Global Scientific and Academic Research Journal of Multidisciplinary Studies
ISSN: 2583-4088 (Online)
Frequency: Monthly
Published By GSAR Publishers
Journal Homepage Link- https://gsarpublishers.com/journals-gsarjms-home/

Formulation and Quality Evaluation of Sugar-free and Low-sugar Nutritional Cookies from Bitter gourd (Karela); A Sustainable Health Impediment of Diabetic.

By

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Article History

Received: 25/10/2024
Accepted: 04/11/2024
Published: 06/11/2024

Vol – 3 Issue – 11

PP: - 01-10

DOI:10.5281/zenodo.14044787

Abstract

Diabetes is a chronic metabolic and hormonal disease characterized by elevated blood glucose levels accompanied by impaired metabolism of carbohydrates, fats and proteins due to pancreatic abnormalities that cause impaired insulin secretion and insulin action. This disorder is often accompanied by long-term complications. Cookies are the most commonly consumed baked products on the market. They are usually high in calories, carbohydrates and fats and low in vitamins, minerals and proteins, making them unsuitable for daily consumption. These cookies are specially formulated for consumption by diabetics. We developed the cookies by adding various ingredients (oats, wheat flour, skimmed milk powder, bitter melon powder, butter and stevia). This formula gradually reduces insulin spikes and makes it easier to digest for diabetics. Moreover, due to the current trend, it takes longer for the body to metabolize and break down the ingredients, reducing the amount of insulin required. Sugar-free and low-sugar nutritional cookies were developed by fortifying with bitter melon powder and using the natural sweetener stevia instead of sugar. Bitter melon has unique biologically active ingredients such as charantin, vicine, and polypeptide-P, which exhibit hypoglycemic properties that aid in insulin production. In this study, three biscuits were formulated, developed, and evaluated considering factors such as skimmed milk powder (SMP), stevia, butter, and karela powder. Furthermore, the nutritional value of the developed sugar-free and low-sugar nutritional cookies was analyzed. The ingredients used in the preparation of sugar-free cookies were SMP 0.5g-6.5g, 0.5g-5.5g stevia, butter 10-50g, and karela powder 5%. The optimized parameters of the developed sugar-free cookies included SMP (1.7727%), stevia (4.3484%), butter (37.8788%), almond, cashew, pistachio and dried karela powder (5%). After development of sugar-free and low-sugar nutritional biscuits, the diameter and thickness of were reported to be 4.92 cm and 5.04 mm respectively. The final product contained carbohydrates (76.75%), protein (5.92%), fat (14.85%), ash (about 1%), moisture (4%) and crude oil.

Keywords: *Bitter gourd, sugar-free cookie, anti-diabetic, nutrition.*

Introduction

Diabetes mellitus is an emerging global health problem affecting over 285 million people worldwide. It is estimated that about 75% of the affected people are from developing countries. Hyperlipidemia is a lipid metabolism disorder and a major risk factor for the development of cardiovascular abnormalities. It is estimated that 7% of the adult population is affected, with 25 million people affected (Joshi, 2017). Bitter melon belongs to the Cucurbitaceae family and has the effect of lowering blood sugar levels. It grows in several regions such as Asia, South America, and Africa. People have been using bitter melon for various ailments for a long time. Bitter cucumber (Momordica charantia L.) is a perennial climbing plant of the Cucurbitaceae family. In the past, it was often used as an antidote for diabetes, abdominal pain,

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wounds, tumors, malaria, rheumatism, colic, inflammation, measles, and fever (Krawinkel, 2006). Due to the presence of insulin-like molecules, bitter melon can be used as a soil component or as a dietary supplement for diabetics and prediabetics (Zhu, 2012). Recently, many researchers have studied the role of bitter melon in lowering blood glucose levels (Zhu, 2012), cholesterol levels (Oishi, 2007), and visceral fat mass (Fuangchan, 2011). Diabetes in Ayurveda 'as' This incident, known as 'Madhumeha', has raised growing concerns worldwide. This is indicated by high blood sugar or glucose levels. A hormone called insulin, produced by the pancreas, is responsible for transporting sugar from the blood to the cells, where it is used for energy. Recent studies have also shown that bitter melon extracts can reduce high-fat diets such as obesity and hyperlipidemia in animal models. Incorporating bitter melon supplements into your diet can lead to weight gain and reduced visceral fat mass. This may be due to increased levels of fatty acid oxidation and ultimately weight loss and deposition of fat in the abdominal cavity. Most of these studies were carried out on the pulp only; little information is available to compare different plant parts and formulations in side-by side experiments. Diabetes is a chronic metabolic and endocrine disorder characterized by elevated blood glucose levels accompanied by disease. Due to pancreatic disorders that cause impaired insulin secretion and insulin action on both carbohydrate, fat and protein metabolism. This disorder is often accompanied by long-term complications.

