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Development and evaluation of organoleptic and nutritional quality of Gurmar based healthy cookies

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Abstract
As health is major concern in our day-to-day life, nutritious and health beneficial products are on high demand. Herbal functional foods are extensively used for the prevention and treatment of several health disorders. Cookies are the important source of nutrients such as protein, iron and calcium. The present study aims to formulate healthy cookies using Gulmar (*Gymnema sylvestre*) leaf powder, which is an Ayurveda component with enhanced the Nutraceutical value. The ingredients used for preparation of healthy cookies were refined wheat flour, egg, baking powder, blended sugar free sweetener, food flavor and Gulmar leaves powder. The powder was made by using tray dryer in which the leaves were dried at 50˚C for 2 hrs followed by pulverization in home grinder. Gulmar leaves powder was incorporated at different levels as 1gm, 2gm, 3gm and 4gm. Traditional sugar was replaced by non-nutritive sweetener and fat was replaced by margarine. Sugar in cookies formulations was reduced from 100 to 60% by replacing with sorbitol 0 to 40%. The sensory value was determined by 9-point hedonic scale of 10 panel judge's expert in food technology. Minerals were determined by Atomic Absorption Spectroscopy. Sample B_2 healthy cookies was found to be organoleptically superior over other samples.

Keywords: Cookies, herbal, functional, disorders, nutrients, Gulmar, Ayurveda, Nutraceutical, non-nutritive

Introduction
Cookie, one of the snack items originally contains refined flour, sugar, butter. As health is a major concern in our day-to-day life, nutritious and health beneficial products are on high demand. Cookies are the most popular bakery items because of their high nutritive value, ready-to-eat nature and easy availability in different shapes and sizes at an affordable cost. Cookies are widely consumed as they are rich in carbohydrates, fats and low calories. Currently, incorporation of several materials in cookies has evolved to improve its nutritional and functional quality. Cookies are an important source of nutrients *viz*. energy, protein, iron, calcium and calories. Cookies are not considered as staple food as bread but can be considered as fiber carriers due to their longer shelf-life enabling their large scale production and widespread distribution (Laveena *et al.*, 2013) [8]. Margarine is made from vegetable oils, so it contains unsaturated "good" fats, polyunsaturated and monounsaturated fats. These types of fats help to reduce low-density lipoprotein (LDL), or "bad," cholesterol when substituted for saturated fat. Functional properties of Cookies can be increased by modifying and supplementation of health promoting ingredients like "Gulmar" leaves, blended sugar (artificial + natural) sweeteners, fat replacers and wheat flour (Kroger, *et al.*, 2006) [14].
Gymnema sylvestre R. Br. is one of the important medicinal plants of India widely used in the treatment of diabetes mellitus. *Gymnema sylvestre* R.Br. is an imperative remedial woody climber belonging to family *Asclepiadaceae* 'The Milk Weed Family'. One special name of this plant species is 'Miracle fruit'. The name '*Gymnema*' probably derives from the Latin word meaning 'naked' and *sylvestre* means 'from the forest' (Najafi, *et al.*, 2011) [14]. *Gymnema sylvestre* R.Br. is widely distributed in India, Malaysia, Sri Lanka, Australia, Indonesia, Japan, Vietnam, tropical Africa and Southwestern China. (Fabio *et al.*, 2013) [5] *Gymnema sylvestre* is considered to have potent anti-diabetic properties. This plant is also used for controlling obesity in the form of *Gymnema* tea, often called "Gulmar" (destroyer of sugar). Chewing the *Gymnema* leaves causes the loss of the ability to taste sweetness. Extracts of its leaves and roots are used in India and parts of Asia as a natural treatment for diabetes due to properties that lower and balance blood sugar levels. In addition, the plant possesses antimicrobial, Anti-hyphal, Antihyper - Cholesterolemic and Hepato-protective activities. It also acts as a feeding deterrent to the caterpillar *Prodenia eridania*, prevents dental caries caused by *Streptococcus mutans* and is used in cosmetics.

