Nutrient, Phytonutrient Composition, and Antioxidant Activity analysis of Fresh and Cabinet dried Coconut (*Cocos nucifera* L.) inflorescence

ABSTRACT

Background: Lately manufactories with medicinal properties play an important part in food and medicinal diligence for their capacities on disease prevention and treatment. Phytonutrients and antioxidant are the naturally occurring compounds found in the plant materials which has positive effects to avoid the oxidative stress-related diseases like cancer, cardiovascular disease, and diabetes. Antioxidant protects cells from the damage caused by the free radicals and to slow down or prevent oxidation of the other molecules. Antioxidants are extremely important in many plant base foods. Coconut (*Cocos nucifera* L.) inflorescence are rich in Phytonutrients and antioxidants. Nutrient are compound in the food which provide energy that facilitates repair, growth and also helps to carry out different life processes. They can help in reducing the risk of diseases and improves overall health. Hence for the objectives of the present study is to determine the nutrient composition and to estimate the phytonutrients and to analyse the antioxidant activity of fresh and the cabinet dry(45℃ for 24h) *Cocos nucifera* (L.) inflorescence.

Methods&Results: Nutrients such as carbohydrate (0.23g,0.19g), protein (24.7g,21.5g), fibre (11%,34.3%), iron(0.115mg,0.135), vitamin-C (0.01mcg,0.0062mcg), calcium (2.8mg,1.6mg) were analyzed by the AOAC method. The Preliminary qualitative phytonutrient analysis was carried out by the standard methodology with extraction of the plant material through the maceration process to identify the secondary metabolites like alkaloids, flavonoids, quinons, phenol, saponin, tannin, terpenoids and steroids in various solvents of aqueous, ethanol, methanol, acetone, petroleum ether and chloroform. Antioxidant activity were analyzed by the DPPH method.

Conclusion: Cabinet dried sample have a better profile of the phytonutrients and antioxidant activity compared to fresh sample. So it is better to utilize cabinet dried sample in product development and supplementation of *Cocos nucifera* (L.) inflorescence.

Keywords:- Phytonutrients, Free radicals, Oxidative stress and Antioxidants.

I. Introduction

Nature has long been a source of therapeutic substances, and the constituents of nature have been exploited to make an astounding array of contemporary drugs. Since ancient times, people have employed plant remedies to treat their maladies. Eighty percent of individuals only use medicinal plants as a means of treatment, particularly in poor nations (Grace, 2022). Within the kingdom of plants is the Arecaceae family member. Its whole is good for human health; this includes the root, husk, water, inflorescence, leaves, and fruit. It is readily available and has a sizable fan base in India. The majority of it comes from islands between Indian and Pacific oceans in the Southeast Asia.It has been shown that certain of the *Cocos nucifera* (L.) constituents possess a range of pharmacological qualities, such as antibacterial, anti inflammatory, antihelminthic, antioxidant, and the anti arthritic effects (Kaur *et al*., 2020).

It has been shown that coconut powder is an excellent source of gluten-free, high-fiber protein that may be utilized to make cookies for persons with gluten sensitivity conditions like one in 33 people who have celiac disease (Devi *et al*., 2022). Although it hasn't been well studied, the inflorescence, or flower, of the plant *Cocos nucifera* (L.) may provide a palatable and healthy replacement for wheat and other grains. In India, tea steeped with coconut flowers is used to cure illnesses connected to menstruation (Kavitha *et al*., 2012). Apart from being abundant in B complex vitamins (B1, B2, B3, and B6) and the considerable levels of potassium, magnesium, zinc, and iron, coconut inflorescence nectar also includes 17 amino acids, minerals, and vitamin C (Martinez, 2020).

