

# काजू की पोषक मान NUTRITIVE VALUE OF CASHEW



राष्ट्रीय काजू अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद्)

पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक



**NATIONAL RESEARCH CENTRE FOR CASHEW**

(Indian Council of Agricultural Research)

**PUTTUR - 574 202, DK, KARNATAKA, INDIA**



# काजू की पोषक मान

## NUTRITIVE VALUE OF CASHEW

राष्ट्रीय काजू अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक



**NATIONAL RESEARCH CENTRE FOR CASHEW**

*(Indian Council of Agricultural Research)*

**PUTTUR - 574 202, DAKSHINA KANNADA,  
KARNATAKA**



Published by:

**Dr. M.G. Bhat**

Director

National Research Centre for Cashew

Puttur - 574 202

Tel No. : 08251-231530 (O), 230992(R), 233490 (R)

EPABX : 08251-230902, 236490

Fax : 08251 - 234350

Gram : CAJUKENDRA

E-mail : nrccaju@sancharnet.in / nrccaju@rediffmail.com / nrccaju86@yahoo.com

Website: <http://www.nrccashew.org>

**March 2008**

Compiled and Edited by:

**Dr. K.V. Nagaraja**

Word processed by:

**Mr. R. Muthuraju**

Printed at:

**Codeword Process & Printers**

**Falnir, Mangalore, Phone: 2421418, 5261818**

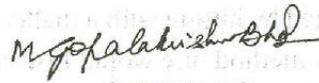


# PREFACE

Cashew, a crop introduced into India from Brazil is one of the important horticultural crops grown in India. India is the first country to commercially exploit this crop for its highly nutritious kernel and developed technologies for the extraction of the same from the raw nut. An attempt has been made in the present publication to highlight the nutritive value of cashew kernel and apple. The publication on "Cashew Nutritive Value" brought out by this Centre in the year 2002 has now been revised and updated. There is misconception regarding the health benefits of cashew among the public. This publication deals with the nutritive value of cashew kernel and composition and utilisation of cashew apple and its by-products. It is hoped that this publication will help in overcoming the unfounded misconception about nutritive value of cashew resulting in increased demand in the domestic market.

I appreciate the efforts of Dr. KV Nagaraja, Principal Scientist (Biochemistry) of this Research Centre in revising and updating the earlier publication.

March 2008



(MG BHAT)

Director

# NUTRITIVE VALUE OF CASHEW

## 1. INTRODUCTION

Cashew was introduced into India by Portuguese travellers during 16th Century. It is grown in an area of 8.54 lakh ha with a production of 5.5 lakh tons of raw cashew nut. During 2006-07, India earned a foreign exchange of 2455 Crores by exporting 1.19 lakh tons of cashew kernel. Cashew nuts are to be processed to extract edible kernel which is highly nutritious.

## 2. PROCESSING OF RAW NUT

Conventionally, raw nuts are roasted in a perforated pan and the kernel is extracted by hitting with a mallet. However, by this method one would lose cashew nut shell liquid (CNSL), an important by-product. Commercially raw nut is shelled by oil bath roasting, drum roasting and steam boiling and kernel is extracted. Oil bath roasting is not employed in recent days. Drum roasting is practised in Kerala, Tamil Nadu, Andhra Pradesh and Orissa. Steam roasting is predominantly practised in Karnataka, Goa and Maharashtra. In recent years, on-farm processing units have been established in Maharashtra and are gaining importance.

The major steps involved in cashew nut processing by steam boiling method are drying the raw nut, humidification of dried nut, steam roasting of dried and humidified nut at 100 lbs for 20 min, shelling of the steam boiled nut using foot and pedal operated sheller after cooling them for 24

h, drying the peeled kernel at 70 C for 7 h, peeling the testa using a wooden / steel knife, grading the kernel and packing using moulded vacuum packing. Well dried cashew nuts (moisture content 6%) could be stored at ambient temperature (27-30°C) for 12 months without either processing or biochemical quality deterioration. The kernel reject obtained during processing is attributed to the extent of floaters and immature nut and the extent of kernel reject could be reduced if the floaters and immature nut are separated before processing.

