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Review Article on Therapeutic Anti Diabetic Biscuit – An Effective Functional Food

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Abstract

Cookies are commonly eaten as snacks to satisfy hunger and provide quick energy. However, most cookies available in the market are made using refined flour, sugar, and butter. These ingredients can increase blood sugar levels; therefore, such cookies are usually not suitable for diabetic or obese individual. In this study, an attempt was made to prepare healthier polyherbal cookies using oats, wheat flour, and selected ayurvedic herbs. Several formulations were prepared to identify the most palatable and acceptable product. The optimized cookies were further analyzed for physiochemical parameters such as moisture content and ash value. Nutritional analysis indicated that the developed polyherbal cookies possessed higher protein content and improved nutritional quality. The result suggest that polyherbal cookies can serve as a nutritious and diabetes-friendly alternative to commonly available cookies.

Keywords: Cookies; Polyherbal; Ayurveda; Physiochemical; Nutrition

INTRODUCTION:

Diabetes is a very common, non communicable metabolic disease and is associated with other disease like cardiovascular disease and kidney disease etc. It occurs when the pancrease does not synthesise insulin.

Diabetes is generally grouped into three types :

TYPE-1 diabetes mellitus / Insulin-dependant diabetes mellitus, which is mostly caused by T-cell-mediated autoimmune destruction of the beta-cell of the pancrease leading to lose of insulin secreation (1).

TYPE-2 diabetes mellitus / Non-insulin-dependent diabetes mellitus occurs due to reduced beta-cell mass or low insulin circulation because of genetics or metabolic factor.

TYPE-3 diabetes occurs during pregnancy when insulin is not synthesized properly or cells become resistant to insulin.

MATERIAL AND METHODS:

Collection of Sample

Oats, wheat flour, roasted black-gram flour, Ashwagandha powder, Ginger powder, Cinnamon powder, Fenugreek seed, Milk, Flavouring agent (vanilla and cocoa), salt, baking powder, baking soda, butter, artificial sugar (sugar free Natura), leaves of *Murrayakonigii* and Drumsticks were purchased from local market of Kota, Rajasthan, India. The raw materials were stored at room temperature for use in experiments [35].

Preparation of Cookies

Polyherbal cookies were prepared using different ratios of oats, wheat flour, and roasted black gram flour. Functional ingredients such as ashwagandha powder, ginger powder, cinnamon, and fresh curry leaves (Murraya koemigii) and drumstick leaves (Moringa oleifera) were incorporated to enhance nutritional and functional properties. Milk, butter, salt, baking powder, baking soda, artificial sweetener, and flavouring agents were added to improve texture and sensory quality. All ingredients were mixed thoroughly to form a uniform dough, which was shaped into cookies and baked under controlled conditions. The formulation showing the best palatability, texture, and overall appearance was selected for further sensory and nutritional evaluation.

Physiochemical Properties of Cookies:

Ash value:

Ash value is commonly assessed in studies evaluating the nutritional and mineral composition of therapeutic biscuit. Research generally follows standard AOAC methods to determine total mineral residue after complete incineration of the sample. Across various formulations, the ash content of anti-diabetic biscuits is reported to range from 1-3%, depending on the inclusion of mineral rich ingredients, such as whole grain, oats, fenugreek seeds, black gram flour. Higher ash values typically indicate better mineral availability, which contributes to the functional and nutritional benefits of therapeutic biscuits.

Moisture content:

Moisture is an important quality parameter influencing shelf life, texture and microbial stability of biscuits. Review of previous studies shoes that moisture level in therapeutic anti-diabetic biscuits generally fall within the range of 3-6%, reflecting the low moisture nature of baked products. These values are typically determined using standard oven-drying procedures. Lower moisture content is desirable because it enhances shelf stability and reduces the risk of spoilage, while also supporting crispiness and overall sensory quality.

QUALITATIVE ANALYSIS:

Organoleptic / Sensory Evaluation:

Studies on therapeutic anti-diabetic biscuits commonly report sensory evaluation results using trained or semi-trained panels. Attributes such as colour, aroma, taste, texture, hardness, and overall acceptability are typically assessed using a 5- or 9-point hedonic scale. Most findings indicate that biscuits formulated with oats, millets, or fenugreek, generally show good acceptability, although fiber-rich formulations may slightly reduce crispness or flavour intensity.

PHYSICAL PROPERTIES OF BISCUITS:

Literature shows that physical properties such as weight, diameter, thickness, and spread ratio are key indicators of biscuit quality. These parameters vary depending on the flour type, fiber content, fat composition, and baking conditions. Most studies report that the incorporation of functional ingredients may increase thickness and reduce spread ratio due to higher water absorption capacity. However, structural integrity and texture often remain acceptable.

SHELF ANALYSIS OF THE BISCUITS:

Several studies have evaluated the shelf stability of therapeutic biscuits through microbiological assays, moisture monitoring, and sensory changes over storage. Research generally shows that low-moisture biscuits have a stable shelf life of up to 30-60 days when stored in airtight containers. Moisture uptake and microbial growth remain minimal during this period, confirming good product stability.

ANTI BACTERIAL ACTIVITY:

Some formulations enriched with spices (such as cinnamon or ginger), plant extracts, or functional ingredients exhibit mild antibacterial properties. Studies indicate that these bioactive compounds can inhibit common spoilage microorganisms, contributing to extended shelf life and added therapeutic benefits.

