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A study on the development and acceptability of Spiced molasses cookies for Diabetic patients

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1. Abstract: A novel approach was carried to develop diabetic friendly cookies which could be an alternative snack option for in between meals by completely substituting sugar with molasses The spiced flavoured cookies were prepared using low GI composite flour made from Oats, sprouts (moth beans and horse gram), finger millet (Ragi). The method involved in successfully replacing 95.7% of refined flour and 100% of refined sugar. The cookies were subjected to 9 point hedonic scale sensory evaluation by 20 diabetic panel members. The diabetic cookie which had 100% removal of refined sugar was better accepted by the panel members with respect to colour, taste and overall acceptability. The results were encouraging as it did not show any alteration in the blood glucose profile of the panel members.

Keywords : Snacking, Diabetes mellitus, Molasses, GI (Glycamic Index)

2. Introduction :

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from the defects in insulin secretion, insulin action or both. The chronic hyperglycemia of diabetes is associated with long- term damage, dysfunction and failure of different organs, especially the eyes, kidneys, nerves, heart and blood vessels.

When a patient has diabetes, he/she need to control the blood sugar. Insulin or diabetic medicines, as well as exercise, will lower the blood sugar level. To balance this, the food eaten will definitely raise the blood sugar. The major nutrients in food are carbohydrates, protein and fat. Our body quickly turns carbohydrate into a sugar called glucose which in turns raises the blood sugar level. Carbohydrates are found in fruit, cereal products like bread, pasta, rice. Protein and fat can also alter the blood sugar level too but not as fast. If one has diabetes, they need to know how to eat carbohydrate snacks during the day. This will help balance the blood sugar. This is especially important if one has type I diabetes.

It is also seen that diabetic patients follows restricted diet as a result of which they lack food choices and variety to their diet. They have restricted snacking options (if they have

options, they are often confused what to munch to maintain the blood sugar levels).

Hence, thinking for this solution, it was decided to develop a cookie recipe which not only is diabetic friendly but also something which can be eaten as a snack with enjoyment; made easily at home.[9][10][11][32]

3. Review of Literature:

Nutrient dense snacks can be especially important for growing children and for the elderly both of whom may have smaller appetites. A recent study in the Journal of the American Dietetic Association looked at the influence of snacking on energy intakes and energy density in older adults since their energy intakes tend to decline with age. The study concluded/ showed that snacking helped them to consume the calories they needed. Snack consumption, especially if the snack is eaten in a non-hungry state, may be associated with excess weight gain, mostly because of the snack high-energy content, palatability, and high amounts of refined carbohydrates and sugar that may result in low satiety and increased hunger.[39][55]

Having diabetes does not mean to stop eating snacks. It does mean that one should know what a snack can do or affect to the blood sugar. The patients also need to know what healthy snacks are. One must always consult a dietician or nutritionist about what snacks can be eaten and what changes needed for the treatment (such as extra insulin shots) for snacks. People should always read label enclosed in food for carbohydrates and calories. Even one also refers carbohydrate counting books. Over time, it will easier for people to tell, how many carbohydrates are in foods or snacks.[39]

Cookies are representatives of concentrated food because of significant energy content and higher nutritional value. The application of new ingredients in the production of cookies can expand the product range giving the products with new flavours and higher nutritional values. Such an ingredient, containing important nutrients is molasses. Molasses is a promising ingredient for use in confectionary products having been a natural sweetener, nutritious (rich in minerals and vitamins) and as such an alternative to highly refined sugars. Molasses has high content of solids (approximately 80% solids), saccharose (51% in average), 1% raffinose, 0.25% glucose and fructose, 5% proteins, 6% betain, 1.5% nucleosides, 1.5% purine and pirimidine bases, organic acids and pectin. Minerals and vitamins present in molasses are important constituents. Molasses also contains B-group vitamins and does not contain fats and fibres. In addition, molasses shows humectancy, antioxidant and water activity lowering properties which are important to the shelf-life of the products. Molasses obtained from sugarcane juice and pomegranate juice provides a sweetener that is safe for most glucose or blood sugar level issues and has severally naturally minerals.[50]

To balance and enhance the flavour and taste, spices such as cardamom, cinnamon, clove and ginger which also have anti-diabetic properties, are incorporated. Clove extract acts like insulin in hepatocytes and hepatoma cells by reducing

