



Full Length Research Paper

## Nutritional efficacy of avocado seeds

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Screening of the aqueous extract of Tanzanian avocado seed of *Persea* specie was done for nutrients and phytochemical compounds of nutritional importance. The aim of the study was to test for the presence of nutrients (carbohydrate, protein and vitamin C) and other phytochemical compounds of nutritional and medicinal values in avocado seeds. Both dry and fresh avocado seeds were tested for presence of saponnin, flavonoids, tannin, carbohydrates, proteins and vitamin C. Tannins and flavonoids were indicated only in fresh avocado seeds but none in dry samples. Saponins were found in both dry and fresh seeds. Proteins, carbohydrates and Vitamin C were indicated in both fresh and dry seeds. The compounds are reported to be present in the edible part of avocado in different proportions. Interestingly, Tannin, a widely distributed compound in most unripe fruits, with the main role in protection of the fruit from predation, and perhaps as pesticides, was tested only in fresh seeds. Tannin is a water soluble compound and hence making the fresh and unripe fruits well protected against pests as well as predators. Furthermore, it was noted that the avocado seed is nutritionally valuable based on the phytochemical and nutrients it constitutes. Tannins that are said to be poisonous are normally present in fresh seeds and not in the dry seeds, hence recommended to dry the seeds before processing for consumption.

**Key words:** Avocado seed, carbohydrates, efficacy, flavonoids, nutrition, proteins, phytochemical compounds, saponnins, tannins and Vitamin C

### INTRODUCTION

Avocados in tropical region and Tanzania in particular are abundantly available despite the fact that they are highly underutilized. The low popularity of the fruit amongst consumers results in a lot of fruits going to waste every time it is in season. The avocado fruit is rich in nutrients, high in protein and vitamins. Studies have shown that avocados are rich in macro nutrients like carbohydrate, vitamin and proteins (Whitney & Rolfes, 2005). Tanzanian avocado fruits vary from round to pear-shaped with a long, slender neck, but

sometimes completely round shapes, and the color ranges from green to dark purple. Avocados are one of the great cancer fighting foods, rich in a multiplicity of nutrients, including many potent anti-oxidants and phytochemicals as well as vitamins, minerals, fiber and monounsaturated healthy fats (Chen *et al.*, 2008, Ensinger, 1994., Kushi, *et al.*, 2006). Dry avocado seeds are used locally as a relief drink, in treating diarrhea or dysentery, teeth aches as well as skin diseases.

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Consumption of avocado fruits in Tanzania communities is very wide. This is due to the availability of avocado fruits in Tanzania. A good number of people eat avocado due to its taste, documented medicinal and nutritional values and its cheap availability in the region. Apparently, the commonly consumed part of avocado remains to be the edible part i.e. the soft part, the layer between the skin and the seed. The seed part of the fruit is commonly not consumed due to its poor taste, little information on its medicinal/nutritional value and also difficult processing to taste. Therefore, different people never prefer the avocado seeds mainly because they are not informed of the nutrients and phytochemicals compositions in the seed part.

The study aimed to establish the baseline on the nutrients and phytochemical composition in the seed part and hence recommend on the best exploitation of the avocado seeds. The main objective of the study is therefore to test for the presence of nutrients (carbohydrate, protein, and vitamin C) and other chemicals of nutritional and medicinal values in fresh and dry avocado seeds.

## MATERIALS AND METHODS

### Study Area

The study was conducted in Dar es Salaam in which avocados were bought from Kariakoo market and the samples were analyzed at Dar es Salaam Institute of Technology (DIT) Laboratory. Samples of avocado seeds both fresh and dry were tested.

### Sample Preparation and Analysis

Fresh ripe fruits were taken and then the first and second layer was peeled (removed) to obtain the central hard seeds. Ten (10) seeds were grinded fresh while another ten (10) seeds grinded dry both giving a uniform powders. Aliquots of 100gm powders were soaked in 200ml distilled water for 12 hours at room temperature to form the aqueous extract solutions. The extracts were filtered using filter paper and the filtrates were analysed in the laboratory.

