

# Performance evaluation of pilot cashew nut processing unit

■ P.D. UKEY, S.K. SAWANT AND P.A. PATIL

**SUMMARY :** A small cashew (*Anacardium occidentale* L.) processing unit consisting of steamer, cooker, shelling machine and dryer was tested for its performance for the cashew nut variety 'Vengurla-5'. The unit was received at Zonal Agricultural Research Station, Sub-montane Zone, Shenda Park; Kolhapur under "Technology Park" sanctioned Commissioner, Agriculture M.S., Pune. The six treatments consisting of various combinations for pressure and time were evaluated for the performance of the pilot unit. The study revealed that treatment combination (4.5 kg/cm<sup>2</sup> and 20 min.) gave maximum recovery of whole kernels as well as over all recovery of kernels with minimum moisture content, which is desirable for good quality product in the markets. Therefore, the treatment condition consisting of keeping raw cashew nut at 4.5 kg/cm<sup>2</sup> pressure for 20 minutes duration for the given processing unit was found to be the best giving maximum recovery of good quality kernels and overall total recovery of kernels with minimum moisture content.

**Key Words :** Cashew nut processing unit, Quality of cashew kernel, Kernel recovery, Grading of cashew kannel

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Cashew (*Anacardium occidentale* L.) was not considered as fruit crop in India since a long time, rather it was considered as a wild crop on non arable land for soil conservation. Cashew is mostly grown in costal area of Kerala, Karnataka, Goa, Maharashtra, Andhra Pradesh, Orissa and Tamil Nadu. Cashew kernels are nutritious and tasty. They are mostly used as roasted and salted nuts in snacks, alone or in mixture with other nut. Broken kernels are used in confectionary and sometimes as substitute for almonds. Ground powder can replace peanuts butter in exotic dishes. Cashew kernels are integrated in delicious chocolates. The value added products are honey coated cashew, cashew roasted with special flavours-garlic, cheese, etc. It earns maximum foreign exchange.

Cashew kernel may be used as food medium for loss of appetite, general depression, nervous weakness and scurvy. It is also a rich source of riboflavin, which keeps body active and energetic. 100 g of cashew kernel contributes about 600 kilocalories energy, 22 per cent carbohydrates, 21 per cent protein and 47 per cent fat along with minerals like Ca, Mg, K, Na and Fe (Ohlem, 1979). Being rich in iron it also useful in anemic. Its regular use is beneficial in the treatment of gastric, chest, urinary and liver disorders. Cashew nut shell liquid (CNSL) is a by-product of cashew industry. It is a unique monomeric source for making various polymeric compounds. Cashew apple is used for manufacturing of cashew apple jam, cashew apple candy, chutney, canned cashew apple, pickles, vinegar, and alcoholic beverages. The distilled cashew liquor called "feni" is very famous in Goa. The Maharashtra state has maximum scope for farm mechanization and initiating subsidiary occupations. Small and marginal farmers /or cashew growers can initiate such type of family owned agro-business for supplementary income through value addition. In view of this, a pilot cashew processing unit was studied for its performance. The study was, therefore, undertaken with following specific objectives:

- To study the performance of cashew processing unit.
- To study various combinations of steaming pressure

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and cooking time on recovery of cashew nut kernels.

## EXPERIMENTAL METHODS

The cashew variety Vengurla-5 was used for the performance evaluation of cashew processing unit. Vengurla-5 is most common cashew variety adopted in Konkan region and used for processing. There are 200 to 210 cashew nuts in 1 kg sample of Vengurla-5. Five kg sample consisting of 1000 to 1050 cashew nuts was used for individual treatment / combination of steam pressure and cooking time. The cashew-processing unit used for its performance evaluation was manufactured by M/s Shree Vyankateshwara Industries, Nagpur. It has 20 kg processing capacity and runs on single phase electric supply. It consists of steamer, cooker, pedal operated shelling machine and dryer.

### Steamer:

The steamer is one of the important components provided along with cashew processing unit. It is cylindrical in shape, made up of heavy M.S. sheet. It has diameter of 27.0 cm and height 47.0 cm. It is filled with water up to 11.5 litres for generating steam. It has inlet and outlet pipe for filling and removal of water. To maintain water level in the cylinder, the water level pipe is also provided at a depth of 20.0 cm. It generates steam for softening of nuts. The steamer is provided with steam outlet pipe with pressure gauge to measure steam pressure up to 14 kg/cm<sup>2</sup>.

