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PM Formalisation of
Micro Food Processing Enterprises Scheme

Processing of Cashew Nuts

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The cashew tree, native to Brazil, was introduced to Mozambique and then India in the sixteenth century by the Portuguese, as a means of controlling coastal erosion. It was spread within these countries with the aid of elephants that ate the bright cashew fruit along with the attached nut. The nut was too hard to digest and was later expelled with the droppings. It was not until the nineteenth century that plantations were developed and the tree then spread to a number of other countries in Africa, Asia and Latin America.

Cashew processing, using manual techniques, was started in India in the first half of the twentieth century. It was exported from there to the wealthy western markets, particularly the United States.

1.1.1 The importance of cashew

Cashew is known by many names. In Mozambique, the Maconde tribe refer to it as the "Devil's Nut". It is offered at wedding ceremonies as a token of fertility and is considered by many to have aphrodisiac properties.

The cashew industry ranks third in the world production of edible nuts with world production in 2000 at about 2 million tonnes of nuts-in-shell and an estimated value in excess of US$2 billion. India and Brazil are the major cashew exporters, with 60 percent and 31 percent respectively of world market share. The major importers are the United States (55 percent), the Netherlands (ten percent), Germany (seven percent), Japan (five percent) and the United Kingdom (five percent).

Cashew kernels are ranked as either the second or third most expensive nut traded in the United States. Macadamia nuts are priced higher and pecan nuts can be more costly, if the harvest is poor. The extensive market connections of exporters from Brazil and India make it difficult for the smaller exporters to make gains in the United States market. Importers may appreciate the low prices offered by small suppliers, but the lack of reliability in quality tends to make them favour the larger, more reputable suppliers.

1.2 Opportunities for small scale processors

Cashew processing is a very competitive but also a potentially lucrative activity that can and should be exploited by more small-scale processors. African countries that are in the process of re-building their local cashew processing industry would be well advised to follow the Indian example of small scale, mainly manual processing operations. There are several good reasons why small-scale producers and processors should get involved in cashew processing, including the following:

- Cashew kernels are a high value luxury commodity with sales growing steadily at an annual rate of seven percent, with every expectation that the market will remain strong.
- There is substantial potential to exploit cashew by-products, such as cashew butter, from broken nuts, CNSL for industrial and medicinal purposes and the juice of the cashew apple that can be processed further.
- Cashew is a good crop for smallholder farmers. In Mozambique cashew is considered by smallholder farmers to be one of their most lucrative crops. It requires few inputs and harvesting does not coincide with peak labour demands for other food crops

Thus cashew has the potential to increase the incomes of poor producers, to create employment opportunities during harvesting and processing and to increase exports. However, as with all small-scale processing operations, cashew processing is not without risk or problems. In order for the small-scale processor to succeed, there are certain constraints, which also need to be considered:

- Cashew production is very weather dependent so supply is variable. World prices, although stable on average, are
- Highly volatile in the short term.
- Luxury goods must be of high quality. In order to compete directly in the world market, a high level of standards,
- Branding and marketing are required.
- Exploitation of by-products requires new technology, which may be expensive or difficult to obtain.

- Production volumes must be sufficient to ensure a consistent supply of raw material.

1.2.1 Cashew products

Three main cashew products are traded on the international market: raw nuts, cashew kernels and cashew nut shell liquid(CNSL). A fourth product, the cashew apple is generally processed and consumed locally.

The raw cashew nut is the main commercial product of the cashew tree, though yields of the cashew apple are eight to ten times the weight of the raw nuts. Raw nuts are either exported or processed prior to export. Processing of the raw nuts releases the by-product CNSL that has industrial and medicinal applications. The skin of the nut is high in tannins and can be recovered and used in the tanning of hides. The fruit of the cashew tree that surrounds the kernel can be made into a juice with a high vitamin C content and fermented to give a high proof spirit.

1.2.2 Cashew kernels

It is estimated that 60 percent of cashew kernels are consumed in the form of snacks while the remaining 40 percent are included in confectionery. The cashew competes in the same market as other edible nuts including almonds, hazels, walnuts, pecans, macadamias, pistachios and peanuts. There has recently been a considerable rise in demand for edible nuts by consumers interested in quality and health aspects of food. The breakfast cereal, health food, salads and baked goods markets are all expanding markets for cashew nuts.

1.2.3 Cashew nut shell liquid

Cashew nut processing allows for the development of an important by-product, which can increase its added value. Theliquid inside the shell (CNSL) represents 15 percent of the gross weight and has some attractive possible medicinal andindustrial uses. CNSL is one of the few natural resins that is highly heat resistant and is used in braking systems and inpaint manufacture. It contains a compound known as *anacardium*, which is used to treat dermatological disorders.

1.2.4 Botanical characteristics of cashew

The cashew tree, *Anacardiumoccidentale L.*, belongs to the *Anacardiaceae*family of plants. The tree is native to Brazil, but has spread to other parts of tropical South and Central America, Mexico and the West Indies. The cashew tree is a tropical evergreen, resistant to drought, unexacting as to soil (although it prefers deep, sandy soil), which grows up to 12 metres high and has a symmetrical spread of up to approximately 25 metres. It has leathery oval leaves. Reddish flowers grow in clusters and the pear-shaped fruits, referred to as cashew apples, are red or yellowish in colour. At the end of each fruit is a kidney-shaped ovary, the nut, with a hard double shell. Between the shell and nut is black caustic oil, which is difficult to remove and can be used in varnishes and plastics. Optimum conditions include an annual rainfall of at least 889 mm (35 inches) and not more than 3 048 mm (120 inches).

1.2.5 Harvesting

The harvesting and processing of cashew is very labour intensive. After producing clusters of flowers, cashews produce the edible apple and also a nut encased in a heavy shell, which is the true cashew fruit. The cashew tree flowers for two or three months and fruit mature about two months after the bloom. The cashew nut forms first at the end of the stem.

Subsequently, the stem swells to form the "apple" with the nut attached externally. The cashew nut is 2.5 to 4.0 cm (1.0 to 1.5 inches) long and kidney shaped. Its shell is about 5 mm thick, with a soft leathery outer skin and a thin hard inner skin. When fully ripe, it falls to the ground.

Harvesting generally involvescollecting the nuts once they have dropped to the ground after maturing. Workers scour the area and detach the nut from the fruit. The nuts are generally collected in baskets or sacks. Cashew fruit are generally left to fall to the ground before being collected, as this is an indication that the kernel is mature. If fruit are picked from the trees, the cashew apple will be ripe, but the kernel will still be immature. Apples to be used for processing into products such as jam or juices should be picked from the tree before they fall naturally.

1.2.6 Drying of the raw material

Cashew nuts are dried in the sun for two reasons:

- To reduce the moisture content of the nut,

- To mature the seed in the infrared and ultra-violet rays of the sun.

Cashew nuts should keep for 12 months or more, provided that they are dried to moisture content of eight percent or below, packed in sealed polythene bags and stored under dry conditions. The moisture content of cashew nuts at harvest is dependent on climatic conditions, moisture content of the soil, on which the nuts have fallen, weed growth density under the tree and the time between nut fall and harvest. High moisture content may cause deterioration of the kernel due to mould or bacterial attack or enzyme action. Drying the nuts immediately after harvesting is essential in preserving their quality, but this process is often neglected.

Sun drying of cashew nuts can be done on specially prepared drying floors or mats made of bamboo or palm leaves. The drying areas should be smooth and slightly sloping, so as to allow rainwater to run off. The cashew-nut layer on the drying floor should not be thicker than 10 cm, thus allowing for about 60 kg of nuts per square metre. The nuts should be constantly raked in order to ensure that they all receive the same benefit of the sun's rays and therefore they are dried evenly. The nuts should be heaped together and covered in the evenings. If the nuts are heaped while still warm, they will continue to dry under the cover of a tarpaulin. The nuts should be checked the following morning to ascertain the need for further drying.

Dried nuts should make a rattling sound when falling. Drying may take between one and three days depending upon local climatic conditions. As soon as the nuts are dry, they should be stored and protected from rain.

1.2.7 Storage

Technical requirements for storage are dependent on weather conditions. As cashew nuts are usually produced in climates with a long dry season, simple buildings with concrete floors and walls and roofs of corrugated metal, should provide adequate storage.

Certain prerequisites must be satisfied to ensure safe storage:

1. a waterproof, dry floor,
2. a firm and secure roof,
3. openings in the wall must be protected in order prevent water from entering the room,
4. headroom must be adequate to allow the bags in a stack to be moved around if large quantities are to be stored,

5. the store should be easily inspected: there must be sufficient clearance between the wall and the bags,to allow individuals to walk around and check the condition of the stack,
6. the stack must be placed on a raised wooden platform, in order to prevent moisture from being drawn from the floor to the nuts.

