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Underutilized cucurbits: Neglected vegetables with therapeutic potential

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Abstract
Investigation on physical characters and glycemic response of fresh and dehydrated underutilized cucurbits was carried out to evaluate the therapeutic value of in both fresh and dehydrated form. Fresh vegetables (*Karachikai*, bitter gourd and spine gourd) were analyzed for the physical characteristics and dietary fiber. The glycemic index (GI) of the vegetables in the fresh whole and powder form seasoned like *bhaji* as an accompaniment with *chapathi* was assessed in non-diabetic volunteers. The study revealed length, breadth and mean diameter of spinegourd and bittergourd (5.90:15.74, 2.70:3.20 and 9.36:9.23, respectively) and the weight and volume of the fruit respectively was 1.58:35.60 g and 4.60:43.00 ml. *Karchikai* had high GI in both powder and *bhaji* (72.41 and 74.03 respectively) compared to bittergourd (53.40 and 56.68) and spinegourd (54.82 and 42.44 respectively). Spinegourd (*Adavi hagal*) in the form of *bhaji* having low GI and a high soluble fiber may be of value in planning diabetic diets.

Keywords: Karachikai, spine gourd, dietary fiber, glycemic index

Introduction
India is the second largest producer of vegetables in the world next only to China with a production of 66 million tonnes (Arora, 2005) [2]. This increased production has not translated into consumption due to wastage, low purchasing power and alike. In this context there is a dire need to improve the per capita availability of vegetables since this group of foods is the sole source of micronutrients. The per capita consumption of vegetables can be improved either by increasing the vegetable production or by exploring additional sources of plant food. From this perspective the use of locally available wild flora has not been fully exploited as a means of reducing the load on production of conventional foods. Many of the underutilized plants are far superior sources of nutrients and have medicinal properties besides having high yield potential (Parvathi and Kumar, 2002) [7]. The utility of them is restricted either as remedy for common ailments or as ingredients in ayurvedic concoctions (Kulkarni, 2003) [5].
The underutilized foods can be defined as the foods which are less available, less utilized or rarely used or region specific (Kulkarni, 2003) [5]. Two of the documented underutilized vegetable *viz.*, *karchikai* and adavihagal have been mentioned as medicinal plants in India and different parts of the plant are used for the treatment of common ailments, while another member of Cucurbitaceae family – bitter gourd is well exploited for health benefits. The hypoglycemic activity of the bittergourd fruit has been shown in both spontaneous and chemically induced diabetes mellitus in experimental animals as well as in human patients (Leatherdale *et al.*, 1981, Ali *et al.*, 1993) [6, 1]. Similarly, *Momordica tuberosa* (*Karchikai*) is reported to reduce the AUC in severe diabetic subjects (Radha and Srijaya, 2003) [8]. It is hypothesized that the vegetables possess antidiabetic potency. Keeping this in view the present investigation was attempted with the objectives to study the physical characteristics of the vegetables and to assess the glycemic index of the vegetables in both fresh and processed form.

Material and Methods
The vegetable namely *Karchikai* (*Luffa tuberosa*), bitter gourd (*Momordica charantia*) and spine gourd (*Momordica dioica*) were collected from the local market during the month of July-August. The vegetables were washed in running water to remove adhering soil and the tail ends were cut and air dried.

Assessing Physical properties and dietary fiber
The physical characteristics of the selected vegetables *viz.*, Range of colour (using RHS colour chart),

shape, weight (electronic balance), volume (water displacement method), bulk density, seed/fruit, length, breadth and diameter (using scale in cm) were determined. Dietary fiber content of the vegetable was determined using enzymatic method of Asp *et al.* (1983) [3]. Effect of drying conditions on dietary fiber components was analysed. Drying methods employed were shade or air drying, sun drying, oven drying and microwave drying.

