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## Assessment of nutritional and phytochemical components of *Cocos nucifera* vegetative BUD

**Karpagapandi L****Abstract**

**Introduction:** *Cocos nucifera* vegetative bud is a vegetable harvested from the inner core and growing bud of coconut. In Indian folk medicine, the fresh coconut vegetative bud is useful in treating ulcer, stomach pain, jaundice, body heat, diabetes, piles, fever, indigestion, kidney stone and strangury. Consequently, the profiling of nutritional qualities and phytochemical screening of *Cocos nucifera* vegetative bud is essential to produce evidence for the functional properties of coconut vegetative bud. Hence, the study was planned to document the pioneer data about the nutritional and phytochemical constituents of vegetative bud of coconut.

**Methods:** The physico-chemical properties such as moisture, carbohydrate, starch, total sugar, fat, protein, fibre, pH, acidity and ash content were determined. Minerals such as calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper and manganese was analyzed by Inductively Coupled Plasma Optical Emission Spectrometry. Screening of phytochemicals such as alkaloids, glycosides, phenols, flavonoids, tannins, terpenoids, saponins, phytosterol and oxalates were done using ethanol, methanol, hexane, petroleum ether, acetone, and aqueous medium of extracts of coconut vegetative bud.

**Results:** The moisture content of the fresh vegetative bud was 81 percent and the pH is  $6.34 \pm 0.04$ . The proximate nutrients like carbohydrate, starch, total sugar, fat and protein were found to be 49.75, 38.70, 6.174, 8.38 and 10.18 gram percent in dry weight basis respectively. It has a higher amount of fibre 11.41 g in dry weight basis. Acidity and ash content of vegetative bud were 3.07 % and 9.32 g in dry weight basis respectively. The study also revealed that *Cocos nucifera* vegetative bud is rich in essential minerals. Phytochemical screening by using different solvents has shown the presence of alkaloids, glycosides, phenols, flavonoids, tannins, terpenoids, saponins and phytosterol.

**Discussion:** It indicates that the presence of different nutrients and phytochemicals in the vegetative bud of *Cocos nucifera* further confirm the ability of the bud to serve a source of natural medicines.

**Keywords:** *Cocos nucifera* vegetative bud, nutritional, phytochemicals, qualitative test

**1. Introduction**

Plants have been used as a source of traditional medicine for years to treat various diseases and conditions. Many of these medicinal plants are also excellent sources of phyto-chemicals, many of which have potent antioxidant activities. They are non-nutritive plant chemicals that have protective or disease preventive properties. Plant produces these chemicals to protect itself but recent research demonstrates that many phytochemicals can protect humans against diseases (Mehta *et al.*, 2010) [10].

Palms are one of the best known and most widely planted tree families. They have held an important role for humans throughout much of history. Many common products and foods come from palms. The palm family (Arecaceae) is comprised of 183 genera and over 2400 species. The five major palm species are nut palm, peach palm, coconut palm, oil palm and date palm (Johnson, 2012) [5]. Coconut (*Cocos nucifera* L.) also called as *Kalpavrisha* in Sanskrit, means wish fulfilling tree is a large palm belonging to the family Arecaceae or Palmae. The coconut has been described as the "tree of life" or "tree of heaven" and nature's greatest gift to man. Different coconut products like coconut oil, kernel and water are used as culinary items and as natural remedy for curing some ailments in tropical regions of the world. Other part of the coconut tree such as root, trunk, leaves, shell, husk, spathe and gunit, flowers etc. can be used to produce items of value for the community (Kumar *et al.*, 2009) [6]. Because of its versatile properties, coconut palm is considered very auspicious in Indian system of medicine and culture. The parts of its fruit like coconut kernel and tender coconut water have numerous medicinal properties such as antimicrobial, antioxidant, hypoglycemic, hepatoprotective, immunostimulant etc. (Mandal and Mandal, 2011) [8].