1.2.8 Infestation of harvested nuts

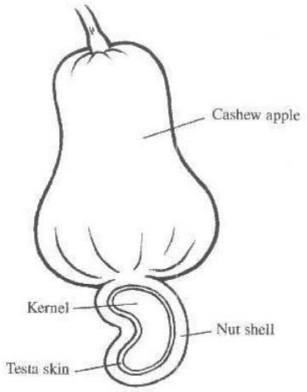
Raw cashew nuts, stored in sacks, sometimes in the open awaiting shipment and frequently without protection from rain, are subject to infestation through the stem-end. This may go undetected until damage has progressed to the point of heavy loss. Infestation also occurs in the shelled kernels at various stages of handling.

CHAPTER 2

PROCESSING OF CASHEW NUTS

2.1 Post-harvest handling

The nut is encased in a rock hard shell that is virtually impossible to penetrate after harvest. In order to extract the nut, the whole shell is soaked in water, softened by steaming and carefully air-dried to the final moisture content (9 percent). Each nut is hand massaged and cracked via a manual process that entails putting the nut against one sharp blade and bringing another blade, which is on a foot powered lever, through the outer shell. The blade on the foot lever is raised by an enthusiastic stomp allowing the outer shell to separate from the nut. The nut inside is carefully picked out of the outershell using a nut pick.



Cross section of cashew fruit

Cashews have served nutritional, medicinal and wartime needs. More recently, they have been used in the manufacture of adhesives, resins and natural insecticides. The cashew kernel is a rich source of fat (46 percent) and protein (18 percent) and is a good source of calcium, phosphorus and iron. It has a high percentage of polyunsaturated fatty acids, in particular, the essential fatty acid linoleic acid. The tart apple is a source of vitamin C, calcium and iron. The bark, leaves, gum and shell are all used in medicinal applications.

The leaves and bark are commonly used to relieve toothache and sore gums and the boiled water extract of the leaf or bark is used as a mouthwash. A paste of bark ground in water is used in topical applications for the cure of ringworm; in this form it can however act as an irritant and should not be applied to sensitive skin or to children. The root has been used as a purgative. Fibres from the leaves can be used to strengthen fishing lines and nets and as folk remedies for calcium deficiency and intestinal colic, as well as a vitamin supplement. The water-resistant wood is used for boats and ferries, while the resin, in addition to having industrial uses, is used as an expectorant, cough remedy and insect repellent.

2.1.1 Uses of cashew nut

The cashew nut kernel is constituted of three different portions namely the shell, the kernel and the adhering testa. The primary product of cashew nuts is the kernel, which is the edible portion of the nut and is consumed in three ways:

- directly by the consumer,
- as roasted and salted nuts,
- in confectionery and bakery products, for example, finely chopped kernels are used in the production of sweets, icecreams, cakes and chocolates, both at home and industrially and as paste to spread on bread.

The relative importance of these uses varies from year to year and country to country, but it is estimated that at least 60percent of cashew kernels are consumed as salted nuts. Separately packed cashew nuts are a good selling line, mainly asan appetizer to cocktail drinks. Salted cashews are part of the snack food market. They compete mainly with other nuts,although chips, salted popcorn and other savoury snacks can impinge on the nut market. The price of cashew

nuts ismuch higher than the price of peanuts or other snacks so those sales must be based on a strong taste preference by theconsumer.

2.1.2 Uses of cashew nut shell liquid (CNSL)

The cashew nut shell contains a viscous and dark liquid, known as cashew nut shell liquid (CNSL), which is extremelycaustic. It is contained in the thin honeycomb structure between the soft outer skin of the nut and the harder inner shell.The CSNL content of the raw nut varies between 20 and 25 percent. Cashew nut shell liquid (CNSL) is an important and versatile industrial raw material. There are more than 200 patents forits industrial application. CNSL is also used in mouldings, acid-resistant paints, foundry resins, varnishes, enamels and black lacquers fordecorating vases and as insecticides and fungicides. In tropical medicine, CNSL has been used in treating leprosy,elephantiasis, psoriasis, ringworm, warts and corns.

2.1.3 Uses of cashew apple

The cashew "apple" or false fruit is an edible food rich in vitamin C. It can be dried, canned as a preserve or eaten fresh from the tree. It canalso be squeezed for fresh juice, which can then be fermented into cashew wine, which is a very popular drink. In parts of India, it is used to distil cashew liquor referred to as *feni*. The cashew apple isbetween three and five inches long and has a smooth, shiny skin that turns from green to bright red, orange or yellow incolour as it matures. It has a pulpy, juicy structure, with a pleasant but strong astringent flavour. Furthermore, the fruit has medicinal properties. It is used for curing scurvy and diarrhoea and it is effective in preventingcholera. It is applied for the cure of neurological pain and rheumatism. It is also regarded as a first-class source of energy.

Cashew fruitcan be made suitable for consumption by removing the undesirable tannins and processing the apples into value-addedproducts, such as juices, syrups, canned fruits, pickles, jams, chutneys, candy and toffee. The recommended methods forremoving the astringent properties of the cashew apple include steaming the fruit for five minutes before washing it incold water, boiling the fruit in salt water for five minutes or adding gelatin solution to the expressed juice.

2.1.4 Using cashew apples in recipes

In gathering the fruits and transporting them to be processed, the prime purpose should be to have the fruit arrive in the very best condition possible. Cashew apples should be sorted and only mature, undamaged cashew apples should be selected for use in recipes. These should be washed in clean water prior to use.

2.1.5 Cashew wine

Cashew wine is made in many countries throughout Asia and Latin America. It is a light yellow alcoholic drink, with an alcohol content of 6 to 12 percent.

Processing

Cashew apples are cut into slices in order to ensure a rapid rate of juice extraction when they are crushed in the juicepress. The fruit juice is sterilized in stainless steel pans at a temperature of 85oC in order to eliminate any wild yeast. Thejuice is filtered and treated with either sodium or potassium metabisulphite, to destroy or inhibit the growth ofundesirable types of micro-organisms such as acetic acid bacteria, wild yeast and moulds.Wine yeast (*Saccharomyces cerevisiae* - varellipsoideus) should be added. Once the yeast has been added, the juice isthoroughly stirred and allowed to ferment for about two weeks. The wine is separated from the sediment and clarified bymixing fining agents, such as gelatin, pectin or casein, with the wine. Filtration is carried out with filter-aids such asfullers earth. The filtered wine is transferred to wooden vats.The wine is pasteurized at 50 to 60oC.

The temperature should be controlled, so that it does not rise exceed 70oC, sincealcohol vaporizes at a temperature of 75 to 78oC. The wine is then stored in wooden vats and subjected to ageing. Atleast six months should be allowed for ageing. If necessary, the wine should be clarified again before bottling. Duringageing and subsequent maturing in bottles, many reactions, including oxidation, occur. The formation of traces of estersand aldehydes, together with the tannin and acids already present enhance the taste, aroma and preservative properties ofthe wine. The product is packaged in glass bottles with corks and should be kept out of direct sunlight.

Dried cashew fruits

Cashew fruit are not readily consumed in the raw state because of their high content of astringent compounds. If these areremoved and the fruit is sweetened, it can be converted into a useful dried product. The fruit must therefore beextensively processed prior to drying.

Fruits are prepared according to the following process:

Fruits are picked from the tree using special hooked sticks (note that fruits harvested at this stage of maturitycontain nuts that are immature). The fruit is washed and boiled in salted water (two percent solution) for fiveminutes to remove the astringent compounds.The skin is pricked with a fork and the fruit pressed in a small hand press to extract the juice. The collected juice isreserved for later use.The fruit is boiled for three hours in a solution of cashew juice and raw sugar (2 kg raw sugar in 10 litres of juice).Other sweeteners can also be used, for example: 0.5 kg white sugar in 1.8 litres of cashew juice; 1.2 litres canejuice in 1 litre cashew juice; 250 ml (1 cup) honey in 2 litres cashew juice.The boiled, sugared fruit is laid out on screens and placed in a drier. In a simple solar drier, drying time takes aboutthree days.The fruit is packaged in airtight moisture-resistant packaging.

2.2 Cashew processing in Asia

India is the main cashew processing country in Asia. The highly skilled workforce and low labour costs in India allowed it to have a virtual monopolyon the manual processing of cashew for many years.