Determination of Glycemic Index

Six non-diabetic volunteers were selected to assess the glycemic index of selected underutilized vegetables. The selection criteria included age of the volunteer, non-diabetic state, socio-economic status and life style. Demographic profile of selected volunteers including age, gender, educational status and anthropometric measurements was recorded using a simple questionnaire.

The volunteers were instructed to arrive for test with overnight fasting for at least 12hrs. The standard food (50g glucose) was fed and informed to consume within 10min. With a wash out period of one week test food was given. Capillary blood samples were collected at zero, 30, 60, 90, 120min. Graphs were plotted to determine AUC and to calculate glycemic index.

To determine the glycemic index of fresh vegetable, the vegetable was cooked as a *bhaji* and served with *chapathi* such that the meal supplied 50 g carbohydrate. The amount of fresh vegetable given was equivalent to the amount of powdered vegetable (10 g) based on per cent weight loss of the vegetable on drying.

To determine the glycemic index of vegetable powder, 10 g of vegetable powder seasoned similar to *bhaji* was given with *chapathi* such that the meal provided 50 g carbohydrate. The glycemic index was calculated using the below mentioned formula.

$$\text{Glycemic index (GI)} = \frac{\text{Area under food curve}}{\text{Area under glucose curve}} \times 100$$

The glycemic index indicates the extent of rise in blood sugar in response to a test food in comparison with the response to an equivalent amount of glucose. The concept of GI of the foods is considered as physiological basis for ranking foods and is helpful in planning diabetic diets.

Results and Discussion

Physical characteristics of selected vegetables

The fruit of spine gourd had a mean length of 5.90 cm (ranges 5.70-6.00 cm) and breadth of 2.70 cm (2.50-2.90 cm) with a mean diameter of 9.36 cm (8.10-11.40 cm) at the broadest. The colour of the fruit ranged from dark green to grass green and the fruit was ovate in shape with an average weight of 1.58 g (1.57-1.59 g). The fruits were found to occupy a mean volume of 4.60 ml (4.60-4.65 ml) with a bulk density of 0.34 g per ml (0.33-0.35 g/ml). On an average the fruit was found to have eight seeds (Table 1).

In the case of bitter gourd the fruit length was on an average 15.74 cm (range 12.50-20.00 cm) with a breadth of 3.20 cm (3.00-3.60 cm) and diameter of 9.23 cm (7.50-10.80 cm). Each fruit on an average weighed 35.60 g (23.60-64.20 g) occupying a volume of 43.00 ml (30.00-80.00 ml) and with a mean bulk density of 0.90 g per ml (0.77-1.07 g/ml). The colour of the fruit was dark green and it contained 20 seeds (14.00-26.00) on an average.

The fruit of *karchikai* had a mean length of 2.60 cm and 0.95 cm breadth. The diameter at the broadest was 1.85 cm with 4 seeds. The fruit had a bulk density of 0.89 g per ml with weight and volume of 0.46 g and 0.52 ml respectively.

Dietary fiber content of selected vegetables

Table 2 reveals the dietary fiber content of selected vegetables. *Karchikai* had higher total dietary fibre content (80.40%) followed by spine gourd (69.00%). Bitter gourd contained lower total dietary fiber (55.20%) under air-drying. Methods of drying did influence the dietary fiber content. Oven and microwave drying resulted in lowering of the dietary fiber from 68.20 to 63.10 and 63.50 respectively.

Soluble fiber content of vegetables was higher under sun drying (5.40%) compared to oven drying (2.20%) and microwave drying (2.10%). The insoluble dietary fiber content did not differ much between different drying methods of the vegetables. But air dried vegetables had significantly higher insoluble fiber.

Total dietary fiber content of vegetables was less under oven drying (63.10%) which was higher with microwave drying (63.50%), sun drying (66.30%) and air drying (68.20%). The difference in the total dietary fiber content under different drying methods and vegetables was statistically significant.

