



Research Article

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Formulation of Polyherbal Antidiabetic Cookies

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ABSTRACT

Most people consume cookies during breakfast, snacks and leisure time to control their hunger and get some energy, in market there are so many varieties of cookies are available, and whose main components are refined flour, sugar and butter. Hence these cookies are generally avoided by obese and diabetic patients as they cause high sugar level in blood. Therefore, in this investigation, we have formulated Polyherbal cookies with the help of oats, wheat flour and different Ayurveda herb. Different varieties were formulated using different plant to find out the best composition for cookies on the basis of palatability. After selection of the best composition, cookies were prepared for the physiochemical, sensory and nutritional analysis. Sensory analysis was evaluated based on organoleptic property: color, taste, aroma and overall acceptability on the basis of 9-point hedonic scale. Physiochemical evaluation included total ash value, total water and alcoholic extraction, total moisture content. On the basis of nutritional value comparison, it was found that protein content is higher in our formulation than other marketed product.

Keywords: Cookies; Polyherbal; Ayurveda; Physiochemical; Nutrition

INTRODUCTION

Diabetes is a very common, non-communicable metabolic disorder mostly occurring in young ones and associated with other diseases like cardiovascular disease, kidney disease etc. It occurs when pancreas does not synthesized insulin or is not properly utilized by body. According to WHO survey report globally, an estimated 422 million adults were suffering in 2014 and rate of increment is about 4.7% to 8.5%. Diabetes mellitus is a chronic metabolic disease condition enounced by high glucose level in blood (Hyperglycemia), glycosuria, hyperlipidemia, negative nitrogen balance and sometimes ketonaemia. Basically, diabetes mellitus is grouped in three main classes: Type-1 diabetes mellitus / Insulin dependent diabetes mellitus/Juvenile onset diabetes mellitus, which are mainly caused by T-cell mediated autoimmune destruction of islets of insulin secretion Beta cells [1]. Type-2 diabetes mellitus /Non-Insulin Dependent diabetes mellitus occurs due to moderately reduction in β cell mass or low circulation of insulin due to interplay of genetic or metabolic factor. Almost 90% of diabetes patients are suffering from type-2 diabetes. Type-3 occurred during pregnancy when insulin is not synthesized properly or cells become resist to insulin. Insulin is a two polypeptide 51 amino acid hypoglycemic hormone. 1U insulin is secreted per hour by human pancreas but higher amount is secreted after meal and controlled by chemical, hormonal and neural mechanism. Insulin is site specific and present on all cell membrane but more density depends on the cell type: liver and fat cells are rich in presence. Some secondary messenger like PIP_3 activate PI_3 kinase also mediates the action of insulin on metabolism enzymes. Insulin activates glucose transport across cell membrane by ATP dependent transfer of glucose transporter (GLUT-4) to the plasma membrane. The secondary messenger PIP_3 and some tyrosine phosphorylated guanine exchanger protein help to GLUT-4 to move from cytosol to plasma membrane. Modern drugs which are used to treat diabetes worldwide are effective, but some natural therapies, natural foods and change in lifestyle would be a wise act to treat and control diabetes and associated disease. Various plants and plants part or plant products (more than 1200) are identified as hypoglycemic with less side effect [2-5].

Polyherbal antidiabetic cookies are combination of various herbs and cereals that have a great potency to stimulate insulin secretion by various mechanism of action. These cookies are containing oats, curry leaves, ashwagandha, ginger, drumsticks, cinnamon, honey, artificial sugar (sucralose) etc., which is tasty, healthy as well as beneficial for a diabetic patient for all age group persons and the product is containing herbs and cereals so it has less adverse effect on human body. According to WHO report 2016 it was made an action plan for 2013-2020 in which it included various actions and suggested that natural food products which can reduce or normalize glucose level in blood should be develop more [6]. Oats (*Avena sativa*) belongs to family Poaceae. It has soluble fiber known as beta glucan is polysaccharides which containing glucose residue binds with 1, 3 and 1, 4 bonds. Products that have β glucan have been used from thousands of years for human health, but β glucans has been recently scrutinized as active ingredient [7,8]. Since then, they have been studied extensively for immune stimulation effects and developed for the treatment of various diseases including cancer, infectious diseases. Oat β glucan have been used for several clinical trials to reduce glucose. Studies showed that oat β glucan lowered postprandial glycemia [7,9,10], The effect of β glucans to reduce blood glucose could be mediated possibly by delaying stomach emptying so that dietary glucose is absorbed more gradually [7,11]. After ingestion of oats (bran flour or crisp), the blood glucose level was lower at 15, 30 and 45 min but higher at 90 min after 12.5g glucose loading [7,12]. Thus, the peak level is much smoothed and the shape of the plasma glucose response curve is flatter [7,13]. These changes reduce the feeling of hunger caused by rapid decrease in blood glucose [7,12,14]. Thus, β glucan may reduce appetite and reduce food intake.

