

## Review Article

<https://doi.org/10.20546/ijcmas.2018.709.229>

## Coconut Sap (*Neera*) - Untapped Opportunity of Spinoff Gains in West Bengal, India

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### ABSTRACT

Coconut (*Cocos nucifera*) cultivation is gradually becoming not profitable due to several causes. To make it profitable, an emphasis is being given on production of *neera* and its value-added products like sugar, jaggery, and *neera* based milk made sweets etc. *Neera* is the sweet, honey-coloured fresh unfermented coconut inflorescence sap collected through ICAR-CPCRI made coco sap chiller box, having total sugar (15.18g), reducing sugar (0.554g), amino acid (0.245g), and rich in minerals like sodium (90.6mg), potassium (168.4mg), phosphorus (3.9mg), manganese (0.012mg) zinc (0.020mg), and iron (0.053 mg) and pH 7.18 with low Glycemic Index (35). It can be consumed even by diabetic patients because of its low Glycemic index. It has also an excellent antioxidant property as it has vitamin E, C and B. In W.B. under the technical supervision of ICAR-CPCRI and BCKV, work on *neera* collection and its value addition was started on pilot basis in a farmer's field of Hooghly district where at present on an average 250 liters of sap/year are being produced from six inflorescences of a plant with a minimum return of Rs15000/plant/year leaving rest six for nut production. *Neera* production has also created an excellent employment opportunity. The farmer having 100 plants can create employment opportunities of 8 heads/year with an average net return of Rs 9, 24,000/year. As value added product *neera* jaggery, *neera* sugar and *neera* based milk made sweets are also being prepared and marketed with higher demand in W.B. the process of which was already patented jointly by the concern scientists of BCKV, ICAR-CPCRI, farmer and sweets maker of W.B. Considering the above fact the scope for tapping of Cocosap *neera* may also be explored in the coconut growing North Eastern states which may reflect on the state GSDP by uplifting the economic status of the farmers.

#### Keywords

Coconut, *neera*, Jaggery, Sugar, Glycemic index, Diabetic patients, Employment opportunity

#### Article Info

##### Accepted:

12 August 2018

##### Available Online:

10 September 2018

### Introduction

Coconut palm, botanically known as *Cocos nucifera* L., belongs to the family of Arecaceae (Palmae), which is an important

member of the monocotyledons. Coconut is a unique tree, where every part is useful in one way or another. Coconut sap (*neera*) is obtained by tapping the unopened spadix of the coconut palm. *Neera* is traditionally

tapped from the coconut tree in an organized manner, and consumed largely by the rural population. It is reported to be highly nutritive and a good digestive agent. Besides, it plays an important role in the Indian economy, contributing \$105 million per year to the national GDP. In India, it was grown in approximately 2 million ha with an estimated production of 20440 million nuts in 2014-15 (CDB, 2015). Traditionally Kerala, Tamil Nadu, Karnataka, Andhra Pradesh are the major states where coconut is grown in large scale. Of late coconut farmers of the country are, however, in a very precarious situation for quite some time due to multiple issues beset with the sector. Frequent fluctuation and fall in the price of coconut, the severity of many pests and diseases, escalation of input cost, fragmentation of holdings, etc. are a few to cite. Due to a high cost of production and low profit, coconut cultivations are carried out with negligence and as a result, coconut farming is often considered to be a non-profitable enterprise in India. Therefore, there is an urgent need to make coconut cultivation profitable through processing and value addition. In the recent past, coconut trees grown in the southern part of India have been largely affected by mite (*Acerai guerreronis*) attack and the repercussion of the mite attack is worse than the attack of other pests and debilitating diseases, such as root wilt, gonoderma wilt, Thanjavur wilt and tatipaka disease. This has tremendously affected the yield and thereby the lives of coconut farmers and farm workers. To sustain the loss of revenue, the farmers have resorted to tapping the trees for collection of coconut sap (*neera*) and selling it to realize some revenue for their livelihood.

### **A success story in West Bengal: The beginning**

ICAR-CPCRI developed coco-sap chiller has been extensively used in states of Kerala,

Tamil Nadu, Goa for the collection of hygienic and unfermented sap called as *Kalparasa* (Hebbar *et al.*, 2015a) and evinced considerable interest in farmers of other states. Considering the scope and importance of coco sap, first time “*neera*” collection work in North Eastern States has started in the farmer’s field of Balagarh, Hooghly, W.B. on pilot basis under the supervision of BCKV with the technological support from ICAR-CPCRI, Kasaragod, Kerala from the month of August 2015. Full-fledged *neera* production has started at Balagarh block, Hooghly district, W.B from the month of October 2015 and officially *neera* and sugar was launched in W.B. on 9.2.2016. Besides fresh *neera* production and marketing different value-added products of *neera* like *neera* jaggery, *neera* sugar, milk based *neera* sweets are also being prepared and marketed in West Bengal.

