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REVIEW ARTICLE

Indian Cashew Processing Industry-An overview

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Abstract

Cashew is often regarded as 'poor man's crop and rich man's food' and is an important cash crop and highly valued nut in the global market. The area under cashew cultivation is the highest in India. However, it is not so in the case of productivity, processing and quality. In reality, the Indian cashew industry has a high untapped potential to support the livelihood of cashew farmers, provide numerous employment opportunities and improve returns through global trade. The present work projects the need for important changes to be made in the existing system, so as to find a substantial improvement in the growth of the Indian cashew industry.

Keywords: Cash crop, Indian cashew industry, global market, global trade.

Cashew and Human Health

Cashew (*Anacardium occidentale* L.) is an important tropical cash crop and is native of Eastern Brazil. It was introduced in India five centuries ago by Portuguese travellers. Cashew is a rich source of protein (21.2 %), carbohydrates (22 %), fat (47 %) and minerals (Calcium, Phosphorous and Iron) (Sharma, 2004) and provides 575 kcal of energy per 100 g (Sathe, 1994). As a delicacy, cashew is used in confectioneries, breakfast cereals, health foods, baked goods and as adjuncts in chocolate manufacture. Besides being known as an edible nut, cashew is also known to possess therapeutic value, the potential to treat several common diseases including scurvy, anaemia, cough, urinary complications, liver disorders and diabetes. Its role in treating cardiovascular diseases and obesity is due to the high content of unsaturated fatty acids (Yang *et al.*, 2009). The medicinal uses also extend to treating nervous weakness, general depression and loss of appetite (Puranik, 2003).

India and the World Cashew Market

India is among the top producers of cashew nuts, next to Vietnam, Nigeria and Ivory Coast. These four countries contribute to 70 % of the global cashew production. The area under the crop is 4.71 million ha worldwide with a production of 2.75 million tonnes annually. In 2010, India produced 0.61 million tonnes of in-shell nuts from an area of 0.92 million ha (NHB, 2010). This corresponds to 17.10 % of the global cashew production from 19.6 % of the global area under cashew cultivation (FAOSTAT, 2010). Major contributions within the country are from Maharashtra (32.3 %), Andhra Pradesh (16.15 %), Orissa (13.7 %), Kerala (10.76 %) and Tamil Nadu (9.8 %), indicating maximum growth of the crop in the peninsular region (Personal communication, 2010). In the context of imports, India is the major importer, particularly from various countries of the African sub-continent.

Indian Cashew Industry

India was the first country to enter the global cashew trade. The country processed about 1.14 million tonnes of cashew in 3650 cashew processing mills scattered around the country. The number of cashew processing mills shows an increase from 170 units in 1959 to over 3500 in 2008. The industry provides employment to around 0.5 million people and about 95 % of them are women (Anon, 2009). Forty-six per cent of cashew processing is in the organised sector while 54 % is in the unorganised sector. Annual demand on the Indian cashew processing industry is in the order of 1.5 million tonnes, only a half of which is met by the existing production. To meet the rising demand, India imports raw in-shell cashew from Congo, Tanzania, Indonesia and Thailand (Zheng, 2012). India exports processed nuts to USA, UK, Japan, Netherlands, Australia, Canada and Germany (Directorate-General of Commercial Intelligence and Statistics, 2011). Cashew is of global value and Table 1 shows a summary of the various uses of cashew products and by-products.

Commercial Cashew processing

Cashew processing is a series of unit operations essential to make available, the edible nut. Variations

Table 1: Cashew nut, products and by-products

Component	Percent weight[a]	Value (Rs.)[b]	Usage
Raw cashew nut[c]	15 %	75	Requires further processing
Cashew kernel	3.75 %	750	60 % used as an ingredient with in the snack food industry and 40 % in the confectioneries.
CNSL	3.60 %	66	Component in drugs, paper ink, textiles, cosmetics and paints manufacturing; also in the treatment of certain dermatological disorders
Outer shell	7.5 %	-	Fuel; Directly burnt as a biomass or is used as feedstock for gasification or is converted into briquettes.
Testa/ peel	0.15 %	-	Natural antioxidant, uesful resource in leather manufacturing industry
Cashew apple	75- 85 %	20	Medicinal: treatment of scurvy, diarrhoea, pharyngitis and chronic dysentery. Food: jam, syrup, chutney, beverage and juice

