Development and Qualitty Evaluation of High Fibre Cookies Using Copra Waste Powder

Dharanidharan J[1], Sathasivam N[2], Jyothika V[3]
[1,2,3] *Sri Shakthi Institute of Engineering and Technology*

***Abstract*—Conventional refined wheat–based bakery products are typically low in dietary fiber and contribute limited functional benefits, highlighting the need for nutrient-enriched alternatives. Copra waste, a by-product of coconut oil extraction, is generated in large quantities and is often underutilized despite being rich in dietary fiber and residual nutrients. In this study, high-fibre cookies were developed by incorporating copra waste powder (CWP) as a partial substitute for refined wheat flour at varying levels (1:0, 1:1, 1:2, 1:3, 2:1).**

The formulated cookies were evaluated for proximate composition, physical characteristics (diameter, thickness, spread ratio), texture profile, color attributes, water absorption, and sensory acceptability. Incorporation of CWP significantly increased dietary fiber content and improved mineral and residual protein levels compared to control cookies. As the level of CWP increased, cookie thickness and hardness increased, while spread ratio slightly decreased due to higher fiber content and water-binding capacity. Sensory analysis revealed that cookies with 15 - 20% CWP achieved the highest overall acceptability, exhibiting desirable crispness, mild coconut flavor, and acceptable color.

The optimized formulation (2:1 Ratio substitution) demonstrated enhanced fiber content, acceptable texture, and good sensory scores without compromising product quality. The results indicate that copra waste powder can be effectively utilized as a functional ingredient in bakery products, contributing to value addition of agro-industrial by-products, improved nutritional quality, and promotion of sustainable food systems.

***Index Terms*—High-fibre cookies, copra waste powder, coconut by-product, dietary fiber enrichment, bakery product development, sensory evaluation, value addition**

I. INTRODUCTION

People are getting more aware about eating healthy these days, and with all the problems like obesity, diabetes, and heart issues on the rise, there's a bigger push for foods that have extra Fiber and nutrients. Regular cookies made from white flour are super popular because they taste good and last a while, but they do not have much Fiber or vitamins. That makes researchers look into adding better ingredients to baked stuff. I think using waste from things like copra could help make cookies healthier without changing them too much.

Copra waste comes from drying coconut kernels and taking out the oil, and it is packed with fiber, some protein left over, and minerals. It is cheap and everywhere in places where coconuts grow, but a lot of it just gets thrown away or fed to animals. Putting this powder into cookie dough seems like a way to boost nutrition and not waste resources. When you add it, the cookies get more fiber, the texture changes a bit, and you even get that coconut taste, which might be nice for some people.

This project is about making high-fiber cookies by replacing some flour with copra waste powder. We will check how to mix it right, look at the physical properties, the makeup of nutrients, how it feels to eat, and if people like the taste. It also ties into bigger ideas like using waste better and making food production more sustainable, kind of supporting that circular economy thing.

Coconut (Copra)
Coconut is a big deal in tropical areas, especially in India, Indonesia, and those places. In India, states like Kerala and Tamil Nadu grow a ton of it, and it helps a lot with jobs in rural spots. Copra is the dried part used for oil, processed in mills big and small.

After extracting oil, you end up with this residue called copra cake, and while some goes to animal feed, too much is just sitting around unused. It has good fiber though, so why not use it in food. Throwing it away causes pollution and loses money for the factories. Turning it into powder for baking could fix that, making everyday foods better.

By adding copra waste to cookies, it is like turning something leftover into useful stuff. That stands out to me, how it helps with waste and makes functional snacks. Some might worry about the flavor overpowering, but it seems manageable. Overall, this could push for more sustainable ways in food.

II. MATERIALS AND METHODOLOGY

2.1. MATERIALS

Refined wheat flour was the main thing we used as the base for the cookies. It acted like the control, you know, to compare with the other versions. Then there was this copra waste powder, which I think comes from the leftovers after extracting oil from copra. It was first-grade quality, and they milled it fine so the particles would be even when mixed in. That seems important for how the dough turns out. Sugar, the granulated kind, went in for sweetness. It helps with the taste and makes the texture better somehow. Butter was unsalted, and it added fat to make everything tender and flavourful. The mouthfeel gets nicer too, I guess. Without it, cookies would probably be dry.

Baking powder or soda helped the cookies rise. That gives them the right texture, not too flat. Milk came next, to make the dough smoother and add some nutrition. It feels like without milk, the mix might be too crumbly. Vanilla essence was for flavor, giving a good smell and making the whole thing more appealing. I am not totally sure if it affects the fiber part directly, but it improves how the cookies taste overall.The high-fiber cookies we developed used all these. Some parts get a bit messy when thinking about the exact roles.

