



Research Article

A Study on the proximate composition and nutritive value of local tree almonds, *Prunus amygdalus*

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Abstract: Tree nuts form an essential part of our diet. They are rich in proteins, fats and an array of micro and macronutrients and are also palatable and considered as a delicacy. Among all the tree nuts, the almond is often referred to as the king of nuts. This is because it contains high amounts of nutritive elements like monounsaturated fatty acids, minerals such as magnesium and copper, α -tocopherol and fiber making it an integral part of the diet. Almonds are known to reduce oxidative stress, inflammation and the risk of cardiovascular diseases and diabetes. The present study endeavored to determine the proximate composition of locally available tree almonds, *Prunus amygdalus*. The moisture content, ash value, iron, phosphorous, calcium, protein, fat and fiber levels were estimated by standard protocols. The results obtained were then correlated with previously described studies. The findings of this study were in line with previous studies. Locally available *P. amygdalus* was found to be a rich source of protein, fat, calcium and phosphorous. The moisture and ash content were low. The fiber content is moderate and amount of iron is considerably low. This makes locally available almonds a suitable, accessible and vital part of the diet.

Keywords: *Prunus amygdalus*, proximate composition, almonds, nutritive value

Introduction

Plant seeds constitute an essential part of human diet. Seeds serve as an excellent source for proteins, essential oils and fats and important micronutrients. While cereals and pulses represent seeds which are staple foods, tree nuts are the seeds that make up the auxiliary component of the diet. The use of nuts as auxiliary foods dates back to pre-agricultural times. An explosion of scientific studies on the merits of these nuts has served to advance their importance. This has led to the development of cutting-edge agricultural technologies for mass cultivation and processing due to the increasing demand for consumption.

Almonds are one of the most important and well consumed tree nuts across the world. While it is an important food crop grown commercially, it is also grown as an orchard crop and as an avenue tree in many places. Though the almond tree is widely distributed in the different tropical, sub-tropical and temperate regions of the world today, it is originally native to the warmer parts of North America and Western Asia. Almonds are prunes belonging to the rose family known as Rosaceae.

The almond tree is a small deciduous tree that grows to a height of around 4-10 meters. The trunk at its thickest can go up to 30cm in diameter. The young twigs that develop are green to begin with, but turn purplish on exposure to sunlight and later

become grey after two years. The mature leaves are around 3-5 inches long with serrated margins and a 1 inch long petiole. The flowers of the almond tree are light pink or white, with 5 petals. Flowers appear in early spring, singly or in pairs, before leaves are produced. The almond tree can be considered as an economic crop only after a period of three years, which is when it actually begins to produce the nuts. The tree however reaches its full bearing status only after around 5-6 years of planting. Mature almonds are produced only 7-8 months post the flower formation, which is in autumn. In true botanical terms, the almond is not a nut but a drupe which is 3.5-6 cm long. The fruit is made up of four portions, a hard outer green shell called the hull, a middle hard shell, a thin brown leathery layer known as the skin of the almond and the seed or kernel which is inside.

Almonds or 'badam' as they are commonly referred to, in the commercial sense allude to the two edible parts among these four parts, the leathery skin and the kernel. They may be eaten blanched (with water or milk) or unblanched, raw or cooked/ roasted. Almonds are also used across a wide range of cuisines and for the preparation of various delicacies. They are used in the preparations of cakes and confectionary, in making sweets and chocolates, processed to develop butter and milk, known as almond butter and almond milk which is

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used in various preparations, ground in to a fine paste and added various dishes to enhance flavor and nutritive value and used for the extraction oil known as almond oil which is used in baking and for garnishing after cooking.



Figure 1. Local Almond Tree, *Prunus amygdalus*



Figure 2. Inflorescence and Fruit of *Prunus amygdalus*



Almonds are a rich source of proteins, healthy fats, vitamins and minerals. It is essential in maintaining the vitality of the brain, strengthening muscles and improving muscle tone, reduces anemia and prolongs life. Given the above benefits and also being one of the most nutritive nuts, it is often called the king of nuts.

There are two types of almonds, sweet almonds and bitter almonds, the sweet almonds being more popular. The almond trees with pink flowers produce sweet almonds while those with white flowers give bitter almonds. The bitter almonds can be distinguished from the sweet ones as they are broader and shorter in appearance. Chemically too they differ, with the presence of a compound called amygdaline in the bitter almonds. As such, bitter almonds are not edible and are poisonous. This is because amygdaline on hydrolysis, yields glucose and the chemicals benzaldehyde and hydrocyanic

acid (HCN). This hydrocyanic acid is poisonous, the salt of it being cyanide. Bitter almonds yield 4-9 mg of hydrogen cyanide per almond (Hari and Lakshmi, 2012). However, they are primarily used in the preparation of oil which is used in herbal and ayurvedic medicine for disease cure and also for the production of flavor extracts which can be used for cooking or baking.

