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

ABSTRACT

Background: Recently plants with medicinal properties play an important role in food and pharmaceutical industries for their functions on disease prevention and treatment. Phytochemicals and antioxidants are naturally occurring compounds found in plants which has positive effects in avoiding oxidative stress-related diseases like cancer, cardiovascular disease, and diabetes. Antioxidants protect cells from damage caused by free radicals and slow down or prevent the oxidation of other molecules. Antioxidants are extremely important in many plant base foods. Coconut (*Cocos nucifera* L.) inflorescence are rich in phytochemicals and antioxidants. Nutrients are the compounds in food that provide energy that facilitates repair and growth and helps to carry out different life processes. They can help in reducing the risk of diseases and improves overall health. Hence the objectives of this present study is to analyse the nutrient composition and to identify the phytochemicals and to estimate the antioxidant activity of the fresh and cabinet dried(45℃for 24h) *Cocos nucifera* (L.) inflorescence.

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 AOAC method. Preliminary qualitative phytochemical analysis was carried out by the standard methodology with extraction through 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 better profile of phytochemicals and antioxidants compared to fresh sample. So it is better to utilize cabinet dried sample in product development and supplementation of *Cocos nucifera* (L.) inflorescence.

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

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 *Cocos nucifera* (L.), also known as the coconut or coconut of the beach. 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 the islands between the Indian and Pacific oceans in Southeast Asia.It has been shown that certain of *Cocos nucifera* (L.) constituents possess a range of pharmacological qualities, such as antibacterial, anti-inflammatory, antihelminthic, antioxidant, and 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 vitamins (vitamins B1, B2, B3, and B6) and considerable levels of potassium, magnesium, zinc, and iron, coconut inflorescence nectar also includes 17 amino acids, minerals, and vitamin C (Martinez, 2020).

The Arecaceae family includes the *Cocos nucifera* (L.), sometimes referred to as the coconut or beach coconut. All of its parts, 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 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 its powder as a wheat substitute by considering its gluten free nature, nutritional value and natural sweetness. Though it hasn't been investigated yet, the flower, or inflorescence, of *Cocos nucifera* (L.) may also be a tasty and healthy substitute for wheat and 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 vitamins, including vitamins B1, B2, B3, and B6. The low-glycemic "sap" that was extruded from the coconut blooms is the coconut flower 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, the aim of this investigation is to examine the phytochemicals, assess the nutritional value, and assess the ability of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence to scavenge free radicals.

Hence the present study is carried out by following objectives: To analyse the nutrient composition of the fresh and cabinet dried *Cocos nucifera* (L.) inflorescence, To identify the phytochemicals present in *Cocos nucifera* (L.) inflorescence and To estimate the antioxidant activity of the *Cocos nucifera* (L.) inflorescence.

I. METHODS

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

*Cocos nucifer*a (L.) inflorescence is one of the important ingredient in 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 sample was first visually examined for any kind of infection, damage, discoloration, and distortion. 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.

Fig 1 : Cocos nucifera (L.) inflorescence

fig 2 : Kept in Cabinet drier at 45℃ for 24hours

Fig 3 : After 24hours of drying

fig 4 : Dried *Cocos nucifera* (L.) inflorescence

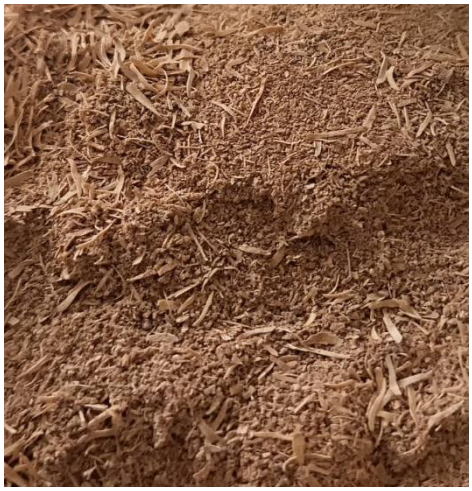


Fig 5 : Grinded dry *Cocos nucifera* (L.) inflorescence

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

The extraction was done with different solvents such as aqueous, methanol, ethanol, chloroform, petroleum ether, acetone for phytochemical analysis. For antioxidant and nutrient analysis the extract was done with aqueous solvent.

