

REVIEW ARTICLE

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The use of coconut in rituals and food preparations in India: a review

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Abstract

India is highly diverse ranging from snow-capped mountains to deserts, plateaus, and plain regions. It has a tropical climate with diverse climatic condition that favors the cultivation of wide range of fruit, vegetables, cereals, pulses, cotton, and various crops of medicinal importance making it one of the top producers in the world. India ranks second in the production of coconut grown in coastal regions playing a significant role in the agrarian economy and is known as a Nature's gift to mankind; it is a source of food, beverage, oil seed, fibers, timbers, and health products. Further, it is a highly appreciated fruit with antibacterial, antifungal, antioxidant, antiparasitic, antiviral, and many other qualities. Considering the growing increase in consumption of coconut and its products and the large number of studies that address the theme, it is felt necessary to carry out a bibliographic survey based on the most current and relevant works in the area using books, journal articles, and other available print and electronic resources. This study attempts to gather information on a detailed assessment of the coconut; its uses in rituals, its health benefits, and culinary preparations across India as the delicacies of immemorial ethnic fruit are of rising significance. The importance and significance of documenting this coconut ethnicity in Indian cuisine are an attempt to keep it relevant and take it to broader viewers who admire such unique delicacies. The study reveals coconut has a high value in Indian ritual, and the survey of pharmacological studies on its medicinal uses supports its beneficial properties to human health.

Keywords: Ethnic fruit, Health benefits, Coconut water, Coconut oil, Coconut sweets, Coconut flour

Introduction

The coconut plant is a multipurpose tree with immense benefits to mankind. The seed or fruit of the coconut palm is referred to as a coconut. The coconut palm, scientifically known as *Cocos nucifera* L., belongs to the Arecaceae (Palmae) family, which is a monocotyledon. The coconut palm is thought to be one of nature's marvels. It is properly eulogized as "*Kalpavriksha*" (a legendary tree thought to grant all desires—"the tree that offers all the essentials of life") in India. Its advantages and multipurpose property have earned it sobriquets such as "Tree of life" or "Tree of heaven" for a Filipino, "Tree of abundance" or "Three generations tree" for an Indonesian

and various other [1]. Botanically, the coconut fruit is a drupe, not a true nut [2]. Like different organic products, it has three layers: exocarp, mesocarp, and endocarp. The exocarp and mesocarp make up the "husk" of the coconut. Coconuts sold in the shops of non-tropical nations frequently have had the exocarp (peripheral layer) eliminated. The mesocarp is made of a fiber, called coir, which has numerous conventional and commercial applications. The shell has three germination pores (stoma) or "eyes" that are noticeable on its external surface once the husk is eliminated [3] (Fig. 1).

Coconut production is dominated by Indonesia. North Sulawesi produces the vast majority of the nation's coconut [4]. Coconuts are grown in abundance in the Philippines, which is the world's second largest producer (Fig. 2) [5]. Indonesia had previously surpassed it as the world's largest producer. India ranks third in

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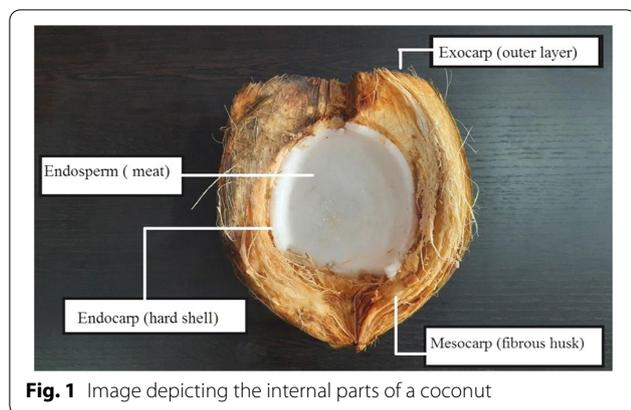


Fig. 1 Image depicting the internal parts of a coconut

the world in terms of coconut production. The country produced more than 119 million tonnes in 2016. Coconut farming is critical to India's agrarian industry and economy, particularly in rural areas [6]. Sri Lanka is the fourth-largest coconut cultivator in the world. The island country of Sri Lanka is the world's fourth-largest producer of coconuts [7]. Sri Lanka trails just behind Brazil with 2,513,000 tonnes produced annually. The country's warm and sunny climate is ideal for coconut growth. Brazil is the fifth largest producer of coconuts in the world. Brazil produced more than 2 million tonnes of coconut in 2016. Although not as large as the Asian countries on this list, Brazil's coconut industry has been growing as the popularity of coconut products starts to rise [8]. Coconut production, like that of the other nations on this list, is a significant part of the nation's economy. It has been a valuable product for decades and faces strong competition from some of the other plant oils and; it looks like it will proceed to be so in the future.

Coconut trees require high humidity and warm conditions for proper growth and are intolerant of cold weather. Under proper environmental conditions, coconut palms produce their first fruit in 6 to 10 years, taking 15–20 years to reach peak production.

In 2014, India contributed to 75.6% of the total world production. The largest producers of coconut were India, Indonesia, and the Philippines 21.7 billion, 16.4 billion, and 14.7 billion, respectively [9]. In India, coconut palms are developed on the entire coastal belt. Extensive shares go to Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh followed by Goa, Maharashtra, Odisha, West Bengal, and the islands of Lakshadweep and Andaman and Nicobar (Fig. 3). Four southern states consolidated record for practically 92% of the total production in the nation: Kerala (45.22%), Tamil Nadu (26.56%), Karnataka (10.85%), and Andhra Pradesh (8.93%) [10]. Different states, like Goa, Maharashtra, Odisha, West Bengal, and the northeastern state Tripura and Assam, represent

the excess 8.44%. The ethnic people of these coastal areas depend on coastal coconut for their livelihood. In India, coconut is known by different names in different regions: *Narikel* (Bengali, Punjabi, Assamese), *Nariyal* (Hindi), *Nariker* (Maitheli), *Nardiya* (Orissa), *Tengu/Enna* (Tamil), *Narikadam*, *narikelamu*, *kobari* (Telugu), etc.

Kerala has the maximum number of coconut trees, and it is well known for its coconut-based items—coconut water, copra, coconut oil, coconut cake (likewise called coconut dinner, copra cake, or copra feast), coconut drink, coconut shell-based items, coconut wood-based items, coconut leaves, and coir substance. The basic preparation of each dish involving the use of coconut or molding any of its plant part varies from tribe to tribe within the states of India. Since very less recorded data are available on such dishes, every household prepares it in their unique way yet there is very little variation in the core ingredients (Fig. 4).

Coconut is rich in nutrients, and it is highly susceptible to being contaminated with microbes. The microbial diversity in coconut is yet to be comprehended. Its antibacterial, antifungal, antioxidant, antiparasitic, and antiviral studies have no scientific validation. There have been recent studies on small population samples that have failed to establish a clear link between consumption of coconut products and cardiovascular disease [11].