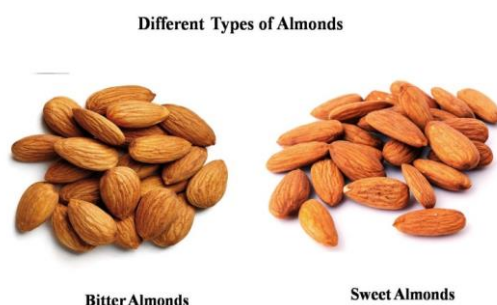


Figure 3. Bitter and Sweet Almonds

Almonds are an excellent source of energy, as they typically contain around 575 kcal/100g. Though they contain about 50% fat, the amount of monounsaturated fatty acids (MUFA-62%) dominates that of the polyunsaturated fatty acids (PUFA-24%) and the saturated fat content is 3.7 g/100g, which is the lowest of all nuts. Almonds are naturally low in sugars; the total sugar content is only 3.9g/100g. Almonds are a rich source of vitamin E and vitamin B₂ (Richardson *et al.*, 2009).

Table 1. Composition of Almonds

Nutrients	Units	Value per 100 g Whole Almonds
Proximates:		
Calories	Kcal	579
Water	G	4.14
Protein	G	21.15
Lipids (Total)	G	49.93
Dietary Fiber (Total)	G	12.5
Sugars (Total)	G	4.35
Ash	G	2.97
Minerals:		
Calcium	Mg	269
Iron	Mg	3.71
Magnesium	Mg	270
Phosphorous	Mg	481
Potassium	Mg	733
Sodium	Mg	1
Zinc	Mg	3.12
Copper	Mg	1.03
Manganese	Mg	2.18
Vitamins:		
Vitamin E (α -tocopherol)	Mg	25.63
Thiamin	Mg	0.21
Niacin	Mg	1.14
Riboflavin	Mg	3.62
Pantothenic acid	Mg	0.47
Vitamin B6	Mg	0.14
Folate, food	Mcg	44
Fatty Acids:		
Saturated (Total)	G	3.80
16:0 Palmitic	G	3.08
18:0 Stearic	G	0.70
Monounsaturated (total)	G	31.15
16:1 Palmitoleic	G	0.23
18:1 Oleic	G	31.29
Polyunsaturated (total)	G	12.33
18:2 Linoleic	G	12.32

USDA 2016 SR28 Nutrient Database No.12061 Nuts, almonds

The phytochemical composition of almonds has also been studied. The phytosterol content of almonds which was found to be 187 mg/100g is considerably high. Although a low amount of carotenoids are found in almonds, they are not a major source of dietary carotenoids. The total phenol content of almonds was assessed to be 4.2 mg GAE/g, which is moderate when compared to other nuts. Resveratrol was not found in almonds. The total flavanoid concentration of almonds is one of the highest among nuts, 15 mg/100g. It is of considerable interest to note that almonds can contribute total flavonoids to the diet in amounts equivalent to fruits, as they have a similar quantity of total flavonoids as red delicious apples at 15 and apricots at 13 mg/100 g. The amount of proanthocyanidins in almonds is also high, 184 mg/100g (Oliver and Jeffrey, 2008).

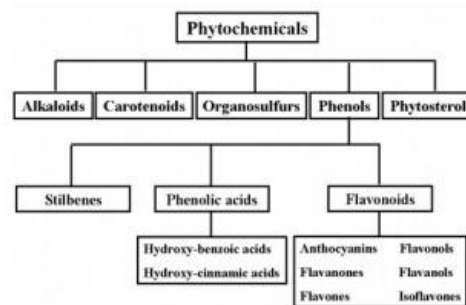


Figure 4. Different Phytochemicals responsible for Pharmacological Activities in Plants

