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A reviewed article: Nutritional value and health benefits of Cashew Nuts

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Abstract
Cashew nuts have been a staple in diets for centuries, valued for their rich energy content, nutritional profile, and diverse flavor. Nutritionally, cashew kernels offer a balanced composition of proteins, carbohydrates, and fats, with a notable presence of essential amino acids and unsaturated fatty acids. The kernel is cholesterol-free and rich in oleic acid, a monounsaturated fat known for its role in lowering cholesterol levels. Cashew nuts provide a significant amount of energy (611 Kcal/100 g) and are comparable to other nutrient-dense foods like almonds, milk, eggs, and meat. This presentation aims to explore the nutritional content and health benefits of cashew nuts (*Anacardium occidentale*), specifically focusing on their role in promoting cardiovascular health, managing weight, and providing essential nutrients. It also seeks to provide an overview of cashew production in the coastal region of Karnataka.

Keywords: Sensory evaluation, sensory characteristics, cashew nuts, cashew apples, cashew nut shell oil, unsaturated fats, cardiac health, weight management

Introduction

Cashew (*Anacardium occidentale L.*) is a native plant of tropical America from Mexico to Peru and Brazil and also the West Indies. Cashew trees were introduced to India when the Portuguese came sailing down to Indian coasts, later on, these trees took a deep root in the entire coastal region of India, especially in South India. The first introduction of cashews in India was made in Goa and widely spread to Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh (Kumar N. *et al*.,2012) [7]. Cashew trees play an important role in afforestation and soil conservation (Bhat M G. *et al*., 2010) [2].

The word 'cashew' is derived from the Portuguese name for the nut 'caju', which was adopted by them from the native name 'acuju' (Kumar N. *et al*., 2012) [7]. Cashew research in India started way back in 1950s under the schemes of *ad-hoc,* sanctioned by Indian Council of agricultural Research (ICAR). Cashew research was widely improved through the formation of Central Plantation Crops Research Institute and later on establishment of an Independent National Research Centre for Cashew (NRCC), Puttur – Karnataka in 1986 (Bhat M G. *et al*., 2010) [2].

Table 1: Growth in area, production and productivity of cashew in India during 2000-01 to 2014-15

Table 1. Growth in area, production and productivity of cashew in India during 2000-01 to 2014-15

Years	Area (hectare)	Production (metric tonnes)	Productivity (kg/ha)
2000-01	720	627	710
2001-02	750	666	710
2002-03	770	675	760
2003-04	780	684	800
2004-05	820	700	810
2005-06	837	760	815
2006-07	854	765	820
2007-08	868	770	860
2008-09	893	835	773
2009-10	923	882	695
2010-11	945	906	720
2011-12	979	924	749
2012-13	992	944	760
2013-14	1,011	980	759
2014-15	1,030	998	723
Mean	878.13	806.86	764.27
CV (%)	11.34	15.24	6.34
R^2	0.99	0.98	0.02^{NS}
CAGR (%)	2.58**	3.46**	-0.17

Note: ** Significant at 1% level. NS= Non-significant
Source: Ministry of Agriculture and Farmers Welfare, Govt. of India

According to D'Silva, R.J., 2021 [6], Coastal Karnataka is responsible for 70% of Karnataka's cashew production. In India the Karnataka state is the largest cashew producer, yearly this state aims to produce 1,50,000 metric tons of cashew in which 70% of cashew nuts are produced by the coastal region of this state.

Among the several districts of this state, Dakshina Kannada takes first place in terms of area under cultivation and Mangalore is the birthplace of the large-scale labor-intensive cashew processing unit. The cashew industry in coastal Karnataka mainly focuses on women empowerment by hiring 95% of female workers (D'Silva, R.J., 2021) [6].

Cashew nuts play an important role in the diet because of its high calorific value and nutrient contents. Most of the calories are derived from the fats, still it's considered as healthy diet because cashews are made up of good fats such as unsaturated fats. Along with high amount of good fat cashew also contains several other nutrients which play an important role in healthy life by preventing the non-communicable diseases such as cardiovascular diseases, diabetes, weight gain, stroke and, also it decreases the risk of metabolic syndromes, helps to improve the mental health, increases bone mineral density, increases antioxidant capacity and many more (Rico R. *et al*., 2016) [9].