[a]*assigning a weight of 100 to the sum of weights of freshly harvested raw cashew nut and fruit.*
[b]*corresponds to the per kg market value of the particular component in its freshly obtained form.*
[c]*comprises of cashew kernel, outer shell and testavariety.*

in processing methodology between different manufacturers are attributed to differences in cashew, availability of equipment-type, human resource and fuel source. In India, most cashew processing units are at rural level. After 1960, unit operations such as roasting, shell liquid extraction and shelling have been mechanized. However, most other processing steps remain as tedious as manual operations. The following section explains the most commonly adopted unit operations in cashew processing.

The unit operations involved in commercial cashew nut processing are explained in Fig 1. Cleaning is usually done manually and eliminates unwanted extraneous materials such as stones, sand, twigs and leaves before any further processing. Soaking of nuts in water helps to avoid scorching during the roasting operation. This conditioning operation (soaking-draining-drying) is carried out until an approximate moisture content of 9 % w.b. is reached (Balasubramanian, 2001). Roasting of nuts makes the shell brittle and loosens the kernel from the shell. Simultaneously, the nut releases the dark brown coloured Cashew Nut Shell Liquid (CNSL). Most common methods of roasting include: open pan method, drum roasting method and oil bath method. While open pan and drum roasting methods involve direct heat transfer, the latter method employs non-edible oils as heat transfer medium. The effect of roasting is seen in the texture, colour, flavour and overall appearance of cashew kernels. Hence, selecting the correct roasting method is a deciding parameter of end product quality (Saklar *et al.*, 2001). The next step is shelling removal of the roasted outer cover. This process is done either by manual (nuts are placed over a flat surface and cracked individually with a wooden mallet) or mechanical (mechanical action of a knife to open up the shell) methods. Most Indian units have an out turn off at 50-56 % (Kyle, 2009). An efficient unit produces minimal brokens and splits. However, most units yield less than 70 % whole kernels (Ojolo and Ogusumia, 2007). Separation of cashew kernels from broken shell pieces and unshelled kernels is the next requirement. This is done either manually (hand picking) or mechanically (using a blower). Shelled kernels thus obtained would contain the testa adhering to the surface. Kernels are passed through subsequent stages of drying and cooling to make the testa brittle. Most conventional drying systems such as hot air and kiln dryers suffer huge levels of energy losses. During this stage, the moisture content of the kernel is observed to reduce from 7 % to 3 % w.b. (Mandal, 2000). Next, the testa is peeled either manually (rubbing the kernels, followed by a knife-finish) or mechanically (air-blasting kernels passed through a series of rubber rollers). However, the testa is known to be a rich source of polyphenols (Mathew and Parpia, 1970) and catechins (Trox *et al.*, 2011). These values are reported to be higher than in tea and chocolates. Ethanolic extract of testa showed significant levels of anti-oxidant activity (Kamath and Rajini, 2007). The nutraceutical of the testa has been ignored. A sorting operation is required to segregate the kernels into whole, brokens and splits. Cashew kernels are finally graded based on size, colour and other standards. In

India, Cashew Export and Promotion Council (CEPC) specifications are usually adopted for grading cashews. International market prices are mainly based on the kernel size and percentage of broken kernels as per ISO specifications (Nouwligbèto and Jèrôme, 2003). Whole kernels fetch higher market prices. However, brokens have a higher nutritional value and are commonly used in nut butter formulations of other products (Lima and Bruno, 2007). The kernels are finally packed in flexible polymers or metal packs, preferably under vacuum. This is to minimize the effects of deteriorative oxidative reactions that would result in development of rancid off-flavour compounds and hence, degrade market value.

Problems in Cashew Processing in India

Cashew nut processing demands high labour and fuel requirements. Though many technologies have been developed, most small and medium processing units follow traditional processing methods. This could be because of problems with technology-transfers, insufficient capital investments, shortage of resources and mere negligence. There have also been concerns about the need to address the safety and healthy working standard requirements of labours engaged in cashew processing. The following sections explain the problems faced in the Indian cashew processing industry.