2.2.1 Traditional processing in India

The traditional practice in the south Arcot region of India was to spread the nuts out on flat rocks in the sun, to allowthem to dry until the shell became brittle. The kernel could then be removed from the shell by striking the nut with awooden batten to split the shell along the natural line of cleavage. The cashew kernel was removed from the shell withoutbecoming contaminated by the CNSL. Use of this method was made possible by the suitability of humidity and climatecondition in that particular region of India. Shells are further processed to obtain the CNSL.An alternative method of removing the kernel from the shell is to subject the nuts to very low temperatures, thus causingthe shell to become brittle. Following this, the nuts are mechanically cut along the natural line of cleavage and the kernelsremoved. The shells are then

further treated to remove the CNSL. This method of kernel removal has been commerciallyadopted.

2.2.2 Open pan roasting

Open pan roasting is used by traditional cashew processors in India. This roasting technique is very simple with minimalequipment requirements. It however requires skill and judgement in order to prevent the nuts from burning.The roasting pan is an open circular mild steel dish, measuring 600 to 675 mm (2 to 2.5 feet) in diameter, supported overan open fire. Between 1 and 1.5 kg of raw nuts are placed on to the heated pan at a time. The nuts are heated on the pan,with constant stirring, in order to prevent burning (Figure 6). As the nuts heat up, the CNSL is exuded onto the pan andeventually ignites, producing clouds of thick black smoke. After heating and burning for about two minutes (judged byexperience) the pan is dowsed in water and the nuts are thrown off and allowed to cool, during which the shells becomebrittle and can be readily removed from the nut.

2.2.3 Traditional manual shelling

The nuts for shelling and the tin for receiving must be correctly positioned so as to avoid wasting effort in reaching from one to the other. The raw and cleaned nuts must alsobe separated in order to avoid contamination of the extracted kernels. If the sheller is right-handed, the pile of nuts forshelling should be placed on the left hand side. The nut is picked up in the left hand and struck with the mallet on theright hand. The kernel is removed and deposited in the receiving can in the centre or on the right hand side. The shellpieces are brushed aside into a pile. The hands and striking point have to be regularly coated in wood ash to keep the kernels clean.

Shelling is a technique that can be relatively easily learnt. Strength is not required for breakage of the shell. Correctpositioning of the nut and the ability to hit the nut in the correct position, so as to allow its breakage is most important. Ifthe nuts have been properly roasted and are correctly positioned on the striking platform, they will easily break down thenatural line of cleavage when struck at the broad end. The convex side of the nut should be placed in contact with thestriking platform, with the plane of cleavage at right angles to the surface of the striking post. Occasionally, a nut willrequire more than one strike in order to open the shell, but this

technique comes with practice. An average sheller canopen one nut in about six seconds or ten nuts per minute. In an eight hour working day, this amounts to about 4 800 nutsor about 5 kg of kernels.

2.2.4 Quality control in shelling

Several points must be to monitored:

The discarded shells must be inspected for completeness of removal. An inspector should aim to inspectapproximately one in ten discarded shells for kernels, wholes and pieces that are being discarded with the shell,partially shelled nuts and unshelled nuts.The inspector should also inspect the extracted kernels and pieces for cleanliness and to make sure there are nopieces of shell included.At the end of the day the quantity of shelled kernels should be weighed to assess the productivity of each sheller. Ifshellers are paid on a piece-rate basis, then the individual amounts are weighed separately. The percentageextraction, which is the ratio of kernels to raw roasted nuts, is calculated.Shelled kernels have a moisture content of over 6 percent, which makes them susceptible to fungal attack. It is imperativethat they be dried immediately after shelling.

2.2.5 Manual peeling

Manual peeling is performed by gently rubbing with the fingers. Those parts still attached to the kernel are removed withthe use of a bamboo knife. One person can peel about 10 to 12 kg of kernels per day.It is important that the kernels are not cut or damaged during the peeling process. The use of knives increases thelikelihood of the kernels becoming damaged, but it is also essential that all of the testa be removed. Gentle scraping ofthe testa with a blunt knife is the most effective way of removing it.Peeled kernels can be separated into different grades with the use of a peeler. At the most basic level, the kernels areseparated into white wholes, scorched wholes, white pieces, scorched pieces, browns and refuse. However, the moreexperienced graders are able to separate the kernel into a larger number of categories. It is preferable that grading iscarried out at the time of peeling as thiscuts down on handling of the brittle kernels. There is, however, the opportunityfor further grading subsequent to peeling.

2.3 Modern cashew processing

Cashew processing methods have improved considerably over the years. Difficulties in shelling cashew nuts are due tothe irregular shape of the nut, the tough leathery outer shell and the CNSL within the shell that must not be allowed tocontaminate the kernel during its removal from the shell. An early method used to remove the CNSL in cashewproducing countries was to burn the raw nuts for a short period in order to burn the shells and the CNSL withoutaffecting the taste or appearance of the kernel. This was a delicate operation requiring an experienced processor to gaugethe length of time required for burning. Kernels produced using this method are only suitable for either homeconsumption or for the local market.

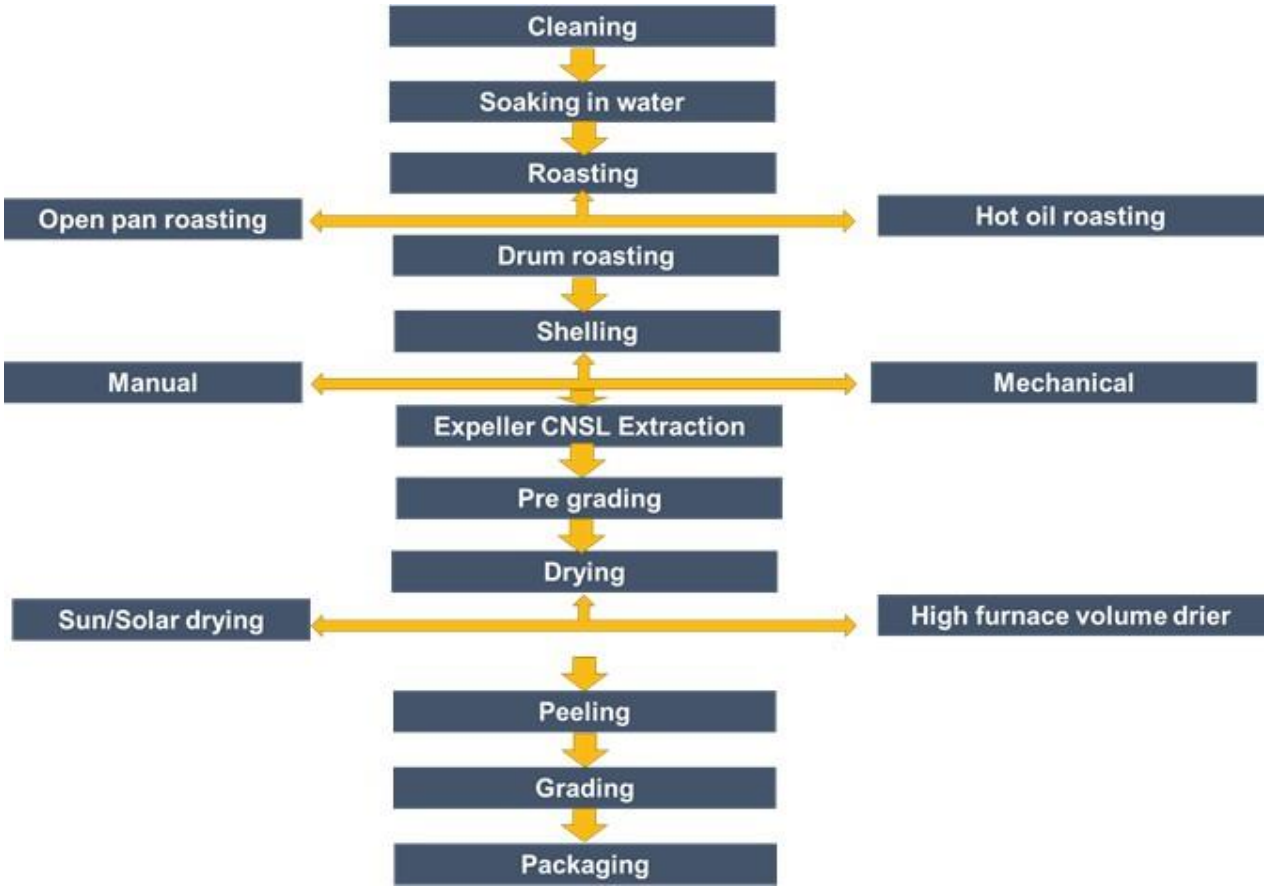
The most economic features of processing are the ratio of kernels to whole nuts obtained and the percentage of wholekernels obtained. Kernel yields usually vary between 22 and 24 percent of the total weight of raw material processed. Thepercentage of whole kernels at the end of processing varies between 55 and 85 percent depending upon the processing
method and factory management. In general, 65 percent may be considered a satisfactory result. The main objective of processing is to remove the valuable cashew kernel from the shell with as little damage as possible.Whole kernels command a higher price than do broken pieces. Pale, ivory coloured or white kernels are preferable tocoloured or burnt ones. The CNSL has to be removed during the process, without either contaminating the cashewkernels or burning the hand of the processor. The processor must therefore, finely tune the process in order to achieve thebest quality kernels.

