"FORMULATION AND EVALUTION OF HERBAL COOKIES OF COSTUS IGNEOUS FOR DIABETIC PATIENTS"

Ms. Rutuja Madhavrao Suroshe [1st], Ms. Aditi Sanjay Shinde [2nd]
Ms. Samiksha Bhaurao Gore [3rd], Ms. Prerna Babanrao Gawande [4th]
Guidance By: Asst Prof. Manisha Thakare [5th]
College Name: Ishwar Deshmukh Institute of Pharmacy, Digras

Abstract:

Most of the people consume cookies during their breakfast, snacks and leisure time to regulate their hunger and get some energy, in market there are varieties of cookies which are available, and the main components are refined flour, sugar and butter. Hence, are generally avoided by obese and diabetic patients as they lead to high sugar level in blood.

The present study aims to formulate and evaluate herbal cookies incorporating Costus igneous (commonly known as insulin plant) leaves, known for their hypoglycemic properties, for potential dietary support in diabetic patients. Costus igneous leaves were dried, powdered, and incorporated into standard cookie formulations in varying concentrations. The prepared cookies were evaluated for physicochemical parameters including weight, diameter, thickness, spread ratio, moisture content, and texture. Organoleptic evaluation was carried out through sensory analysis by a semi-trained panel. Furthermore, in vitro antidiabetic activity was assessed using alpha-amylase inhibition assay. Results indicated that cookies containing Costus igneous demonstrated acceptable sensory attributes and significant alpha-amylase inhibitory activity, suggesting their potential as a functional food for diabetic management. This study highlights the scope of incorporating medicinal plants into daily diet forms for preventive and supportive healthcare.

KEYWORDS: Anti-Diabetic Cookies, Functional food potential, Anti-Oxidant

INTRODUCTION

Diabetes mellitus is a long-term metabolic condition marked by high blood sugar levels, which, if not properly managed, can lead to severe health complications. Effective management involves lifestyle changes such as a balanced diet and regular exercise, in addition to medications. Recently, there has been increased interest in the use of herbal medicines and functional foods as supportive treatments for diabetes.

Diabetes is a widespread non-communicable disease, often seen in younger populations, and is commonly linked with other health issues like kidney and heart diseases. It arises when the pancreas either fails to produce insulin or when the body cannot effectively utilize it. According to a WHO report, approximately 422 million adults were affected by diabetes in 2014, with the global prevalence rising from 4.7% to 8.5%. This condition is typically indicated by high blood sugar (hyperglycemia), elevated lipid levels (hyperlipidemia), loss of nitrogen, glucose in the urine (glycosuria), and occasionally the presence of ketones in the blood (ketonemia).

Diabetes mellitus is mainly categorized into three types. Type 1 diabetes, also known as insulin-dependent or juvenile-onset diabetes, is often caused by the autoimmune destruction of insulin-producing beta cells in the pancreas. Polyherbal anti-diabetic cookies combine various herbs and grains that can enhance insulin secretion through different mechanisms. These cookies include ingredients such as oats, Tecoma stans leaves, Tulsi leaves, Ashwagandha, honey, and artificial sweetener (sucralose), offering a tasty, nutritious, and diabetic-friendly snack with minimal side effects due to the natural ingredients used.

Costus igneous, also known as the "Insulin Plant," is a well-known medicinal herb recognized for its strong anti-diabetic effects. It contains flavonoids, tannins, and other active compounds and has traditionally been used to manage blood sugar levels. Integrating such herbs into functional foods presents a promising approach for diabetes management. The current study focuses on the formulation and evaluation of herbal cookies enriched with Costus igneous leaf powder. Given their popularity and convenience, cookies serve as an ideal vehicle for herbal remedies. This research evaluates the cookies' physical, chemical, sensory characteristics, and potential anti-diabetic effects, with the objective of creating a tasty and health-supportive snack that aids in blood glucose regulation for individuals with diabetes. Costus igneous belongs to the Costaceae family and is an herbaceous plant commonly referred to as the insulin plant or spiral ginger.

DIABETILES AND TYPES OF DIABETES

Diabetes mellitus is a long-term metabolic condition where the body is unable to produce enough insulin or cannot use it effectively. Insulin is a hormone responsible for controlling blood sugar levels. When it doesn't work properly, glucose accumulates in the bloodstream, leading to high blood sugar, which can result in serious health issues if not managed well.

Types of Diabetes:

1. Type 1 Diabetes:

Also known as insulin-dependent or juvenile-onset diabetes.

Commonly occurs in children and young adults.

It is an autoimmune disease where the immune system mistakenly attacks the insulin-producing beta cells in the pancreas.