The Oxygen Radical Absorbance Capacity (ORAC) of almond was found to be moderate, 45 μ mol TE/g as was the Ferric Reducing Antioxidant Power (FRAP), 41 μ mol Fe²⁺/g (Oliver and Jeffrey, 2008). Defatted almond seeds were extracted with aqueous acetone and subjected to column chromatography. The two fractions obtained and the crude extract was assessed for Total Antioxidant Activity (TAA). One of the fractions was found to be rich in tannins, and it exhibited the highest TAA of 3.93 mmol Trolox/g, while that of the crude extract was 0.24 μ mol Trolox/mg and the other fraction TAA was 0.09 μ mol Trolox/mg (Ryszard *et al.*, 2005). The antioxidant activity of whole almond seed, brown skin and green shell cover was also assayed, using different food model systems. While all three exhibited high antioxidant activity, it was observed that the method used determined which exhibited the highest, from some it was the green shell cover while for another, it was the seed (Subhashineet *et al.*, 2006). The methanolic extract of almond hulls when assayed for antioxidant activity exhibited a higher activity than that of α -tocopherol (Gray and Lan, 2003). On the whole it is certain that the almond exhibits antioxidant activity due to the presence of different phytochemicals it contains.

HPLC analysis of almond extracts revealed the presence of the following major phenolic acids, caffeic, ferulic, *p*-coumaric and sinapic acids (Subhashinee *et al.*, 2006). Methanol extract of almond hulls were analyzed by HPLC and showed the presence of chlorogenic acid, cryptochlorogenic acid and neochlorogenic acid (Gray and Lan, 2003).

The presence of these different phytochemicals and an array of nutritive elements in almonds result in them possessing several important pharmacological activities. Several studies have shown an association between nut consumption and a reduced risk of CHD (Coronary Heart Disease). Consumption of almonds regularly on a daily basis was found to result in decreased levels of cholesterol and LDL (low-density lipoprotein) and an improvement in serum lipid profiles (Chen *et al.*, 2006; Hari and Lakshmi, 2012). The hypoglycemic activity of almonds is because they have a low glycemic index

and are rich in fiber, which results in appetite suppression due to increased satiety. Consumption of almonds was found to lower post-prandial glycaemia, insulinaemia and oxidative stress. Ethanolic extracts of almond leaves, flowers and seeds exhibited ability to lower blood glucose levels in streptozotocin-induced diabetic mice (Hari and Lakshmi, 2012). Almonds were found to possess immunostimulant activity, consumption of almonds resulted in high levels of cytokine production; interferon- α (INF- α), interleukins (IL-12), INF- γ and tumor necrosis factor (TNF- α) (Adriana and Bisignano, 2010). A paste of almonds was found to reverse scopolamine-induced amnesia in rats, suggesting that almonds are a useful memory-restorative agent (Kulkarni *et al.*, 2010). The prebiotic activity of almonds has been studied. They are found to alter the composition of gut bacteria by stimulating the growth of bifid bacteria and *Eubacterium rectale* (Mandalari *et al.*, 2008). Almonds also possess anticancer activity. An almond-based diet was found to activate anti-proliferative signaling and reduce aberrant crypt foci in the gastrointestinal tract in rats (Davis and Iwahashi., 2001).

Care was taken while removing the shell so that the sample is not damaged.

The almond kernels obtained were separated into two groups. For one group the seed coat was removed, while for the other the seed coat was left undisturbed. The samples of both groups was powdered in a blender for homogeneity and stored in air-tight containers at -4°C until further use.



Figure 6. Locally collected *Prunus amygdalus* with Seed Coat



Figure 7. Seeds of *P. amygdalus* without Seed Coat

Some Phytochemicals Identified in Almonds

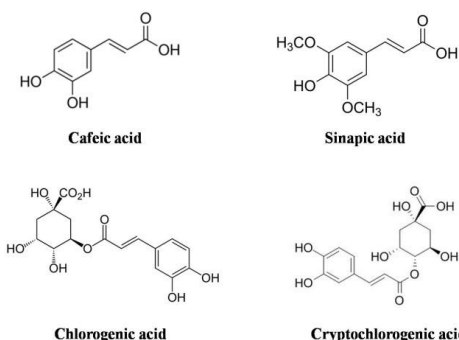


Figure 5. Few Phytochemicals Found in Almonds

The consumption of nuts has been heralded as a healthy dietary habit. There are, however some instances of individuals being allergic to tree nuts, including almonds. This kind of IgE mediated adverse allergic reactions is estimated to affect only 1-2% of the population. Methods have been developed to identify and detect amandin, the major storage protein of almonds (Sathe *et al.*, 2002). In order to reduce this IgE binding activity of almond proteins, pre-treatment processes such as blanching and roasting can be performed before consumption (Venkatchalam *et al.*, 2002).