Due to the limited availability of data about the use of coconut in Indian festivals, more research is needed to fully comprehend its ethnic significance. The tradition of preparing ethnic foods not only highlights creativity but also a link that connects the economic, sociocultural, spiritual, and lifestyle of the concerned communities. At the current juncture, the global food market is looking forward to such ethnic dish preparation that has changed from generation to generation from a broader perspective. Through the latest scientific documentation, this review attempts to highlight the importance of coconut in Indian rituals, its nutritional composition, health benefits, and various food preparations of coconut and highlights the socioeconomic significance of the Indian subcontinent scientifically.

Methods

Information was gathered from popular academic databases such as Science Direct, Google Scholar, and PubMed. The relevant studies were identified by using keywords and Boolean operators: "coconut," and "composition" or "health benefits" or "Coconut Tender water" or "Coconut flour" or "Coconut biscuit" and Coconut in rituals or "Coconut cultural significance." In this case, the Google Scholar database was mainly preferred because of its high accessibility to coconut-related fields. Manual research was also conducted to

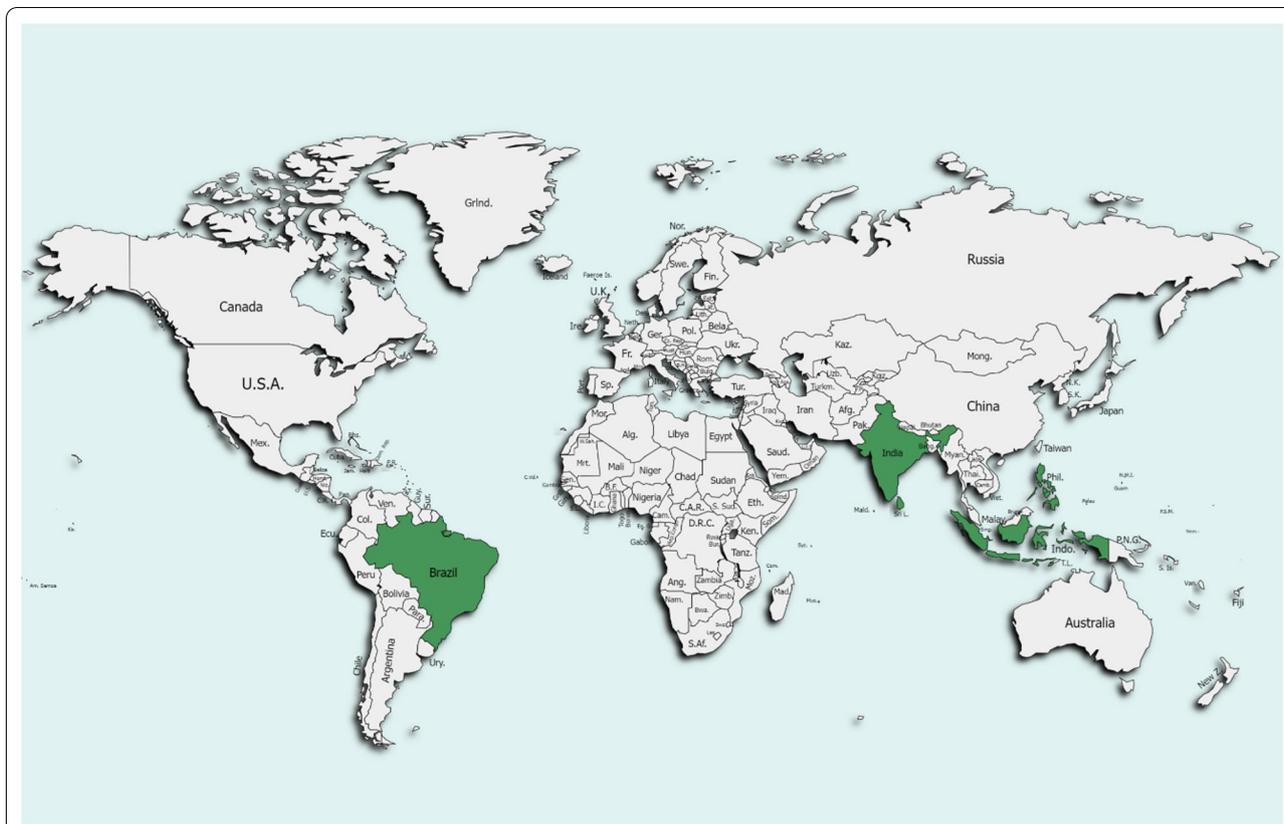


Fig. 2 Geographical distribution of the world's top coconut producing countries

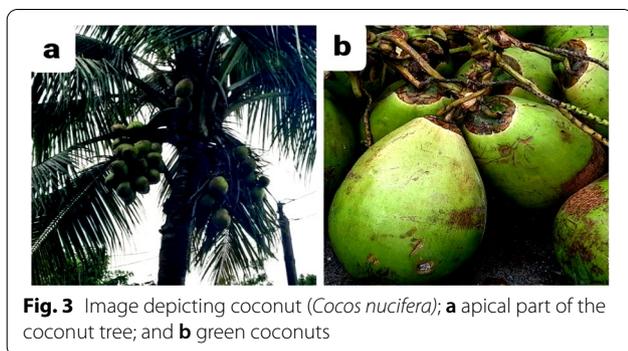
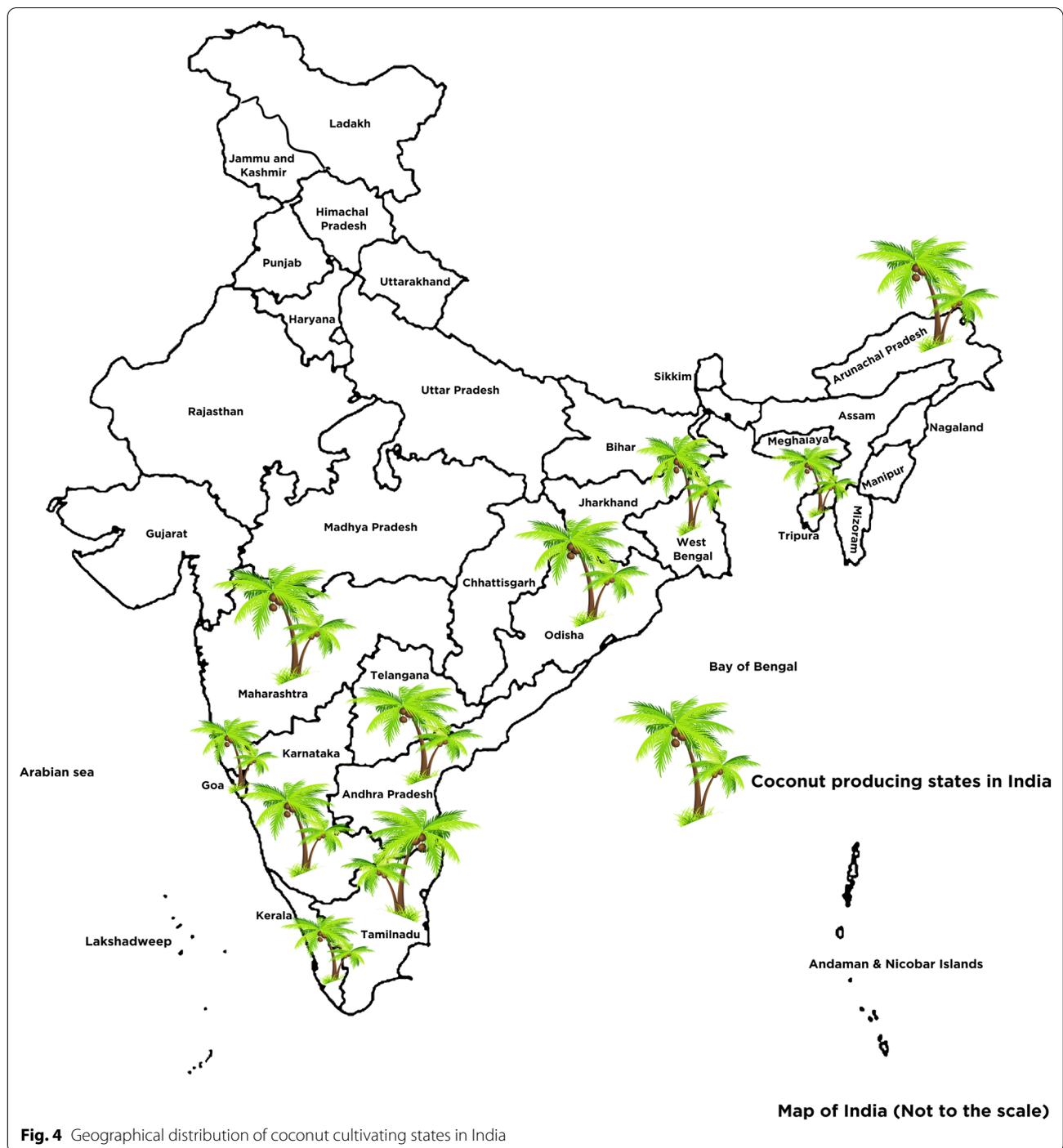