Therefore, there is a demand for baked goods with satisfying taste, long shelf life, easy transportability and good nutritional profile (Martins et al., 2017; Tandang Silvas et al., 2011). Baked products available on the market do not provide high-quality protein due to the lack of lysine in whole wheat or refined flour. Biscuits, cookies, breads, crackers and donuts serve as vehicles to provide protein in the human diet (Qayyum et al., 2017; Shabeer et al., 2016). Study was conducted to investigate the effectiveness of the use of bitter melon powder and fortified cookies were developed. The cookies were examined for various physical, chemical, functional and sensory properties. cookies are the most processed convenience food ever created. It is one of the few universal staple foods that is complete and requires no additional preparation. Thus, for many people, cookies are an important source of high molecular weight carbohydrates, proteins and some vitamins and minerals. Cookies are mostly consumed by the lower class of society, especially children in rural and urban areas. Snack cookies and biscuits can easily be enriched with nutritional value, and cookie manufacturers have started to take this into account. Bitter melon extract has a moderate hypoglycemic effect at a dose of 200 mg. Bitter cucumber is effective in treating obesity as it increases insulin secretion and cellular glucose uptake, helping in the rearrangement of fat cells. It improves glucose tolerance and has promising effects in preventing diabetic complications such as nephropathy, neuropathy, gastroparesis, cataracts, and insulin resistance. Cookies are the most commonly consumed baked goods in the market. They are usually high in calories, carbohydrates, and fats and low in vitamins, minerals, and proteins, making them not suitable for daily consumption. These cookies are specially designed to be consumed by diabetics. Most of the cookies were made with the addition of various ingredients (oats, wheat flour, skimmed milk powder, bitter melon powder, stevia). It has been scientifically proven that bitter melon has anti-diabetic, antibacterial, anti-viral, and anti-cancer properties.

Materials and Methods

Ingredients: Matured bitter gourd (*Momordica charantia*) was obtained from a farm near Kuvempu University, Shankaraghatta (Tavaraghatta-Shimoga region). Bitter gourd was inspected for any obvious physical damage or insect infestation and discarded if present. All chemicals used in this study were of high analytical quality. The materials used were purchased from Spar Hyper Market (Shimoga), India, namely stevia, SMP (skimmed milk powder), wheat flour (commercially available) and all other baking ingredients like eggs, baking powder, fat milk, flavours were also purchased from there. Bitter gourd was washed in fresh water to remove dust and other impurities. After washing, the fruit was cut into small pieces and dried (dried in the sun) for a few days. The dried fruits were ground into fine powder using a domestic blender and the dried powder was sieved and subsequently used for further evaluation.

1. Cookies Recipe and Preparation

Two types of cookie recipes were prepared using wheat flour and bitter melon powder. Different ingredients like flour, stevia, sodium bicarbonate, vanilla extract were carefully mixed and milk was added to get a good dough formation. The total mixing time was 7-8 minutes to get a homogenous mixture. Once the dough was properly mixed, it was rolled out into a 1/4 inch thick sheet on a cookie table. The diameter of the cookie cutter was 4.92 cm. The oven was preheated to 180^{o}C and the cookies were baked at the set temperature for 10 minutes. The baked cookies were cooled for 1-2 minutes and stored in an airtight container for further analysis.