Materials and Methods

Local almonds (*Prunus amygdalus*) were collected from Andhra University Ladies Hostel Campus during the month of December, 2016. The almonds were plucked from the trees along with their shell and were dried in the sunlight for one week post which the shell was removed to obtain the kernel.

Moisture:

The moisture content of the samples was determined by the AOCS method. 5 g of test sample is taken in a dish container and dried in an oven at 130°C for 2 hours. The heated portion was then allowed to cool in a dessicator to room temperature and the loss of weight was determined.

Ash:

The ash content of the samples was determined by the AOCS method. Accurately weighed sample, of about 0.5 g is placed in a ceramic crucible (that is previously heated and cooled until constant weight is obtained) and then subjected to ashing at 550°C for about 12 h in a muffle furnace, and then ash content determined.

Iron:

The amount of iron in the samples is quantified calorimetrically, by Wong's method, 1928, that makes use of fact that ferric ion gives red colour with potassium thiocyanate. The intensity of red color is directly proportional to the iron present in the given sample and is measured at 540nm.

Phosphorous:

The method described by Fiske and Subbarow, 1925 was used to determine the amount of phosphorous in the samples under study. This method uses ANSA (1-amino-2-naphthol-4-sulphonic acid) and results in a blue color complex being formed, which can be measured colorimetrically at 660nm. Hence, color intensity is directly proportional to concentration of phosphorous.

Calcium:

The amount of calcium the almond samples is estimated by the procedure described by Raghu Ramulu *et al.*, 1983. 2ml of ash solution is adjusted to a suitable pH for the precipitation of Calcium. The treated solution is then titrated with $KMNO_4$ in hot condition. The end point was noted which was definite pink color which persists for 1 min.

Protein:

Lowry *et al.*, 1951 method was employed to study the protein content of the sample. This method is based on the principle that colorimetrically at 660 nm. The intensity of the blue color produced depends upon the amount of the aromatic amino acids, which vary for different proteins.

Crude fiber:

The fiber content of the sample was determined by the method given by Raghu Ramulu *et al.*, 1983. This method gives the crude fiber content of the sample. The procedure is as follows: The sample is weighed and then subjected to extraction with 1.25% NaOH for 30 minutes. The solution is filtered and the filtrate was then washed into another flask using distilled water. The filtrate is then subjected to extraction with 1.25% NaOH for 30 minutes. The same process is repeated with the acid and the alkali solutions alternatively for 4-6 times. After the final filtration process, the pre-weighed muslin cloth is dried and weighed with residue. The difference in the initial and final weights gives the amount of fiber in that particular quantity of the sample.

Crude fat:

The crude fat content in local almonds was estimated by the method given by Raghu Ramulu *et al.*, 1983. Crude fat content is determined by extracting the fat from the sample using a suitable solvent, then determining the fat recovered. 10g of the sample was subjected to extraction with 150 ml of petroleum ether in a Soxhlet liquid/solid extractor. The extraction was continued for 6 hours, then the heat source was removed and the solvent drained from the extractor into the flask. The flask was replaced by the heat source to evaporate off the solvent. The flask was cooled and then weighed with its contents. Then the crude fat calculated from the recorded weights.

Results and Discussion**Moisture content:**

The moisture content of locally collected tree almonds was determined by the AOCS method.

Both the samples; almonds with and without seed coat showed a relatively low moisture content as anticipated, being nuts. Among the two samples, the almonds without seed coat showed higher levels of moisture, 9.9 g/100g when compared to almonds with seed coat, having a moisture content of 6.4 g/100g.