### **Rationale**

To prove that *neera* can also earn better returns as compared to Nuts.

To create employment opportunities for the rural youths.

To make the coconut cultivation profitable.

To provide natural health drink to all including diabetic patients.

To aware the consumers about the positive effects of *neera* as an ideal sweetener.

### ***Neera* and its significance**

*Neera* is the sweet honey coloured, unfermented sap tapped from the immature inflorescence of coconut. It is a rich source of sugars, minerals and vitamins. As it is rich in minerals and vitamins, it is considered one of the best natural health drinks. The most significant characteristic of *neera* is its low

Glycemic Index (GI) (35), an indicator of the extent of sugar absorbed into the blood. Foods with GI less than 55 are classified as low GI foods. The global demands for low GI sugar are increasing day by day. Hence *neera* and palm sugar as natural products can fill up this gap in the future. As *neera* and its value-added products are the latest additions which hold the potential to revitalize the prospects of coconut farmers of India, therefore, to popularize this *neera* as health drink as well as source of employment opportunities, the relevant literature is reviewed on the basis of Books, Periodicals, News Papers, Websites and Research Papers.

Hebbar et.al (2015a; 2015b), reported that *neera* is the honey-coloured sweet vascular sap collected by tapping the immature unopened spadix or inflorescence of coconut. It is translucent, high in nutritional value and susceptible to natural fermentation at ambient temperature within a few hours of extraction. On fermentation, *neera* becomes today. It is widely consumed in India, Sri Lanka, Africa, Malaysia, Indonesia, Thailand, and Myanmar. It is a delicious and nutritious drink rich in carbohydrates with sources of minerals, vitamins proteins etc and nearly neutral pH. It contains ascorbic acid, nicotinic acid and riboflavin. Hebbar *et al.*, (2013) and Jayashree (2013) reported that the *neera* is popular as a health drink on account of its high nutritive value, delicious taste and agreeable flavour. Siddharameswara Swamy (2013) reported that *neera* is otherwise called sweet toddy, a sap extracted from the inflorescence of various species of toddy palms. It is a natural and non-alcoholic beverage, high in nutritional value and an instant thirst quencher. It is sweet, oyster white, and translucent. This sweet sap of the palm is fast becoming a popular drink on account of its highly nutritive value, delicious taste and agreeable flavour. Palani Velu *et al.*, (2013) reported that Palm *neera* is a very popular nutritional drink, during the

flowering season. The *neera* season begins in January when the palm trees start budding. In this period, the juice is obtained only from the male palm trees. The female palm trees start giving sap in the last week of March or the first week of April. The unfermented natural sap from the unopened inflorescences of coconut has high sucrose content as reported by Jnanadevan (2013). He also reported that the average sugar content of *neera* varied between 12% to 14.4 per cent. The maximum sugar content of 17% was also reported from Malaysia which shows that there is great variation in sugar content between cultivars.

### **Chemical constituents of *neera***

Akkarakaran (2015) reported that the main constituent of the coconut sap juice is sugar (14-18 per cent). The physical and chemical composition of freshly collected coconut blossom “sap” or “nectar” indicates that it is naturally rich in Potassium, Magnesium, Zinc and Iron and is a natural source of 12 of the essential vitamin B complex and vitamin C and has a neutral pH. Hebbar *et al.*, (2015,) reported that 100ml *Kalparasa (neera)* contains 15.18g total sugar, 0.554g reducing sugar, 0.245g amino acid, 0.321 antioxidant activity (m MTE), sodium 90.6mg, potassium 168.4 (mg), phosphorus 3.9 (mg), manganese 0.012(mg) zinc 0.020(mg), and iron 0.053 (mg) with pH 7.18. Muralidharan and Nair (2013) reported that 100 ml *neera* contains 15.2-19.7g total solids, total sugars 14.40g, total reducing sugars 9.85 g, original reducing sugars 5.58 g, total ash 0.11-0.41.g, citric acid 0.50 (g), total protein, 0.23-0.32(g), iron 0.15(g), phosphorus 7.59(g), ascorbic acid 16-30(mg) with pH ranges between 3.9-4.7. CFTRI also reported that nutritionally ‘Keraamritham’ is superior to tender coconut water. The available total soluble sugars, vitamins and minerals are low in tender nut water, say the total sugars: 3.3%, minerals like potash: 53.2ppm, Calcium: 5.78ppm,