## 3. BY-PRODUCTS OF CASHEW PROCESSING

The important by-products obtained during commercial processing are testa and cashew shell. The cashew kernel testa is very rich in tannin which is extracted and used for curing skin and hide. Cashew kernel testa after removal of tannin contains proteins, carbohydrates, minerals and fibre. Acidic extract obtained after removal of pectin is a good source of antioxidant which is related to tannin content. Varietal variation has been observed for the composition of cashew kernel testa.

Cashew shell contains cashew nut shell liquid (CNSL) to an extent of 35% by weight. Commercially CNSL is extracted by expeller and the residue after extraction of CNSL is used as fuel for generation of steam required for steam boiling of the cashew nut. CNSL contains 90% of anacardic acid,

5% each of cardanol and cardol. Anacardic acid finds extensive industrial application in textile, timber protection, preparation of formaldehyde resins, abrasives, brick lining, and ship building because of its high antimicrobial properties. Anacardic acid exhibits antifilarial activity. The recent application of CNSL is in the stabilization of nanoparticles. More than 250 patents have been filed on the various industrial uses of CNSL.

Cashew shell after removal of CNSL contains proteins, carbohydrates, minerals and crude fibre. Residual CNSL from cashew shell cake obtained after removal of CNSL by expeller could be removed by washing thoroughly with excess of water over a period of 5 days with several changes of water. Water washing helps in improving the *in vitro* digestibility of protein and water absorption capacity of crude fibre.

#### 4. CASHEW KERNEL

Cashew kernel contains proteins (21%), carbohydrates (22%), fat (47%), minerals and vitamins. Cashew kernel proteins contain all the essential amino acids and is comparable with other nuts like almond. Cashew kernel proteins are rich in acidic amino acids (38.78%). The major basic amino acids such as leucine and arginine are present to an extent of 22.23%. Cashew kernel proteins are comparable with casein in terms of protein efficiency ratio (PER). The PER of cashew kernel protein is 3.2 which is comparable with that of milk protein casein. Cashew kernel does not contain any anti-nutritional factors.

Allergic reactions to cashew kernel globulins, however, have been reported from USA. Similarly, proteinase inhibitors have been detected in cashew kernel from Brazil. These proteinase inhibitors have not been detected in Indian cashew kernel. Cashew kernel contains 47% fat which is quite rich in unsaturated fatty acids. The major fatty acids present in cashew kernel fat is oleic acid (73.4%) followed by linoleic acid (11.9%). Stearic acid is the major saturated fatty acid present (11.9%). Ratio of unsaturated to saturated fatty acid is 5.9. Cashew kernel is free from cholesterol and contains sizeable quantity of mono unsaturated fatty acid (oleic acid) which is now believed to be as efficient as unsaturated fatty acids in lowering the blood cholesterol. The linoleic acid (18:2) present in cashew kernel helps in lowering serum LDL and elevating HDL. Besides these, cashew kernel contains about 1.3% of dietary fibre. Cashew kernel provides more energy compared to animal food (147-272 K cal/100 g) and fish (234 K cal/100 g). Cashew kernel provides an energy of 611 K cal/100 g and this is very much comparable with that of almond (612 K cal/100 g).

Cashew kernel besides protein, fat, and carbohydrate, contains number of inorganic elements like sodium, potassium, calcium, manganese, phosphorus, iron, copper, zinc, manganese, selenium and chlorine. Cashew kernel is rich in potassium and phosphorus. Potassium is known to be essential for upkeep of human kidney.

Selenium present in cashew kernel could help in protection against, lung, liver, skin, brain and gastro intestinal cancer.