Fig. 3 Image depicting coconut (*Cocos nucifera*); **a** apical part of the coconut tree; and **b** green coconuts

Cultural significance of coconut

Coconut is called *Narikela* in Sanskrit, it is believed to be an aboriginal word, *Niyor* for oil and *Kolai* for nut derived from two words of South Asian origin. The coconut in Sanskrit is alluded to as “*Sriphala*” signifying “The God’s fruit.” It is mentioned in the post-Vedic works as the epic of Mahabharata (3000 BC), Ramayana, Puranas, and stories of Jataka in Buddhism. The coconut is into domestic rituals, attained sanctity as an offering to God, and become stable as a pure object of gift to guests on occasions like festivals, marriage, and other ceremonies known in numerous portions of India before the 6th century AD [12]. Later, it became a requirement in religious rites during the time of Agni Purana (800-900 AD) and Brahma Purana (800–900 AD). It is considered a medicinal plant as a requirement in religious rites and essential plant for atmospheric purity, beauty, and peacefulness in Agni Purana and Brahma Purana. Matsya Purana recommended planting coconut trees among other holy trees in a garden attached to with a house and considers it as a tree that brings prosperity and increases riches. It is believed that coconut is important to lord Ganesha, he was given by his father lord Shiva to play and it was how coconut came into the world. Coconut is used in rituals:

identify any relevant studies in those databases. This study uses publications from 1985 to 2022. The publications that specifically address the cultural importance, value-added products, and ethnomedicinal use of coconut were chosen over those that promote various recipes because their area of interest is outside the purview of this study. It is believed that this review would be used to further explore and expand coconut as a traditional Indian culinary ingredient.



in social, family, and religious ceremonies, and is related to fertility, society culture, totems, taboos, and beliefs.

Marriage The link between the human fertility cult and coconut is prominently highlighted during wedding traditions. The fruit is usually put in a pot, which symbolizes the womb, while the nut, which symbolizes life, grants fertility to the wedding pair. As it is a symbol of life,

pregnant women are restricted from breaking the coconut as it is equal to killing a life form. It is also believed that the sound of breaking down coconut harms the fetus in the womb. According to Gujarati traditional rituals, it is normal for a bride to present a coconut to the groom at the time of marriage and to be preserved by the respective husband throughout his life. It is given as a marriage

proposal, a betrothal sign, a bride’s welcome, and to protect against evil. The coconut also features prominently in a variety of Gond and Bhil marriage ceremonies and funeral service rites in Rajasthan, Gujarat, and Madhya Pradesh, according to ancestral networks. The Kunbis of Maharashtra’s Konkan region appreciate the coconut and keep it in memory of their ancestors [13, 14].

Religious and social ceremonies Lots of importance is given in the Hindu religion, while worshiping deities, several fruits and flowers are offered to the deities. One of the most typical offerings during religious rites is a coconut. Priests in southern part of India temples never accept a devotee’s contribution if it does not include a coconut. Coconut offering is a frequent tradition in temples; the coconut is broken and put before the Lord, after which it is given as “Prasad.” Coconut is also placed at the “Pandal” during auspicious events [15]. It is offered and broken while starting any new ventures like starting a business, buying a car, house, etc., and by doing so, it is believed to remove all negative energies and architectural defects from the house. In Hindu mythology, animal killing was replaced with coconut to fulfill their desires. Coconuts are given as ceremonial presents in Asia, particularly in India, and are used as purifying medium during traditional events [16]. The three eyes of their greatest god, Lord Shiva, are thought to be represented by the coconut among Hindus. The coconut also symbolizes a noble and proud heart, with its tough shell on the outside and sweet, delicate fruit on the inside. Coconut breaking is also considered as breaking one’s ego or “Ahankara,” and the flesh white portion of coconut is considered as the brain which is selfish, egoist, and jealous. Coconut is also symbolized as a representation of divine consciousness and is kept in leaves in a copper vessel known as “Kalasha.” For all these festivals Ganesh Puja, Diwali, Dussera, Durga Puja, and Holi, a huge number of coconuts were offered to the gods and to guests.

In Tamil Nadu, Aadi Perukku is celebrated for life-giving nature and sustainability of water, whereas as a part of ritualistic practices, the practice of breaking coconut on the devotee’s head is done and is quite unusual.

In Daman and Diu, Narali Purnima is celebrated by Hindus on the west coast of India and in the coastal region of Maharashtra like Thane, Ratnagiri, Konkan, etc., and it is offered to the sea on the full moon day or Purnima. This festival is the beginning of the fishing and the water trade among the fishermen. They offer prayers and worship the sea God, Varuna, for a smooth journey and more profitable catch in the seas. They celebrate by dancing and singing and eating the traditional food sweet coconut rice and curry. In Kerala, coconut is first put into the sea to calm it and offered to the devotees before starting fishing hoping to catch abundant fish.

