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PRESENT STATUS OF CASHEW NUT PROCESSING MACHINES

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ABSTRACT

Cashew is highly appreciated in a large number of countries and cultures. The cashew nut world production in 2000 was estimated at 2 million tones of nuts – in-shell, with an overall estimated value exceeding 2 billion USD. India is the largest cashew processor in the world. Export of cashew nut shell liquid from India stood at 11,677 million tonnes (MT), valued at US$ 9 million in 2015-16, while exports of cashew kernels stood at 96,346 MT, valued at US$ 756 million. Export earnings from cashew and allied products during FY 2015-16 stood at US$ 765 million. India accounts for about 65 per cent of global cashew exports. India exports cashew kernels to over 60 countries. Its major markets are the US, the Netherlands, Japan, Spain, France, Germany, the UK as well as Middle East countries such as the UAE and Saudi Arabia. The US is the largest market for Indian cashew kernels, followed by the UAE and the Netherlands, while Indian Cashew nut shell liquid is largely exported to South Korea, followed by China and the US. The cashew industry ranks third in the world production of edible nuts. The major exporters of cashew in the world are India and Brazil with 60% and 31% respectively of the world market share. The major cashew nut importers are the United States (55%), the Netherlands (10%), Germany (17%), Japan (5%) and the UK (5%). Cashew kernels are ranked as either the second or third most expensive nut traded in the US. Also process of cashew nut is very much important as to improve production rate. Now days there are various machineries used to save the time and to improve the quality. The Industries are using manual, Semi-Automatic and fully automatic machineries to increase the production rate. But In conventional process, it takes more time to complete operation and hence production rate is very low. Thus to reduce human injuries in conventional methods and to increase the production of cashew nut the present study has been studied.

INTRODUCTION

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 Figure 1. Between the shell and nut is black caustic oil, which is difficult to remove and can be used in varnishes and plastics.

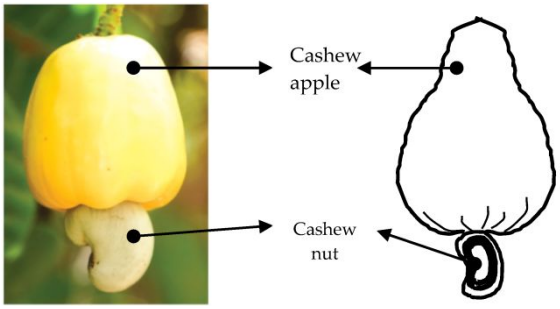

Fig.1.Cashew Nut

The cashew tree grows with a minimum of attention and is easily cultivated. It is usually found from sea level to an altitude of 1000 metres (3000 feet), in regions with annual rainfall as low as 500 mm (20 inches) and as high as 3750 mm (150 inches). For maximum productivity, good soil and adequate moisture are essential. Optimum conditions include an annual rainfall of at least 889 mm (35 inches) and not more than 3 048 mm (120 inches). The tree has an extensive root system, which helps it to tolerate a wide range of moisture levels and soil types,

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but commercial production is only advisable in well-drained, sandy loam or red soils. The cashew tree can flourish in the sand of open beaches, but it grows poorly in heavy clay or limestone. The cashew tree is usually grown from seeds placed directly in the field, since seedlings do not transplant well due to their delicate root system. Seed nuts should be thoroughly dry, clean and free from insect or fungal attack. Seeds should be stored until the next rainy season before they are planted in the field, unless irrigation facilities are available, or seedlings are raised in polythene bags in a nursery where water is available. After a few months, stored nuts gradually lose their germination capacity. Seeds should be water tested prior to planting those that sink should be chosen as they have a high success rate and tend to germinate quickly. Seeds should be planted at a depth of about 5 cm. The maximum depth at which a seed should be sown is about 10 cm, depending on the soil conditions. Two or three seeds should be planted together, stem end up, at a slight incline and covered with 5 to 8 cm of soil. Germination usually takes place in 15 to 20 days, although seeds of low density (i.e. those that float in water) may require as long as eight weeks to germinate. Using seeds of high density, from selected trees, considerably increases the chance that some of the seeds at one site will perform well. Two months after sprouting, the two weakest seedlings should be removed from the site, leaving only the strongest one to grow. By planting more than one seed, the occurrence of gaps in a plantation is reduced 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:

