil extraction uses hard, mature whole fruit and involves drying, mechanical processing at high temperatures and oil extraction with an organic solvent. The most recent techniques however involves ripening, which allows softening of the fruit previous to mechanical processing and centrifuging the mixture to separate the oil from water and solids (Werman and Neeman, 1987). The ripening step is to allow softening of the lipid cell walls by natural senescence processes (Dolendo *et al*., 1966). The centrifugal method press the avocados to a pulp which is subjected to a curing process and heat before centrifugation which removes most of the solid materials due to differences in densities of the oil and water (Smith

and Lunt, 1981). Nowadays, the oil is usually extracted from the pulp using three major methods. These are the extraction method which uses the tube press, the rendering process and solvent extraction process (Swarts, 1976; Turatti, 1985). In the extraction process, the tubes are filled with avocado pulp under pressure. The oil is pressed through perforations with the inner tubes. In the rendering process, the avocado pulp is heated in avocado oil. The mesocarp evaporates and leave the oil and other plant materials. After settling, the oil can be decanted and the remaining slurry further subjected to hydraulic pressure. The solvent extraction as previous described uses solvents such as n-hexane and petroleum ether.

Akpabio *et al* (2011) reported the physical properties of avocado oils to be as follows: melting point (31 – 33^{o}C and 15 – 23^{o}C), setting point (32^{o}C and 44^{o}C), refractive index (1.4 and 1.4), and moisture content (1.2% and 0.1%), viscosity (532.8kg/m/s and 434.8kg/m/s) and density (0.9kg/m^3 and 0.9kg/m^3) respectively. Their chemical characteristics include lipid content (52.4% and 56.5%), saponification value (188.8mg KOH/g and 25.9mg KOH/g), free fatty acid value (5.4% and 2.4%), peroxide value (16mg/kg and 126.3mg/kg), and acid value (16.8mg KOH/g and 7.1mg KOH/g) respectively.

4.2.2 Production of Snacks

According to Pauker *et al* (1992), there has been great interest in processing the fruit of avocado for extended shelf life and marketability. Studies showed avocado to be very sensitive to heat and freezing. The fruit develops off-flavours (Bates, 1970) and discoloration (Golan, *et al*., 1977) even after the minimal thermal treatment needed to destroy microorganisms and deactivate enzymes (Cruess *et al*., 1951; Brown, 1972; Garcia *et al*., 1976). Compounds involved in off-flavour and bitterness vary in polarity between neutral lipids to phospholipids (Bates, 1970) and include l-acetoxy-2,4-dihydroxy-n-heptadeca-61-ene and 1,2,4-trihydroxy-n-heptadeca-16-ene (Ben-Et *et al*., 1973). Likewise, freezing is detrimental to texture and flavour of whole avocado. Although rapid freezing of avocado slices by lipid freon (Smith and Winter, 1970) or liquid nitrogen with proper pretreatment with ascorbic and malic acids (Hanson, 1976) were claimed to produce acceptable products, these procedures still await for large scale implementation.

Pauker *et al* (1992) observed that a frozen puree known as guacamole salad is a well-known avocado product of commercial relevance. This product can be stored for weeks, frozen at -18^{o}C (Hester and Stephens, 1970; Salomon *et al*., 1980; Scudamore-Smith, 1984; Stephens *et al*., 1957, 1958). Freeze-drying of guacamole salad and storage of the dry product under inert atmosphere of nitrogen did not apparently obliterate the need for refrigeration (Lime, 1969a, b; Gomez and Bates, 1970). Sorber (1947) recommended the use of avocado puree as a flavour base for ice cream.

