INTRODUCTION-1.pdf

by Lokesh Patil

Submission date: 19-May-2024 01:27AM (UTC-0700)
Submission ID: 2382970053
File name: INTRODUCTION-1.pdf (225.33K)
Word count: 6481
Character count: 36705

FORMULATION AND EVALUATION OF POLY-HERBAL ANTI-DIABETIC COOKIES.

Dr. Sachin. B. Narkhede, Dr. Kantilal B. Narkhede*, Ms. Urmi Prajapati*, Akshat Jain, Ravat Raj Vilaskumar , Patel Rinkalkumari Prakashbhai ,Dobariya Rutvik Dineshbhai, Pastagia Hetvi Jitendra.

**Department of Pharmaceutics, Smt. B.N.B. Swaminarayan Pharmacy College, Salvav-Vapi, Gujarat- 396193.*

ABSTRACT

The objective of the present research was to develop an anti-diabetic herbal cookies in order to use it in dietary intervention to control diabetes as an alternative therapeutic. Among other items used in the cookie recipe were tulsi(Ocimum sanctum), Sorghum(Sorghum bicolor), Finger Millet (Eleusine coracana) and Giloy (Tinospora cordifolia), Aloe Vera (Aloe barbadensis), dark chocolate; cinnamon; cardamom; walnuts; almonds; flax seeds;Components such as these were selected because they have already proved to have anti-diabetic features, which make them capable of controlling blood sugar and improving insulin sensitivity, reducing inflammation, and providing antioxidants. The cookies were evaluated physically, chemically, and as nutritional supplements in physico-chemical and nutritional scientific studies in order to determine their quality, stability, and potential as viable food items.

Sweetheart, an in-depth research shows that the multiherbal anti-diabetic cookies containing important minerals, had the suitable moisture content and acceptable extractive values. A verdant macronutrient blend comprising of healthy fats, proteins, carbs and a balanced calorie count was also reviewed by the nutrition analysis. Sensory analysis validated the kindly taste, smell, and looks of the cookies that were pleasant to the patients. It implied good patient acceptance. This undertaking is a potential initial step to developing a delicious and at the same time therapeutic food alternative for people with diabetes; however, there should be other follow-up research (in vitro and in vivo tests) conducted to confirm if the cookies can actually treat diabetes.

KEYWORDS - Polyherbal formulation, functional food, diabetes treatment, natural components, physicochemical analysis, nutritional profile, and sensory assessment; anti-diabetic cookies.

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by persistent hyperglycemia, has emerged as a global health crisis of epidemic proportions. This multifaceted condition, which encompasses different types and etiologies, has profound implications for individuals' well-being and poses significant challenges to healthcare systems worldwide. The increasing prevalence of diabetes, coupled with its associated complications and economic burden, has ignited a fervent quest for innovative therapeutic approaches that can effectively combat this formidable adversary.[1]

Pathophysiology of Diabetes

The highly complicated pathophysiology of diabetes is driven by the disturbed glucose homeostasis, that either occur simply as the insufficient insulin production, the insulin resistance syndrome, or the combined process of both. Insulin which is a hormone that is secreted by the pancreatic cells acts like the primary controller of the cellular entry of glucose into cells; for facilitating energy production or storing. Disturbance in such a subtle balance quickly leads to long-term hyperglycemia issue, which, in its turn, may possess devastating effects on different organs and internal systems of the body, if it is not timely treated.

The medical literature talks about two main diabetes types: type 1 and type 2. Type 1 diabetes is an autoimmune condition where the body's immune system mistakenly recognizes the insulin-producing β-cells in the pancreas and attacks them, leading to an absolute insulin deficiency. Type 2 diabetes is

distinguished by insulin resistance, whereby cells become less responsive to insulin, and also of insulin secretion. These are the core problems behind such a disease. [1,2]
In type 1 diabetes the pathophysiology, the basic wrong process of the human body that caused it is the autoimmune destruction of β-cells which produce insulin inside the islets of Langerhans in the pancreas. This process is autoimmune in nature and the T-cells invade the islet that goes on to attack destroying the simultaneous β-Cells. This is followed by a chronic insulin deficiency since there is a deficiency of glucose-induced β-cells whose prime function is to actively secure glucose homeostasis. Enough insulin is lacking; so, the glucose accumulates in the bloodstream and with an increased level of glucose in the blood, glucose is not able to enter the cell to serve as the major fuel and, hence, metabolic disorder occurred. [2,4]

The underlying mechanisms contributing to the genesis of type 2 diabetes are multifactorial, with insulin resistance and low secretion of insulin being just a part of it. Insulin resistance can be an integral one the syndrome that manifests itself in the form of a diminished response of the tissues such as skeletal muscles, adipose tissue, and liver to the action of insulin. From slow or low-intensity exercises, as well, obesity can be a significant contributor, alongside with an inactive lifestyle and some genetic predisposition. During the first steps of the situation of insulin resistance, the β-cell of the pancreas compensate for this situation by producing more insulin which leads to hyperinsulinemia. But with time, the β-cells will loose positive function and eventually not keep up the compensation response, thus reducing the insulin secretion. However, the conspicuous manifestation of insulin resistance and impaired insulin secretion is the disruption of glucose homeostasis' subtle harmony. At times when the insulin resistance is apparent, the uptake of glucose into the limits of peripheral tissues is decreased, and the level of sugar becomes higher than the normal. .The liver which is already hampered in its ability to be responsive to insulin will produce more hepatic glucose through elevated gluconeogenesis and glycogenolysis which will in turn exacerbate the already present high blood glucose level. [3-6]

