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Research Article

Acceptability of Selected Recipes Incorporating Treated Fenugreek (Trigonella foenum Graecum) Flour in Type II Diabetes and Normoglycaemic Controls– Organoleptic Study.

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ABSTRACT

Impairment in taste modalities is described long before in patients with T2DM. The threshold for bitter taste is reduced in these patients due to diabetic neuropathy. Despite the evidence demonstrating the efficacy of fenugreek in the treatment of diabetes, its use for that purpose has been inhibited by its extremely bitter taste. Sensory evaluation of a food is related to the organo leptic feel of the product. Aim: To determine any significant difference in bitter flavor and taste perception between diabetics and normoglycaemics at each per cent level of fenugreek incorporation. To determine the significant difference in the threshold level for bitter flavor and taste perception in diabetics between different per cent level of fenugreek incorporation. To determine per cent level of fenugreek incorporation and the product acceptability in terms of visual attributes and tactile feel. Method: Three Indian recipes biscuits, dhoklas and Kozhukattai were standardized with each recipe consisting of 10 ,15, 20 and 25 per cent variation of treated fenugreek flour and a control at the food science department of SRM arts and science college –kattankulathur. The experimental group consists of 20 T2DM and the control with 20 normoglycaemic subjects in the age group of 35-45 years from among the staff members. The product was evaluated using score card based on product related lexicon of 5 point hedonic scale rating. The results were statistically analysed using 2- way anova with interaction model and post-hoc test for paired comparison. Results: The study revealed a lower sensitivity to bitter flavour and taste modality in diabetics. Statistically there was significant difference($P<0.001$) in evaluation of biscuits at all four levels of fenugreek incorporation. A significant difference ($P<0.001$) was also observed in dhoklas at 20 and 25 per cent.In kozhukattai significant difference ($P=0.795$) at 10 percent and 25 percent ($P=0.356$) was observed between diabetics and normoglycaemics. The post-hoc test in diabetics showed significant difference ($P<0.005$) in taste perception in biscuits at 10,20 and 25 per cent. A significant difference was also observed in dhoklas ($P<0.005$) between different concentration. In kozhukattai significant difference ($P<0.005$) was noticed at 10,15 and 25 per cent in flavour and taste perception in diabetics. The threshold for bitter taste was perceived by diabetics slightly at 25 per cent level in all three products. In terms of visual attributes and tactile feel biscuites and dhoklas were acceptable at 10 per cent and kozhukattai was acceptable at 25 per cent of fenugreek incorporation. Conclusion: The study revealed a lower sensitivity to bitter flavour and taste modality in diabetics. The threshold for bitter taste was perceived only at higher concentration of 25 per cent in biscuits,dhoklas and kozhukattai.Treated fenugreek flour can be incorporated to about 25 per cent to reduce blood sugar in type II diabetes

Keywords: T2DM, Fenugreek, Sensory evaluation, Organo-leptic Normoglycaemic, Dhoklas

INTRODUCTION

Type II diabetes is a metabolic disorder associated with insulin resistance and β cell dysfunction with micro and macro vascular complications. Inflammatory diseases of oral cavities and soft tissue changes are associated with diabetes mellitus[1]. Taste disorder is a common observation in type 1 and type 2 diabetes due to neuropathy. It is reported that more than 250 medications affect smell and taste sensation in diabetes[2].There is an abnormal metabolism of carbohydrate, protein and fat in diabetes mellitus. Dietary intervention plays a major role in the treatment of type II diabetes along with drugs and exercise. Low carbohydrate diet (30-40%) followed for more than hundreds of years is no longer necessary. It is universally agreed that carbohydrate may form 60-65% of total calories[3].Three fourth of total carbohydrate may come preferably from complex carbohydrate like unrefined cereals in the form of hand pounded rice, whole wheat, ragi, jowar, quinoax and other minor millets. The gluten present in wheat increases the chewing counts and the sense of satiety. The dietary fibre present in milled cereals increases the standing time of food in the gut and fullness to prevent hyperglycaemia. An optimum level of fibre would be 25gms per 1000 calories[4]. Green leafy vegetables like cluster beans, kovakkai, plantain stem and ladies finger are rich sources of dietary fibre. In the management of hyperlipedemia in obese T2dm fat content should be reduced to 20-25%. The unsaturated