I. directly by the consumer
II. As roasted and salted nuts
III. In confectionery and bakery products

For example, finely chopped kernels are used in the production of sweets, ice creams, 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 60 percent of cashew kernels are consumed as salted nuts. Separately packed cashew nuts are a good selling line, mainly as an 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 is much higher than the price of peanuts or other snacks so those sales must be based on a strong taste preference by the consumer. Cashew nuts are generally considered a luxury product and an element of their appeal may lie in this status. The cashew nut shell contains a viscous and dark liquid, known as cashew nut shell liquid (CNSL), which is extremely caustic. 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 for its industrial application, in particular, its use as raw material for phenolic resins and friction powder for the automotive industry (brake linings and clutch disks). In drum-brake lining compounds, cashew resins are used as fillers and may also be used as binders. In disc pads, the role of cashew resin is restricted to the use of friction dust as filler. The advantage of the cashew resins compared with synthetic phenolic resins is that they are more economical and produce a softer material, which gives a quieter braking action. CNSL is also used in mouldings, acid-resistant paints, foundry resins, varnishes, enamels and black lacquers for decorating vases and as insecticides and fungicides. In tropical medicine, CNSL has been used in treating leprosy, elephantiasis, psoriasis, ringworm, warts and corns. Like cashew nuts, CNSL also has an excellent international market and its imports have reached almost US$10 million annually, corresponding to the sale of the raw liquid. However, the exporting country would earn much more foreign currency if manufactured products were exported. In cashew-producing countries, the nut is only one of the products enjoyed by the local populations. 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 can also be squeezed for fresh juice, which can then be fermented into cashew wine, which is a very popular drink in West Africa. In parts of India, it is used to distil cashew liquor referred to as *feni*. As this is a high cost food it must produced with a high care to maintain its qualities. So we are going through conventional process of cashew nut and updated processes used to improve the quality.

MATERIALS AND METHODS

Present Status

The production of horticulture crops like cashew, coconut at various countries is increasing day by day. Therefore the harvesting, pruning, spraying, shelling etc. is a major problem in most of the country.Kolhe et al designed, developed and tested a tractor mounted hydraulic elevator for harvesting, pruning and spraying of

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horticulture crops [5-13].however it is observed from the field testing and engineering analysis the above machine is very useful to the farmers community. The above machine is also useful for harvesting, pruning and spraying for cashew orchard. The tractor mounted harvester found suitable for 40 to 45 ft tree height. It is also suitable for cashew orchards.

In India, cashew is produced in the coastal regions of the states of Kerala, Karnataka, and Goa, Maharashtra andhra Pradesh, Orissa and Tamil Nadu. The state of Kerala accounts for approximately 50 per cent of cashew production in India. Kerala has a centralized procurement system and much of the processing is done on an outworker basis by families. Although Kerala only accounts for about 25 percent of the total area under cashew, yields in this state are relatively high when compared to those in other states. Estimated cashew productivity in Kerala is 900 to 950 kg raw cashew nuts per hectare, which is almost, double that in the rest of India. The traditional practice in the south Arcot region of India was to spread the nuts out on flat rocks in the sun, to allow them to dry until the shell became brittle. The kernel could then be removed from the shell by striking the nut with a wooden batten to split the shell along the natural line of cleavage. The cashew kernel was removed from the shell without becoming contaminated by the CNSL. Use of this method was made possible by the suitability of humidity and climate condition 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 causing

The shell to become brittle. Following this, the nuts are mechanically cut along the natural line of cleavage and the kernels removed. The shells are then further treated to remove the CNSL. This method of kernel removal has been commercially adopted. Following are the methods used conventionally and updated methods are also explained.