### Cooker:

Cooker is provided for steaming the raw cashew nuts. It has cylindrical chamber with diameter of 28 cm and height 54.5 cm. The total capacity of cooking chamber is of 20 kg. The chamber is made up of the thick gauge mild steel sheet duly painted with heat resistive paint. It is totally leak proof to prevent temperature loss during steaming process. The nuts are placed from the top and the steam is provided from the bottom of cooking chamber.

### Pedal operated shelling machine:

The unit is provided with pedal operated shelling table for shelling of steamed and cooled cashew nuts. It is manually operated with capacity 10 kg of kernels per day. The cutter blade is made up of special steel. It has 4.75 cm length and provided with heavy duty double springs.

### Dryer:

The cashew processing unit is provided with electric dryer for drying of shelled cashew nuts. It requires single phase electric supply. It has thermostat arrangement for regulating temperature in between 20 and 200°C (Anonymous, 2003).

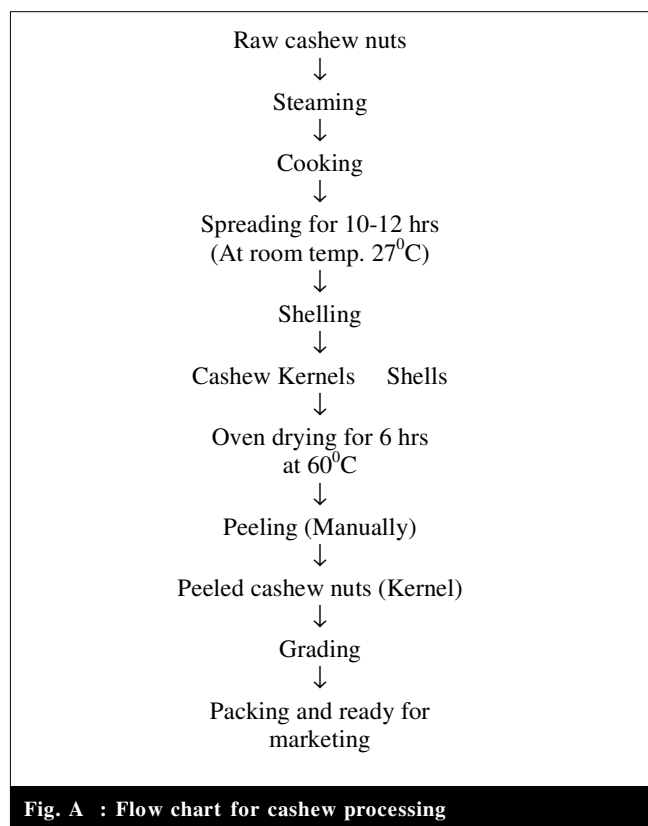


Fig. A : Flow chart for cashew processing

### Methodology:

The methodology adopted for the cashew processing is presented in flow chart as given in Fig. A and the various treatment combinations of steam pressure and cooking time are given in Table A.

Table A : Pressure and cooking time for different treatments

Treatments	Pressure (kg/cm <sup>2</sup> )	Time (min.)
B <sub>1</sub>	4.0	20
B <sub>2</sub>	4.0	15
B <sub>3</sub>	4.5	20
B <sub>4</sub>	4.5	15
B <sub>5</sub>	5.0	20
B <sub>6</sub>	5.0	15

### Steaming:

Direct steaming method (Allowed directly pass in cooling chamber) was adopted for steaming of individual sample of 5 kg raw cashew nuts. The steamer was filled with clean water up to required water level pipe and heated with single phase electric supply for generation of steam. The pressure in the pressure gauge was monitored with the help of pressure gauge. When the pressure reaches to 4.0, 4.5 and 5.0 kg/cm<sup>2</sup>, the steam was allowed to pass from steam outlet to cooking chamber from its

bottom portion.

**Cooking:**

The steam was allowed to pass for 15 and 20 minutes duration for individual sample at pressure of 4.0, 4.5 and 5.0 kg/cm<sup>2</sup>. So there were six different treatment combinations i. e (B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub>, B<sub>5</sub> and B<sub>6</sub>) as given in Table A.

