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"EVALUATION OF PHYTOCHEMICALS, ANTIOXIDANT & NUTRIENTANALYSIS OF *COCOS NUCIFERA* HAUSTORIUM"

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Abstract

Coconut Haustorium is the germination occurred from the coconut. Coconut apples, jungle bread, coconut pearl are the other common names of coconut haustorium. It contains several interesting bioactive constituents and possesses health promoting properties. Coconut apple is best for cancer patients, cardiac patients, pregnant ladies etc. In the present study phytochemical analysis of coconut haustorium revealedthe presence of phenol, tannin, flavonoid, saponin, terpenoid, alkaloid and steroid. DPPH activity of coconut haustorium was also done by various concentration and solvent extracts. Nutrients such as total carbohydrate, protein, fat, amino acids, vitaminC, sodium, potassium and calcium were analyzed. Products such as Coconut Apple Balls, Coconut Apple Steamed Rolls, Coconut Apple Shell Cake, and Coconut Apple Halwa were prepared from coconut haustorium and sensory evaluation of the formulated products were done by 20 selected panel members andevaluated using score card.

Keywords: Coconut haustorium, bioactive constituents, phytochemicals, nutrients, DPPHactivity

Introduction

Cocos nucifera, popularly known as coconut tree, is a perennial, monocot tree,belonging to the family Arecaceae. The tree, native to Southeast Asia and Melanesia, is distributed throughout the tropics and sub-tropics of the world (Chan and Elevitch, 2006). Coconut is useful in multiple ways to human kind and plays a major role in ecological balance and economic importance. Due to its versatile utilization, it is widelyacclaimed as 'Kalpaviriksha' or 'Tree of Heaven' (Batugal *et al*., 2005).

The coconut shell has three eyes, out of which two eyes are non-functional and calledblind eyes and the remaining is called soft eye which act as germ-pore (Smit, 1970). The matured coconut has only one embryo, which is embedded in the endosperm, is situated beneath the germ-pore (Nathanael, 1959; Desai, 1988). Interestingly coconut does not have dormancy, under suitable conditions of moisture and temperature, it starts germinate approximately after two months from sowing of nuts (Chan and Elevitch, 2006).

Coconut is considered as germinated when the shoot is visible just above the husk.Theappearance of shoot above the husk varies with varieties and also in the same variety (Davis and Anandan, 1956). The first morphological sign of germination is the enlargement of embryo and protrusion of the apical mass outside the shell (Kartha, 1981). During germination, embryo enlarges and differentiates into cotyledon and the stem apex where the seedling leaves develops (Desai, 1988). The cotyledon surface secretes various hydrolytic enzymes, which mobilize the reserved nutrients from the endosperm for the growingseedlings (Davies and Slack, 1981). Since coconut have tiny embryo and copious endosperm, the basal part of the embryo develops in to a spongy absorbent tissue called coconut "**haustorium**".

The haustorium consists of loosely connected thin walled cells with large interspace between them (Child, 1974). It initially absorbs food materials from the coconut water and later from the kernel (Menon and Pandalai, 1958). The appearance of shoot above the coconut husk is observed only six weeks after germination (Davis and Anandan, 1956).

Coconut haustorium is a spongy absorbent tissue formed from the basal part of coconutembryo during germination. Anatomically, coconut haustorium has two parts,carbohydrate rich inner white portion and the oil rich outer yellow portion. The outer yellow portion has undulated structure with numerous serrations, the active multi- enzymes involved in the digestion of complex nutrient reserves are present in the highlycorrugated surface of the yellow portion.

The cotyledon of coconut, also known as **coconut apple, jungle bread, queen's bread, sprout** and **pearl**, is a white, off-white or creamy, spongy structure, formed during the germination of zygotic embryo. They form the basis of nutrition for the developing plant.Cotyledons are found to possess parenchyma cells with few vasculartissues. Though the cotyledons of coconut are being consumed by people at large, theyhave been explored only for their role in clonal propagation (Nguyen *et al*., 2015).

Available literature on the coconut haustorium is limited to cytological and histo- chemical changes in profile of starch, glucose, fructose & sucrose content etc. Systematic study on complete nutritional composition of haustorium is not clearly available and no onestudied about the formulation of food items with coconut haustorium properly. Presently, in most of the coconut processing industries andhouses, most of the germinated stored coconuts were utilized for the

preparation of oiland other products. Detailed study on the phytochemicals, antioxidant and nutrients of haustorium will help to provide knowledge about the benefits of coconut haustorium and formulation of nutrient rich food items with coconut haustorium.