All parts of *Cocos nucifera* (L.) , including the root, husk, water, inflorescence, leaves, and fruit, have increased therapeutic potential for people. Primarily originating from Southeast Asia and the islands situated between the Indian and Pacific oceans, it is extensively accessible in India. Pharmacological qualities such as antioxidant, anticancer, anti helminthic, anti inflammatory, anti arthritic, anti diabetic, and the antibacterial activity have been documented for the different components of *Cocos nucifera* (L.) (Wendkouni *et al*., 2021). Traditionally, the blooms of *Cocos nucifera* (L.) have been used as a powerful remedy for a variety of inflammatory conditions, including postnatal alterations(Yadav *et al*.,2020. Studies based on food technology are being conducted to use the powder of coconut flower as the wheat substitute by considering its gluten free property, nutritional benefits and the natural sweet taste. Though it hasn't been investigated yet, the flower, or

inflorescence, of *Cocos nucifera* (L.) must be a tasty healthy substitute for the wheat and also for grains.

In India, menstrual cycle abnormalities are treated using infusions of coconut flowers, which are taken as tea (Lakshmi *et al*., 2023). According to Vadivu *et al*. (2020), coconut blossom nectar is rich in potassium, magnesium, zinc, and iron. It also includes 17 amino acids, minerals, and vitamin C. Additionally, it contains a wide range of B complex vitamins, including B1, B2, B3, and B6. The low glycemic "sap" which was extruded from coconut inflorescence is the coconut flowers nectar syrup (in the form of Bali Sun). By easing the strain on the pancreas and the body's enzyme systems, coconut flower lowers the risk of pancreatitis and diabetes. It lessens issues related to cystic fibrosis and malabsorption syndrome (Sewwandi *et al*., 2023). Thus, aim of the investigation is to determine the phytonutrients, assess the nutritional value, and assess the ability of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence to scavenge free radicals.

Hence for the objectives of the present study is: To determine the nutrient composition of fresh and the cabinet dry *Cocos nucifera* (L.) inflorescence, To estimate the phytonutrients present in *Cocos nucifera* (L.) inflorescence and To analyse the antioxidant activity of the *Cocos nucifera* (L.) inflorescence. Hence for the objectives of the present study is to determine the nutrient composition and to estimate the phytonutrients and to analyse the antioxidant activity of fresh and the cabinet dry(45℃for 24h) *Cocos nucifera* (L.) inflorescence.

II. METHODS

2.1. Selection and collection of *Cocos nucifera* (L.) inflorescence:

Cocos nucifera(L.) inflorescence is the important ingredients in many ayurvedic medicine for post natal care and menstrual problems. Main ingredients for the preparation of *Cocos nucifera* (L.) Inflorescence are coconut inflorescence which are taken from the coconut tree in Kerala by the coconut tree climbers. The selected *Cocos nucifera* (L.) Inflorescence should not be matured, it should be tender. Coconut flower should be unopened from its covering.

2.2. Processing of *Cocos nucifera* (L.) inflorescence:

The plant sample was visually examined first for any kind of the infections, damages, discolorations, and distortions. For drying of the sample selected and collected *Cocos nucifera* (L.) Inflorescence are seperated into grains. The grains are dried using cabinet drier at 45℃ approximately for 24 hours. After that the grains will be dry enough to make it into a powder. Timing for drying may vary due to size and maturity difference of coconut flower. They are grinded into fine powder using a mixer jar. It is done carefully for preventing water content in the powder which may cause spoilage. Then Stored in an air tight container.

Fig1: Cocos nucifera (L.) inflorescence for 24hours

Fig2: Kept in Cabinet drier at 45℃

Fig 3: After 24hours of drying inflorescence

Fig4: Dried *Cocos nucifera* (L.)

