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DEVELOPMENT AND NUTRITIONAL ASSESSMENT OF SWEETMEAT FROM IMMATURE COCONUT INFLORESCENCE

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Coconut (*Cocos nucifera*) is a highly versatile crop cultivated in tropical regions for its various edible and non-edible applications (Pham, 2016). While coconut based products such as oil, milk and water are well-documented, limited research has focused on the potential use of coconut inflorescence, particularly its immature stage, as a functional food ingredient. Coconut inflorescence, often referred to as the "coconut flower," has traditional culinary applications but remains underutilized in contemporary food processing (Bourdeix and Prades, 2017).The coconut inflorescence or the flowering part of the coconut tree, is typically harvested before it fully matures. Traditionally, it has been used in various indigenous culinary practices and holds cultural significance in certain regions. However, its broader culinary potential remains largely untapped. By transforming this underutilized resource into a sweetmeat, this study not only seeks to diversify coconut-based products but also to enhance the economic value derived from coconut farming (Malhija and Kumaran, 2020).

This study conducted in 2022 aimed to develop a value-added sweetmeat from immature coconut inflorescence and evaluate its nutritional composition. Nutritional evaluation is a critical aspect of this research, as it provides insights into the health benefits and dietary contributions of the sweetmeat. Immature coconut inflorescence is known for its unique composition, rich in dietary fibers, vitamins and minerals, which could offer significant health benefits in treating lifestyle diseases. Assessing these nutritional properties will help establish the sweetmeat as a viable and healthy addition to modern diets.

Selection and Collection of Coconut Inflorescence:

Freshly harvested coconut inflorescence with vibrant green color buds were selected. Wilted, discolored, or damaged inflorescence was avoided. The buds were examined to ensure they were intact and free from mold or pests. The inflorescence was assessed for texture, ensuring firmness and crispness, and any soft or mushy samples were excluded. A pleasant, slightly sweet aroma was considered an indicator of quality.

Selection of Ingredients

Good quality jaggery, turmeric powder, cumin seed powder, dry ginger powder, cardamom powder, coconut milk and rice flour were sourced from local stores.

Processing of Coconut Inflorescence

The outer leaf was removed from the inflorescence, and the flowers were cut until the buds were visible. The stem part was not

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Table 1 presents the ingredient composition used in sweetmeat preparation.

S.No.	Ingredient	Quantity (g/ml)
1	Coconut inflorescence	100 g
2	Jaggery	50 g
3	Turmeric powder	2.5 g
4	Cumin powder	2.5 g
5	Dry ginger powder	2.5 g
6	Coconut milk	80 ml
7	Rice flour	10 g
8	Cardamom powder	2.5 g

used. Only the tender portion was utilized, avoiding the hard portions. The flowers were ground before the browning reaction occurred.

COMPOSITION OF SWEETMEAT

Preparation: The chopped coconut inflorescence was mixed with thick coconut milk and simmered on medium heat. Jaggery syrup was added, followed by spices (turmeric, cumin and dry ginger) and mixed thoroughly. The mixture was simmered on low heat for 10-15 minutes. A slurry of rice flour, cardamom powder and additional coconut milk were added and stirred in. The mixture was cooked for 2-3 minutes until thickened, then cooled and stored in an airtight container.

SENSORY EVALUATION

A panel of 10 semi-trained members evaluated the sweetmeat using a 9-point hedonic scale for appearance, color, flavor, texture, taste, and overall acceptability. Statistical analysis was conducted using SPSS software, employing one-way ANOVA and T-tests. For Phytochemical analysisEthanolic extracts of the sweetmeat were analyzed for alkaloids, flavonoids, saponins, tannins, steroids, and anthraquinones following standard protocols (Salawu *et al.,* 2016; Shaikh & Patil, 2020). For nutritional analysis, macronutrients, vitamins, and minerals were determined using the AOAC (1990) official method.The antioxidant potential of sweetmeat was assessed using the DPPH method, comparing its scavenging effect to ascorbic acid. The IC50 value was derived from the absorbance inhibition curve.

Table 2. Sensory (Organoleptic) Evaluation of Sweetmeat

S.No.	Attribute	Mean ± SD
1	Appearance	8.48 ± 0.67
2	Color	7.36 ± 0.63
3	Flavor	8.55 ± 0.85
4	Texture	6.78 ± 0.57
5	Taste	9.13 ± 0.68
6	Overall Acceptability	8.67 ± 0.45

Organoleptic tests of the sweetmeat depend on its appearance, colour, flavour, texture, taste and overall acceptability of the product. Table 2 shows the sweetmeat of their organoleptic quality factors. Coconut inflorescence obtained a good score of 8.67±0.67 for its appearance. Appearance of the sweetmeat depends on appearance of the coconut inflorescence and other raw ingredients and on processing technique. Sweetmeat obtained the score 7.36±0.63 for its colour. Colour of the sweetmeat depends on the colour quality of the ingredients. The flavor and smell of the products depends on

Table 3. Nutrient Composition (per 100 g)