In a study on the processing potential of avocado fruit, Pauker *et al* (1992) investigated the processing potential of three avocado cultivars namely; Ettinger, Hass and Fuerte at different stages of maturation. The composition of the avocado mesocarp was observed to vary with different cultivar and harvest seasons. The representative values of the nutrient composition of the avocadoes used were as follows: dry mater 19.18 to 30.29%, fat 8.3 to 16.75%, protein 2.1 to 2.3%, carbohydrates 6.8 to 8.1%, mineral ash 0.7 to 1.2%, with the higher values belonging to fruits harvested towards the end of the season. The items produced and procedures were as follows:

4.2.2.1 Frozen Avocado Salad Base

The avocado paste was prepared on an industrial scale. The processing procedure comprised of washing, cutting, stone removal, pulping, formulation, and mixing. Immediately after preparation, one kg paste was dispersed into polyethylene bags. Excessive air was removed and the bags were promptly sealed and frozen at -18^{o}C. Occasionally, some recipes were repeated in the laboratory from 2 – 5kg fruit using a bench top mixer. Periodic chemical analyses and organoleptic evaluations of the product were made at intervals during 40 weeks of frozen storage. The primary aim of the study was to define the characteristics of a frozen avocado salad base prepared by blending fresh fruit with acidulants, stabilizers, salt and flavours. Several composition parameters of the frozen salad base were periodically monitored during a 40 week storage period. The results showed the fatty acid composition to vary with type of cultivars, stage of ripening, anatomical region of the fruit and geographical growth location. The typical composition of the fatty acids was found unchanged after 40 weeks storage. Also there was no oxidation products during storage as judged by free fatty acid, peroxide value and TEA tests. No indication of rancidity were detected in the organoleptic tests. This observed stability in lipid fraction was suggested to be due to high content of natural antioxidants and tocoperherols in avocado (Biale and Young, 1971) while polyphenol oxidases (PPO) are among the enzymes most destructive to quality of avocado products (Khan, 1975). The study showed the extent of browning to be primarily a function of fruit variety. The adjustment of the pH value of Ca 4.5 gave an acceptance flavour and reduced spoilage while pH below 4.5 overwhelms the typical avocado flavour of the spread and increased the acceptability of the product indicating that acceptable safe food can be manufactured. The test indicated that an avocado mixture can be prepared on industrial scale with excellent characteristics that would be preserved even after 9 months in frozen state.

4.2.2.2 Fermented Dairy-Avocado Products

Also, Pauker *et al* (1992) in a study in which yogurt was supplemented with avocado in view of its healthy nutritional components, made a yogurt-like product with avocado. The product was made from fresh avocado

paste, milk, and dairy starter culture was made. The homogeneity of the product was improved by addition of a stabilizer (such as gelatin 0.2 – 0.4%). Two freeze-dried bacterial starter culture preparations were separately tested: a mesophilic culture consisting of a *Streptococcus cremoris*, and a mixed thermophilic culture consisting of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. Time of fermentation averaged 4 hours. The rate of developing acidity was monitored and it was found unaffected by the presence of avocado in the mixture.

Table 2: Saturated Fatty Acids

S/N	Saturated Fatty Acids	% Content
1.	Mysristic level	0.1%
2.	Palmitic	7 – 12%
3.	Stearic	1 – 1.7%

Table 3: Unsaturated Fatty Acids

S/N	Unsaturated Fatty Acids	% of Total Content
1.	Palmitoleic acid	5.5 to 11.0%
2.	Oleic acid	52 – 81%
3.	Linoleic acid	9 – 14%
4.	Non-Saponifiable	1.6 to 2.4%
5.	Iodine value	94.4

Table 4: Amino Acids of the Pulp

S/N	Amino Acids	% of Total Composition
1.	Arginine	3.4
2.	Cystine	0
3.	Histidine	1.8
4.	Isoleucine	3.4
5.	Leucine	5.5
6.	Lysine	4.3
7.	Methionine	2.1
8.	Phenylalanine	3.5
9.	Tryptophan	0.0
10.	Tyrosine	2.3
11.	Valine	4.6
12.	Aspartic acid	22.6
13.	Glutamic acid	12.3
14.	Alanine	6.0
15.	Glycine	4.0
16.	Proline	3.9
17.	Serine	4.1

*All values depicts % of the total.

4.3 Medicinal Application

The leaves, seed and bark of avocado trees are also employed for treatment of various diseases as shown in Table 8. This provide opportunities for the extraction of active ingredients in these parts for drug formulation.