According to Dendena B., & Corsi S., 2014 [5] cashews are mainly used as food and also for the manufacture of pharmaceuticals by many countries. Around 60% of cashew nuts are consumed in the form of snacks, mostly roasted and salted. Remaining 40% of nuts are consumed in the form of confectionary and bakery products. Cashew apples also contain good amount of nutrients and the juice which is extracted by the cashew apple is fermented to produce liquor in India called Feni, having 40% of v/v alcohol. Other main by product produced during the processing of cashew nut is cashew nut shell oil, which contains unique chemical properties and used for the manufacturing of several industrial products such as brake lining, paints and surface coatings etc.

Cashew processing

Cashew requires processing to extract kernel, the edible portion. Raw cashew nuts are usually picked from the ground. These nuts have a moisture content of about 25%. Harvested / picked raw nuts are to be sun dried for 3 days before it is stored or taken to commercial processing units for processing. Raw nuts dried to a moisture level of 5-6% could be stored at ambient temperature for a year without either processing or biochemical quality deterioration (Malhotra S. K. *et al*., 2017) [8].

The methods namely oil bath roasting, drum roasting and steam roasting are employed for commercial processors. Processors in Kerala, Tamil Nadu, Andhra Pradesh and Orissa who are following currently drum roasting method are switching over to steam roasting due to environmental pollution. The important steps involved in commercial processing by steam roasting method are cleaning the dried raw nuts, humidification of raw nuts, steam roasting of the nuts for 18 to 20 min, at 100 lbs, cooling of the steam roasted nuts at ambient temperature for 24h, shelling of the raw nuts, drying of the kernels at 70° C in Borma Dryer for 8h, peeled kernels were then packed in tin containers with CO_2 / N_2 atmosphere (5%) to prevent rancidity. Recently, due to problems related to disposal of tin containers, moulded vacuum packing is being practised by the commercial processors. Manually operated cashew decorticator has been fabricated and evaluated for its performance. The performance parameters such as shelling capacity, shelling efficiency, percentage of unshelled seeds and broken nuts have been shown to be influenced by seed size and steaming period (Malhotra S. K. *et al*., 2017) [8]. The existing foot and pedal operated cashew sheller used in cashew processing industries in India has been redesigned at Directorate of Cashew Research, Puttur and the modified cashew decorticator is being patented.

Recently, on-farm processing with a capacity of 80 kg / batch is being practised by farmers for processing the raw nuts. Around 1800 such units have been established in the country, mostly in Maharashtra. Operation conditions such as steaming period and drying temperature for getting better recovery of kernels have been standardized. Depending on the origin of the raw nuts, these conditions need to be varied. During commercial processing of raw nuts, kernel rejects to the tune of 3% are obtained. Rejects obtained during processing are mainly due to immature nuts and floaters and if these are separated before processing, extent of kernel rejects could be reduced. Cashew kernel rejects obtained at different stages of commercial processing have been analysed for biochemical parameters and peroxides content was high in some of the rejects compared to good kernels indicating the possibility of lipid peroxidation. Oil from cashew kernel rejects could be extracted and refined by solvent, alkali and charcoal treatment to yield a yellow-coloured oil which is comparable with the oil extracted from good kernels. The recovery of kernel oil after refinement is around 50% (Malhotra S. K. *et al*., 2017) [8].

Nutritional aspects of cashew

Nuts are a part of healthy diet because of their high energy and nutritional value which also provide a unique sensory attribute to the diet (Rico R. *et al*., 2016) [9]. According to Cordeiro T A., 2014 [4], a nut is botanically "a dry, hard, shelled, one seeded fruit with a hard pericarp often cultivated as a fruit crop." Tree nuts are a traditional part of many ethnic cuisines, due to their rich flavors that compliment just above any herbs, fruits, vegetables, cheese and meat. Rico R. *et al*., 2016 [9] mentioned that, the tree nuts usually the cashews are rich in unsaturated fatty acids, both in mono- and poly unsaturated FA with a huge variety of good number of vitamins, minerals, amino acids, phytosterols and a dietary fiber. Consumption of these nutrients daily shows a significant health benefits, further discussion on this can be found on the subsequent pages.