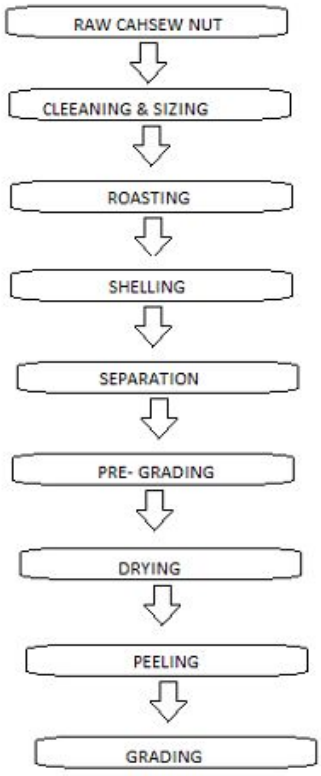

Fig 2: Flowchart showing details of Cashew Nut Processing

i. ***Cleaning, Conditioning And Sizing***

The first processing operation is the removal of foreign matter and dirt from the nuts. The nuts are collected from the ground after falling from the trees. Apples are removed along with other foreign matter. At the simplest level, the nuts can 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 of the shell and thereby facilitates its removal.

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ii. ***Medium-scale cleaning of raw cashew nut***

On a slightly larger scale, in the processing of 2 to 10 tonnes per day for example, a simple cleaning and conditioning system 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.

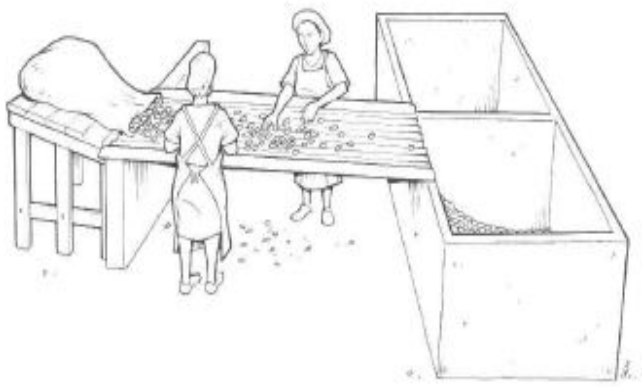

Fig.3. Medium-scale cleaning of raw cashew nut

A vat that is large enough to contain the volume of nuts required for one day's processing. There are two vats so that 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 the grill and into one of the vats. Water is then sprayed on to the nuts contained in the vat. The water trickles down through the nuts, while excess water is drained through a hole situated at the bottom of the tank. Spraying is stopped when drainage of excess water begins and the surface water which adheres to the nuts is allowed time to be absorbed by the nuts. The spraying treatment is repeated at three-hourly intervals until the required moisture condition (9 percent) of the raw nuts is met.

iii. Large-scale cleaning and conditioning

Specially designed equipment for cleaning and conditioning operations has been developed for large scale cleaning operations. The equipment basically consists of a feed hopper into which the raw cashew nuts are delivered. The nuts flow out of the hopper through a cylindrical cleaning trammel. The cleaning trammel consists of two concentric cylinders made of mild steel rods built on rings of flats. The cylinders rotate and the shaft is mounted at a slight angle in order to ensure that the material passes through it during rotation. The cashew nuts are fed into the inner cylinder. Large pieces of foreign matter are retained in the inner cylinder and removed later at the discharge end. The nuts and small pieces of foreign matter pass through the inner cylinder to the outer cylinder where the nuts are retained and the dirt and debris falls through, on to the floor below. The clean nuts are discharged into a chain bucket elevator hopper. 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 to the second. When silo one is empty, more nuts are loaded onto the receiving hopper to re-fill the first silo.

Roasting

i. Open pan roasting

Open pan roasting is used by traditional cashew processors in India. This roasting technique is very simple with minimal equipment requirements. It however requires skill and judgment 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 over an 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. As the nuts heat up, the CNSL is extruded onto the pan and eventually ignites, producing clouds of thick black smoke. After heating and burning for about two minutes (judged by experience) the pan is dowsed in water and the nuts are thrown off and allowed to cool, during which the shells become brittle and can be readily removed from the nut.