In addition it is also used in the treatment of rheumatism, cough, ulcer, jaundice, dyspepsia, constipation, asthma, eye complaints, inflammations and snake bites (Fabio *et al.*, 2013) [5]. A high amount of sugar is used in bakery products, which may cause diabetes and obesity. Due to these reasons, sugar is being replaced with substitutes. A number of well-known food safety and regulatory agencies from around the world have made their apprehension with stevia based ingredients accurately known for many years. It has also been reported that *S. rebaudiana*, as a non-calorie first natural sweetener used in medicinal green teas for treating heart burn and other ailments (Gupta R, *et al.*, 2014) [6]. Even though there are more than 200 species of the genus *Stevia*. Out of all, only *S. rebaudiana* gives the sweetest essence. Japanese have been using stevia and its products in cooked or baked goods. It can be safely used in herbal medicines, tonics, for diabetics and also in the daily usage products like mouth washes, and tooth pastes. Leaves of this plant produce zero-calorie, a non-nutritive, high potency sweetener and substitute to sucrose. Among polyols, sorbitol is an efficient replacer that can mimic sugar with minimal effects on cookie quality. It is preferable to sorbitol as a sugar substitute in foods for diabetics. (Kroger, *et al.*, 2006) [14].

2. Materials and Methods

2.1 Raw material preparation

Wheat Flour and Gulmar leaves were purchased from the local market and necessary pre -treatments such as washing, drying, grading, sorting, incorporation etc. was carried out. Sugar free Sweetener, Margarine, Baking powder artificial green colour and essence were purchased from Kolhapur local market. Margarine stored Proper refrigeration at -40°C.

2.2 Preparation of Gulmar powder

Selection of raw material
↓
Grading
↓
Washing
↓
Cutting
↓
Drying
↓
Grinding
↓
Screening
↓
Fine flour/powder

Fig 1: Flow sheet for Preparation of Gulmar powder

2.3 Preparation and optimization

Table 1: Optimization for control and healthy cookies

Sample code / Ingredient	Control sample	B_1	B_2	B_3	B_4
Wheat flour	44.98	44.98	44.98	44.98	44.98
Margarine	23.89	23.89	23.89	23.89	23.89
Gulmar powder	-	1	2	3	4
Blended sweetener	11.71	11.71	11.71	11.71	11.71
Baking powder	1.26	1.26	1.26	1.26	1.26
Egg	17.46	17.46	17.46	17.46	17.46
Salt	0.70	0.70	0.70	0.70	0.70

Cookies were prepared with some modifications. The optimization of blending of wheat flour, Margarine and Blended Sugar free sweetener by varying proportion of two was carried out.

2.4 Preparation of Gulmar based healthy cookies

Creaming of blended sugar and margarine
↓
Addition of dry ingredients
↓
Prepare knead like a dough
↓
Shape in to thin cookies
↓
Spread in to greased baking tray
↓
Preheat the oven
↓
Baking cookies
↓
Out of the oven
↓
Allow to cool
↓
Packing and Storage

Fig 2: Flow sheet for Preparation of Gulmar based cookies

2.5 Physico-chemical analysis

The gulmar powder physical characteristics, such as: height, width, thickness were measured with digital Vernier calipers with 0.01mm precision and the spread ratio calculated by the method described. While the functional properties like bulk density, Tapped Density, Hausner's Ratio, acid insoluble ash and water insoluble ash were determined by Sharma, 2017 [10] and A.O.A.C., 2000 [1].

2.6 Phytochemical Analysis

The phytochemical Screening of the gulmar powder extracts was done using standard procedure as described. Qualitative tests such as Steroids, Terpenoids, Alkaloids Flavonoids and Tannins were carried out as follows. (Shirish *et al.*, 2016) [11]

2.7 Proximate composition

Proximate composition (moisture content, carbohydrate, ash, fat, protein, fiber content, total reducing sugars and total energy) was determined by using different methods (AOAC, 2000; Amin & Thakur, 2016, Ranganna, S. (2001) [1, 2, 9].

2.8 Mineral determination

The minerals such as calcium and iron content of sample were determined by using the Atomic Absorption Spectroscopy as described in (Laveena *et al.*, 2013) [8].

2.9 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 color, taste, texture and overall acceptability were evaluated (Ranganna, 2001) [9]. 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.