Extraction of the kernel from the shell of the cashew nut has traditionally been a manual operation. Roasting causesbrittleness of the shell and loosening of the kernel from within the shell. Soaking increases the moisture content of thekernel, thereby reducing the risk of it being scorched during roasting and increasing its flexibility so as to make it lesslikely to crack. The CNSL is released when the nuts are roasted. Collection of this material in sufficient quantities can beeconomically advantageous. CSNL is unlikely to be collected by very small-scale processors, due to the high cost of thespecialised roasting equipment required for its collection.After the kernels are taken out of the shells, the testa (the thin skin covering the kernel) must be removed, followingwhich the kernels are graded and packaged. The process consists of five main steps:

- **Shelling:** removal of the outer shell and CNSL
- **Peeling:** removal of the testa
- **Grading:** into different sizes and colours in accordance with standard grading
- **Drying or humidifying:** to a final moisture content of 5 percent
- **Packing:** into airtight bags or cans, depending upon the scale of operation

2.3.1 Cleaning, sizing and conditioning

The first processing operation is the removal of foreign matter and dirt from the nuts. The nuts are collected from theground after falling from the trees. Apples are removed along with other foreign matter. At the simplest level, the nutscan be sieved by hand using a three-quarter inch (20 mm) mesh sieve to remove dust and dirt. The cleaned nuts are then conditioned in preparation for removal of the shell. Conditioning increases the brittleness ofthe shell and thereby facilitates its removal.



2.3.2 Soaking or conditioning

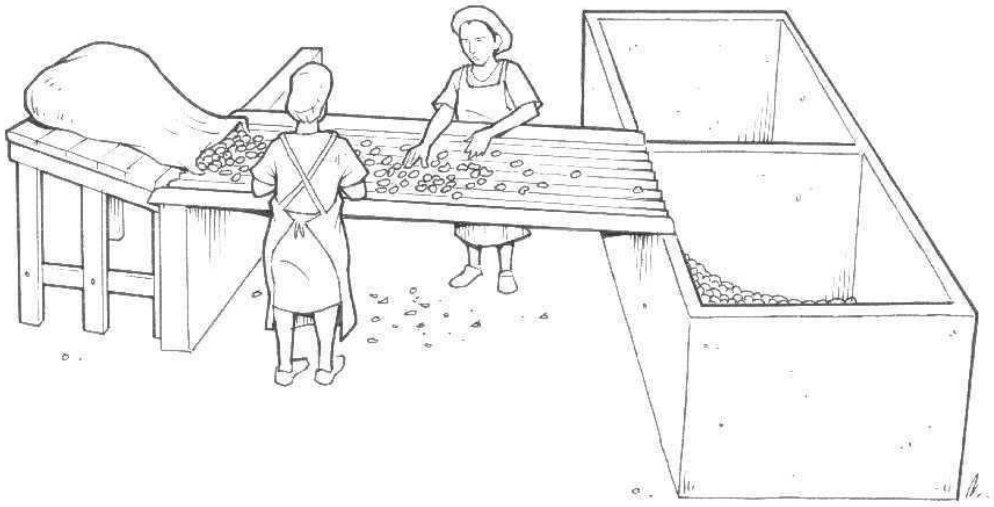
The nuts are soaked in water in order to avoid scorching during the roasting operation. Conditioning is carried out in order to prepare for removal of the CSNL.In small-scale operations, after cleaning, the nuts are placed in a large open drum (180 to 220 litres/40 to 45 gallons).Water is poured into the drum and the nuts are allowed to stand for ten minutes prior to draining off the water through ahole in the base of the drum. The dampened nuts are then allowed to stand in order to absorb the adhering water. Thissoaking and conditioning operation is repeated up to three or four times until moisture content of nine percent isattained.On a slightly larger scale, in the processing of 2 to 10 tonnes per day for example, a simple cleaning and conditioningsystem can be set up.

This consists of three main parts:

- A platform on which a bag of cashew nuts can be placed and opened.
- A long grill of mild steel rods placed along a length of an enclosed frame across which the nuts are drawn by hand.
- The sand and dirt pass through the grill and the cleaned nuts fall over the edge into a vat.

A vat that is large enough to contain the volume of nuts required for one day's processing. There are two vats sothat one may be filled while the other is emptied for further processing.
The sacks of harvested nuts on the stand are generally opened by two people, who clean the nuts as they pass over thegrill and into one of the vats. Water is then sprayed on to the nuts contained in the vat. The water trickles downthrough the nuts, while excess water is drained through a hole situated at the bottom of the tank. Spraying is stoppedwhen drainage of excess water begins and the surface water which adheres to the nuts is allowed time to be absorbed bythe nuts. The spraying treatment is repeated at three-hourly intervals until the required moisture condition (9 percent) ofthe raw nuts is met.

All nuts conditioned in this way are further processed in the same batch and the vat is completely emptied prior to thefurther addition of nuts. If nuts are left in the vat when new ones are added, the moisture content of the remaining nutswill be too high for processing. After the vat is emptied it must be thoroughly cleaned to remove all traces of dirt.



The platform grill and vat can be locally made from a variety of materials. The platform must however be sturdy enough to withstand the impact of the many bags of nuts being dumped on to it. The grill must also be sturdy since the full weight of the nuts resting on it at any one time may increase to as much as 100 to 150 kg. The vat can be constructed from either concrete blocks or from bricks, rendered on the inside with cement to give a smooth finish. Drains contained within the vat should be small enough to prevent the nuts from flowing out with the water. The drains should be kept free so as to allow the water to drain away freely. The vat can be fitted with a small closure that can be lifted to allow the nuts to flow out for subsequent processing. A vat with internal dimensions of 3.0 ´ 2.4 ´ 2.1 metres will hold about 10 tonnes of cashew nuts.

2.3.3 Large-scale cleaning and conditioning

Specially designed equipment for cleaning and conditioning operations has been developed for large scale cleaningoperations. The equipment basically consists of a feed hopper into which the raw cashew nuts are delivered. The nutsflow out of the hopper through a cylindrical cleaning trommel. The cleaning trommel consists of two concentric cylindersmade of mild steel rods built on rings of flats. The inner cylinder is made of 13 mm (0.5 inches) rods spaced at 33 mm(1.25 inch) centres, about 260 mm (10 inches) in diameter and 2 metres (6 feet) long, mounted on a central shaft. Theouter cylinder consists of 7 mm (0.25 inches) rods spaced at 13 mm (0.5 inches) centres, about 75 mm (30 inches) indiameter and mounted on the same shaft.

The cylinders are lined up at the feed end and the inner cylinder projects 375mm (15 inches) beyond the discharge end.The cylinders rotate and the shaft is mounted at a slight angle in order to ensure that the material passes through it duringrotation. The cashew nuts are fed into the inner cylinder. Large pieces of foreign matter are retained in the inner cylinderand removed later at the discharge end. The nuts and small pieces of foreign matter pass through the inner cylinder to theouter cylinder where the nuts are retained and the dirt and debris falls through, on to the floor below. The clean nuts aredischarged into a chain bucket elevator hopper.The buckets on the chain elevator are drilled with drain holes. They pass through a water bath at the bottom of the chain.The nuts fall into the bucket elevator while it is on the downward leg of travel, passing through the water bath and thendraining as they are taken on the upward leg of the chain. At the top of the elevator they are discharged into a mild steel silo with a conical bottom. They are discharged from the

silo via a hole in the apex of the inverted cone. Excess water drains through this hole. The capacity of the silo is sufficientfor one day's processing in the roasting plant. There is a second silo into which the nuts from the first silo can betransferred by a belt bucket elevator.

Additional water can be added to the silos as required. The quantity of water to be added is determined from experience.Conditioned nuts leave the second silo for the roasting plant. When this happens, nuts from the first silo are transferred tothe second. When silo one is empty, more nuts are loaded onto the receiving hopper to re-fill the first silo.An alternative method of cleaning and conditioning employs the use of a shaking sieve whilst blowing air to remove alllightweight debris. The nuts are washed and then pass over sizing grills, which separate them into three different grades.The nuts fall into the relevant bins where they can be further conditioned if necessary. All the conditioning operations must be done in a closed environment. They all require a certain amount of time and anexperienced operator.