Phosphorus: 11.8ppm, Iron: 1.54ppm. Naik et.al (2013) reported that 'Keraamritham' or *neera* in 100 ml contains 15 -18 % total sugar, 90.5ppm of K, 1.3mg of Vitamin C, Ca 60.0ppm, P 15.0ppm, Acidity 10.0m eq. /l, Fe 45.0ppm, Phenols 8.0mg/100ml, Na 9.5ppm with pH 6.8. Debmalaya and Mazumdar, (2008), reported that fresh coconut sap from the cut inflorescence has 12-15% of sucrose (by weight) and a trace amount of glucose, fructose, maltose and raffinose. The sap contains approximately 0.23% protein, 0.02% fat and is rich in Na and K content. They also reported that as the fresh palm sap (*Borassus flabelliform*) is sweet, it is processed to produce palm sugar (Tamil Nadu and Kerala) and palm Jaggery (West Bengal), alcohol and vinegar and has nutritive value such as Ca, Fe, Zn, Cu, P, niacin and Vitamin A and the fermented sap results in increase in the level of Thiamin, riboflavin and niacin content.

### **Glycemic index and glycemic load in *neera***

Glycemic index is an indicator to the extent of sugar absorbed into the blood is low (35) in *neera*, It is a numerical ranking system (0 to 100) that compares a given food to pure glucose (GI – 100). Low GI is measured at 55 or less medium GI at 56 to 69 and high GI at 70 or more. Low Glycemic food contains unrefined, complex carbohydrates that break down into glucose more slowly and allow for a slower release of usable energy. Therefore it is controlling blood sugar levels in the body. Glycemic Index should be taken into account when we decide the quality of carbohydrate in a food item. A GI value, therefore, tells us how rapidly a particular carbohydrate turns into sugar. It does not tell how much of that carbohydrate is in a serving of a particular food. The Glycemic Index value alone does not give an accurate picture of the food. The Glycemic Load takes both quality and the quantity of carbohydrate content of the food into account. Glycemic Load is the Glycemic

Index divided by 100 multiplied by its available carbohydrates content. The Glycemic Load of coconut palm sugar is 1.4, or 1 when rounded off. Akkarakaran (2015) reported that the Glycemic Index (GI) is a measure of how quickly and how high a particular carbohydrate raises blood sugar level by releasing glucose into the blood stream. FNRI study in (2007) revealed that coconut sugar has naturally lower Glycemic Index rating (GI) of 35 compared to that of most available commercial sugar such as table sugar's GI index of 70, honey's GI of 55 and cane sugars GI of 68.

### **Low GI food and its impact**

Akkarakaran (2015) reported that to maintain lower blood sugar insulin level, a low-GI diet may be useful in preventing and treating a variety of health problems. He has also highlighted some examples in support of the utility of low GI sugar which can help to promote excellent health. Diabetes – Substituting low - GI carbohydrates (like thick – cut oats, pasta and legumes) for high- GI carbohydrates (like processed cereals, white bread, and potatoes) can help lower blood glucose levels in people with diabetes. This is why the GI has been an integral part of medical nutrition therapy for diabetes in Australia, New Zealand, Canada and Europe for many years. Harvard University researchers who tracked the eating habits of over 100,000 men and women found that people whose diets are low in fibre and high in refined and high – GI carbohydrates are more than twice as likely to develop type 2 diabetes, as are people who eat the diet with a low Glycemic Load. Cancer - Insulin is a cellular growth factor; many studies have shown an association between high insulin levels and a variety of cancers including breast, colorectal, prostate, and pancreas. Other studies have shown links between diets high in sugar, refined carbohydrates, Glycemic Load and

cancer. This suggests that lifestyle changes like maintaining a healthy body weight, exercising and eating a healthy low – GI diet may help protect against cancer at least partly by lowering insulin levels. Cardiovascular Disease - As with type 2 diabetes, researchers have found that a diet rich in refined and high GI carbohydrates may substantially raise the risk for heart disease. These foods increase blood insulin levels which in turn contribute to high blood pressure, higher levels of blood fats (triglycerides), lower levels of HDL (good) cholesterol and an increased tendency for dangerous clots to form and linger in the blood. Hypoglycemia - People who have meal related reactive hypoglycemia secrete too much insulin after eating. It was also reported by Mathrubhumi newspaper of Kerala in 2015 that *neera*, has high medicinal and nutritional value without containing any alcohol. It was also reported that *neera* is beneficial in the treatment of tuberculosis, urinary problems and asthma.