Cashew kernel contains sizeable quantity of vitamin E, a naturally occurring antioxidant (210 mg/100 g) and few water soluble B vitamins such as thiamine, riboflavin, niacin, biotin, folic acid, vitamin B6, B12 and pantothenic acid. During commercial processing by steam boiling method, cashew kernel reject is obtained to the tune of about 3%. Kernel oil from the reject could be extracted and refined by solvent, alkali and charcoal treatment to get pale yellow oil. Refinement of the oil from kernel reject leads to a loss of 50% of oil. Antioxidant activity in the oil is reduced by 85 to 90% due to refining. Vitamin E content of the oil, however, is not reduced. As cashew kernel oil contains vitamin E, the oil obtained from cashew kernel reject could find use in cosmetic industry after refinement.

Leading international nutritionists have come out with a new mediterranean diet pyramid emphasizing the nutritional benefits of plant based food including tree nut. The base of the newly developed diet pyramid includes grains, fruits, vegetables, legumes, olive oil, cheese, bread and tree nuts. Cashew kernel is an ideal supplement in the diet of children, pregnant women, and lactating mothers. It could be an alternate source of proteins and carbohydrate and could reduce the risk of ischemic heart disease due to consumption of meat and meat products.

## 5. CASHEW APPLE

The pseudo fruit which is otherwise called cashew apple is a juicy fibrous nutritious fruit. Cashew apple contains sugars, amino acids, tannin, ascorbic acid (Vitamin C) and crude fibre. Cashew apple is very rich in ascorbic acid (240 mg/100 g) which is almost six times that of citrus fruits (40 mg/100 g), a very rich source of Vitamin C. Besides vitamin C, cashew apple contains free soluble sugars most of which are reducing sugars. Cashew apple is quite rich in crude fibre and on a dry weight basis the crude fibre content varies from 15 to 18%. Phenols, tannin and flavonols present in cashew apple could serve as natural antioxidants which play a major role in destroying free radicals. Cashew apple is a good source of Vitamin C and fibre. Consumption of cashew apple could help in overcoming the Vitamin C deficiency and also constipation.

## 6. CASHEW APPLE PRODUCTS

For every ton of cashew nut produced, 10 tons of cashew apples are produced. However, its utility is far from satisfactory. Research work conducted at CFTRI (Mysore), KAU (Madakkathara), Dr. BSKKV (Dapoli) and UAS (Bangalore) has resulted in developing protocols for preparation of a number of products of cashew apple. The major problem in cashew apple utilization for product development is the presence of tannin which is responsible for the astringency, seasonal availability and shorter shelflife. Tannin could be removed by precipitating with gelatin. Clarified

cashew apple juice (after precipitation of tannin) could be used for preparation of RTS, jam, candy, jelly and syrup. Cashew apple is fermented to produce an alcoholic beverage called 'Feni' in Goa.

## 7. VALUE ADDITION IN CASHEW

Different grades of kernel are obtained during commercial processing of cashew. Cashew kernel baby bits are the lowest grade kernels obtained. Cashew kernel baby bits could be coated with sugar, honey and salt. The optimum concentration for coating is 70% in case of sugar and honey. Cashew kernel baby bits could be coated with sugar and a combination of flavour and colour. Cashew kernel baby bits coated with honey and combination of cardamom flavour and apple green colour are organoleptically preferred over other combinations of flavour and colour. Cashew kernel baby bits coated with sugar and different flavours such as cardamom, vanillin and ginger have a shelf life of one year at ambient temperature (27-30°C).

Sweetened and flavoured spread could be prepared from cashew kernel baby bits by blending with sugar and refined vegetable oil.

Cashew apple pomace, the residue obtained after removal of juice, is a good source of crude fibre. Cashew apple pomace could be blended with cereals (rice, finger millet and wheat) and pulses (green gram) flours upto 10% without affecting the in vitro digestibility of both protein and carbohydrate.