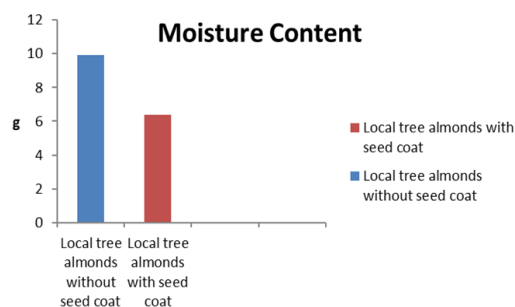


Figure 8. Moisture Content of locally collected *Prunus amygdalus* Seed

The protein content of the sample. This method is based on the principle that colorimetrically at 660 nm. The intensity of the blue color produced depends upon the amount of the aromatic amino acids, which vary for different proteins. The moisture content of locally collected tree almonds is in line with several studies conducted on other different varieties of almonds. A study by Aslanta *et al.*, 2001, on thirteen types of sweet almonds showed that the moisture content ranged from 3.60-4.39%. Susan *et al.*, 2005 found that the moisture content in three varieties of almonds from California ranged from 3.60-4.39%. This method gives the crude fiber content of the sample. The procedure is as follows: The sample is weighed and then subjected to extraction with 1.25% NaOH for 30 minutes. The solution is filtered and the filtrate was then washed into another flask using distilled water. The filtrate is then subjected to extraction with 1.25% NaOH for 30 minutes. The same process is repeated with the acid and the alkali solutions alternatively for 4-6 times. After the final filtration process, the pre-weighed muslin cloth is dried and weighed with residue. The difference in the initial and final weights gives the amount of fiber in that particular quantity of the sample. The crude fat content in local almonds was estimated by the method given by Raghu Ramulu *et al.*, 1983. Crude fat content is determined by extracting the fat from the sample using a suitable solvent, then determining the fat recovered. 10g of the sample was subjected to extraction with 150 ml of petroleum ether in a Soxhlet liquid/solid extractor. The extraction was continued for 6 hours, then the heat source was removed and the solvent drained from the extractor into the flask. The flask was replaced by the heat source to evaporate off the solvent. The flask was cooled and then weighed with its contents. Then the crude fat calculated from the recorded weights.

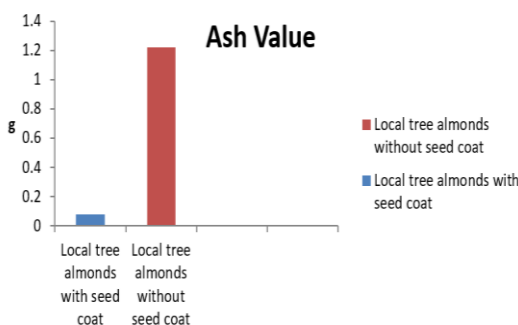


Figure 9. Ash value of *P. amygdalus* Seeds

Ash Value:

Estimation of ash value was done in the two samples of local tree almonds, with seedcoat and without seedcoat by the AOCS method. The

ash content in almonds is very low, for almonds without seed coat it is 1.22g/100g and for those with seed coat it is 0.08g/100g in each sample.

Studies on ash value of different varieties of almonds from several regions of the world also revealed that the ash value in them is very low. Seham *et al.*, 2014 reported a low ash content of 3.82% in almonds from the Middle East region. Nine varieties of almond kernels from Turkey were studied (with the seed coat), revealing ash value of 3.12-4.69 % (Mikdat and Veysi, 2017). Agunbiade and Olanlokun, 2006 studied the ash content on Indian variety of almonds (*P. amygdalus*) growing in Nigeria, which was found to be a little higher when compared to that of other studies, 6.76%. Studies on the almond kernel carried out by Ozcan *et al.*, 2011 also revealed low ash content, ranging from 2.74-3.05%. The ash content of three varieties of almond seeds (*P. dulcis*, with seed coat) was found to be 3.74-4.56 g/100g (Susan *et al.*, 2005).

Iron:

Iron is an indispensable component for every living organism. It is essential for the transport of oxygen, electron transfer and oxidation-reduction reactions in the body. Foods containing high amounts of iron are of great interest to the scientific community as the deficiency of iron is a persistent problem. The Recommended Dietary Allowance (RDA) for all age groups of men and postmenopausal women is 8 mg/day; the RDA for premenopausal women is 18 mg/day. The median dietary intake of iron is approximately 16 to 18 mg/day for men and 12 mg/day for women. The amount of iron in the samples is quantified calorimetrically, by Wong's method, 1928. The iron content in the samples with seed coat is found as 6.25mg/100g and that without seed coat is 8.325mg/100g.

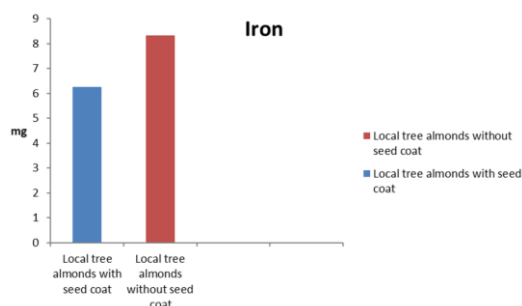


Figure 10. Iron Content of locally collected *P. amygdalus* Seeds

Mikdat and Veysi, 2017 found that *P. amygdalus* contained trace amounts of iron; 5.39-10.28 mg/100g in the nine genotypes studied. Saura and Cafiellas, 1982 reported the presence of 3.10-4.40 mg/100g and 3.00-4.00