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fatty acid(UFA) present in olive oil, cottonseed oil, corn oil, soy bean oil and sunflower oil, are necessary for the metabolism and function.There is evidence that T2dm can be treated by the use of indigenous foods like bitter gourd juice, ginger, garlic oil, thulasi extract, jamun seed extract and fenugreek seeds[5].Fenugreek(Trigonella foenum graecum) is a common condiment used in Indian homes as a spice and food to reduce hyperglycaemia. About 25-100gms of fenugreek seeds taken daily can diminish reactive hyperglycaemia. The beneficial effect of soluble dietary fibre fraction of fenugreek on insulinemic and lipidimic status in type 2 diabetes is well established[6].Indian diet recipes and food ingredients are yet to be standardized. In a heterogenous culture like ours one has to necessarily take into account the factors such as regional and local food habits,cooking habits, eating habits, timing and frequency of food intake, various recipes, and indigenous dietetic ideas prevalent in the society[7]. Sensory analysis of a product is related to the organoleptic feel of the product. They are the visible attributes like appearance and colour , the tactile feel consisting of texture, the olfactory and gustatory sensations like the flavor per se and taste per se[8].

MATERIALS AND METHODS

The study was conducted at the food science department of SRM arts and science college –kattankulathur with 20 T2DM taking oral hypoglycaemic drugs and 20 normoglycaemic controls from among the staff members in the age group of 35-45 years. A written consent was obtained and they were appraised of the study. Fenugreek seeds were purchased in lots and soaked in hot boiling water for 1 minute so as to inactivate lectins to produce less fenugreek odour with-out compromising the taste and flavor. The seeds were dried to remove moisture by evaporation method and fried slightly to remove the bitternes[9].The seeds were powdered in mill so as to pass through a 60' mesh sieve and packed in blends of 10per cent,15percent ,20per cent and 25per cent respectively for further use. Three Indian recipes namely biscuits, dhoklas and kozhukattai were selected for their commonality of use in Indian homes. Each recipe had four variation with four blends of fenugreek incorporation with a control. The recipes were standardized for their repeated consistency. Score cards were developed as given in table 1 using product related lexicon based on 5 point hedonic scale rating[10]. One recipe with four variation was prepared each day. The recipes were coded as S_1, S_2, S_3 and S_4 to prevent any bias. The panel members were invited by 12.30pm for sensory analysis. A glass of water was provided to rinse their mouth each time they tasted a different variation.

The results were statistically analyzed using 2- way anova with interaction and post-hoc test for paired comparison.

RESULTS

Biscuits

As evident from table 2 there was significant difference (P<0.001) in evaluation of biscuits between diabetics and normoglycaemics at 10, 15, 20 and 25 per cent level of

Figure 1a : Biscuits

fenugreek incorporation. Pathological changes in the peripheral nerves of diabetics affects the myelin sheath resulting in reduced thresh hold for bitter taste[11]. A significant difference (P<0.001) in perception of different attributes at 10, 15and 25 per cent was also observed. The results showed a significant interaction between patients and attributes at all four levels with (P<0.001) 10 per cent and (P=0.024) 25 per cent respectively. The post-hoc tukey test reveals a significant difference (P<0.005) in flavor perception of biscuits between the experimental and control group. The diabetic mean was higher (4.2±0.17) compared to normal subjects (3.8±0.2) at 10 per cent. The diabetics have lesser acuity for bitter taste and flavour[12]. Subsequently the diabetics gave a higher mean score as the concentration of fenugreek was increased to15,20 and 25 per cent. In general diabetic subjects were less sensitive than non diabetic subjects . A significant difference (P<0.005) in taste perception was also observed at each of the four levels .The mean score was higher(4.±0.25) in the experimental group compared to control(2.8.±0.09) group at 10 per cent. Continuosly a higher mean score was rated by diabetics compared to normoglycaemics at each of 20 and 25 per cent of fenugreek incorporation .