A study says that acetaldehyde; a poisonous substance is deposited in the liver mainly due to liquor consumption. *neera*'s ability to remove this poisonous product from the liver is now proved in the study. The enzymes in the liver convert alcohol to acetaldehyde. When this harmful chemical is deposited in large amounts in the liver, it destroyed liver cells. It was also reported that 100ml *neera* contains 75 calories of energy, 250mg of protein. The study says though *neera* is sweet in taste, it can be consumed even by diabetic patients also as its Glycemic index is low. It has also an excellent antioxidant property as it has vitamin E, C and B and regular consumption can increase the function of a normal liver also. As reported by Padanna (2014) that the Kerala government has launched *neera*, a sweet, non-alcoholic sap tapped from the coconut tree, and its value-added products. In Kerala, it is being marketed as an energy drink, rich in sugars, minerals

and vitamins, with a low Glycemic index of 35. The state hopes to launch the product in the international market as a diabetes-friendly food. It is also claimed to be good for digestion which facilitates clear urination and prevents jaundice. Jnanadevan (2013) reported that *neera*, the health benefits of coconut sap sugar has already been established in other coconut growing countries and classified it as low GI (35) alternative sweetener for diabetics. There is a vast scope for the development of this industry with vast economic prospects in the local and global market in future.

### **Uses of *neera***

*Neera* is popular as a delicious healthy drink.

It can be promoted as an instant energy provider, as a functional food or nutraceutical drink

It is good for digestion, facilitates clear urination and prevents jaundice.

The nutrient-rich "sap" has low Glycemic Index (GI of only 35) and hence diabetic-friendly since very low amounts of the sugar is absorbed into the blood.

It is an abundant source of minerals, 17 amino acids, vitamin C, broad-spectrum B vitamins, and has a nearly neutral pH.

It is good for persons in post-operative care due to a high content of electrolytes

It is a body cooler and is good for digestion and with no side effects

Coconut crystals can be made out of this pure, low Glycemic natural sap. While most brown sugar is boiled at temperatures up to 2210 F the end product containing 93% sucrose, sap crystals contain only 0.5% glucose, 1.5%

fructose, 16% sucrose and 82% inulin- a prebiotic that promotes digestive health.

It can be used as an ideal sweetener & can fetch much better returns compared to copra

### **Economic return and employment opportunity of *neera***

Besides financial return, *neera* production can create excellent employment opportunities for the unemployed youth also (Hebbar *et al.*, 2015b). They reported that from 250 coconut palms monthly production of *neera* will be 15,000 litres. The saleable quantity will be 10,500 litres (30% after deduction of wastage). If realization price is Rs100/ per litre then monthly sales revenue will be Rs1050000 and farm monthly income will be Rs 376809 and per month per palm income will be Rs 1507. Thampan (2013) reported that toddy tapping and the sale of sweet toddy offer opportunities to coconut farmers for enhancing on farm income and employment. In a study on tapping conducted in Kerala in 1998 by Peekay Tree Crops Development Foundation (PTCDF) the gross income recorded for 30 gardens was Rs.269,356 per ha per annum with a net income of Rs.139,661. In another case study conducted in the Vechoor Island, Kerala by PTCDF reported that the farmer employed one professional tapper for a unit of 20 trees. For the first 15 days when there was no toddy yield, the worker was paid a daily wage of Rs.150 for preparing the trees. After today yield commenced the average yield was around one litre per palm per day or 20 litres from the unit of 20 trees. Following this, the yield increased to around 2-2.5 litres per palm per day or an average of 45 litres from 20 trees. The wages for the tapper after the toddy yield commenced were @ of Rs.4 per litre of toddy collected. The total wages paid to the tapper in one year was Rs.58, 350. By selling 14,025 litres of today at the rate of Rs.15 per

litre the farmer received a gross income of Rs.2, 10,375, which left Rs.152, 025 as net income or Rs.7, 601.25 per tree per annum. The net income from tapping was found to be 19 times higher than that from untapped trees which were in the yield group of 60-75 nuts per palm per annum. In a field study conducted in the same year, the average yield of today recorded for 68 palms was 1.99 litres per palm per day. These palms were assigned by the farmers for tapping on the rental basis to Professional tappers and the rental receipt averaged Rs.56.47 per palm per month. In the surveyed area the practice was to allow tapping for 6-9 months a year. If one-third of the palms in a garden or 60 Palms per ha are allowed to be tapped for 9 months, the average rental receipt at the rate recorded in the study will be around Rs.30, 500 over the tapping period. Nair (2013) reported that if 10 per cent of the palms in Kerala are tapped, the contribution of *neera* to the Gross State Domestic Product (GSDP) would amount to Rs. 54,000 crores (with the market price of *neera* to be at the lowest of Rs.100 per litre). The rural employment generation through *neera* will be around 10 lakh. The total income to the workforce of *neera* will be around Rs.13, 500 cores. The income of coconut farmers will be about Rs.27, 000 cores. About Rs.4, 050 cores will be generated as tax revenue to the state through the increased purchasing power of the farmers and workers. There could be roughly 17 per cent increase in GSDP through *neera* production. Production of palm syrup, palm jaggery and coconut palm sugar may add more value to GSDP. *neera* has the potential to increase the income of the producers by 10-fold,” According to him, earnings through *neera* production is very high compared with coconut sales, which can fetch only about Rs 1,200 / year/tree as reported by Sugatha Ghosh (2013). Nair *et al.*, (2013) reported that promotion of *neera* as nutritious health drink has been identified as an important marketing

strategy for ensuring remunerative price to coconut farmers. Naik *et al.*, (2013) reported that a tapper could tap 12 palms daily and each palm yield on an average 1.5 litres of sap per day, the total inflorescence sap would be 18 litres per day from 12 palms tapped by one person. From this, processing 9 litres as the final product can be obtained after processing. This can be made into 60 bottles of 150 ml each. Being a health drink, one bottle could be sold at Rs.20/-. The total income per day will be Rs.1200/- and it is Rs.36 000/- per month.