The study of Vyavahare R D. *et al*., 2020 [11] reveals that ¼ cup serving of cashews roughly provides;

- 196 calories
- 5 grams of protein
- 1 gram of fibre
- 16 grams of fat
- 750 milligrams copper (84% Daily Value)
- 89 milligrams magnesium (33% DV)
- 167 milligrams phosphorus (28% DV)
- 9 milligrams zinc (23% DV)
- 27 milligrams manganese (15% DV)
- 11 milligrams iron (11% DV)
- 23 milligrams folate (6% DV)

1. Lipids

Cashew nuts are energy dense and most of the calories are derived from the lipids, according to Rico R. *et al*., 2016 [9] fat is major macronutrient present in the nuts, it accounts for 48.3 ± 1.6% (average) of the total weight, of which 61.8 ± 1.8% were monounsaturated FA, 17.9 ± 0.8% polyunsaturated FA, 20.1 ± 1.7% saturated FA, and 0.19 ± 0.02% trans FA, along with these 14 different types of fatty acids are identified such as oleic acid, linoleic, palmitic, stearic, arachidic, palmitoleic, vaccenic, gadoleic, lignoceric, margaric, elaidic and etc.

According to a study conducted by Chen. *et al*., 2023 [3] cashew provides 24.02 kJ/g energy, where 46.35% of the nut weight was fat, which was found to be having 9.157%

and 35.153% of saturated and unsaturated fatty acids respectively. Also, the research showed the presence of variable amount of fat-soluble vitamins such as Vitamin E and phytosterols. Usually, vitamin E exists mainly as tocopherols and/or tocotrienols among which γ-tocopherol was found to be abundant.

Cashew kernel lipids are rich in monounsaturated fatty acids such as oleic acid (73.7%) and polyunsaturated fatty acid such as linoleic acid (7.67%). Saturated fatty acid such as, stearic acid is present to the extent of 11.2%. Ratio of unsaturated to saturated fatty acid is 5.9, 3.0, 0.008 and 2.0 in triglycerides, monoglycerides, glycolipid and phospholipids respectively. Cashew kernels are free from Cholesterol and contain sizeable quantity of mono unsaturated fatty acid (oleic acid) which is now believed to be as efficient as poly unsaturated fatty acids in lowering cholesterol (Malhotra T.A., 2017) [8].

2. Proteins

By following the protein hydrolyzation methods 20 different types of amino acids are detected, it includes nine essential amino acids such as histidine, cystine, tyrosine etc., non-essential amino acids such as glutamic acid, aspartic acid and proline are found in greater amounts when compared to other amino acids (Chen. *et al*., 2023) [3]

The cashew kernel proteins contain arginine (2.123g), histidine (0.456g), lysine (0.928g), tyrosine (0.508g), phenylalanine (0.951g), cystine (0.393g), methionine (0.362g), threonine (0.688g) and valine (1.094g) per100g of kernels. Cashew kernel protein contains all the essential amino acids and is rich in glutamic acid followed by aspartic acid and arginine. However, variation in the amino acid's composition has been noticed (Malhotra T. A., 2017) [8].

This combination of amino acids makes the cashew nut rich in high quality proteins and also these proteins may trigger certain allergic reactions.

Based on the report of Chen. *et al*., 2023 [3] Cashew nut allergens have been identified as seed storage proteins, vicilin like protein or 75 globulins, legumin like protein or 115 globulin and 25 albumins have been characterized as major allergens.

Nutritional values of various parts of the cashew

The fruit of cashews consists many parts such as an outer shell called cashew nutshell (CNS), the cashew nutshell liquid (CNSL), an inner shell (Testa) and the kernel (Chen. *et al*., 2023) [3]. All of this part will contribute significant quantity of different nutrients which is mentioned below;

1. Cashew kernels

Cashew kernels contain at around 47% fat, 21% and 22% of proteins and carbohydrates respectively. Along with the presence of some amount of minerals and vitamins. Cashew proteins are complete proteins because they contain all the essential amino acids, and these proteins are rich in acidic amino acids (38.78%). Leucine and arginine are the major basic amino acids present to an extent of 22.23% and according to PER (protein efficiency ratio) the cashew proteins (3.2 PER) are comparable with milk protein casein (Bhat M G., 2008) [1].

Cashew kernels contain 47% of fats (Bhat M G., 2008) [1]. Cashew kernel lipids are rich in unsaturated fatty acids mainly oleic acids up to 73.7% and PUFA (polyunsaturated fatty acids) such as linoleic acids up to 7.67% (Cordeiro T A., 2014) [4]. Stearic acid is the major saturated fatty acid present (11.9%). The ratio of unsaturated to saturated fatty acids is 5:9 (Bhat M G., 2008) [1]. The specialty of cashew kernel lipid is that, they are completely free from cholesterol, because of these conditions, cashew helps to lower the LDL (low density lipoprotein) and elevate the HDL level (high density lipoprotein) (Bhat M G., 2008) [1].