Spine gourd had the maximum soluble fiber content of 3.95 per cent followed by bitter gourd 3.15 per cent. *Karchikai* recorded the minimum soluble fiber content irrespective of method of drying. This difference in soluble fiber content of vegetables was statistically significant.

Glycemic index

The selected volunteers (2 males : 4 females) were under the age group of 45-53 years, with a weight of 58 and 60 kg in males and 54-68 kg in females and height of 153-168 cm (males : 158-168 cm, females: 153-167 cm). All the volunteers except one were under normal body mass index (BMI) range (males: 21.26, 23.20; females: 22.78-29.05). All were vegetarians and had 3-4 meals a day. The vegetables were served in the form of *bhaji* with *chapathi* and the powder seasoned similar to *bhaji* was given with *chapathi* in order to assess the glycemic index of fresh and dried vegetables.

Fig. 1 shows the glycemic index (GI) values for the selected vegetables in fresh and dried form. The glycemic index of *karchikai* was found to be high in both the forms (*Bhaji*-74.03 and powder-72.41). The GI of bitter gourd was found to be 53.40 in the form of *bhaji* and 56.68 in the form of powder with range of 66.40-37.83 and 81.29-34.06 respectively. Spine gourd showed the lowest glycemic index of 42.44 in the form of *bhaji* and 54.82 in powder form with *chapathi*. Low GI of spine gourd can be reasoned to higher soluble fiber content. The glycemic index of wheat *chapathi* (83.15) is found to be reduced when eaten with the vegetables, which suggests hypoglycemic activity of the vegetables. The bhaji form of vegetables (bitter gourd and spine gourd) showed lower GI values compared to powder form. The modern methods of food processing including grinding, extruding, flaking and puffing and increased starch gelatinization have been associated with glycemic responses (Wolever, 1990) [9]. Jenkins *et al.* (1982) have reported that processing affects the glycemic responses to foods, which may be a reason for high GI of powdered vegetables.

Correlation between glycemic index and dietary fiber

Inter-relation between glycemic index and dietary fiber components are given in Table 3. The insoluble fiber content of both bitter gourd and spine gourd showed a significant positive relation with the glycemic index. With increase in soluble fiber content of the vegetables the glycemic index decreased which is evident from the significant negative relation between soluble fiber content and glycemic index. *Karchikai* and spine gourd showed a significant positive relation between their total dietary fiber content and GI.

The dietary fiber components and GI of *karchikai* had a very low, positive and non-significant relation in powder form. The insoluble fiber content of sun dried bitter gourd and spine gourd had a significant negative relation with GI in both fresh and powder form.

Table 1: Physical characteristics of selected vegetables (per fruit)

S. No.	Physical characteristics	*Karchikai**		Bittergourd		Spine gourd	
		Mean	Range	Mean	Range	Mean	Range
1.	Length (cm)	2.60	2.50-2.71	15.74	12.50-20.00	5.90	5.70-6.00
2.	Breadth (cm)	0.95	0.94-0.97	3.20	3.00-3.60	2.70	2.50-2.90
3.	Daimeter (cm)	1.85	1.80-1.91	9.23	7.50-10.80	9.36	8.10-11.40
4.	Weight (g)	0.46	0.45-0.48	35.60	23.20-64.20	1.58	1.57-1.59
5.	Volume (ml)	0.52	0.51-0.54	43.00	30.00-80.00	4.60	4.60-4.65
6.	Bulk density	0.89	0.83-0.92	0.90	0.77-1.07	0.34	0.33-0.35
7.	Seed (No)	4.00	4 in all	20.00	14-26	8.00	6-12
8.	Colour	Dark green to slightly yellowish green		Dark green		Dark green to grass green	