1. Supply-Demand Imbalances

Though India is the leading producer of raw cashew nuts, the country continues to rely on various forms of the commodity from the Middle-East to meet the growing demands. India (58 %), Vietnam (25 %) and Brazil (15 %) dominate the global processed cashew markets (Kyle, 2009). From Table 1, it is evident that there is a 10 fold increase in market value when raw cashew nut is processed to segregate the kernel. Also, subsequently processed product like spiced cashew would fetch about Rs. 1300 per kg, indicating a 17 to 18 % increase in value as compared to raw cashew nut. Apart from the edible portion obtained, Table 1 explains that the processing by product CNSL has a wide scope for several industrial applications (Paramashivappa *et al.,* 2001). Nut butter production is a relatively simpler, yet less performed processed in India.

2. Energy losses

Most cashew processing units continue to involve non-standardized unit operations that result in huge losses of fuel and energy. Steaming or roasting of raw cashew nuts and mechanical drying of kernels are classical examples. These high temperature treatments are indispensible to break the shell and remove the testa. Temperatures ranging from 75 to 200 ^{o}C are commonly used in such processes (Trox *et al.,* 2010). During steaming, water molecules penetrate into the shell structure and result in loosening of cell matrix components. Hence, pressure, temperature and time of exposure are critical process parameters. Cutting and shelling operations involve heavy consumptions of energy. This is because of the peculiar kidney-shaped kernel, the presence of a tough outer shell, the reactive CNSL and the brittleness of the kernel (Jain and Kumar, 1997, as cited by Ogunsina and Bamgboye, 2013). There is a scope for an overall energy savings of up to 30–48 % (Mohod *et al.,* 2010a). Mohod *et al.* (2010a) also proposed, there is scope for utilization of renewable energy sources such as solar energy and bio-mass gasification in this sector. Use of modern equipments demand huge investment costs. This is because of the use of conventional, inefficient devices. Fuel used in roasting is in most cases, high– moisture agricultural bio-mass. This may involve the direct combustion of cashew nut shells in furnance or semi–open pits and is characterized by low fuel calorific value and subsequent thermal energy losses (Bhoi *et al.,* 2006).

3. Inferior Product Quality

The work atmosphere of many small-scale cashew processing units is deplorable and unhygienic, leading to inferior quality of cashew nuts, with high levels of contamination. For example, the soiling operation commonly adopted in most rural units prior to shelling (Fig 2), so as to remove the oil adhering to the surface is known to be a potent source for direct contamination of the edible product. High temperatures used to loosen the outer shell can have adverse effects on heat sensitive bioactive compounds in the kernel. Further, storage of high moisture cashew kernels under adverse conditions would result in aflatoxin contamination, a rising concern in food safety. Among recent interventions that could possibly be implemented in India, the ‘‘Flores’’ hand-cracking method developed in Indonesia allows the cashew nut kernels to be separated from the shell by means of a manual cracking device. The cashews produced after a 3 hours mild temperature drying at about 45°C has the testa undamaged, with minimal emergence of CNSL, which could come in contact with the kernel and lower its value. The method also exhibited low levels of reduction of bio-active compounds in the cashew kernel and is considered to be a better shelling process compared with open pan roasting and oil-bath roasting (Trox *et al.,* 2010). Further, there is limited knowledge available on grading standards for cashew kernels in