The procedure for cookies formulation,

The cookies were made with wheat flour (100gm), stevia (50gm), butter(60gm), skimmed milk powder(10gm), salt(0.3gm), baking powder(0.5gm), water(8-10ml), bitter gourd powder (5%), nuts(3-5 gm), oats(10gm). The butter and stevia were blended until they were creamy. After that wheat flour, skimmed milk powder, salt, baking powder, bitter gourd extract, oats are added. The bitter gourd powder was mixed with milk and then added oats, edible salt and mixed for 8- 10 mins, then wheat flour was added.The mixturewas taken in a bowl and kneaded to get dough. The dough was correctly kneaded and resulted in no sticky, uniform dough. The dough was then rolled to uniform thickness. Then cutted the dough using mould. The cookies were placed in oven and baked at 150^{0}C for 25 minutes. The cookies are stored at room temperature. For sugar free cookies - For Sugar free Spicy Cookies, the dough was not added with any refined sugar or stevia, it is added with dry chili flakes and crushed pepperto enhancepalatability. For low sugar cookies - For low sugar

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cookies formulation, the dough was added with Stevia, and it is free from chilly, pepper flakes.

2. Proximate Analysis of Formulated Cookies

The proximate composition of formulated cookies was analyzed by AOAC official methods of analysis.The formulated cookies were analyzed formoisture content using hot air oven single stage method (130ºC for 1 hour), fat by Soxhlet solvent extraction method, protein by micro-Kjeldahl method (N x 6.25), crude fiber by gravimetric method and ash content by dryashing method.Carbohydrate content was determined by difference method [Carbohydrate (%)=100 − (Moisture% + Fat%+ Protein% + Crude fibre% + Ash%)].

3. Physical Properties of Cookies.

1. **Cookie Thickness**: After the cookies were baked, they were allowed to cool for approximately 30 minutes. Then, six cookies were placed on a tray in a stack and their overall height was measured with a vernier caliper. The measurement was then divided by six to get the thickness of the cookie. This process was repeated two more times (times) to obtain the same measurement. The mean thickness and its standard deviation were calculated and reported in cm (AOAC, 1990).
2. **Cookie diameter:** The diameter of the cookies was measured with a vernier caliper. The cookies were then rotated 90Â° and their diameter was measured again in cm. Three replicate measurements were made and the mean and standard deviation were calculated (AOAC, 1990).
3. **Cookie Spreadability:** Spreadability was determined by dividing the diameter of the cookie by its thickness. Quality notes are available. The mean and standard deviation of three replicate experiments are reported (AOAC, 1990).
4. **Shelf life and microbial analysis of cookies:** The cookies were stored at room temperature (28 Â± 2 Â°C) in airtight polyester bags (120 mm Ã— 200 mm (250 g), thickness: 50 microns). The storage period was investigated over a period of 3 months (90 days) and microbiological analyses were performed including (total bacterial count, total yeast and mold count) using FDA/CFSAN (Center for Food Safety and Applied Nutrition) standard methods. The total number of aerobic microorganisms was determined using nutrient agar and yeast and mold were counted using potato dextrose agar.

4. Gas Chromatography-Mass Spectrometry (GC-MS)

GC-MS analysis of bioactive compounds present in the extracts of reformulated Karela biscuits was performed using a GC system equipped with an MS column. 1 g of powdered biscuit sample was extracted with 10 mL of acetone and 1 Î¼L of the extract was injected. Spectroscopic detection of by GC-MS required an electron ionization system using high energy electrons and detector gain (0.95 kV). Pure helium gas (99.95%) was used as the carrier gas at a flow rate of 1 mL/min. The injection temperature was set at 280 Â°C, the column superheat temperature was maintained at 80 Â°C, and the pressure was maintained at 24.2 kpa. Ramp rate 40 °C/min, hold time approximately 5 min Finally, the temperature was increased to 330 °C with a hold time of 10 min. One microliter of 1% extract prepared by dilution with each solvent was injected in split mode. The relative amounts of chemical compounds present in the Carrera biscuit extract were expressed as percentages based on the peak area generated in the chromatogram.

5. Sensory Evaluation

The sensory evaluation consisted of an evaluation of the quality of the baked cookies by a panel of 20 Kuvempu faculty members drawn from various life science departments. The evaluation involved the analysis of the overall sensory quality of the cookies as perceived through sight, taste and touch. A hedonic rating test was used to measure the level of pleasant and unpleasant experiences with the cookies on a 9-point scale ranging from "very like" to "very dislike". Participants received an evaluation form listing the various sensory parameters and rating options with numerical rankings. Once all evaluation forms were completed, the data was averaged and presented in tabular form. The cookies were evaluated based on sensory characteristics such as taste, texture, color, appearance and overall acceptability.