### Phytochemical Screening

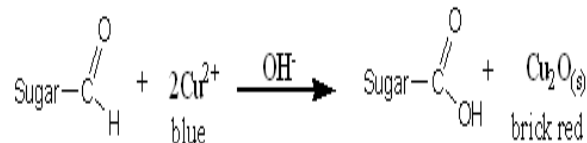
Phytochemical screening of the extracts was carried out to test for the presence of saponins, tannins and flavonoids. Chemical tests were carried out on the aqueous extracts to test for the presence of phytochemicals in the avocado seeds of both fresh and dry fruits. Tannins were tested by taking about 2g of the both fresh and dry powders, boiled in 20 ml of water in a beaker and then filtered. Few drops of 0.1% ferric chloride were added. The formation of brownish green or

blue black coloration indicated presence of tannin in the seeds. A portion of 10ml of the filtrate were mixed with 5ml of distilled water and shaken vigorously for persistent froth. The froth was mixed with 3 drops of olive oil and shaken vigorously; the presence of saponins was indicated by the formation of emulsion. Flavonoids were tested by adding 5ml of dilute ammonia solution ( $\text{NH}_4\text{OH}$ ) to a 5ml of portion of aqueous filtrate, then 1ml of concentrated sulphuric acid ( $\text{H}_2\text{SO}_4$ ) from which the formation of yellow coloration indicated presence of flavonoids.

## Nutrients Screening

### Carbohydrates

Carbohydrates were tested as both reducing and non reducing sugars. Benedict's solution was used to test for reducing sugars. A 2.5g of seed powder were soaked in 45ml hot distilled water and cold distilled water added to make a total of 50ml extract. Additions of cold distilled water lead to color change to milky color indicating presence of carbohydrates. Aliquots of 10mls were taken from each flask into two beakers; 5mls of copper reagent were added in each beaker, the mixture boiled for two minutes. The change of colour from blue to brick red indicated the presence of carbohydrates.



The reaction involves reduction of  $\text{Cu}^{2+}$  to  $\text{Cu}^+$  (precipitated as Cuprous Oxide) indicating the presence of reducing sugars. Potassium iodide was added followed with vigorous shaking; again the colour change from brick red to light blue confirms the presence of carbohydrates as polysaccharides. Addition of 5ml of normal 0.1M HCl changed the colour to brick red confirming the presence of reducing sugars as ketoses.

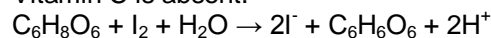
### Proteins

Aliquots of five (5) drops of millon's reagents were added to 1ml of the extract in a test tube followed by 3 drops of  $\text{NaOH}_{(\text{aq})}$ . White precipitates were observed, which turns red on heating, indicating presence of proteins.

### Vitamin C

Portions of 10ml of the extracts were measured into test tubes followed by addition of 2-3 drops of starch solution as an indicator and few drops of iodine solution as potassium iodide (KI) were added in the test tubes. In the presence of Vitamin C ( $\text{C}_6\text{H}_8\text{O}_6$ ), Iodine is oxidized to Iodide. The more iodine added to the vitamin C solution more iodide is formed until all vitamin C had reacted to

form dihydroascorbic acid (C<sub>6</sub>H<sub>8</sub>O<sub>6</sub>). Thereafter, more addition of iodine increased its concentration in the solution hence changing the starch to blue-black colour. Therefore, the immediate change of the starch to blue-black colour when iodine was added indicates that Vitamin C is absent.



### Data Analysis

The test results were presented as positive (where the tested component was indicated in the reaction) and/or Negative (where the component could not be indicated).

## RESULTS

### Testing for Nutrients (Protein, Carbohydrate and Vitamin C) in Avocado Seeds

The three nutrients were found to be present in the seed extracts of both fresh and dry seeds. It was observed that fresh seeds of avocado may contain more proteins than the dry seeds based on the number of drops of the millions reagent consumed per volume of the extract. The general test for **carbohydrates** indicated presence of carbohydrates in both fresh and dry seeds. Carbohydrates are sugars that the body uses for energy. Simple carbohydrates, also called simple sugars, provide the body with quick energy. **Vitamin C** was present in both samples though at small amount. Addition of iodine solution to 10ml extracts of both fresh and dry seeds containing starch indicator was performed. Few drops of iodine were furnished without changing of the colour of the starch. The end point was shown by a colorless solution indicating that all ascorbic acid (Vitamin C) had reacted. More addition of the iodine resulted to change in colour of the solution to blue-black solution indicating a complete consumption of the vitamin C (Iodine reacting with the starch).

**Table 1:** Screening results for nutrients and photochemical compounds of both fresh and dry avocado seeds.

SN.	Component	Fresh seed	Dry seed
1.	Protein	√	√
2.	Carbohydrate	√	√
3.	Vitamin C	√	√
4.	Tannins	√	X
5.	Saponins	√	√
6.	Flavanoids	√	X

### Testing for Tannins, Saponins, Flavanoids in Avocado Seed.

Phytochemical screening of the seeds showed presence of **saponins** in both fresh and dry samples whereas; **tannins** were detected in fresh seeds but not in dry seed. **Flavanoids** were present in fresh sample but not in dry seeds.