Objectives

- To find out the phytochemicals present in coconut haustorium quantitatively andqualitatitvely.
- To determine the nutrient composition of coconut haustorium.
- To study the antioxidants present in coconut haustorium.
- To formulate products using coconut haustorium.
- To evaluate the sensory qualities of the products.

Methodology Selection of Topic:

"Evaluation of Phytochemicals, Antioxidant &Nutrient Analysis of *Cocos Nucifera* Haustorium" was selected as the topic. The main purpose of selecting this topic is to prove that formulation of food items is also possible using germinated or sprouted coconut. There has been a false belief that sprouted or germinated coconuts are useless and considered as post-harvest waste. So this study brings new idea about the nutritional importance and health benefits of coconut hastorium (coconut apple) developedinside the coconut as a part of germination.

Collection of Samples:

The samples used for the study is coconut haustorium. The samples are collectedfromdifferent houses located in Kanyakumari District, Tamilnadu. Correct picture of coconut haustorium is given below

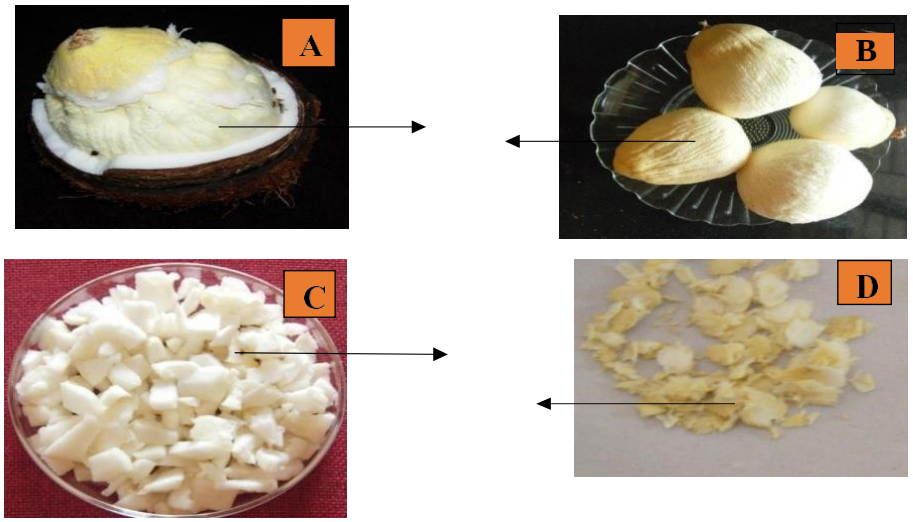


Figure. Coconut haustorium. Germinated coconut was dehusked and haustoriumwas separated out from the nut and both white and yellow portions were separated carefully and presented. A: Cut opened germinated coconut with haustorium; B:coconut haustorium separated from germinated coconut C: Inner white portion of haustorium and D: Outer yellow portion of haustorium.

Weighing and Measuring

The collected samples are grated and weighed for food formulation.

Phytochemical Analysis

Phytochemical analysis is done to find out the phytochemicals present in coconut haustorium qualitatively and quantitatively.

Qualitative Analysis

Qualitative analyses of the major constituents present in the coconut haustorium were determined using standard procedures (Harborne, 1973). Phytochemicals such as phenolic compounds, tannin, flavonoids, saponins, alkaloids, glycosides, quinone, fatty acids, steroids and resins were analysed.

Quantitative Analysis

The phytochemicals which showed positive in qualitative analysis were subjected to quantitative analysis. Qualitative analysis showed the presence of phenol,tannin, flavonoid,saponin, terpenoid and steroid.

Antioxidant Analysis

Dpph Radical Scavenging Assay

Radical scavenging activity of the test sample against stable 2, 2- diphenyl 2- picrylhydrazyl hydrate (DPPH) was determined according to the method of Brand- William*etal.,* (1995) with slight modification. DPPH reacts with an antioxidant compound, whichcan donate hydrogen, and reduce DPPH. The change in colour (fromdeep violet to light yellow) was measured at the optical density 515 nm on a UV visiblespectrophotometer.
Radical scavenging activity was calculated by the following formula:

$$\text{Percentage inhibition} = \frac{(\text{Absorbance of Control at 0 min} - \text{Absorbance of test}) \times 100}{\text{Absorbance of control at 15 min}}$$

Nutrient Analysis

Nutrient analysis is a branch of analytical chemistry. It has the need of both qualitativeand quantitative analysis. Its interest lies in determining not only what, but also how much of component may be present in the food. **(**Marris B, Jawbs, 1999**)**. Nutrient analysis was done for the fresh coconut haustorium especially for carbohydrate, protein, fat, amino acids, crude fibre, Vitamin C, sodium, potassium and calcium.