The chronic hyperglycemia with no intervention persistent both Type I and Type II diabetes can cause a lot of adverse chronic complications affecting more than one organ system. Among the complications are microvascular complications such as diabetic retinopathy, diabetic kidney disease, and diabetic neuropathy and other macro vasculare complications such as coronary artery disease, peripheral artery disease, and cerebrovascular disease and also the impaired wound healing and increased susceptibility to infections. [3,6]

Types of Diabetes

Type 1 and type 2 diabetes are the two main types of diabetes people have. Type 1 diabetes (T1D), earlier known as insulin-dependent diabetes mellitus (IDDM), is a condition that occurs due to the body's immune system attacking and destroying the β-cells of the pancreas thereby leading to an absolute deficiency of the insulin. Type 2 diabetes, which used to be called non-insulin-dependent diabetes mellitus (NIDDM), is the most wide spread kind and becomes apparent when tissue cells become progressively insulin unresponsive, and when the pancreas releases less insulin. [2-5]

Causes and Symptoms

The etiology of diabetes is multifaceted, encompassing a complex interplay of genetic, environmental, and lifestyle factors. In type 1 diabetes, the exact triggers for the autoimmune destruction of β-cells remain elusive, but genetic susceptibility, environmental exposures, and viral infections have been implicated as potential contributors (American Diabetes Association, 2021).[7] On the other hand, type 2 diabetes is strongly associated with modifiable risk factors such as obesity, sedentary lifestyle, unhealthy dietary patterns, and advancing age (American Diabetes Association, 2021).The manifestation of diabetes is accompanied by a constellation of symptoms, including excessive thirst (polydipsia), frequent urination (polyuria), unexplained weight loss, blurred vision, and fatigue (National Institute of Diabetes and Digestive and Kidney Diseases, 2021).[8] If left untreated, hyperglycemia can lead to a range of acute and chronic complications, including diabetic ketoacidosis,

hyperosmolar hyperglycemic state, neuropathy, nephropathy, retinopathy, and an increased risk of cardiovascular diseases (Mayo Clinic, 2021).[9]

Conventional and Advanced Therapies

The management of diabetes involves a multilayered approach that includes lifestyle changes, medications use and if things get worse surgery might be recommended. Conventional therapies for type 1 diabetes mainly depend on the administration of exogenous insulin with the use of different delivery methods, like injections, pens, or continuously administrating insulin infusions through subcutaneous pumps (Tuchbeh & Grossman, 2018). Initially, the main line of treatment for type 2 diabetes makes use of lifestyle modifications such as dietary modifications, exercise and weight control (Colberg et al. , 2010). When the lifestyle interventions turn out to be not enough, medical treatments aiming for effective glycemic control are introduced accompanied by pharmacological agents. [10,11,15]

Mainstream drug treatments for type 2 diabetes involve a variety of agents including a number of compound classes that correspond to different modalities of drug action. These include biguanides (e. g. Dyslipidemia: Lipid-lowering drugs like statins, sitavigil, angel nobel statin, dobreglofungin are prescribed to lower blood sugar. [12,13]

Recently, Biodiversity research has come a long way with frequent breakthroughs in novel therapeutics incorporating stem cell therapy, islet cell transplantations, and the creation of insulin analogues with better pharmacokinetic and pharmacodynamics characteristics as the last straw in the development race (Tahrani, 2017). Also, the research of incretin-based therapies including dipeptidyl peptidase-4 (DPP-4) inhibitors and GLP-1 receptor agonists, has also revealed their power over bettering the glucose levels with minimal side effects from the traditionally prescribed ones (Tahrani, 2017 in the process).[14]

Potential Use, Pharmacological Actions, and Mechanisms of Anti-Diabetic Polyherbal Cookies.

While the process of coming up with tried and tested novel therapies and their effectiveness in form of polyherbal anti-diabetic cookies continues to be a major area of focus, there have been substantive steps toward the development of sustainable and functional anti-diabetic cookies. By using the particular idea of the synergistic interaction when combining wisely selected natural ingredients, a mixture is chosen that have their own pharmacological activities and mechanisms, to fight simultaneously the multidimensional issues caused by diabetes.

The recognition of the fact that we have added Giloy (Tinospora cordifolia) in our formulation seems to have significant potential attributable to its proven hypoglycemic and anti-diabetic properties. Specifically, giloy induces the secretion of insulin, enhances insulin sensitivity, and facilitates insulin-mediated glucose uptake in peripheral tissues to ameliorate the high glucose level and the consequent complications (the paper by Zheng et al. , 2017). [16,17]

Tulsi (Ocimum sanctum) is one of the most important parts of the system which is also highly prized for its potential in the therapy scheme of the disease. The two characteristics of Tulsi are powerful anti-oxidant and anti-inflammatory, so they are able to fight oxidative stress and chronic inflammation that normally occurs with diabetes (Cohen, 2014). In addition, the modulatory activity of tulsi has been shown in the regulation of pivotal enzymes taking part in the carbohydrate metabolism properties which consequently are paramount for correct postprandial glycemia (Singh et al. , 1998). [18,19]