S.No	Proximate Composition	Amount Mean±SD
1	Energy(Kcal)	277±1.6
2	Carbohydrate(g)	5.1±1
3	Protein(g)	10.7±0.4
4	Fat(g)	2.85±0.1
5	Calcium(mg)	98.1±0.1
6	Magnesium(mg)	77±1.5
7	Iron(mg)	3.8±0.3
8	Dietary fibre(g)	24.4±0.1
9	Folate (µg)	5.7±0.05
10	Phosphorous(mg)	140±1
11	Potassium(mg)	79.5±0.1
12	Selenium(mcg)	11.5±0.3
13	Zinc(mg)	0.08±0.005
14	Vitamin A(mcg)	1.2±0.05
15	Vitamin B1(mg)	0.05±0.005
16	Vitamin B2 (mg)	0.14±0.01
17	Vitamin B5(mg)	0.60±0.05
18	Vitamin C (mg)	1.8±0.05
19	Vitamin E (mg)	0.3±0.05
20	Vitamin A(mcg)	1.2±0.05
21	Vitamin B1(mg)	0.05±0.005
22	Vitamin B2 (mg)	0.14±0.01
23	Vitamin B5(mg)	0.60±0.05
24	Vitamin C (mg)	1.8±0.05
25	Vitamin E (mg)	0.3±0.05

the volatile constituents of sweetmeat. The flavour mean score was 8.67±0.85.Texture of the sweetmeat depends mainly upon the Selection of coconut inflorescence and the proportion of jaggery used. The wide variation in the quality parameter of sweetmeat can be attributed to the processing conditions and type of raw material used. The mean score of texture was 6.78±0.57.Taste is also influenced by the quality of the raw materials used in the processing of coconut inflorescence. The mean taste score of sweetmeat was 9.13±0.68. In overall acceptability test, Hedonic scale showed that the sweetmeat was highly acceptable with score of 8.67±0.45 for all quality characteristics by the panel members.

Nutritional Composition

Table 3 provides the nutrient profile of the sweetmeat. Minerals of sweetmeat was 3.8mg of iron , 9.81 mg of calcium , 77 mg of magnesium, 140 mg of phosphorous, 79.5mg of potassium, 11.5 mcg of selenium & 0.08 mg of Zinc.Vitamins like A, B1, B2, B5, C and E Content were found to be 1.2 mcg,0.05,0.14,0.60,1.8,0.3 mg respectively.

Phytochemical Composition

Phytochemicals are natural bioactive compounds found in vegetables, fruits, medicinal plants, aromatic plants, leaves, flowers and roots which act as a defense system to combat against diseases. A number of bioactive compounds from plants like isoflavones, diosgenin, resveratrol, quercetin, catechin, sulforaphane, tocotrienols & carotenoids are proven to reduce the risk of cardiovascular diseases and aid in cardioprotection which is the leading cause of global death. Table 4 and 5 gives the details ont he phytochemical Screening of sweetmeat by both qualitative and quantitative method.

The phytochemical analysis of the sweetmeat by qualitative method revealed that alkaloids and flavonoids were highly present, steroids and tannins were present.

The phytochemical analysis of the sweetmeat showed the presence of 4.2mg/gm of alkaloids, 2.5 mg/gm of Flavonoids, 0.3 mg/gm of Tannins and 0.02 mg/gm of steroids

Table 4.Phytochemical screening by Qualitative Method

S.No	Phytochemicals	Eathonolic extract of Sweetmeat
1	Alkaloids	+++
2	Flavonoids	+++
3	Steroids	+
4	Tannins	+
5	Terpenoids	-
6	Anthraquinones	-

(+++)–Highly Present(++)-Moderately Present (+)-Presence (-)-Absence

Table 5. Phytochemical Screening by Quantitative Method

S.No.	Parameters	Amount (mg/gm)
1	Alkaloids	4.2
2	Flavonoids	2.5
3	Tannins	0.3
4	Steroids	0.02

Antioxidant Activity

DPPH (1-Diphenyl 2-picryl hydrazyl) is one of the free radicals widely used for testing preliminary radical scavenging activity of sweetmeat. Itshowed the maximum inhibitory activity in the aqueous extract at 60mg/mL.The percentage of inhibition was from 10, 25, 50, 100,150 at 52,11,22,40,60mg/mL for sweetmeat and the IC_{50} value for sweetmeat was 60mg/ml while for standard it was found to be 123mg/ml. Table 6 shows the antioxidant activity of sweetmeat.

According to (Fidrianny *et al*., 2015), lower the value, higher the antioxidant property. The sweetmeat exhibited an IC_{50} value of 123mg.Hence, the product developed exhibited good antioxidant property.

The development and evaluation of sweetmeat from immature coconut inflorescence demonstrated its potential as a nutritious and functional food product. The formulation was well-accepted organoleptically and contained essential nutrients. The presence of bioactive compounds and antioxidant properties further highlights its potential health benefits. Nutritional evaluation is a critical aspect of this research, as it provides insights into the health benefits and dietary contributions of the sweetmeat. Assessing these nutritional properties will help establish the sweetmeat as a viable and healthy addition to modern diets.Future research should explore the long-term stability and commercial feasibility of this novel product.

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Table 6. Antioxidant activity of Sweetmeat

Name of the Assay	10mg	25mg	50mg	100mg	150mg	IC_{50}
DPPH Scavenging activity	5.2%	11.6%	21.8%	40.9%	60.7%	123mg

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