## DISCUSSIONS

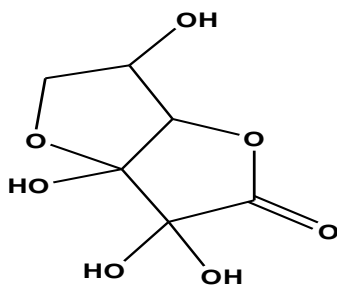
### The Composition of Nutrients (Carbohydrate, Protein and Vitamin C) in Avocado Seeds

Proteins, carbohydrates and vitamin C were all present in both the dry and fresh seed samples. Studies have shown that avocados are rich in macro nutrients like carbohydrate, vitamin and proteins (Whitney & Rolfes, 2005). Carbohydrates exist in varying amounts in the avocado seeds depending on the different activities that took place in the fruit during storage process before the analysis. During storage, fruits lose weight, shrivel and change colour, lose acidity and ascorbic acid but gain sweetness (Pareek & Dhaka, 2008, Pareek *et al.*, 2009). Also during this period, the enzyme activity, sugar and carotenoid contents increase with corresponding decrease in acidity, pectin and tannin content. To compare the carbohydrates in both fresh and dry seeds it needs a test that is specific for a specific type of carbohydrates. The study by Flitsch & Rein, (2003), explains the vital functions of carbohydrate found in avocado seeds as supplying energy for the body process. Some of the carbohydrates are immediately utilized by the tissues and the remaining is stored as glycogen in the liver and muscles and some are stored as adipose tissues for future energy needs (Flitsch & Rein, 2003).

The **proteins** were also indicated in avocado seeds though in varying amounts. Protein is a large biological molecules consisting of one or more chains of amino acids. The functions of proteins in the body include replicating DNA and strengthen the blood vessels (Gulteridge & Thornton, 2005). Like other biological macromolecules such as polysaccharides and nucleic acids, proteins form essential parts of organisms and participate in virtually every process within cells. Many proteins found in avocados catalyze biochemical reactions and are vital to metabolism (Gulteridge & Thornton, 2005).

**Vitamin C** constitutes a group of micro nutrients commonly found in the seeds of certain species like avocado (Ensminger, 2010). The presence of small amounts of vitamin C in both fresh and dry samples may be related to the effect of storage temperature of the seeds and preservation method. The low storage temperatures maintain relatively high Vitamin C content

compared to fruits stored at intermediate and ambient storage temperatures (Lee and Kader, 2000). Water loss has also been documented to have a greater effect on vitamin C levels than temperature (Nunes *et al.* 1998). Apparently, Vitamin C is among the micro nutrients those required in very small amounts for the functions of the body. Vitamin C (ascorbic acid) is one of the most important antioxidants. Blood levels of vitamin C are used to measure nutritional, immune, and cardiovascular status. Low values occur in scurvy, malabsorption syndromes, inflammatory bowel disease, alcoholism, pregnancy, hyperthyroidism, and kidney failure. The study showed that Vitamin C is obtainable at higher amounts in the fresh seeds than the dry ones. This is well in agreement to the argument that higher temperatures of storage and consequent water losses have an impact in the stability of Vitamin C (Nunes *et al.* 1998). Ascorbic acid is easily oxidised to dehydroascorbic acid in the iodine test. Complete reaction is shown by intense blue colour complex indicating the presence of unreduced iodine (I<sub>2</sub>) in the solution.



Dihydroascorbic acid

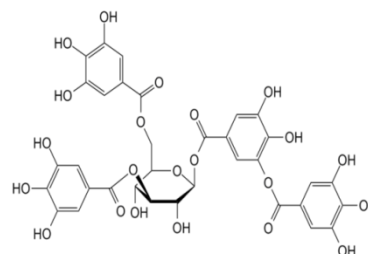
**The Composition of Tannins, Saponins and Flavonoids in Avocado Seed**

The presences of saponin in avocado seed make this fruit more important because saponins have both hypertensive and cardiac depressant properties. Saponin binds to cholesterol to form insoluble complexes; dietary saponins in the gut of monogastric combine with endogenous cholesterol excreted via the bile. This prevents cholesterol reabsorption and resulting to reduction of serum cholesterol. Tannins are polyphenols of high molecular weight which are water soluble and capable of precipitating proteins (Bryant *et al.*, 1992; Kraus, *at al.*, 2003). Tannin because of their binding properties, are known to be strongly astringent. This astringency appears to be major cause of reduced food intake in mammals. There is some controversy, however, over whether reduced food intake is the result of the toxic nature of tannins or not (Hagerman *et al.*, 1992; Silanikore *et al.*, 2001). This has been very important in protecting fruits from the attack by insects especially before ripening. Tannins decreases with the time of ripening and hence reduced to amounts that are harmless to

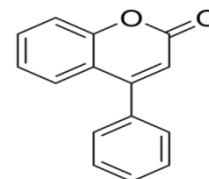
mammals. Tannins have high contributions in the organoleptic properties. In the current study, tannins were only detected in fresh sample.