Cashew apple powder could be prepared by solar drying the apple for 5 days (8 h/day) followed by drying in a hot air cabinet dryer for 2 days at 70°C. This yielded a free flowing cashew apple powder. Alternatively cashew apple powder could be prepared by autoclaving at 16 lbs for 10 min followed by drying at 70°C for 2 days in a hot air cabinet dryer. Pretreatment of cashew apple with sodium chloride at 2 to 10% concentration over a period of 5 days (concentration of sodium chloride to be increased by 2% daily upto 10%) before autoclaving and drying resulted in cashew apple powder with lower tannin content. Cashew apple powder could be blended upto 20% with cereal flours (rice, finger millet and wheat) to get fibre and antioxidants rich flour blends. Cashew apple powder / pomace has a shelf life of 12 months at ambient temperature (27-30°C). Antioxidant activity in cashew apple powder, however, decreased beyond 4 months of storage at ambient temperature. Antioxidant activity in cashew apple powder is associated with tannin, phenols, amino acids and sugars and ascorbic acid. Antioxidant activity in cashew nut and apple decrease with maturity. Pectin from cashew apple powder could be extracted by acidic extraction (pH1) at boiling temperature for 30 min, concentration of the extract to 1/3rd of its volume followed by ethanol precipitation. The yield of the pectin will be around 5%. The cashew apple pectin is a low methoxyl type and is not preferred as gelling agent.

## 8. TABLES

a) Aminoacid composition of cashew kernel protein

Aminoacid	%
Glutamic acid	28.00
Leucine	11.93
Isoleucine	-
Alanine	3.18
Phenylalanine	4.35
Tyrosine	3.20
Arginine	10.30
Glycine	5.33
Histidine	1.81
Lysine	3.32
Methionine	1.30
Cystine	1.02
Threonine	2.78
Valine	4.53
Tryptophan	-
Aspartic acid	10.78
Proline	-
Serine	5.76

b) Mineral content of cashew kernel(%)

Calcium(Ca)	0.04
Phosphorus(P)	0.88
Sodium (Na)	0.005
Potassium (K)	0.57
Magnesium (Mg)	0.28
Iron (Fe)	0.008
Copper (Cu)	0.002
Zinc (Zn)	0.004
Manganese (Mn)	0.002

c) Vitamin content of cashew kernel (mg/100g)

Thiamine (B1)	0.56
Niacin	3.68
Tocopherol (E)	210
Riboflavin (B2)	Traces
Pyridoxine (B6)	
Axerophthol	
Vitamins D	

d) Composition of cashew apple

g/100 g	
Moisture	86.1
Protein	0.8
Fat	0.2
Carbohydrate	12.6
Fibre	0.6
Ash	0.3

mg/100 g	
Calcium (Ca)	0.2
Phosphorus(P)	19.0
Iron (Fe)	0.4
Vitamin B1 (Thiamine)	0.2
Vitamin B2 (Riboflavin)	0.2
Niacin	0.5
Vitamin C	200

e) Vitamin and mineral contents of various tropical fruits(mg /100g)

Constituent	Cashew apple, Yellow	Cashew apple, Red	Pine-apple	Avo-cado	Banana	Lime	Grape fruit	Mand-arin	Ora-nge
Thiamine			90	120	90	10	40	70	90
Riboflavin	99	124	20	150	60	Traces	20	30	30
Vitamin C	240	186	24	16	10	45	40	31	49
Calcium(Ca)	41	41	16	10	8	14	-	33	33
Phosphorus(P)	11	11	11	38	28	10	-	23	23
Iron (Fe)	3	3	0.3	0.3	0.6	0.1	-	0.4	0.1

f) Fatty acid composition of kernel oil of different tree nuts (% of total fatty acids)

