Evaluation of Nutrient, Mineral analysis and quality characterization of *Gymnema sylvestre* multi grain cookies for diabetes

Abstract

Diabetes is a group of metabolic disorders with various etiologies that are defined by persistent hyperglycemia and worsening carbohydrate, lipid, and protein digestion due to flaws in insulin discharge and insulin activity. Indians account for one out of every five diabetics on the earth today. Around 35 million Indians suffer from diabetes, which affects around 150 million individuals worldwide. Because our health is such a major concern in our daily lives, foods that are healthy and beneficial to our health are becoming increasingly popular. Natural food variations are widely used for the prevention and treatment of a variety of health issues. Supplements such as protein, iron, and calcium can be found in plenty of treats. The goal of this study is to develop solid treats using *Gymnema sylvestre* leaf powder, an Ayurvedic component with increased Nutraceutical value. Multigrain powder, heating powder, palm sugar, cardamom powder, Margarine, salt, bubbling blend, and *G. sylvestre* leaf powder were among the ingredients used to make the solid snacks. The powder was created by drying the leaves in a plate dryer at 50°C for 2 hours before crushing in a home processor. *G. sylvestre* leaf powder was fused at different percentages: 0.25 percent, 0.50 percent, 0.75 percent, and 1.00 percent. Supplement testing, mineral analysis, and tactile testing are not set in stone. Atomic Absorption Spectroscopy was used to determine mineral composition. Over a variety of examples, test 0.50 percent sound snacks were found to be organoleptically superior.

Keywords: Cookies, Nutritional analysis, Mineral analysis, Microbial analysis, *G. sylvestre*.

Introduction

Diabetes mellitus is a metabolic disorder characterised by a lack of the chemical insulin in the blood, resulting in abnormalities in the body's absorption of carbs. In view of the fact that the age of onset isn't the underlying predictor of the type of diabetes, the phrases 'adolescent onset' and 'developmental onset diabetes have been replaced with 'Type I and Type II' (Bamji *et al.*, 1996). Heredity, incorrect dietary proclivities, lack of movement, the effects of pharmaceuticals and poisons, the impact of chemicals, mental factors, and diabetes as a complication of other illnesses such as pancreatitis and cardiovascular failures are the most generally acknowledged causes of diabetes (Bhatnagar, 2005). Polydipsia, polyuria, and

polyphagia are the most common symptoms of diabetes mellitus. Vision blurring, skin irritation, general weakness, and a lack of solidarity are some of the negative effects. Finally, it causes water and electrolyte imbalances, ketoacidosis, and a trance-like state (Tiwari and Rao, 2002). Retinopathy, nephropathy, neuropathy, and repeating myocardial dead tissue are among the persistent problems, which are associated with an increase in the frequency of congestive cardiovascular breakdown, ulceration, foot infection, and even gangrene (Blank, 2002). For diabetics, a high-complex-sugar, low-fat diet that includes a variety of soil-based products would be ideal (Garrow and James, 1993).

One of the nibbling things, a treat, contains refined flour, sugar, and spread at first. Because health is such a major concern in our daily lives, nutritious and beneficial things are in high demand. Treats are the most well-known bread shop items due to their excellent nutritional value, ready-to-eat nature, and easy availability in a variety of shapes and sizes at a fair price. Treats are popular because they are high in carbohydrates, lipids, and calories. Currently, the fusion of a few elements in treats has evolved to improve its nutritive and beneficial qualities. Treats are a good source of energy, protein, iron, calcium, and calories, among other things. Treats are not considered staple foods like bread, but they can be considered fibre transporters because of their longer shelf life, allowing for a wider range of manufacturing and distribution (Laveena *et al*., 2013). Margarine is made from vegetable oils, therefore it contains polyunsaturated and monounsaturated fats, as well as unsaturated "excellent" fats. When filling in for submerged fat, these fats aid to lower low-thickness lipoprotein (LDL), or "bad," cholesterol. Cookies' useful features can be enhanced by altering and supplementing them with health-promoting ingredients such as "Gulmar" leaves, mixed sugar (fake + regular) sugars, fat substitutes, and wheat flour (Kroger *et al*., 2006).