In determining the sensitivity for bitter flavour and taste in diabetics a significant difference (P<0.005) was observed between various concentration of fenugreek. The threshold for bitter flavor was seen at reduced level and was perceived only at higher concentration of 15 per cent with a minimum (3.4±0.18) score. It is reported that more than 250 medications affect smell and taste sensation in diabetes[13]. In perception of bitter taste higher score (4.±0.25) was observed at 10 per cent . The threshold for bitter taste was observed at 25 per cent with a minimum (3.4±0.18) score value.

Acceptability of food products in terms of sensory variables is an important step in determining research priority[14]. The biscuits had high acceptability fig1(a) in terms of appearance (4.4±0.11) and texture (4.4±0.12) at 10 per cent. The colour (4.±0.17) was acceptable at 25per cent.

Dhoklas

Table 3 shows that there was significant difference (P<0.001) in rating of dhoklas by diabetics and

Table 1. Score card to evaluate biscuites,dhoklas and kozhukatai

Quality	Biscuits	Dhoklas	Kozhukattai	Score
Appearance	Very good	Very good	Very good	5
	Good	Good	Good	4
	Fair	Fair	Fair	3
	.Poor	Poor	Poor	2
	Very Poor	Very poor	Very Poor	1
Colour	Cream	Golden yellow	White	5
	Creamy yellow	Yellow	Cream	4
	Light yellow	Light yellow	Light Yellow	3
	Brown	Yellowish brown	Yellow	2
	Dark brown.	Brown	Yellowish Brown	1
Texture	Crisp	Soft	Very soft	5
	Slightly Crisp	Moderately Soft	Soft	4
	Soft	Fairly hard	Moderately soft	3
	Fairly hard	Soggy	Slightly hard	2
	Very hard	Hard	Hard	1
Flavour	Biscuite flavour	Highly acceptable	Highly acceptable	5
	Mild feugreek flavour	Acceptable	Acceptable	4
	Strong fenugreek flavour	Mild Fenugreek Flavour	Mild fenugreek flavour	3
	Very strong fenugreek flavour	Strong fenugreek flavour	Strong fenugreek flavour	2
	Unacceptable flavour.	Raw flavour	Raw flavour	1
Taste	Good	Good	Good	5
	Fair	Fair	Fair	4
	Slightly bitter	Slightly Bitter	Slightly bitter	3
	Bitter	Bitter	Bitter	2
	Highly bitter	Highly bitter	Highly bitter	1

Table 2: Organoleptic evaluation of biscuits as rated by diabetics and normoglycaemics

Variation	Diabetic					Normoglycaemic					P-Value		
	Apper-ance	Colour	Texture	Flavour	Taste	Apper-ance	Colour	Texture	Flavour	Taste	Patients	Charac-ters	P×C[I]
10 s1	4.4±	3.4±	4±	4.2±	4±	3.8±	2.4±	4.4±	3.8±	2.8±	<0.001	<0.001	<0.001
percent	0.11[a]	0.18[bc]	0.18[ab]	0.17[a]	0.25[ab]	0.2[ab]	0.15[d]	0.11[a]	0.2[ab]	0.092[cd]			
15 s2	3.8±	3.7±	4±	4±	3.4±	3.7±	2.8±	4	±3.4±	2.6±	<0.001	<0.001	0.093
per cent	0.2[a]	0.18[a]	0.25[a]	0.25[a]	0.18[ab]	0.18[a]	0.092[b]	0.18[a]	0.18[ab]	0.23[b]			
20 s3	3.8±	3.8±	3.8±	3.4±	3.6±	3.6±	3±	3.4±	3±	2.4±	<0.001	0.004	0.15
percent	0.2[a]	0.2[a]	0.2[a]	0.18[a]	0.26[a]	0.26[a]	0.123[ab]	0.18[a]	0.23[ab]	0.15[b]			
25 s4	3.8±	4±	3.6±	3.6±	3.4±	3.6±	3.2±	3.6±	3±	2	±<0.001	<0.001	0.024
percent	0.2[a]	0.18[a]	0.26[a]	0.26[a]	0.18[a]	0.26[a]	0.22[a]	0.26[a]	0.23[ab]	0.18[b]			