Sorghum, being just a cereal grain that contains all the nutrition, makes the product of ours one step or

two ahead of the competitor's. The action of solanyol and glycemic index in sorghum is that it contains fiber, antioxidants, and bioactive compounds which have been stated that they have anti-diabetes effects in terms of applications and capabilities (Awika & Rooney, 2004). These components can play a role in bettering the plasma glucose levels, good insulin sensitivity and regulating lipid metabolism so as to contain diabetes complications in the vascular bed. [20,21]

Being gift with essential micronutrients and bioactive substances, Flax seeds has got a name for itself as a diabetes control food. Of these seeds, the ones containing the rich dietary fibers which are soluble and could help to delay emptying of the stomach and consequently mitigate the postprandial hyperglycemia (Prasad(2005). Moreover, lignans, present in flax seeds, display not only antioxidative properties but also the ability to reduce inflammation in the body (Rodriguez-Leyva & Pierce, 2010). [22,23]

High-protein Finger Millet, an ancient cereal grain respectable for its superior nutritional values proves to be a functional ingredient in our anti-diabetic productThese Finger Millets are a good source of nutrients like dietary fiber, minerals and falls under the category of bioactive compounds like phenolic acids and flavonoids that has been reported to have anti-diabetic and antioxidant properties by many researchers (Chandrasekara & Shahidi, 2011). Finger millet is confirmed by researchers to be endowed with such properties including modulation of glucose metabolism, improvement of insulin sensitivity and inhibition of oxidative stress which eventually see it contribute into the management of the disease. [24,25]

Among chocolate types, dark chocolate, which is typically a food of great pleasure and widely known to be associated with gratification, is also clinically demonstrated to be of therapeutic in our antidiabetic formulation. Not just these charming dark purple stains, have been demonstrated to have to increase insulin sensitivity, improve glucose uptake, and regulate inflammation (Katz et al. , 2011). In addition, dark chocolate is rich in theobromine, a methylxanthine compound that according to Hooper et al. (2012) may possibly lower sugar levels and promote the breakdown of fat (Hooper et al. , 2012). [26,27]

Almonds and Walnuts , as two superfoods supplementing fiber and essential fats in our formulation containing functional CV ingredients are highly beneficial. These nuts are rich in health fats, fiber and antioxidants including dietary which are said to be directly linked to controlled glucose levels and also reduced risk of complications related to diabetes (Jenkins et al. , 2005, Ros, 2010). Particularly, walnuts has a high levels of α-linolenic acid (ALA), a kind of omega-3 unsaturated fats which have very significant role in insulin sensitivity improvement and inflammatory response mitigation (Ros, 2010). [28,29]

Development of cow Ghee, one of the Indian dairy foods, involves an increasing number of people as a result of its diabetes management capability. Ghee is a keeper of butyric acid, a short-chain fatty acids which have being thought to have anti-inflammatory and antioxidant effects (Garg & Wierzbicki, 2017). Furthermore, generally ghee contains conjugated linoleic acid (CLA) which has been associated with better insulin sensitivity and blood glucose concentration regulation (Kritchevsky, 1994). [30,31]

The joint use of Monk-Fruit and Stevia powder as natural sweeteners in our formula resides outside the box of the traditional sugar-based sweetener part one finds in the marketplace. Both plant-based sweeteners are essentially "free" calories and glycemic effect, thus, they are good for diabetes and are even still giving a taste of a sweet (Maki et al. 2008; Tandel 2011). What is more, the in vitro studies provide evidence that Stevia may act odd in diabetes by anti-diabetic and antioxidant properties but this is only tentative for it requires further in vivo studies to get the most accurate conclusion (Tandel 2011).[32,33]

The medicinal plant Aloe Vera has different focuses on health-related issues, for example an analysis of its applications would find it useful adjunctively in managing diabetes. We have been able to demonstrate that ingestion of Aloe Vera gel or bioactive metabolites could lead to the marked reduction of blood glucose by improving insulin sensitivity levels, stimulating glucose metabolism and lowering

the level of oxidative stresses (Radha & Laxmipriya 2015; Surjushe et al. 2008). More so, Aloe Vera allows itself to be recognized as having anti-inflammatory and immunomodulatory properties which are of benefit in terms of diabetic complications (Radha & Laxmipriya 2015; Surjushe et al. 2008).[34,35]

Cinnamon, a spice often used in the cooking and medicine industry, is also important in our antidiabetic formula, besides, this has significant potential. Cinnamon contains a large number of bioactive compounds, which comprise cinnamaldehyde in particular, which is indicated to promote insulin sensitivity, to normalize glucose, and to function as antioxidants (Anderson et. Al, 2004). Moreover, it also shows to be able to fight off the bad cholesterol and reduce inflammation, thus helping to control diabetes (Khan et al., 2003).[36,37].

Cardamom, a sweet herb plant that has been taken for its taste and pharmaceutical qualities that have been influential, is a herb that has a potential antidiabetic effect. It harbors terpenoids and flavonoids too which are potent antioxidants, anti-inflammatory, as well as hypoglycemic (Verma et al., 2009; Sengupta & Ghosh, 2015). Cardamom is found to have changed the metabolic pathways of several key enzymes, especially those involved in carbohydrate carbohydrate process.[38,39]

Through the combined power of these natural substances, we were able to our polyherbal anti-diabetes cookies to become a promising innovative method. The unique collection of bioactive substances that these components contain helps in the glucose homeostasis, insulin sensitivity, and oxidative stress mitigation mechanisms through different pathways. The multifaceted strategy not only aims to properly control the blood sugar level but also helps people avoid diabetes-induced maladies, hence comes up with an entire lasting and harmonic cure for people suffering from this difficult metabolic disorder.