Murraya konigii, commonly known as curry leaves in India, belongs to Family Rutaceain which more than 150 genera and 1600 species are present and well known for its characteristic aroma and medicinal value. This whole plant is used as antioxidant, free radical scavenger, Hypoglycemic, hepatoprotective, antimicrobial, antifungal, pancreatic lipase inhibitor, protect from dental caries, anticancer, anti-inflammatory, antipyretic immunomodulatory, kidney protective, antiobesity etc. This is scientifically proved that when its leaves were fed to rat, cause hypoglycemic activity by increasing hepatic glycogenesis as evident by increased the activity of glycogen synthase. A decrease in glycogenolysis and glyconeogenesis is reported and was evident from decreased activity of glycogen phosphorylase and gluconeogenic enzyme [15-21].

Cinnamoni cassia is a very effective medicinal plant belongs to the family Lauraceae, which is commonly used for muscle spasms, vomiting, common cold, and loss of appetite. According to modern research cinnamon have a miraculous tendency to lower blood sugar level in diabetic patients. The chemical constituents of cinnamon act on PPAR α and PPAR γ (Peroxisomal proliferators' activator receptor) that have been identified as therapeutic target against dyslipidermia and diabetes. Activation of PPAR α lowers the triglycerides and uplifted the level of plasma HLD cholesterol level, while PPAR γ elevated the sensitivity for insulin. [22-24]

Ashwagandha (*Withania somnifera*) belong to family Solanaceae. Ashwagandha root is mainly containing steroids and alkaloids that have rejuvenative herb that is used to treat mental health problem associated with other disease. It controls the lipid profile, cholesterol level and blood glucose level as compare to oral hypoglycemic agent [25-27]. The flavanoids and antioxidant which is present in root of Ashwagandha is responsible for its antidiabetic property through improve the liver and kidney function and balanced albumin and globulin ratio that play a vital role to treat diabetes. Honey is the cardinal of ayurveda system and for many Indian drugs. Honey is cardinal for medicinal use, it is widely use in various medication system all around the world. honey is composed of from various kinds of amino acid, mineral, enzymes etc. honey has been defined as an antibacterial, antifungal, protect from gastrointestinal infection, wound healer, protect from cardiovascular disease and hypoglycemic. Due to low Glycemic index than with glucose or sucrose it significantly helps to control glucose level in blood plasma as well as caused reduction of blood lipids, homocystein CRP level in normal and hyperlipidaemia subjects. Various research and clinical trials says that honey stimulates insulin and increase hemoglobin (HbA_{1c}) level and GPT and cause reduction in lipid profile like LDL/HDL-Cholesterol, Triglyceride etc. So it can be a good option for diabetic patients for sweetening [28,29].

Moringa oleifera is a very valuable plant belongs to the family Moringaceae and cultivated in all over the India and tropical part of the world. All the parts of plant are known for its therapeutic value. This leaf contains more vitamin than carrots, more calcium than milk, more iron than spinach, more vitamin C than orange, more Potassium than banana and more protein than egg and milk [17,21]. The active phytochemicals are glucosinolate, isothiocyanates, mineral, vitamins and carotenoids. These phytochemicals make it potentiate to treat infection, ulcer, spasm, hypertension, inflammation, elevated cholesterol level as well as hyperglycemia. Ginger (*zingiber officinale*) belongs to family Zingiberaceae that have some active constituent like gingerols, shagoals, zingerone, paradol. These active constituents are widely accepted that are responsible for treating pain, cold, constipation, cancer, clotting and diabetes. Similar to ashwagandha they also increase mediated enzymes and help to control diabetes [30-32] as well as pulses are also identified as a source to control diabetes mellitus [33,34].

MATERIALS AND METHODS

Collection of Sample

Oats, wheat flour, roasted black-gram flour, Ashwagandha powder, Ginger powder, Cinnamon, Milk, Flavoring agent (vanilla and cocoa), salt, baking powder, baking soda, butter, artificial sugar (sugar free Natura), leaves of *Murraya konigii* 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

Different compositions of cookies were formulated using different ratios of Oats, wheat flour, roasted black-gram flour, Ashwagandha powder, Ginger powder, Cinnamon, Milk, Flavoring agent (vanilla and cocoa), salt, baking powder, baking soda, butter, artificial sugar (sugar free Natura), leaves of *Murraya konigii*, drumsticks, and based on the palatability and visual appealing final product were selected for sensory evaluation and nutritional value analysis.