In Assam, coconut sweet dishes known as *Laru* and *Narikol Pitha* are made during Magh Bihu also called Bhogali Bihu, and in mid-January, it is a harvest festival and marks the end of harvesting season and is celebrated with great pomp and show in the households.

Ethnomedicinal values of coconut in India

Coconut’s medicinal value has been known in India since ancient times [17]. The flesh, water, milk, and oil found in the coconut are all healthy and nutritious. Coconut is also referred to as a “functional food” because it has health advantages in addition to its nutritional components [18]. Coconut contains more fat than carbohydrates and, however, some important vitamins such as folate (B9), thiamine (B1), riboflavin (B2), niacin (B3), B6, vitamin E, vitamin C, and vitamin K. The fat present is known to promote better hair growth and reduce early graying. It is especially high in manganese, which is essential for bone health and the metabolism of carbohydrates, proteins, and cholesterol (Table 1).

The coconut plant provides a wide range of medicinal benefits. The coconut tree and its fruits are utilized in Ayurveda, particularly Indian traditional medicine, as a component in the creation of a number of herbal remedies used to cure a variety of illnesses. Here are a few ailments listed where coconut has been found to be beneficial (Table 2).

Table 1 Biochemical composition of coconut kernel. *Source:* USDA

Constituents	Values*	Constituents	Values*
<i>Proximates</i>			
Moisture	46.99	Carbohydrates# (g)	15.23
Protein	3.33	Total dietary fiber (g)	9.00
Total fat	33.49	Total Sugar (g)	6.23
<i>Minerals</i>			
Calcium (mg)	14	Potassium (mg)	356
Iron (mg)	2.43	Sodium (mg)	20
Magnesium (mg)	32	Zinc (mg)	1.10
Phosphorus (mg)	113		
<i>Vitamins</i>			
Vitamin C (mg)	3.3	Vitamin B6	0.054
Thiamine (mg)	0.066	Folate, DEE (µg)	26
Riboflavin (mg)	0.020	Vitamin E (mg)	0.24
Niacin (mg)	0.540	Vitamin K (µg)	0.2
<i>Lipids</i>			
Total SFA (g)	29.698	Total PUFA (g)	0.366
Total MUFA (g)	1.425		

MUFA monounsaturated fatty acids; *PUFA* polyunsaturated acids; and *SFA* saturated fatty acids

*Values are given on fresh weight basis per 100 g coconut kernel

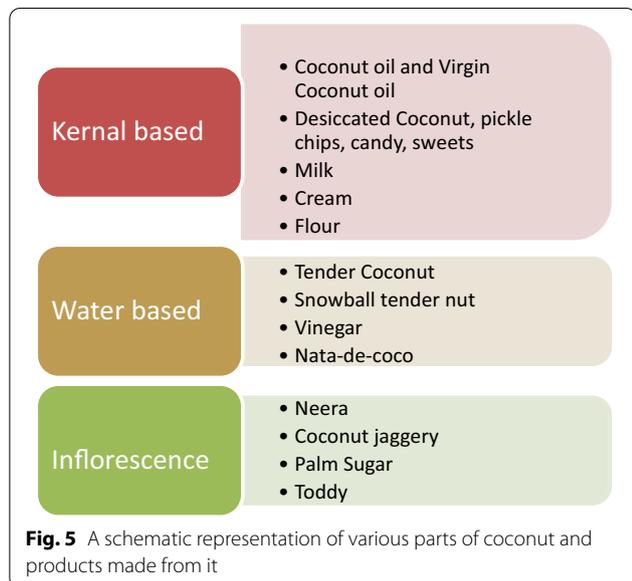
#Carbohydrates by differences

Table 2 The ethnomedicinal benefits of different parts of coconut

Part	Ailment	Ethnomedicinal belief
Root	Gingivitis	Boiling coconut roots in water and potash alum can be used as a mouthwash to cure gingivitis
Stem bark	Gastritis	Ash generated from burning coconut tree stem bark combined with water may be used to relieve gastritis and indigestion-related pain
Meristematic stem	Allergies	It lessens any potential negative effects that occur on eating pickles, cuttlefish, and tuna fish
Leaves	Allergies	Skin eruptions and inflammation caused on by some allergies are reduced when the skin is fumigated by smoke produced by burned raw, delicate coconut leaves
Inflorescence	Vaginal bleeding due to gynecological disorders	Tender coconut inflorescence, rhizome of native banana— <i>Musa paradisiaca</i> , <i>Syzygium cumin</i> or jamun in Hindi, and stem bark of wood apple are boiled with water and consumed
	Fractures	Palm stem bark, lodh tree bark, and coconut inflorescence are squeezed out to get juices and applied extremely thick before being applied and bandaged
	Diarrhea	For the treatment of diarrhea in children, nutmeg seeds are rubbed on a stone along with freshly squeezed juice from young coconut inflorescence
Tender coconut water also known as Sheetala (cold)	Besides relieving thirst it is considered to be cardioprotective, digestive stimulant, Aphrodisiac (Promoting semen), removes burning sensation in urination, headache, it is used as an agent in cholera, diarrhea and dysentery; treatment of cancer; as a hair nutrient in alopecia in India [19]. Retards aging and helps in treatment of degenerative brain diseases like dementia and Alzheimer's disease [20] Organic pesticide	Burning sensation in Urination: To lessen the burning during micturition, one should drink young coconut water Also acts as a laxative Tender coconut water mixed with sugar is believed to relieve headache. Sugars in water reduce blood sugar levels and are believed that liver is healthier and gets more energetic life. Intake of coconut water by infants can help prevent nutritional rickets as it is a major source of calcium to the body Cytokines present in coconut water slows aging and treats brain diseases Panchagavya is prepared as a concoction by mixing five products of cow like cow dung, urine, milk, curd and ghee. These are mixed in proper ratio and then allowed to ferment using yeast bananas, groundnut cake, and the water of tender coconut, is a potent growth promoter and organic pesticide
	Poisoning of <i>Nerium indicum</i> known as <i>Karavira</i>	Leaves of <i>Dregia volubilis</i> known as <i>Murd bel</i> in Hindi language is mashed and combined with water from tender nuts and consumed to remove poisoning
Coir	Scorpion sting	Old coir fiber ashes combined with coconut oil can be placed to a scorpion sting to lessen the pain and swelling
Coconut shell	Fracture	A paste of coconut shell, turmeric, unrefined salt, and stem bark of mango is applied as bandage in a fracture to hasten healing
Coconut shell oil	Toothaches	Coconut shells that have been dried out to burn and the extinguish shells will be shedding a small amount of oil. The oil is gathered and used to treat toothaches
Kernel	Rheumatic arthritis	Finely grated fresh coconut, fresh turmeric, and beetle nut flower are cooked in a pan together the mixture is compressed and bandaged over the swollen joints in rheumatoid arthritis while still warm
Coconut milk	Poisoning, weight reduction	Coconut milk is administered as a poisoning remedy Coconut milk consumption helps feel full and in weight loss
Coconut oil	Dermatitis	Heated coconut oil is combined with an equal amount of common salt water and applied to the body. After an hour which <i>Pogostemon parviflorus</i> juice is put over followed by warm water bath to treat dermatitis, this process is performed daily for seven days Used in case of healthy skin and hair