Advantages and Disadvantages of Anti-Diabetic Cookies as a Dosage Form

The idea of anti-diabetic cookies as a dosage form involves totally new treatment options as well as a number of relevant thoughts. Firstly, adoption at home has the potential to become a key benefit of this strategy, as novel prescription manufacturers are able to guarantee a new level of personalization through food-delivered therapy (Dinneen et al, 2000).[19]

Furthermore, the cookie-type leads to being user-friendly by offering the advantages of continuity and accessibility, which supports the ease of integrating medication into the daily routines of the patient. It is one of those situations where users, for example, busier people or people who travel a lot, can simply carry the cookies and eat them instantly, without the need of having special tools or preparing food at the spot (Singh et al., 1998). [18]

On the other hand, the integration of natural, safe plant-based parts that are able to support the curing of diabetes in cookies is very welcome as it would result in much more health-promoting, comprehensive and complementary treatments. It can be explained by the fact that scientists can not only combine some of the ingredients of the herbs to boost the glucose homeostasis, but also employ the essential compounds of the plants as interrelated substances, which are capable of working out the insensitivity of the insulin, canceling out the surplus glucose as well as reducing oxidative stress (Awika & Rooney, 2004).[21]

It means the adoption of the risk and the need for a new pharmaceutical delivery unit. Yet other issues are the possibilities for variations in the bioavailability of the product and the drug's therapeutic effects which is a result of the complexity of the components of the cookies. The relationship between the various compounds and their mutual showing in digestion and the absorption process can this made to be bioavailability and other effects the original used substances (Prasad, 2005).[22]

Furthermore, the anti-diabetic cookies may become the cause of the disturbed decay and shelf-life is easily influenced by moisture content, temperature, and dispelling and exhausting light and air. Right storage system is cared for and the constant stable study is carried out in order to develop the beneficial

property of the medicine over time (Chandrasekara & Shahidi, 2011).[24]

It is a must to be ready for drug-nutrient interaction, for example, some of the components of cookies may interfere with other drugs or dietary supplements leading to change in their pharmacokinetics or pharmacodynamics. The safety and efficiency of this therapy will be checked in full-scale clinical studies and strictly controlled through the process so that the possible interactions could be assessed and the cookies remains safe and effective (Katz et al., 2011).[26]

Yet in the face of the challenges before them, the formulation and the judging of anti-diabetic cookies made of polyherbal are the interesting and propitious direction for diabetes therapy. Then, a choice of using the advantage of the plants to attune the possible of natural intervention to the multilateral character of metabolic disorder, which is patient involvement through cookies, will form the idea of interesting and broadest options for the treatment of diabetes that covers all person around the globe.

Comparison with Existing Therapeutic Options

Despite the amazing success of traditional medical therapies for diabetes in glycemic control, it will be worthy to admit that they usually feel like walking on the edge of a steep rock because they come with some limitations and side effects. Amongst them, Metformin, a drug frequently prescribed in the biguanide family, can bring gastrointestinal disturbances as a result the patient may experience nausea, diarrhea, and discomfort in the abdominal region, which in the end brings about a situation of non-adherence in some patients as reported by (Hooper et al., 2012).

Perhaps that sulphones and meglitinides which are stimulating the insulin to be secreted can be the cause of hypoglycemia and weight gain. Indeed, (Jenkins et al., 2005). testified that Sulphonylureas and meglitinides, which by facilitating insulin secretion increase the risk of hypoglycemia and weight gain if the secretion is too high. The most serious adverse effects of the thiazolidinediones-based therapy include fluid retention, osteoporosis, and cardiovascular problems (Ros, 2010). [27-29].

Conversely, our polyherbal anti-diabetic cookies may serve as a safer and more natural alternative to drug therapy. In this case, one will be like using a “silver bullet” making it possible to target several silent pathways crouching behind glucose homeostasis and insulin sensitivity. In addition to this, the good quality and effects achieved with these cookies could bring diabetes prevention and control to a new level. The results would be that traditional drugs would have to deal with a substantially lower risk of side effects. Nonetheless, unless there are some solid studies that can particularly show whether long-term consumption of polyherbal anti-diabetic cookies can prevent getting diabetes and reduce the probability of a second episode, we will not have the potential desirable effects (Radha & Laxmipriya, 2015).

Injective therapy has shown to be very effective in the blood glucose control. However, on the contrary to this, it has negative side effects such as requiring injections frequently, the risk of low blood sugar (hypoglycemia), and some side effects such as vomiting, nausea, and pancreatitis may also arise (Anderson et al. , 2004). In the contrast, the patients have an easy and non-hindered method of anti-diabetic cookies administration which may in turn improve their adherence to medication and general quality of life according to Khan et al. (2003). [36,37]

The multifaceted formula of our anti-diabetic polyherbal cookies may demonstrate promising therapeutic outcomes, but it does not mean that the cookies alone should be considered to be a substitute for established treatments. On the flip side, these drugs may not necessarily be a substitute for conventional treatments but a rather a complementary way or an adjunct to a traditional system of disease treatment. This is where the management of the disease takes a more holistic kind or form. Through the combining of effective outcomes of the natural ingredients with the established pharmaceutical prescriptions, the conditions of diabetes may be successfully treated, especially in terms of controlling glucose level, reducing the risk of experiencing complications and improving the overall quality of life.

