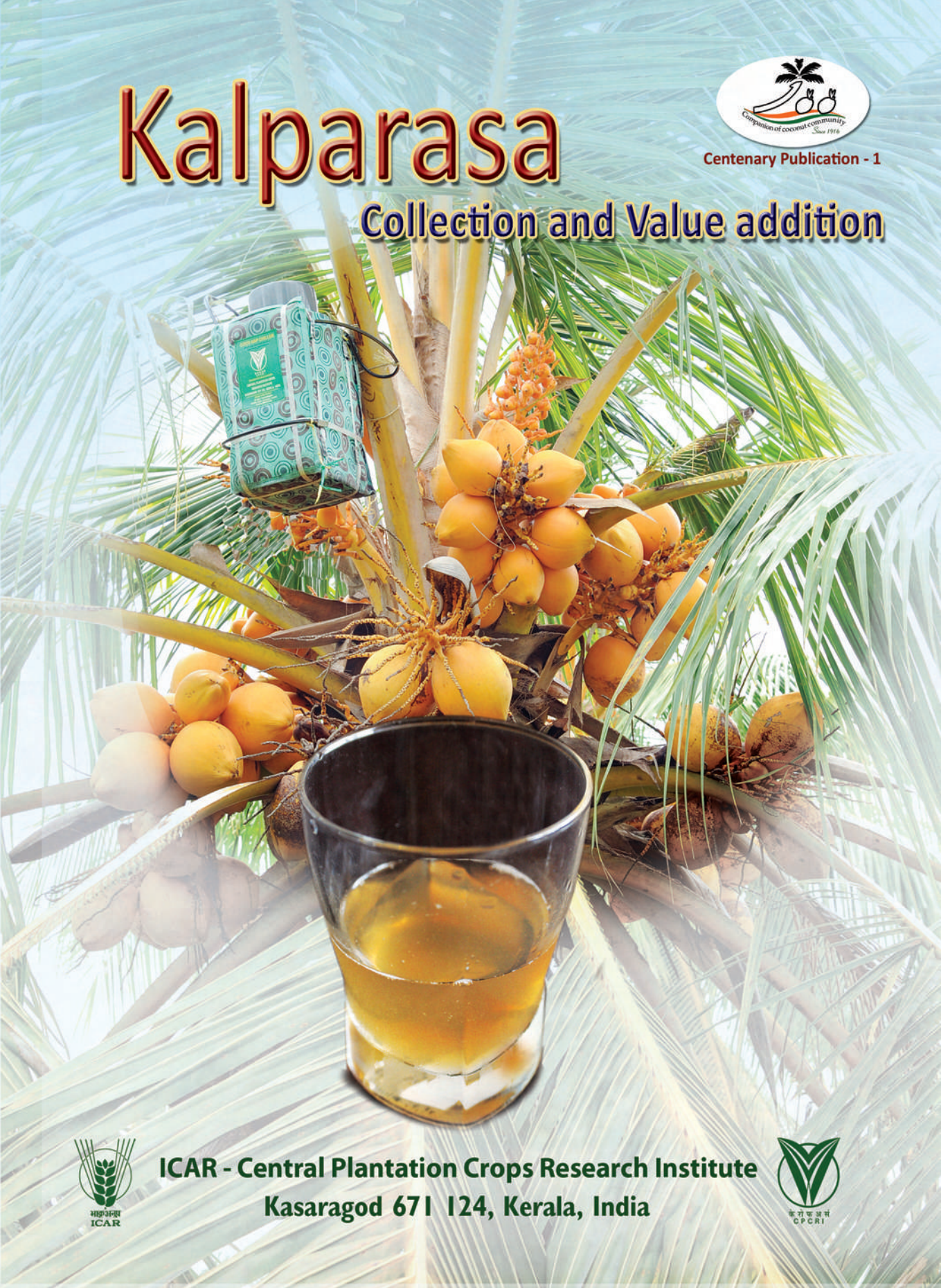
Kalparasa

Collection and Value addition

Centenary Publication - 1



ICAR - Central Plantation Crops Research Institute
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CONTENTS

KALPARASA : COLLECTION AND VALUE ADDITION

Introduction

Kalparasa (coconut sap) in Sanskrit means 'life essence' of coconut tree. Coconut sap, normally called as *neera*, is a natural health drink, which is traditionally collected from the coconut spadix and consumed largely by the rural population. It is the phloem sap, rich in sugars, protein, minerals, antioxidants, vitamins and utilized by the plant for the growth and development of nuts. The sap is highly predisposed to fermentation and, therefore, collection of fresh and unfermented sap is a challenging task in coconut. Lime is commonly used as a fermentation inhibitor, by coating the inside of the collection container. Even with the lime application, the sap gets partially fermented and becomes unfit to be marketed as a health drink. The fermented sap is called 'toddy' which is a traditional alcoholic beverage. The lack of proper method of collection and suitable inhibitors to prevent fermentation led to the inclusion of both fermented (toddy) and unfermented (neera) sap under the category "toddy". Accordingly, the Karnataka Excise Act, 1965 (Act 21 of 1966) adapted from the Mysore Excise Act, 1901(Act No. V of 1901), The Hyderabad Abkari Act, 1316 (No. 1 of 1316 F), and the Madras Abkari Act, 1886 (Madras Act 1 of 1886) were enacted and tapping of coconut sap is prohibited. Coconut is included as an excise tree (Section 11A) and the unfermented juice of coconut tree from which toddy can be produced is also interpreted as toddy. However, unfermented neera and toddy are two different products, chemically and nutritionally. Unfermented neera is a more nutritious health beverage than fermented toddy and supposed to be non-alcoholic. The challenge of collecting unfermented neera has been resolved with the development of 'Coco sap chiller' by CPCRI and the sap thus collected is fresh, hygienic and zero alcoholic. This unfermented sap of coconut is named as Kalparasa and registered under trademark. This sap is ideal to be sold as fresh juice or processed for the preparation of natural coconut sugar, jaggery, honey, syrup, etc without the addition of chemicals. The quality and market price of fresh juice has kindled great hope in Indian coconut farmers who have been otherwise struggling to cope up with unstable price and rising labor costs. Though the financials of Kalparasa tapping and marketing looks attractive, operationalising the same calls for meticulous and professional planning, monitoring and quality check. This technical bulletin describes the technique of collecting fresh and unfermented sap and its value addition for those coconut frmers, entrepreneurs, academicians who wish to collect and market Kalparasa in an organized way. Case studies are also included to show how it can be operated at the farm level.