**Cooling :**

The individual sample after steaming for particular steam pressure and steaming time was spread on ground for cooling for 12 to 15 hours at room temperature. The cooling would help to make hard shell brittle and facilitate easy shelling.

**Shelling:**

Shelling of nuts was done manually with the help of pedal operated shelling machine. Cooked nuts when cooled at room temperature were taken for shelling. The operation is laborious but requires skill for maximum recovery of whole kernels. The per cent recovery of whole kernel was calculated using equation 1

$$\text{Per cent whole kernel recovery} = \frac{\text{Number of whole kernels}}{\text{Total number kernels shelled}} \times 100 \quad (1)$$

The output / overall efficiency of cashew processing unit depend on the shelling efficiency, which ultimately reflects the skill.

**Separation:**

After shelling, the kernels were separated manually and the unshelled nuts were again put for shelling. 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. Mostly needles are used to separate the kernels from shell.

**Drying:**

The shelled kernels with testa kept for oven drying to produce the blanched kernel. Drying was done prior to peeling. It causes shrinkage of kernel for easy removal of testa by mechanical means or by hand with knife. Drying process also protects the kernels from pest and fungal attack at this vulnerable stage. The moisture content of kernels is reduced from 6 to 3 per cent by drying.

**Peeling:**

The testa is loosely attached to the kernel. Sometimes a few kernels may have already lost the testa during drying operation. Peeling is done manually by gently rubbing with the fingers. The parts still attached to the kernel are removed with bamboo knife. An individual can peel approx. 10 to 12 kg

of kernels in a day (Ohler, 1979).

It is important that the kernels are neither cut nor damaged during the peeling process. The use of knives increases the possibility of kernels to be damaged. It is also essential that the entire testa is removed. Gentle scraping of the testa with a blunt knife is the most effective way of removing it.

After peeling, the kernels are weighed in order to record daily production. The peeled kernels are vulnerable to insect infestation and mould growth. In the present study, the peeling

White wholes	Count per pound
W-180 (Super large)	Between 120 and 180 kernels per lb.
W-210 (Large)	Between 190 and 220 kernels per lb.
W-240	Between 230 and 260 kernels per lb.
W-280	Between 260 and 300 kernels per lb.
W-320	Between 300 and 340 kernels per lb.
W-400	Between 370 and 450 kernels per lb.
Scorched whole	
S-180	Between 150 and 190 kernels per lb.
S-210	Between 200 and 220 kernels per lb.
S-240	Between 230 and 280 kernels per lb.
S-320	Between 300 and 360 kernels per lb.
S-400	Between 380 and 480 kernels per lb.
W-1	Wholes (Naturally bended)
DW-1	Desert wholes
DW-2	Dotted wholes
Scorched whole	Count per pound
RW	Red wholes
FW	Follow wholes
KW	Curls wholes
Yellow	Yellow colored
Half kernels	
JH	Jumbo half
S	Splits (A kernel which has broken down naturally)
K	Cuts (20% cut pieces)
LWP	Large white pieces (20-50% cut pieces)
SP	Scorched pieces (50% cut scorched Pieces)
SK	Scorched cuts (Smaller Scorched cuts)
SWP	Small white pieces (Smaller than SK, White cuts)
SSP	Second small pieces (Smaller than SWP)
SS	Scorched splits
BB-I	Baby bits-I ( Greater than BB-II)
BB-II	Baby bits-II (Greater than BB-III)
BB-III	Baby bits-III ( Smaller)
BBH/HSK	Baby bits with husk
RS	Red splits
DP	Dotted pieces

was done manually with the help of blunt knife and at the same time the grading was done in three broad groups such as white wholes, white pieces and scorched grades.

### Grading:

The grading of peeled kernel is important for quality aspect. As per American standard, the grading system is also incorporated in India for export of good quality kernels. Kernels are categorized in to 11 to 24 grades on the basis of colour and condition of peeled cashew nuts. The grades are broadly divided in to three groups such as white wholes, white pieces and scorched grades. The three groups are further sub-divided in to following grades depending upon the number of kernels per pound.