Cashew kernels do not contain any anti-nutritional factors. It provides 611Kcal/100g of energy which is similar to almonds 612Kcal/100g (Cordeiro T A., 2014) [4]. Cashew nut may trigger some allergic reaction in some individuals due to the presence of globulins (Bhat M G., 2008) [1].

Along with these cashews also contain some number of vitamins like Thiamine, Niacin, Vitamin E, Vitamin D, Riboflavin, Pyridoxine etc., and also minerals like calcium, Phosphorous, Sodium, Potassium, Magnesium, Iron, Copper, Zinc and Manganese (Cordeiro T A., 2014) [4]. These composition of cashew kernels make it perfect for a healthy diet.

2. Cashew Apples

Cashew Apple is a pseudo fruit which is a juicy fibrous nutritious fruit. Cashew also contains sugars, tannins, phenols, amino acids, ascorbic acids, minerals and fibre (Cordeiro T A., 2014) [4]. Cashew apple is very rich in ascorbic acid (240mg/100g) which is almost six times as that of citrus fruits (Bhat M G., 2008) [1]. Besides the vitamin C, cashew apple contains free soluble sugars most of which are reducing sugars. Cashew also contain good amount of antioxidants such as Phenols, Tannins and Flavanols which play a major role in destroying free radicals. Research shows that consumption of cashew apple could help in overcoming the Vitamin C deficiency and also constipation (Bhat M G., 2008) [1].

An article by Cordeiro T A., 2014 [4] showed that cashew apple juices serve as a good substrate for growing *saccharomyces cerevisiae.*

Cashew and health benefits

The nutritional composition of cashew nuts makes it perfect for a healthy diet and some potential health benefits of cashew nuts are as follows:

1. Heart health

From recent studies cashew nut has gained value as a good food, traditionally nuts were considered unhealthy because of their high fat content. However, the fat present in the nuts is unsaturated fat hence it plays an important role in the heart health (Cordeiro T A., 2014) [4]. Cashew has a high amount of oleic acid which is very important to protect heart from atherosclerosis and consist low amount of cholesterol (Vyavahare R D. *et al*., 2020) [11].

Cashew nut contains 47% fat, where 82% is constituted by unsaturated fat with a proportion of MUFA and PUFA being 4:1. Cashew fats protect the heart from **bad fat** called low-density lipoproteins and cholesterols along with this, these nuts have also shown a positive response in boosting the level of good fat called high-density lipoproteins (Cordeiro T A., 2014) [4].

Cashew apple is rich in dietary fiber and the nut contains abundant proteins (Chen. *et al*., 2023) [3], cashew kernels contain about 1.3% fiber. Including cashews in the diet thus provides high fiber, unsaturated fatty acids with minimum

amount of saturated FA and cholesterol, preventing the chances of developing coronary heart diseases (Cordeiro T A., 2014) [4]. Dietary fiber will be broken down by the probiotics in the gut and reduces the absorption of cholesterol from the diet.

In various studies of diabetic patients' additional low-fat diet with unsaturated fat was found to be beneficial since it has the capacity to reduce the level of triglycerides in the blood. Low triglycerides in blood is a sign of a healthy heart (Vyavahare R D. *et al*., 2020) [11].

2. Maintains Blood sugar level

Foods with a high glycemic index raise blood glucose levels. The glycemic index of cashew nuts is 22, which is considered low. Hence, a diet that includes cashews, which are low-GI, high in dietary fiber, and rich in MUFAs, is ideal for diabetic patients. Cashew nuts are considered safe for diabetic patients. (Cordeiro T A., 2014) [4].

3. Prevents cancer

The cashew kernels consist of a wide variety of antioxidants such as gallic acid, quercetin, ascorbic acid, trolox, catechin, β-carotene, lutein, α-tocopherol etc (Chen. *et al*., 2023) [3], which play an important role in preventing the cancer.

To fight against the lung, liver, skin, brain and gastrointestinal cancers, a diet containing cashews which are rich in selenium. Shows a positive response (Cordeiro T A., 2014) [4].

Copper is one of the vital components in preventing the colon cancers. Our daily diet, which is really lacking in copper, can benefit from cashews as they provide copper to the body. Flavonols like Proanthocyanidins fight against the tumour cells. These flavonols contain high amount of copper, which helps prevent cancerous cells from growing (Vyavahare R D. *et al*., 2020) [11].