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(Mandal and Mandal, 2011) [8]. In turn, several studies stated that the flowers of *Cocos nucifera* have potent therapeutic value on the areas of anti-bacterial, larvicidal, antioxidant, anti-inflammatory, hepatoprotective and anti-cancer (Dyana and Kanchana, 2014) [2]. Based on this, the project focuses the light on coconut vegetative bud, also known as heart of palm.

Heart of palm is a vegetable harvested from the inner core and growing bud of certain palm trees like coconut, peach, date etc. Heart of palm may be eaten on its own, and often it is eaten in a salad. Coconut vegetative bud (*Thennankuruthu*, in Tamil), also called as palm heart, coconut cabbage, coconut shoot or coconut trunk kernel, is a vegetable harvested from the inner core and growing bud of coconut. The edible heart lies inside the trunk lies between the brown woody part and the place where fronds begin to form. It is a small section relative to the overall size of the tree and easily distinguished by a smooth bright green color. In countries like China, Philippines, Malaysia and Indonesia the people are consuming it for a very long period for its health benefits. There are several studies revealed that the heart of palm tree such as date palm, peach palm, cabbage palm etc. has potential importance as a product rich in essential minerals and antioxidants (Trabzuni *et al.*, 2014; Salvi and Katewa 2014; Helm *et al.*, 2014) [16, 13]. Although, the people experience the health benefits of coconut vegetative bud there is no scientific evidence for their functional properties so far. However, nowadays, it is essential to provide scientific evidence to justify the use of a plant or its active principles. Based on the above facts, the present investigation aims to document the pioneer data about the nutritional and phytochemical constituents of vegetative bud of *Cocos nucifera*.

## 2. Methodology

### 2.1 Sample collection and preparation

*Cocos nucifera* vegetative bud (Fig 1) is one of the less known foods, which is available at district like Madurai, Theni, Coimbatore districts of Tamil Nadu state in India. It has a mild sweetness with a unique delicate flavour. The vegetative bud of the *Cocos nucifera* is obtained by cutting the whole tree and it is mostly done when the tree is affected by any disease or after its productive period. In the present study, the *Cocos nucifera* vegetative bud was collected through the local vendors of Madurai. The collected samples were packed aseptically and stored in lower temperature for analyzing the nutrient and phytochemical content since it is

highly perishable. The cleaned healthy *Cocos nucifera* vegetative bud was dried in mechanical tray drier at 40°C for three days and ground into fine powder. The powder was stored in air tight container and kept at 4 °C until further analysis.

### 2.2 Estimation of chemical composition

The chemical constituents such as moisture (%), carbohydrate (g), starch (g), sugars (g), fat (g), protein (g), fibre (g), pH, acidity (%) and ash (g) content were determined by adopting standard methods (AOAC, 2006) [1].

### 2.3 Estimation of mineral composition

The mineral such as calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper and manganese present in the *Cocos nucifera* vegetative bud was carried out by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). The samples were acid digested using triple acid (nitric, sulphuric, perchloric acids in the ratio 9:2:1) by keeping in sand bath until getting a clear solution and filtered through Whatman No 41 ash less filter paper. The filtrate was made up to 100 ml and the obtained ash solution was used for the estimation of minerals.

### 2.4 Phytochemical screening (Qualitative test)

#### 2.4.1 Preparation of extracts (by maceration)

The coconut vegetative bud samples were extracted by solvent extraction method especially maceration method (24 hr soaking) (Handa, 2008) [3]. The solvents used for this study are methanol, ethanol, hexane, petroleum ether, acetone, and aqueous medium. The powdered sample (25 g) was soaked in 250 ml of each solvent at room temperature and it was kept in rotary shaker at 100 rpm for 24 hrs. The materials were filtered first with muslin cloth and then with Whatman No 1 filter paper. The filtrates were concentrated using flash evaporator and the concentrates were used for the phytochemicals screening by qualitative test.