2.3.4 Roasting and centrifuging

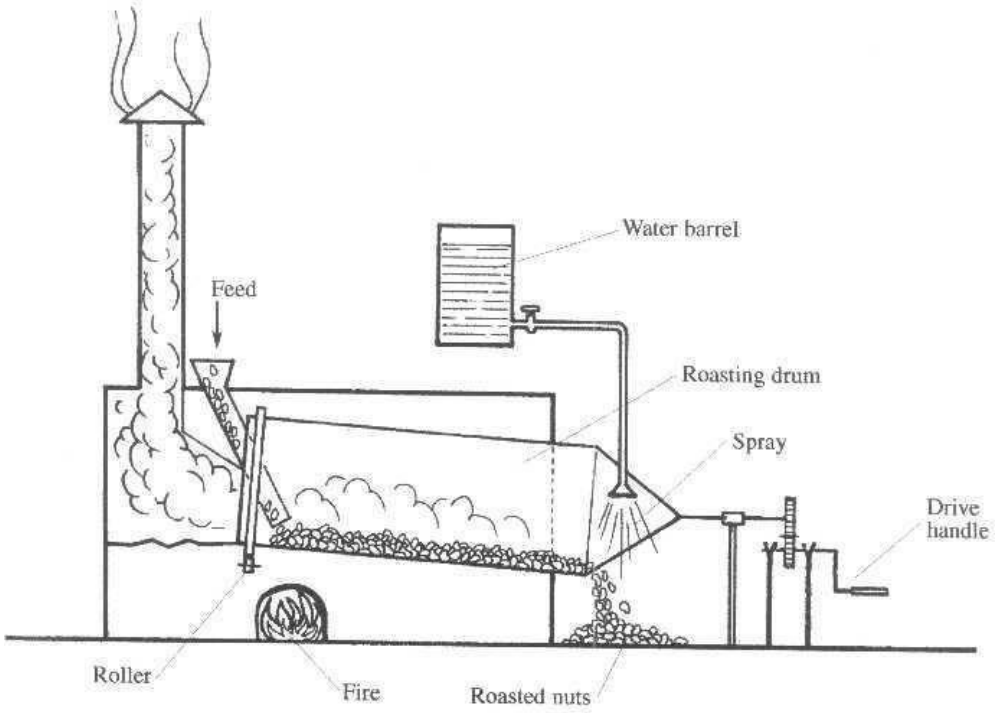
Following conditioning, the nuts must be prepared for the removal of shells. The application of heat to the nut releasesthe CNSL and makes the shell brittle, thus facilitating extraction of the kernel when breaking the shell open. Threemethods of roasting are used: open pan roasting, drum roasting and roasting via the hot oilmethod. The latter is best suited to medium-scale operations because of the associated higher equipment costs andviability of CNSL

collection. The roasted cashew nuts may be centrifuged to remove any adhering surface liquid from thenut.

At the start of the cashew industry in India, open pan roasting was the method used by all processors. The only advantageof the method was its low cost. The fumes and large amounts of black smoke given off during this process made it a veryunpleasant operation. Particular care and attention were required in order to ensure that the kernels were not lost or
ruined. The process also suffered from the disadvantage that the by-product CNSL was lost.

2.3.5 Drum roasting

An improvement on the open pan roaster was the development of a drum roaster, within which the cashew nuts areroasted. The drum is tilted at an angle over the fire and rotated during heating to prevent the nuts from burning.During rotation, nuts pass through the cylinder and out of the opposite end of the drum. The duration of the roastingprocess can be regulated by changing the speed of rotation of the drum. The cylinder is covered in a hood connected to achimney which draws the black smoke upward into the atmosphere and makes it less unpleasant for the operator.



2.3.6 The hot oil method

An increased demand for CNSL in the mid 1930s, led to a major change in cashew nut processing. The 'hot oil' methodwas developed and was widely adopted.The principle of this method is that oil bearing substances, when treated in the same or similar oil at a high temperature,give up their oil constituents to the bulk, thereby increasing the volume of the bulk. When cashew nuts are submerged ina bath of hot CNSL, the CNSL within the shell is therefore extracted, resulting in an increase in the volume of the bathliquid.

2.3.7 Simple hot oil process

The simplest hot oil process is one that consists of a tank in which CNSL is heated and a wire basket that contains thenuts to be roasted. The nuts are placed in the basket and weighted down with a piece of mild steel plate (1 mm thick). Athermometer is inserted in the side well below the liquid level. Trays on either side of the tank act as draining areas,allowing excess oil to run back into the tank. The tank is heated from below by a built-in furnace. The nuts are held in thehot oil for 1.5 minutes at a temperature of 185°C. The entire process is manually operated. After roasting, the nuts areplaced on a wire mesh screen over a tank for further draining and cooling prior to shelling.A slight modification of this simple method allows larger quantities to be processed in one day. The equipment involvesthree circular baths situated in close proximity, each with a separate furnace. The baths are approximately 900 mm wideby 900 mm deep and are fitted with wire mesh baskets, which hold the raw nuts. The baskets are successively dipped intothe three oil baths.

The ***Pierce Lesley*** **'hot oil' method** was the first of many to be patented. All subsequent methods are copies ormodifications of this method and the equipment used by it. Equipment used varies in its degree of sophistication,throughput and price.

The ***Oltremare*****hot oil** plant is one such modified version that operates on the same principles. Oneadvantage of this equipment is that it grades the nuts prior to roasting, thus allowing the nuts to be roasted for differentlengths of time in accordance with their relative sizes.

Clean, conditioned cashew nuts are packed in a feed hopper, from which they are discharged at a controlled rate on to aconveyor that carries them through a hot oil bath maintained at 190°C. The equipment is designed such that the residence

time within the oil bath is 1.5 minutes. The roasted nuts are subsequently discharged from the conveyor. The liquid levelin the bath is maintained by an overflow pipe.The bath is heated to a constant temperature by a furnace that runs along its length. Two thermometers are mountedwithin the bath to monitor the temperature. The oil bath is cleaned on a daily basis by a device that scrapes the bottom ofthe tank, gathering all the sludge and debris that has built up during the day.The liquid overflow is channelled into drums in which it is filtered and allowed to settle in order to remove pieces of shelland other debris. Excess oil is filtered into drums for shipment.

Decarboxylation of the oil is inevitable throughout the process. The oil begins to froth as soon as new material is fed intothe system and frothing continues until a steady state is attained. The oil bath design allows adequate space toaccommodate frothing. Soon after roasting, the froth is broken and surplus liquid formed overflows into the settlingdrums.

Raw conditioned nuts, having a moisture content ranging between 15 and 17 percent are fed into the hot oil bath andheated until moisture is given off as steam. This produces some frothing. The production of steam within the nutshellassists with the extraction of CNSL, thus causing the shell to become brittle. There is a direct correlation between theamount of oil removed from the shell, its degree of brittleness and hence ease of cracking.Large quantities of water vapour are produced in the oil bath due to the production of steam and the decarboxylation andevaporation of the lower fractions of the CNSL. Water vapour production can however be minimized by covering thebath and drawing off the vapour.

Fuel from a range of sources can be used to heat the furnace. The use of spent cashew shells, which also contain someexcess CNSL provides one of the most economical methods of heating the furnace. Problems caused by fumes musthowever be addressed. The bottom plate of the tank must be made of steel (20 mm thick) that is reinforced with chromium. Mild steel will pitand distort under the constant heat and the action of the hot CNSL.The nuts are discharged from the bath on to a cooling conveyor. Scorching of the kernels occurs if the heated nuts areallowed to remain in a pile. It is essential that the kernels be cooled quickly on emerging from the hot oil bath. Theconveyor is designed to draw off the liquid from the nut and allow air to circulate around it in order to facilitate itscooling. Excess liquid is collected in a tank situated

below.The nuts are discharged from the end of the cooling conveyor into a centrifuge, which removes much or the remainder ofthe adhering surface oil. They are then either manually or mechanically shelled.

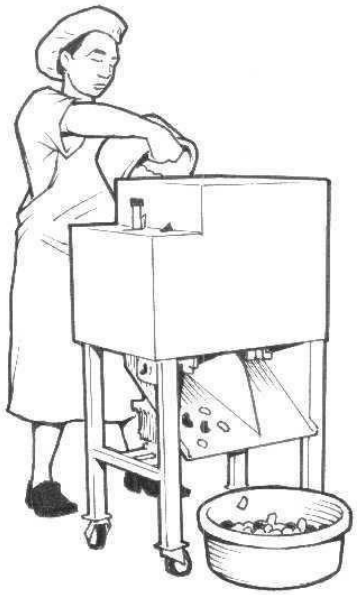
The hot oil method is preferred by larger scale processors. A power driven plant, however, requires capital investmentand is less flexible than a less sophisticated drum roaster. It has been shown that hot oil plants are successful when used for processing large quantities of nuts. This is due to thefact that the constant heating and cooling of the CNSL causes polymerization, which changes the characteristics of the oiland seriously affect the efficiency of the roasting process. When large quantities are roasted in a single batch, new liquidadded to the bath keeps the liquid fresh while displacing some of the liquid which has been heated and cooled a number of times. It is advantageous to cool the oil bath as quickly as possible subsequent to roasting. This is done by removing the heatsource and allowing air to circulate freely. Cold CNSL can be added to the bath to assist in the cooling process.