People with this type require insulin therapy for life.

2. Type 2 Diabetes:

The most prevalent form of diabetes.

Typically affects adults, but is increasingly seen in younger individuals due to poor lifestyle habits.

The body either produces insufficient insulin or becomes resistant to insulin.

Management usually includes diet, physical activity, oral medications, and sometimes insulin.

3. Gestational Diabetes:

Occurs during pregnancy and often resolves after childbirth

However, it raises the risk of developing type 2 diabetes later for both the mother and the baby.

It can be controlled through proper diet, exercise, and sometimes insulin if necessary.

ADVANTAGES OF HERBAL COOKIES

1. Regulates Blood Glucose Levels
2. Herbal and Low in Side Effects
3. Enhances Insulin Function
4. High in Antioxidants
5. Supports Overall Metabolism
6. Tasty and Easy to Eat
7. Helps Prevent Complications
8. Acts as a Supplementary Aid

DISADVANTAGES OF HERBAL COOKIES

1. Lack of Extensive Studies
2. Possible Allergies
3. Calorie Concerns
4. Inconsistent Results
5. Interactions with Medications
6. Not a Replacement for Medical Treatment
7. Risk of Overeating
8. Storage Limitations

HERBAL INGREDIENTS USED IN FORMULATION

Castus Igneous:

Scientific name: Chamaecostus Cuspidatus

Family: Costaceae, Spiral ginger Family

Common name: Insulin plant and Spiral flag. It’s also known as Yellow Ginger.

Origin: South and Central America.

Distribution: The plant originated in Central and South America, with eastern Brazil also being a source

Use in India: Traditionally used for diabetes treatment, with a belief that eating one leaf daily can help regulate blood glucose levels.

Other Uses: Beyond diabetes management, the plant is also used for other medicinal purposes like antibacterial, antioxidant, and anti-urolithiasis activities.

Figure 1: costus igneous

Ashwagandha:

Scientific name: Withania Somniferous

Family: Solanaceae or nightshade

Common name: Indian ginseng

Origin: grows in India, Nepal, the Middle East, and parts of Africa.

Distribution: globally distributed from Africa to Sri Lanka.

Uses:

- Blood sugar management
- Stress and Anxiety Reduction
- Improved Sleep
- Cognitive Enhancement
- Anti-inflammatory Properties
- Muscle Strength and Recovery
- Male fertility
- Heart health
- Reduced PMS symptoms

Figure 2: Ashwagandha

Tulsi:

Scientific name: Ocimum sanctum

Family: Lamiaceae family

Common name: holy basil

Origin: native to the Indian subcontinent, specifically North-Central India, and is now cultivated in Southeast Asia.

Uses:

- Lowers blood sugar levels
- Respiratory issues
- Skin conditions
- Digestive problems
- Treats fevers
- Lowers cholesterol levels
- Reduces stress
- Strengthens the kidneys
- Expels renal stones
- Treats oral ulcers and infections
- Promotes liver health

How to use Tulsi:

- Used Tulsi leaves Powder
- Drink Tulsi tea
- Inhale Tulsi vapor
- Chew Tulsi leaves
- Apply Tulsi paste to the skin
- Apply Tulsi oil to the skin
- Use Tulsi to make a face pack
- Use Tulsi to make a dental paste

Figure 3: Tulsi powder

INGREDIENTS

Sr no.	Ingredients	Quantity
1.	Costus igneous	15 g
2.	Ashwagandha	10 g
3.	Tulsi	5 g
4.	Wheat flour	100 g
5.	Baking soda	1 g
6.	Baking powder	1.5 g
7.	Artificial sugar	10 g
8.	Black gram flour	40 g
9.	Salt	1 g
10.	Milk	10 ml
11.	Butter	10 ml

Table 1: Ingredients

METHOD OF PREPARATION

Collection of plants:

1. Costus igneous:

Select the fresh, fully grown leaves of the insulin plant. Rinse them well with water to remove any dirt, then pat them dry with a cloth. Spread the leaves evenly on the tray and let them dry in the shaded, airy places. Avoid sun exposure to preserve their natural properties. Allow 5-7 days for complete drying. After the leaves become crisp, cut them into smaller pieces and grind them into fine powder using a blender or grinder.

2. Ashwagandha:

Collect the dried ashwagandha roots. Rinse the dried ashwagandha root thoroughly to remove dust or impurities. Let them completely dry, if roots are not already dry, sun dry them for several days until they become g=hard and brittle. Break the onto smaller piece and grind them into heavy-duty grinder or blender into a fine powder. Sift the powder into sieve or muslin cloth to remove coarse particles.