For antioxidant activity and nutrient analysis extraction of the sample was done through maceration process. In the extraction process known as maceration, coarsely ground drug material—such as leaves, stem bark, or root bark—is put into a container and menstrual fluid is poured over it until the drug material is fully submerged. After that, the container is sealed and stored for a minimum of three days. To guarantee full extraction, the contents are frequently shaken and stirred if they are stored within bottles. After extraction, the micelle and mark are separated by decantation or filtering. The micelle is then extracted from the menstruum by evaporating it in an oven or over a water bath. This approach works well with thermolabile plant material and is highly convenient.(Abubakar *et al.*, 2020)

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

The presence of various phytochemicals in fresh and cabinet dried *Cocos nucifera* (L.) inflorescence were analyzed. Phytochemical such as alkaloids, saponin, tannin, terpenoids, quinons, flavonoids, phenol and steroids were analysed by standard procedures with different solvents as mentioned above. Qualitative Phytochemical screening procedure is given below:

Table No. 1
Qualitative phytochemical analysis in various solvent extract

PHYTOCHEMICALS	PROCEDURE	OBSERVATION
Alkaloids **(Wagner test)**	2ml extract, 2 to 3 drops of Fecl	Greenish to black color indicates the presence of alkaloids
Flavonoids **(Alkaline reagent test)**	2ml extract +Few drops of NaOH solution	Intense yellow color which become colorless on addition of dil Hcl
Phenol **(Ferric chloride test)**	2ml extract +5%Fecl	Deep blue or green color indicates presence of phenol
Saponins **(Foaming test)**	2ml extract +6ml distilled H_2O and shake vigorously	Staple foam indicates the presence of saponins
Tannins **(Braymers test)**	2ml extract + Alcoholic $Fecl_3$	Blue or green colour indicates the presence of tannins
Terpenoids	1ml chloroform+2ml extract+few drops $C.H_2SO_4$	Reddish brown precipitate indicates presence of terpenoids
Quinone	2ml extract +con HCL	Yellow precipitate indicates the presence of quinone
Steroids **(Salkowski test)**	2ml extract +chloroform +H_2SO_4	Development of reddish brown colour indicates the presence of steroids

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

Antioxidants are neutralizing chemicals that minimize oxidative damaging to natural processes by giving free radicals electrons and passing them off as safe(Shantabi *et al.*, 2014). Antioxidant composites can scavenge free radicals and raise shelf life by

decelerating the procedure of lipid peroxidation, which is one of the considerable explanations for decaying of food and pharmaceutical products during processing 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. The DPPH scavenging test relies on antioxidants' capability to contribute electrons in order to neutralize DPPH radicals. The 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. 100 µL of sample extract and 3 mL of DPPH working solutions were associated simultaneously in a test tube. Three milliliters of solution containing DPPH in 100 µL of methanol is frequently given as a standard. After that, the tubes were observed in total darkness for 30 min. The absorbance was thereupon decided at 517 nm.

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

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

The nutritional analysis is the description of the method used to determine the amounts of the nutrients in a particular food. The extraction was carried out by aqueous solvent by the maceration.

Table No.2
Nutrient analysis in aqueous extract

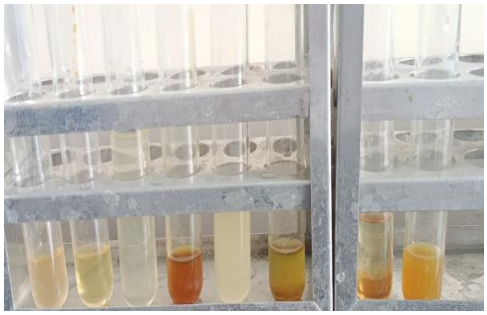
Nutrients	Method	Author & Year
Carbohydrate	Anthrone reagent method	E.E.Layne, (1975), David T. Plummer (1990)
Protein	Lowry's method	Chang-Hui Shen (2023)
Crude Fibre	Weende method	D. O. Holst (1982)
Vitamin-c	Titration method	Earle Willard Mchenry and Murray Graham (1935)
Iron	Colorimetric method	Braunschweig (2012)
Calcium	Titration method	Kahandal S (2017)