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Fig.4. Pan roasting of cleaned cashew nut

ii. 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 the nuts to be roasted. The nuts are placed in the basket and weighted down with a piece of mild steel plate (1 mm thick). A thermometer 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 the hot oil for 1.5 minutes at a temperature of 185°C. The entire process is manually operated. After roasting, the nuts are placed 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 involves three circular baths situated in close proximity, each with a separate furnace. The baths are approximately 900 mm wide by 900 mm deep and are fitted with wire mesh baskets, which hold the raw nuts. The baskets are successively dipped into the three oil baths.

iii. Roasting and centrifuging

Following conditioning, the nuts must be prepared for the removal of shells. The application of heat to the nut releases the CNSL and makes the shell brittle, thus facilitating extraction of the kernel when breaking the shell open.

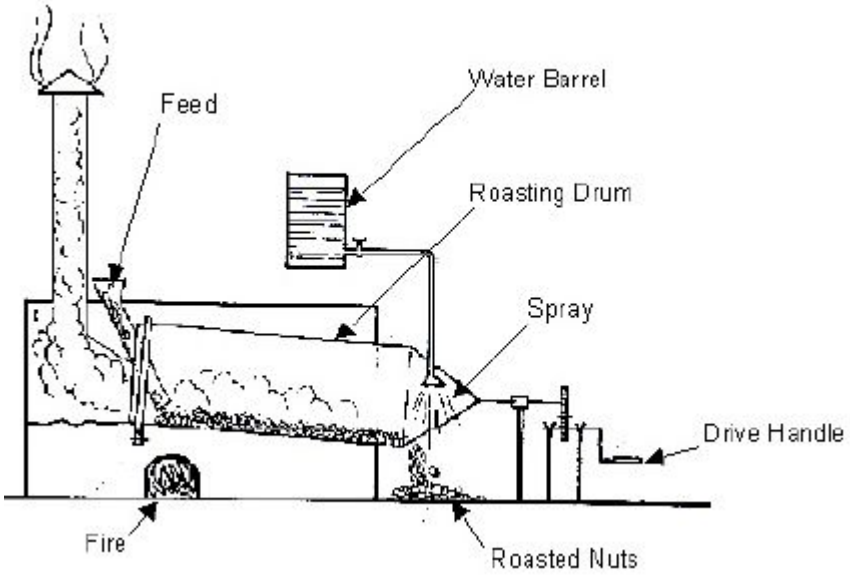

Fig.5. Drum roaster fired from a furnace below

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The roasted cashew nuts may be centrifuged to remove any adhering surface liquid from the nut.At the start of the cashew industry in India, open pan roasting was the method used by all processors. The only advantage of the method was its low cost. The fumes and large amounts of black smoke given off during this process made it a very unpleasant 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. An improvement on the open pan roaster was the development of a drum roaster, within which the cashew nuts are roasted. 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 roasting process can be regulated by changing the speed of rotation of the drum.

The cylinder is covered in a hood connected to a chimney which draws the black smoke upward into the atmosphere and makes it less unpleasant for the operator.

iv. Baby Boiler

The baby boiler is a hand stoked fire tube boiler, which produces steam at 7.0 – 8.5 kg/cm2. The roasted cashew shell or de-oiled cake are fed manually (about 2 to 3 kg fuel once in 15 to 20 minutes) at the bottom of the boiler. The combustion air is drawn through the grate by natural draft stack at the top of the boiler. The flue gases from the boiler are discharged into atmosphere through the stack 12 – 15m high. The flue gas emissions from the boiler are the source of air pollution.[15]

v. Cashew Nut Cooker

A cylindrical steam cooker with provision of cashew nut feeding at the top and discharging of cooked nuts from the side near bottom, has a capacity of holding 4 bags (80 kg each) of cashew nut in a batch. Once the cashew nut is loaded, steam from a boiler is introduced into cooker at a pressure of 7.0 – 8.5 kg/cm2. The cashew nuts in the cooker are steam cooked and when all the nuts are sufficiently cooked, the excess steam starts releasing near the bottom outlet. The steam is injected into the cooker till the steam starts escaping from the outlet mouth of the cooker. This process takes about 10 – 20 minutes time. Then the steam injection into the cooker is stopped and the condensed water at the bottom of the cooker is discharged in to a container and disposed on ground through septic tank . In cashew nut cooking process in Kerala have different process in steam injection quantity. The steam is injected for about 15 minutes even after the steam starts escaping from the outlet mouth of the cooker. This method consumes more steam. The cooker condensate water is the source of water pollution. The cooked cashew nut are removed from the bottom of the cooker and spread on the floor for cooling. The cooled nuts are sent for cutting section to cut open and collect the kernel. The total batch time is about 40 – 45 minutes. Usually, the units are provided with a baby boiler and minimum two cookers, while one cooker is in cooking operation, the other cooker is in unloading and loading operation. Normally the cooking operation is carried out for 2 – 4hrs in a day, cooking 5 to 10 batches of nuts, depending on the production capacity of the units.[15]