3. Results and Discussion

The results obtained during present investigation and discussed under suitable headings in view of available relevant scientific literature. Analysis of raw materials, control cookies, control cake and healthy cookies, healthy cake was performed.

3.1 Analysis of raw material

3.1.1 Physical properties of Gulmar leaves

Table 2: Physical properties of Gulmar leaves

Physical properties	Result
Colour	Green
Shape	Elliptical
Average Weight (g)	0.157
Average Width (cm)	2.56
Average Length (cm)	4.46

*Each value is an average of three determinations

A range of physical properties of Gulmar leaves were determined. The average color, weight, height, width and length of leaves were determined and given in the table no.2. Digital Vernier caliper with the sensitivity of 0.01 mm was used to measure the axial dimensions of randomly selected Gulmar leaves diameter, length etc. as given in the above table no.1. The quantity of Gulmar leaves per kg was measured using an electronic digital balance with 0.01 gm sensitivity. (Sharma, D *et al.*, 2017) [10].

3.1.2 Physico-chemical properties

Table 3: Physico-chemical properties of Gulmar leaves

Physico-chemical parameters	Results*
Color	Green
Bulk Density(g/ml)	0.43
Tapped Density(g/ml)	0.54
Carr's Index	20.37
Hausner's Ratio	1.247
pH 1% solution	6.92
Acid insoluble ash (%)	1.93
Water soluble ash (%)	2.64
Water soluble extractive values (%)	17.29
Alcohol soluble extractive value (%)	4.52

*Each value is an average of three determinations

The color of Gulmar powder was observed visually and found to be green in colour. The pH 1 per cent solution of Gulmar powder was 6.93. The values of Bulk Density (g/ml), Tapped Density (g/ml), Carr's Index and Hausner's Ratio were 0.43, 0.54, 20.37 and 1.255 repectively. Tapped density gives information on consolidation of a powder. A consolidated powder is likely to have a greater arch strength than a less consolidated one, and may therefore be more resistant to powder flow. Calculated Hausner's ratio and Carr's Index for Gulmar powder were mentioned in the Table No 3. *Gymnema sylvestre* had values 20.37 and 1.255 respectively for Carr's Index and Hausner's ratio indicating fair compressibility. Similar results with respect to Bulk Density, Tapped Density, Carr's Index and Hausner's Ratio were reported by A.O.A.C., 2000 [1], (Sharma D, *et al.*, 2017) [10].

3.1.3 Phytochemical Analysis

Table 4: Phytochemical analysis of leaves of *G. sylvestre*

Sr. No.	Phytochemicals	Water Extract
1	Tannins	-
2	Flavanoids	+
3	Terpenoids	+
4	Saponins	+
5	Steroids	-
6	Carbohydrates	+
7	Glycosides	+
8	Anthraquinones	-
9	Anthocyanins	-
10	Phenolics	+

The preliminary phytochemical screening study of *G. Sylvestre leaves* extract revealed the presence of alkaloids anthraquinones, Flavoinds, Phenols, Steroids, Tannins and Terpenoids. The therapeutic effect of medicinal plant is due presence of these secondary products present in the plant. Phytochemical screening of *G. Sylvestre* root indicates that the plant is richest source of Phytochemicals like saponins, glycosides, tannins and flavonoids. Saponins and glycosides were found in higher concentrations but lower concentration of phenols, flavonoids, alkaloids, steroids were recorded. The results are presented in Table No 4. (Shirish *et al.*, 2016) [11].