Values are means ±SEM,n =20 per treatment group.
Means in a row without a common superscript letter differ(<0.005) as analysed by two-way anova.
P×C[I] = Patients ×Characters interaction effect

normoglycaemics at 20 and 25 per cent of fenugreek incorporation. Diabetic neuropathy has possibility to change all four senses of taste[15]. A significant difference (P<0.001) in perception of different attributes was observed at 15, 20 and 25 per cent. An altered sensitivity to various perception was seen in diabetics. Continuously a significant difference (P<0.001) in interaction was observed at 25 per cent between experimental and control group for perception of different attributes.

Results of post-hoc tukey test revealed that there was significant difference (P<0.005) in taste perception between experimental and control group at all four levels of fenugreek incorporation. The diabetic mean score (4.2±0.17) was higher than normoglycaemics (3 ± 0.23) at 10 per cent. Continuously a higher mean score was marked by diabetics stating that the taste acquity for bitterness was lesser in diabetics than normoglycaemics.At 25 per cent level of fenugreek incorporation again diabetics scored maximum(3.7±0.18) compared to normoglycaemics (2 ±0.18). The perception to bitter flavour was reduced in diabetics with a highest (3.0.23) mean score compared to normoglycaemics (2.8±0.09) at 15 per cent.

Table 3: Organoleptic evaluation of dhoklas as rated by diabetics and normoglycaemics

Variation	Diabetic					Normoglycaemic					P-Value		
	Apper-ance	Colour	Texture	Flavour	Taste	Apper-ance	Colour	Texture	Flavour	Taste	Patients	Characters	P×C[I]
10 s1 4 per cent	4± 0.25[a]	4± 0.25[a]	4.6± 0.11[a]	3.7± 0.18[ab]	4.2± 0.17[a]	3.7± 0.18[ab]	4± 0.23[a]	4± 0.18[a]	3.8± 0.2[ab]	3.0± 0.23[b]	0.003	0.01	0.008
15 s2 per cent	3.7± 0.18[bc]	3.8± 0.2[ab]	4.6± 0.11[a]	3.4± 0.18[bc]	3.8± 0.2[ab]	3.6± 0.15[bc]	3.8± 0.2[ab]	3.8± 0.2[ab]	3.4± 0.18[bc]	3.0± 0.23[c]	0.004	<0.001	0.036
20 s3 percent	3.2± 0.22[bc]	3.8± 0.2[ab]	4.4± 0.11[a]	3.0± 0.23[c]	3.8± 0.2[ab]	3.4± 0.18[bc]	3.4± 0.18[bc]	3.8± 0.2[ab]	2.8± 0.092[c]	2.8± 0.092[c]	<0.001	<0.001	0.015
25 s4 percent	3.2± 0.22[bc]	3.7± 0.18[ab]	4.2± 0.17[a]	2.8± 0.092[c]	3.7± 0.18[ab]	3.4± 0.18[bc]	3.4± 0.18[bc]	3.4± 0.18[bc]	2.8± 0.092[c]	2± 0.018[d]	<0.001	<0.001	<0.001

Values are means ±SEM,n =20 per treatment group.
Means in a row without a common superscript letter differ(<0.005) as analysed by two-way anova.
P×C[I] = Patients ×Characters interaction effect

Figure 1 b: Dhoklas

Figure 1 c: Kozhukattai

In determining the sensitivity to bitter flavor and taste perception in diabetics a significant difference (P<0.005) was seen at different levels of fenugreek incorporation.

The diabetics had low threshold for bitter flavour and scored a maximum (3.7±0.17) at 10 per cent. The bitternes was not felt until 20 per cent. The threshold for bitterness was perceived at 25 per cent with a minimum (2.8±0.09) score. Systemic disorders like diabetes mellitus can secondarily cause taste changes through neuropathy[16]. In terms of taste perception again the threshold was decreased with a maximum score (4.2±0.17) at 10 per cent. A higher thresh hold for bitter taste was perceived at 25 per cent with a (3.7±0.17) minimum score.