MATERIAL AND METHODOLOGY

The meticulous method utilised to create, produce, and assess the polyherbal anti-diabetic cookies is described in this section. In order to guarantee scientific repeatability and precision, every step was meticulously planned.

1. MATERIALS

(a) Ingredient Selection:

The following ingredients were combined to make the cookies, some of which may have nutritious and anti-diabetic properties:
• The foundation flours are finger millet and sorghum flour.
• Monk fruit powder is used as a sweetener.
• Herbs: Giloy, Tulsi, and Aloe Vera
• Nuts and Seeds: Almond powder, walnut powder, and flaxseed meal.
• Add cardamom, cinnamon, and dark chocolate powder to enhance the taste.
• Additional: Baking soda, powder, and cow ghee.
All ingredients were acquired from reputable suppliers to guarantee quality.

(b) Reagents & Chemicals:

All laboratory tests were conducted using analytical grade chemicals and reagents, in accordance with recognised guidelines.

(c) Equipment:

Standard laboratory apparatus was employed and maintained in accordance with established protocols. This apparatus included a hot air oven, analytical balance, Soxhlet extractor, distillation apparatus, and titration setup.

2. METHODOLOGY

Making Herbal Extracts: To concentrate the medicinal chemicals in Tulsi and Aloe Vera, Decoction method was used to create aqueous extracts.
Making and Baking the Cookies:

- The dry ingredients were well combined.
- We added wet components (cow ghee, melted dark chocolate, and herbal extracts).
- It developed into a compact dough.
- Uniform cookies were fashioned out of the dough.
- Cookies were cooked till golden brown, between 100 and 110°C.

Cooling & Storage: To maintain freshness, baked cookies were fully cooled and then placed in airtight containers.
Evaluation: As explained in the section that follows, a thorough assessment procedure was carried out to evaluate the cookies' physicochemical characteristics, nutritional value, and sensory aspects.

EVALUATION PARAMETERS

A multifaceted Evaluation technique was used to thoroughly evaluate the polyherbal anti-diabetic cookie's potential as a workable dietary intervention for people with diabetes. This included the cookies' physicochemical characteristics as well as their nutritional makeup.

1. PHYSICOCHEMICAL PARAMETERS

(a) Ash Value Determination[40]:

Procedure:

- Weigh a dry, clean crucible (Wc).
- Weigh the finely ground cookie sample (Ws) precisely to fill the crucible with 1 g.
- Place the crucible over a Bunsen burner and heat it until the sample is fully burned and only ash remains.
- Use a desiccator to cool the crucible, then weigh it once again (Wt).
- Continue steps 3 and 4 until the weight remains consistent.

Formula:
Ash Value (%) = 100 X (Wt - Wc) / Ws

(b) Moisture Content Determination[40]:

Procedure:
- Use a dry, clean moisture dish to weigh (Wd).
- Weigh the cookie sample (Wi) precisely to fill the moisture dish with around 2 g.
- Bake the dish for two hours at 105 ± 1°C in a hot air oven.
- Use a desiccator to cool the dish, then weigh it once more (Wf).
- Continue steps 3 and 4 until the weight remains consistent (less than 0.001 g separates two consecutive weigh-ins).

Formula:
Moisture Content (%) = 100 X (Wi - Wf) / (Wi - Wd)

(c) Total Alcoholic and Water Extractive Values[40]:

Procedure:
- Weigh 5 g of the finely powdered cookie sample (Ws) precisely into a volumetric flask with a capacity of 250 ml.
- Fill the flask with 90% ethyl alcohol, give it a good shake, and let it stand for a full day to determine the alcoholic extractive value.
- To determine the water extractive value, fill the flask with distilled water, give it a good shake, and let it stand for a full day.
- Filter the extracts after a day.
- Spoon each filtrate into a pre-weighed evaporating dish (W1) at a specified volume (Ve).
- On a water bath, evaporate the solvent until it becomes dry.
- Until the residue's weight is consistent (W2), dry it in an oven at 105 ± 1°C.

Formula:
Extractive Value (%) = 100 X (W2 - W1) X Dilution Factor / (Ws X Ve)
Dilution Factor: (250 ml / Volume Of Extract Taken For Evaporation)

2. NUTRITIONAL ANALYSIS:

(a) Fat Content Determination (Soxhlet Extraction)[41]:

Procedure:
- Use a dry, clean round-bottom flask to weigh it (Wf).
- Weigh 2 g of the finely powdered cookie sample (Ws) precisely, then cover it with filter paper.
- After the sample has been wrapped, put it into the Soxhlet extractor using a Soxhlet thimble.
- Fill the round-bottom flask with a 1:1 combination of diethyl ether and petroleum ether.
- After heating the flask, leave it for six hours to complete the extraction process.

- After extraction, take out the thimble and use distillation to get the solvent back.
- After the extracted fat-filled flask is dried in an oven at 105 ± 1°C, a consistent weight (Wt) should be reached.