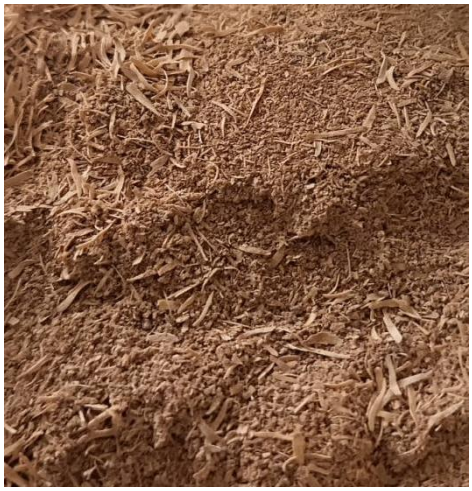


Fig 5: Grinded dry *Cocos nucifera* (L.) inflorescence

2.3. Extraction of *Cocos nucifera* (L.) inflorescence:

The extraction method known as maceration involves placing coarsely ground medicinal material—such as leaves, stem bark, or root bark—into a container and forcing the menstruum over the top until the container is completely filled with the medicinal material. The vessel is also closed and kept for at least three days. The content is agitated periodically, and if disposed inside bottle it should be agitated time to time to ensure complete extraction. At the end of extraction, the micelle is parted from marc by filtration or decantation. latterly, the micelle is also separated from the menstruum by evaporation in an oven or on top of water bath. This system is accessible and veritably suitable for thermolabile manufactory raw material. Through this extraction technique *Cocos nucifera* inflorescence extract is taken.
(Abubakar *et al.*, 2020)

2.4. Qualitative phytonutrient analysis fresh and cabinet dried *Cocos nucifera* (L.) inflorescence:

The presence of the different phytonutrients in fresh and cabinet dried *Cocos nucifera* (L.) inflorescence were identified. Phytonutrient such as the alkaloid, saponin, tannin, terpenoid, quinone, flavonoid, phenol and steroid were analysed by standard procedures with different solvents as mentioned above. Qualitative Phytonutrient screening procedure are given below:

Table 1
Qualitative Phytonutrient analysis in various solvent extract

PHYTONUTRIENTS	PROCEDURES	OBSERVATIONS
Alkaloid **(Wagner test)**	2ml of extract, 2-3drops of Fecl	Greenish to black color indicates presence of the alkaloids
Flavonoid **(Alkaline reagent test)**	2ml of extract +Few drop of the NaOH solution	Intense yellow color which become colorless on the addition of dil.Hcl
Phenol **(Ferric chloride test)**	2ml of extract + 5%Fecl	Deep blue or green color indicates presence of the phenol
Saponin **(Foaming test)**	2ml of extract +6ml of distilled H_2O and shake vigorously	Staple foam indicates presence of saponins
Tannin **(Braymers test)**	2ml of extract + Alcoholic $Fecl_3$	Blue or green colour indicates presence of tannins
Terpenoid	1ml of chloroform+2ml of extract+few drops of $C.H_2SO_4$	Reddish brown precipitate indicates presence of terpenoids
Quinones	2ml of extract + conc. HCl	Yellow precipitate indicates the presence of quinone
Steroid **(Salkowski test)**	2ml of extract + add chloroform + add H_2SO_4	Development of reddish brown colour indicate presence of steroids

2.5. Estimation of the Antioxidant activity of fresh and the cabinet dried *Cocos nucifera* (L.) inflorescence

Antioxidants are neutralizing chemicals which minimizes the oxidative damaging by the natural processes by giving the free radical electrons and by passing the free radicals off as safe(Shantabi *et al.*, 2014). Antioxidant composites scavenges the free radical and raise the shelf life by decelerating procedure of lipid peroxidation,

which considered as one of the explanations for the decay of the food and the pharmaceuticals product during the processes and storehouse (Selvakumar *et al.*, 2016). Hence antioxidant exertion of the fresh and press dried *Cocos nucifera*(L.) inflorescence was measured by DPPH radical scavenging assay(DPPH).