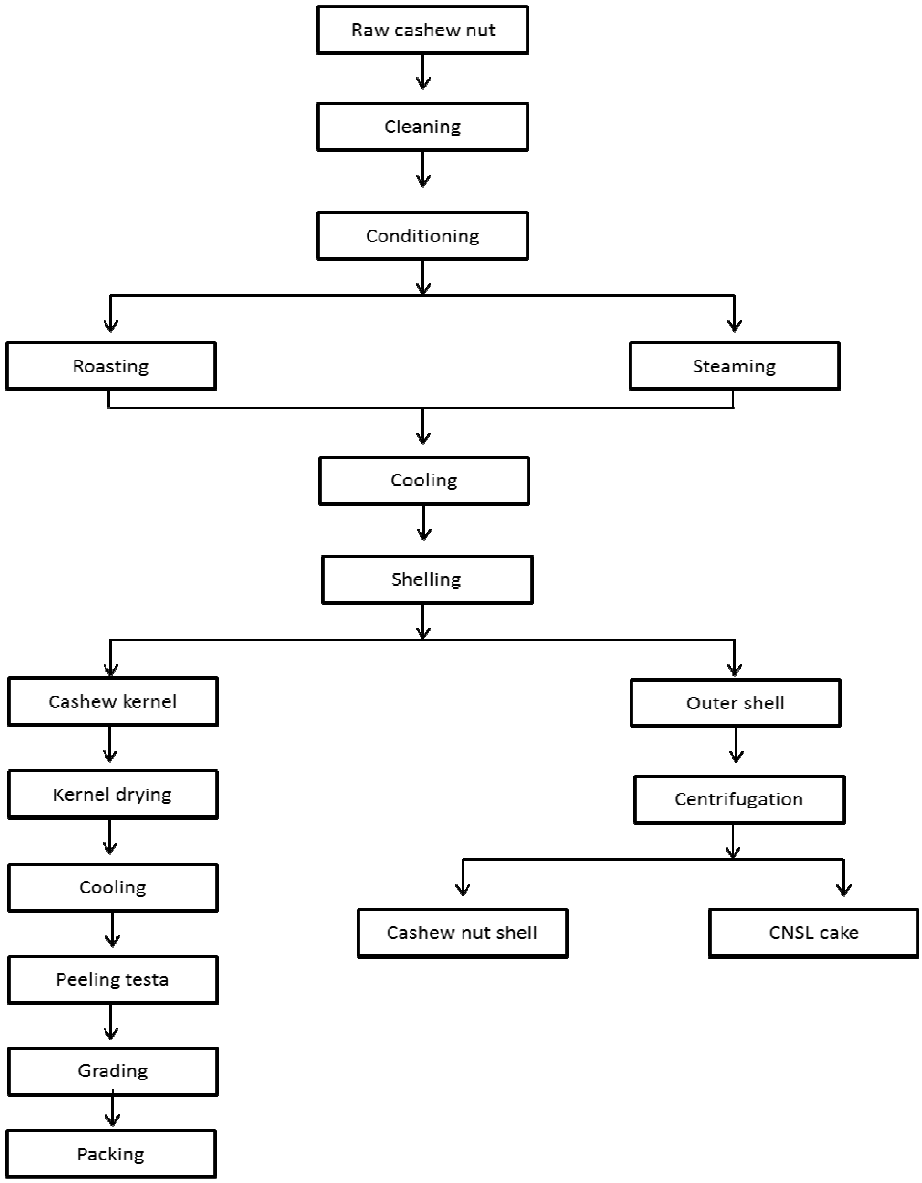

Fig 1: Unit operations involved in cashew nut processing

India. This is an important concern because improperly roasted kernels with improper shape and smaller size fetch lower prices at the international market. Yet another issue is the risk to mould contamination in improperly roasted kernels. Fig 3 presents the Indian grading standards for cashew kernels.

4. Health and Safety Issues

In most cashew processing units, workers face several health problems. Shelling is considered to be the most hazardous section in the process line. Workers squat in rows on congested and unhygienic floors littered with burned nutshells and dust (Fig 4). Female workers are commonly adopted for this purpose. In India, over 82 % are manual-processing units compared with 40 % in Vietnam and 25 % in Brazil. While breaking the shells CNSL oozes out. This caustic oil can cause severe irritation to fingertips and often results in skin burns. To avoid this, workers apply a layer of oil (commonly coconut oil) and smear ash over skin parts (Fig 5). Very few units provide hand-gloves