2.3.8 Shelling

The objective of shelling is to produce clean, whole kernels, which are free of cracks. Shelling has always been manuallyperformed in India. Other countries have difficulty in competing with the great skill and the low wages of Indian workers.India has therefore enjoyed a virtual monopoly of cashew processing for a long time.Several pieces of equipment are designed to remove shells from cashew nuts. The main challenge with mechanicalshelling is to remove the kernel without damage or contamination from the CNSL. This challenge is exacerbated by theirregular shape of the nut and the wide variation in the size of the nut. The most successful mechanized decorticatorswork on nuts that have been conditioned by the hot oil process, which makes the shell brittle and easier to break.A semi-mechanized process that has been predominantly utilized in Brazil incorporates the use of a pair of knives, eachshaped in the contour of half a nut. When the knives come together by means of a foot operated lever, they cut throughthe shell all around the nut, leaving the kernel untouched. Two people work at each table; the first cuts the nuts while thesecond opens them and separates the kernel from the shell. About 15 kg of shelled nuts are produced on a daily basis bythis team.

The first mechanized shelling system, *Oltremare*, is also based on two nut-shaped knives. The nuts are brought to theknives on a chain, each nut aligned to fit between the knives. The nuts are pushed between the knives and cut. The chainitself has to be fed manually. After coming together, the knives make a twisting movement, thus separating the shellhalves. The disadvantages of this method are that nuts smaller than 18 mm cannot be processed and output is reducedsince not all the spaces on the chain can be filled. This can count for as much as ten percent of the production volume.

The shelling machines of the *Cashco*system are also chain fed but the nuts are automatically aligned. The shelling devicehas two knives that cut the sides of the nut and a pin that is wedged into the stalk end of the nut separates the shell halves.This system is advantageous in that it is a fully mechanized operation with an output of about 75 percent whole kernelquality. Nuts smaller than 15 mm cannot however be processed using this system.Centrifugal shellers use a system, which is simple and enables a continuous flow. A rotary paddle projects the shellsagainst the solid casing of the machine and the impact cracks open the shell without breaking the kernel. All sizes of nutscan be processed by this method. It is however, necessary to grade the nuts into about four sizes, since a different rotaryspeed is used for each of the various size groups. The percentage of whole kernels produced is around 75 percent. Byweakening the shells with grooves before the operation begins, the percentage can be increased. The speed of the rotorcan be reduced and the risk of damaging the kernels is minimized.



2.3.9 Separation

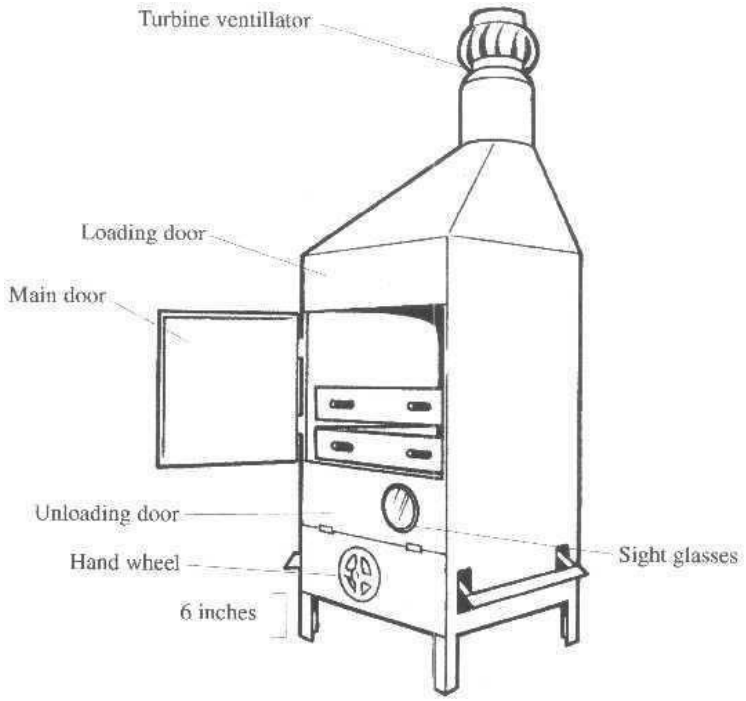
After shelling, shell pieces and kernels are separated and the unshelled nuts are returned to the shelling operation. Blowers and shakers are generally used to separate the lighter shell pieces from the kernels. Recovery of small pieces of kernel sticking to the shell poses the greatest problem. This is usually done manually from a conveyor belt used to carry all the sorted semi-shelled nuts.

2.3.10 Pre-grading

Pre-grading can be done before or after drying the kernels and may greatly reduce the work involved in final grading. Pre-grading can be done mechanically for large-scale processes, separating mainly the whole from the broken kernels and sometimes separating the different size groups of whole kernels.

2.3.11 Drying

The shelled kernel is covered with the testa, the removal of which is facilitated by drying the shelled kernel, to produce the blanched kernel. Drying causes shrinkage of the kernel, thereby allowing the testa to be easily removed either mechanically or by hand with a knife. Drying also protects the kernel from pest and fungal attack at this vulnerable stage. All processors dry the shelled kernels prior to peeling.The moisture content of the kernel is reduced from approximately six percent to three percent by drying. It is important that the drying capacity exceeds the shelling capacity, should there be periods of heavy rainfall. Under such circumstances, the drying operation is increased, since the kernels absorb moisture very quickly.



Sun drying, where the kernels are spread out in the sun in thin layers is possible. It is however heavily reliant on a constant supply of sunshine. Although sun-drying does not pose any risk of scorching the kernels, it may be prolonged under conditions of bad weather, which can lead to mould development.

Artificial drying is more reliable and is required in medium or large-scale operations. Drying usually takes six hours, at a temperature of around 70°C. A uniform temperature throughout the drier is essential to avoid under-drying or scorching.Various drier designs are available. The dryer contains a series of mesh-bottom trays that are slotted into the drying cabinet. The trays should be of a size that can be lifted when full. A lever mechanism automatically moves the trays down when dried trays are removed and when new ones are entered into the cabinet. Hot air circulates over the trays and is exhausted through the chimney. The heat source can either be a gas or electric powered heater. Burning cashew shells or other sources of fuel can also beused to provide a heat source. Drying programmes are generally organized so that the kernels from one day's shelling go directly into the oven for overnight drying. Kernels in the dried state are most vulnerable, since they are brittle and break very easily. It is essential that the kernels are carefully handled in order to minimize damage.

2.3.12 Peeling

At this stage, the testa is loosely attached to the kernel, although a few kernels may have already lost the testa duringprior operations. Manual peeling is performed by gently rubbing with the fingers. Those parts still attached to the kernelare removed with the use of a bamboo knife. Approximately 10 to 12 kg of kernels can be peeled by one individual perday.It is important that the kernels are neither cut nor damaged during the peeling process. The use of knives increases thelikelihood of the kernels becoming damaged. It is also essential that the entire testa be removed. Gentle scraping of the testa with a blunt knife is the most effective way of removing it.The peeled kernels can be separated into different grades by the peeler. At the most basic level, the kernels are separatedinto white wholes, scorched wholes, white pieces, scorched pieces, browns and refuse. More experienced graders are ableto separate the kernels into more categories. It is preferable that grading is carried out at the time of peeling since this cutsdown on handling of the brittle kernels. There is however an opportunity for further grading subsequent to peeling.It is essential that the peelers work under well-lit conditions in order to enable them to remove the entire testa. At the endof the day, the removed testa is winnowed and all cashew pieces removed. The dust and very fine pieces that cannot bepeeled, together with the diseased pieces, are classified as refuse and are thrown away. The browns, which are kernelsthat are badly diseased and which have not been separated out during the shelling operation, must also be removed and discarded.