Rationale for tapping

The inflorescence sap of coconut is the phloem sap and used by the plant mainly for the development of the fruit. Generally, coconut produces 12 to 14 inflorescences

(spadix) in a year, on an average one per month. Each spadix can support 20 to 25 either tender or mature coconuts. Tender nut requires 6 to 8 months while, mature nut takes almost a complete year for its maturity. At a reasonably high water content of 500 ml per tendernut, the total water equivalent per spadix is just 10 to 12.5 l. If the same unopened spadix is tapped for sap it could produce 60 to 67.5 l of sap in a period of just 40 to 45 days at a conservative yield of 1.5 l/day. Moreover, it is rich in nutrients and phytochemicals as compared to tender coconut water. The sap thus collected can be sold as a health drink or processed into sugar, jaggery, honey or syrup which has a great demand in domestic and international market.

Tapping techniques

Selection of palm and inflorescence:

Coconut trees can be tapped at an early age as soon as it attains yield stability. Generally, healthy trees which bear more fruits tend to yield more sap. Tapping is done in unopened inflorescence. The development of female flowers inside the spathe (about 60 cm long) causes a swelling at the base, which is an indication of appropriate stage for tapping (Fig. 1a). The inflorescence selected for tapping is first tied around with a strong coir or plastic rope to prevent it from bursting (Fig. 1b). The spadix is then trained by a gentle uniform beating using a mallet (Fig. 1c) and hand massaged (using the palms) (Fig. 1d) all over, twice a day, in the morning and in the evening for a week. After 4-5 days of stroking, 7-10 cm tip is sliced off (Fig. 1e) and in a week's time sap starts oozing out from the cut end.

Fig. 1. a. Ideal spadix ready for tapping

Fig. 1b. Spadix tied with plastic rope

Fig. 1c. Uniform beating using a mallet

Fig. 1d. Massaging the spadix

Fig. 1e. Slicing tip after 4-5 days of stroking

Traditional method of sap collection:

The initial preparation of the spadix to be tapped is same as described above. As soon as the sap starts oozing from the cut surface, tappers apply clay, some type of gummy material or leaf extract to the sliced surface as shown in Fig. 2b. Though, tappers say it

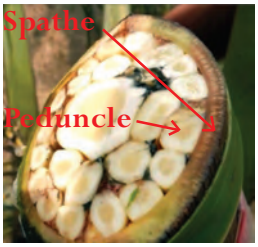


Fig. 2. Cut surface of spadix a. shows spathe and peduncle


Fig. 2b. Clay applied to the cut end and leaf lamina tied along the circumference

stimulates the flow of sap, it appears to prevent the internal seepage of the sap in the space available between the peduncles (Fig. 2a). Because of the upright or vertical (forms an angle of 20 to 30° to the main axis) position of the spadix in the crown, the sap from the cut end doesn't easily trickle to the pot below, instead it moves along the surface of the spadix. Hence, a coconut lamina is tied along the circumference of the cut end through which the sap trickles down to the pot (Fig. 2b).

The sap is then collected in an open earthen pot or bamboo sac connected to the cut end of the spadix (Fig. 3). In order to prevent fermentation of sap, lime is coated on the inner surface of the pot. The sap collected by this method is oyster white in color and emanates a harsh odour. The sap collected without applying lime is used exclusively for the preparation of toddy, an alcoholic drink. Since, the sap is collected in the open it is often contaminated by insects, ants, pollen and dust particles in addition to the chemicals, clay or leaf extract.


Fig. 3. Traditional method of Neera collection

CPCRI method of sap collection: In the sap collection method developed at the institute a simple connector as described below is attached to the cut end of spadix, instead of the traditional application of clay or other materials, to ensure the free flow of hygienic sap and a coco-sap chiller is connected for the collection of sap, instead of the traditional earthen pot.

Connectors: A PVC pipe of required size (approx. 50-60 mm diameter) nearest to the diameter of spadix excluding spathe is selected. This pipe is inserted in to an end cap of the same diameter making the connector closed at one end. Sharp edged groves of 3 mm are made at the open end of the connector, which fits into the inflorescence. A hard tapering tubular adaptor of 10 mm diameter fitted 20 mm above the grooved end of the connector, drains the sap to the collection container


Fig. 4. Connectors of different diameter attached with hard tubular tube

(Fig. 4). As the connector is tightly screwed, there is no inter-peduncle space left, hence avoiding the need to apply clay or any gunny material or leaf extracts (Fig. 5).

Fig. 5. A connector fastened to the cut end of the spadix

A transparent pipe is connected to the free end of the adaptor and the other end is connected to a screw cap container or zipped plastic envelope (Fig. 6a). The sap oozed from the cut end of the spadix flows freely

Fig. 6a. The sap collection in screw cap bottle

Fig. 6b. Connection of ice box

through the pipe and is guided to the Kalparasa collection container through the transparent connecting tube. The container is kept in an ice box containing ice cubicles (Fig. 6b). Thus, fresh and hygienic Kalparasa can be collected using this new device. The device is filed for patent (Application No. 2425/CHE/2013 A dated 03/06/2013).

Drawback: The sap while flowing through the plastic pipe which is exposed to the sun undergoes mild changes in quality of the sap in terms of its colour and odour. The efficiency of the commercial ice box to retain the cool temperature is less.

Coco-sap chiller: It is an improvised version of sap collection, developed jointly by CPCRI and a farmer Mr. Augustine Joseph from Karkala, Karnataka exclusively for the sap collection of coconut or palm trees (Fig. 7). Coco-sap chiller is a portable device characterized by a hollow PVC pipe of which one end is expanded into a box shape to house a sap collection container bound by ice cubes and the other end is wide enough to insert and remove a collection container of 2 litre capacity. Each side wall of the pipe from outside are covered with an insulating jacket excluding the portion of spadix holder which retains the internal cool temperature for a longer period. This Coco-sap chiller is lighter in weight, water proof, easy to connect to the spadix, requires less ice, and retains low temperature for longer period as compared to commercially available ice boxes. The device is filed for patent (Application No.4077/CHE/2014 A dated 05/09/2014).

Fig. 7. Coco-sap chiller

It is a novel method of collecting unfermented sap and preserving its flavor and aroma without the use of preservatives. In this method, the sap from the cut end of the spadix directly trickles down to a container which is housed in the ice box. Ice cubes are placed around the sap collection container which maintains the internal temperature at very low levels (2 to 3°C). The sap thus collected is farm fresh, hygienic, chemical free and zero alcoholic. It can be stored fresh for any length of time under subzero temperature. The whole process is simple; allowing local farmers to tap and sell it as chemical free nutritious drink or produce natural coconut sugar and can convert their coconut palms into an instant cash crop that reaps great financial benefits.