*G. sylvestre*is a prominent Indian medicinal plant that is widely used in the treatment of diabetes mellitus. *G. sylvestre* is a basic therapeutic woody climber that belongs to the Asclepiadaceae ('Milk Weed Family') family. 'Wonder natural product' is one of the unique names for this plant species. The name *'Gymnema sylvestre*' comes from a Latin word that means 'bare' and, which means 'from the woods' (Najafi *et al.,* 2011). *G. sylvestre* can be found in India, Malaysia, Sri Lanka, Australia, Indonesia, Japan, Vietnam, tropical Africa, and western China in general (Fabio *et al*., 2013). *G. sylvestre* is thought to have potent anti-diabetic effects. When you bite on the *Gymnema* leaves, the lack of capacity tastes good. Because of qualities that lower and balance glucose levels, concentrates of its leaves and roots are used as a typical treatment for diabetes in India and parts of Asia. Antimicrobial, antihyphal, antihyper - Cholesterolemic, and hepato-defensive exercises are also performed

by the plant. It also acts as a repellent to the caterpillar *Prodenia eridania*, prevents dental cavities caused by *Streptococcus mutans*, and is used in cosmetics. *Gymnemic* corrosive is found in *G. sylvestre* leaves, and it is known to suffocate the glucose transporter from the digestive system to the circulatory system. It could potentially restore or regenerate the pancreas' insulin-producing beta cells, as well as reduce cholesterol and glucose absorption from the GI tract. Supplementing with *G. sylvestre* appears to enhance glucose control in type 2 diabetic patients. Reduced postprandial blood glucose resulted in a decrease in HbA1C, lowering the risk of diabetic complications (Paul, 2005). This plant's leaves create a zero-calorie, non-nutritive, high-power sugar that can be used as a sucrose alternative. Sorbitol, one of the polyols, is a good sugar substitute that has no effect on the quality of the treat. For diabetics, it is preferable to sorbitol as a sugar alternative in a variety of foods (Kroger *et al*., 2006).

Materials and Methods

Raw material preparation

Multigrain and *G. sylvestre* leaves were purchased from the local market and necessary pre -treatments such as washing, drying, grading, sorting, incorporation etc. was carried out. Palm sugar, Margarine, Baking powder and essence were purchased from local market. Margarine stored Proper refrigeration at -40°C.

Cookies Preparation and optimization

Table 1: Optimization for control and multigrain cookies

Composition	Control	0.25%	0.50%	0.75%	1%
Multi Grain Powder (Cup)	1	1	1	1	1
Baking Powder (Tablespoon)	1/4	¼	1/4	¼	1/4
Palm Sugar (Cup)	1/4	¼	1/4	¼	1/4
Cardamom Powder (Tablespoon)	1/2	½	1/2	½	1/2

UNDER PEER REV

Margarine (Cup)	1/4	¼	1/4	¼	1/4
Salt (Tablespoon)	1/8	1/8	1/8	1/8	1/8
Boiled Mix (Tablespoon)	2	2	2	2	2
G. sylvestre Leaf Powder (%)	-	0.25	0.50	0.75	1

Cookies were prepared with some modifications. The optimization of multigrain powder, Margarine and palm sugar free sweetener by varying proportion of two was carried out.

Proximate composition

Proximate composition (moisture content, carbohydrate, ash, fat, protein, fibre content and sugar content) was determined by using different methods (AOAC, 2000; Amin & Thakur, 2016; Ranganna, 2001).

Mineral determination

The minerals such as Sodium and potassium content of sample were determined by using the Atomic Absorption Spectroscopy as described in (Laveena *et al*., 2013).

Organoleptic analysis

Sensory evaluation was carried out by a panel of ten semi trained panel members. Hedonic rating test was employed using 9-point hedonic scale. Sensory parameters such as colour, taste, texture and overall acceptability were evaluated (Ranganna, 2001). The following were the numerical scores assigned: 9: Like extremely 8: Like very much 7: Like moderately 6: Like slightly 5: Neither like nor dislike 4: Dislike slightly 3: Dislike moderately2: Dislike very much 1: Dislike extremely.