3.2 Proximate composition

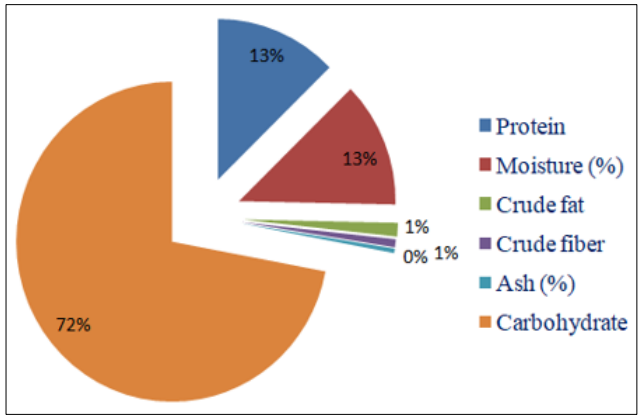

Fig 3: Proximate composition of wheat flour

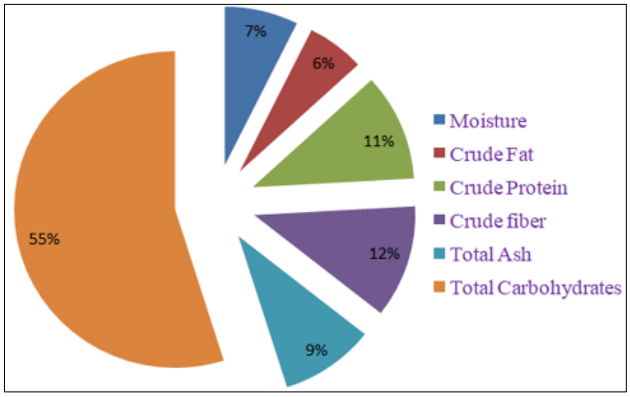

Fig 4: Proximate composition of Gulmar Powder

The results of proximate composition revealed that wheat flour is good source of carbohydrate, protein and crude fiber, content and Gulmar powder is good source of carbohydrates, crude fiber, crude protein Figure no.3 and Figure no.4 revealed that moisture content in wheat flour and Gulmar powder was found to be 12.86 and 7.38 per cent and the fat content was low in concentration 1.40 and 5.80 per cent.Wheat flour and Gulmar powder contained higher amount of carbohydrate (73.15 and 54.89 per cent) than other parameters. Crude fiber, protein and ash content of wheat flour and Gulmar powder were found to be 0.82:11.50, 12.86:10.94 and 0.46:9.49 per cent respectively.

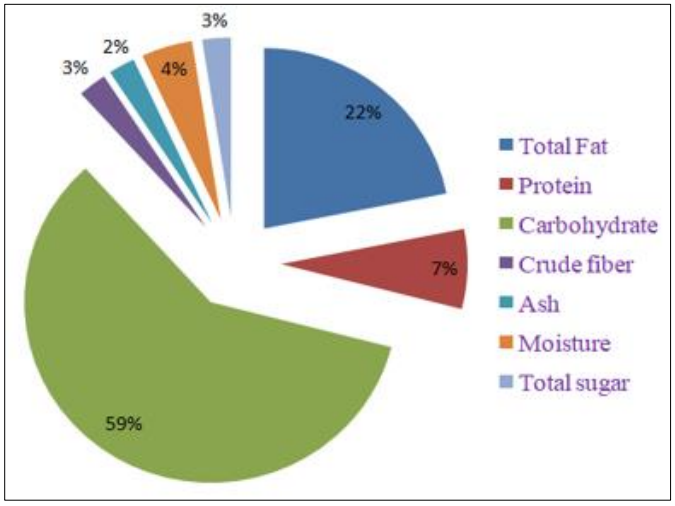

Fig 5: Proximate composition of healthy Cookies

Values of proximate analysis showed that healthyCookiesis good source ofTotal Energy, carbohydrate, fat, and protein content Figure no.5revealedthat moisture content in healthy Cookies Was found to be 4.63per cent and the total fat content was high in concentration 22.77 per cent. Healthy Cookies contained higher amount of carbohydrate (61.68 per cent). Total sugar contained in healthy Cookies is 1.6. The Total Energy value of healthy Cookies is 477.23, similarly the moisture contained in healthy Cookies 4.63 than other parameters. Crude fiber, protein and ash content of healthy Cookies were found to be 2.6: 2.9, 7.4: 5.62 percent respectively.