2.6. 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence

The DPPH radical scavenging test is a extensively retained method that provides the first step of assessing antioxidant activity. The experiment is ET- based, and the HAT technique is actually a lesser reaction pathway (Prior *et al.*, 2005). The profound purple chromogen radical DPPH is stable. It can be attained commercially and does not have to be created before the experiment. DPPH scavenging tests relies completely on antioxidant capability for contributing electrons to neutralize the DPPH radicals. DPPH color changes during the reaction, which can be noted at 517 nm, and this discoloration serves as a gauge for the effectiveness of the antioxidants. 100µL of the sample extracts and 3mL of the DPPH working solutions was associated simultaneously in a test tube. 3ml of the solution containing DPPH in the 100µL of the methanol is frequently given as the standard. After that, the tubes was observed in the total darkness for the next 30 mins. The absorbance were thereupon decided at 517nm.

$$\text{Scavenging Activity} = \frac{\text{Absorbance of the control} - \text{Absorbance of the sample} \times 100\ \%}{\text{Absorbance of the control}}$$

2.7. Determination of Nutrient analysis of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence

The nutrient analysis is the description of methods used for the determination of the amount of nutrients in a particular food or raw materials. The extraction of the plant material was carried out by the aqueous solvent by the process maceration.

Table2

Nutrient analysis in the aqueous extract

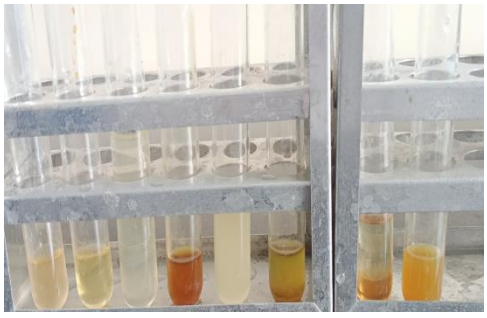
Nutrients	Methods	Authors & Years
Carbohydrates	Anthrone reagent method used	E.E.Layne, (1975), David T. Plummer (1990)
Proteins	Lowry's method used	Chang-Hui Shen (2023)
Crude Fibre	Weende method used	D. O. Holst (1982)
Vitamin-C	Titration method used	Earle Willard Mchenry and Murray Graham (1935)
Iron	Colorimetric method used	Braunschweig (2012)
Calcium	Titration method used	Kahandal S (2017)

III. RESULTS

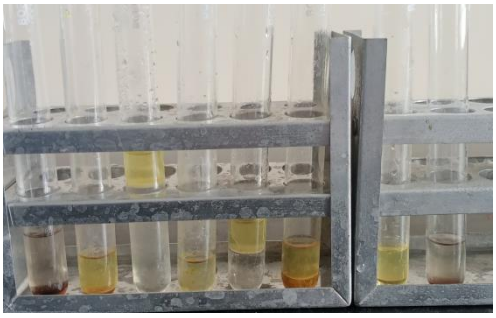
Table 3

Qualitative Phytonutrient Analysis of Fresh and Cabinet dried *Cocos nucifera* (L.) inflorescence in Different Solvents

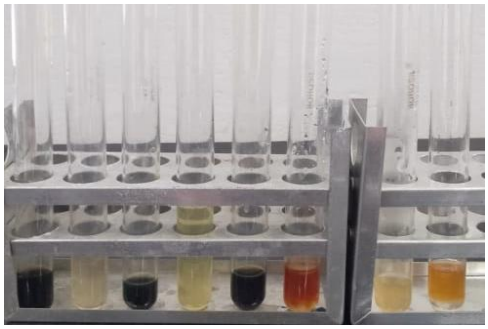
Phytonutrient	Aqueous solvent		Ethanol solvent		Methanol solvent		Acetone solvent		Petroleum Ether solvent		Chloroform solvent	
	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried
Alkaloid	+	+	+	-	+	+	-	-	-	-	+	+
Flavonoid	+	+	+	+	+	+	+	+	+	+	+	+
Phenol	+	+	-	-	+	+	-	-	-	-	-	-
Saponin	-	-	-	+	-	+	-	-	-	+	-	+
Tannin	+	+	+	+	+	+	+	-	-	-	+	+
Terpenoid	-	+	+	+	+	+	-	-	+	-	+	+
Quinone	-	-	-	-	-	-	-	-	-	-	-	-
Steroid	-	-	-	-	-	-	-	-	-	-	-	-