Shelling

The objective of shelling is to produce clean, whole kernels, which are free of cracks. Shelling has always been manually performed 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.

Fig.6.Cashew nut shell

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i. Traditional manual shelling:

In the manual shelling process, the nuts are placed on a flat stone and cracked with a wooden mallet. The sheller requires a few basic pieces of equipment, namely cans for shelled kernels and shelled pieces, a shelling mallet, a striking point and a supply of wood ash to dust both the cashews and the fingers of the sheller. The working area should be kept clean to prevent the ash and spilled CNSL from contaminating the extracted kernels. This is quite easily achieved by organizing the work area and following an accepted routine. Although this is a labourious routine, efficiency can be improved if attention is paid to ergonomic details, such as the positioning of the pile of nuts in relation to the striking point. 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 also be separated in order to avoid contamination of the extracted kernels.

If the sheller is right-handed, the pile of nuts for shelling should be placed on the left hand side. The nut is picked up in the left hand and struck with the mallet on the right hand. The kernel is removed and deposited in the receiving can in the centre or on the right hand side. The shell pieces 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. Correct positioning of the nut and the ability to hit the nut in the correct position, so as to allow its breakage is most important. If the nuts have been properly roasted and are correctly positioned on the striking platform, they will easily break down the natural line of cleavage when struck at the broad end. The convex side of the nut should be placed in contact with the striking platform, with the plane of cleavage at right angles to the surface of the striking post. Occasionally, a nut will require more than one strike in order to open the shell, but this technique comes with practice. An average sheller can open one nut in about six seconds or ten nuts per minute. In an eight hour working day, this amounts to about 4800 nuts or about 5 kg of kernels. At an extraction rate of 24 percent, this quantity corresponds to about 21 kg of raw nuts per day or about 7 tonnes per year. Experienced shellers in India can produce around half as much again, with a quality of 90 percent whole kernels. A good sheller will produce a high percentage of clean, unbroken kernels, whereas a poor sheller cashew will produce a larger quantitiy of dirty broken kernels.

ii. Mechanical Shelling:

Several pieces of equipment are designed to remove shells from cashew nuts. The main challenge with mechanical shelling is to remove the kernel without damage or contamination from the CNSL. This challenge is exacerbated by the irregular shape of the nut and the wide variation in the size of the nut. The most successful mechanized decorticators work 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, each shaped in the contour of half a nut. When the knives come together by means of a foot operated lever, they cut through the shell all around the nut, leaving the kernel untouched. Two people work at each table; the first cuts the nuts while the second opens them and separates the kernel from the shell. About 15 kg of shelled nuts are produced on a daily basis by this team.

The cooked cashew nuts are de-shelled by hand and leg operated cutters. The nut is placed between two set of blades to fit the contour of fixed blade. The pressing of the pedal pierces the by the two blades. Simultaneously the handle is operated to split the nut. After de-shelling the nut fall down due to gravity and is collected below the cutter. A skilled worker de-shells about 40 kg of cashew nut in 8 hour. Its general practice to rinse the hand with Castrol oil or some suitable oil or cream to protect operators hands form C.N.S.L oozing out in the de-shelling process. The system with a Cashew Shelling Machine is simple and enables a continuous flow. A revolving paddle sets the shells against the solid casing and pierces them on the convex side by means of two blades. The two blades are used to split the nut by operating the handle of the cutter. Thus the operation forces the shell to crack open without breaking the kernel. After de-shelling the nut falls freely due to gravity and is collected beneath the cutter.