Table 2 (continued)

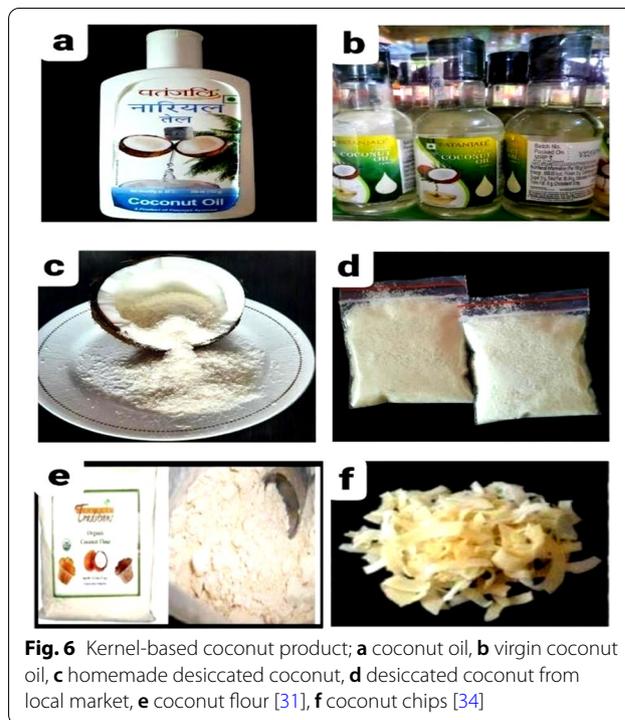
Part	Ailment	Ethnomedicinal belief
The root, leaves, stem bark, flower and the pith of coconut tree	Treat all kind of snake bites	The coconut tree's stem, root, barks, leaves, flowers, and pith are mashed together; the juice obtained by squeezing the mixture is mixed with millet seeds before being cooked in an earthen pot over a fire. After cooking, it is eaten after being combined with cow's ghee



Value-added products from coconut

The coconut palm is grown for decoration, as well as for its many cooking and non-culinary uses; every part of the coconut palm can be used by humans in some manner or the other and is considered to have significant economic value. For this reason, coconut in the Sanskrit language is “Kalpa vriksha” or “the tree which offers all the necessities of life.” Coconut is a multipurpose fruit that can be modified in different ways. The non-edible parts are used to make hand fan, baskets, and brooms from leaves; from coir: ropes doormats, brushes, and mattresses; coconut oils can be used to make soaps, hair oil, and cosmetics; coconut shell may be used as utensils; coconut trunks in Kerala can be used for building houses; and callus can be used in tissue culture, etc.

The various edible products from coconut are shown in Fig. 5 including coconut milk, dried coconut or copra, desiccated coconut, coconut oil, coconut water, Nate-de-coco, coconut flour, vinegar, jaggery, etc.



Coconut-based food preparations in India

Only about 5% of coconut in India is consumed as tender coconut, and the remaining is utilized as matured nuts for household and religious uses and the production of milling copra, edible copra, and desiccated coconut powder.

Kernel-based products

Several items can be made from the meat or kernel of coconut in India.

Coconut oil and virgin coconut oil Coconut oil is edible oil and is consumed in many countries including India for many years. The major portion of coconut produced in India is used for the extraction of oil, and 40% is consumed for edible purposes, 46% for toiletry and 14% for industrial uses [21]. After olive oil, coconut oil for edible purposes is now being claimed to be the second best edible oil in the world. It is especially used in the southern

part of India like Kerala and Karnataka. Refined coconut oil is mainly used for the preparation of chocolates, ice cream, biscuits, and other confectionery items, pharmaceutical products, and paints. The filtered coconut oil is used for cooking and toiletry purposes. The demand for coconut oil increases by 15–20% during the season of festivals. The kernel or meat of mature coconuts collected from the coconut palm is used to extract coconut oil. It has a higher percentage of saturated fat, which slows oxidation and makes it more resistant to rancidity, lasting up to two years without rotting and having a shelf life of up to three years (Fig. 6).

Mechanical extraction methods are commonly used to get coconut oil. Well-dried copra is pressed in a screw press or hydraulic press to extract oil by shattering the oil cells in the kernel in the dry extraction process. Filtration separates the oil and cake after extraction. In India, the total production of edible grade coconut oil is about 4.0 lakh tonnes, which was 1.5 lakh tonnes in comparison with that, produced in the 1980s [22]. A study shows that crude coconut oil had more stability than refined oil because the refined oil reduces the amount of tocopherol in the oil [23].

Cake can be used as a substrate for *Aspergillus oryzae* species to produce *alpha amylase* [24]. Oil extraction employing the enzymes *polygalacturonases*, *α-amylase*, and *proteases* was found to be a more efficient process in terms of energy expenditure, yielding an 8% yield [25]. Virgin coconut oil is coconut oil that has been generated using the wet technique. Fresh coconut meat or milk can be used to make virgin coconut oil (Fig. 6). By grinding, drying, and pressing fresh meat, it can be collected. Manufacturing it from coconut milk involves grating it, combining it with water, and then centrifuging it at a high speed. The cream can also be heated to eliminate any left-over oil after the milk has been fermented for 36–48 h. This process of extracting coconut oil from coconut milk does not require the use of a solvent and lowers the investment cost and energy requirements significantly. Moreover, it eliminates the RBD (refining, bleaching, and deodorizing) process [26]. There have been several virgin coconut oil (VCO) production processes being followed in India and the world that cause variations in the physicochemical properties, which in turn affect its medicinal and nutritional properties. ICAR-Central Plantation Crops Research Institute, India, has designed and developed a virgin coconut oil (VCO) cooker for the extraction of oil by the hot process. The extraction process revealed high total phenolic and flavonoid content and antioxidant capacity [27].

Desiccated coconut

It is widely used in the preparation of sweets, confectionery, curry preparation, chutney, etc., as one of the primary ingredients in fillings for chocolate, sweets, and other confections (Fig. 6). It is also used raw as a garnish for cakes, biscuits, ice cream, and toasted snacks. About 4000 tonnes of desiccated coconut are produced annually in India. Dehydrated coconut meat in the grated and the shredded form is desiccated coconut. It is obtained from the drying of shredded, ground coconut after separating from the brown testa. A sharp knife is used to de-shell the kernel, which is then fragmented into smaller pieces using a hammer mill or pin mill. To minimize the microbial count, the coconut flakes are steam blanched for around 20 min. The fragmented kernel is dried in a hot air dryer for around 10 h at a temperature of 80–90 °C to reduce the moisture content to 3%. It was found that 60–120 °C temperature of air with a velocity of 2.5 m/s could reduce the moisture level from 105 to 3% d.b [28].

In Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, and Maharashtra, the main attention of units producing desiccated coconut is not only generation of value-added product but also generates a large number of employment opportunities and it is a labor-intensive industry. Coconut in Kerala is the major element used in the preparation of breakfast lunch and dinner. In the preparation of curries, coconut paste is usually added. Instead of that desiccated coconut powder is added. Hence, desiccated coconut finds a good market in areas where coconuts are not produced particularly

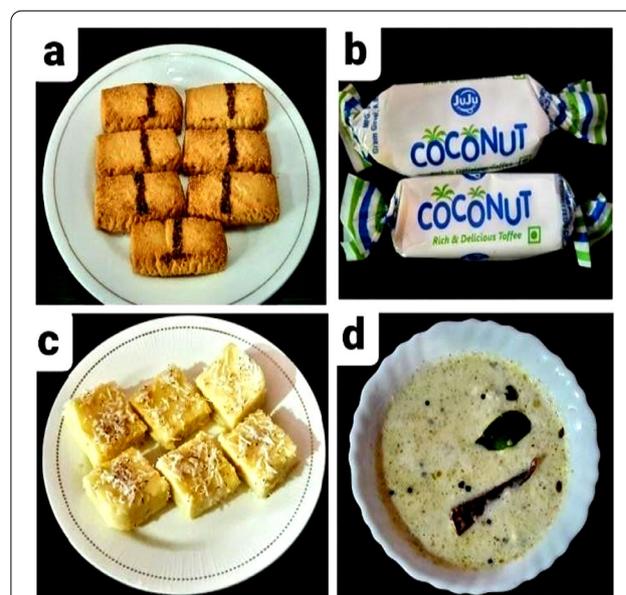


Fig. 7 Products made from dehydrated coconut; **a** Coconut biscuits, **b** coconut candy, **c** coconut burfi, **d** coconut chutney

in Northern India. The following are the products made from dehydrated coconut.

- (1) *Coconut biscuit* Almost all over India, coconut confectioneries items such as biscuits, buns, and cookies are made. The biscuit is prepared with grated coconut, wheat flour, sugar, salt, and a binding agent such as some water. After that, it is cooked until it turns brown, crispy, and crunchy [29]. It can be prepared in different varieties through addition of cocoa, butter, and many more. Coconut biscuits are highly nutritious and delicious with low calories and high fiber content. The product has a shelf life of three months under ambient conditions (Fig. 7).
- (2) *Coconut chips* It is made mainly in Kerala and Maharashtra, Bangalore, Coimbatore, Tamil Nadu, and West Bengal. The dehydrated coconut chips are in ready-to-eat form and can be used as snacks (Fig. 6). It can be prepared by dehydrating the intermediate moisture coconut kernel. Coconut chips are crispy and can be packaged and marketed in laminated aluminum pouches, which will have a shelf life of 6 months. Coconut chips with different flavors can be prepared by adding the required flavor essence in the osmotic medium. Instead of sweet, salted coconut chips and medicated coconut chips can also be prepared by suitable a change in the osmotic medium [30].

In India, ICAR-Central Plantation Crops Research Institute (CPCRI) is involved in the preparation coconut chips.

The following are the other products made from the kernel or meat of the coconut:

- (1) *Coconut sweets* In day-to-day diet, coconut finds extensive application in the preparation of many traditional Indian sweets. One such sweet which is quite popular in India is coconut “burfi” (Fig. 7) [33]. Coconut “burfi” is a famous Indian delicacy served during festivals. To make coconut “burfi,” a 1:1 mixture of coconut gratings with a particle size of 1–2 mm and sugar was heated in a pan with constant stirring until a soft-textured result was generated. Ghee (clarified butter) and cardamom powder were added, and everything was thoroughly mixed. After 30 min, the substance was poured out and spread to form a sheet of 1.0–1.5 cm thickness on a plate greased with a thin coating of ghee and then cut into 4 cm X 4 cm square pieces and packed after chilling for 4 h [34]. In Assam, coconut sweets dishes known as *Laru* and *Narikel Pitha* are made during the festival Magh Bihu also called

Bhogali Bihu, festival of crop harvest, and mark the end of harvesting season. Similarly in Bengal, *Narikel Pitha* in Makar Sankranti, *Bhappa* in the winter season, and *Narikel Laddu* are prepared and festivals are celebrated with great enthusiasm in the households. *Narikel Pitha* and *Narikel Laddu* are made in Makar Sankranti also known as Uttarayan or *Mokor Sonkrati* in Bengali, and it means a day where the transition of the sun into Capricorn takes place. *Narikel Pitha* is prepared by mixing rice powder with coconut powder and warm water and sugar is added, and then, round balls are made and flattened and steamed on low flame. For the preparation of *Narikel Laddu*, coconut is ground in a blender, and then, it is heated with sugar or jaggery for 30 to 45 min in low flame until turned into brown color. Then, the mixture is allowed to come to normal temperature and round balls are made and served. In Himalayan parts of India like Sikkim and Darjeeling, *Selroti* is prepared by coconut powder mixed with rice flour, sugar, spices, and milk to form a batter and kept overnight to ferment. The next day the batter is poured in hot oil to make rings. In various parts of India, coconut powder is sprinkled over *gulab jamun* and other sweets to make them more attractive and to improve their taste.

- (2) *Coconut chutney* Coconut “chutney” is a South Indian cuisine specialty and food accompaniment as a thick gritty paste, slurry, or dried. Coconut “chutney” is made from the gratings left over after extracting coconut milk. Bengal gram, green chili, coriander, ginger, tamarind, garlic, and salt are among the components, and water is made into a paste and then mixed with coconut gratings in the required proportions and then the “chutney” is seasoned and then packed [35] (Fig. 7). Coconut chutney is served with *idli* and *dosa*, a dish prepared with fermented rice and black gram pulses in South India.

Milk-based products

- (1) *Coconut milk* Using a rotary wedge cutter, the coconut kernel is fragmented and then pressed and squeezed with hot water to extract the milk. Following extraction, the milk is filtered to remove solids before being pasteurized to kill microorganisms. Increased water temperature during extraction has no positive effect; however, repeated extractions increase the amount of milk produced [36]. Coconut milk is an instant product that can be used

directly/diluted with water to make various preparations. Coconut cream or coconut milk is used to make coconut candy. In the correct proportions, malt syrup and sugar are added to the coconut milk. The mixture is then cooked to a very high temperature to cause caramelization. The thick mass is then put into the mold and chilled once it has reached the desired consistency. After the candy has cooled, it is cut into the proper form and size and wrapped. Coconut milk is used to prepare *Malai Chingri* in Punjab and *Maloi Chingri* in Bengal, and it is a curry eaten as a side dish with rice or bread. It is prepared by cooking the prawns in a mixture of spices, salt, turmeric, and coconut milk. It is highly relished by the people of these regions.