The *modus-operandi* of Coco-sap chiller: The initial preparations of the spadix to be tapped are same as described under the section selection of palms and inflorescence. Once the sap starts oozing, a Coco-sap chiller is prepared to be connected to the spadix. Ice cubes (0.5 to 0.75 kg depending on climate and amount of sap) or 3 to 4 gel ice packets are spread in the inner space of the container using ice spreader as shown in the Fig. 8a. A container or plastic pouch of food grade quality which is connected to the O-ring is placed above the groove made for the purpose (Fig. 8b and 8c). A stainless steel or plastic filter is placed above the O-ring so that no pollen or plant

Fig. 8. Preparation of Coco sap chiller for connection to inflorescence. a- ice spread

Fig. 8b. Polythene pouch is connected to O-ring

material falls inside the collection container from the sliced end of inflorescence (Fig. 8d). The spadix is inserted through the spadix holder in such a fashion that, the cut end is just above the centre of the filter as shown

Fig. 8c. Polythene pouch with O-ring fixed above the groove

Fig. 8d. A filter placed above the grove

in Fig. 9. The spadix is tightly fastened to spadix holder using rexin or plastic cover to prevent the entry of ants, insects etc. The top of the box is tightly closed during sap collection as shown in Fig. 9e. The box is hanged to the tree using the handles provided (Fig. 10a and b).

For the initial few days of tapping when the inflorescence is upright or vertical, a

connector is attached to the cut end to ensure free flow of sap from the cut surface to the collection container (Fig. 9a). Within a few days of tapping, the spadix becomes flat and the sap from the cut end directly trickles to the container without the requirement of connectors (Fig. 9b).

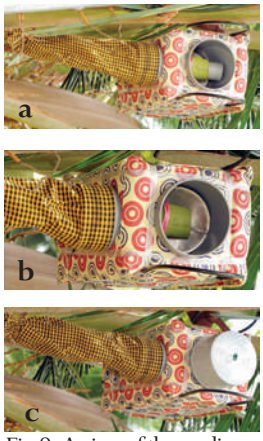


Fig. 9. A view of the spadix inside the box a-with adaptor; b-without adaptor and c-view of a completely closed system

The sap that trickles from the cut surface flows on to the stainless steel filter and is collected in the container. The filled container is taken out twice a day (in the morning and the evening) and transferred to another ice box and transported to the storage place. The Cocosap chiller, the filter, connectors are washed regularly to maitain hygine and ice cubicles and collection container are replaced and the box is reconnected as mentioned above. Each spadix requires one box and at a time two to three boxes can be connected on a single tree as shown in Fig. 10a and 10b.

Fig. 10. Coconut crown with Coco-sap chiller. a-single spadix and b- multiple spadix connection.

The sap thus collected from the completely closed system is not only fresh and unfermented but also free from the contaminants like insects, ants, pollen, dust, etc. To produce good quality Kalparasa, it is necessary that all containers and vessels used should be clean at all times.

Advantages of CPCRI ice-box technology over traditional method of collection

- The sap collected is zero alcoholic, fresh and hygienic
- Sap is devoid of lime, clay, leaf extract etc.
- Free from contamination by insects, ants, pollen and dust particles.
- Freshly collected sap can be preserved fresh for long duration under freeze or sub zero condition (<0°C).
- The sap collected by this method is a ready to serve natural health drink.
- Products like natural coconut sugar, jaggery, confectionery and honey can be prepared without the addition of lime and other chemicals.
- Since it is completely closed system no emission of volatiles and thus do not attract harmful insects to coconut palm.
- Fabrication is simple and parts required are relatively cheaper and can be prepared from locally available material. It is easy to operate and anyone can adopt it with one or two days training.
- The device is not only suitable for the collection of sap from coconut but also

can easily be connected to other sap yielding palms.

- It is easy to handle as compared to the traditional method, and hence, men and women (who are skilled climbers) can easily tap for Kalparasa.

Tapping frequency

Tapping is done twice a day (in the morning and evening). Each time 1 to 2 mm spadix is sliced using a sharp knife and can be tapped in this way for 40 to 45 days, depending on the tapper's skill, seasonal conditions, and nature of the palm. A single spadix can be tapped until it is reduced to a stump of about 10-15cm length. About three weeks before reaching this point, another spadix is prepared in order to ensure continuity of sap production. At a time, two to three spadices can be tapped simultaneously from a tree.

Kalaparasa yield

Sap yield is influenced by both genotype and environment; it varies from day to day, season to season, spadix to spadix and tree to tree. Talls and hybrids are known to produce more Kalparasa as compared to dwarfs. A healthy tree can produce 1.5 to 3.0 l of sap per spadix per day and can produce on an average 60 to 80 l of sap in 40 to 45 days. Coconut produces 12 to 14 spadices per year almost one per month. Even if six spadices are tapped and the remaining are allowed to produce nuts, around 400 l of sap and few fruits can be produced. The sap yield is also influenced by the skill of the tappers. Highly skilled tappers can tap the spadix for two months as against 30-45 days of average tapping period.

Quality attributes of Kalparasa

Distinct differences are noticed between the Kalparasa/neera collected by CPCRI technique and traditional method as shown in Table 1 and Fig. 11. Fresh sap collected by CPCRI technique is slightly alkaline in pH, golden brown or honey colour and sweet and delicious.

Table 1. Quality attributes of Kalparasa collected by CPCRI technique and traditional technique

Attributes	CPCRI Technique	Traditional technique
Soluble solids (°Brix)	15.5 to 18	13 to 14
pH	7 to 8	6 or below 6
Colour	Light orange & honey color	Oyster white
Debris, insects, Pollen, dust	Absent	Present
Flavour	Sweet and delicious	Harsh odour
Pathogens, chemicals and extraneous matter	Absent	Present
Microbial load	Low	High

Fresh sap when left exposed to atmosphere undergoes initial lactic acid fermentation, middle alcoholic fermentation and final acetic fermentation consequent on the action of micro organisms. As the sap gets fermented, it becomes acidic and the pH reduces. The freshly collected sap starts fermenting within 2 to 3 hours under ambient temperature and the pH starts declining (Fig. 12). The pH of completely fermented sap is around 3.5. The sap stored in freezer (-1 to -3°C) remains fresh and no change in pH is observed. Fresh sap (pH 7.5) has around 15% sugars (Fig. 13). It decreases to about 6% at pH 4. During the same period, the reducing sugar level increases up to 5% (Fig. 13).