#### 2.4.2 Qualitative test for phytochemicals

The presence of phytochemical compounds like alkaloids, glycosides, flavonoids, phenols, tannins, terpenoids, saponins, steroids and oxalate in coconut vegetative bud were analyzed qualitatively using standard procedures (Manga and Oyeleke, 2008) [9] as given below.

**Table:** Type of indication of presence

S. No.	Metabolites	Name of the test	Indication of presence
1.	Alkaloids	Wagner's test	Formation of reddish brown precipitate
2.	Glycosides	Keller Killani test	Brown ring at the interface
3.	Flavonoids	Alkaline reagent test	Formation of intense yellow colour
4.	Phenols	Ferric chloride test	Formation of deep blue or black colour
5.	Tannins	Braymer's test	Formation of blue or greenish colour
6.	Terpenoids	Salkowshi' test	Formation of reddish brown precipitate
7.	Saponins	Foam test	Formation of persistent foam
8.	Steroids	Salkowshi' test	Formation of reddish brown colour
9.	Oxalate	--	Formation of greenish black colour

### 2.5 Statistical analysis

All analyses were carried out in triplicate and data were expressed as mean  $\pm$  standard deviation.

## 3. Results and Discussion

### 3.1 Chemical constituents of *Cocos nucifera* vegetative bud

The chemical constituents of the *Cocos nucifera* vegetative bud was analysed with the triplicate samples and given in the

table 1. It is observed that the bud has 81 percent ( $81.37 \pm 1.991$  g %) of water and the pH is near neutral ( $6.34 \pm 0.040$ ). The proximate nutrients like carbohydrate, starch, total sugars, fat and protein were found to be  $49.75 \pm 2.725$ ,  $38.70 \pm 2.004$ ,  $6.174 \pm 1.038$ ,  $8.38 \pm 1.070$  and  $10.18 \pm 1.356$  gram percent in dry weight basis respectively. It has a higher amount of fibre  $11.41 \pm 1.515$  gram percent in dry weight basis. Acidity and ash content of vegetative bud were

3.07 ± 0.510 percent and 9.32 ± 0.161 gram percent in dry weight basis respectively. Trabzuni *et al.* (2014) [16] reported the highest amount of protein (2.57% wet weight basis) in heart palm of *sukkari* (Date palm) and also reported that moisture (ranged from 80.44% - 82.82%) was the predominant component in the heart date palm. Fat was low in the three cultivars of Date palm. Tabora (1993) [15] stated that hearts of palm are relatively rich in protein (2.81% - 2.27% in fresh weight). Hearts of palm are also excellent source of dietary fiber, low in fat and sugars.

### 3.2 Mineral composition of *Cocos nucifera* vegetative bud

The nutritive potential of mineral elements of *Cocos nucifera* vegetative bud such as calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, and manganese were analyzed by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). The result shows (table 2) that the *Cocos nucifera* vegetative bud is rich in essential minerals such as phosphorus (240 ± 2.35 mg%), potassium (1680 ± 21.14 mg%), sodium (1790 ± 22.68 mg%), calcium (800 ± 13.11 mg%), magnesium (2540 ± 51.27 mg%), iron (20.5 ± 0.26 mg%), manganese (27.9 ± 0.34 mg%), zinc (4.49 ± 0.021mg%) and copper (0.174 ± 0.002 mg%). The ash content (9.32g %) of coconut vegetative bud reflects the mineral composition. The data reveals that the coconut vegetative bud contain higher amount of major minerals like potassium, sodium, calcium, magnesium, and trace minerals such as iron and manganese. Leterme *et al.* (2006) [7] also found high correlations ( $P \leq 0.001$ ) between total ash and concentrations of most minerals they analyzed in some fruits and unconventional foods. Trabzuni *et al.* (2014) [16] reported potassium was the predominant mineral in the heart date palm. Movahed *et al.* (2012) [11] investigated the nutritional value of heart of palm (extracted from an Iranian date palm variety) and stated that the sample contains unsaturated fatty acids, minerals (Zn, Fe, Mg, P, Mn, Ca, Cu, Na, K and Se).