3.3 Mineral composition

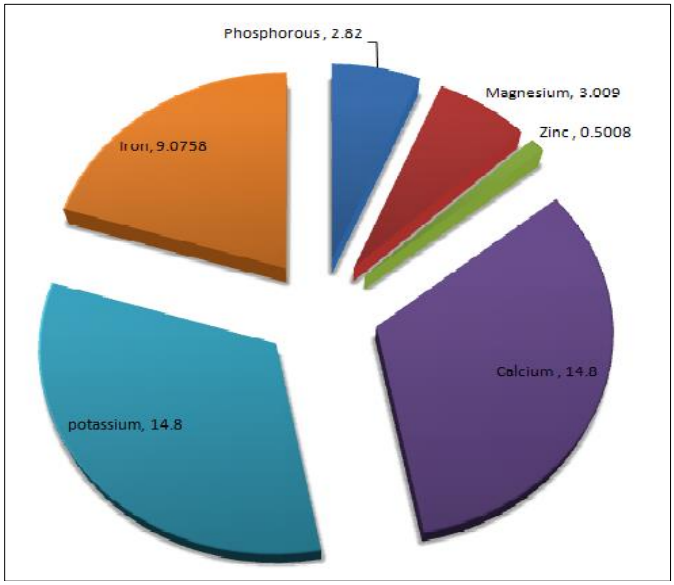

Fig 6: Mineral composition of wheat flour

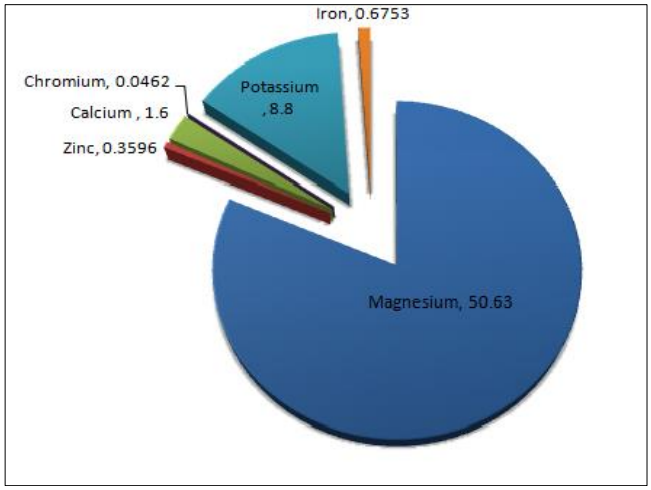

Fig 7: Mineral composition of Gulmar powder

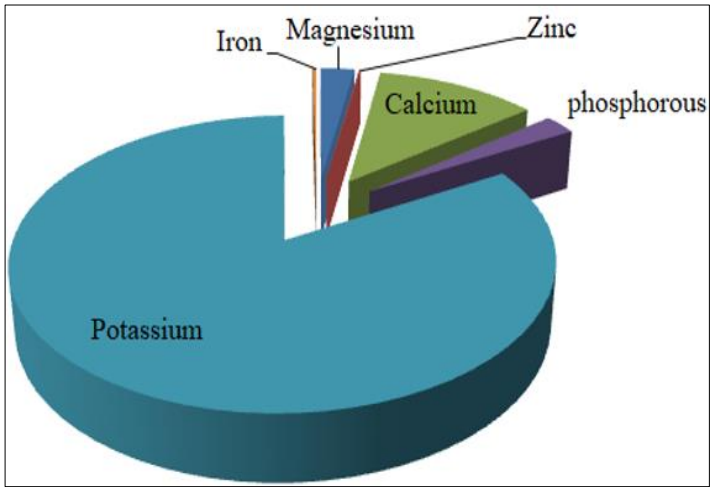

Fig 8: Mineral composition of healthy cookies

Minerals are inorganic elements needed by the body as structural component and regulators of body processes. The data regarding calcium, iron, chromium, zinc and copper of Wheat flour and Gulmar powder are depicted in Figure: 6 and Figure: 7. The macronutrients (Phosphorous, Magnesium, Zinc, Calcium, potassium and Iron) were analyzed from Wheat flour the concentration of these minerals were 2.82, 3.009, 0.5008, 14.8, 14.8 and 9.0758 similarly Gulmar powder content macronutrients such as. (Magnesium Zinc, Calcium, Chromium, Potassium, Potassium) analyzed from Gulmar powder the concentration of these minerals were 50.63, 0.3596, 1.6, 0.0462, 8.8 and 0.6753 (mg/Lit) respectively.