mg/100g of iron in almond varieties. Iron was determined using Atomic Absorption Spectrophotometry for thirteen varieties of sweet almonds by Aslanta *et al.*, 2001. The amount of iron ranged from 54.13-146.35 ppm for the different varieties. The amount of iron found in almond milk extract was 1.40 mg/100ml, which was found to be higher than that of soy milk (0.58 mg/100ml) and dairy milk (0.1-0.3 mg/100ml) (Alozie *et al.*, 2015; Potter, Hotchkiss, 1995; Passmore, Eastwood, 1986). Nigerian grown Indian almonds showed possessed an iron content of 70.62 ppm (Agunbiade and Olanlokun, 2006). The iron content of *P. amygdalus* from Middle East regions was found to be 119.9 mg/kg (Seham *et al.*, 2014).

Phosphorous:

Phosphorous is a macronutrient that is a prerequisite for several biological processes, like protein phosphorylation, DNA synthesis, Membrane synthesis and ATP synthesis. It is also essential for the formation of teeth and bones. The Recommended Dietary Allowance (RDA) of phosphorous is 700 mg/day. The method described by Fiske and Subbarow, 1925 was used to determine the amount of phosphorous in the samples. Locally collected *P. amygdalus* was found to contain considerable amount of phosphorous. There was not much difference in the phosphorous content in both the almond samples; with and without seed coat. Almonds without seed coat contained 135 mg/100g while those with seed coat had 133.25 mg/100g phosphorous.

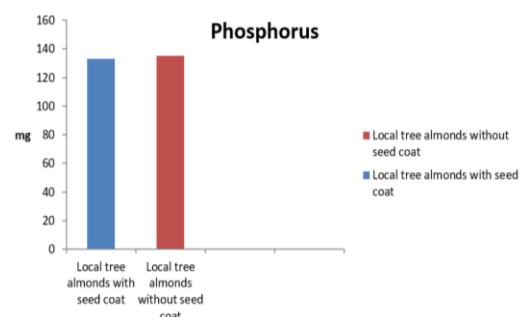


Figure 11. Phosphorous Content of Locally Collected *P. amygdalus* Seeds

Aslanta *et al.*, 2001 found a high phosphorous content in *P. amygdalus* of 800.0 mg/100g. Seham *et al.*, 2014 reported that *P. amygdalus* contains 0.53 mg/kg of phosphorous. Agunbiade and Olanlokun, 2006 reported that the Indian variety of almonds, when grown in Nigeria have 0.19% of phosphorous. Mikdat and Veysi, 2017 reported that the phosphorous content of *P. amygdalus* grown in Mardin region is high, ranging from 562.53-701.93 mg/100g in the nine different genotypes

studied. Barbera *et al.*, 1994 reported that two almond varieties contained 253.00 and 259.00 mg/100g of phosphorous. Studies on the phosphorous content of almonds from Spain revealed the presence of 364.00 mg/100g of phosphorous (Saura and Cafiellas, 1982).

Calcium:

Calcium is a vital nutrient that is an integral part of the skeletal system of the body. It is the most abundant mineral in the body, about 99% of calcium is found in bones and teeth. It is also involved in muscle contraction and release of hormones. Almonds are considered as the richest source of calcium. The proportion of total calcium derived from almonds ranges from 73-86 percent. The recommended dietary allowance of calcium for an adult is 600 mg per day. The calcium content of local tree almonds is more when compared to processed almonds. The amount of calcium the almond samples was estimated by the procedure described by Raghu Ramulu *et al.*, 1983. Calcium in local tree almonds with seed coat was found to be 450 mg/100g and 625 mg/100g in almonds without seed coat.

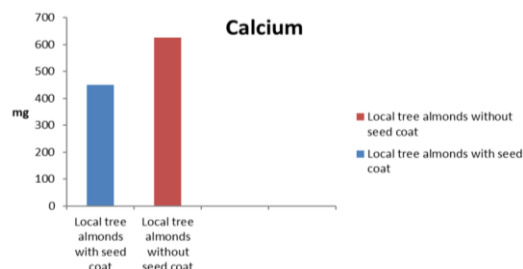


Figure 12. Calcium Content in *P. amygdalus* Seeds

The calcium content in *P. amygdalus* was found to vary between 98.5-187.0 mg/100g (Aslanta *et al.*, 2001). Saura and Cafiellas, 1982 evaluated the calcium content of almonds in Spain, and found it to be 218.00-299.00 mg/100g, for different genotypes. A study on the almonds from the Middle East region revealed the presence of lower amounts of calcium, 0.23 mg/kg (Seham *et al.*, 2014). The calcium content of Indian almonds growing in Nigeria was 845.45 ppm, estimated using an Atomic Absorption Spectrophotometer (Agunbiade and Olanlokun, 2006). The amount of calcium in almond milk was assessed by Alzoe *et al.*, 2015 and found to be 13.10 mg/100ml.