The dhoklas fig1(b) had a high level of acceptability at 10 per cent of fenugreek incorporation in terms of appearance (4±0.25), colour(4±0.25) and texture (4.6±0.17).The product was less acceptable at 20 and 25 per cent with lowest mean score.

Kozhukattai

A significant difference was analysed in kozhukattai from table 4 between experimental and control group with significant difference (P=0.795) at 10 per cent and 25 per cent (P=0.356) respectively. There was difference in the threshold for bitter taste and flavor perception between diabetics and normoglycaemics at all levels of fenugreek incorporation. The diabetics gave a higher mean score (3.7±0.18) for flavour stating a reduced thresh hold for bitterness compared to normoglycaemics (3±0.23) at 25 per cent. The sensitivity to bitter taste was also reduced and diabetics could not perceive bitterness at lower concentration.The experimental mean score (4±0.25) was

Table 4 Organoleptic evaluation of kozhukattai as rated by diabetics and normoglycaemics

Variation	Diabetic					Normoglycaemic					P-Value		
	Apper-ance	Colour	Texture	Flavour	Taste	Apper-ance	Colour	Texture	Flavour	Taste	Patients	Charac-ters	P×C[I]
10 s percent	3.6± 0.15[ab]	3.4± 0.18[ab]	3.6± 0.15[ab]	2.8± 0.092[b]	4.0± 0.25[a]	3.4± 0.18[ab]	3.6± 0.15[ab]	3.0± 0.23[b]	3.4± 0.18[ab]	3.8± 0.2[a]	0.795	<0.001	0.018
15 s2 per cent	3.2± 0.22	3± 0.23	3.2± 0.22	3.2± 0.22	3.4± 0.18	3.0± 0.23	3.0± 0.23	3.0± 0.23	3.4± 0.18	3.4± 0.18	0.603	0.32	0.85
20 s3 percent	3.2± 0.22[ab]	3± 0.23[b]	4± 0.25[a]	3.2± 0.22[ab]	3.7± 0.18[ab]	3.0± 0.23[b]	3.6± 0.15[ab]	3.4± 0.18[ab]	3.0± 0.23[b]	3.2± 0.22[ab]	0.158	0.033	0.051
25 s4 percent	3.2± 0.22[ac]	4± 0.25[a]	4± 0.18[a]	3.7± 0.18[ac]	3± 0.23[bc]	4.0± 0.25[a]	3.8± 0.2[ab]	3.7± 0.18[ac]	3.0± 0.23[bc]	2.8± 0.092[c]	0.356	<0.001	0.011

Values are means ±SEM,n =20 per treatment group.
Means in a row without a common superscript letter differ(<0.005) as analysed by two-way anova.
P×C[I] = Patients ×Characters interaction effect

higher compared to control (3.8±0.2) at 10 per cent. When the concentration was increased to 20 per cent again the diabetics taste threshold was lower. They rated a higher mean score (3.7±0.18) compared to normoglycaemics(3.2±0.22) . The diabetics have decreased taste sensitivity for al fourl taste parameters[17].A significant difference in perception of various attributes (P<0.001) was also observed at 10 and 25 per cent. Post-hoc test reveals a significant difference (P<0.005) in flavor and taste perception in diabetics between 10,15 and 25 per cent. The threshold for bitter flavor(2.8±0.22) and bitter taste(3.±0.23) was lesser and was perceived only slightly by diabetics at 25 per cent. The kozhukattai fig1(c) had high acceptability in terms of appearance (4±0.25) colour (4±0.25) and texture (4±0.18) at 25 per cent.