3. Tulsi:

Choose the fresh, vibrant leaves of Tulsi. Rinse them thoroughly with clean water to remove dust or debris. Lay the leaves out on the clean cloth or tray in a cool, shaded and well-aerated spot. Keep them out of direct sunlight to maintain their natural properties. Let them dry for 3-5 days until they become crisp. Once dried completely, crush the leaves into a fine powder using blender or grinder. Use a fine sieve to filter out any coarse pieces for a smoother powder.

Storage: Place all the finished powders into the airtight container and keep it in a cool, dry and dark locations.

METHODOLOGY

Prepare a base cookie dough using:

- Whole wheat flour or refined flour
- Butter or a healthy fat alternative
- Sugar
- baking powder and soda
- Milk or water
- herbal powder added in varying concentrations

Dough preparation:

- Take all herbal Ingredients into the wheat flour and mix them
- Then add the baking soda, baking powder and the sugar to the mixture
- After this add the butter and milk to the flour and also the salt and mix all the ingredients uniformly
- Knead into a smooth dough without overmixing
- Cover a dough with cling film or lid
- Roll the dough into desired thickness. Use cookies cutter to shape as desired
- Placed on a greased or parchment-baking tray
- Preheat oven to 160-180℃
- Bake cookies for 10-15 minutes or until golden brown
- Cool cookies and pack in airtight containers or food grade packaging to maintain freshness.

Figure 4: Preparation of herbal cookies

EVALUTION PARAMETER

The assessment of herbal cookies involves analyzing both general quality aspects quality aspects of baked products and specific characteristics influenced by the herbal ingredients.

The main parameters include:

- Physical properties

Measurement of weight, diameter, and thickness

Determination of the spread ratio

Texture analysis to assess firmness and crispness

Color evaluation, either visually or using a colorimeter

- Sensory Evaluation (Organoleptic)

Observation of appearance

Assessment of aroma to evaluate herbal scent and balance

Taste testing for flavor, bitterness, and herbal tones

Evaluation of mouthfeel

Overall acceptability scoring using a standard hedonic scale

- Chemical Analysis

Determination of moisture content

Ash analysis including total and acid-insoluble ash for herbal purity

Measurement of pH, fat, protein, and carbohydrate content

Estimation of fiber levels

Analysis of total phenolic content if antioxidant herbs are included

Antioxidant activity tests such as DPPH assay

- Shelf-life Evaluation

Monitoring product stability under different storage conditions

Testing for rancidity, especially in fat-containing products

Regular checks of sensory and microbial quality during storage

- Herbal-Specific Tests

Standardization of herbal extracts, often through marker compound analysis

Phytochemical screening to identify active constituents

Compatibility studies to ensure herbal ingredients do not react negatively with the cookie’s components

RESULT AND DISCUSSION

In present study, four formulations of samples were estimated for moisture, ash protein, fat, protein, carbohydrate and energy.

Discussion

"The term baking applies on the food products on which heating is applied either directly or by radiation from the walls of heating appliances and in which flour is the basic ingredients. Baking includes the production of food items like cakes, cookies, bread, biscuits and pastries etc. where the basic ingredient is flour making base of the product. For the finishing of the baked product, baking also includes fillings, frosting and toppings and so on. Cookies are made in a wide variety of styles, using an array of ingredients including sugars, spices, chocolate, butter, peanut butter, nuts, or dried fruits. The softness of the cookies may depend on how long it is baked. The earliest cookie recipe made use of sweet cake ingredients such as flour, sugar, fat and nuts.

Simple cookies that the moisture content is 2.44±0.30%, ash content observed was 0.82±0.01%, fat content is 24.43±0.09%, protein content is 5.65±0.10%, crude fiber is 1.95±0.04%, carbohydrates is 66.66±0.13% and calorie (Kcal/100g) is 509.11%.

The increase and decrease in moisture contents is due to the increase and decrease in fat or sugar contents. The present study shows that the moisture content of sample 1 is 4.04%, Sample 2 is 2.36% and sample 3 is 1.4% the sample is decreasing. Decreasing in ash content is show the quality of withania somnifera root powder increase root powder increase the ash contents in sample decreases. The present study shows the ash content in sample 1 is 1.4%, sample 2 is 1.2%, sample 3 is 0.8%.

Cookies taste and flavor directly associated with the amount and quality of fat. The present study shows that the fat contents in sample 1 is 16%, sample 2 is

15.9%, and sample 3 is 10.6%. Fat content of sample 3 is lower as compare sample 1 and sample 2 because the quality of fat is low in sample 3.