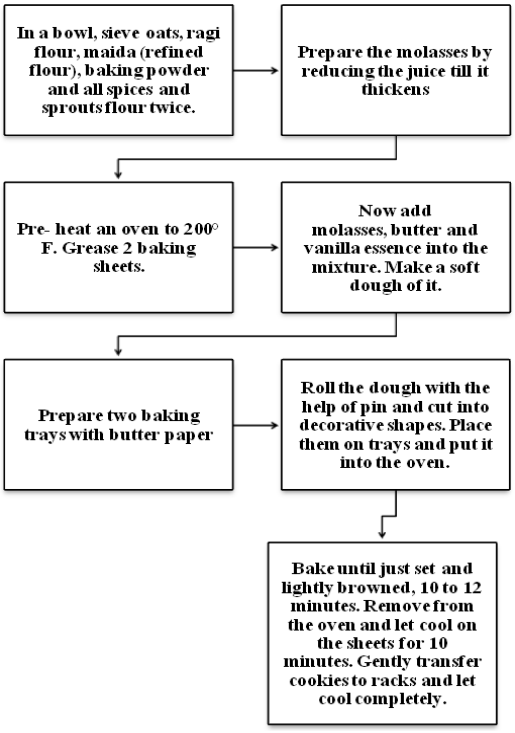
phosphoenolpyruvate carboxykinase (PEPCK) and glucose-6-phosphatase gene expression. Cinnamaldehyde (present in cinnamon) acts as potential oral agent with both hypoglycaemic and hypolipidemic effects. Ciinamon extract and polyphenols with procynadin type-A polymers exhibit the potential to increase the amount of TTP (Thrombotic Thromocytopenic Purpura), IR (Insulin Resistance), and GLUT4 (Glucose Transporter-4) in 3T3-L1 adipocytes and cinnamon polyphenols may have additional as anti-inflammatory and/or anti-angiogenesis agents. To make it nutritionally benefit, flours of ragi (finger millet), sprouts, oats are included which are also low in glycemic index. The treatment with these ingredients might cause a release of insulin activity and improving sensitivity for normalizing blood glucose levels and reduce glucose production by the liver. The fibre present in oats, ragi and sprouts forms a gel which causes the viscosity of the contents of the stomach and small intestine to be increased which may turn slows down digestion and prolongs the absorption of carbohydrates into the bloodstream. This means remarkable changes in blood sugar levels can be avoided. (4)(5)(6)(23)(29)

4. Aims and objectives

The aim of the study was to develop a diabetic snack as cookies with a sugar substitute in the form of molasses prepared from freshly extracted sugarcane juice and pomegranate juice.

The following were the objectives of the study:-

a. Develop a low calorie sweetener as an alternative for refined sugar
b. Evaluate the acceptability of the product
c. Determine the effect of developed product on the blood glucose profile of diabetic patients



5. Methodology

The methodology involved the following:

Selection of place: The preparation and evaluation process of the cookies was conducted in the college laboratory of J D Birla Institute. The food lab was well enlighten, ventilated, highly equipped and well maintained.

Sensory Evaluation: The panelists evaluated the developed product according to sensory properties based on 9-point hedonic scale.

Figure 5.1: Recipe for Spicy molasses cookies (most approved)

Product development: Standard recipe of cookies was chosen for the development. The cookies were incorporated with varying proportions of molasses and spices.

Basic Recipe- Oats (270g), Sprouts flour (30g), Ragi flour (35g), Maida (15g), Butter (100g), Cocoa powder (15g), Vanilla essence, Baking powder
Variation I- Basic recipe with 70g molasses and 30g molasses
Variation II- Basic recipe with 50g sugar and 50g molasses
Variation III- Basic recipe with 10g sugar and 90g molasses
Variation IV- Basic recipe with only 100g molasses
Variation V- Basic recipe+ Variation IV+ Cardamom* + Clove*
Variation VI-Basic recipe+ Variation IV+ Cardamom*+ Clove*+ Ginger* **all spices are grounded and powdered*

Shelf life studies: The shelf life of cookies was studied by keeping separately in zipper pouches namely P3, P5, P7, and P11 for 3, 5, 7 and 11 days respectively. Each packet was opened on respective day to study the appearance and on the basis sensory evaluation was conducted based on 9-point hedonic scale.