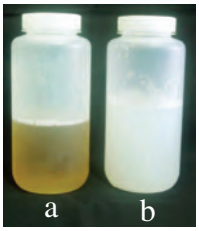


Fig. 11. Coconut sap collected by CPCRI (a) and traditional method (b)

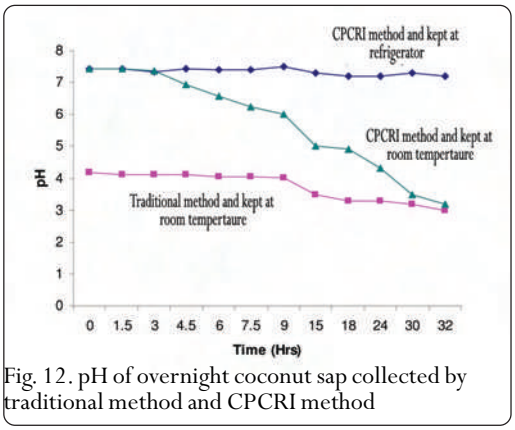


Fig. 12. pH of overnight coconut sap collected by traditional method and CPCRI method

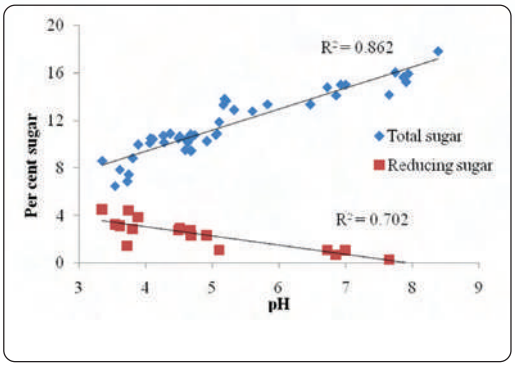


Fig. 13. The relation between the pH and total sugar and reducing sugar content of sap

Therefore to be sold as fresh juice the sap should have a pH of around 7, golden brown color, sweet and delicious and free from debris. Sap with pH less than 6.5 cannot be used for fresh juice or sugar preparation.

Biochemical constituents

Kalparasa is rich in sugar, minerals and proteins. It is also a rich source of phenolics and ascorbic acid. Kalparasa contains high amounts of essential elements such as N, P, K, Mg and micronutrients (Zn, Fe, and Cu). The biochemical constituents, minerals and vitamin composition of Kalparasa are given in the Table 2 & 3.

Table 2. Vitamin content in fresh coconut sap

Vitamin	Value (mg/100 ml)	Vitamin	Value (mg/100 ml)
Thiamine	77.00	Folic acid	0.24
Riboflavin	12.20	Inositol	127.70
Pyridoxal	38.40	Choline	9.00
Pantothenic acid	5.20	Vitamin B12	Trace
Nicotinic acid	40.60	Vitamin C	17.5
Biotin	0.17		

Source: Philippines Coconut Authority

Table 3. Biochemical and mineral composition of Kalparasa (per 100 ml)

Biochemical parameters	Range	Average
pH	6.57-7.50	7.18
Total sugar (g)	10.08 -16.50	15.18
Reducing sugar (g)	0.439 - 0.647	0.554
Amino acids (g)	0.123 - 0.338	0.245
Protein (g)	0.150 - 0.177	0.165
Phenolics (mg)	4.80 - 5.40	5.10
Antioxidant activity (mM TE)	0.299 - 0.355	0.321
Sodium (mg)	69.4 - 117.5	90.6
Potassium (mg)	146.1-182.4	168.4
Phosphorus (mg)	2.0 - 6.4	3.9
Manganese (mg)	0.009 - 0.014	0.012
Copper (mg)	0.028-0.035	0.031
Zinc (mg)	0.018 - 0.026	0.020
Iron (mg)	0.049 - 0.058	0.053

(Source: CPCRI, Kasaragod)

Since, it is rich in minerals and vitamins it is considered as one of the best natural health drinks. It can be promoted as an instant energy provider, as a functional food or nutraceutical drink. It is good for persons in post operative care due to high content of electrolytes. It is a body cooler and is good for digestion and with no known side effects. Frequent consumption of Kalparasa is to prevent diseases like jaundice and keeps one healthy. It is best consumed during summer time.

Shelf life enhancement of Kalparasa

Concerted efforts have been made to improve the shelf life or extend the storage period of Kalparasa so that it can be transported to distant places for marketing. Some of the commonly used techniques are sanitation, refrigeration, filtration, centrifugation, deaeration, pasteurization etc. in addition to the use of commonly available preservatives. However, most of these have been used to purify fermented neera (improving pH value, removing odour etc.), and make it a palatable drink and improve the shelf life. However, it is relatively easy to process and improve the self life of Kalparasa collected by CPCRI method where in the juice quality is intact. Simple pasteurization of the unfermented sap in polypropylene (PP) bottles (Fig. 14) could extend the shelf life of kalparasa up to 45 days at 4 °C to 6°C, which otherwise required to be stored at -1 to -3°C. The pasteurized and bottled sap

Fig. 14. In-pack pasteurised kalpasarapa

maintained all the qualities of fresh Kalparasa as shown in Table 4 except for slight decrease in delicacy. More importantly this bottled sap is devoid of preservatives.