Protein:

The role of protein in the sustenance of the human body is undisputed. They form the major component of the tissues and muscles in the body. They are also involved in the production of hormones and enzymes. Though

proteins are not a primary source of energy, they may serve as an alternate source of energy. A protein rich diet is critical for the health of an individual. Protein content in tree almonds was assayed using Lowry *et al.*, 1951 method. Almonds were found to be rich in protein. The protein content was found to be more in local tree almonds without seed coat. The amount of protein in almond with seed coat is 43.2 g/100g and that of almonds without seed coat is 57.1g/100g. Almonds are an excellent choice for a high protein snack. Their protein is highly absorbable, making it easy for the body to process and use or store.

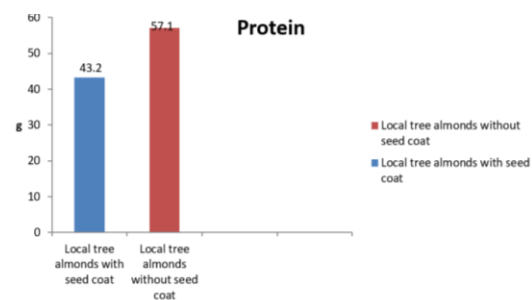


Figure 13. Protein Content in Locally Collected *P. amygdalus* Seeds

The crude protein of Indian almonds (*P. amygdalus*) grown in Nigeria was found to be 11.52 % (Agunbiade and Olanlokun, 2006). A study by Seham *et al.*, 2014 on *P. amygdalus* procured from the Middle East region revealed the presence of 22.83% of protein, suggesting that it can contribute to the daily protein need for adults as recommended by the Dietary Reference Intakes. Mikdat and Veysi, 2017 reported the crude protein content of nine different genotypes of *P. amygdalus* from Mardin region to be 20.81-25.99%. A study by Soler *et al.*, 1989 revealed that the crude protein content in almond samples ranged from 18.00-25.00%. Barbera *et al.*, 1994 reported a protein content of 22.50-25.80%. Susan *et al.*, 2005 studied the protein content in three varieties of Californian almonds (*P. dulcis*), which gave crude protein values of 20.6-23.3 g/100g. Alzoe *et al.*, 2015 studied the protein content in almond milk, which was found to be 1.70 g/100ml.

Fiber:

Dietary fiber is found abundantly in vegetables, fruits, legumes and nuts. It plays an important role in maintaining bowel health, helps control sugar level, lowers cholesterol level and helps in attaining healthy weight. The fiber content of the sample was determined by the method given by Raghu Ramulu *et al.*, 1983. In local tree almonds, the nuts with seed coat had dietary fiber when compared to almonds without seed coat. The fiber content of locally collected *P. amygdalus* with seed coat was found to

be 41.5 mg/100g while that without seed coat was 32.0 mg/100g.

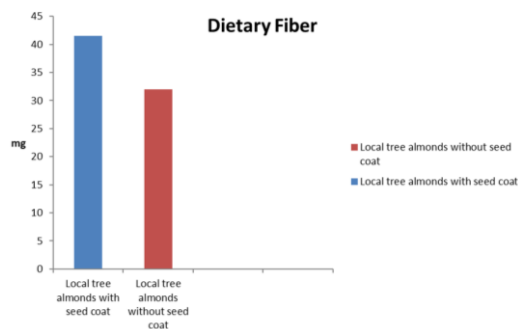


Figure 14. Dietary Fiber Content in Locally Collected *P. amygdalus* Seeds

A study by Agunbiade and Olanlokun, 2006 revealed the presence of 5.09% of crude fiber in *P. amygdalus* grown in Nigeria. A significant amount of crude fiber content was found in almond milk was found to be 1.25 g/100ml, which was higher than that of soymilk, 0.70 g/100ml (Alozie *et al.*, 2015).