Statistical Analysis

The triplicate measurements in the evaluation of each cookie recipe method were analyzed using two way analysis of variance (ANOVA) with ($P<0.05$).

Results and Discussion

1. Cookies preparation

Cookies were prepared using a traditional method as described by Chauhan, Saxena, and Singh (2015). Ingredients used were wheat & all –purpose Flour 100 g ; grounded sugar, 40 g ; sodium bicarbonate, 1.0 g ; Sodium chloride,1.0 g ; skim milk powder, 20 g and water, 20 ml. A pre – mix of flour, milk powder, and sodium bicarbonate was prepared separately. Dough prepared was formed into sheet of approximately 0.5 cm thickness, and then a circular Mold was used to cut the dough sheets. Baking was carried out in baking oven (conventional baking oven, Continental India) at 170^0C for Around 15 min. After 15 min, cookies were allowed to cool.

Fig. 1: Control cookies

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Fig. 2: Spicy cookies

Fig. 3: sweet cookies

2. **Approximate composition of the cookies** The produced cookies were analysed for moisture, protein, fat, fibre and ash content (Table 1).

SL. No.	PARAMETER	RESULTS		
		Control	Spicy	Sweet
1	Moisture Content (%)	4.38	4.12	3.22
2	Energy (kcal/100g)	479.12	476.14	482.24
3	Total Carbohydrate (%)	72.78	72.57	73.98
4	Total Sugar (%)	15.8	2.24	14.97
5	Sucrose (%)	15.21	1.01	1.37
6	Total fat (%)	19.92	19.22	19.64
7	Total Protein (%)	2.18	3.22	2.39
8	Total Mineral Content (%)	0.74	0.87	0.77
9	Texture	Hard	Crispy	Hard

Table 1: Proximate composition of control, spicy and sweet cookies

The moisture contents of cookies prepared with control, savory and sweet cookies were slightly different from each other and ranged from 4.38% to 4.12% and 3.22%, respectively. Among these cookies, control and spicy cookies have the highest moisture contents at 4.38% and 4.12%, respectively. Sweet cookies have a slightly lower moisture content at 3.22%. The protein contents of cookies prepared with control, savory and sweet cookies were significantly different from each other and ranged from 2.18%, 3.22% and 2.39%. The protein contents of control, savory and sweet cookies were measured to be 2.18%, 3.22% and 2.39%, respectively. Of these, spicy cookies have the highest protein content. The fat contents of cookies prepared with control, savory and sweet cookies were significantly different from each other and ranged from 19.92%, 19.22% and 19.64%. The fat contents of control, spicy and sweet cookies were measured to be 19.92%, 19.22% and 19.64% respectively. Of these, control cookie has the highest protein content. The energy contents of cookies prepared using control, spicy and sweet cookies were significantly different from each other and ranged from 479.12%, 476.14% and 482.24%. The energy contents of control, spicy and sweet cookies were found to be 479.12%, 476.14% and 482.24% respectively. Of these, the highest energy content is found to be sweet cookies. The carbohydrate contents of cookies prepared using control, savory and sweet cookies were significantly different from each other and ranged from 72.78%, 72.57% and 73.98%. The carbohydrate contents of control, savory and sweet cookies were found to be 72.78%, 72.57% and 73.98% respectively. Of these, the sweet cookie had the highest carbohydrate content. The sugar contents of the cookies prepared using the control, savory, and sweet cookies were significantly different from each other and ranged from 15.8%, 3.24%, and 14.97%. The sugar contents of the control spicy and sweet cookies were measured to be 15.8%, 3.24%, and 14.97%, respectively. Of these, the control cookie had the highest sugar content. The mineral contents of the cookies prepared using the control, savory, and sweet cookies were significantly different from each other and ranged from 0.74%, 0.87%, and 0.77%. The mineral content of the control, savory and sweet cookies was measured to be 0.74%, 0.87% and 0.77%, respectively. Among them, the spicy cookies had the highest mineral content. The texture of the cookies made from the control, spicy and sweet cookies was significantly different: the control cookies were hard, the spicy cookies were crunchy and the sweet cookies were hard.