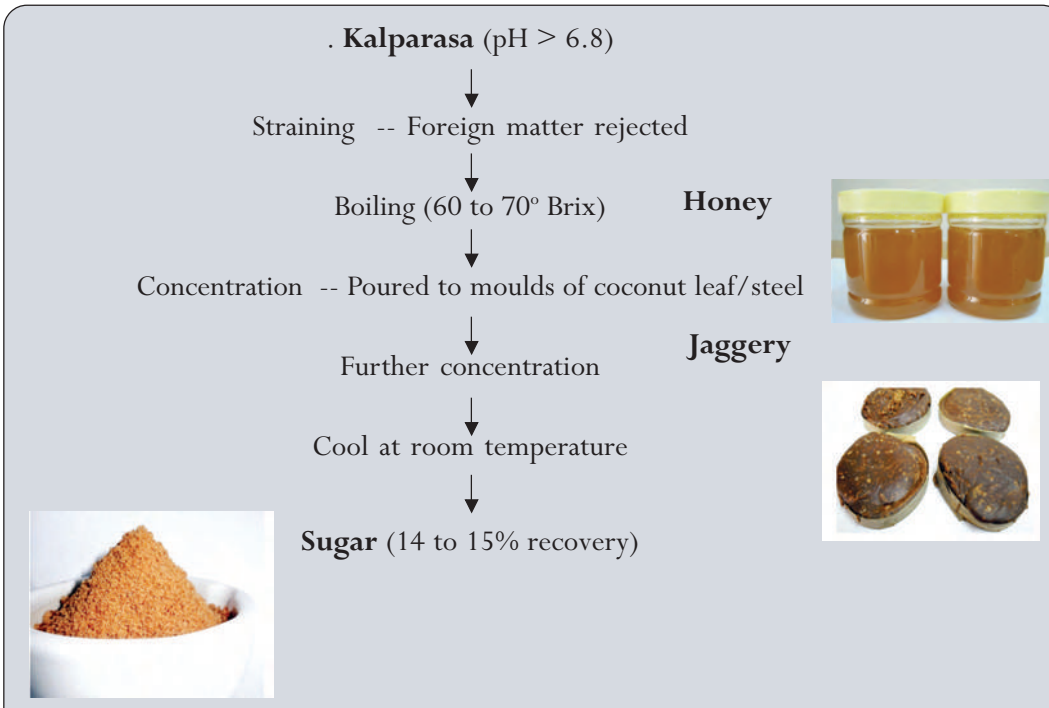
Value addition of Kalparasa

Coconut sugar, jaggery and honey:

Kalparasa contains about 15 % sugars and considerable amount of nutrients, which can easily be converted to various value added products. Coconut sugar, jaggery and honey are obtained by evaporating the water of unfermented sap at 115°C. The viscous and fairly thick hot sap (Brix 60° to 70°) is cooled to get coconut honey or syrup (Flow chart1)

Table 4. Quality attributes of fresh and pasteurized Kalparasa

Attributes	Fresh	Pasteurized
Soluble solids (°Brix)	15.5 to 18	No change
pH	7 to 8	6.5 and above
Colour	Light orange & honey color	No change
Defects, decay, insects,Pollen, dust	Absent	Absent
Flavour	Sweet and delicious	Sweet
Microbial load	Low	Low
Storage temperature	- 1 to -3°C	4 to 6°C
Shelf life	30 days	45 days



Flow chart 1. Protocol for the preparation of coconut sugar, jaggery and honey

Further heating, the sap become more viscous and thicker in consistency, is poured to moulds of either coconut leaf or steel to obtain jaggery. Thicker consistency of the syrup upon further heating, with continuous stirring to avoid charring forms sugar granules. At this stage the liquid will change into crystal form and it is immediately cooled. While cooling, it is stirred continuously to break the lumps. The sugar obtained is sieved to get uniform particle size and to produce quality product.

Traditional heating and evaporation method in open pans for processing value added profucts is cumbersome and can affect quality due to non-homogeneous heating. Alternatively double jacketed oil filled vessels as shown in Fig. 15 ensure uniform heating and better quality products.

Fig. 15. Double jacketed cooker for processing Kalparasa into sugar, jaggery and honey

Best quality Kalparasa is needed for producing coconut sugar. Even small quantity of low quality sap could spoil the sugar quality. The typical productivity ratio of 7 l Kalparasa : 1 kg Sugar can be achieved with good quality Kalparasa as input. Jaggery and honey can be prepared using slightly poor quality sap. Conversion ratio for coconut honey is 5 l :1 kg honey.

Coconut sugar is also known as coconut palm sugar, coco sugar or coco sap sugar. Unlike cane sugar which supplies only calories, coconut sugar supplies calories and nutrients. It has high mineral content as compared to brown sugar and refined cane sugar, and is a rich source of potassium, magnesium, zinc and iron (Table 5). When compared to brown sugar (prepared from sugar cane molasses), coconut sugar has double the amount of iron, four times the amount of magnesium and over 10 times the amount of zinc. In addition to this, it contains all essential amino acids required for protein synthesis, and rich in B complex Vitamins like B1, B2, B3 and B6.

Sweets and Confectionaries from Kalparasa

Kalprasa has high potential for value addition due to its health benefits. Sweets and confectionaries prepared from normal sugar and jaggery can be prepared by substituting with kalparasa sugar/jaggery/syrup/honey as shown in Fig. 16. Some of the products which can be produced from kalparasa include spicy jaggery, cookies, chocolate, neera cake, fruit spread, squash, icecream etc. Diversified products could be produced from coconut neera by adopting simple technologies requiring not much of capital investment. At house hold levels, it could provide employment opportunities to a sizeable population. When the production is organized in a cooperative sector like Farmer Producer Organisations (FPOs), adequate quality control is necessary for the production of good quality products.

Table 5. Mineral nutrient composition of coconut sap sugar in comparison with brown sugar and refined cane sugar

	Coconut Sugar	Brown Sugar	Refined White Sugar
Macro-minerals (mg/100g dry weight)			
Nitrogen (N)	202.0	10.0	0
Phosphorus (P)	79.0	3.0	0.07
Potassium (K)	1,030.0	65.0	2.5
Calcium (Ca)	6.0	24.0	6.0
Magnesium (Mg)	29.0	7.0	1.0
Sodium (Na)	45.0	2.0	1.0
Sulfur (S)*	26.0	13.0	2.0
Micro-minerals (µg/100g dry weight)			
Boron (B)*	30	0	0
Zinc (Zn)	2,100	200	120
Manganese (Mn)	130	200	0
Iron (Fe)	2,190	1,260	120
Copper (Cu)	230	60	6

(Source: CPCRI, Kasaragod & *Philippines Coconut Authority)