A farmer can realize one-third of this amount as profit and the remaining 2/3 as tapping cost, processing, establishment and marketing charges. A palm can be tapped for six months at a stretch in a year and allowed for the next six months for normal tender nut or coconut production as a health restoration measure for the palm. Hence usually 20 to 30% of the palms in a farmer's garden can be used for tapping at a time. This will help the farmers in getting higher income from coconut garden by utilizing their palms for both value-added products like Keraamritham (*neera*), Kerachakkara (jaggery), tender nuts, and traditional coconut, copra and oil production. From the practical experience gained during our study, we can say that in West Bengal one farmer can get on an average 250 litres of sap/year from six inflorescences of a plant leaving rest six for nut production and earn minimum Rs15000/plant/year considering the selling price of Rs60/liter. Besides, the farmer having 100 plants, can create employment opportunities for 8 heads/year at the cost of Rs576000/year with an average net return of Rs 924000/year. Experience says that the sap can be collected even from the unproductive palms also and if 1% of the unproductive plants of W.B. are utilized for sap production then per year income from *neera* will be around Rs6175.2 lakh besides an employment opportunity of 3431 numbers/day.

### **The technological intervention of *neera* tapping**

Selection of palm, inflorescence and efficiency of the tappers are the main important factors for better *neera* production. Hebbar, et.al (2015a), reported that 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 immature inflorescence that is about to burst is the ideal stage at which *neera* tapping is done. The development of female flowers inside the Spathe (about 60 cm long) causes a swelling at the base (Fig. 1), which is an indication of an appropriate stage for tapping. The inflorescence selected for tapping is first tied around with a strong coir or plastic rope to prevent it from bursting. The spadix is then trained by a gentle uniform beating using a mallet and hand massaged (using the palms) all over twice a day in the morning and in the evening for a week (Fig. 2). After 4-5 days of stroking 7-10 cm tip is sliced off (Fig. 3) and in a week's time sap starts oozing out from the cut end. It takes 12 - 15 days for the sap to exude from the inflorescence tip. Tapping is done usually for a period of six months only. A coconut palm can yield, on an average 1.5-3 litres of *neera* per day, which may go even up to 4.5 litres per day based on the health of the palm and management of the garden. Siddharameswara Swamy (2013) reported that *neera* is obtained by slicing the spathe of the Palmyra, coconut and sago palms, and scraping the tender most part, just below the crown. It requires neither mechanical crushing, as in the case of cane nor leaching like that of beetroot. Muralidharan and Nair (2013) also reported that the immature inflorescence which is about to burst is the right stage at which *neera* tapping is done. It takes 12 to 15 days for the sap to exude from the inflorescence tip. Tapping is done usually for a period of six

months only. A coconut palm can yield, on an average two litres of *neera* per day, which may go even up to 4.5 litres per day based on the health of the palm and management of the garden. The best time to start tapping is prior to the splitting of the inner bract and the emergence of the spikes from the spathe Jnanadevan (2013). He also reported that sap yield is much lower if the tapping starts after the spadices have burst open. A spadix tapped prematurely may burst open and become discoloured at the cut portion.

The same may happen to a spadix tapped when over-mature. In both cases, *neera* production may be much reduced because there will be a delay in the commencement of the *neera* flow and a rapid spadix consumption, as each day the discoloured portion has to be cut off. During the first week, the spathe is tied firmly over its entire length with strong string or with fibrous strands stripped off from petioles of young leaves, so as to prevent premature splitting of the inner bract due to an expansion of the spadix. Twice a day, the outer surface of the spathe is gently beaten all around with a wooden mallet. The tapping process is an art, and therefore the result depends upon the skill of the tapper.