Fatty acid	Almond	Hazelnuts	Walnuts	Macadamia	Cashew
Lauric (12:0)	-	-	-	0.62	-
Myristic (14:0)	0.2	2.2	-	0.75	-
Palmitic (16:0)	8.9	3.1	7	6.15	0.9
Palmitoleic (16:1)	4.0	-	-	19.11	-
Stearic (18:0)	62.5	1.6	3	1.64	11.24
Oleic (18:1)	24.4	88.1	30	67.24	73.73
Linoleic 18:2)	-	2.9	57	1.34	7.67
Linolenic (18:3)	-	-	2	-	-
Arachidic (20:0)	-	-	-	3.30	-
Lignoceric (24:0)	-	-	-	-	0.15
Unsaturated	86.9	91.0	89.0	87.69	81.4
Saturated	13.1	6.9	10.0	12.46	12.29
Unsaturated / Saturated	6.63	13.19	8.9	7.04	6.2
Mono unsaturated / Poly unsaturated	2.6	30.4	0.51	64.4	9.6

g) Kernel composition of different nuts (%)

Constituent	Almond	Hazelnuts	Walnuts	Macadamia	Cashew
Moisture	5.2	-	4.5	1.5 - 2.5	-
Protein	20.8	12.7	15.6	9.2	21.0
Fat (Ether extract)	59.9	60.9	64.5	78.2	47.0
Carbohydrate	10.5	17.7	11.0	10.0	22.0
Fibre	1.7	-	2.6	-	1.3
Mineral matter	2.9	-	1.89	-	2.4

### h) Characterization of pectin from dried cashew apple powder

Ash content		0.15 - 0.25%
	- Yellow apple	634.73
Equivalent weight	- Red apple	691.68
	- autoclaved & dried	384.17
Methoxyl content		3.3 to 5.2%
Acetyl content		0.441 - 0.534%
Compared to commercial pectin		Ash content is low

### i) Compositional variation among different released cashew varieties

	Constituent	Range (%)
<b>Kernel</b>	Protein	32 - 70g
	Starch	21 - 33 g
	Free sugars	9 - 19 mg
	Free aminoacids	34 - 25 mg
	Lipids	48 - 50 g
<b>Apple</b>	Ascorbic acid	145 - 270 mg
	Free sugars	6 - 8 g
	Free aminoacids	6 - 15 mg
	Tannin	27 - 150 mg
<b>Shell (after removal of CNSL)</b>	Protein	2 - 4 g
	Free sugars	0.6 - 2.3 g
	Phenols	44 - 148 mg
	Aminoacids	5.37 mg

Range for cashew kernel protein, starch, free sugars and free amino acids is based on defatted cashew kernel flour

### j) Variation of composition of solar dried cashew apple powder of released varieties

Constituent	Variability
Protein <sup>a</sup>	2.28 - 12.29
Starch <sup>a</sup>	6.75 - 28.66
Sugars <sup>a</sup>	11.14 - 42.37
Vitamin C <sup>f</sup>	42.27 - 167.39
Tannin <sup>c</sup>	0.267 - 2.341
Crude fibre <sup>g</sup>	1.99 - 4.7
Pectin of crude fibre <sup>g</sup>	5.2 - 18.91
In vitro digestibility of crude fibre by diastase <sup>b</sup>	0.197 - 3.783
In vitro digestibility of cashew apple powder by diastase <sup>b</sup>	0.8 - 17.21
Carotenoids <sup>c</sup>	0.08 - 0.288
Anthocyanins <sup>d</sup>	11.78 - 34.38
Peroxide <sup>e</sup>	0.8 - 3.375

a - mg/100 mg

b - mg maltose released / 3h / 100 mg

c - mg/g

d - OD units/g

e - n moles MDA /100 mg

f - µg/100 mg

g - µg galacturonic acid/mg fibre

## 9. SUMMARY

### a) Cashew Kernel

- Mini store house of protein, carbohydrate, fat
- Compares well with milk, egg and meat
- Dietary fibre lowers serum cholesterol and risk of coronary heart disease
- Absence of anti-nutritional factors
- Higher unsaturated fatty acids
- Right proportion of saturated, mono unsaturated and poly unsaturated fatty acids
- High mono saturated fatty acids lowers blood glucose
- Rich in phosphorus and potassium
- Contains Selenium which helps in protection against cancer
- Ideal supplement in the diet of children, pregnant women and lactating mothers
- Alternate source of protein, carbohydrate and fat and for meat and meat products
- Cashew contains few water soluble vitamins
- Cashew contains Vitamin E which improves immunity and could function as a naturally occurring antioxidant