Physiochemical Properties of Cookies

Ash value:

Total ash content of the prepared cookies was estimated by following procedure [10]. According to the procedure 1 gm of sample was taken in a tarred crucible and it was burnt on Bunsen burner until all the carbon burnt. Then Sample was cooled, weighed and procedure was repeated until weight become constant. After that total Ash value were calculated based on the equation given below:

$$\text{Total ash value: } 100(Z - X)/Y$$

Where, X=Weigh of empty dish; Y=Weigh of sample taken; Z=Weigh of crucible with sample after complete burn.

Moisture content:

Moisture content was estimated by the method prescribed in the chemical Analysis of food [10]. As mentioned in procedure, cookies samples were weighed accurately in a moisture dish and were kept in hot air oven for 2 hours at 105°C and then it was cooled in desiccators and weighed. Process of heating was repeated for 30 min. and again cooled and weighed. This procedure was done until the difference between two successive weighing became less than 0.001 gm. Moisture content in test sample was calculated based on the equation given below:

$$\text{Moisture \%} = (W_1 - W_2) \times 100 / W_1 - W$$

Where, W_1 = Weight of moisture dish with sample before drying; W_2 = Weight of moisture dish with sample after drying; W = Weight of moisture dish.

Total alcoholic and water extractive values:

For analysis of total alcohol/Water extractive value, 5 gm of cookies powder were taken in 250 ml of volumetric flasks in which 90% of ethyl alcohol/Distilled water were added and kept aside for 24 hours. After 24 hour samples were filtered and were taken in porcelain dishes. All the samples of alcoholic and water extracts were heated at 100°C for evaporation, following evaporation samples were cooled down and further calculations were done by following method.

Calculation: 5 gm of sample gives 4x of alcohol extract so 100 gm of sample gives = $80 \times x/4$

Where, x=Sample after drying.

Nutritional Analysis

Fat content:

According to the procedure [10], 2 gm of sample was kept in soxhlet apparatus with diethyl alcohol and petroleum ether in 1:1 ratio for 6 hours than ether was removed by distillation and dried it in hot air oven at $110 \pm 1^\circ\text{C}$ and then it was cooled in a desiccator. Taken dried sample was weighed again. Left Residue was washed with 2 to 3 ml of diethyl ether and this process was repeated until the weight became constant.

$$\% \text{ of fat content} = (M_1 - M_2) \times 100 / \text{weight of sample}$$

Where, M_1 =Weigh of Round bottom flask with fat; M_2 = Weigh of the Round bottom flask.

Carbohydrate estimation:

Carbohydrate estimation was done by DGHS Manual method [36]. For estimation of carbohydrate 2 gm of cookies powder was taken in a 200 ml of volumetric flask and 50 ml of lead acetate was added. 6 ml of 0.5 N HCl was added and heated on hot water bath. After heating sample were cooled and neutralized with 6 ml of 0.5 N NaOH, finally

the sample volume was makeup to 200 ml by using distilled water, Invert sugar was determined before inversion by Lane and Eynon method. According to method 10 ml of mixed Fehling A and B solution was taken in a conical flask and titration was carried out with sample solution within 3 min without inversion by using 1% aqueous Methylene Blue as an indicator.

$$\text{Reducing sugar \% before inversion} = F \times 10 / C \times R$$

Where, C = concentration; R = Reading; F = Factor of Fehling solution

$$\text{Total invert sugar \% after inversion} = F \times 10 / C \times R$$

C = concentration; R = reading; F = factor of Fehling solution

$$\text{Total Carbohydrate\%} = \text{total invert sugar after inversion} - \text{Invert sugar \% before inversion} \times 0.95$$

Protein estimation:

Protein estimation was done by prescribed method in DGHS Manual [36]. According to method 200-300 mg of cookies powder were taken in 4 test tubes and 3 gm of catalyst ($K_2SO_4 + CuSO_4$) was added in tubes. 10 ml of concentrated H_2SO_4 was added to all tubes and digested for 3-4 hrs. After digestion these samples were distilled with boric acid, potassium permanganate and 40% of Sodium hydroxide and titrated with acid. This titration neutralized the ammonia and by this % of protein was calculated by following equation.