## EXPERIMENTAL FINDINGS AND ANALYSIS

The results of the present study as well as relevant discussions have been presented under following sub heads:

### Effect of steaming pressure and cooking time on whole kernels recovery:

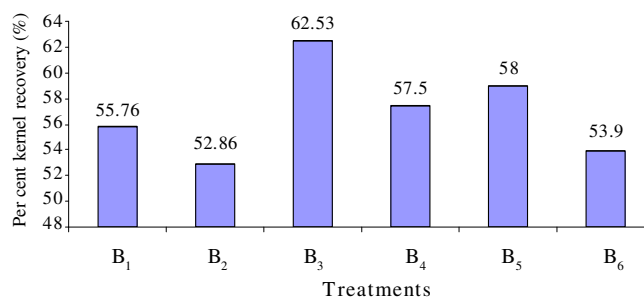
The effect of steaming pressure and cooking time on whole kernel recovery from different treatment combinations are presented in Table 1. The data revealed that the different combinations of steaming pressures and cooking period have profound influence on recovery of whole kernel of cashew. The treatment combination B<sub>3</sub> comprising of 4.5 kg/cm<sup>2</sup> steaming pressure and 20 minutes cooking time had recorded maximum whole kernel recovery to the extent of 62.53 per cent. It was followed by the treatment combinations B<sub>5</sub> (5.0 kg/cm<sup>2</sup> steaming pressure and 20 minutes cooking time). Reducing the pressure as increasing time and vice-versa did not prove beneficial for kernel recovery. Evidently the steam pressure of 4.5 kg/cm<sup>2</sup> and cooking time of 20 minutes is optimum for pre-treatment of raw cashew nuts (Fig. 1).

**Table 1 : Effects of steaming pressure and cooking time on whole kernel recovery**

Treatments	Pressure (kg/cm <sup>2</sup> )	Cooking time (minute)	Whole kernel recovery (%)
B <sub>1</sub>	4.0	20	55.76
B <sub>2</sub>	4.0	15	52.86
B <sub>3</sub>	4.5	20	62.53
B <sub>4</sub>	4.5	15	57.50
B <sub>5</sub>	5.0	20	59.00
B <sub>6</sub>	5.0	15	53.90

### Effect of steaming pressure and cooking time on total kernels recovery:

The steaming pressure and cooking time had also significant influence on total kernel recovery as presented in

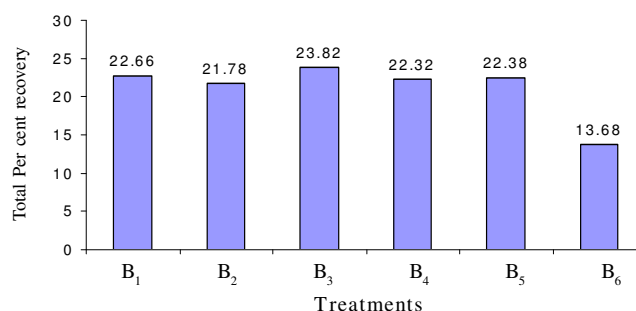


**Fig. 1 : Per cent whole kernel recovery**

Table 2. The treatment combination of B<sub>3</sub> (steaming pressure 4.5 kg/cm<sup>2</sup> and 20 minutes cooking time) proved most effective for maximum total kernel recovery to the extent of 23.82 per cent. It was followed by treatment combination of B<sub>1</sub> (Steaming pressure of 4.0 kg/cm<sup>2</sup> and 20 minutes duration), which gave 22.66 per cent total kernel recovery (Fig. 2). The steaming pressure seems to exert more influence on total recovery than time of steaming.

**Table 2 : Effect of pressure and cooking time on total kernel recovery**

Treatments	Pressure (kg/cm <sup>2</sup> )	Steaming time (min.)	Total weight (g.)	Total per cent recovery
B <sub>1</sub>	4.0	20	1133.35	22.66
B <sub>2</sub>	4.0	15	1089.42	21.78
B <sub>3</sub>	4.5	20	1191.49	23.82
B <sub>4</sub>	4.5	15	1116.39	22.32
B <sub>5</sub>	5.0	20	1119.06	22.38
B <sub>6</sub>	5.0	15	1062.50	21.25



**Fig. 2 : Per cent total kernel recovery**

### Effect of steaming pressure and cooking time on moisture content:

In steaming process, the moisture content of kernel increases and it becomes very difficult to peel the testa. Drying is, therefore, most essential for easy peeling of testa and for increasing its storage life. For this purpose, the optimum moisture content is 3 to 5 per cent. The moisture content of