Formulation of the Products

Cocos nucifera Haustorium was selected for the preparation of the products. The products such as Coconut Apple Balls (CAB), Coconut Apple Steamed Rolls (CASR)), Coconut Apple Shell Cake (CASC) and Coconut Apple Halwa (CAH) were prepared basedon standard procedures.

Sensory Evaluation of the Formulated Products

The prepared products were subjected to sensory analysis to find out theacceptability.The formulated products were organoleptically evaluated by using numerical score card. Sensory assessment were evaluated on the quality description i.e.,appearance, texture, taste, colour, flavour, and overall acceptability. The sensory evaluation was carried out for the products such as coconut apple halwa, coconut appleballs, coconut apple steamed roll and coconut apple shell cake. The products were evaluated by a panel of 20 semi trained panel members from the Department of Nutrition and Dietetics, Muslim Arts College, Thiruvithancode, Kanyakumari District.

Formulated Products

Sensory Evaluation of Formulated products
Statistical Analysis:

All the above said observation was statically analysed. The collected data were interpreted through statistical analysis namely mean, standard deviation and standard error mean.

Result and Discussion

Characterization of Phytochemical From CoconutHaustorium:

The phytochemical constituents of coconut haustorium was analysed for the presenceof secondary metabolites such as phenol, tannin, flavonoid, saponin, terpenoid, alkaloid, glycoside, fatty acid, steroid, resin and the result are represented in thetable based on the presence and absence of phytochemicals.

Qualitative Analysis of Phytochemicals

SL. NO:	**Name of test**	**amplecode**
		CH
1	Phenol	+
2	Tannin	+
3	Flavanoid	+
4	Saponin	+
5	Terpenoid	+
6	Alkaloid	+
7	Glycoside	-
8	Quinones	-
9	Fatty acid	-
10	Steroid	+
11	Resin	-

+ Presence - Absence

Quantitative Analysis of Phytochemicals

The phytochemicals which showed positive in qualitative analysis were subjected in to quantitative analysis. The amount of phytochemicals was determined through properprocedure. The values were tabulated and analysed.

Estimation of Phenol:

Sl.No:	Sample	OD at 750nm	Concentration of phenol in Gallic acid equivalent µg/mg of extract
1	CH	0.068	7

Estimation of Tannin:

Sl.No:	Sample	OD at 700nm	Concentration of Tannin in Tannic acid equivalent µg/mg ofextract
1	CH	0.089	16

Estimation of Flavonoid:

Sl.No:	Sample	OD at 510nm	Concentration of Flavonoid in quercetin equivalent µg/mg ofextract
1	CH	0.112	68.25

Estimation of Saponin:

Sl. No:	Sample	OD at 544nm	Concentration of saponin in Diosgenin µg/mg of extract
1	CH	0.734	136

Estimation of Terpenoid:

Sl. No:	Sample	OD at 540nm	ntration of terpenoid inµg/mg ofextract
1	CH	0.123	73.52

Estimation of Alkaloid:

Sl. No:	Sample	OD at 470nm	entration of alkaloid in Atropine equivalent µg/mg of extract

1	CH	0.045	31.60

Estimation of Steroid:

Sl. No:	**Sample**	**OD at 540nm**	**Concentration of steroid in Cholesterol equivalent µg/mg ofextract**
1	CH	0.256	98.47

Antioxidant Activity

Antioxidant activity was determined according to the method reported by Gorrat (1904).

Tabulation for Standard

Standard	**Concentration (µg/ml)**	**OD at 515nm**	**% of Inhibition**
Control at zero minute	-	0.953	-
Control at 15 minute	-	0.937	-
ıscorbic Acid(Standard)	3	0.717	25.18
	6.25	0.580	39.80
	12.5	0.532	44.93
	25	0.272	72.67
	50	0.063	94.98
IC50	54.53		

Table 4.10

Tabulation for Sample

Sample	**Concentration (µg/ml)**	**OD at 515nm**	**% of Inhibition**
Control at zero minute	-	0.963	-
Control at 15 minute	-	0.945	-