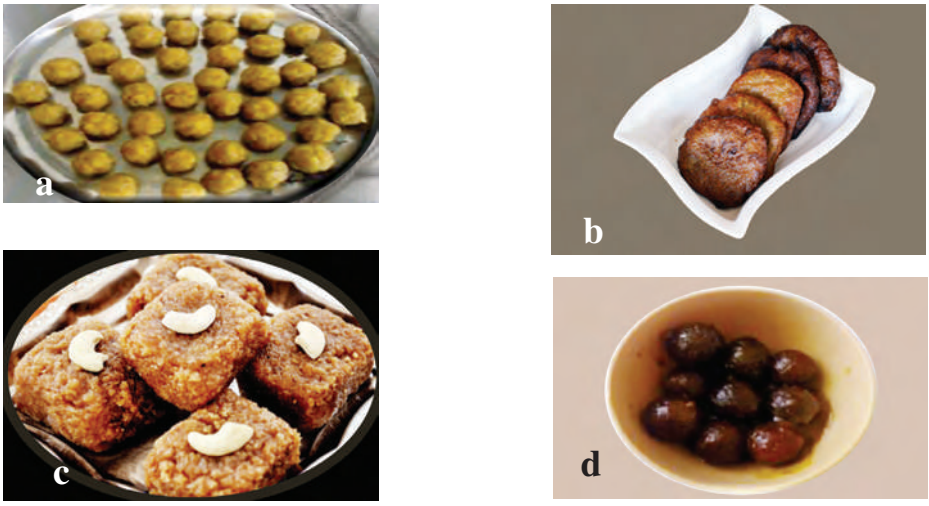


Fig. 16. Coconut sugar based products. A- Boondi ladoos; b- Burfi; c- Gulab jamun; d- Athirasa

Market prospects for Kalparasa and its products:

Kalparasa as a fresh and ready to serve natural health drink: Codex Alimentarius (International Food Standards WHO/FAO) defines juice as "unfermented but fermentable juice, intended for direct consumption, obtained by the mechanical process from extractable fluid contents of cells or tissues, preserved exclusively by physical means". The sap collected by CPCRI technique is purely collected under low temperature and stored without the use of preservatives under refrigerated (subzero) condition. Hence, as per the above definition, it qualifies to be sold as fresh juice under local market with the adherence to quality standards prescribed by CPCRI. In Kerala, Palakkad Coconut Producer Company (PCPCL), Tejaswani Coconut Producer Company and few more companies and entrepreneurs from Karnataka, Tamil Nadu and Goa have adopted the CPCRI technology of tapping and collecting Kalparasa. These companies collect the sap through coconut federations consisting of large number of coconut farmers under refrigerated condition and sell it in roadside kiosks using refrigerated dispensers. The sale of juice has clearly demonstrated that Kalparasa, a natural non-alcoholic beverage, has high demand as an instant thirst quencher.

Coconut sugar: In India, though there is a huge demand for coconut sugar, the production and supply is limited. Coconut sugar is prepared and sold by small scale industries in Tamil Nadu, Andhra Pradesh, Kerala, Lakshadweep Islands and Karnataka. Internationally, Indonesia, Philippines and Thailand are the major producers and suppliers of coconut sugar to the global market. Coconut sugar export from the Philippines, the third largest coconut producing country, to Japan, US, West Asia, Asia, and Europe has grown exponentially in the last few years.

Technology adoption and validation

Case Studies

(Shri Sathish Kumar, Palakkad Coconut Producers Company Ltd, Kerala)

Kalparasa and the market price it commands have fuelled the ambitions of Indian coconut farmers who have been struggling to cope up with unstable prices and rising labour costs. Palakkad Coconut Producer Company Ltd. (PCPCL), Kerala, one of the largest coconut producer companies, is the first to adopt the CPCRI method of sap collection and commercialize the sale of fresh unfermented neera in the market. Fresh sap is collected from the farmers, transported to a storage centre and distributed to different kiosks for marketing. It involves lot of meticulous planning, operational requirements in terms of men and materials, work flow from the collection point till it reaches safely to the consumer. All these issues are discussed in this chapter.

Scope

Fresh neera, if kept at room temperature for couple of hours, start fermenting. Colour of fresh neera is golden, pH value of > 7 and absolutely no foul odour. Traditional way of tapping neera, i.e. collecting fresh neera in mud pot kept on palm top, allows fresh neera to be kept at atmospheric temperature for 8-12 hrs and hence the neera gets fermented before collection itself. Colour turns whitish, pH drops below 6 and odour of toddy (fermented smell) slowly catches up. Hence the only ways to avoid fermentation of neera is either by maintaining the collection boxes at 2- 4°C temperature or to collect neera every hour and store them at low temperature. CPCRI has developed a solution based on the former approach and this method is found to be the ideal one in the given circumstances.

This new method of collection of neera changes the challenge of processing, from "purifying fermented neera (improving pH value, removing odour etc.) and improving shelf life" to "maintaining quality of neera and improving shelf life". This is a paradigm shift.

Good quality neera would have a pH of >7. In chilled storage conditions maintaining a temperature of 2-4°C, fermentation process becomes slow and pH drops to <6.5 in 4-5 days only. It is not advisable to sell neera with pH below 6.5. Change in colour from golden yellowish to white and fermentation odour (toddy smell) are also signs of quality deterioration. The advisable method for detecting adulteration of neera with water is by measurement of Brix value.

Typical juice dispenser with a set point of 2-4 °C, can hold the product for couple of days. This is sufficient, given the fact that continuous sales is expected to happen at outlets where neera is dispensed through juice dispenser (Fig. 17). Necessary care to be taken to ensure that neera is filled to cover the rotating spindle inside the jar. Exposed portion of the spindle tends to form ice at the surface which slows down the rotation and hence affects uniform cooling through the jar, thus causing quality deterioration of the product.

Fig. 17. Kalparasa stored in dispencer for sale

Manual handling is to be avoided to the extent possible. Hand gloves and caps are must for those who handle the product. Visitor entry to be restricted to storage room, separate chappals and head caps to be provided for all those who enter store room.

Tapping (method, men and material requirement)

Tapper is the most important player in the whole process of fresh neera collection. Tappers are to be trained in CPCRI

methodology of tapping neera, at least for 5-6 weeks before entrusting independent tapping.

Traditional Toddy tapping does not bother about various materials that mixes with Toddy - lime, mud, ants, and insects etc. High quality of neera can be ensured only by avoiding presence of any foreign element during neera collection. Usage of lime is to be avoided completely. In order to arrest possible leakage of neera through ruptures of spadix, slight amount of mud can be applied in a way that it doesn't fall in the neera collection box.

The tapping method called "Paanti Chetthu" is ideal for neera tapping, compared to the so called "Cheli Chetthu". Bending of Spadix in "Paanti Chetthu" ensures smooth neera flow and collection, reducing need of applying mud. Tightening of spadix through tying palm leaves need to be followed to avoid neera sipping down the spadix core which could cause its rotting. Also tapping almost till last drop of neera is assured in "Paanti Chetthu". It's highly recommended that all tappers who are used to other forms of tapping method are migrate to "Paanti Chetthu" for neera tapping.

The most important aspect in neera tapping is the hygiene factor. Tapping gear is to be cleansed every day in hot water. Palm top mounted ice box is to be cleaned & dried at least twice in a week. Neera handling is to be avoided at palm top as drops of neera at palm top can invite insects and ants. Care is to be taken to keep away honey bees and insects from palm top as they could tear the covering cloth and enter the ice box.