Fig.7. Manual Cashew Nut Cutter

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The percentage of whole kernels produced is around 75%. By preparing the shells with grooves and weakening the strength of them before the operation begins, the percentage can be increased. A different rotary speed is used for various nuts based on size groups.

iii. Semi-automatic cashew nut sheller

The prime mover is switched on to start the machine and the operator has to place a nut on the bottom holding assembly in between two side support plates and pull the mechanical lever forward. The power is transmitted to the gear box through the front flange and the belt-pulley drive. The cam assembly is rotated by the worm gear to conduct the shelling operation. As the cam rotates, the spring loaded actuating assemblv helps the top shelling assembly to result in the impuls~ action followed by the tensile action to complete shelling of the nut. The next stroke of operation starts again with the placement of another cashew nut in between the side supports. The depth of penetration of the pins through the shelling unit and the holding unit are adjusted as per the size of the cashew nut. For a particular grade of the cashew nut this arrangement can be fixed and can be adjusted when the grade is changed.

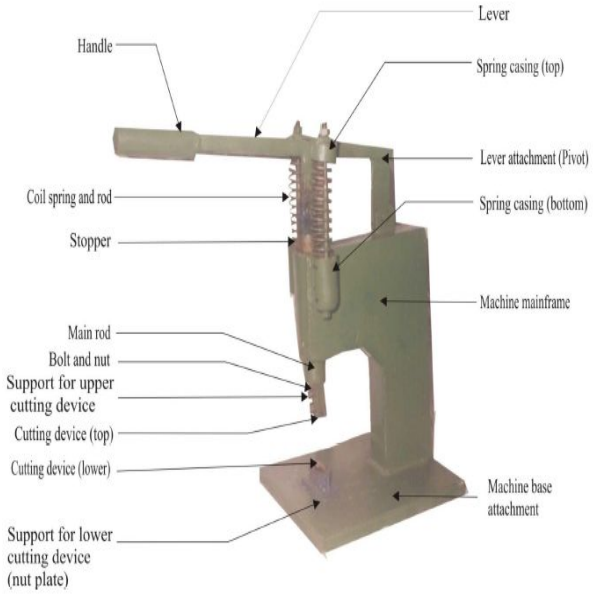

Fig.8.Semi-automatic cashew nut sheller [2]

The mainframe and the base are made of mild steel. These provide support to the cracker. The frame is in the form of inverted capital letter L, with minimum height of 300 mm on both sides separated by a gap of 50 mm. Part of the gap houses the cracking system and flat sheets of metals to which the two sides are welded. The cut side is 130 mm in length and 170 mm from the cracker base. The lever-hand is made of mild-steel. It has minimum length of 506 mm and is attached to the cracker mainframe thr ough the pivot with bolt and nut. The hand attachment of the lever is fabricated for easy grip. The cracking assembly is made-up of two return springs for quick return of lever-hand to its original position before actuation. The springs contain two steel rods to prevent severe bending and ease of movement of the lever-hand, the threaded top of the rods contains hexagonal nuts which are used for height adjustment for upper cutter. The springs contain top and bottom casings. The bottom casings are welded to both sides of the cracker frame for stability. The top casings are welded to the leverhand at minimum distance of 176 mm from the pivot. The lever-hand is joined to the main rod through attachment bolted together. The cashew nut to be cracked is placed on the nut plate. When the lever-hand is activated downward, the upper cutter descends towards the lower cutter. The upper blade cut through the nut concave side while the lower blade cut through the convex side. The nut is removed by hand protected with hand gloves smeared with palm oil. The movement of the upper cutter is adjusted through the thread nuts latching the spring-rods to the lever-hand. The return springs return the upper cutter to its initial position

iv. Motorized cashew shelling Machine:

The machine designed is motorized. During operation, it cracks cashew nuts by impact when the nuts are hurled toward a fixed wall by an impeller which is driven by the electricmotor. The shell of the cashew nut cracks plastically under impact load, implying that there is no conservation of kinetic energy.