**Table 3 : Effect of moisture content on whole kernel recovery and total kernel recovery**

Treatments	Moisture content after steaming (%)
B <sub>1</sub>	10.90
B <sub>2</sub>	11.60
B <sub>3</sub>	10.70
B <sub>4</sub>	10.80
B <sub>5</sub>	11.80
B <sub>6</sub>	13.68

**Table 4 : Effect of grading on quality of cashew kernels**

Treatments	Profit without grading (Rs./kg)	Profit with grading (Rs./kg)
B <sub>1</sub>	13.96	17.24
B <sub>2</sub>	11.53	15.92
B <sub>3</sub>	16.80	24.50
B <sub>4</sub>	13.50	17.61
B <sub>5</sub>	14.21	18.12
B <sub>6</sub>	10.43	13.84

**Table 5 : Grading of cashew kernels**

Treat.	B <sub>1</sub>		B <sub>2</sub>		B <sub>3</sub>		B <sub>4</sub>		B <sub>5</sub>		B <sub>6</sub>	
Time	4.0 kg/cm <sup>2</sup>		4.0 kg/cm <sup>2</sup>		4.5 kg/cm <sup>2</sup>		4.5 kg/cm <sup>2</sup>		5.0 kg/cm <sup>2</sup>		5.0 kg/cm <sup>2</sup>	
Pressure	and 20 min		and 15 min		and 20 min.		and 15 min.		and 20 min.		and 15 min.	
Grade	Wt. (g)	Nos	Wt. (g)	Nos	Wt. (g)	Nos	Wt. (g)	Nos	Wt. (g)	Nos	Wt. (g)	Nos
W-180	-	-	-	-	-	-	-	-	-	-	-	-
W-210	10	4	1.9	1	11.58	5	-	-	2	1	2.1	1
W-240	19.2	11	14.1	7	19.6	11	9.3	6	14.2	7	12.6	6
W-280	28.6	18	-	-	30.8	18	14	8	22	13	18.2	10
W-320	50.2	33	42.2	20	66.8	47	46.8	31	57.6	35	55.2	35
W-450	63.5	52	58.37	45	61.5	50	60.2	48	63.3	52	56.03	46
S-180	22.4	7	23.6	8	24.2	8	13	4	12.6	4	8.6	3
S-210	20.0	10	15.8	8	12.83	6	17.3	7	20.7	11	20.3	10
S-240	43.6	23	36.5	20	68.9	37	35.5	20	31.3	18	30.8	17
S-320	89.7	66	96.85	66	139	95	123.8	83	116.4	77	100.4	67
S-400	105	91	104.7	88	118.9	101	71.7	61	94.3	82	80.8	79
DW-1	49.1	34	46.2	30	41.6	31	55.5	46	54.5	40	51.7	41
DW-2	85.6	56	79.2	63	78.4	45	71.2	57	98.5	75	90.9	69
RW	44.7	34	50.6	43	44.4	23	51.1	36	49.2	45	54.2	52
W-1	81.4	52	79.3	50	69.3	48	96.9	63	89.3	55	89.6	55
FW	63.2	46	62.9	56	67.3	68	83.6	84	57.7	55	39.9	37
KW	30.5	24	27.3	30	38.5	41	33.3	36	30.9	42	19.7	22
Y	-	-	-	-	1	1	-	-	-	-	-	-
Total (Whole)	816	561	739.5	535	893.4	631	783.2	510	814.5	612	731.1	550
JH	19.4	19	17.32	18	19.8	19	23.1	23	18.8	17	16.3	15
S	76	111	82.7	117	65	94	72.4	116	97	130	78.4	116
K	43.5	-	37.1	-	31.4	-	45.9	-	50.9	-	50.3	-
LWP	41.4	-	47.2	-	24.6	-	40.6	-	21.8	-	14.3	-
SP	14.7	-	37.3	-	32.78	-	33.6	-	31.44	-	33.7	-
SK	30.4	-	34.2	-	35.6	-	19.9	-	24.9	-	25.67	-
SWP	14.1	-	15.2	-	25.8	-	21.6	-	18.9	-	18.3	-
SSP	10.6	-	13.2	-	7.7	-	7.3	-	6.6	-	14.2	-
SS	13.3	12	16.16	14	12.3	13	21.3	10	15.4	14	14.7	15
BB-1	5.5	-	6.1	-	8	-	4.5	-	10.1	-	9.2	-
BB-2	3.5	-	5.4	-	4.4	-	5.4	-	9.5	-	10.4	-
BB-3	6.8	-	2.8	-	3.8	-	4.7	-	6.9	-	11.2	-
BBH	9.2	-	10.2	-	6.7	-	13.8	-	8.2	-	8.3	-
RS	14.8	12	9.2	9	11.1	11	8.1	9	13.1	13	11.8	10
DP	13.5	18	15.82	12	9.1	10	10.91	10	14.1	12	14.7	12
Total	1133.3	-	1089.4	-	1191.5	-	1116.3	-	1119.1	-	1062.5	-