Isolation of microbes

The sample is mixed with 1L pure water to make solution sample. This solution sample is taken for process. The sterile Petri dish is labelled. Spread the 1 ml inoculum evenly over the entire surface of the nutrient agar plates until the medium no longer appears moist. Repeat the

UNDER PEER REVIEW

flaming and spreading for each of the remaining plates. Invert the plates and incubate at room temperature of at least 48 hours. The plate's colonies are statistically valid.

Biochemical Tests

The biochemical tests were carried out for different staining methods such as Gram staining, Methyl red and Voges- Proskauer test, Oxidase test, Catalase test, Indole test, Urease test, Nitrate reduction test, Glucose fermentation test, Motility test.

Results and Discussion

In light of the relevant scientific literature, the results collected during this inquiry are addressed under appropriate areas. Raw materials, control cookies, and healthy cookies were analysed at varied concentrations (0.25 percent, 0.50 percent, 0.75 percent, and 1.00 percent). The data collected during the experiments is shown in the tables below, along with a description of the findings. The amount of *G. sylvestre* leaves per kilogramme was determined using an electronic digital balance with a sensitivity of 0.01 gm (Sharma et al., 2017).

Nutritional Analysis

The nutritional analysis such as (Ash, Moisture, Fiber, Carbohydrates, Protein, Fat and Sugar) were analyzed for control and different concentration (0.25%, 0.50%, 0.75% and 1.00%). The Ash value is 1.76 %, 1.95 %, 2.05 %, 1.84 % and 1.74 respectively. The residue left after all the moisture has been removed, as well as the organic material (fat, protein, carbs, vitamins, organic acid, and so on) has been burnt at a temperature of around 500 ^{o}C, is referred to as ash in food. The mineral content of the original food is often measured by ash content (Onwuka, 2005). The moisture content was found to be 3.65 %, 3.84 %, 4.23 %, 3.97 % and 3.89 %. Because the fresh plant has a short shelf life and is susceptible to microbial attack, protracted storage would result in deterioration. This encourages users to store their items in dry state. In the processing, preservation, and storage of food, moisture content is one of the most important and often used measurements (Onwuka, 2005).

UNDER PEER REVIEW

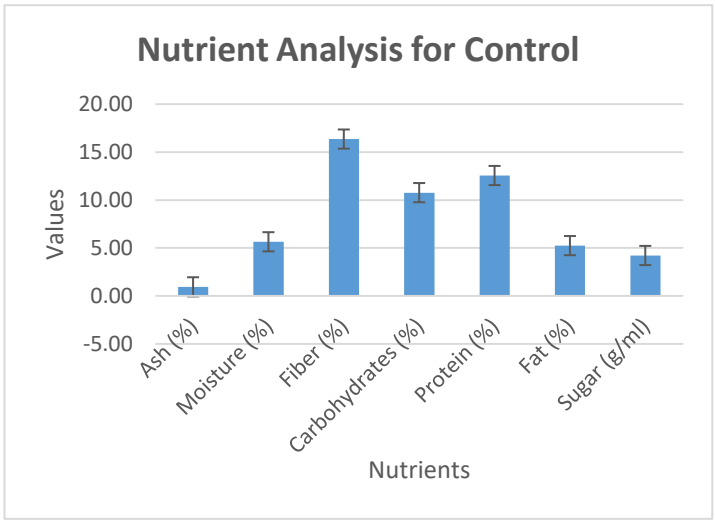
The amount of non-digestible carbohydrate and lignin in a food or plant is measured as crude fibre. The crude fibre obtained for cookies was found to be 8.72 %, 10.13 %, 10.46 %, 10.33 % and 10.03 %. This low amount is thought to be optimal since it improves glucose and fat absorption. Although crude fibre improves digestion, too much of it can produce intestinal discomfort, reduced digestibility, and reduced nutritional utilisation (Oladiji *et al*., 2005). Crude fibre is primarily made up of cellulose, with a little amount of indigestible lignin (Onwuka, 2005).The carbohydrate content of healthy cookies were found to be 62.14 %, 63.77 %, 63.95%, 63.53 % and 63.66 %. When compared to the Recommended Dietary Allowance (RDA) of 130g, the plant is a moderate source of carbohydrate (Pamela *et al*., 2005).The crude protein of healthy cookies were found to be 8.44%, 9.34%, 10.96%, 10.16% and 9.96 %. The RDA for protein is 56 grammes for adults weighing 70 kilogrammes and 46 grammes for adults weight 50 kilogrammes; children may ingest 2 kilogrammes per day (Jones *et al.*, 2005).