CH	6.25	0.738	23.80
	12.5	0.561	42.53
	25	0.363	63.49
	50	0.164	84.55
	100	0.052	96.40
IC50	**41.28**		

Table 4.11
Antioxidant Activity

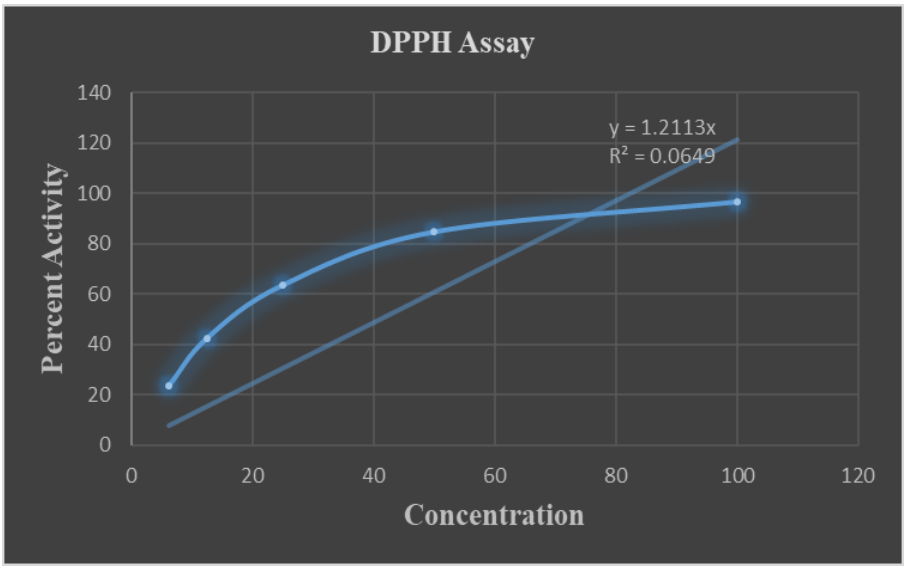


FIGURE 4.2

In the present study, radical scavenging assay was performed to determine the antioxidant potential of coconut haustorium. Concentrations of 6.25, 12.5, 25, 50 and 100 µg/ml were used for the analysis of antioxidant activity of coconut haustorium andfor the Standard the concentrationwas taken as 3, 6.25, 12.5, 25 and 50. Reducing power ability was determined according to the absorbance of spectrophotometer.Finally the results of the assay were compared with the ascorbic acid. It was used as a standard. A significant difference was found between the percent of inhibition values at different concentrations. The percent of inhibition of coconut haustorium is 23.80, 42.53, 63.49, 84.55 and 96.40 and ascorbic acid is 25.18, 39.80, 44.93, 72.67 and 94.98respectively. IC50 value of coconut haustorium is 41.28 and ascorbic acid is 54.53. IC50 values are calculated by using the graph given above.

Nutrient Analysis

The nutrients of coconut haustorium such as carbohydrate, protein, fat, amino acid, crude fibre, vitamin C and minerals such as, sodium, potassium and calcium were analysed. The nutrients were analysed using different methods suchas anthrone method, bradford's, colorimetric method, ninhydrin method etc.

Estimation of Total Carbohydrate (Anthrone Method)

Sl. NO:	Sample	OD at 630nm	Concentration of glucose present in mg/g of sample
1	CH	0.170	32.87

Estimation of Protein (Bradford's Colorimetric Method)

SL. NO	Sample	OD at 595nm	centration protein inµg/1mlof sample
1	CH	0.128	5.5

Determination of Fat Content

SL. No	Sample	Initial weight (g)	Final weight (g)	Fat content (%)
1	CH	2	0.016	0.8

Estimation of Amino Acids (Ninhydrin Method)

SL. NO	Sample	OD at 570nm	ntration amino acid inµg/1mlof sample
1	CH	0.147	22.89

Determination of Crude Fibre Content

SL. NO	Sample	Initial weight(g)	ght of crudefibre(g)	Percentage weight of crude fibre (%)
1	CH	1	0.178	17.8

Estimation of Vitamin C

SL.NO:	Sample name	V1 (mL)	V2 (mL)	Amount of ascorbic acid content (mg/ 100g)
1	CH	5.6	6.3	281.25