Strict cleanliness in the peeling operation is essential, not only in the peeling room and its facilities, but must be observedby all personnel. All workers must follow basic codes of hygiene and wash their hands prior to handling the kernels.The mechanized processes of peeling vary widely. They include air-blasting, suction, a freezing operation and a systemof rubber rollers. These systems are of low efficiency due to the difficulty of removing the testa. The level of breakagecan be as high as 30 percent. Currently research and development is taking place to improve the viability of themechanization of this operation.After peeling, the kernels are weighed in order to record daily production. The peeled kernels are vulnerable to insectinfestation and mould growth. They are also prone to rodent attack and should be stored in rodent-proof containers orrooms.

2.3.13 Grading

The grading operation is important since it is the last opportunity for quality control of the kernels. After the kernels areextracted from the shells, dried and peeled, they are graded for export according to size and condition. The gradingsystem is known as the American Standard, which is also incorporated in the Indian Government export criteria. Kernelsare categorized on the basis of colour and condition.Peeled cashew nuts can be classified into between 11 and 24 grades.

CHAPTER 3
PACKAGING OF CASHEW NUTS

3.1 Packing

The normal packaging used for the export of kernels is airtight cans of 11.34 kg (25 lbs) weight capacity. The packagingmaterial needs to be impermeable, since cashew kernels are subject to rancidity and go stale very quickly. The can will befamiliar to most tropical countries as it is a replica of the four gallon kerosene or paraffin oil can. Cans can be locallymade in order to reduce costs. Parts purchased overseas can be locally fabricated. This may be done by arrangement withcan manufacturers. The output of a can manufacturing line is usually too large for a single consumer, but some cashewnut processors have installed their own can manufacturing plants and supply other processors.After filling and weighing, the cap should be soldered in preparation for the *vita pack* process. This consists of removingall the air from the can and substituting it with carbon dioxide (CO2). The advantages of packing cashew kernels incarbon dioxide are two-fold. Firstly, carbon dioxide will not support life so any infestation that may have been present istherefore arrested. Secondly, carbon dioxide is soluble in cashew oil and goes into solution as soon as the can is sealed.

Within a short period of time, a decrease in pressure takes place as the carbon dioxide goes into solution and the sides,top and bottom of the can are drawn inwards. The kernels are therefore tightly sealed in the can, thus preventingmovement and breakage during transport. Carbon dioxide, being a heavy gas, causes the upward displacement of air andwill remain in the cans after filling. Some large-scale machines will operate on six cans at a time, creating a vacuum ineach and subsequently filling it with carbon dioxide.Some processors do not have

vacuum pumps and displace the air in the can by feeding in carbon dioxide through a smallhole in the bottom of a side of the can. The carbon dioxide valve is turned off when all the air has been replaced. Holes inthe can are then sealed, with the hole at the bottom of the side of the can being sealed first and the one at the top last.

S. NO	GROUPS	SPECIFICATION
1	**White wholes**	
	W180 (super large) W210 (large) W240 W280 W320 W450	Between 120 and 180 kernels per lb (266-395 per kg) 200 and 210 kernels per lb (395-465 per kg) 230 and 240 kernels per lb (485-530 per kg) 270 and 280 kernels per lb (575-620 per kg) 300 and 320 kernels per lb (660-706 per kg) 400 and 450 kernels per lb (880-990 per kg)
2	**White pieces**	
	Butts Splits Pieces Small pieces Baby bits	A kernel broken cleanly across the section of the nut. Kernel which has broken down the natural line of cleavage to form a cotyledon. A kernel which has broken across the section but does not qualify for a butt and is above a specific size. As above but smaller. Very small pieces of kernel which are white in colour.
3	**Scorched grades** Wholes Butts	Whole kernels that have been slightly scorched during the process but are otherwise sound. These are not graded according to size. Butts that have been scorched.

3.2 Packaging requirements

The normal pack for cashew kernels for export is two hermetically sealed tins, of 25 pounds each,in one carton or case.

In the case of exports of cashew kernels, the pattern of business has so far been restricted to the exportof this commodity in bulk. It is inert gas packaged in sturdy tin-plate containers in quantities of 25lbs (11.4 Kgs) each. Two such tinplate containers, popularly known as the “4 gallon” tins, are bulkedin a corrugated box for purposes of exports. The boxes are reinforced using either a rayon or plasticstrapping. The specifications for the tin plate containers and corrugated boxes are given in IS: 916 -1975 and IS 2771 (Part 1 and 2): 1998 respectively.

An inert gas such as carbon dioxide is used to prevent oxidative rancidity and microbial spoilage. For effective vacuumisation, the vacuum gauge must be calibrated. Theadvantages of packing cashew kernels in carbon dioxide are twofold. Firstly carbon dioxide is an inertgas and will not support life. Any infestation that may have been present in the kernels is thereforearrested. Secondly carbon dioxide is soluble in cashew kernel oil and goes into solution as soon as theseals are made. In a short span of time it will be seen that a vacuum has been drawn on the tin and thesides, top and bottom are drawn inwards thus holding the kernels tight in the tin. Earlier, tin lead mixturewas used for soldering, but considering the regulations of importing countries, lead free solderingmaterial are being used now-a-days.

3.2.1 Flexible packaging

The conventional tin packaging system for cashew kernel, is being replaced by a flexible packagingsystem. Under the flexible packaging system, cashews are packed inco extruded multi-layer double barrier vacuum bags using a compacting station and then vacuumised,gas flushed to form rectangular blocks using a computer controlled double chamber vacuum machine.One of the main problem faced by this system is clumping or blocking of kernels. With excess moisturelevels or due to inadequate vacuumisation and gas flushing, the kernels get clumped or blockedand refuse to get disintegrated on unpacking. The problem has been solved by proper vacuumisation and gas flushing. Since flexi packages are highly compact, the drop impact or other stresses in transitwill not be directly on the product, so the number of brokens can be minimized.

3.2.2 GMP for cashew kernel industry

Food safety is considered to be the responsibility of the Government, and government agencies implementthe regulation by vigil, inspection, survey and monitoring. Import procedures are so regulatedthat only safe food is imported. But, it has now been realised that truly effective oversight of the foodsupply by Government is difficult and expensive to achieve. This has led in recent years to a demandfor more individual accountability on the part of the food industry in the production, processing,storage and transport of food in an effort to prevent problems from occurring. Good ManufacturingPractices (GMP), specialised monitoring procedures such as

HACCP and quality system certificationprocedures such as ISO 9000, etc. are examples of these preventive approaches to assure food qualityand safety.

Indian cashew industry has a proven record of being proactive to consumer expectation. Even prior to the promitigation of Export (Quality Control and Inspection) Act, for the Cashew kernels in1966, a system of inspection of processing units for compliance with General Hygienic Practice wasintroduced by the Cashew processing industry itself. Consignments for export were inspected onlyafter the inspection team was satisfied with the Hygiene and Sanitation conditions. Good HygienicPractice Requirements include basic requirements for the following: Hygienic design, constructionand operation, sanitation of food production premises and equipments, hygiene of operations used inthe preparation, processing, storage and use of raw materials and products, the education and trainingof operators in good personal hygiene and good hygienic practices.Consequent to the changed policies of the government in light of the WTO agreement, compulsorypre-shipment inspection by government agencies is not in vogue, but the shippers do continuethe practice voluntarily by engaging private inspection agencies. Moreover, the industry has set up amodern analytical laboratory with state of the art analytical equipments to test samples for microbiological parameters, aflatoxin, pesticide residues, heavy metals, food additives etc. Manyof the processing units have already implemented a quality system conforming to ISO 9001. These

units have taken the initiative to implement HACCP, based on the applications of structured hazardanalysis and the identification of specific means of control of microbiological, chemical and physicalhazards, associated with processing of cashew kernels.

3.2.3 Nutritional and therapeutical characteristics

Modern science evaluates the nutritive and gastronomic quality of food on the basis of their compositionin terms of carbohydrates, proteins, fats, vitamins, minerals and other phytochemicals. Incase of hypertension and obesity, energy rich fats are normally avoided. Phytochemicals in plants aregetting increased attention because of their proven ability to prevent or even heal some of the chronicdiseases. With this background, let us look at the composition of cashew kernels, which is a typicaltreenut, cultivated in India.The average composition of cashew kernels, is given as,

Fats - 47 %

Proteins - 21 %

Carbohydrates - 25%

Minerals - 2%

Moisture - 5%

Because of the high fat content, cashew is considered as “fatty food’ and is listed under foods to beavoided along with meat, fish and poultry. But, there is a lot of difference in the quality of fats presentin foods from animal sources and fat from cashew nuts. Fat in animal foods are composed of saturatedfatty acids, which in humans help to increase the levels of low density lipoprotein (LDLs) in blood.LDLs are considered as bad cholesterol as they can clog the arteries; hence, the recommendations toavoid fatty food. But, now the research has proved beyond doubt that the ‘fat’ in cashew is composedmainly of unsaturated fatty acids (nearly 80 percent), which in humans raise the levels of high densitylipoproteins (HDLs), which is a good fat and reduce levels of LDLs, thus lowering the risk of heartdiseases. Cashew kernels contain polyunsaturated fatty acids, in a 1: 1 ratio with saturated fatty acids,which also is considered to have potential good health effects.