### 3.3 Screening of phytochemicals

Phytochemical compounds such as alkaloids, glycosides, flavonoids, phenols, tannins, Terpenoids, saponins, steroids and oxalates were screened in various extracts of *Cocos nucifera* vegetative bud and results are presented in Table 3 & Plates 1-9. The result shows the presence of alkaloids in all the extracts, the presence of glycosides in ethanol, hexane, petroleum ether and aqueous medium of extracts, and flavonoids are present in all extracts except petroleum ether. It also noted that phenolics and terpenoids are present in methanol, ethanol, acetone and aqueous medium extracts, where as tannins are present less in hexane, petroleum ether and acetone extracts. Renjith *et al.* (2013) [12] also reported the presence of proteins, carbohydrates, phenolic compounds, flavonoids, alkaloids, tannins and resins in methanol and

ethanol extracts of young inflorescence of *Cocos nucifera* (L.). Trabzuni *et al.* (2014) [16] reported total phenols and flavonoids were higher in Solleg cultivar of date palm compared to the other two cultivars. Shimizu *et al.* (2011) [14] investigated the phenolic profile and polyphenol oxidase activity in heart of palm samples extracted from three commercial species.

The results of phytochemical screening also revealed that saponins are abundantly present in ethanol extract of coconut vegetative bud and less in methanol and acetone extracts; Phytosterols are present strongly in methanol, ethanol and acetone extracts than in hexane and petroleum ether extracts. In all the extracts, none of the solvent extracts had the presence of oxalates. Out of six solvents, ethanol and acetone screened more number of compounds than the other solvents. Of the nine phytochemicals screened for, eight compounds were found present in one solvent extract or the other. It indicates that the presence of different phytochemicals in the vegetative bud of *Cocos nucifera* further confirms the ability of the vegetative bud to serve a source of natural medicines and contributes the antioxidant property of the bud which has gained significant recognition in the potential management of several human clinical conditions.

**Table 1:** Chemical constituents of *Cocos nucifera* vegetative bud

S. No.	Parameters	Quantity / 100 g *
1.	Moisture (%)	81.37 ± 1.991
2.	pH	6.34 ± 0.040
3.	Acidity (%)	3.07 ± 0.510
4.	Ash (g)	9.32 ± 0.161 (1.74)**
5.	Fat (g)	8.38 ± 1.070 (1.56)
6.	Protein (g)	10.18 ± 1.356 (1.90)
7.	Total carbohydrate (g)	49.75 ± 2.725 (9.28)
8.	Starch (g)	38.70 ± 2.004 (7.22)
9.	Reducing sugar (%)	4.121 ± 0.906 (0.77)
10.	Total sugar (%)	6.174 ± 1.038 (1.15)
11.	Crude fibre (g)	11.41 ± 1.515 (2.13)

\* Dry weight basis (except moisture).

\*\* Values between brackets are calculated in wet weight basis.

**Table 2:** Minerals content of *Cocos nucifera* vegetative bud

S. No.	Minerals (mg/100g)	Quantity (Dry weight basis)
1.	Phosphorus	240 ± 2.35
2.	Potassium	1680 ± 21.14
3.	Sodium	1790 ± 22.68
4.	Calcium	800 ± 13.11
5.	Magnesium	2540 ± 51.27
6.	Iron	20.5 ± 0.26
7.	Manganese	27.9 ± 0.34
8.	Zinc	4.49 ± 0.021
9.	Copper	0.174 ± 0.002

\* Mean ± Standard Deviation (N = 2)