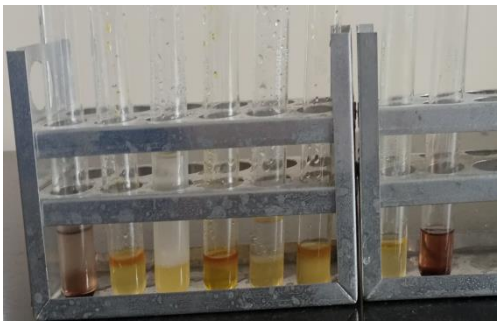
Aqueous



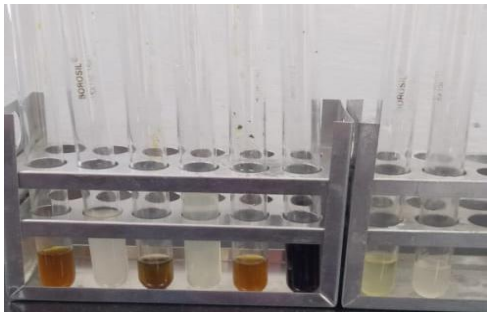
Ethanol



Methanol



Acetone



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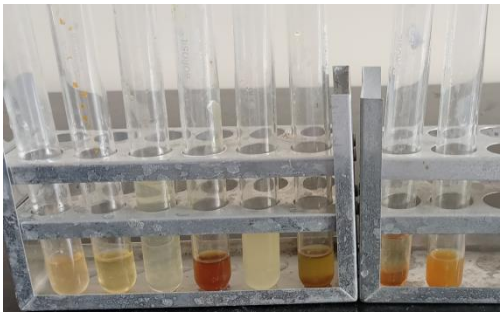


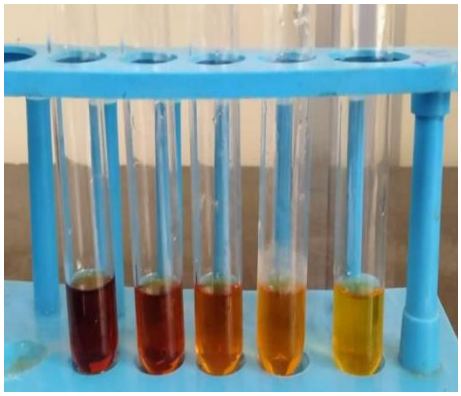
Petroleum ether

Plate 1 : Analytical test

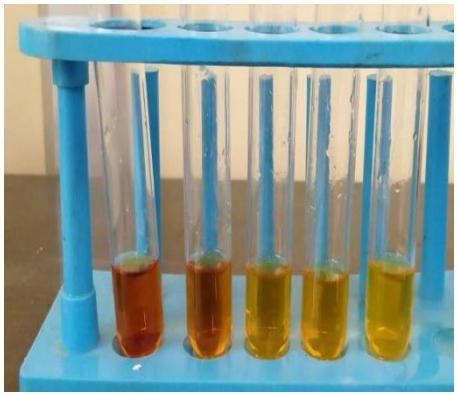
Table 4

Antioxidant Activity of Fresh and cabinet dried *Cocos nucifera* (L.) inflorescence

Concentration(µg/ml)	Absorption		% of inhibition	
	Fresh	Dried	Fresh	Cabinet Dried
100	1.282	0.730	71.76	83.92
200	1.102	0.522	75.63	88.45
300	0.688	0.286	84.78	93.67
400	0.596	0.185	86.93	95.94
500	0.386	0.161	91.48	96.44



Fresh sample



Cabinet dried sample

Plate 2 : Fresh and cabinet dried sample

Table 5
Nutrient Analysis of Fresh and Cabinet dried *Cocos nucifera* (L.) inflorescence