2.2 FORMULATION

SNO	COMPONENT	UNITS	TRAIL 1 (1:0)	TRAIL 2 (1:1)	TRAIL 3 (1:2)	TRAIL 4 (1:3)	TRAIL 5 (2:1)
1	Wheat Flour (Refined)	g	150g	75g	50g	37.5g	100g
2	Copra Waste Powder	g	-	75g	100g	112.5g	50g
3	Unsalted Butter	g	70g	70g	70g	70g	70g
4	Sugar Powder	g	70g	70g	70g	70g	70g
5	Baking Powder	g	1g	1g	1g	1g	1g
6	Baking Soda	g	0.5g	0.5g	0.5g	0.5g	0.5g
7	Milk	ml	10ml	10ml	10ml	10ml	10ml
8	Vanilla Essence	ml	2ml	2ml	2ml	2ml	2ml

2.3. METHODOLOGY

Preparation of Copra Waste Powder

Copra waste obtained after coconut milk extraction was collected and cleaned to remove any foreign particles. The material was dried in a hot air oven at 55–60°C until a constant weight was achieved to reduce moisture content below 8%.

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a) Mixing and Dough Preparation

1. Creaming Process

Butter and powdered sugar were transferred into a mixing bowl and creamed using a hand blender or planetary mixer for 5 minutes until the mixture became light, fluffy, and creamy in texture.

2. Incorporation of Dry Ingredients

Refined wheat flour, copra waste powder, and baking powder were sieved together to ensure uniform mixing and aeration. The dry mixture was gradually added to the creamed butter–sugar mixture with continuous mixing at low speed to avoid lump formation.

3. Dough Formation

Milk and vanilla essence were added slowly to the mixture to facilitate proper binding. The mixture was kneaded gently to form a soft, uniform dough. Overkneading was avoided to prevent gluten overdevelopment, which may affect cookie texture.

4. Resting of Dough

The prepared dough was wrapped in butter paper or cling film and allowed to rest for 15–20 minutes at room temperature to improve dough consistency and ease of rolling.

b) Rolling and Cutting

After resting, the dough was placed on a lightly floured surface and rolled using a rolling pin to a uniform thickness. Cookies were cut into desired shapes using cookie cutters and carefully transferred to a greased or parchment-lined baking tray. Adequate spacing was maintained between cookies to allow spreading during baking.

c) Baking

The cookies were baked in a preheated hot air oven at 170–180°C for 12–15 minutes. Baking was continued until the cookies developed a light golden-brown colour and firm texture. The baking time and temperature were kept constants for all formulations to ensure uniform comparison.

d) Cooling

After baking, the trays were removed from the oven and allowed to cool for 5-10 mins.

III. RESULTS AND DISCUSSION

TRIAL:1

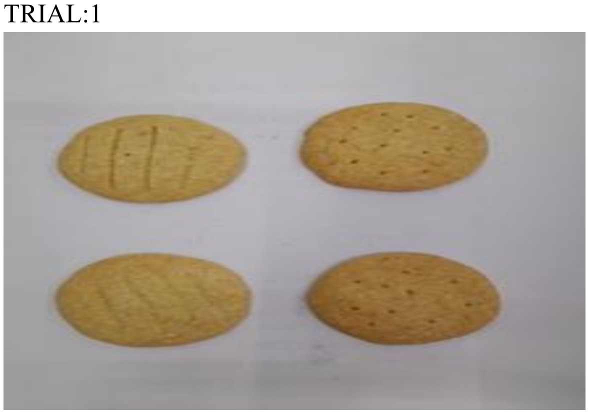

Fig.4.1

The control sample (1:0) prepared with 100% refined wheat flour showed good physical and sensory qualities. The cookies had a uniform round shape with a light golden-brown color and smooth surface appearance. Proper spread and thickness were observed without excessive cracking or breakage. The texture was crisp with a pleasant mouthfeel. The cookies exhibited a typical sweet, buttery aroma and taste. Overall, the control sample was highly acceptable and served as a standard for comparison with fibre-enriched samples.

TRIAL:2

Fig.4.2

The cookies prepared with a 1:1 ratio of refined wheat flour and copra waste powder showed noticeable changes compared to the control sample. The cookies appeared slightly darker in color with a more porous and coarse surface texture. Increased spread and slight irregularity in shape were observed. The texture appeared denser and slightly harder due to higher fibre content. Mild surface cracking was visible in some samples. Overall, the cookies were acceptable but showed moderate changes in texture and appearance due to copra waste incorporation.

TRIAL:3

Fig.4.3

The cookies prepared with a 1:2 ratio of refined wheat flour to copra waste powder showed a darker brown color and a more pronounced coarse surface texture. Increased fibre incorporation resulted in greater surface cracking and a rough appearance. The cookies exhibited reduced spread and slightly irregular edges. The texture appeared firmer and more brittle compared to the control and 1:1 sample. A denser structure with visible pores was observed. Overall acceptability was moderate, as higher fibre content slightly affected texture and appearance.

TRIAL:4

Fig.4.4

The cookies prepared with a 1:3 ratio of refined wheat flour to copra waste powder showed a noticeably darker brown color and a more pronounced coarse surface texture. Higher fibre incorporation resulted in increased surface cracking and a rougher appearance. The cookies exhibited further reduced spread with slightly irregular and fragile edges. The texture appeared firmer and more brittle compared to the control, 1:1, and 1:2 samples. A denser structure with visible pores was observed due to increased fibre content. Overall acceptability was slightly lower, as higher fibre levels affected texture and structural integrity.