II. RESULTS

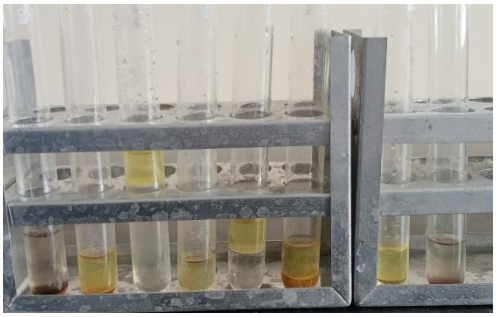
Table No. 3

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

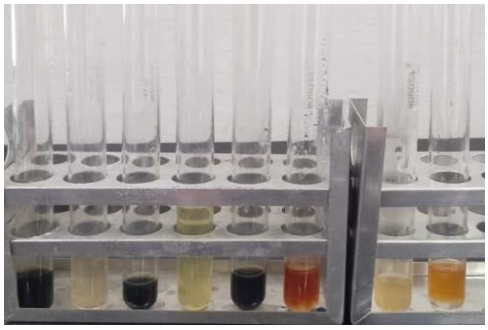
Phytochemical	Aqueous		Ethanol		Methanol		Acetone		Petroleum Ether		Chloroform	
	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried
Alkaloids	+	+	+	-	+	+	-	-	-	-	+	+
Flavonoids	+	+	+	+	+	+	+	+	+	+	+	+
Phenols	+	+	-	-	+	+	-	-	-	-	-	-
Saponins	-	-	-	+	-	+	-	-	-	+	-	+
Tannins	+	+	+	+	+	+	+	-	-	-	+	+
Terpenoids	-	+	+	+	+	+	-	-	+	-	+	+
Quinones	-	-	-	-	-	-	-	-	-	-	-	-
Steroids	-	-	-	-	-	-	-	-	-	-	-	-



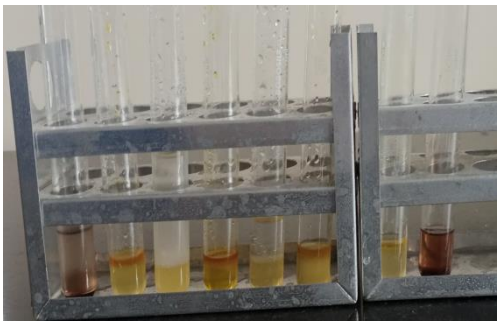
Aqueous



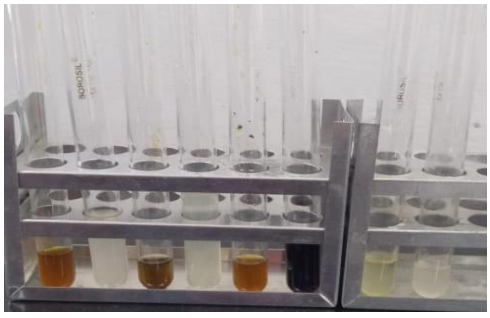
Ethanol



Methanol



Acetone



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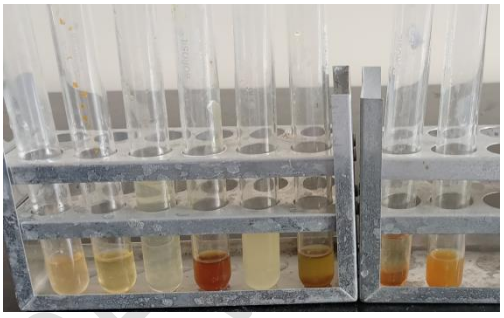