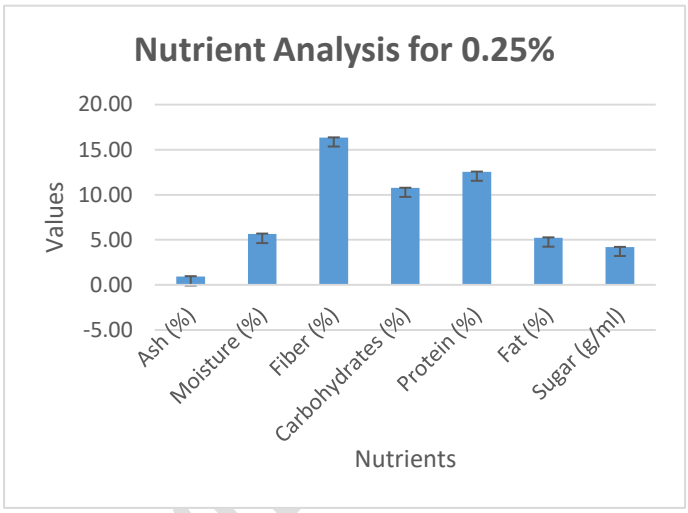
Table 2: Nutrient Analysis for Cookies

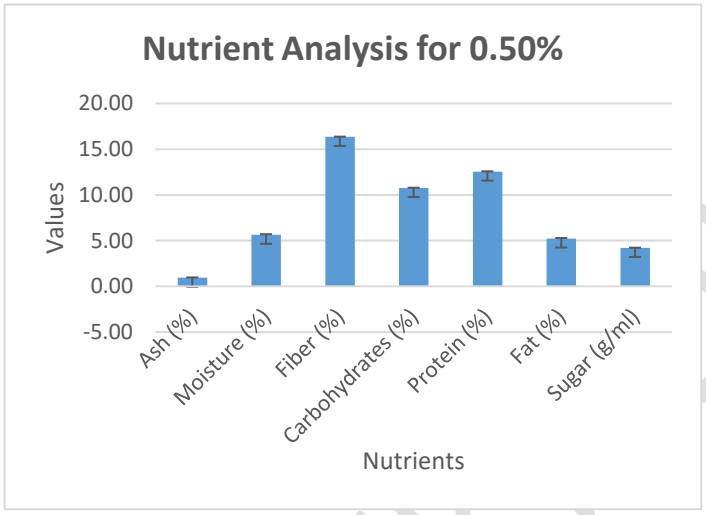
Nutrients Parameters	**Control**	**0.25%**	**0.50%**	**0.75%**	**1.00%**
Ash (%)	1.76 ± 0.03	1.95 ± 0.03	2.05 ± 0.02	1.84 ± 0.04	1.74 ± 0.02
Moisture (%)	3.65 ± 0.03	3.84 ± 0.03	4.23 ± 0.02	3.97 ± 0.02	3.89 ± 0.02
Fiber (%)	8.72 ± 0.01	10.13 ± 0.02	10.46 ± 0.02	10.33 ± 0.02	10.03 ± 0.02
Carbohydrates (%)	62.14 ± 0.04	63.77 ± 0.02	63.95 ± 0.04	63.53 ± 0.02	63.66 ± 0.03
Protein (%)	8.44 ± 0.01	9.34 ± 0.03	10.96 ± 0.02	10.16 ± 0.02	9.96 ± 0.03
Fat (%)	21.25 ± 0.03	21.04 ± 0.03	20.97 ± 0.03	19.34 ± 0.03	19.23 ± 0.02
Sugar (g/ml)	18.44 ± 0.03	11.25 ± 0.03	11.36 ± 0.02	11.06 ± 0.03	10.96 ± 0.02