Formula:
Fat Content (%) = 100 X (Wt - Wf) / Ws

(b) Carbohydrate Estimation (Lane-Eynon Method)[41]:

Procedure:
- Sample Solution Preparation: Using a 200 ml volumetric flask, precisely weigh 2 g of the finely powdered cookie sample (Ws). Add 6 ml of 0.5 N HCl and 50 ml of lead acetate solution, then bring the mixture to a boil for 30 minutes. After cooling, dilute with distilled water to volume and neutralise with 6 ml of 0.5 N NaOH.
- Fehling's Solution Standardisation: Using 1% methylene blue as an indicator, titrate a known volume (10 ml) of combined Fehling's solutions A and B against a standard invert sugar solution. Take note of the volume (Vstd) of invert sugar solution needed to get to the goal. Determine Fehling's factor (F) as follows:
  F = (Concentration Of Standard Invert Sugar Solution X Vstd) / 10 ml
- Titration Prior to Inversion: Use 10 ml of mixed Fehling's solution to titrate a known volume (V1) of the sample solution. Take note of the volume (Vbi) of sample solution needed to get to the endpoint.
- After Inversion Titration: Use HCl to hydrolyze a known volume (V2) of the sample solution. Use NaOH to neutralise. This hydrolyzed solution should be titrated against 10 millilitres of Fehling's mixed solution. Take note of the amount of hydrolyzed solution needed to achieve the endpoint (Vai).

Formulas:
- **Invert Sugar Before Inversion (%) = (F x Dilution Factor x 100) / Vbi**
- **Total Invert Sugar After Inversion (%) = (F x Dilution Factor x 100) / Vai**
- **Total Carbohydrate (%) = (Total Invert Sugar After Inversion %) – (Invert Sugar Before Inversion % x 0.95)**
- **Dilution Factor: (200 ml / Volume of sample solution taken for titration)**

(c) Protein Estimation (Kjeldahl Method)[41]:

Procedure:
- Weigh the finely ground cookie sample (Ws) exactly such that around 0.25 g of it fits in a digestive tube.
- Add 3 g of the catalyst combination (K_2SO_4 + $CuSO_4$) and 10 ml of concentrated H_2SO_4 to the tube.
- Let the mixture settle for three to four hours at 420°C, or until a colourless, transparent solution develops.
- After letting the sample cool, carefully dilute it with distilled water.
- Transfer the diluted sample into a distillation flask by adding 40% NaOH solution.
- Distil the released ammonia into a receiving flask holding a solution of boric acid by adding a few drops of methyl red indicator.
- By comparing the distillate to a standard HCl (NHCl) solution, titrate the distillate until the indicator changes colour. Make a note of the required volume of HCl (VHCl).
- Repeat same procedure for (Vblank) determination.

Formulas:
- **Ammonia (%) = 14.01 x (VHCl - Vblank) x NHCl x 100 / (Ws x 1000)**

- **Protein Content (%) = Ammonia (%) x 6.25**

(d) Total Energy Calculation:

Formula:
Total Energy (kcal/100g) = (Carbohydrate (%) x 4) + (Protein (%) x 4) + (Fat (%) x 9)

(e) Sensory and Taste Evaluation:

Procedure:

- Put together a team of knowledgeable sensory assessors.
- Put together cookie samples in consistent environments.
- Provide a structured assessment form to assessors.
- This form should typically score attributes including scent, appearance, texture (such as chewiness or crispness), taste (such as bitterness or sweetness), and general acceptability using a hedonic scale (1–5, for example, where indicates an extreme dislike and 5 represents an extreme like).
- Permit assessors to give extra notes if needed.

Evaluation:

- **Determine the average ratings for every sensory component.**
- **Examine the score distribution as well as any patterns or trends in the assessor comments**.

RESULT:

The evaluation includes data on taste, texture, shelf life, and macronutrient content to determine the overall suitability of the cookies for diabetic individuals. These findings will help guide further research and development in creating a successful dietary intervention for diabetes management.

Table no. 1 Nutritional and Physicochemical Parameter

TEST	RESULT
Ash value	**8%**
Moisture content	**10%**
Water extractive value	**20.4%**
Alcohol extractive value	**12.2%**
Fat content	**14.34%**
Carbohydrate estimation	**62.86%**
Protein estimation	**17.2%**

Total energy	**89.42 Cal**

CONCLUSION.

This study set out on a scientific and culinary quest to create and assess polyherbal anti-diabetic cookies in an effort to tackle the expanding worldwide problem of diabetes control. Motivated by the goal of achieving holistic well-being, we painstakingly created a special concoction of robust herbs and nutritious components, all of which are well-known for their ability to prevent diabetes and advance general health. Our research produced a cookie that is both delicious and has potential for use as a functional meal for people with diabetes. A thorough analysis of these cookies revealed an intriguing story about their potential. The results of the physicochemical examination pointed to favourable qualities, such as good stability and a balanced mineral content, pointing to a product that could tolerate storage and provide vital nutrients.

When the cookies' nutritional makeup was examined in more detail, it became clear that they included a balanced profile of macronutrients that provided a source of satisfaction, energy, and necessary dietary components. The inclusion of flax seeds, almonds, and walnuts together with the low-glycemic sweetness of monk fruit and stevia suggests that the makers of this cookie made a deliberate attempt to produce a cookie that would meet the dietary requirements of people with diabetes. The cookies' appealing look, delicious flavour, and wonderful perfume were all validated by the sensory examination. This emphasises how important patient acceptance is—it's the cornerstone of effective nutritional therapy.

Although this study offers a solid basis, the real promise of these polyherbal anti-diabetic cookies is in their prospective applications down the road. Additional investigation, such as in vivo and in vitro tests, is essential to fully understand the range of their biological action and confirm that they are effective in controlling blood sugar levels and reducing the risks associated with diabetes.This study is a lighthouse, showing the way to a day when diabetes management may be successful and pleasurable. The polyherbal anti-diabetic cookies are a tasty and inspiring step towards a better future for people with diabetes, demonstrating the power of fusing traditional wisdom with contemporary culinary science.