Cashews are rated as an excellent source of copper, which promotes the activity of lysyl oxidase enzymes. These enzymes are involved in the cross-linking of collagen and elastin. Collagen and elastin provide flexibility in blood vessels, bones, and joints. In the journal by Vyavahare R.D. *et al*., 2020 [11], they clearly mention that the consumption of a diet rich in copper helps prevent problems like anaemia, osteoporosis, joint issues, and broken blood vessels.

4. Bone health

Along with copper, cashews contain a good amount of calcium and magnesium, which are necessary for bone health (Vyavahare R D. *et al*., 2020) [11]. The balance of calcium and magnesium is essential for maintaining bone health (Cordeiro T A., 2014) [4]. A quarter cup of cashews provides 22.3% of the daily value of magnesium (Cordeiro T A., 2014). About 60% of magnesium is found in our bones (Vyavahare R D. *et al*., 2020) [11], the balance of magnesium and calcium helps regulate nerves and muscle tone. Magnesium also acts as nature's own calcium channel blocker, preventing the calcium from rushing into the nerve cell and activating the nerve. By blocking calcium's entry, it keeps the nerves relaxed (Cordeiro T A., 2014) [4]. Insufficient magnesium can contribute to high blood pressure, muscle spasms, migraines, headaches and muscle cramps (Vyavahare R D. *et al*., 2020) [11].

Consumption of cashews has shown a positive response in promoting normal sleep patterns in women suffering from menopausal sleep disturbances. It also reduces the severity of asthma due to the presence of magnesium (Cordeiro T A., 2014) [4].

As mentioned above, copper is responsible for the synthesis of major structural proteins of bone, such as collagen (Vyavahare R.D. *et al*., 2020) [11]. Therefore, cashews are recommended to overcome copper deficiency.

5. Lowers the risk of overweight and obesity

Most individuals are worried about including nuts in their diet because of their high fat content. However, to lose weight, researchers from Harvard University reported that a low-calorie diet containing ample fat from tree nuts and olive oil is an effective method (Cordeiro T. A., 2014) [4]. While cashew nuts are considered high in fat, they contain HDL (High-Density Lipoproteins). Cashews mainly consist of unsaturated fats, including MUFAs and PUFAs, with very low amounts of saturated fat and cholesterol, making them beneficial for weight management.

According to a report by Vyavahare R. D. *et al*. (2020) [11], research conducted in Spain involving 8,865 adult men and women found that those who consumed nuts at least twice a week had a 31% lower chance of weight gain compared to those who never or rarely ate cashew nuts.

6. Helps to prevent the Gallstones

Consuming 2 tablespoons of cashew nuts every week can significantly reduce the risk of developing gallbladder diseases. Supporting this, a study conducted as part of the Nurse's Health Study analyzed 20 years of dietary data from 80,000 women. The results showed that women who consumed 1 ounce (approximately 2 tablespoons) of nuts each week had a 25% lower risk of developing gallstones (Vyavahare R. D. *et al*., 2020) [11].

7. Protects from the early ageing

Cashew nuts contain various vitamins, cashew nuts are particularly rich in immunity-boosting vitamins, such as Vitamin E. 100 grams of cashew kernels contains 46 mg of Vitamin E. According to a study mentioned in the journal of Cordeiro T.A. (2014) [4], men and women, aged 65 and older, consumed about 200IU of vitamin E supplements in their diet showed a positive response, with a decline in the effects of ageing. (Cordeiro T A., 2014) [4].

8. Eye health

Cashews primarily contain two powerful antioxidants, Lutein and Zeaxanthin. Daily consumption of these antioxidants helps to protect the eyes from light damage (Vyavahare R D. *et al*., 2020) [11].

9. Other health benefits

The other health benefits of cashew nuts are listed in the article by Cordeiro T A., 2014 [4]. 28 grams cashews contain 150mg of potassium, an essential mineral for maintaining of healthy kidneys. It also contains 1.30% fibre; fibre absorbs water, softens the stool and helps prevent constipation. Additionally, fiber plays a role in preventing haemorrhoids, varicose veins, hiatal hernias and diverticulosis.

Conclusion

Cashew fruits consist of several parts, including the apple, kernels, CNSL, and testa, all of which are rich in various nutrients, making cashews an ideal choice for a healthy diet. Replacing junk food with tree nuts is an effective method

for preventing many non-communicable global health issues, such as diabetes and cardiovascular diseases. Cashews are also an excellent source of healthy fats, complete proteins, fat-soluble vitamins, and minerals like copper, calcium, and selenium. This article primarily focuses on the nutritional aspects and health benefits of cashews, aiming to promote their nutritional value.

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