### b) Storage of raw nuts

- Raw nut could be stored upto 12 months. Kernel triglycerides decreased while free sterols increased during storage.
- Immature nuts and floaters are responsible for kernel reject obtained during processing.

### c) Cashew kernel testa

- Cashew kernel testa tannin could be extracted at pH 1, which exhibits antioxidant activity.
- Removal of tannin with pH adjustment to 10 followed by treatment with charcoal resulted in lowering of antioxidant activity indicating that tannin is responsible for antioxidant activity exhibited.

### d) Cashew shell

- Anacardic acid isolated from cashew apple juice, cashew nut and CNSL has been shown to be cytotoxic to BT-20 breast carcinoma cells.

### e) Cashew apple

- Rich in Vitamin C
- Rich in fibre which could help in prevention of hemorrhoids, varicose veins, hiatal hernias and diverticulosis
- Cashew apple juice is to be clarified by addition of gelatin(0.5 g/litre)for preparation of various products.
- Clarified juice can be used for preparation of RTS, Jam, Jelly, Syrups

### f) Cashew apple powder lipid

- Palmitoleate and oleic acids are the major fatty acids in cashew apple powder.
- Unsaturated / saturated fatty acids ratio varied from 2.58 to 2.7 in cashew apple pomace lipids.
- Ratio of unsaturated / saturated fatty acids in different fractions of lipids of cashew apple powder varied from 1.62 (Phospho lipid) to 16.28 (Neutral lipid).

### g) Value addition

- Defatted cashew kernel flour is better than defatted almond flour for water absorption capacity, oil absorption capacity and foaming capacity.
- Blending with soy flour (1:1 w/w) improves the water absorption capacity of defatted cashew kernel flour.
- Low oil and high protein cashew kernel could be prepared by partial defatting and rehydration.
- Cashew apple pomace (residue after extraction of juice) could be blended upto 10% with wheat flour without affecting baking quality.
- Cashew apple pomace could be blended upto 10% with cereal / pulses flour without affecting the in vitro digestibility of starch by diastase.
- Cashew apple pomace contains very low level of phytic acid.

### 9. BIBLIOGRAPHY

1. Manuel Fernandez. (2001). Cashew nut: A Health friendly nut. The Cashew. Vol.VX. No.4. 8-11.
2. Sasi Varma, K. Nutritional Value of cashew nuts. In: "Indian Cashew

Industry". Singh, H.P., Balasubramanian, P.P. and Hubballi, V.H. (Eds). Directorate of Cashewnut and Cocoa Development, Kochi ñ 11. pp. 124-129.

3. Ohler, J.G. Cashew. 1979. Koninkijk. Institut voor de Tropen, Amsterdam.
4. Vaidehi, M.P. and Babu, RM Ray. 2000. "Cashew apple and nut recipes with nutritive value". Publ. Division of Rural Home Science, University of Agricultural Sciences, Bangalore. pp. 72.
5. Cashew Export Promotion Council of India. Kochi. "Cashew Apple Preparations".
6. Mini, C., Mathew. J., Augustin, A. 2005. Technology for cashew apple processing. Directorate of Extension, Kerala Agricultural University, Mannuthy, Trissur. 55 pp.
7. Nutrition in a nut shell. Compiled by The Karnataka Cashew Manufacturers Association, Mangalore.
8. Nagaraja, K.V. 2007. Biochemistry of Cashew : A Review. J. Food Sci. Technol. 44:1-9.

\* \* \*