To the maximum possible extent, same tapper should be engaged in a specific palm. Each tapper follows different methodologies and change of hands can lead to poor productivity and adverse effect on the palm.

A trained and experienced tapper with an assistant can cover ~15 palms with two spadix each in 2.5-3 hours during morning time and 2-2.5 hrs during evening. CPCRI method of tapping does not call for tapping in between morning and evening slots as the spadix is kept in covered and cool condition. This means that depending on the number of spadix are being tapped in each palm, distance between palms, height and shape of palm and skill of tapper, 10-20 palms can be managed by one tapper and assistant.

Quantity of ice/gel pack is another factor that determines quality of neera. Inadequate cooling would cause fermentation. Ice/gel packs in sufficient quantity (roughly on a 1:2 ratio, i.e. 1 ml of ice/gel pack to cool 2 ml of neera for 12 hours) is to be placed inside ice box in a way that uniform cooling is assured to all parts of the container box. Depending on climatic conditions, quantities of ice/gel pack are to be fine tuned.

It's advisable to opt for gel packs *in lieu* of ice due to factors of lack of dependence on external vendor for ice and cost. Gel packs are re-usable and can be chilled overnight using chiller.

Work flow

Neera Tapper @ Palm top (Taps every morning and evening)

1 Detaches the "Neera Ice Box" and brings it down using the "Pulley and Rope"

2 Taps the spadix till neera flow in right quantity is assured

3 Receives fresh "Neera Ice Box" from the Tapping Assistant (through "Pulley and Rope")

4 Cuts the tapping point and ensures smooth flow and collection of neera

5 Proceeds with other spadix if there are more spadix been tapped in same palm

Tapping Assistant @ tapping area (one Assistant in one tapping area of max. 30 palms)

1 Collects "Neera Ice Box" from neera Tapper

2 Sends fresh "Neera Ice Box" to the tapper

3 Picks the "Neera Collection Bag" from collected "Neera Ice Box" and puts "Tracking Sticker" {Palm no./Tapper ID/Date-M/E (Morning/Evening)}

4 Stores the collected "Neera Collection Bag" in "Neera Collection Ice Box".

5 Cleans the collected "Neera Ice Box", refills proper quantity of ice (or gel pack) from "Ice Carrying Box", fixes "Neera Collection Bag" and move to next palm

6 Carries "Neera Collection Ice Box" to store and hands over collected "Neera Collection Bags" to Neera Technician @ store, at appropriate intervals

7 Collects appropriate quantity of ice, stores in "Freezer" and fills "Ice Carrying Box"

Neera Technician @ Store

1 Collects the "Neera Collection Bags" from Tapping assistant and stores in cold room set @ 4-6 deg C

2 Checks each bag for pH value, colour and quantity and enters the results in log book

3 Fresh neera from quality passed "Neera Collection Bags" is filtered using "Filter" and poured to "Neera Storage Container" and stored in cold room

4 Max 20 l of same day & time's (morning or evening) produce to be stored in "Neera Storage Container" and puts sticker (Date-(M/E)/Quantity in l)

5 "Neera Storage Container" is packed in "Neera Transport Box" with ice/gel packs and issued for supply to retail outlets and the same is entered in log book

6 Collects return "Neera Storage Container " from retail outlets, moves returned neera if any and cleans the "Neera Storage Container".

Retail outlet

1 Collects "Neera Storage Container" from plant and stores in "Freezer" @ 4-6 °C

2 Fills "Neera Dispenser" set @ 4-6 deg C using "Jug"

3 Vend neera from "Neera Dispenser" in 200 ml "Paper Glass" and serve customer

4 Move left over neera in "Neera Dispenser" to "Neera Storage Container" while closing the shop

5 Check pH value of neera in "Neera Storage Container" every day and return to plant if value <6

6 Orders new "Neera Storage Container" depending on sales & stock

Notes:

- This is the work flow to be followed for every tapping operation, i.e. morning and evening every day
- Its assumed that CPCRI technology based ice boxes are used for tapping every palm
- Its assumed that all palms are in <10 minutes carrying distance from the plant to cold room

Systems, Tools and Tackles

Requirement for typical operations following above mentioned work flow:

Role/ Location	Tool/ Equipment	Specification	Approx. unit cost (Rs.)	Remarks
Neera Tapper	Tapping gear	Knives, Tapping stick, Scissor etc.	2500	
	Pulley & Rope	To carry 7-8 kg	300	Fixed in every palm
	Neera Ice Box	4 l	1000	Fixed for every spadix
Tapping Assistant	Neera Ice Box	4 l	1000	One per Assistant
	Neera Collection bag	4 l storage, flexible material	2	One per spadix per collection (M/E)
	Tracking Sticker	Sticking paper	0.25	In every collection bag and container
	Neera collection	30 l chiller box Ice Box	4000	One per Assistant
	Ice Carrying Box	12 l chiller box	1600	One per Assistant
	Ice			1 kg per 2 l neera

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Role/ Location	Tool/ Equipment	Specification	Approx. unit cost (Rs.)	Remarks
Neera Technician	pH meter		2000	2 no.s
	Measurement jug	3 l	200	3 no.s
	Filter	Plastic	200	3 no.s
	Neera Storage Container	20 l, Steel cans	2000	
	Neera Transport Box	60 l chiller box	3000	2 no.s
Neera store	Freezer	300 l Chest cooler (Positive temp.)	25000	1 no.
	Head cap		1.25	To be used by all those who handle neera
	Hand gloves		100	To be used by all those who handle neera
Retail outlet	Freezer	225 l Chest cooler (Positive temp.)	20000	1 no.
	Neera dispenser	4-10 °C, single jar, 10 l	30000	1 no.
	Measurement jug	3 l	200	2 no.s
	Paper Glass	210 ml		
	pH meter		2000	2 no.s

Parameters and variables for a typical farm

Variable	Quantity	Unit
No. of palms	250	Numbers
Average yield per palm	2	Litre
Average farm yield	500	Litre
No. of palms per tapper and assistant	15	Numbers
Total no. of tappers needed	17	Numbers
Total no. of assistants needed	17	Numbers
No. of Technicians needed	2	Numbers
No. of Supervisors needed	1	Numbers
Average sales per outlet	40	Litre
No. of outlets needed	10	Numbers
Tapper salary per month	15000	Rupees
Assistant salary per month	7500	Rupees
Supervisor salary per month	20000	Rupees
Technician salary per month	15000	Rupees
Margin for sales	20	Per cent
Average selling price of neera/l	125	Rupees
Wastage/Damage of neera	30	Per cent