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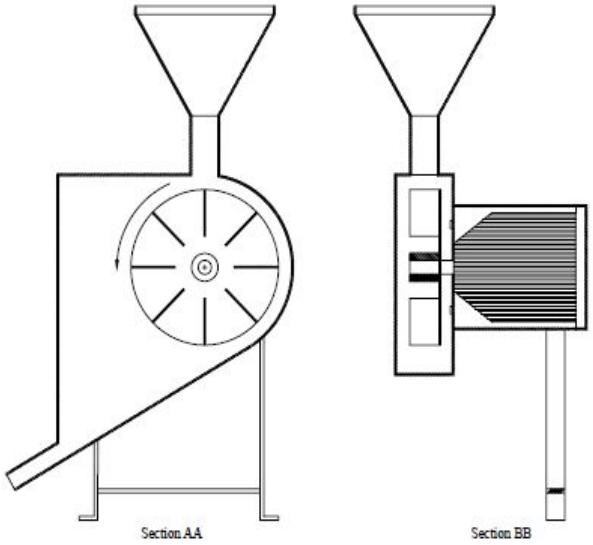

Fig.9.Motorized cashew nut shelling

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 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. 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.

Pre-Grading

Pre-grading can be done before or after drying the kernels and May greatly reduces 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.

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. 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. Figure 11 shows a tray dryer, designed by ITDG, for drying cashew kernels. The dryer contains a series of mesh-bottom trays that are slotted into the drying cabinet. The trays would 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 be used to provide a heat source. Drying programmer are generally organized so that the kernels from one day' s shelling go directly into the oven for overnight drying.

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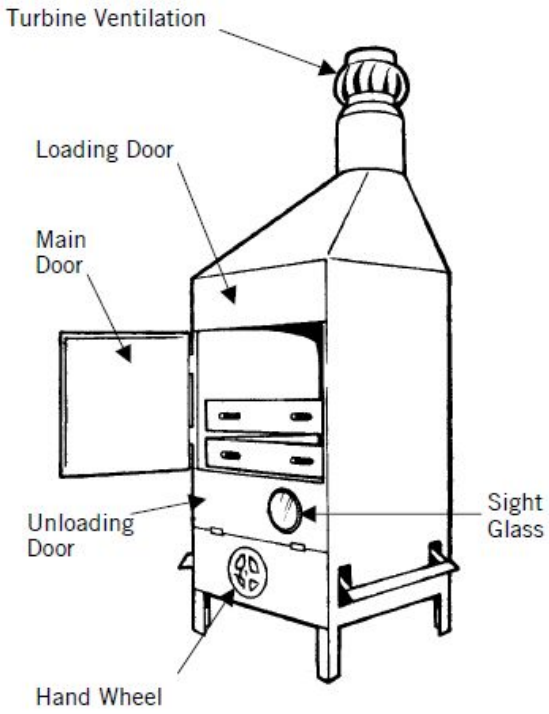

Fig.10. Cashew nut tray dryer.

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.

Peeling

Manual peeling is performed by gently rubbing with the fingers. Those parts still attached to the kernel are removed with the 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 the likelihood of the kernels becoming damaged, but it is also essential that all of the testa be removed. Gentle scraping of the 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 are separated into white wholes, scorched wholes, white pieces, scorched pieces, browns and refuse. However, the more experienced graders are able to separate the kernel into a larger number of categories. It is preferable that grading is carried out at the time of peeling as this cut down on handling of the brittle kernels. There is, however, the 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 end of the day, the removed testa is winnowed and all cashew pieces removed. The dust and very fine pieces that cannot be peeled, together with the diseased pieces, are classified as refuse and are thrown away. The browns, which are kernels that 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 observed by 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 system of rubber rollers. These systems are of low efficiency due to the difficulty of removing the testa. The level of breakage can be as high as 30 percent. Currently research and develop pment is taking place to improve the viability of the mechanization of this operation. After peeling, the kernels are weighed in order to record daily production. The peeled kernels are vulnerable to insect infestation and mould growth. They are also prone to rodent attack and should be stored in rodent-proof containers or rooms.