**Table 3:** Phytochemical screening of various extracts of *Cocos nucifera* vegetative bud

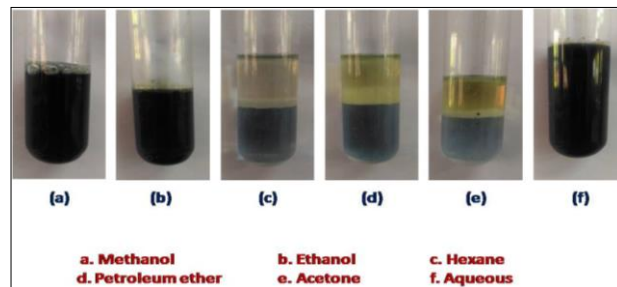
Metabolites	Methanol	Ethanol	Hexane	Petroleum ether	Acetone	Aqueous medium
Alkaloids	++	++	++	++	++	++
Glycosides	-	++	++	++	-	+
Flavonoids	++	++	+	-	++	++
Phenols	++	++	-	-	++	++
Tannins	-	-	+	+	+	-
Terpenoids	+	++	-	-	+	+
Saponins	+	++	-	-	+	-
Steroids	++	++	+	+	++	-
Oxalates	-	-	-	-	-	-

Note: ++ (Much Abundant), + (Less), - (Absent)

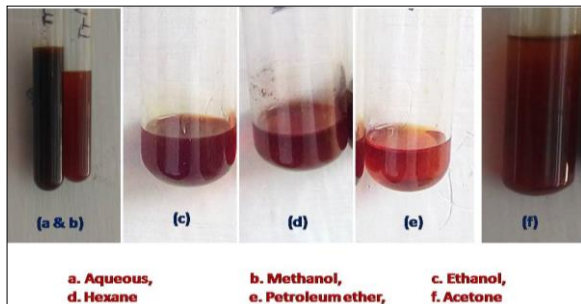




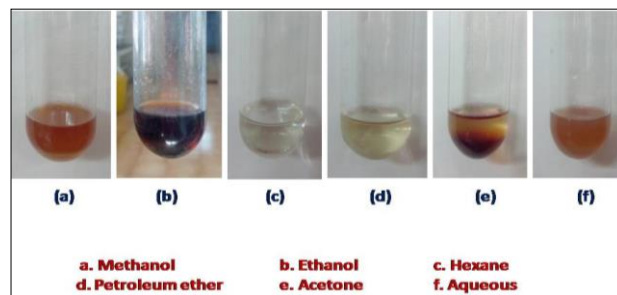
**Fig 1:** *Cocos nucifera* Vegetative Bud



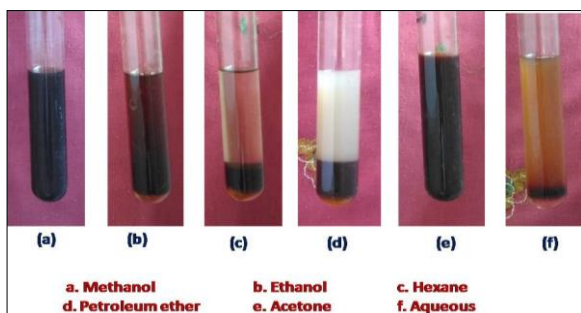
**Plate 5:** Test for tannins in various extracts of coconut vegetative bud



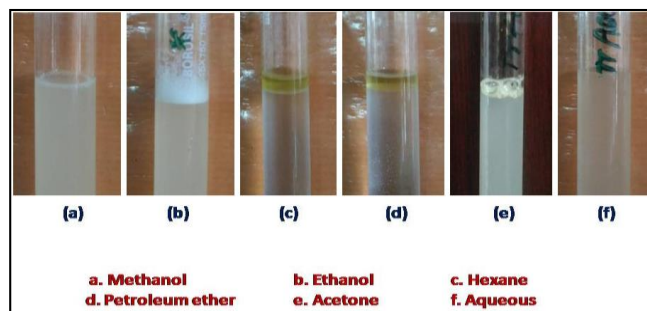
**Plate 1:** Test for alkaloids in various extracts of coconut vegetative bud