Cashews contain no cholesterol. Cashews do not contain trans fatty acids. Cashew is a good sourceof protein, comprising of essential amino acids such as arginine, histidine, lysine, cystine, methionine,valine, phenylamine etc. which have important role in body building; thus are important in preventionand treatment of several chronic diseases. The carbohydrates present in cashew are composed of sugars,starch and dietary fi bre. Cashews are rich in potassium (5421 ppm), calcium (248 ppm), magnesium(2536 ppm), iron (60 ppm), phosphorus (8400 ppm) etc. and contain significant levels of copper(22 ppm) and zinc (38 ppm). Content of sodium in cashew kernel is very low (48 ppm). The important

vitamins recorded in cashews are Vitamin E (tocopherol), Vitamin A (retinol), Vitamin 131 (thiamine),Vitamin B2 (ri

CHAPTER 4

FSSAI STANDARDS AND FOOD SAFETY

4.1 FSSAI STANDARDS AND ADDITIVES OF COFFEE POWDER

4.1.2 Processed fruits

Includes all forms of processing other than peeling, cutting and surface treating fresh fruits.

4.1.2.2 Dried fruits, nuts and seeds

Fruit from which water is removed to prevent microbial growth which includes dried fruit leathers (fruit rolls)prepared by drying fruit purees. Such as cashew nut, almond, raisins, dried apple slices, figs, copra (dried coconut whole or cut), dried shredded or flaked coconut, prunes, dehydrated fruits etc.

Food Category System	Food Category Name	Food Additive	INS No	Recommended maximum level	Note
4.1.2.2	**Dried fruits, nuts and seeds**	**ASCORBYL ESTERS**		**80 mg/kg**	**10**
		BENZOATES		**800 mg/kg**	**13**
		ETHYLENE DIAMINE TETRA ACETATES (EDTA)		265 mg/kg	21
		Diacetyltartaric and fatty acid esters of glycerol	472e	10,000 mg/kg	
		HYDROXYBENZOATES, PARA		800 mg/kg	27
		Lauric arginate ethyl ester	**243**	**200 mg/kg**	

		Mineral oil, high viscosity	905d	5,000 mg/kg	
		Mineral oil, medium viscosity, class I	905e	5,000 mg/kg	
		Calcium phosphate	341(i)	20,000 mg/kg	
		Magnesium phosphate	343(ii)	20,000 mg/kg	
		SORBATES		**500 mg/kg**	**42**
		SULFITES		1,000 mg/kg	44, 135, 218
		Tartaric acid, L (+)	334	GMP	

4.2 Food Safety

Part I - General Hygienic and Sanitary practices to be followed by Petty Food Business Operators applying for Registration (See Regulation 2.1.1(2))

SANITARY AND HYGIENIC REQUIREMENTS FOR FOOD MANUFACTURER/ PROCESSOR/HANDLER

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.

2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.

3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.

4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.

5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects. No spraying shall be done during the conduct of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises. Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.

6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.

7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.

8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).

9. All equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.

10. All equipments shall be placed well away from the walls to allow proper inspection.

11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.

12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.

13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.

14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.

15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.

16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.

17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.

18. The vehicles used to transport foods must be maintained in good repair and kept clean.

19. Foods while in transport in packaged form or in containers shall maintain the required temperature.

20. Insecticides / disinfectants shall be kept and stored separately and `away from food manufacturing / storing/ handling areas.

4.3 LABELLING

Labeling Requirements

All food products sold in India that are prepackaged are required to comply with the Food Safety and Standards (Packaging and labelling) Regulations, 2011. The Food Safety and Standards Regulation, 2011 is a notification issued by the Food Safety and Standards Authority of India under the Ministry of Health and Family Welfare. In this article, we look at the regulations pertaining to food labelling in India.

Applicability of Food Labelling Regulations

The food labelling regulations require all “Prepackaged” or “Pre-packed food” to comply with the labelling regulations in India. As per the rules, prepackaged food means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.

General Labelling Requirements

The following labelling requirements must be complied with by all prepackaged food sold in India:

- The label must be in English or Hindi or Devnagri language. In addition to the above, the label can contain information in any other language, as required.
- The label must not contain information about the food that could be deemed to be false, misleading, deceptive or otherwise create an erroneous impression regarding the product.
- The label must be affixed to the container in such a manner that it would not easily be separated from the container.
- The contents or information presented in the label should be clear, prominent, indelible and readily legible by the consumer.
- If the container is covered by a wrapper, then the wrapper must contain necessary information or make the label of the product inside readily legible by not obscuring.
- The name of the food must be mentioned along with the trade name and description of the food contained. In case the food contains more than one ingredient, then a list of ingredients must be presented in descending order of their composition by weight or volume, as the case may be, at the time of its manufacture;

Nutritional Information

Nutritional Information or nutritional facts per 100 gm or 100ml or per serving of the product must be given on the label along with the following information:

- energy value in kcal;
- the amounts of protein, carbohydrate (specify the quantity of sugar) and fat in gram (g) or ml;
- the amount of any other nutrient for which a nutrition or health claim is made:

- It is important to note that any “health claim” or “nutrition claim” or “risk reduction” claim made in the label will be thoroughly scrutinized by the FSSAI authorities. Hence, any such claim must be validated by test data. As per the rules, the following is the definition for “health claim”, “nutrition claim” and “risk reduction” claim:

- “Health claims” means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health and include nutrition claims which describe the physiological role of the nutrient in growth, development and normal functions of the body, other functional claims concerning specific beneficial effect of the consumption of food or its constituents, in the context of the total diet, on normal functions or biological activities of the body and such claims relate to a positive contribution to health or to the improvement of function or to modifying or preserving health, or disease, risk reduction claim relating to the consumption of a food or food constituents, in the context of the total diet, to the reduced risk of developing a disease or health-related condition;

- “Nutrition claim” means any representation which states, suggests or implies that a food has particular nutritional properties which are not limited to the energy value but include protein, fat carbohydrates, vitamins and minerals;

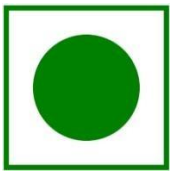
- “Risk reduction” in the context of health claims means significantly altering a major risk factor for a disease or health-related condition;

Veg or Non-Veg Symbol

All packaged food that is “Non-Vegetarian” must have a symbol that is a brown colour filled circle inside a square with a brown outline. If a food contains only egg as a non-vegetarian ingredient, then the manufacturer may provide a declaration that the product contains only egg and add the non-vegetarian symbol.

Non-Veg Symbol

Packaged vegetarian food should have a symbol that consist of green colour filled circle inside a square with green.



Veg Symbol

Information Relating to Food Additives, Colours and Flavours

Food additives contained in the food product must be mentioned along with class titles along with the specific names or recognized international numerical identifications. Addition of colouring matter should be mentioned on the label along with certain statements like "CONTAINS PERMITTED NATURAL COLOUR(S)", just beneath the list of the ingredients on the label. In case of addition of extraneous flavouring agent, then it should be mentioned in a statement like "CONTAINS ADDED FLAVOUR" just beneath the list of ingredients on the label.

Name and Complete Address of the Manufacturer

The name and complete address of the manufacturer must be mentioned on every package of food. In the case of imported food, the package must contain the name and complete address of the importer in India.

Net Quantity

All packaged food must carry the bet quantity by weight or volume or number, as the case may be. The net quantity of the commodity contained in the package must exclude the weight of the wrappers and packaging materials.

Lot Number of Batch Identification

A lot number or batch number or code number must be mentioned on all packaged food so that it can be traced while manufacturing and distribution. Only bread and milk including sterilised milk are not required to comply with this regulation.

Date of Manufacture or Packing

The date, month and year in which the commodity is manufactured, packed or pre-packed must be mentioned on the label. In the case of food products having a shelf life of more than three months, then the month and the year of manufacture can be given with the "Best Before Date". In case of products having a shelf life of fewer than three months, the date, month and year in which the commodity is manufactured or prepared or pre-packed must be mentioned on the label with best before date.

Country of Origin for Imported Food

For imported food, the country of origin of the food should be declared on the label of the food. In case a food product undergoes processing in a second country which changes its nature, the country in which the processing is performed should be considered to be the country of origin for the purposes of labelling.

Instructions for Use

Instructions for use, including reconstitution, should be included on the label, if necessary, to ensure correct utilization of the food.

Contact Us

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