$$\text{Ammonia \%} = 14.01 \times \text{Reading} - \text{Blank} \times 100 \times \text{Normality} / \text{sample weigh} \times 1000$$

$$\text{Protein content} = \text{Ammonia\%} \times 6.25$$

Total Energy

Total energy was estimated on the basis of carbohydrate, protein and fat content of cookie sample.

$$\text{Total energy} = \text{carbohydrate} \times 4 + \text{Protein} \times 4 + \text{Fat} \times 9.$$

Sensory Analysis

Sensory attributes such as flavor, aroma, taste, appearance and odor were evaluated by 9-point hedonic scale, total 64 people participated in this survey. Questionnaires and mouth rinsing water were conferred to taste panelist, through the session product was introduced and questions were explained to the volunteers. The obtained data were analyzed by Microsoft Excel on the basis of age group.

Comparative Study of Nutritional Content from Market Product

Various marketed products were compared on the basis of nutritional fact like carbohydrate, fat, protein and total energy with normal energetic wheat flour biscuits and marketed preparation of digestive biscuits with the sample prepared in this study.

RESULTS AND DISCUSSION

Table 1: Chemical and physiochemical parameter

S No	Chemical and Physiochemical Parameter	Results
1	Ash content	7.10%
2	Moisture content	6.91%
3	Alkaloid	Present
4	Alcohol extraction	6.58%
5	Water extraction	5.30%
6	Fat content	14.04%
7	Carbohydrate content	60.51%
8	Protein content	11.65%
9	Total energy	414.9874 Kcal

By above mentioned Table 1 of results shown, those Cookies were spanning in nutritional values with controlled fat and carbohydrate and high rich in protein content which have made it acceptable among the health-conscious people, growing people and case of malnutrition. Comparative studies of different parameters of sensory evaluation exhibited that use of curry leaves as an active ingredient has given an appetizing and flavoring effect. Selected composition of cookies has made it acceptable around 90-96% that will give us a hope to convert this formulation into large scale production. In terms of physiochemical properties, nutrition value, sensory evaluation and comparison with other marketed product were in acceptable range.

Sensory Evaluation

Taste is a strategic parameter of sensory evaluation. The product might be captivating and having an eminent energy but sans of righteous taste it is likely to unaccepted. So on the basis of sensory evaluation it is found that due to use of *Murraya* leaves its mean score was 90-95% among the age group of 18-40. Graph of taste has been depicted below (Figure 1).

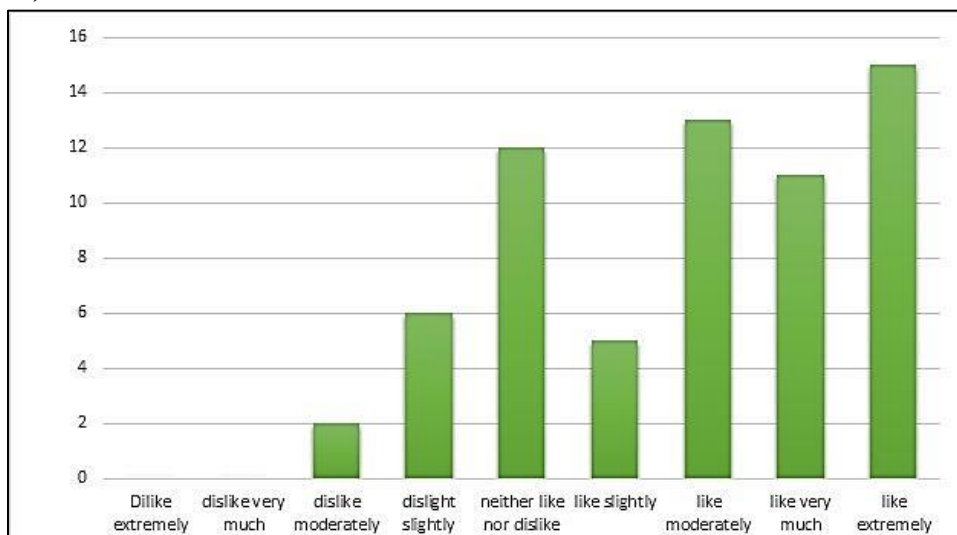


Figure 1: Acceptance of taste

Flavor

Flavor is an integral part of taste that plays a vital role in the acceptance of any food material. Used flavor of *Murraya* leaves and coco was found to be highly appreciable among all the volunteer of sensory evaluation because its smell act as an appetizer, because of that it means score on excel was found to be 90-95% (Figure 2).