Requirement of Tools, Equipment & Consumables for above farm

Tool/ Equipment	Specification	Quantity and Unit	Approx. unit cost (Rs)	Approx. cost (Rs)	Expense type	Remarks
Tapping gear	Knives, Tapping stick, Scissor etc.	17 No.s	2500	42,500	CAPEX	
Pulley & Rope	To carry 7-8 kg	250 No.s	300	75,000	CAPEX	Fixed in every palm
Neera Ice Box	4 l	517 No.s	1000	517,000	CAPEX	Fixed for every spadix. Considered 2 spadix per palm
Neera collection Ice Box	30 l chiller box	17 No.s	4000	68,000	CAPEX	One per Assistant

Tool/ Equipment	Specification	Quantity and Unit	Approx. unit cost (Rs)	Approx. cost (Rs)	Expense type	Remarks
Ice Carrying Box	12 l chiller box	17 No.s	1600	27,200	CAPEX	One per Assistant
pH meter	3 l	22 No.s	2000	44,000	CAPEX	
Measurement jug		24 No.s	200	4,800	CAPEX	
Neera Storage Container	20 l, Steel cans	50 No.s	2000	100,000	CAPEX	For storage and transport of neera
Neera Transport Box	60 l chiller box	10 No.s	3000	30,000	CAPEX	For neera transport
Freezer	300 l Chest cooler (Positive temp.)	4 No.s	25000	100,000	CAPEX	
Freezer	225 l Chest cooler (Positive temp.)	10 No.s	20000	200,000	CAPEX	1 per outlet
Neera dispenser	4-10 °C, single jar, 10 l	10 No.s	30000	300,000	CAPEX	1 per outlet
TOTAL CAPEX				**1,508,500**		
Neera Collection bag	4 l storage, flexible material	30000 No.s	1	30,000	OPEX	One per spadix per collection (M/E). Considered for 1 month
Tracking Sticker	Sticking paper	30000 No.s	0.25	7,500	OPEX	In every collection bag and container. considered for 1 month
Ice		15000 kg	3	45,000	OPEX	1 kg per 2 l neera
Filter	Plastic	20 No.s	200	4,000	OPEX	Considered for 1 month
Head cap		1500 No.s	1.25	1,875	OPEX	
Hand gloves		50 No.s	100	5,000	OPEX	
Paper glass	210 ml	60000 No.s	1	60,000	OPEX	Considered sales of 400 l per day
TOTAL OPEX per month				**153,375**		

Requirement of Tools, Equipment and Consumables

Economic analysis

Monthly indicative expenses

Sr No	Category	Head	Expense (Rs)	Remarks
1	Consumables	Consumables	153,375	
2	Labour	Tappers	255,000	
3		Assistants	127,500	
4		Supervisor	20,000	
5		Technicians	30,000	
6	Logistics	Electricity & Water	7,500	
7		Rent	10,000	
8		Maintenance	5,000	
9		Transport	20,000	For collection and transport of Neera
10		Miscellaneous	10,000	
11	Funding	Interest on CAPEX	18,856	
12		Interest on working capital	15,959	2 months expenses as working capital
		TOTAL	**673,191**	

Monthly returns from farm

Monthly production of neera in litres	15,000
Saleable quantity in litres (Minus wastage)	10,500
Per litre price realization (Rs)	100
Monthly sales revenue (Rs)	**1,050,000**
Monthly income from farm (Rs)	**376,809**
Income per palm per month (Rs)	**1,507**

Notes:

1 Above cost structure is indicative only. Depending on geography, productivity, Yield and Processing of By-Products, the scenario would vary.

2 Fixed salary for tappers and Assistants assumed above. There are other models like commission on yield which are in practice

3 There would be fluctuations in sales depending on seasons (low during winter). Average wastage/unsold quantity is assumed as 30% of production. Option of processing of by-products could be considered during low sales seasons. There would be change in expenses and income.

4 Average sales rate per litre is assumed as Rs 125 (prevailing market rate) and sales margin as 20%.

Future prospects

The recent advancements in fresh and unfermented coconut sap collection, bottling and processing into value added products and its health benefits has led to a sudden surge in domestic market for Kalparasa and domestic and international market for coconut sugar. Apart from assuring stable and lucrative income to the coconut farmer, switching to kalparasa tapping provides multiple advantages to economy, environment, farmer and consumer, as listed below:

- Infusion of billions to GDP and that too in a de centralized and distributed form (to farmers, labourers, retail sales, technicians etc.). The potential to develop new and indigenous technologies for Kalparasa by-products (Honey, Sugar, Jaggery) and value added products (ice creams, toffees, syrups, jam, pudding, cake, snacks etc.) would be a boost to the local economy.
- Coconut growers in most of the countries are small farmers. The low and unpredictable world prices for copra and oil has resulted in a scenario where it has become increasingly difficult for small farmers to depend on coconut production for their livlihood. Experiences from countries where coconut is allowed for tapping like in South Sumatra suggest that it is 8 to 10 times more profitable than selling nuts. A tapper earns per day two to three times more than a field worker. An important advantage for the tapper is that he has a daily income throughout the year. Similarly, in Philippines, a sequential coconut toddy and nut production system is able to provide the small scale coconut farmers with incomes nearly 10 times higher per hectare and per year compared to the traditional practice of producing nuts only.
- Organic cultivation is practiced at least in certain regions like Lakshadweep Islands of the country. Many farmers in other states too have recently turned towards organic cultivation of coconut. Hence, there are high prospects of production of organic coconut neera/sugar and its export in the international market.
- Adoption of CPCRI technology for the collection of fresh, hygienic and unfermented sap and its sale in roadside kiosks has showed very encouraging results for its promotion as ready to serve drink. Promotion

of this technology will help to revive the economy of the coconut sector. Many rural areas are likely to benefit from a new source of self-employment and sustainable income once the potential of tapping palm trees for ready to serve drink or sugar production has received the full attention it deserves from policy makers.

- It is estimated that even if 10 per cent of the 2 million ha coconut trees in the country are tapped, with conservative yield of a litre a day, ₹ 36,000 crores can be generated annually of which 25 to 30 per cent will be the farmer's share. It is expected to improve the livelihood of coconut farmers, generate employment opportunity to rural youth and women and provide nutritional security.


KALPARASA