**The Nutritional Value of Avocado Seeds**

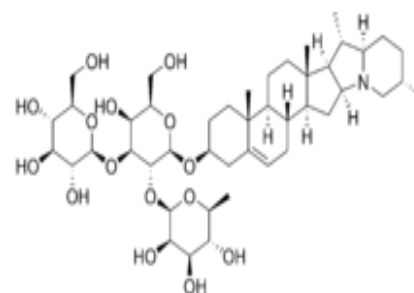
The phytochemical compounds in avocado seeds are responsible for color and organoleptic properties and also for prevention and treatment of many health conditions, including cancer, heart disease, diabetes, and high blood pressure (Kush *et al.*, 2006). There is some evidence that certain phytochemicals may help prevent the formation of potential carcinogens (substances that cause cancer), block the action of carcinogens on their target organs or tissues, or act on cells to suppress cancer development (Kush *et al.*, 2006). Tannins were found in fresh seeds and not in dry ones. This is well indicated even in unripe fruits causing the bitter taste of the fruits. Tannins protect fruits from predation, and perhaps also as pesticides, and in plant growth regulation (Cheeke, *et al.*, 2006). Likewise, the taste or smell from the tannins is what causes the dry and the formation of small purse-like gathering (puckery) feeling in the mouth following the consumption of unripened fruit of avocado. The seed of the avocado contains a concentrate of tannins, and these makes the taste extremely bitter. Tannins is an acid commonly found in some drinks (e.g. wine, coffee, tea.); but in some cases it can be the cause for an allergic reaction. In the seeds tannins were found to concentrate in fresh seeds and upon drying it disappears. Avocado seeds are high in tannins, which you may be familiar with from wine, which give them a somewhat bitter taste and red color. Despite the taste, tannins are present in seeds at reasonable levels which are harmless to consumers. The presence of



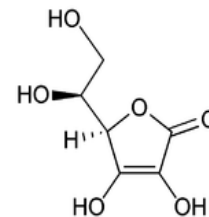
Tannin



Flavonoid



Saponin



Ascorbic (Vitamin C) Acid

tannins in the body can improve the appetite and reduce respiratory problem and circulatory disorder like lowering blood pressure and reduce of cholesterol in blood (Cheeke, *et al*, 2006). **Saponins** are naturally occurring compounds that are widely distributed in all cells of avocado plants. Saponins, which derive their name from their ability to form stable, soap-like foams in aqueous solutions, constitute a complex and chemically diverse group of compounds (Shi *et.al.*, 2004). Saponins affect the immune system in ways that help to protect the human body against cancers, and also lower cholesterol levels (Shi *et.al.*, 2004).

The **flavonoids**, have diverse beneficial biochemical and antioxidant effects (Donald & Miranda, 2000). Their dietary intake is quite high compared to other dietary antioxidants like vitamins C. The antioxidant activity of flavonoids depends on their molecular structure. Flavonoids are different from other phytochemical compounds especially on its reactivity nature. The other compounds have the acidic groups that have binding and neutralizable groups that are lacking in the flavonoids. Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species, such as singlet oxygen, superoxide, peroxy radicals, hydroxyl radicals and peroxynitrite (Donald & Miranda, 2000). An imbalance between antioxidants and reactive oxygen species results in oxidative stress, leading to cellular damage. The flavonoids have aroused considerable interest recently because of their potential beneficial effects on human health-they have been reported to have antiviral, anti-allergic, ant platelet, anti-inflammatory, and antitumor and antioxidant activities (Donald & Miranda, 2000).

## CONCLUSION AND RECOMMENDATIONS

Avocado seed contains a diverse number of nutrients and phytochemical compounds of nutritional value. Biologically, the seed part of avocado is meant for reproduction purposes. Apparently, most of the seeds are discarded harvazardly compounding the problem of dangerous wastes especially in the cities. The study shows that almost all the nutrients and phytochemicals found in the soft edible part are also found in the seed part though in varying concentrations. It is learnt that the seed part is also a potential source of nutrients and medicinal phytochemical compounds. Avocado seeds prepared in different ways can be used to keep the body fit from many diseases and hence reducing expenses for treatments. The dry seeds are preferred over the fresh ones for their easy processing and also the reduced

amount of tannins in their product. On the environmental point of view, utilization of avocado seeds in this way shall reduce a lot of solid wastes in the environment and hence keeping our cities cleaner.

The maximum exploitation of the avocado shall require further studies especially in quantifying the nutrients and phytochemical compounds in both the seeds and the soft edible part of the avocado.

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