Grading

The grading operation is important since it is the last opportunity for quality control of the kernels. After the kernels are extracted from the shells, dried and peeled, they are graded for export according to size and

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condition. The grading system is known as the American Standard, which is also incorporated in the Indian Government export criteria. Kernels are categorized on the basis of colour and condition.

RESULTS AND DISCUSSION

We have seen the actual process on cashew nut to be performed using conventional and updated machines. As conventional methods are time consuming and there are more chances of low quality. Particularly if we use conventional techniques, it will take more time and there is risk of CNSL oil. Hence latest updated machines must be used to avoid risk and to improve the quality.

CONCLUSION

The conventional cashew nut process and shelling is more time consuming and with low rate of production. Hence all conventional processes must be mechanized. Shelling of roasted cashew nut is conventionally accomplished by cracking the nut by manual hand beating method to release the edible kernel. The irregular shape of the cashew nut and the brittleness of the kernel inside the hard shell make the shelling process complicated and results in breakage of kernels leading to reduction of market price and acceptability for export. The cashew nut shell liquid (CNSL) present over the drum roasted cashew nut shell surface causes a blistering effect on human skin, and to avoid that ash is mixed with them before shelling. This method is very difficult and time consuming. Also in conventional methods, labour quantity is more and work output is less. Hence there is need of mechanization to save time and improve the quality.

REFERENCES

1. *Ojolo S.J.,V,".Design and development of cashew nut shelling machine",July 2009*
2. *Onwualu A.P.,"Journal OF agricultural engineering and technology ",2007,Pp.40-55*
3. *SWAIN S.K., "Development and performance evaluation of a semi-automatic cashew nut sheller",2011*
4. *Azam-Ali S.H.,Judge E.C.," Small-scale cashew nut processing",2006,Pp.19-55*
5. *Kolhe.K.P and Jadhav .B.B ,"Testing and performance Evaluation of Tractor Mounted Hydraulic Elevator for Mango Orchard"American journal of Engineering and Genral Sciences.DOI.10.3844/ajeassp.2011ISSN 1941-70202011,4(1)Pp.179-186*
6. *Kolhe K.P., Powar A.G.,Dhakane A.D. and Mankar S.H."Stability and Ergonomic DesignFeatures of Tractor Mounted Hydraulic Elevator"American Journal of Engineering and applied sciences.DOI.10.3844/ajeassp.2011.ISNN 1941-7020*
7. *Kolhe K.P..,"Testing of Tractor Mountedand Self Propelled Coconut Climber for Coconut Harvesting" American Journal of Engineering and applied sciences.DOI.10.3844/ajeassp.2011.ISNN 1941-7020*
8. *Kolhe K.P."Testing and Ergonomically Evaluation of Tractor Mounted and self Propelled coconut Climber"2014,Int. Journal of Engineering and Technology ISSN 2321-1163.3(9)Pp.357-362.*
9. *Kolhe.K.P."Stability analysis of Tractor Mounted hydraulic elevator for Horticulture Orchard"2015,World Journal of Engineering.accepted for publication Hebei Universityy of Engineering ,Guangming South street199, Handan,Hebei,china,056038*
10. *Kolhe K.P."Testing of Tractor Mounted and Self Propelled Coconut Climber for Coconut Harvesting"2015, World Journal of Engineering.*
11. *Kolhe.K.P."Devlopement and Testing of Tree climbing and Harvesting device for mango and coconut Tree"Indian coconut Journal,Published by Ministry of Agriculture,CDB board kochi Kerla(ISSN No 0970-0579)2009,LII(3)Pp.15-19*
12. *Kolhe K.P."Mechanised Harvesting Device A Need of Coconut Growers in India",Indian Coconut Journal,published by Ministry of Agriculture,CDB board Kochi Kerla(ISSN No 0970-0579)2010,73(2)Pp. 15-19*
13. *Kolhe K.P. and Admane S.V."Studies of Multipass GMAW Butt Joint for Welding of AA7020"2013, Indian journal of Scholarly Research.2(8)Pp.23-26.*
14. *Atul mohod,Sudhir Jain"Cashew Nut Processing: Sources of Environment pollution and Standards" BIOINFO Environment And Pollution, 2011*