3. **Storage stability and microbial analysis of the produced cookies.**

The shelf life of the developed cookies was evaluated during storage at room temperature (280 °C) for 3 months. Peroxide levels, total bacterial counts, total yeast and mould counts varied between cookies, with control cookies generally showing the highest values and the incorporation of bitter melon powder simultaneously decreasing the values of these characteristics. Interestingly, the incorporation of bitter melon powder into the cookies during storage of significantly improved the storage stability of after 3 months of storage. The total bacterial, yeast and mould counts were also affected by the incorporation of bitter melon powder into the cookies. During storage, the bacterial counts and the yeast and mould counts increased to their maximum values at the end of storage.

SL. No.	PARAMETER	RESULTS	
		Cookie	Cookie
1	Description	0^{th} month	3^{rd} month

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2	Moisture Content (%)	4.38	4.87
3	Total Sugar (%)	15.8	14.39
4	Sucrose (%)	15.21	13.99
5	Total fat (%)	19.92	18.23
6	Total Protein (%)	2.18	2.11
7	Total Mineral Content (%)	0.74	0.73
8	Texture	Hard	Hard
9	Rancidity	Not Rancid	Not Rancid
10	Total Bacterial count CFU/gm	1 x 10^3	1 x 10^3
11	Total fungal count CFU/gm	0 x 10^2	x 10^2

Table 2: Storage stability and microbial analysis of Control cookies.

SL. No.	PARAMETER	RESULTS	
		Cookie	Cookie
1	**Description**	**0th month**	**3rd month**
2	Moisture Content (%)	4.12	4.38
3	Total Sugar (%)	3.24	3.22
4	Sucrose (%)	1.18	1.10
5	Total fat (%)	19.22	19.01
6	Total Protein (%)	3.22	3.18
7	Total Mineral Content (%)	0.87	0.88
8	Texture	Crispy	Crispy
9	Rancidity	Not Rancid	Not Rancid
10	Total Bacterial count CFU/gm	2x 10^3	1x 10^3
11	Total fungal count CFU/gm	0 x 10^2	x 10^2

Table 3: Storage stability and microbial analysis of Spicy cookies.

SL. No.	PARAMETER	RESULTS	
		Cookie	Cookie
1	**Description**	**0th month**	**3rd month**
2	Moisture Content (%)	3.22	3.51
3	Total Sugar (%)	14.97	13.23
4	Sucrose (%)	1.37	1.21
5	Total fat (%)	19.64	19.59
6	Total Protein (%)	2.39	2.30
7	Total Mineral Content (%)	0.77	0.75
8	Texture	Hard	Hard
9	Rancidity	Not Rancid	Not Rancid
10	Total Bacterial count CFU/gm	0x 10^3	0x 10^3
11	Total fungal count CFU/gm	0 x 10^2	0 x 10^2

Table 4: Storage stability and microbial analysis of sweet cookies.

4. Determination of compounds in bitter gourd by GC-MS.

The outcomes of the lively additives estimation of the acetone extract of Bitter Gourdcookies have been provided in Table 6. The outcomes of cookiesextract screening with the aid of using GC-MS confirmed a substantial end result that lots of lively compounds associated with diabetes ailment curation homes. The chemical additives gift withinside the cookies have been diagnosed the usage of GC-MS evaluation with the lively principle and retention time (RT), and location attention proven in Table 6.

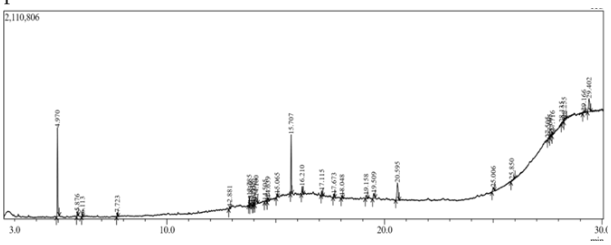

Fig 4: GC-MS analysis of chemical components present in sugar-free cookies.