Nutrients	Fresh *Cocos nucifera* (L.) inflorescence	Cabinet dried *Cocos nucifera* (L.) inflorescence
Carbohydrate	0.23g	0.19g
Protein	24.7g	21.5g
Crude Fibre	11%	34.3%
Vitamin-C	0.01mcg	0.0062mcg
Iron	0.115mg	0.135mg
Calcium	2.8mg	1.6mg

IV. DISCUSSION

The qualitative phytonutrient analysis of the fresh and the cabinet dry *Cocos nucifera* (L.) inflorescence with different solvents extract. Aqueous extracts fresh sample reveal that they have all phytonutrients alkaloids, flavonoids, phenols, and tannins while in cabinet dried sample contains all phytonutrients only except the saponins, steroids and quinone. Ethanol extracts fresh sample contains phytonutrients Alkaloids flavonoids, tannins, and terpenoids while in cabinet dried sample contain phytonutrients like flavonoid, saponin, terpenoid, & tannin. Similar results were observed in the study done by Kahandal *et al.,* (2016), the presence of alkaloids, tannins and terpenoids. Methanol extracts fresh sample contains every phytonutrients only except the saponin, quinone, terpenoid while in cabinet dried sample contains all phytonutrients except quinones and steroids. Same results was revealed by Nagappan *et al*., (2021) presence of the alkaloid, flavonoid, phenol, terpenoid & tannin. Acetone extracts fresh sample contains flavonoids and tannins remaining are absent while in cabinet dried sample contains flavonoids. Petroleum ether of fresh sample contains flavonoids and terpenoids while in cabinet dried sample contains flavonoids and saponins. Chloroform extracts fresh sample contain alkaloids,flavonoids, tannins & terpenoids while in the cabinet dried sample contain every phytonutrients except phenols, quinones & steroids. Most of tested phytonutrient was present in aqueous, ethanol, methanol and chloroform extract of the fresh and cabinet dried samples.

The antioxidant activity of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence. DPPH radical scavenging assay in cabinet dried sample (71.76%, 75.63%, 84.78%, 86.93%, 91.48%) contain more antioxidant than the fresh sample(83.92%, 88.45%, 93.67%, 95.94%, 96.44%).

The nutrient analysis of fresh and the cabinet dry *Cocos nucifera* (L.) inflorescence with the aqueous extracts. Carbohydrates and proteins present in the fresh sample are high in the amount comparing to the cabinet dry sample whether in the fibre, vitamin-c and iron present in the cabinet dried sample are high in the amount while comparing to fresh sample.

V. CONCLUSION

Cocos nucifera (L.) inflorescence is a small miracle cure in the field of vegan, sustainable nutrition or raw food nutrition and in ayurvedic medicines. An Ayurvedic preparation called “thengin pookula lehyam”, made from the *cocos nucifera* inflorescence, is widely used by women of Kerala state in India as a post natal medicine and it relieves stress on the pancreas & the enzyme systems, reducing risks which are related with diabetes & pancreatitis. It also reduces the problems associated with PCOD & the cystic fibrosis. The flower contains unique therapeutic properties, owing to their phytonutrients, antioxidants and nutrients. The present study revealed that the fresh *Cocos nucifera* (L.) inflorescence have major phytonutrient constituent in aqueous, ethanol, methanol and chloroform extract than cabinet dried *Cocos nucifera* (L.) inflorescence. Antioxidant activity are higher in the cabinet dried sample when compared to the fresh sample. Nutrient like carbohydrates, proteins are greater in the fresh sample while fibre, vitamin C and iron are rich in the cabinet dried sample. Products with cabinet dried sample would have better nutrient profile rather than fresh sample products.

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Competing interests

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Authors' contributions

The research study was solely conducted by the author Nikhila.P.Vinod under the guidance of Dr.D.Jancy Rani. Collection of materials and raw ingredient were done primarily. Processing of the ingredient and the procedures of analysis were done within 7 days of time period.

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