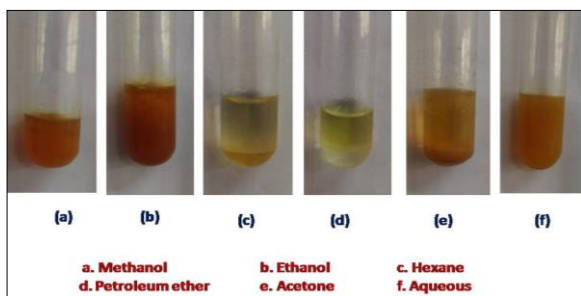
**Plate 6:** Test for Terpenoids in various extracts of coconut vegetative bud



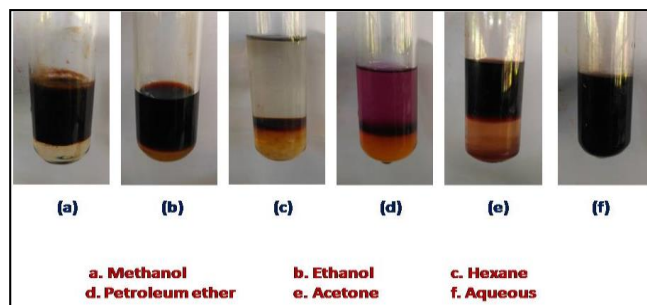
**Plate 2:** Test for glycosides in various extracts of coconut vegetative bud



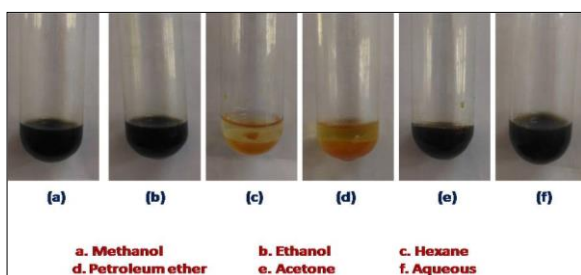
**Plate 7:** Test for Saponins in various extracts of coconut vegetative bud



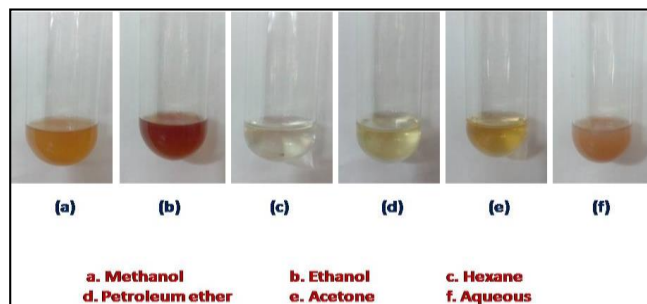
**Plate 3:** Test for flavonoids in various extracts of coconut vegetative bud



**Plate 8:** Test for Steroids in various extracts of coconut vegetative bud



**Plate 4:** Test for phenols in various extracts of coconut vegetative bud



**Plate 9:** Test for Oxalates in various extracts of coconut vegetative bud

#### 4. Conclusion

*Cocos nucifera* vegetative bud is one of the indigenous foods whose functional properties are less known. Nowadays the common public is more aware about the functional foods due to the awareness created through different mass media to meet out the nutritional requirements and also concentrating the consumption of nutrient rich diet from the natural resources. In view of this in mind, the present study was planned to assess the nutritional and phytochemical constituents of vegetative bud of *Cocos nucifera* and this pioneer findings concluded that the *Cocos nucifera* vegetative bud has potential importance as a product rich in protein, fibre, essential minerals and phytochemicals which have gained significant recognition in the potential management of several human clinical conditions. The *Cocos nucifera* vegetative bud is natural, economically potent food source for human health and can be a nutrient supplement with cost effective approach. They can also be recommended to the food industry for the large-scale production of nutrient-based foods with a quality check.

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