DISCUSSION

Fenugreek was found bitter in taste but incorporating treated fenugreek flour in recipes in varied concentration decreased the bitterness. The study revealed a lower sensitivity to bitter flavour and taste modality in diabetics. Statistically there was significant difference (P<0.001) in evaluation of biscuits between diabetics and normoglycaemics at all four levels of fenugreek incorporation. The post-hoc test reveals significant difference

(P<0.005) in taste perception between diabetics at 10,20 and 25 per cent. The threshold for bitter taste was perceived slightly at 25 per cent level in diabetics. The product was acceptable at 10 per cent. In dhoklas a significant difference (P<0.001) at 20 and 25 per cent was found between diabetics and normoglycaemics. The post-hoc test reveals significant difference (P<0.005) in taste perception between diabetics and normoglycaemics at all four levels. The flavour perception also differed significantly (P<0.005) between various concentration in diabetics. The threshold for bitter taste was perceived slightly at 25 per cent level in diabetics. The product was acceptable at 10 per cent. In evaluation of kozhukattai a significant difference (P=0.795) at 10 per cent and 25 per cent (P=0.356) was observed between diabetics and normoglycaemics. Post-hoc test reveals a significant difference (P<0.005) in flavour and taste perception in diabetics at 10,15 and 25 per cent. The threshold for bitter taste was perceived slightly at 25 per cent level in diabetics. The product was acceptable at 25 per cent.

CONCLUSION

The study revealed a lower sensitivity to bitter flavour and taste modality in diabetics. The threshold for bitter taste was perceived only at higher concentration of 25 per cent in biscuits,dhoklas and kozhukattai. Treated fenugreek flour can be incorporated to about 25 per cent to reduce blood sugar in type II diabetes

REFERENCES

1. Shailesh M Gondivkar, Atul Indurkar,Shirish Degwekar,Rahul Bhowate. Evaluation of gustatory function in patients with diabetes mellitus type 2.Oral surgery, oral medicine, oral pathology,oral radiology and endodontology oral medicine December2009;108(6).
2. Evaluation of taste threshold for four main tastes between diabetic and healthy individuals, European scientific journal February2014;10
3. Sharma DC, Ahuja MMS, Diet and diabetes in india, Diet, digestion and diabetes, Workshop manual, 10.
4. Viswanathan M, Ramachandran A, Mohan V, Snehalatha C, Dietary management of diabetes mellitus an update, Diet, digestion and diabetes, Workshop manual, 23.
5. Giri J,Sakthidevi TK,Meerarani S, The effect of ginger on serum cholesterol and blood glucose levels, Society of biological chemists,abstract,Baroda,85.
6. Nutrition News, Use of fenugreek seeds (Trigonella foenum graecum) by diabetics,, National Institute of Nurition,ICMR,1987:8(4).
7. Munichoodappa C,Lalitha CK, Indigenous dietetic ideas in diabetic dietetic regiment, Diet, Diabetes and Digestion, Workshop manual 1987;20
8. Palmer HH, Sensory methods of food quality assessment, Food theory and applications, John wiley and sons, New York,1972,727.
9. Annual report. Hypoglycaemic effect of fenugreek. National institute of nutrition ICMR, 1984-85;11.

10. Morr ML, Irmiter TF, Evaluation of food products, Introductory foods, II edition, Macmillan publishing company, New York,1975,446
11. Olson RK, Taste changes in diabetes mellitus. Nutrition review1982;40(8):236-237.
12. Sudharshani W, Priyadarshika H, Shamini P, Sweet taste sensitivity in pre-diabetics, diabetics and normoglycaemic controls: a comparative cross sectional study, BMC Endocrine disorders 2014;14:67.
13. Raghuram TC. Diabetes mellitus. Nutrition quarterly NIN, ICMR,1988;22(1):3
14. Larmond E, Methods of sensory evaluation of foods, Canada department of agriculture, 3-12
15. Hardy SL, Brennand CP. Taste threshold of individuals with diabetes mellitus and of control subject. Journal of American dietetic association september1981;79(3):286-289.
16. Ajgoankar SS. World congress on diabetes in the tropcs and developing countries. Journal of diabetic association of india 1982;22:57.
17. Wagstaff MA, Diabetes and aging, Journal of diabetes association of india,1983: 82 (2) 206.