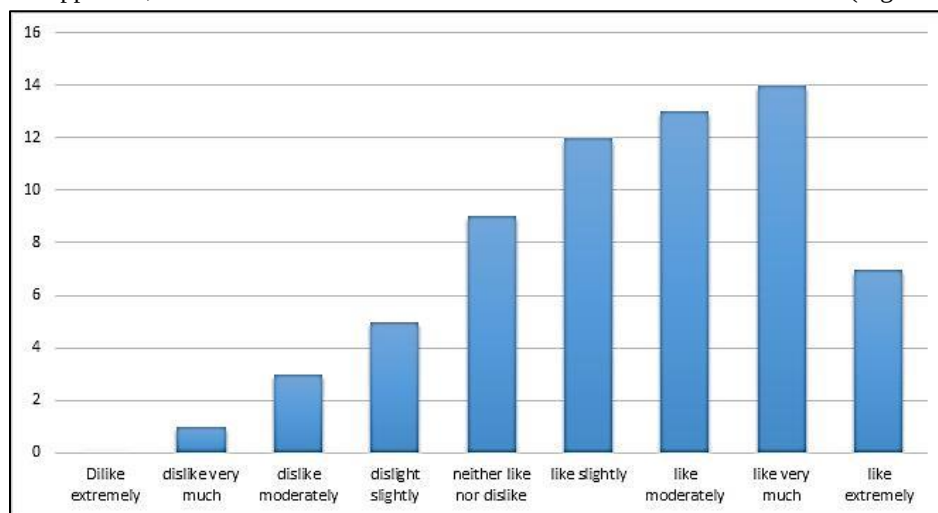


Figure 2: Acceptance of flavor

Aroma and Color

Aroma or fragrance of foods are the indiscernible part of the acceptance and play a crucial role in mouth feel. Aroma is the first sign of consumer to choose any food for consumption as well as color of food product is a sign of acceptance that have a great impact on the choice of any product. Aroma and color shows an elegant effect on the acceptance. The outcome of results showed that strong combined *Murraya*, cinnamon and coco powder's aroma influenced the people greatly.

Overall Acceptance of Cookies

It is very important for food, snacks, and soft drinks that after taking the bite or ship it must give a palatable and flavorful effect on tongue so it could be taken easily. The results of sensory evaluation on the basis of taste, flavor, crispiness and aroma was found to be appreciable with medicated effect.

Comparative Study of Nutritional Factor

Nutritional factor is the main aim of this study. After completion of all evaluation when it was compared with different brands of biscuits and it was found that it have less fat and carbohydrate which is highly beneficial for diabetic patient as well as high protein content due to use of black gram powder, this make it protein rich which might be use full for growing and malnourished children (Figure 3).

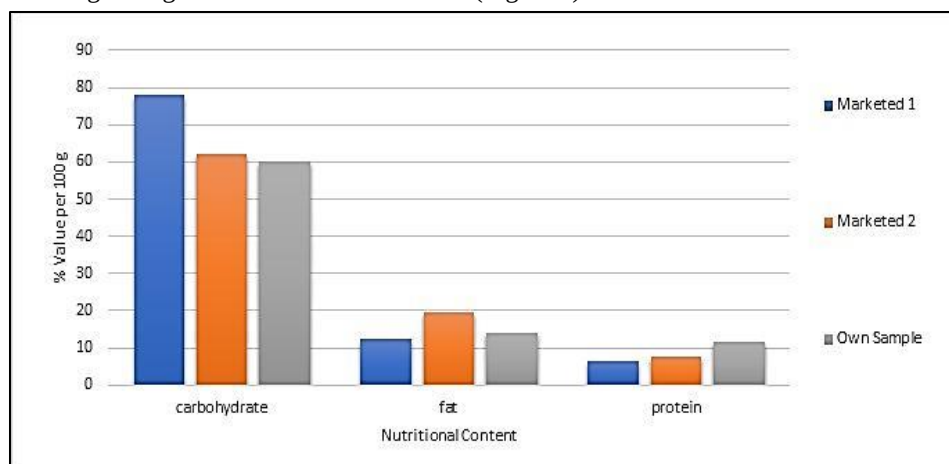


Figure 3: Comparative studies with other marked product

CONCLUSION

Based on statistical data it was found that herbal cookies have high amount of protein, controlled amount of fat and carbohydrate in compared to other marketed product. Presence of curry leaves and drumsticks leaves have given a new direction to convert home remedies into a marketed preparation which gives the highest acceptance in terms of flavor as well as the ingredients used in formulation has already proven significant role to control Non-insulin dependent diabetes mellitus and other health issue. So, it could be serviceable in the manufacturing of highly nutritious cookies with low cost and high efficiency.

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