The mineral compositions of the healthy cookie samples are shown in Figure: 8 Potassium is the most abundant element in the healthy cookie samples. The highest potassium content (316 mg/lit) was recorded in healthy cookie and healthy. The macronutrients (Phosphorous, Magnesium, Zinc, Calcium and Iron) were analyzed from healthy cookie the concentration of these minerals were 3.14, 9.075, 0.4364, 38.6 and 0.6065 respectively.

3.4 Organoleptic Analysis

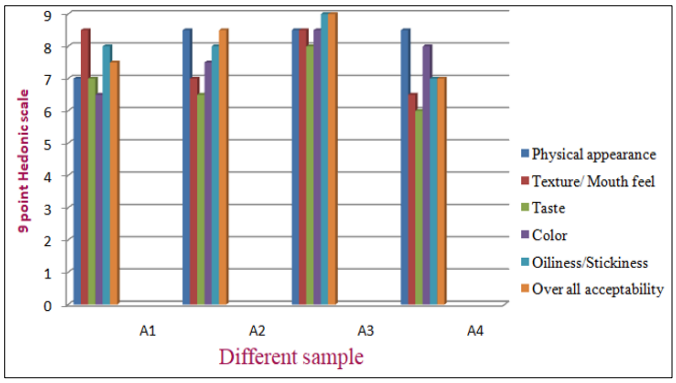

Fig 9: Sensory Evaluation of control cookies

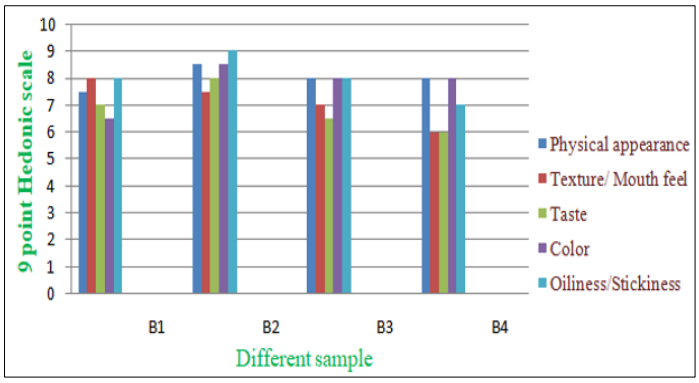

Fig 10: Sensory Evaluation healthy cookies

The control and healthy cookies were evaluated for sensory attributes by a panel of 10 semi-trained judges, using a 9 point Hedonic scale system for different parameters like Physical appearance, Texture/ Mouth feel, Taste, Color, Oiliness/Stickiness and Over all acceptability. The mean values of 10 semi-trained judges were considered for evaluating the quality. The results of sensory evaluation showed that control sample cookies A_3 scored high for all parameters compared to others. Hence sample A_3 was selected for formulation of healthy Cookies. Than the results of sensory evaluation healthy Cookies showed that B_2 scored high for all parameters compared to others

4. Conclusion

Present investigation was carried out to develop the healthy cookies to improve the nutritional quality and functional properties of cookies. In general cookies are made up of sugar and hydrogenated vegetable oil, but in preparation of healthy cookies, sugar is totally replaced by stevia and sorbitol and hydrogenated vegetable oil is partially replaced margarine. The prepared healthy cookies have Gulmar powder which is source for low cholesterol for antidiabetic properties which can be very useful for type 2 diabetic people as a low calorie food and controlling blood sugar. Physical analysis of blending stevia and sorbitol containing cookies showed that the diameter and spread factor of cookies decreased with higher levels of sorbitol, whereas thickness, color, hardness and water activity of cookies increased. The calorific value of cookies decreased with the increasing levels of sorbitol. At up to 40% replacement of sugar, other parameters of cookies were not affected. The prepared healthy cookies are rich in Energy value, Carbohydrate, protein content, iron content and calcium content. Thus the healthy cookies will open a new avenue for commercial use of value added bakery products which will address the treatment of skin problems, bronchitis, fungal infections, eye disease, cancer, dyspepsia, constipation, jaundice, cardiopathy, asthma, diabetes and urinogenital infection.

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