- (2) *Coconut Cream* It is mostly utilized as a fat source, and it is comparable to coconut milk but has a thicker, paste-like consistency. Coconut cream can be used directly or diluted with water to make various preparations. It can be used for fish and meat dishes, curries, sweets, desserts, cakes, puddings, cakes cookies, jam, ice creams, etc., in India [37].
- (3) *Coconut flour* The coconut residue left over after extracting the coconut milk is a by-product of the coconut milk industry. Coconut flour is formed from coconut waste, which is thought to provide nutritional fiber. Dietary fiber has been found to provide significant health benefits in the prevention of chronic diseases like cancer, cardiovascular disease, and diabetes. It is a non-starch polysaccharide that is not digested in the small intestine but can be fermented into short-chain fatty acids (SCFA) such as acetate, propionate, and butyrate in the colon. SCFA provides 1.5–2.0 kcal per gram of dietary fiber [38]. It is used in the bakery industry.

Coconut water-based products

- (1) *Tender coconut water* It is known as nature's miracle drink, a very famous refreshing and a traditional medicinal drink consumed almost in all parts of India like in Bengal, Maharashtra, Bangalore, Kerala, etc. It is known as coconut *padhaneer* in South India. Coconut water has a low matter content (2% to 5% wet basis), mainly comprising sugars and minerals. Tender coconut water is a natural isotonic beverage that balances electrolytes in our blood while being environmentally sustainable. The flavor of tender coconut water is due to a substance called delta lactone. The tender coconut water has a variety of functions, including electrolytic fluid hydration, anticarcinogenic, antimyocardial infarction,

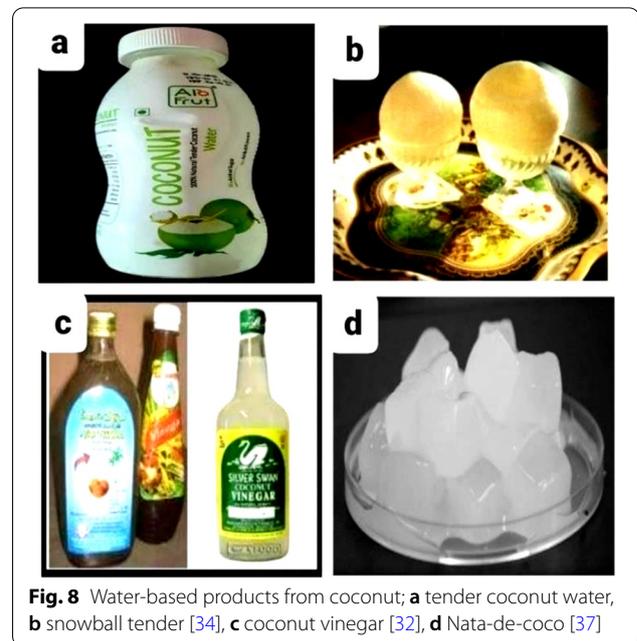


Fig. 8 Water-based products from coconut; **a** tender coconut water, **b** snowball tender [34], **c** coconut vinegar [32], **d** Nata-de-coco [37]

hepato-protective, antioxidant, antiaging properties, and antithrombotic effects [20, 39] (Fig. 8).

- (2) *Snowball tender nut* Snowball tender nut is a delicate coconut with no husk, shell, or testa that is round, soft, and white. The 8-month-old coconut is better for creating snowball delicate nut than the standard months old coconut. A straw can be inserted into the top white-sensitive coconut kernel to ingest the snowball. The snowball is scooped out of the shell by putting a scooping instrument between the tender kernel and the shell. Because the sensitive coconut water is not exposed to the atmosphere, it preserves its sterility. If the sensitive nut is separately packed and chilled under hygienic circumstances, the shelf life can be extended to more than 10 days (Fig. 8) [40].
- (3) *Vinegar* Coconut vinegar, a natural alternative to synthetic vinegar, can be made from coconut water or coconut sap. It often is used in pickles, salad dressings, and sauces as a flavor and preserving ingredient. It is high in vitamins and minerals including calcium, phosphorus, iron, and sodium, and it is also anti-inflammatory and antimicrobial [41]. Coconut vinegar is made from sugar-enriched coconut water that has undergone alcoholic and acetic fermentation (Fig. 8).
- (4) *Nata-de-coco* Nata-de-coco is a chewy, transparent, jelly-like culinary product made from fermented coconut water, consumed mainly in the western and southern regions of India. *Acetobacter aceti* subspecies *xylinum*, a cellulose-forming bacterium,

is used to make it from matured coconut water [42]. The culture solution is prepared by mixing coconut water with sugar and acetic acid at a stipulated proportion, which is inoculated with *Acetobacter xylinum* through a culture liquid. It is placed in glass jars with thin linen covering and left undisturbed for 2–3 weeks. During this time, a white jelly-like substance forms on top of the culture media and floats. It is picked, cut into pieces, cleaned in pure water to remove any acids, and then soaked in flavored sugar syrup for 12 h before being packed into glass bottles. It is great in sweet fruit salads, pickles, fruit cocktails, beverages, ice cream, and a variety of other dishes. Nata can be made with a variety of fruits such as bananas, pineapples, tomatoes, and other vegetables, and the product is named after the medium used, such as “Nata-de-coco” from coconut and “Nata de pina” from pineapple (Fig. 8).

Coconut inflorescence

- (1) *Neera* In its fresh form, the vascular sap collected from immature unopened coconut inflorescence is known as “Neera.” Neera is widely consumed in the Southern part of India, Sri Lanka, Africa, Malaysia, Indonesia, Thailand, and Myanmar [43]. It is a sugary juice and tasty health drink with plenty of sweets, minerals, and vitamins. To preserve the product, it is filtered and pasteurized, and bio-preservatives are added. The nutrient-dense “sap” has a low glycemic index (GI 35), making it diabetic-friendly because very little sugar is taken into the bloodstream. It is high in minerals, amino acids, vitamin C, and broad-spectrum B vitamins, and it has a pH that is close to neutral. Neera is used to make a variety of high-value products, such as coconut flower syrup, jaggery, and coconut palm sugar. “Sweet toddy” is a misnomer for Neera [44, 45] (Fig. 9).
- (2) *Jaggery* The concentration of unfermented coconut sap or flower yields coconut jaggery. It is high in calcium, iron, and a variety of other vitamins and minerals. It can be used as a low-calorie natural sweetener and digestive aid. Evaporation is required to remove approximately 80% of the water in the sap collected. The sap is filtered through sand filters to eliminate contaminants before being heated, and a little amount of alum is added to stimulate the precipitation of lime and magnesium. This will make the finished jaggery considerably less delectable, have better color, and stay hard for a long time. Following evaporation, a thick mass is formed, which