ANTI DIABETIC TESTS:
In-Vitro Alpha-Amylase Inhibition:

Several studies have evaluated the anti-diabetic potential of therapeutic biscuits by measuring their ability to inhibit the alpha-amylase enzyme, which is responsible for breaking down starch into glucose. Research shows that biscuits enriched with ingredients such as cassia, fenugreek, jamun seed powder, resistant starch, and herbal extracts exhibit significant alpha-amylase inhibitory activity. This reduced enzyme activity slows the digestion of carbohydrates, which helps in lowering the post-meal rise in blood sugar levels. Many studies compare these results with standard inhibitors like acarbose and report that plant-based functional biscuits show moderate but meaning anti-diabetic effects.

Determination of Total Sugar Content:

Previous research on anti-diabetic biscuits has focused on reducing total sugar content by replacing refined sugar with natural sweeteners (stevia, sucralose) or low-GI carbohydrate sources Studies consistently report that biscuits formulated with whole grains, resistant starch, and fiber-rich ingredients contain lower levels of available sugars compared to conventional biscuits. Lower sugar content contributes directly to better glycemic control and makes such biscuits more suitable for diabetic individuals.

Determination of Mineral Content:

Mineral analysis from past studies highlights that therapeutic biscuits often contain higher levels of essential minerals such as iron, potassium, magnesium, and calcium, especially when prepared using multigrain, legume, or herbal ingredients. These minerals support overall metabolic function and may help improve glucose utilization in the body. Research also shows that ingredients like millets, chickpea flour, fenugreek seeds, and oats naturally enhance the mineral profile of the final product, making anti-diabetic biscuits more nutritious than regular biscuits.

Sensory Analysis:

Sensory evaluation studies indicate that the acceptability of therapeutic anti-diabetic biscuits depends on the balance between health benefits and taste. Most studies report that biscuits containing moderate levels of fiber, herbal extracts, and sugar substitutes maintain good scores for taste, texture, aroma, and overall

acceptability. However, very high incorporation of bitter or fiber-rich ingredients sometimes effects flavour or hardness. Overall, research shows that with proper formulation, anti-diabetic biscuits can be both nutritious and organoleptically acceptable, even when evaluated by untrained panelists.

Statistical Analysis:

In several studies that assessed the nutritional and therapeutic value of anti-diabetic or functional biscuits, data were generally presented as mean ± standard deviation (SD). Researchers commonly applied one-way Analysis of Variance (ANOVA) to compare multiple formulations or commercial products. Post-hoc tests-particularly Turkey's HSD-were frequently used when significant differences were observed, usually at a significance level of $p < 0.05$. These statistical approaches helped determine whether variations in nutrient levels or functional components were meaningful across different biscuit formulations.

COMPERATIVE STUDY OF MUTRITIONAL CONTENT FROM MARKET PRODUCT:

A number of published works have compared the nutritional composition of therapeutic or anti-diabetic biscuits with regular wheat-flour biscuits available in the market.

Typical comparison parameters include:

- Carbohydrate content
- Fat and protein content
- Moisture and ash levels
- Extractive values (such as water and alcohol extract)
- Total caloric energy

RESULTS REPORTED IN PREVIOUS LITERATURE

Table 1: Examples of chemical and physiochemical parameters reported in studies

S No	Parameter	Typical Find Reported
1	Ash content	~7%
2	Moisture content	~6-7%
3	Alkaloid	Present
4	Alcohol extractive value	~6.5%
5	Water extractive value	~5%
6	Fat content	14%
7	Carbohydrate content	~60%
8	Protein content	10-12%
9	Total energy	~410-420 Kcal

Sensory Evaluation:

A major focus of biscuit development research is sensory evaluation. Even though the goal is to produce healthier biscuits, it is essential that these products maintain good taste, aroma, and texture to achieve consumer acceptance.

Taste and Flavour:

Taste is consistently highlighted as a major acceptance factor. Research reports that when herbal powders are added in moderate amounts, the flavour becomes more appealing and slightly aromatic.Ingredients like cinnamon and curry leaf extract contribute pleasant natural aromas, while cocoa powder is frequently used in literature to balance or mask strong herbal notes.

Texture and Mouthfeel:

Fiber-rich biscuits tend to have a firmer texture, and multiple studies discuss adjusting moisture content and fat percentages to maintain a desirable crispness. The literature suggests that using a combination of whole-grain flours and adequate fat results in good structural stability and enhanced mouthfeel.

Overall Acceptability of Cookies:

Studies reviewing consumer feedback show that properly balanced therapeutic biscuits achieve good acceptability scores. Products that maintain a balance between health benefits and sensory properties are preferred over those with overly strong herbal flavours. Overall, the literature supports that therapeutic biscuits can be both nutritious and palatable, making them suitable as a functional snack.

Comparative Nutritional Findings in Therapeutic Biscuits:

The nutritional composition of therapeutic biscuits has been widely examined in research aimed at developing healthier bakery products, especially for diabetic and health-conscious individuals. Instead of presenting a single formulation, published studies commonly compare different biscuit types available in the market with those designed using whole grains, herbal extracts, or enriched flours.

CONCLUSION:

The review highlights that herbal cookie formulations offer improved nutritional quality and sensory acceptability compared with conventional commercial products. The incorporation of medicinal plant ingredients such as curry leaves (Murraya koenigii) and drumstick leaves enhances protein content while maintaining controlled levels of fat and carbohydrates, making these products suitable for individuals with diabetes and metabolic disorders. Sensory evaluations indicate favourable aroma, flavour, colour, and overall acceptability, demonstrating that functional bakery products can be developed without compromising consumer appeal. Overall, herbal cookies represent a promising, economical, and sustainable functional food with potential applications in health-oriented bakery product development.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

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