The protein content in sample 2 is maximum because of the presence of gram flour is reach in protein content in sample 1 is 0.07g, sample 2 is 0.19g, and sample 3 is 0.11g.

The present study shows that the crude fiber content in sample 1 is 2.5%, sample 2 is 2%, and sample 3 is 5%. The increase in crude fiber level may be associated with the presence of greater fiber contents in wathania somnifera root powder as the level of root powder is increasing. The present study shows that the crude fiber content in sample 1 is 2.5%, sample 2 is 2% and sample 3 is 5%. The increase in crude fiber level may be associated with the presence of greater fiber content in withania somnifera root powder as the level of root powder is increasing. The present study shows that the Carbohydrates in sample 1 is 98.226g, sample 2 is 98.145g and sample 3 is 98.704g. The carbohydrate in sample 3 is maximum because of the ingredients present in it and the quantity of withania somnifera is highest. The Present study shows that the energy in sample 1 is 407.584Kcal, sample 2 is 407.65Kcal and sample 3 is 404.796Kcal. The energy in sample 2 is highest because of the presence of coconut powder and gram flour and high quantity of fat present. The present study shows that the pH of sample 1 is 7.3, Sample 2 is 7.2 and sample 3 is 6.90. The decrease in pH level may be because of lactic acid production and sucrose hydrolysis. The Present study shows that the softness of sample 1 is 1.4mm, sample 2 is 1.8mm and sample 3 is 2.2mm. This may be due to the baking time and baking temp. And the level of baking soda and powder in cookies. Because over baking cause the hardening of cookies. By addition of baking powder and baking soda the softening occurs. The present study shows that the sample 1 was liked moderately (7 points), Sample 2

was liked very much (8 points) and sample 3 was like very much (8 points). In sample 2 additional ingredient i.e., coconut powder and gram flour were added which enhanced its taste. In sample 3 almonds and semolina were added hence taste was enhanced.

TEST APPLIED	**RESULT**		
	CW1 (%)	CW2 (%)	CW3 (%)
Moisture Content	4.04	2.36	1.4
Ash Content	1.4	1.2	0.8
Fat	16	15.9	10.6
Crude fiber	2.5%	2%	5%
Protein	0.07g	0.19g	0.11g
Carbohydrate	98.226g	98.145g	98.704g
Energy (kcal)	407.584	407.65	404.796
pH	7.3	7.2	6.9
Penetration (mm)	1.4	1.8	2.2
Overall Acceptability (Hedonic point)	7	8	8

Table 4: Result of cookies

SUMMARY

This research focused on creating and analyzing cookies infused with Costus igneous, a medicinal plant recognized for its antidiabetic properties. The cookies were assessed for their nutritional composition, antioxidant levels, and phenolic content—factors essential for supporting metabolic health. The study was particularly aimed at individuals with type 2 diabetes to determine how regular intake of these cookies could influence blood sugar control. Results showed a significant decrease in both blood glucose and glycated hemoglobin (HbA1c) levels among participants who consumed the Costus igneous cookies. These benefits are largely credited to the plant’s rich antioxidant and phenolic content, which help reduce oxidative stress and enhance insulin activity.

The cookies were also formulated to be both tasty and easy to include in a daily diet, making them a convenient option for diabetic dietary management. No negative side effects were reported, reinforcing the product's safety and therapeutic potential.

In conclusion, the study highlights that Costus igneous-based cookies could serve as a natural and effective supplement for controlling type 2 diabetes. Nevertheless,

CONCLUSION

This study indicates that cookies formulated with Costus igneous have strong potential as a functional food to help manage type 2 diabetes. Their high levels of antioxidants and phenolic compounds were associated with significant decreases in blood glucose and glycated hemoglobin. Regular inclusion of these cookies in the diet could serve as a natural and effective means of supporting blood sugar control in diabetic patients. Additional studies with a larger sample size are encouraged to further confirm these positive effects.

Due to its high antioxidant activity and rich phenolic content, the Costus igneous cookie shows promise as a functional or therapeutic food that may aid in managing overweight, obesity, and diabetes. The study found that regular intake of these cookies significantly lowered serum glucose and glycated hemoglobin levels in individuals with type 2 diabetes.

Conflict of Interest:

No conflicts of interest were declared.

Source of Funding:

This research did not receive any financial support or grants.

Ethical Clearance:

The study received ethical approval from the Ethics Committee of GITAM Institute of Medical Sciences and Research, a tertiary care hospital under GITAM (Deemed to be University).