The technique consists of carefully bruising and rupturing the tender tissues of the floral branch by gently hammering and pounding the spathe. Special care is taken not to reduce the flower buds inside the spathe to a pulp, in which case the spadix becomes useless. Beating is stopped once the sap starts dripping. After about three days, five cm of the apical tissues is sliced off. During preparation, the spathe is bent downwards, so that later the sap can be collected in a container. To facilitate the bending of the spathe, the sheath covering the inflorescence may be split at the base. The bending is a delicate operation, as too much force would

result in breaking the rachis tissues. From the first day of tapping onwards, after beating, a very thin slice of the apical tissue is cut off (about 2 mm thick). This slicing is performed twice daily and the beating is done in the morning only. This continues until the sap starts oozing out. It is observed that the interval from the beginning of the tapping to the dripping of the *neera* varies much. It differed from tree to tree and from spadix to spadix in the same tree. The commencement of the flow takes place as early as five days and as late as 32 days after the tip of the spadix had been cut off for the first time. When the sap starts flowing, a container is placed under the dripping spadix. The sap flow gradually increases and may reach a peak after 3-5 weeks. The peak may then continue for 1-3 weeks, after which the flow declines. The flow may continue for about a month until the length of the spathe is reduced to a length of about 10-15 cm. The longest productive period observed was 74 days. This may also depend on the spadix length. Palms with relatively low nut yields also have a shorter productivity of the spadix than high yielders. The flow of *neera* dwindles when the spadix is damaged by rats, insects, caterpillars/worms etc., and also when the spathe covering the inflorescence is removed partially or totally after it has cracked open.

When the cut-end of the spadix touches the liquid in the container, the *neera* flow may reduce as well. To prevent sap fermentation after slicing, the fresh cut may be brushed with the anti-ferment solution, or some anti-ferment solution may be put in the container. The most effective harvesting cycle is twice a day. More harvests are not profitable in relation to the additional work, and fewer harvesters involve the risk of breaking the spathe under the excessive weight of the container, and they may also provoke other problems such as sap fermentation and drying of cuts.





**Fig. 1: Ideal stage of tying**



**Fig. 2: Massaging of spadix is then trained**



**Fig. 3: Ideal stage of tying and tip slicing**





Fig. 4: Coco-sap Chiller



Fig. 5: Neera and its value added products

### Hi-tech neera collection box

Hebbar *et al.*, (2015a and 2015b,) reported that *neera* tapping requires adherence to strict procedures right from selection of the inflorescence to collection of the first drop. This is because the sap on extruding comes into contact with air and the process of

fermentation is initiated. In order to collect fresh, hygienic and unfermented sap CPCRI has developed a simple 'Coco-sap Chiller', (Fig. 4) a farmer-friendly technology to extract farm fresh, hygienic, ready to serve *neera*. The sap thus collected is farm fresh, hygienic, chemical free and zero alcoholic. It can be stored fresh for any length of time

under sub-zero condition ( $<0^{\circ}\text{C}$ ). This coco-sap chiller is lighter in weight, waterproof, easy to connect to the spadix, requires less ice, and retains low temperature for the longer period as compared to commercially available ice boxes. The sap thus obtained is called as *Kalparasa* or *neera* (Fig. 5) and registered under trademark. Muralidharan and Nair (2013) reported that *neera* tapping requires adherence to strict procedures right from the collection of the first drop. This is because the sap on extruding comes into contact with air and the process of fermentation is initiated. Technologies have been developed by institutions like Kerala Agricultural University, Central Food Technological Research Institute and Defense Food Research Laboratory for arresting the fermentation process. The collected *neera* is then subjected to filtration, refrigeration, centrifuging, processing and packaging. The processed product has a shelf life up to one year. Apart from this, value-added products like palm syrup, palm jaggery and palm sugar are produced from *neera* (Hebbar *et al.*, 2015a). Sanjiv, (2015), reported that *neera* extraction technology developed by Central Plantation Crops Research Institute (CPCRI), Kasaragod helped to revive *neera*, a nutritious drink made from Coconut inflorescence, in Kerala. Since the collection container was contained in an icebox, the collected sap remains fresh and unfermented for a long time

### **Factors affecting *neera* yield**

Jnanadevan (2013) highlighted that the growing conditions of the palm and its vigour plays an important role in *neera* production. Tapping may be continued for periods of one year or longer. Continuous tapping of coconut Inflorescence does not affect the palm. Once the tapping is stopped, nut yields may show a temporary increase compared to the normal nut yield of the palm. Higher nut yields after tapping are due to more female flowers being