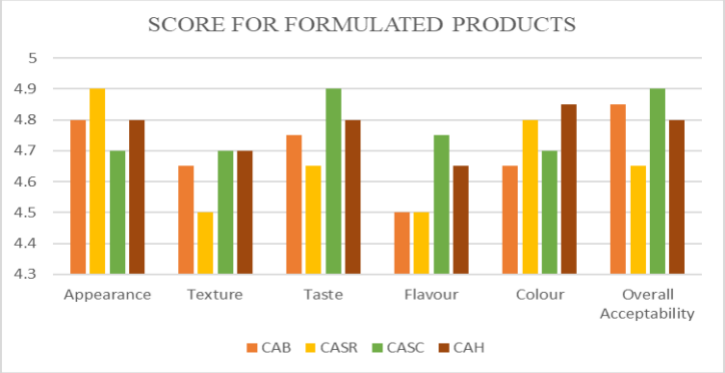
Determination of Sodium, Potassium and Calcium (FlamePhotometry)

ample	Element	Special preparation	Diluents	ilutionfactor	Standards	Result (ppm/10ml of test sample)
CH	Na	None (No ash preparationdone)	stilledwater	1	100ppm, 50ppm NaCl	13.78
	K			1	100 ppm, 0 ppmKCl	90.60
	Ca			1.5	300 ppm, 00 ppmCaCO3	137.40

Sensory Evaluation:

The sensory analysis of the formulated products is given in the following table.

Sensory Evaluation of the Formulated Products



Discussion

The present study "Evaluation of Phytochemicals, Antioxidant & Nutrient Analysis of *Cocos nucifera* L.Haustorium (Coconut Apple)" examined the phytochemical content, antioxidant rate and nutritive composition of coconut haustorium. In this study, phenol, tannin, flavonoid, saponin, terpenoid, alkaloid and steroid were detected in high amount, while glycoside, quinone, fatty acid and resin were not detected. This is in agreement with the report of Abiraami Valli S. and S. UmaGowrie (2017), showed that phytochemicals suchas alkaloids, saponins, terpenoids, glycosides, phenols, flavonoids etc. are widely distributedin the coconut haustorium.

Phytochemical composition and antioxidant activity of coconut cotelydon was

reported by Udaya Prakash Nyayiru Kannaian *et al*., (2020). Plant source and solvent extraction was used for the detection. Qualitative and quantitative tests were conductedfor the identification. Different types of free radical scavenging assays such as 2,2- diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assat, Ferric Reducing Antioxidant Power (FRAP) assay, Thiobarbituric acid (TBA) assay, Ferric thiocyanate(FTC) etc. were carried out for the antioxidant testing. In the present study DPPH radical scavenging assay test was conducted to dertermine the antioxidant activity of coconut haustorium and 41.28 µg/ml IC50value was determined. The study proves thatcoconut haustorium consists of high antioxidantproperty.

Arivalagan Manivannan *et al*., (2018) explained about the nutrient compositionof coconut haustorium. Haustorium consists of moisture as the main part. The total fatcontent was very less, when compared to the other nutrients. So it can be used for the fat restricted patients. Carbohydrate, protein, ash etc. are present in the coconuthaustorium. Haustorium contained considerable amount of both soluble and insoluble fibre also. In this study nutritional composition also analysed. Carbohydrate, protein, fat, amino acids, crude fibre and vitamin C were dertermined through proper tests.

Owori *et al.,* (2007) states that sensory evaluation is an essential component ofa foodresearch project or product development. It is a scientific discipline used to evoke, measure,analyze and interpret reactive to those characteristics of food and materials as they are perceived by the senses of sight, smell, taste and touch. In the present study, products were formulated using coconut haustorium. Coconut Apple Balls, Coconut Apple Steamed Rolls, Coconut Apple Shell Cake and Coconut Apple Halwa are the formulated food products. Sensory evaluation was done by 20 panel members. Score card was used for evaluating appearance, texture, taste, flavour, colourand overall acceptability of the food products formulated from coconut haustorium.

Conclusion:

The results of the present study indicated that the coconut haustorium (coconutapple)is rich in phytochemicals and nutrients that are very beneficial for various healthbenefits andalso prevents various diseases. This could be attributed to the fact that high amount of phytochemicals such as phenol, tannin, flavonoid, saponin, terpenoid,alkaloid, steroid and macronutrients such as carbohydrate, protein, fat, amino acids, crude fibre were presented inthe coconut haustorium. Also micronutrients such as vitamin C, sodium, potassium and calcium were recorded. Different types of food products can be prepared using fresh coconuthaustorium and it is socio-economic friendly. We can use the germinated or sprouted coconut leftover as a part of post- harvest waste. The coconut haustorium can be consumed by all theage groups and all types of diseased patients, especially cancer patients and pregnant ladies.

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