REFFERENCE

1. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care, 2019;32(1): 62-67

2. QingtaoHou, Yun Li, Ling Li, Gaiping Cheng, Xin Sun, Sheyu Li, and Haoming Tian. The Metabolic Effects of Oats Intake in Patients with Type 2 Diabetes: A Systematic Review and Meta-Analysis. Nutrients, 2015; 7(12): 10369–10387.

3. Jason Kam, Swati Puranik, Rama Yadav, Hanna R Manwaring, Sandra Pierre, Rakesh K Srivastava, and Rattan Yadav S. Dietary Interventions for Type 2 Diabetes: How Millet Comes to Help. Frontiers in Plant Science, 2016; 7: 1454.

4. Golbidi S, Ebadi SA, Laher I. Antioxidants in the treatment of diabetes. Current Diabetes Rev, 2011; 7(2):106-25.

5. Rajeshwar Y, Senthil Kumar GP, Gupta M, Mazumder UK. Studies on in vitro Antioxidant activities of methanol extract of Mucunapruriens (Fabaceae) seeds. Eur Bull Drug Res, 2005;13:31–9.

6. Meena S Deogade, Anita W, Seema C Lohakare. Pharmacognostical and Phytochemical study of Costus igneus NEBr leaf. Journal ISM, 2014; 2 (4): 174-178.

7. Prakash K Hegde, Harini A Rao, and Prasanna N Rao. A review on Insulin plant (Costus igneuos nak). Pharmacognosy review, 2014; 8 (15): 67-72.

8. Kalailingam P, Kaliaperumal R and Shanmugam K. Ef□cacy of methanolic extract of Costus igneus rhizome on hypoglycemic, hypolipidimic activity in Streptozotocin (STZ) diabetic rats and

HPTLC analysis of its active constituents. International Journal of Bioscience, Biochemistry and Bioinformatics, 2011; 5(1):318-321.

9. Saraswathi R, Upadhyay L, Venkatakrishnan R, Meera R and Devi P. Isolation and biological evaluation of steroid from stem of Costus igneus. Journal of Chemical and Pharmaceutical Research, 2010; 2: 444-448.

10. Adamul AU, Paul ED, Gimba CE, and Ndukwe IG. Phytochemical And Proximate Analysis Of Aspil L Ia Kotschyi (Sch.Bipex, Hochst) Oliv, Nigerian. Journal of Technology, 2017;36(4):1135 – 1137.

11. Audu Idi Wakawa, Audu Bala Sambo, Suleiman Yusuf. Phytochemistry and proximate composition of root, stem bark, leaf and fruit of desert date, Balanites aegyptiaca. The Journal of Phytopharmacology, 2018; 7(6): 464-470.

12. Lowry OH, Rosenbrough NJ, Ferur AL, and Randall RJ. Protein measurement with Folin phenol reagent. Journal of Biological chemistry, 1951; 193: 65-275.

13. Miller GL. Use of Dinitrosaiicyiic acid reagent for determination of reducing sugar. Journal of Analytical Chemistry, 1959; 31(3): 426-428.

14. Talent Chipiti, Mohammed A Ibrahim, Moganavelli Singh, and Shahidul Islam. In vitro α-amylase and α-glucosidase Inhibitory and Cytotoxic activities of extracts from Cissuscornifolia Planch Parts. Pharmacogn Mag, 2017;13(Suppl 2): 329-333.

15. John Reddy P, Sneha Sri M, SrinivasaVarma K, Anitha P, RavindraBabu P. Chromatographic analysis of phytochemicals in Costus igneus and computational studies of □avonoids. Formatics in Medicine Unlocked, 2018; 13: 34-40.

16. Vasantharaj S, Sathiyavimal S and Hemashenpagam N. Antimicrobial potential and screening of antimicrobial compounds of Costus Igneus using GC-MS. IJPSR, 2013; 4(5): 1815-1819.

17. Bakari S, Amal D, Samir F, Slim S, Neji Gharsallah, Adel K. Proximate analysis, mineral composition, phytochemical contents, antioxidant and antimicrobial activities and GC-MS investigation of various solvent extracts of cactus cladode, Food Science and Technology, 2017; 37(2): 286-293.

18. Pisoschi AM, Danet AF, Kalinowski S. Ascorbic Acid Determination in Commercial Fruit Juice Samples by Cyclic Voltammetry. 2008; 2008: 1-8.

19. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. American Journal of Enology and Viticulture, 1965; 16, 144-158.

20. Akhila J Shetty, Divya Choudhury, Rejeesh, Vinod Nair, Maria Kuruvilla, and Shashidhar Kotian. Effect of the insulin plant (Costus igneus) leaves on dexamethasone-induced hyperglycemia. Int J Ayurveda Res., 2010; 1(2): 100–10