Determination of nutrient composition: The cookies were analyzed with the help of the food composition tables according to food composition tables available at "Nutritive value of Indian foods- C Gopalan"

6. Results and Discussions :

Table 6.1: The average scores of 20 panel members of the Basic product and variations based on 9 point hedonic scale

	Appearance	Colour	Texture	Taste	Odour	Overall rating
Basic recipe	7.9	7.9	7.3	7.55	7.55	7.8
Variation I	7.15	7.2	7.6	7.85	7.6	7.5
Variation II	7	8	7.65	7.75	7.7	7.6
Variation III	7.75	8	7.45	7.85	7.85	7.85
Variation IV	7.7	7.5	7.7	7.6	7.55	7.65
Variation V	8.05	8.05	8.05	7.75	7.95	8
Variation VI	8.5	8.5	8.65	8.15	8	8.35

Acceptability rate of the product:

The table mentioned above explains the acceptability rate of the spicy molasses cookies in terms of organoleptic properties given by 20 diabetic panel members based on 9-point hedonic scale. Each variation (excepting the basic recipe) was prepared with molasses of different quantities. The final last two variations (Variations V and VI) include spice mix which add-on the flavour more to the product. It was seen that Variation VI was the most acceptable and preferred product among all. Molasses can be used as an effective natural colorant and sweetener in a wide range of products. It can be directly added to dough directly thereby contributing improved colour and sweetness to cookies.

The table plotted above shows the nutritive analysis of the spied molasses cookies compared to basic recipe, Variation VI was highly nutritive. From the table it can be noted that the amount of nutrients increased with each variations. Spices have little contribution in increasing the fat content due to presence of

Table 6.2:Nutritive Analysis of the product:

	Protein (g)	Fat (g)	Carbohydrate (g)	Energy (kcal)	Dietary fibre (g)	Calcium (mg)	Sodium (mg)	Potassium (mg)
Basic recipe	44.935	82.6075	343.69	2297.48	40.0225	313.325	39.32	390.85
Variation I	44.935	82.6075	373.13	2438.1	47.2925	359.725	41.66	723.35
Variation II	44.935	82.6075	364.79	2410.48	48.425	367.325	42.02	789.85
Variation III	44.935	82.6075	372.23	2459.28	54.0225	402.525	43.82	1055.85
Variation IV	44.935	82.7625	428.54	2711.98	62.425	456.325	46.52	1454.85
Variation V	45.56	82.7625	431.26	2726.78	63.8725	463.825	46.52	1454.85
Variation VI	46.02	83.7625	437.61	2882.13	68.0525	505.825	47.02	1454.85

essential oils (although the amount of butter was kept constant). Oats, sprouts and ragi present in it are all rich source of dietary fibre and major source of protein, complex carbohydrates and minerals like calcium, sodium and potassium. The addition of molasses made from sugarcane and pomegranate juices is all easy sources of sweetness thereby increasing the carbohydrate content but in a healthy manner. [13]

compared to sugar. Molasses coming as a by-product of sugar processing, is a rich source of minerals like sodium, phosphorus and potassium which is rarely present in sugar (since it is refined completely).[13]..

The spiced molasses cookies (Variation 6- the best approved one) were eaten by 20 diabetic people and their blood glucose was checked before and after 2- hour consumption. Then, the product was served to them. Then, blood

Table 6. 3: Nutrient content of Molasses and refined sugar

Nutrients	Amount per 100 gms of Molasses	Amount per 100gms of Sugar
Protein	0.1 gm	0.1 gm
Carbohydrate	15 gm	99.4gm
Fat	0.2 gm	-
Energy	60 kcal	398 kcal
Sodium	40 mg	-
Potassium	50 mg	-
Calcium	3 mg	12mg
Iron	0.1 mg	0.155mg
Phosphorus	10 mg	1 mg

The table plotted above shows difference in the nutrient content of sugar and molasses. Both being an easy of simple carbohydrates, molasses is comparatively nutritive. 1 Tbsp of molasses provide 2.25 gm of carbohydrate and 9 kcal of energy where as sugar provides 14.9 gm of Carbohydrate and 59.7 kcal of energy. The carbohydrate present in molasses is lower

samples were taken for measuring plasma glucose of each subject 2 hours after snacks. The tests were repeated for three days continuously.