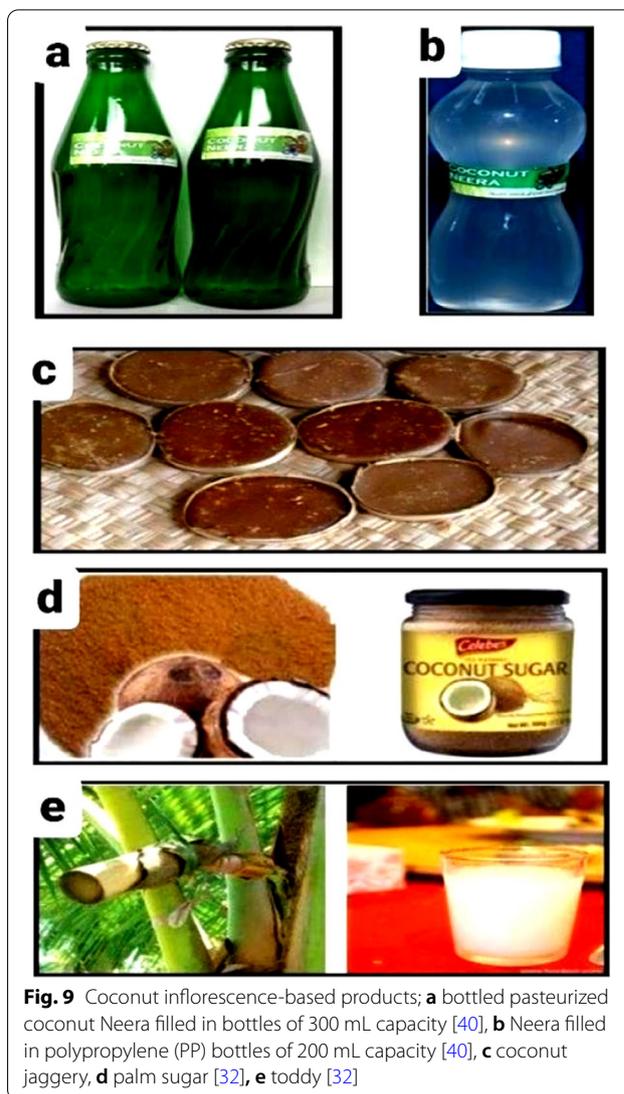


Fig. 9 Coconut inflorescence-based products; **a** bottled pasteurized coconut Neera filled in bottles of 300 mL capacity [40], **b** Neera filled in polypropylene (PP) bottles of 200 mL capacity [40], **c** coconut jaggery, **d** palm sugar [32], **e** toddy [32]

crystallizes upon further heating and solidifies upon cooling. Due to the caramelization of the sugar, the finished product has a dark color (Fig. 9).

- (3) *Palm sugar* To coagulate albuminous contaminants, the coconut sap is treated with 2% lime. After that, the limed sap is carbonated twice and filtered to remove any excess lime. The cleared liquid is evaporated to sugar content of 75%, and the resulting syrup is concentrated in vacuum pans until crystallization starts. The syrup is then discharged into crystallizers, and the crystalline sugar is separated by centrifugation [46]. Based on a study by Food and Nutrition Research Institute (FNRI), the glycemic index (GI) of coconut sap sugar is 35, and therefore, it is considered a low glycemic index food that will not raise the blood sugar levels (Fig. 9).

- (4) *Toddy* It is an alcoholic drink made from coconut sap. It is also called *Kallu* (in South India), palm toddy, or simply toddy/tadi (in North India). Toddy ferments into an alcoholic beverage. The sap is usually gathered from the coconut tree's cut bloom. To collect the sap, a jar is connected to the flower stump. Before it is fermented, the white liquid that accumulates is usually quite sweet and non-alcoholic. Due to natural yeasts in the pores of the pot and air, coconut sap begins to ferment almost soon after collection (often spurred by residual yeast left in the collecting container). Fermentation produces an aromatic wine with up to 4% alcohol content that is pleasantly intoxicating and sweet in less than two hours. For the formation of vinegar, the wine can be fermented for up to a day to yield a stronger, sourer, and acidic flavor [46] (Fig. 9).

Conclusion

The coconut is ubiquitous in Indian culture, appearing in every ritual or event. The coastal areas of India contribute to about 75% of the world's coconut production. It is known as "*Shrifal*" or fruit of prosperity since the tree produces not only fruit with refreshing water, oil, and delectable kernels that may be eaten fresh or dried, but also because every part of the tree: the fruit, nut, shell, and leaves, are used for some purpose or the other in India. It is no wonder that the Sanskrit word for coconut is "*kalpavriksha*," which means "the tree that provides the essentials of life." Coconut in the Indian subcontinent is a major holy fruit offered to deities during the start of any good work like buying a house, vehicle, land, starting a business, etc. Coconut is used in a variety of ways, including cooking, as medicine, and cosmetics. It is a good source of dietary nutritional fiber believed to help with digestion as a result; demand for desiccated coconut is increasing in many industrialized countries.

Like its kernel counterpart, coconut water can potentially be used in new products with standardized composition for health benefit uses. The kernel can be a potent source of raw material for the development of phytochemistry and even allopathic medicine. Different components of coconut include antioxidant and anticancer characteristics making it a better alternative for removing the poisoning impact of other foods that are part of modern life. Coconut oil has been used in the production of a variety of medications, lotions, and ayurvedic oils. Virgin coconut oil is a good source of vitamin E and lauric acid. These coconut products have a lot of potential for development, value addition, and commercialization. These coconut-based dishes can serve as an important aspect of the culture and ethnicity of the Indian people. However,

coconut-based recipes have been a brand of ethnic Indian cuisine for ages and therefore it is high time to make it popular and spread it worldwide for the advantage of rich Indian tourism and upliftment of the community in general. Coconut-based recipes have been an integral part of South Indian cuisine and its food cultural diversity. It is home to many ethnic communities, and the use of coconut and the cuisine of all these indigenous ethnic groups are a beautiful sign of widespread food tradition. There are a plethora of opportunities to be explored using coconut as a base to work on newer recipes which will represent the local food culture of this Indian state. Moreover, these coconut-based recipes have been a trademark of ethnic Indian cuisine for ages and it is high time to popularize it and spread it worldwide for the benefit of tourism and upliftment of the community in general.

Numerous ethnomedicinal benefits of coconut exist. Therefore, an in-depth research is required to maximize their therapeutic utility in the treatment of ailments. To create contemporary medications using the chemicals identified in coconuts, a drug discovery process should be started. To ascertain the hidden aspects of coconut and their real-world clinical uses that can benefit humanity, more research must be done on the coconut. This work is an attempt to summarize the multiple uses of coconut and its parts and to document them in a scientific way.

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Competing interests

The authors have no competing interest to declare.

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