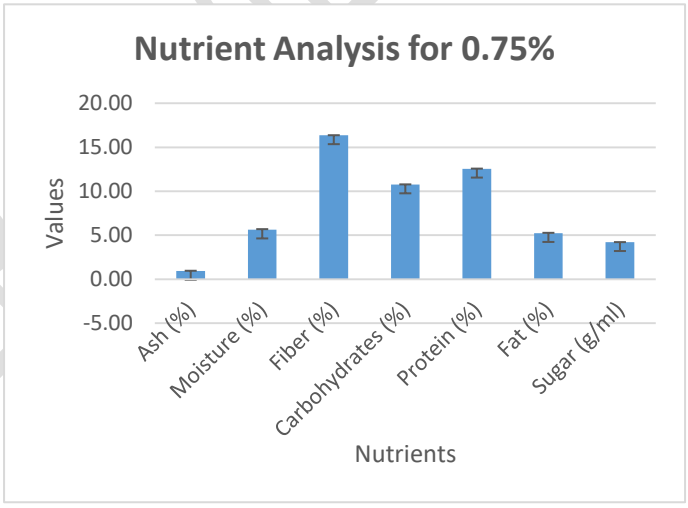
UNDER PEER REVIEW

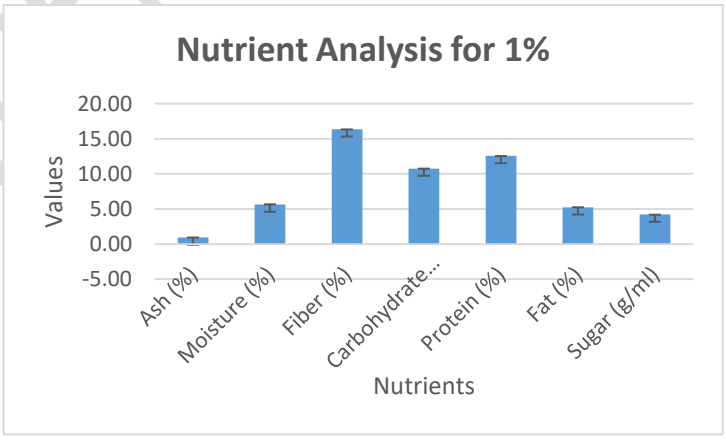
Figure 1: Nutrient Analysis for Cookies











The plant has a moderate protein content. Plant-based proteins have a lesser nutritional value, according to Pamela *et al.*, (2005), but when combined with many

other protein sources, such as animal protein, they can provide appropriate nutritious value. Protein is required for a variety of bodily processes, including body development, fluid balance, hormone production, enzyme production, and maintaining a robust immune system (Emebu and Anyika, 2011).The Fat content of healthy cookies were found to be 21.25%, 21.04 %, 20.97 %, 19.34 % and 19.23 %. The low fat content (1.83mg/100g) is lower than the range (8.3 percent -27.0 percent) observed for various Nigerian green vegetables (Sena *et al*., 1998). Carr's Index and Hausner's ratio for *G. sylvestre* were 20.37 and 1.255, respectively, showing fair compressibility. A.O.A.C., 2000; Sharma, *et al.,* 2017) obtained similar results for Bulk Density, Tapped Density, Carr's Index, and Hausner's Ratio. The results of proximate composition revealed that multigrain is a good source of carbohydrate, protein, and crude fibre, while *G. sylvestre* powder is a good source of carbohydrate, crude fibre, and crude protein. Moisture content in multigrain and *G. sylvestre* powder was found to be higher while fat content was lower as concentration increased. Multigrain and *G. sylvestre* powder contained higher amount of carbohydrate in 0.50% (63.95 ± 0.04) when compared to other concentrations. Crude fibre, protein and ash content of wheat flour and *G. sylvestre* powder were found to be 10.46, 10.96 and 2.05 per cent respectively.