Statistical analysis:

It was seen that P values at 5% level of significance has higher values, hence null hypothesis was rejected and alternate hypothesis was accepted which implies that

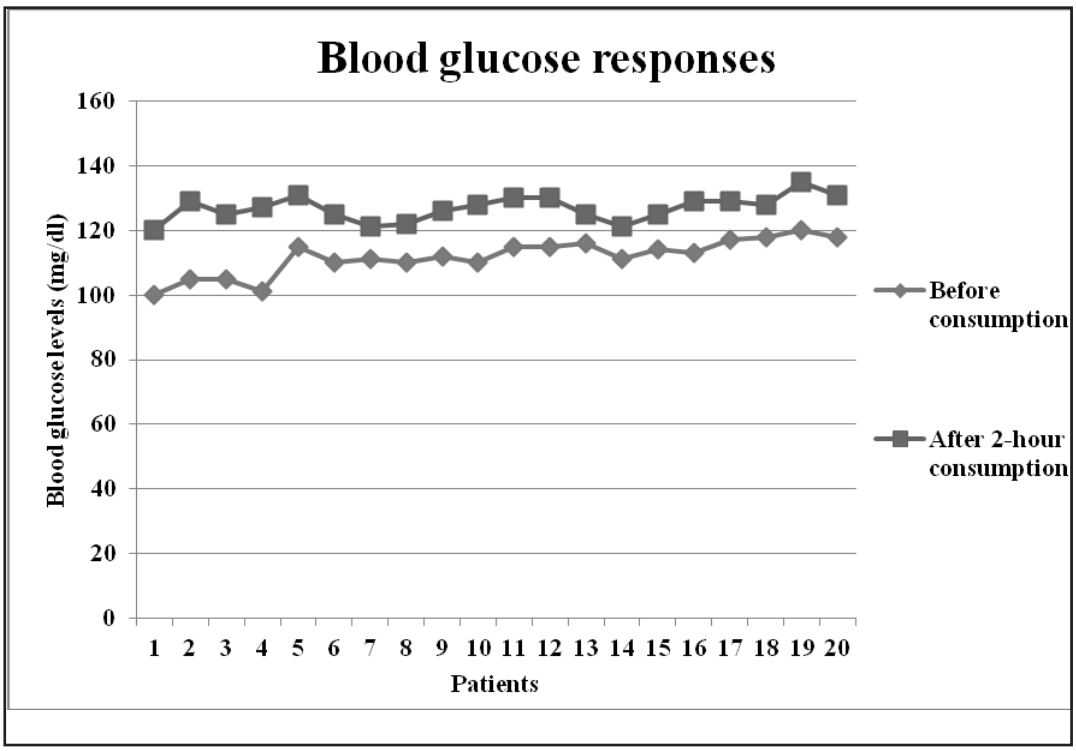


Fig 6.1: Blood glucose profile before and after consumption of 20 gms of spiced molasses cookies.

there is significant difference in the average score of the panel members regarding the organoleptic characteristics of various products.

7. Limitation and Future recommendations:

Further effective methods of chemical analyses on macronutrients and micronutrients contents are required; animal testing can be conducted to prove its efficacy.

8. Conclusion:

The present study shows the successful production of spiced molasses cookies as a snack item for diabetic patients. Molasses are being prepared from sugarcane juice and pomegranate juice whereas spices such as cardamom, clove, cinnamon, ginger and nutmeg are being used.

Molasses is an interesting ingredient for the production of confectionary products, especially biscuits and related products because of its nutritive value (natural sweetener with high mineral content) and physical characteristics (colour, consistency, humectancy). It has been added directly to the dough contributing to improved flavour, colour (chocolate- like) and softer consistency. Molasses can be used as an effective natural colorant in a wide range of products.

Molasses are though available in supermarkets but are expensive and so everyone cannot buy it. Therefore, it is prepared fresh at home using pomegranate and sugarcane juice. The juices are

reduced in heat till it becomes syrupy with thick consistency.

Cookies prepared with both sugarcane molasses and pomegranate molasses had better physical and sensory properties (structure, odour and taste). Spices too contribute flavour and taste to the cookies. Also, they have shown hypoglycaemic reactions by lowering the blood sugar levels. Cookies are prepared with oats, sprouts (moong and lal chana) and ragi (finger millet). All these ingredients have shown positive responses towards diabetes mellitus by increasing the fibre, energy and protein intake. Also, blood glucose tests were also conducted (prior and before consumption) which were found to be stable.

Molasses and spices are therefore included in the recipe with different variations. The last (6^{th}) variation (with 100g molasses and 20g all-spice mix) was the most approved one since it met up the above mentioned criteria.

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