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Peak	R.Time	I.Time	F.Time	Area	Area %	Height	Height%	A/H	Name
1	4.970	4.920	5.050	15955178	25.02	899011	32.69	1.77	6-Oxa-bicyclo [3.1.0] hexan-3-one
2	5.876	5.845	5.920	86561	1.36	48511	1.76	1.78	2H-Pyran-2,6(3H)-dione
3	6.113	6.080	6.140	52218	0.82	30680	1.12	1.70	1,2,3,4-cyclopentanetetrol, (1. alpha.,2. beta.,4. alpha.)
4	7.723	7.685	7.755	69836	1.10	41421	1.51	1.69	4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6-methyl-
5	12.881	12.840	12.915	49126	0.77	22786	0.83	2.16	1,3-Dioxane, 5-(hexadecyloxy)-2-pentadecyl-, cis-
6	13.785	13.750	13.810	148757	2.33	97610	3.55	1.52	Neophytadiene
7	13.830	13.810	13.895	75189	1.18	28500	1.04	2.64	1-Heptanol,2,4-diethyl-
8	13.955	13.930	13.980	49886	0.78	22802	0.83	2.19	Neophytadiene
9	14.012	13.980	14.040	138252	2.17	46950	1.71	2.94	2,2,4,6,6,8-Hexamethyl-4,8-diphenylcyclotetrasiloxane
10	14.100	14.040	14.170	305369	4.79	73543	2.67	4.15	Neophytadiene
11	14.505	14.480	14.605	66515	1.04	12474	0.45	5.33	Bis[di(trimethylsiloxy)phenylsioxy]trimethylsiloxyphenyl
12	14.639	14.605	14.695	107414	1.68	35036	1.27	3.07	Octasiloxane,1 ,1,3,3,5,5,7,7,9,9,11,1
13	15.065	15.015	15.095	73819	1.16	33394	1.21	2.21	Bis[di(trimethylsiloxy)phenylsiloxy]
14	15.707	15.670	15.750	993010	15.57	597794	21.74	1.66	Phytol
15	16.210	16.175	16.265	154086	2.42	78339	2.85	1.97	Bis[di(trimethylsiloxy)phenylsiloxy]trimethylsiloxyphenylsiloxan
16	17.115	17.085	17.165	107165	1.68	49466	1.80	2.17	Glycidyl palmitate
17	17.673	17.635	17.720	88771	1.39	36230	1.32	2.45	Bis[di(trimethylsiloxy)phenylsiloxy]trimethylsiloxyphenylsiloxan
18	18.048	18.005	18.080	64536	1.01	23599	0.86	2.73	Cyclononasiloxane, octadecamethyl-
19	19.158	19.110	19.225	102698	1.61	33571	1.22	3.06	Cis, cis, cis-7,10,13-hexadecatrienal
20	19.158	19.450	19.575	166684	2.61	51125	1.86	3.26	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester
21	20.595	20.515	20.680	666719	10.46	175142	6.37	3.81	Triphenylphosphine oxide
22	25.006	24.940	25.055	141115	2.21	38431	1.40	3.67	squalene

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23	25.850	25.815	26.000	99135	1.55	15104	0.55	6.56	Di-n-decylsulfone
24	27.505	27.490	27.590	49820	0.78	11913	0.43	4.18	1,2-Bis(trimethylsilyl)benzene
25	27.605	27.590	27.660	51580	0.81	19278	0.70	2.68	Pyrimidine, 2-[4-(3-pyridinylmethyl)-1-piperazinyl]
26	27.716	27.700	27.745	51545	0.81	32217	1.17	1.60	N-Methyl-1-adamantaneacetamide
27	28.135	28.125	28.240	76228	1.20	13378	0.49	5.70	Pentasiloxane, 1,1,3,3,5,5,7,7,9,9-decamethyl-
28	28.255	28.240	28.365	141614	2.22	29530	1.07	4.80	Cyclodecasiloxane, eicosamethyl-
29	29.166	29.110	29.215	74209	1.16	19223	0.70	3.86	Stigmasta-5,22-dien-3-ol, acetate, (3. beta.,22Z)-
30	29.402	29,330	29.480	529210	8.30	13297 6	4.84	3.98	dl-alpha. -Tocopherol
				6376245	**100.0**	**2750034**	**100.00**		

Table 5: The compounds identified in bitter gourd extract using GC – MS analysis.