Mineral analysis

Minerals are inorganic elements that serve as structural components and process regulators in the body. The sodium and potassium content of multigrain and *G. sylvestre* powder are shown. Table shows the mineral contents of the healthy cookie samples. The sodium content in healthy cookies were found to be 53.16 mg, 57.51 mg, 61.25 mg, 59.86 mg and 58.73 mg. Sodium is a vital mineral that aids in the transmission of nerve impulses as well as the preservation of cell osmotic balance. The Recommended Daily Allowance for sodium for humans is 1100-3300 mg/100g, according to the National Research Council (1974). Dehydration or muscle cramps can result from a sodium deficiency (Michael, 2007). The Potassium is the most abundant element in the healthy cookie samples. The highest potassium content (257.95 mg) was recorded in healthy cookie. The potassium content in healthy cookies were found to be 173.44 mg, 238.15 mg, 257.95 mg, 241.24 mg and 231.65 mg. The Recommended Dietary Allowance for potassium for adults is 1875-5625 mg/kg,

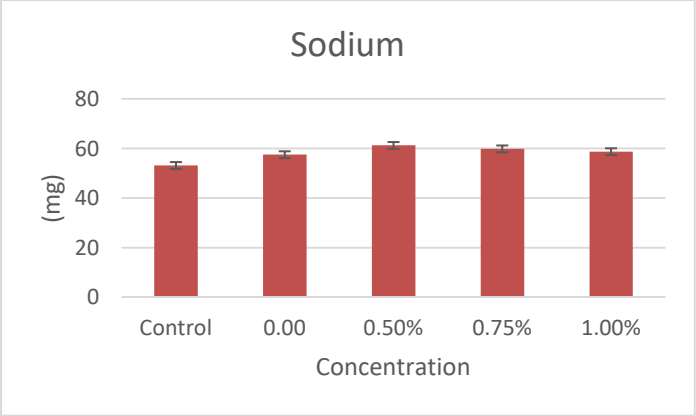
UNDER PEER REVIEW

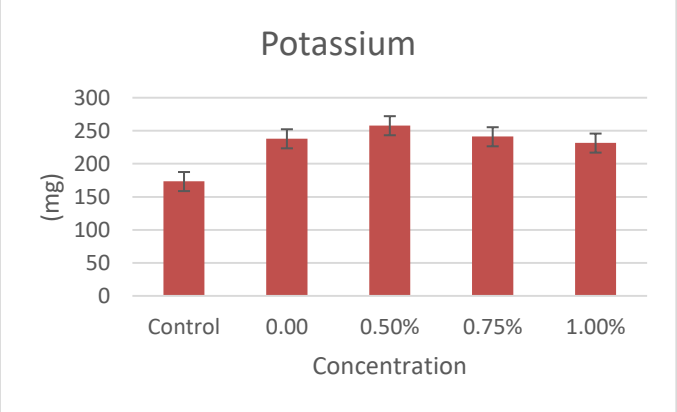
according to the National Research Council (1974). Potassium is essential for the management of water and electrolyte balance as well as acid-base balance in the body, as well as nerve action and muscular function. Potassium deficiency causes muscle paralysis (Michael, 2006).The sensory analysis were found to be good in every parameters. A panel of ten semi-trained judges evaluated the control and healthy cookies for sensory qualities using a 9 point Hedonic scale method for several parameters such physical appearance, texture/mouth feel, taste, colour, and overall acceptability. The quality was assessed using the mean values of ten semi-trained assessors. Sensory evaluation revealed that the control sample cookies 0.50 percent scored well on all metrics when compared to the others. As a result, sample 0.50 percent was chosen for the creation of nutritious cookies.

Table 3: Mineral Analysis for Control Cookies

Minerals	Control	0.25%	0.50%	0.75%	1.00%
Sodium (mg)	53.16 ± 0.02	57.51 ± 0.04	61.25 ± 0.02	59.86 ± 0.02	58.73 ± 0.03
Potassium (mg)	173.44 ± 0.04	238.15 ± 0.02	257.95 ± 0.02	241.24 ± 0.03	231.65 ± 0.02

Figure 2: Mineral Analysis for Cookies





Microbial Analysis

The isolation of microbes were carried out in 0.50% cookies. In each and every test which was performed the results were good in 0.50% cookies. The healthy cookies of 0.50%

UNDER PEER REVIEW

concentration were tested in different storages that is AF, LDPE and HDPE. The CFU count was obtained in AF (0.12 X 10^2,0.48 X 10^2, 0.72 X 10^2) and more CFU count was obtained in HDFE (0.36 X 10^2, 1.98 X 10^2 and 2.52 X 10^2). The dilution was 10^{-6}.