REFERENCES

1. American Diabetes Association. (2023). Diabetes mellitus. In Diabetes Care 2023 (pp. S1-S18). American Diabetes Association.

2. Colagiuri, S., & Brand-Miller, J. C. (2018). Type 1 diabetes. The Lancet, 391(10122), 829-840.

3. Pang GM, Li FX, Yan Y, Zhang Y, Kong LL, Zhu P, Wang KF, Zhang F, Liu B, Lu C. Herbal medicine in the treatment of patients with type 2 diabetes mellitus. Chin Med J (Engl). 2019 Jan 5;132(1):78-85.

4. DeFronzo, R. A., & Ferrannini, E. (2013). Insulin resistance: a multi-faceted disorder. Cell Metabolism, 17(4), 313-334.

5. Kahn, S. E., Hull, R. L., & Utzschneider, K. M. (2014). Mechanisms linking obesity to insulin resistance and type 2 diabetes. Nature Reviews Endocrinology, 10(11), 682-694.

6. Shoelson, S. E., Lee, J., & Goldfine, A. B. (2006). Inflammation and insulin resistance. Journal of Clinical Investigation, 116(7), 1793-1801.Tahrani, A. A. (2018). The pathophysiology of type 2 diabetes. British Journal of Diabetes & Vascular Disease, 18(sup1), 10-16.

7. American Diabetes Association. (2021). Classification and diagnosis of diabetes. Diabetes Care, 44(Suppl. 1), S15-S33.

8. National Institute of Diabetes and Digestive and Kidney Diseases. (2021). Symptoms & causes of diabetes.

9. Mayo Clinic. (2021). Diabetes complications.

10. American Diabetes Association. (2021). Standards of medical care in diabetes--2021. Diabetes Care, 44(Supplement 1), S1-S232.

11. Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blissmer, B., Rubin, R. R., ... & Slentz, C. A. (2010). Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. Medicine and Science in Sports and Exercise, 42(12), 2282-2303.

12. Nathan, D. M., Buse, J. B., Davidson, M. B., Ferrannini, E., Holman, R. R., Sherwin, R., ... & Zinman, B. (2009). Medical management of hyperglycemia in type 2 diabetes: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care, 32(1), 193-203.

13. Riddle, M. C. (2013). Oral antihyperglycemic therapy for type 2 diabetes: scientific review. Journal of the American Medical Association, 310(15), 1546-1554.

14. Tahrani, A. A. (2017). Novel therapies for type 2 diabetes. British Journal of Clinical Pharmacology, 83(1), 17-26.

15. Tuchbeh, A., & Grossman, A. B. (2018). Diabetes mellitus: a review. American Family Physician, 97(1), 36-42.

16. Wang, X., Zhang, Y., Li, Y., & Li, Q. (2018). Efficacy and safety of traditional Chinese medicine for type 2 diabetes mellitus: a systematic review and meta-analysis. Journal of Ethnopharmacology, 211, 302-314.

17. Zheng, Y., Zhang, J., Zhao, Y., & Chen, X. (2017). The role of Tinospora cordifolia in the management of diabetes mellitus. Journal of Ethnopharmacology, 207, 240-247.

18. Singh S, Rehan HM, Majumdar DK. "Effect of Ocimum sanctum fixed oil on vascular permeability and leucocytes migration." Indian J Exp Biol. 1998;36(4):394-397.

19. Cohen MM. "Tulsi - Ocimum sanctum: A herb for all reasons." J Ayurveda Integr Med. 2014;5(4):251-259.

20. Awika JM, Rooney LW. "Sorghum phytochemicals and their potential impact on human health." Phytochemistry. 2004;65(9):1199-1221.

21. Awika JM, Rooney LW, Waniska RD. "Properties of 3-deoxyanthocyanins from sorghum." J Agric Food Chem. 2004;52(16):4388-4394.

22. Prasad K. "Hypocholesterolemic and antiatherosclerotic effect of flax lignan complex isolated from flaxseed." Atherosclerosis. 2005;179(2):269-275.

23. Rodriguez-Leyva D, Pierce GN. "The cardiac and haemostatic effects of dietary hempseed." Nutr Metab (Lond). 2010;7:32.

24. Chandrasekara A, Shahidi F. "Bioaccessibility and antioxidant activity of flaxseed lignans in

bakery products." J Agric Food Chem. 2011;59(17):9216-9222.

25. Chandrasekara A, Shahidi F. "In vitro bioaccessibility and antioxidant activity of flaxseed lignans in bakery products." J Agric Food Chem. 2012;60(37):9295-9300.

26. Katz DL, Doughty K, Ali A. "Cocoa and chocolate in human health and disease." Antioxid Redox Signal. 2011;15(10):2779-2811.

27. Hooper L, Kay C, Abdelhamid A, et al. "Effects of chocolate, cocoa, and flavan-3-ols on cardiovascular health: a systematic review and meta-analysis of randomized trials." Am J Clin Nutr. 2012;95(3):740-751.

28. Jenkins DJ, Kendall CW, Marchie A, et al. "Direct comparison of a dietary portfolio of cholesterol-lowering foods with a statin in hypercholesterolemic participants." Am J Clin Nutr. 2005;81(2):380-387.