cashew nut after steaming under various treatment combinations are given in Table 3. The treatment combinations B<sub>3</sub> (Steam pressure 4.5 kg/cm<sup>2</sup> and 20 minutes cooking time) resulted into minimum moisture content up to 10.70 per cent which is desirable for easy removing of testa and for increasing its storage life. Maximum moisture content 13.68 per cent was recorded (Fig. 3) in treatment combination of B<sub>6</sub> (5 kg/cm<sup>2</sup> steaming pressure and 15 minutes cooking time).

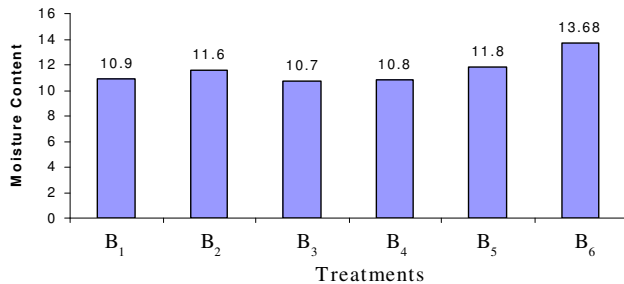


Fig. 3 : Moisture content curve at different treatment for before drying

#### Effect of grading on quality and market rates of cashew kernels:

The kernels with and without grading have significant influence on quality parameters and market rate of cashew kernels. Although the treatment combination B<sub>6</sub> (4.5 kg/cm<sup>2</sup> steaming pressure and 20 minutes cooking time) gave maximum whole kernel and total kernel recoveries, but the kernels with higher grading fetch maximum market rate as presented in Table 4. The grade wise distribution of kernels in terms of its weight and numbers in six different treatments (B<sub>1</sub> to B<sub>6</sub>) are presented in Table 5. The market rates and profit for the graded kernels are always more as compared to the ungraded kernels irrespective of the treatments (Table 4). Nevertheless, the treatment B<sub>3</sub> proved more effective for obtaining greater profit than other treatment under study indicating that observed optimum steam (4.5 kg/cm<sup>2</sup>) pressure, time of cooking (20 min) is most important for higher profit.

#### Overall performance of processing unit:

Better performance of cashew processing unit was observed for treatment combination B<sub>3</sub> (4.5 kg/cm<sup>2</sup> steam

pressure and 20 minutes cooking time). It has given maximum whole kernel recovery of 62.53 per cent as well as maximum total kernel recovery of 23.82 per cent and resulted in minimum moisture content of 10.70 per cent which is desirable for easy removing of testa and for increasing its storage life. The treatment combination 4.5 kg/cm<sup>2</sup> steam pressure and 20 minutes cooking time was, therefore, found to be optimum for given cashew processing unit.

#### Conclusion:

On the basis of present study, the following conclusions are drawn:

- The steam pressure and cooking time had significant influence on whole kernel and total kernel recoveries.
- It had also significant impact on moisture content of the steamed nuts.
- The treatment combination steaming pressure 4.5 kg/cm<sup>2</sup> and cooking time 20 minutes gave higher recovery of whole kernels as well as high average recovery of total kernels and proved optimum for the unit.
- Optimum pressure and time of steaming resulted in minimum moisture content in the kernels after steaming which is desirable for easy removal of testa and longer storage life.
- Steaming pressure 4.5 kg/cm<sup>2</sup> and cooking time of 20 minutes is the suitable and optimum combination for the given cashew processing unit.

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