produced per spadix after tapping, with a similar Percentage of fruit set compared to non-tapped trees. *neera* yields differ with palm variety, palm vigour and season (Hebbar *et al.*, 2015b). It is further reported that the average yield of sap/day/plant with eight months tapping per Year is 1500 ml. It is observed that sap flow is closely associated with the leaves, water content, suggesting an influence on sap flow by the internal water condition of the trees. The *neera* yield decreases strongly after the relative water content of the leaves decline. Low rainfall, particularly when the soil water reserves were low and palms suffered from water stress affect *neera* yield. As the flow of *neera* decreases with increasing transpiration, high temperature and low relative humidity have similar effects. *Neera* yield was not significantly correlated with photosynthetically active radiation. Sap production is relatively high at night, due to reduced transpiration and increased sap pressure. It was also observed that *neera* flow had an inverse relationship with the total soluble solids content of the *neera*. Tall palms yield much more *neera* than dwarf palms. A good tall palm may yield about two litres per day and hybrids even more. Hebbar *et al.*, (2015) also “reported that the tapping of *neera* is done twice a day (in the morning and evening). A healthy tree can produce 1.5 to 3.0 L of sap per spadix per day with an average production of 60 to 80L of sap in 40 to 45 days. 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. 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. A single spadix can be tapped until it is reduced to a stump of about 10-15cm length. Tall and hybrids are known to produce more *Kalparasa* as compared to dwarfs. Our experience says that the production of *neera*

mostly depends upon the following points like the efficiency of the tapper, stage of selection of inflorescence, type of massage, season and variety etc.

### **Quality attributes of *Kalparasa***

Distinct differences between the *Kalparasa* collected by CPCRI technique and traditional method was also observed and recorded by Hebbar et.al (2015). They reported that fresh sap collected by CPCRI technique is slightly alkaline in pH, golden brown or honey colour and sweet and delicious. Fresh sap when left exposed to atmosphere undergoes initial lactic acid fermentation, middle alcoholic fermentation and final acetic fermentation consequent on the action of microorganisms. 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 sap is around 3.5. The sap stored in a freezer (-1 to -3°C) remains fresh and no change in pH is observed. Fresh sap (pH 7.5) has around 15% sugars. It decreases to about 6% at pH 4. During the same period, the reducing sugar level increases up to 5%. But in a traditional method of sap collection, the sap is oyster white in colour and emanates a harsh odour. The sap collected without applying lime is used exclusively for the preparation of today, 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.

### **Shelf life enhancement of *Kalparasa***

Patric Tauro and Rama Rao (1964) reported that pasteurization of the lime-treated concentrate of *neera* prevented fermentation but it led to the development of an unwanted odour and colour. The material without lime kept well after concentration without any

development of unwanted colour and flavour under room temperature for three months. Hebbar *et al.*, (2015a) highlighted that to improve the shelf life or extend the storage period of *Kalparasa* concerted efforts have been made so that it can be transported to distant places for marketing. Some of the commonly used techniques are sanitation, refrigeration, filtration, centrifugation, de-aeration, and 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 shelf life of *Kalparasa* collected by CPCRI method where the juice quality will be intact. Simple pasteurization of the unfermented sap in polypropylene (PP) bottles could extend the shelf life of *Kalparasa* up to 45 days at 40 C to 60C, which otherwise required to be stored at -1C to -30C.

### **Value addition of *neera*: Sugar, Syrup, Jaggery, and milk-based *neera* sweets**

Muralidharan and Nair (2013) reported that boiling the sap under moderate to low heat yields a golden brown sticky liquid with high mineral content which is called palm syrup. It is free from total fats and cholesterol with a sucrose content of 50% and a Glycemic index of 35 GI. It can be used for healthy food preparations, as topping on a wide variety of appetizers, desserts or beverages. It is also used in Ayurveda and other systems of medicine. They also reported that boiling the sap and preparation of granular palm sugar is the value-added product of the future with immense potential from *neera*. The application of this palm sugar is enormous owing to the high nutrient content and low Glycemic index. Low GI food finds applications in proper control of Diabetes mellitus and in lowering cholesterol levels.

The GI of table sugar is nearly 85 while that of Palm Sugar is only 35. Generally, GI below 55 is considered low. The product has increased demand in the domestic and international markets. It is a good substitute for commercial sweeteners available in the market. Palm sugar (in 100 g) contains Moisture 0.06 %, Protein 432 mg, Minerals 5.24 mg, Carbohydrate 11.0 mg, Calcium 18.9 mg Phosphorous 1.9 mg, Iron 5.2 mg. Ashraf Padanna (2014) reported that *neera* is the raw material for many value-added products such as palm syrup, palm jaggery and palm sugar having high domestic and International demand. Promotion of *neera* as nutritious health drink has been identified as an important marketing strategy for ensuring remunerative price to coconut farmers. *neera* and its downstream products like coconut palm sugar, jaggery and syrup are some of the viable products for commercial exploitation to augment income for coconut farmers (Nair *et al.*). *Kalparasa* contains about 15 % sugars and a 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 (*Kalparasa* (pH > 6.8) at 115°C. The viscous and fairly thick hot sap (Brix 60o to 70o) is cooled to get coconut honey or syrup. Further concentration with continuous stirring to avoid charring forms of sugar granules and cool at room temperature to get Sugar (14 to 15% recoveries). 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 the quality product. The conversion ratio for coconut honey is 5L: 1 kg as reported by Hebbar *et al.*, (2015). They also reported that *Kalparasa* has the high potential for value addition due to its health benefits. Confectionaries prepared from normal sugar and jaggery can be prepared by substituting with *Kalparasa*