TRIAL:5

Fig.4.5

The cookies prepared with a 2:1 ratio of refined wheat flour to copra waste powder showed a uniform light golden-brown color with a smoother surface texture. Surface cracking was minimal, and the cookies maintained a well-defined round shape with even edges. The spread was uniform and consistent compared to other trials. The texture appeared crisp yet less brittle, indicating better structural balance. The internal structure seemed moderately porous without excessive density. Overall, this formulation showed the best sensory and physical characteristics among all trials.

S.no	Parameters	Unit	Test Result (Trial-4)	Test Result (Trial - 5)
1	Tensile Strength	Mpa	5.2	7.2
2	Water Vapour Transmission	Qualitative	Passes Test	passes Test
3	Oxygen Transmission Rate	%	52.9	76.9
4	Density	Kg/m3	125	269
5	Water Absorption Test	%	43	63
6	Oil Resistance	%	0.11	0.24
7	Elongation at Break	Qualitative	passes Test	passes Test
8	Thickness	Cm	0.1	1.2
9	Optical Test	Qualitative	passes Test	passes Test

3.1 Evaluation of Physicochemical and Functional Properties

A total of five trials were conducted for the preparation of high-fibre cookies using copra waste powder, among which the fifth trial (2:1 ratio of refined wheat flour to copra waste powder) yielded the most satisfactory results. All analytical tests were performed using the cookies obtained from the fifth trial. The developed high-fibre cookies were assessed for their physicochemical, functional, and microbiological properties.

3.1.1 Moisture Content
The moisture content of the optimized cookies was recorded as 6.28%, which falls within the acceptable range for bakery products. This low moisture level contributes to improved shelf stability by minimizing microbial growth and preventing texture softening. Compared to normal cookies, the value is comparable, indicating proper baking and moisture control during processing.

3.1.2 Crude Fibre
The crude fibre content was found to be 9.31%, which is significantly higher than that of conventional cookies. This increase is directly attributed to the incorporation of copra waste powder, a rich source of dietary fibre. The enhanced fibre content improves the nutritional profile of the product and supports digestive health benefits.

3.1.3 Crude Fat
The crude fat content was recorded at 33.6%, mainly due to the residual oil present in copra waste. This fat level contributes to desirable sensory properties such as crispness, flavor retention, and mouthfeel. Compared to control cookies, the fat content is slightly elevated but remains within acceptable limits for biscuit formulations.

3.1.4 Protein Content
The protein content was measured at 2.65%. While moderate, this value aligns with typical bakery formulations using refined wheat flour. The incorporation of copra waste does not significantly alter protein levels but contributes more toward fibre enrichment.

3.1.5 Ash Content
The ash content was found to be 9.12%, indicating a higher mineral composition compared to normal cookies. This increase reflects the presence of natural minerals in copra waste powder, thereby enhancing the overall nutritional value of the developed product.

3.1.6 Functional Properties (Water and Oil Absorption Capacity)
The oil absorption capacity was recorded at 73.8%, indicating good fat-binding ability, which contributes to improved flavor retention and mouthfeel. The water absorption capacity was measured at 3.11%, reflecting moderate hydration properties due to fibre incorporation. These functional characteristics improve dough handling properties and structural stability of the cookies.

3.1.7 Peroxide Value
The peroxide value was found to be 0.13 meqO_2/100g, indicating minimal lipid oxidation and good oxidative stability. This low value confirms that the product is free from rancidity and suitable for storage under proper conditions.

3.1.8 Texture Analysis
Texture analysis revealed a uniform and well-structured cookie matrix. The optimized 2:1 formulation exhibited balanced crispness without excessive brittleness, unlike higher fibre trials. The structural integrity and moderate porosity contributed to improved sensory acceptability.

3.1.9 Total Plate Count (TPC)
The total plate count was recorded as 3.0×10^8 CFU/g. While the physicochemical properties were satisfactory, this value suggests the need for improved hygienic practices during preparation and packaging to enhance microbial safety and shelf life.

IV. CONCLUSION

The high-fibre cookies developed using copra waste powder demonstrated improved nutritional and functional characteristics compared to conventional cookies. The optimized 2:1 formulation exhibited desirable physicochemical properties, including acceptable moisture content (6.28%), enhanced crude fibre (9.31%), and stable fat composition (33.6%). The cookies showed uniform texture, moderate crispness, low peroxide value (0.13 meqO_2/100g), and satisfactory structural integrity, indicating good product stability and quality.
The incorporation of copra waste powder significantly enhanced the dietary fibre and mineral content without adversely affecting sensory attributes. The functional properties such as oil and water absorption capacity further supported desirable texture and mouthfeel characteristics.
Overall, the study confirms that copra waste powder can be effectively utilized as a value-added functional ingredient in bakery products. This approach not only

improves the nutritional profile of cookies but also promotes sustainable utilization of agro-industrial by-products, contributing to waste reduction, cost-effectiveness, and development of healthier food alternatives.

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