Table 4: Counts for Colony Forming Unit in 0.50% Cookies

Samples	Day 1		Day 15		Day 30		Dilution
	No. of Colonies	CFU (No. of Cells/ml)	No. of Colonies	CFU (No. of Cells/ml)	No. of Colonies	CFU (No. of Cells/ml)	
AF	2	0.12 X 10^2	8	0.48 X 10^2	12	0.72 X 10^2	10^{-6}
LDPE	7	0.42 X 10^2	36	2.16 X 10^2	46	2.76 X 10^2	10^{-6}
HDPE	6	0.36 X 10^2	33	1.98 X 10^2	42	2.52 X 10^2	10^{-6}

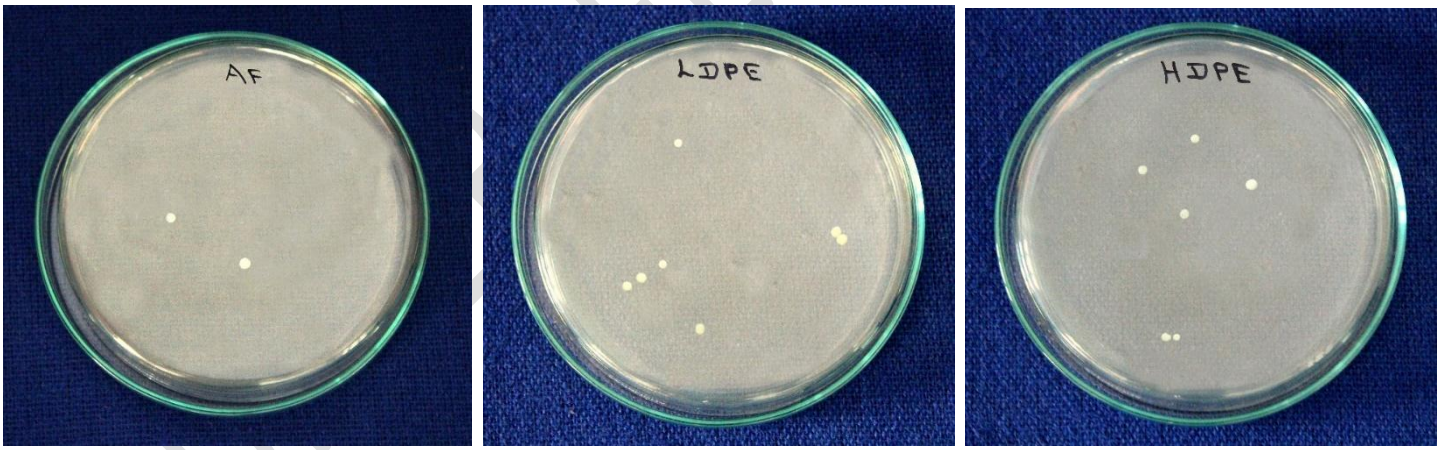


Figure 3: Microbial Plate View Day 1

UNDER PEER REVIEW

233 **Figure 4:Microbial Plate View Day 15**

234 **Figure 5:Microbial Plate View Day 30**

235

236 **Table 5: Organisms Identified for Cookies**

Day	Samples	Organisms Identified
Day-1st	AF	*Lactobacillus bulgaricus*
	LDPE	*Lactobacillus lactis*
	HDPE	*Streptococcus thermophillus*
Day-15th	AF	*Lactobacillus casei*
	LDPE	*Pseudomonas mephitica*
	HDPE	*Pseudomonas nigrificans*
Day-30th	AF	*Lactobacillus acidophilus*
	LDPE	*Bifidobacterium longum*
	HDPE	*Bacillus polymyxa*

PEER REVIEW

Conclusion

In recent years, medicinal plant conservation and use have received a lot of attention. It has been utilised by indigenous and marginal people around the world to treat a variety of ailments from time immemorial. The goal of this study was to assess the nutritional value, mineral content, and microbial activity of healthy cookies. When compared to other concentrations and controls, the 0.50 percent concentration of *G. sylvestre* demonstrated superior activity. *G. sylvestre* was a traditional medicinal plant whose leaves had remarkable therapeutic characteristics and were highly efficient for diabetic therapy. As a result, *Gymnema* leaves can be utilised in the preparation of hypoglycemic mix-in foods. According to the findings of the study, these meal preparations may aid in instilling the habit of taking herbal mixtures, which are curative and therapeutic for diabetes patients. As a result, we must raise knowledge about the usage of locally available but underutilised medicinal herbs.