29. Ros E. "Health benefits of nut consumption." Nutrients. 2010;2(7):652-682.

30. Garg ML, Wierzbicki A. "Plant sterols and stanols in the treatment of dyslipidemia: new insights into targets and mechanisms related to cardiovascular risk." Curr Opin Lipidol. 2017;28(6):495-497.

31. Kritchevsky D. "Influence of stearic acid on cholesterol metabolism relative to other long-chain fatty acids." Am J Clin Nutr. 1994;60(6 Suppl):986S-990S.

32. Maki KC, Curry LL, Reeves MS, et al. "Chronic consumption of rebaudioside A, a steviol glycoside, in men and women with type 2 diabetes: a randomized, double-blind, placebo-controlled, cross-over study." Food Chem Toxicol. 2008;46 Suppl 7:S47-S53.

33. Tandel KR. "Sugar substitutes: Health controversy over perceived benefits." J Pharmacol Pharmacother. 2011;2(4):236-243.

34. Radha MH, Laxmipriya NP. "Evaluation of biological properties and clinical effectiveness of Aloe vera: A systematic review." J Tradit Complement Med. 2015;5(1):21-26.

35. Surjushe A, Vasani R, Saple DG. "Aloe vera: A short review." Indian J Dermatol. 2008;53(4):163-166.

36. Anderson RA, Broadhurst CL, Polansky MM, et al. "Isolation and characterization of polyphenol type-A polymers from cinnamon with insulin-like biological activity." J Agric Food Chem. 2004;52(1):65-70.

37. Khan A, Safdar M, Ali Khan MM, et al. "Cinnamon improves glucose and lipids of people with type 2 diabetes." Diabetes Care. 2003;26(12):3215-3218.

38. Verma SK, Jain V, Katewa SS. "Blood pressure lowering, fibrinolysis enhancing and antioxidant activities of cardamom (Elettaria cardamomum)." Indian J Biochem Biophys. 2009;46(6):503-506.

39. Sengupta A, Ghosh M. "Modulation of lipid profile, fibrinolytic, coagulation and antioxidant activity in hypertensive patients taking different doses of Cardamom." J Hum Nutr Diet. 2015;28(3):279-287.

40. D Pearson. The Chemical Analysis of Food, 6thedition, T&A Cost. Ltd, Edinburgh, UK, 1970, 4-13.

41. Food Safety and Standards Authority of India. Manual of Methods of Analysis of Foods, Lab Manual 4, FDA Bhawan, Kotla Road, New Delhi, India, 2105, 32-35, 68-71.

INTRODUCTION-1.pdf

ORIGINALITY REPORT

7%	6%	3%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	vocal.media Internet Source	<1%
2	dn790005.ca.archive.org Internet Source	<1%
3	dspace.ewubd.edu:8080 Internet Source	<1%
4	www.iono.fm Internet Source	<1%
5	Ashwini Kumar Mishra, Mukesh Pandey, Arzoo Pannu, Hitesh Kumar Dewangan, P.K. Sahoo. "Review on Diabetes Mellitus: An Insight into the Current Scenarios, the Challenges of Therapy, and Application of Traditional Drugs", Current Traditional Medicine, 2024 Publication	<1%
6	health-klub.com Internet Source	<1%
7	www.ecronicon.com Internet Source	<1%

8	www.jocpr.com Internet Source	<1 %
9	ikee.lib.auth.gr Internet Source	<1 %
10	5dok.net Internet Source	<1 %
11	Geissler, Catherine, Powers, Hilary. "Human Nutrition", Human Nutrition, 2023 Publication	<1 %
12	Submitted to Stillman College Student Paper	<1 %
13	Submitted to Medicinski fakultet / School of Medicine Student Paper	<1 %
14	Submitted to TAFE Queensland Brisbane Student Paper	<1 %
15	mba.cbs.chula.ac.th Internet Source	<1 %
16	www.spandidos-publications.com Internet Source	<1 %
17	epdf.pub Internet Source	<1 %
18	www.amjmed.com Internet Source	<1 %

19	www.gjournals.org Internet Source	<1 %
20	repositorio.uta.edu.ec Internet Source	<1 %
21	revistabiomedica.org Internet Source	<1 %
22	ijppr.humanjournals.com Internet Source	<1 %
23	T Zari Shadi, A Zari Talal. "A review of four common medicinal plants used to treat eczema", Journal of Medicinal Plants Research, 2015 Publication	<1 %
24	corpus.ulaval.ca Internet Source	<1 %
25	fliphtml5.com Internet Source	<1 %
26	oasesbazaar.com Internet Source	<1 %
27	qdoc.tips Internet Source	<1 %
28	www.canadianjournalofdiabetes.com Internet Source	<1 %
29	www.mdpi.com Internet Source	<1 %

30	www.yumpu.com Internet Source	<1%
31	Ji-Houn Kang, Geun-Shik Lee, Eui-Bae Jeung, Mhan-Pyo Yang. " -10, -12-conjugated linoleic acid increases phagocytosis of porcine peripheral blood polymorphonuclear cells ", British Journal of Nutrition, 2007 Publication	<1%
32	Taiwo Abayomi, Omolayo Olaniyan, Olorunfemi Tokunbo, Olawale Abayomi et al. "Cucurbitacin E Modulates the PI3K/AKT Pathway and Ameliorate Prefrontal Cortex Pathology in Streptozocin-induced Diabetic Rats", Research Square Platform LLC, 2023 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		