Table 2: Dietary fiber (%) of selected vegetable powders

S. No.	Method of drying	*Karchikai*			Bittergourd			Spinegourd		
		IDF	SDF	TDF	IDF	SDF	TDF	IDF	SDF	TDF
1.	Shade drying	78.6	1.8	80.4	52.6	2.6	55.2	66.0	3.0	69.0
2.	Sun drying	68.4	2.3	70.7	57.0	6.8	63.8	57.4	7.0	64.4
3.	Oven drying	69.0	2.1	71.1	56.8	1.4	58.2	57.0	3.0	60.0
4.	Microwave drying	68.3	1.7	70.0	58.0	1.8	59.8	57.8	2.8	60.6
	Mean	71.08	1.98	73.05	56.10	3.15	59.25	59.55	3.95	63.50

Source	IDF			SDF			TDF		
	S.Em.±	CD	'F' value	S.Em.±	CD	'F' value	S.Em.±	CD	'F' value
Drying method	0.19	0.56	59.56**	0.20	0.57	135.44**	0.22	0.64	49.46 **
Vegetable	0.17	0.48	798.91**	0.17	0.49	87.49**	0.19	0.56	515.21**
Drying x vegetable	0.34	0.97	55.32**	0.34	0.99	27.45**	0.33	0.97	48.36 **

** - Significant at one per cent level

IDF-Insoluble dietary fiber; SDF-Soluble dietary fiber; TDF-Total dietary fiber

Table 3: Correlation (r) between dietary fiber components and glycemic index

S. No.	Dietary fiber components	Fresh form			Powder form		
		Karchikai	Bittergourd	Spine gourd	*Karchikai*	Bittergourd	Spine gourd
1.	Insoluble fiber	0.3686^{NS}	0.8438**	0.5146**	0.0006^{NS}	-0.7235**	0.7521**
2.	Soluble fiber	-0.3387^{NS}	-0.8440**	0.5533**	0.0004^{NS}	-0.2296^{NS}	0.7519**
3.	Total dietary fiber	0.5533**	0.8446**	0.5122^{NS}	0.0003^{NS}	-0.7238**	0.7521**

** Significant at five per cent level, NS – Non-significant

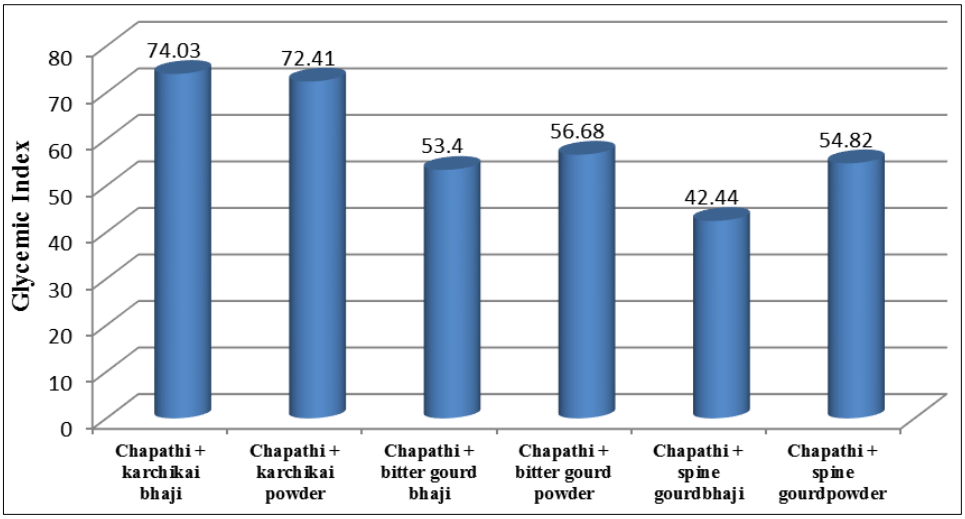

Fig 1: Glycemic index of underutilized cucurbits

Conclusion

Hence, it can be concluded from the present study that spine gourd in the form of bhaji is found to have a low glycemic index and a high soluble fiber content which may be of value in planning diabetic diets. The consumption of spine gourd can be promoted as this vegetable is found to lower postprandial glycemia.

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