sugar/jaggery/syrup/honey. Some of the products which can be produced from *Kalparasa* include spicy jaggery, cookies, chocolate, *neera* cake; fruit spread, squash, ice cream etc. In West Bengal as value-added products of *neera* presently milk based *neera* Sweets are being produced and marketed with different combinations for diabetic patients only. Milk and curds are the main ingredient and *neera* and coco sugar are the sweetener. The colour of the sweets are milky white, creamy white, yellowish, pinkish and named as *neera* Kalakand, *neera* Kancha Golla, (Fig. 6) Keshar Peda, *neera* Rabri etc. Besides *neera*, now jaggery and sugars are also being prepared from *neera* and being marketed in different parts of West Bengal. At present more than 50 sweet makers of different districts of West Bengal including one big house of Kolkata are also engaged in the preparation of milk-based *neera* sweets with *neera* jaggery and *neera* sugar commercially. These sap, jaggery, sugar and sweets are the blessing for diabetic patients and getting popularity day by day. The process of milk-based *neera* sweets was also patented.

*Neera*, the immature coconut inflorescence sap is an important product recently available from Kalpavriksha. Different value-added products prepared from *neera* is also important with respect to its nutraceutical values. It is a rich source of sugar, minerals, vitamins, fibre in addition to its low Glycemic content (35). It helps in increasing more income generation from coconut palms enhancing employment generation providing natural organic nutrition for all including diabetic patients, resulting in increasing better return from coconut palm as compared to copra. Review on the chemical constituents of *neera* recorded that it is naturally rich in Na, K, with a considerable amount of other minerals like Zn, Fe, Mg, different amino acids, antioxidant activity and content of Vitamin B complex, Vitamin-C and low fat. It

is superior to tender coconut water which is low in sugar, minerals, vitamins etc. The scope of employment generation through *neera* tapping may be around 10Lacks/year with its proportionate income generation. This may be the only way out for high-value agriculture through product diversification, value addition in *neera* (which is farm fresh, hygienic, chemical free and “o” alcoholic) through the production of *neera* jaggery, *neera* sugar and milk-based *neera* sweets. The production of *neera* is relatively more during night hours due to reduced transpiration and increased sap pressure inside the palm as compared to the production during the day hours. The *neera* yield is influenced by both day and night, season to season, spadix to spadix and with respect to genotype and environment. The *neera* is being tapped and collected all throughout the year in a different season under the low-temperature condition on the palm itself and is being stored under cool chain system until its marketing to the consumers or end users. It can also be stored up to six months under low-temperature condition ranging between 2-60C without hampering its quality. *neera* sugar, *neera* syrup, *neera* jaggery, and milk-based *neera* sweets are the popular high-value products being prepared from *neera*. *Neera* sugar is the product of the future with its high nutritional value and low Glycemic index value resulting in increasing demand among the diabetic patients in the domestic and international market. It is becoming a good substitute for commercial sweetener in place of normal table sugar.

### **Future scopes**

Normal sugar is a major contributing factor in the aggravation of diabetes, heart disease, gum disease, obesity, and other health problems. As a result, many people have been turning to "natural" sweeteners as a healthier choice. Globally, *neera* and its value-added

products are being manufactured by all the major coconut producing countries except India. The major players in the field are Indonesia, Philippines, Thailand, Malaysia, Sri Lanka and Vietnam. The major export destinations are USA, Canada, Norway, France, Middle East, South Korea, Japan, Australia and New Zealand. Export of *neera* and palm sugar has shown a surging trend in Indonesia, Philippines and Thailand as a healthy natural product. The production of palm sugar in Indonesia was estimated to reach 10 lakh MT in 2012. While it is a matter of pride that India leads the world in production and productivity of coconut ahead of Indonesia and Philippines, countries like Sri Lanka and Malaysia which are far behind us in coconut production, have already ventured into production of *neera* and palm sugar. Considering the above fact the scope for a tapping of Cocosap *neera* may also be explored in the coconut growing North Eastern states like West Bengal, Assam, Bihar, Odisha, and other adjoining states which may reflect on the state GSDP by uplifting the economic status of the farmers

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#### **How to cite this article:**

Ghosh, D.K., A. Bandyopadhyay, S. Das, K.B. Hebbar and Biswas, B. 2018. Coconut Sap (Neera)-Untapped Opportunity of Spinoff Gains in West Bengal, India. *Int.J.Curr.Microbiol.App.Sci*. 7(09): 1883-1897. doi: <https://doi.org/10.20546/ijcmas.2018.709.229>