The bioactive compounds gift withinside the acetone extract of karela cookies are proven in 6. Their identity and characterization have been primarily based totally on their elution order in MS column of beginning from 2.00 min to 33 min with test velocity of 1666. The elution time and the quantity of those bioactive compounds have been additionally provided. Based on abundance, the pinnacle 3 primary compounds gift withinside the acetone extract became 6-Oxa-bicyclo [3.1.0] hexan-3-one (32.69%), Phytol (21.74%) and Triphenylphosphine oxide (6.37 %)because the pinnacle 3 primary compounds that performs a main position in diabetic control. The GC chromatograms of the karela cookies extracts provided in parent 6, displaying the retention time withinside the column and the detected peaks which correspond to the bioactive compounds gift withinside the extract. 2H-Pyran-2,6(3H)-dione is utilized in the medication for problems of metabolism. 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- (DDMP) is a compound with antioxidant and antiinflammatory homes that has been studied as a capability remedy for diabetes, osteoporosis, and cardiovascular ailment. DDMP or 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one is a strong antioxidant in glucose-histidine Maillard response products.1,3-dioxane carboxylic acid derivatives along with PPAR activator however exhibited robust hypolipidemic and anti-hyperglycemic sports *in vivo* because of advanced bioavailability (Pingali Harikishoreet al., 2010). Neophytadiene is previously suggested as an enzymeinhibitor and its extract have a capability position withinside the control of insulin resistance and metabolic problems that accompany diabetes or obesity (Kanimozhi D & Bai V. R., 2012). The compound benzoic 2-[(trimethylsilyl) oxy]-, methyl ester (cas) methyl o-trim ethyl-silyl salicylate became compound significantly.

5. Sensory characteristics of cookies

All cookies produced obtained acceptable sensory values for all evaluated parameters (Figure 1). All produced cookies had sensory scores above 7.7 and represented a score of 6 on the hedonic "like" scale. However, among these three types of cookies, the spicy cookie obtained the highest scores on the hedonic scale of sensory attributes, namely, cookie appearance, taste, texture and aroma. The occurrence values of the spicy cookies are high compared to the control and sweet cookies. In one study, spicy cookies were made using bitter melon powder (5%) due to its crumbly texture and dark color. The flavor value was significantly reduced from 8 (for cookies with bitter melon) to 6.7. This is probably due to the oat flakes, pistachios and cashew nuts incorporated in the flour which have a unique flavour. The overall acceptability of the spicy cookie (SP) was rated as 8 on the hedonic scale by the sensory panelists, followed by the sweet cookie (SW) and lastly the control cookie (C). A sensory evaluation is usually required for a product to be marketed. A score of at least 7 (moderate etc.) is required.

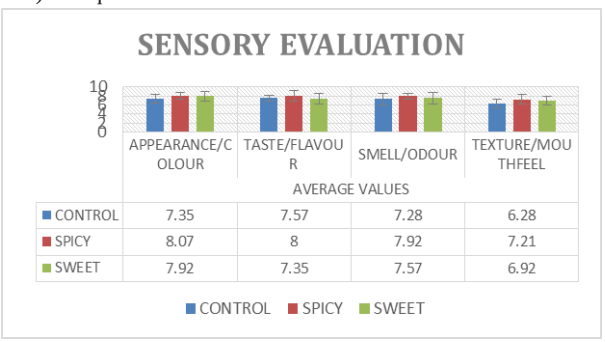

Fig. 5: Sensory evaluation and scoring of Different formulated cookies.

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Conclusion

Researchers investigated the role of bitter melon in lowering blood glucose, cholesterol and visceral fat levels. Sugar-free cookies are made from bitter melon powder and the natural sweetener stevia can be used to create nutritious cookies for diabetics. Consumer interest in cookie consumption prompted researchers to develop bitter melon blended cookies. Incorporation of bitter melon powder at different levels of added value resulted in changes in the nutritional, qualitative and sensory properties of the cookies. It was clearly observed that the addition of bitter melon powder had a strong impact on the chemical and sensory properties of the cookies. As baked goods made from refined sugar have adverse health effects on diabetic patients, the nutritional value of cookies can be improved by adding bitter melon along with oats, almonds, pistachios and other ingredients. The shelf-life stability also showed very good results. Thus, bitter melon can be successfully added to produce cookies that act as a natural source of anti-diabetic nutrients with notable health benefits, which are gaining in consumer acceptance.

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