Table 5: Average Nutritional Composition (on a fresh weight basis) of the Edible Part of Avocado Fruit

Component	Value (100g Flesh)	Method
Water (%)	74.9	Air oven (FAO, 1981)
Fat (%)	19.8	Soxhlet Extraction (AOAC, 1980)
Protein (%)	1.9	Kjeldhal
Fibre (%)	1.7	Tricholoroacetic acid
Ash (%)	1.2	(TDRI, 1984)
Sugars (%)		
Glucose	0.2	Differential
Fructose	0.1	
Sucrose	0.1	
Starch (%)	0.1	
Energy (Kj 100g 1)	914	
Vitamins (mg%)		
Ascorbic acid	11.3	DCPIP
Thiamin	+	Alkaline oxidiation (AOAC, 1980)
Riboflavin	++	Chromatography
Pamtothenic	++	Chromatography
Nicotinic acid	+++	Cynigen bromide colour reaction (AOAC, 1980) Chromatography
Vitamin B6	++	
Folic acid	+	“
Biotin	+	“
Carotenoids (mg%)	0.18	“
Minerals (mg%)		
Potassium	46.7	FES
Sodium	2.0	“
Phosphorus	28.3	AAS
Calcium	22.3	“
Magnesium	22.3	“
Iron	0.6	“
Zinc	0.5	“

Source: RMRDC (2010)

Table 6: Average Fatty Acid Composition (as a % of Total FAS)

Fatty Acids	Values Flesh	Seed
Saturated		
Myristic (C14.0)	0.06	0.8
Palmitic C16.0)	12.3	20.2
Stearic (C16.0)	0.42	0.6
Arahidic (C20.0)	0.19	0.21
Monounsaturated		
Palmitoliec (C16:1)	5.0	3.65
Oleic (C18:1)	70.4	27.7
Polyunsaturated		
Linolenic (C18:2)	10.7	39.2
Linoleeic (C18:3)	0.72	6.8
Arachidonic (C20:0)	0.22	0.8
Total saturated f. a (SFA)	12.96	21.8
Total unsaturated f. a (UFA)	87.04	78.2
UFA/SFA	6.72	3.58

Source: RMRDC (2010)

Table 7: Food Value per 100g of Edible Portion (Flesh) of Avocado

S/N	Amino Acids	% of Total Composition
1.	Moisture	65.7 – 87.7g
2.	Ether extract	5.13 – 19.80g
3.	Fibre	1.0 – 2.10g
4.	Nitrogen	0.130 – 0.382g
5.	Ash	0.46 – 1.68
6.	Calcium	3.6 – 20.4mg
7.	Phosphorus	20.7 – 64.1mg
8.	Iron	0.38 – 1.28mg
9.	Carotene	0.025 – 0.0475mg
10.	Thiamine	0.033 – 0.117mg
11.	Riboflavin	0.065 – 0.176mg
12.	Niacin	0.999 – 2.220mg
13.	Ascorbic acid	4.5 – 21.3mg

Table 8: Medicinal Values of Plant

Plant Organ (Part)	Uses
Flesh	For anaemia, hypertension, antioxidant properties, beneficial aspects of dietary fibre e.g. against duodenal ulcer, verticuloses, diabetes, lowers blood cholesterol etc., skin diseases e.g. eczema, irritations, pregnancy stretch marks, dandruff, hair loss, rheumatic, muscular aches, etc.
Leaves	Rich in tannins, used as infusion for digestive/carminative, headaches, etc.
Seeds	Mashed, used as poultices, for abscesses decoction for dysentery diarrhoea.

4.4 Conclusion

Avocado pear is a very important fruit in Nigeria. Presently, marketing of avocado fruit constitutes more than a significant volume of economic activities in rural areas where it is produced during season. It is important to state that opportunities exist for commercial production of avocado for export. Also the processing of avocado into oil and other products, could provide a significant source of foreign exchange earnings in Nigeria. However, for this to be feasible, necessary institutional considerations and arrangements must be made. These should provide the necessary framework for the production, products development, processing and marketing of avocado and its products in the country.

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