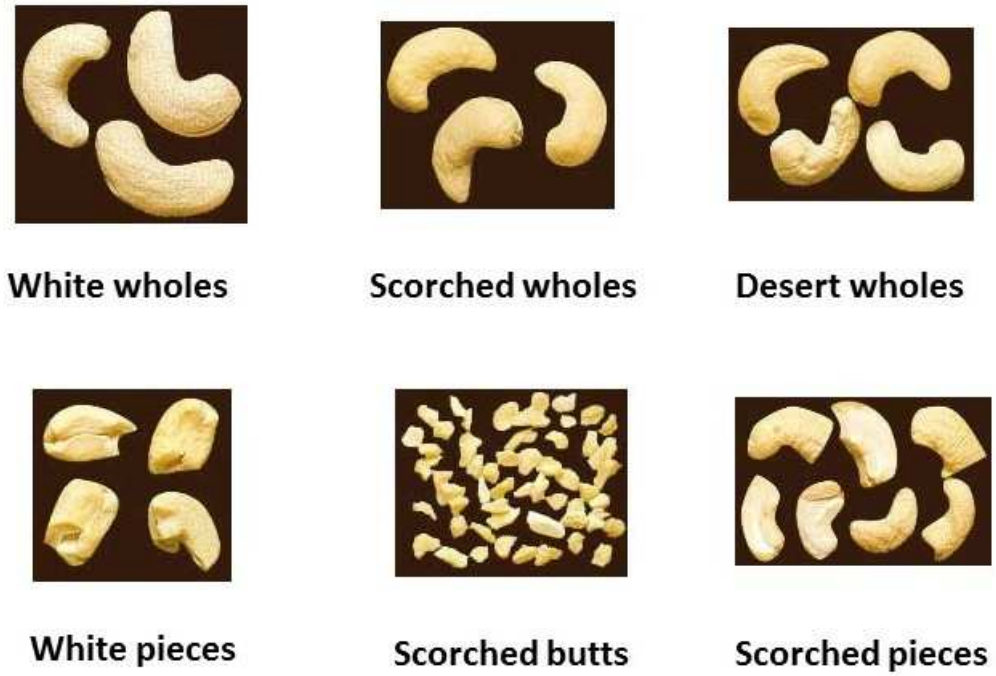

Fig 3: Commercial cashew grades in the Indian cashew industry *(Source: Adapted from the Cashew export promotion council of India)*

for workers. There have also been instances when sharp broken pieces strike the worker's eye during shelling, often resulting in permanent vision problems. Almost 90 % of workers suffer health hazards while employed in such operations.

Fig 2: Soiling the outer shell for surface oil removal

Several other medical issues such as allergic contact dermatis, respiratory diseases, cancer, reproductive disorders, lower back pain, stiff neck, pain in the heels, strain on eye muscles, finger pain, numbness and even bleeding from finger nails were reported by those workers (Kannan, 1978). The condition remains same even after 25 years of publication of the work just cited. Medical findings explain that prolonged squatting leads to degenerative tissue changes and functional defects of the musculoskeletal system. In the peeling and grading section also, women workers suffer similar issues in addition to muscular discomfort and cramps. Such working conditions also make them prone to asthma and other respiratory disorders.

5. Environmental Issues

In India, many state governments have banned drum roasting of cashew nuts because of its contribution to air pollution. Its economical afford ability is at the price of the ill-effects to the environment. Eco-friendly steam cooking is an alternative.

Fig 4: Woman working in the shelling section

Fig 5: Ash used to avoid skin burns

A study claims that the combined use of steam cooking and hand-cum-pedal operated sheller is more cost-effective than other processing systems (Line, 2003). However, the method is not adopted in most units. Also, the thick acrid fume generated during the roasting process pollutes the environment (Azam-Ali and Judge, 2001). With considerations to environmental protection, cashew processing units need to strictly adhere to environmental protection standards which have been approved by the Peer and Core Committee of Central Pollution Control Board (Mohod *et al.*, 2010b).

Conclusions

As the demand of cashew nut grows, the area under cashew crops is also increasing. But this trend is constrained. Research and development presently - focuses on implementing good cultivation practices and developing high yielding varieties, pest resistant crops and other technologies to improve the productivity and quality of cashew. In order to balance the gap in supply-demand, India imports various forms of cashew. India needs to take necessary actions to improve productivity, cultivation practices and food safety standards in the cashew processing sector. Limited data is available on the processing efficiency of different unit operations by manual and mechanical means in cashew processing. There is also a need for an informative survey of other problems in Indian cashew units, so as to re-focus research and development. Such measures will ensure greater value of Indian cashew at the global markets.

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