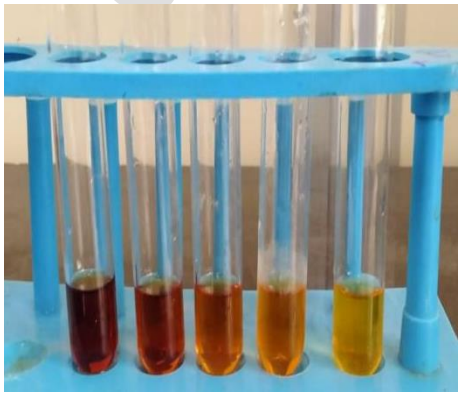
Petroleum ether

Plate 1 : Analytical test

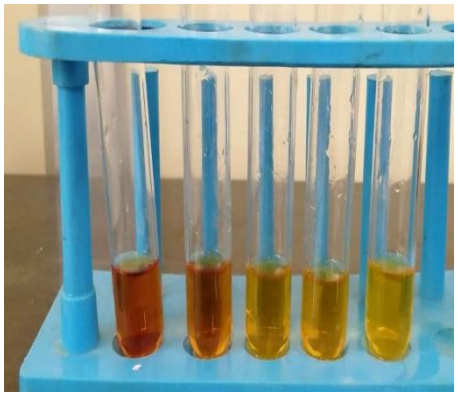
Table No. 4

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 No. 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

III. DISCUSSION

Table no.3 depicts the qualitative phytochemical analysis of fresh and cabinet dried *Cocos nucifera* (L.) inflorescence with various solvent extract. Aqueous extract of fresh sample reveals that it had all the phytochemicals alkaloids, flavonoids, phenols, and tannins while in cabinet dried sample contains all phytochemicals except saponins, steroids and quinones. Ethanol extract of fresh sample contains phytochemicals Alkaloids flavonoids, tannins, and terpenoids while in cabinet dried sample contains phytochemicals flavonoids, saponins, terpenoids and tannins. Similar results were observed in the study done by Kahandal *et al.,* (2016), the presence of alkaloids, tannins and terpenoids. Methanol extract of fresh sample contain all phytochemicals except saponin, quinones, terpenoids while in cabinet dried sample contains all phytochemicals except quinones and steroids. Same results was revealed by Nagappan *et al.,* (2021) the presence of alkaloids, flavonoids, phenols, terpenoids and tannins. Acetone extract of 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 extract of fresh sample contains alkaloids,flavonoids, tannins and terpenoids while in cabinet dried sample contains all phytochemicals except phenols, quinones and steroids. Majority of the tested phytochemical were present in the aqueous, ethanol, methanol and chloroform extract of the fresh and cabinet dried samples.

Table 4 depicts 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%).

Table no.5 depicts the nutrient analysis of the fresh and cabinet dried *Cocos nucifera* (L.) inflorescence with aqueous extract. Carbohydrate and protein present in fresh sample are higher in amount compared to cabinet dried sample whether in fibre, vitamin-c and iron are present in cabinet dried sample are higher in amount when compared to fresh sample.

IV. 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 named “thengin pookula lehyam”, made from coconut flowers, is widely used by the women of Kerala as a post-natal medicine and it also relieves stress on pancreas & enzyme systems, reducing risks related with diabetes & pancreatitis. It reduces problems associated with PCOD & cystic fibrosis. The flower contains unique therapeutic properties, owing to their phytochemicals, antioxidants and nutrients. The present study revealed that the fresh *Cocos nucifera* (L.) inflorescence have major phytochemical constituent in aqueous, ethanol, methanol and chloroform extract than cabinet dried *Cocos nucifera* (L.) inflorescence. Antioxidant activity are high in cabinet dried sample compared to fresh sample. Nutrients like carbohydrate, protein are in fresh sample while fibre, vitamin-c and iron are rich in cabinet dried sample. Products with cabinet dried sample would have better nutrient profile rather than fresh sample products.

LIST OF ABBREVIATION

Not applicable

Consent for publication

Not applicable

Availability of data and material

The data collected and references are mentioned in the bibliography which is included in the manuscript.

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