Fat:

Fat obtained from food is a vital component of the diet. Fats serve to provide the body with energy, play a key role in the absorption of fat-soluble vitamins, and make up the structural elements of cell walls. While a controlled intake of fats is essential for the well-being of the body, an increased intake is associated with several health complications, such as obesity, metabolic syndrome, coronary heart disease and cancer. The crude fat content in local almonds was estimated by the method given by Raghu Ramulu *et al.*, 1983. Fat content in almonds with seed coat was found to be 20.5 g/100g and those without seed coat 46.0 g/100g.

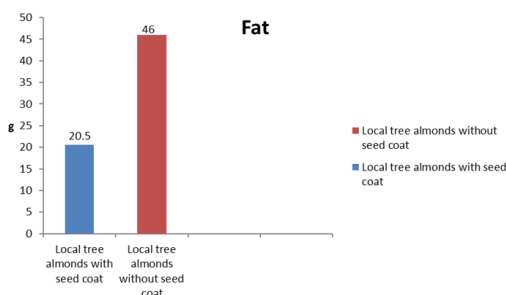


Figure 15. Fat Content in *P. amygdalus* Seeds

Nuts are a rich source of fat, but many studies have shown that fat in nuts is absorbed very poorly. The fat in almonds is located inside the almond cells. Even after prolonged chewing, most of the almond cells remained intact, and fat was still inside the almond cells. These results are in accordance with other studies carried out on different varieties of almonds.

Simsek and Demikiran, 2010 previously reported the crude fat content in different varieties of almonds ranging from 43.50-54.81%. Ozcan *et al.*, 2011 reported the crude fat levels in almonds to be 48.80-55.70%. Agar *et al.*, 1997 reported that almonds contain 52.08-57.49% fat. The crude oil content in thirteen different varieties of *P. amygdalus* L. from Turkey was found to be 48.93-55.96% (Mikdat and Veysi, 2017). Seham *et al.*, 2014 reported 52.083% of crude fat in almonds from the Middle East region. Almond milk was found to possess 3.40 g/100ml, which did not differ significantly with that of soymilk, 3.20 g/100ml (Alozie *et al.*, 2015).

Conclusion

Nuts (tree nuts and peanuts) are nutrient dense foods with complex matrices rich in unsaturated fatty and other bioactive compounds: high-quality vegetable protein, fiber, minerals, tocopherols, phytosterols, and phenolic compounds. By virtue of their unique composition, nuts are likely to beneficially impact health outcomes (Emilio, 2010). The most popular edible tree nuts are almonds, *Prunus amygdalus*. Almonds can improve human health when consumed in small (10 g/day) or large portions (100 g/day) (Ravila *et al.*, 2017). There have been various studies which examined the health benefits of almond intake in the fields of weight management, heart health, and diabetes. One of major results from the previous almonds studies might be improvement of blood lipid profiles, including the levels of triglycerides, total cholesterol, low-density lipoprotein (LDL) cholesterol, and high-density lipoprotein (HDL) cholesterol particularly among subjects with diet-related clinical symptoms such as obesity, diabetes, and hyperlipidemia (Liu *et al.*, 2017). In addition to providing a good source of dietary fiber, almonds are also rich in unsaturated fatty acids. Unsaturated fatty acids, as opposed to saturated fatty acids, have been shown to have antimicrobial properties through the inhibition of bacterial fatty acid synthesis and growth, and also reduce microbial adhesion to mucus (Hannah *et al.*, 2018).

Almonds have been a part of the traditional Indian diet since time immemorial and have been a part of several Indian cuisines. Traditionally, almonds in India are soaked and peeled to be eaten early in the morning and has had several positive connotations with respect to health (Kalita *et al.*, 2018). Claire *et al.*, 2015 suggest that a daily consumption of almonds (1.5 oz.) may be a simple dietary strategy to help prevent the onset of cardiometabolic diseases in healthy individuals. All the above studies demonstrate that there are multiple health benefits which may be attained by consumption of almonds on a regular basis.

The proximate composition of locally available tree almonds, *Prunus amygdalus* was studied. Eight parameters were selected; moisture content, ash value, iron, phosphorous, calcium, protein, fat and fiber levels and were estimated by standard protocols. The findings of this study were in line with previous studies. Locally available *P. amygdalus* were found to have high amounts of protein, fat, calcium and phosphorous. While the fiber content was moderate, the amount of iron is considerably low, and the moisture and ash content were also low. The results obtained were in agreement with previously described studies. This makes locally available almonds a suitable, accessible and vital part of the diet.

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Conflict of Interest

The authors declare that there is no conflict of interest.


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