NOTE:

The study highlights the efficacy of " Ayurvedic component " which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable

References

- A.OA.C. Official methods of analysis. Association of Official Analytical Chemists, 2000.
- Amin T, Bashir A, Dar BN, Naik HR. Development of high protein and sugar free cookies fortified with pea (Pisumsativum L.) flour, soya bean (Glycine max L.) flour and oat (Avenasativa L.) flakes. International Food Research Journal. 2016; 23(1):72.
- Bamji MS., Rao NP., Reddy V., Textbook of Human Nutrition, Oxford and IBH publishing co. Pvt. Ltd 1996;34- 36.
- Bhatnagar PC., A Look at Diabetes, Health Action 2005;17:6:17-21.
- Blank FC., Handbook of Food and Nutrition, Agrobios (India) 2002;31-34.
- Di Fabio G, Romanucci V, Zarrelli M, Giordano M, Zarrelli A. C-4 gem dimethylatedoleanes of Gymnemasylvestre and their pharmacological activities. Molecules. 2013; 18(12):14892-14919.
- GarrowJS., James WP., Human Nutrition and Dietetics. 9th edition, Churchill Livingston 1993; 521.

UNDER PEER REVIEW

- Kroger, M., Meister, K., & Kava, R. (2006). Low-calorie sweeteners and other sugar substitutes: a review of the safety issues. Comprehensive reviews in food science and food safety, 5(2), 35-47.
- Laveena M Tahilramani1, RupaliSengupta, 2013. Multigrain Healthy Cookies for Diabetes Mellitus. From wheat flour supplemented with cassava and water chestnut flours. Cogent Food & Agriculture, 1(1):1019815.
- Najafi, S., &Deokule, S. S. (2011). Studies on Gymnemasylvestre - a medicinally important plant of the family Asclepiadaceae. TJS, 9(2), 26-32.
- Paul SA., Textbook of Bio-Nutrition curing diseases through diet, 1st edition, CBS Publishers and Distributers 2005:411-413.
- Ranganna S. Proximate constituents. Handbook of analysis and quality control for fruit and vegetable products. 2001; 2:12-17.
- Sharma D, Sawate AR, Patil BM, Kshirsagar RB. Studies on physico chemical characteristics of Gymnema sylvestre (Leaf, powder and extract). Journal of Pharmacognosy and Phytochemistry. 2017; 6(5):250-255.
- Tiwari AK., Rao JM., Diabetes mellitus and multiple therapeutic approaches of phytochemicals: Present status and future prospects, Current Science 2002; 83: 1:30-38.
- Emebu PK, Anyika JU. Proximate and mineral composition of Kale (Brassica oleracea) grown in Delta State, Nigeria. Pakistan Journal of Nutrition, 2011; 10(2): 190 – 194.
- Sena LP, Vanderjadt JJ, Rivera C, Tsin ATC, Muhammadu I, Mahamadu, O, Milson M, Pastosyn A, Glew RH. Analysis of nutritional component of eight famine foods of Republic of Niger. Plant Food Human Nutrition, 1998; 52: 17 – 30.
- Oladiji, A. T. and Mih, F. O. (2005). African J. Biotech., 4 (12): 1440- 1441.
- Onwuka, G. I. 2005. Food Analysis and Instrumentation; Theory and Practice. Naphthalic prints, Surulere, Lagos, Nigeria. 219- 230.
- Pamela, C. C., Richard, A. H. and Denise, R. F. (2005). Lippincotts illustrated Reviews Biochemistry 3rd ed., Lippincott Williams and Wilkins, Philadelphia, pp. 335- 388.
- National Research Council. 1974. Recommended daily dietary allowance, USA Nutrition Review. 31 (12): 374 – 390.
- Michael, W. K., 2007. Medical Biochemistry. 3rd ed., Queen Mary Publishers London, pp. 13 – 17.

UNDER PEER REVIEW