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Development of micronutrient rich healthy snack using fenugreek leaves

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Abstract
Fenugreek (*Trigonellafoenumgraecum)* is an annual plant belongs to the family Leguminosae. It is rich in calcium, phosphorus, and a good source of iron and vitamin C. The present research was carried out with the objective to develop a healthy snack (*dry mini samosa*) as well as to assess the sensory acceptability, its nutritional composition and cost. The incorporation of refined wheat flour, pearl millet flour, buckwheat flour and dehydrated *feenugreek* leaves were done at three different ratios named as T_1,T_2 and T_3 (65:15:15:5, 63:15:15:7 and 61:15:15:9 respectively). *Dry mini samosa* prepared from the refined flour only served as control (T_0). The product was organoleptically evaluated by Nine Point Hedonic Scale. The nutritional composition of product was estimated using the food composition table (Gopalan *et al*.,).On the basis of sensory evaluation, treatment T_2 (63:15:15:7) was most acceptable with regards to overall acceptability. There was a significant difference between the sensory attributes of different treatments at 5% significance level. The nutritional composition increased with increase with of incorporation level of dehydrated *feenugreek* leaves. The cost of the product (*dry mini samosa)* per 100g ranged from Rs 13.5-16.9.*Fenugreek leaves* being rich in all micronutrients and affordable will serve as substitute for food from other sources.

Keywords: *Fenugreek* leaves, pearl millet flour, buckwheat flour, nutritional composition, micronutrients

Introduction
Micronutrients deficiency has a complex etiology. It is referred to as the hidden hunger since often times it is not an obvious killer or crippler, but extracts heavy human and economic cost.
Besides poor diet (due to poverty, ignorance, low agricultural productivity, and cultural factors) inadequate access to safe drinking water, clean disease-free environment, and health-care outreach also contribute. Infections result in loss of appetite, impaired absorption and utilization of nutrients, particularly micronutrients.
Fenugreek (*Trigonellafoenum-graecum*) is an annual plant in the family Fabaceae. It is cultivated worldwide as a semiarid crop, and its seeds are a common ingredient in dishes from the Indian subcontinent. Fenugreek leaves (Kasurimethi) is rich in calcium, phosphorus, and a good source of iron and vitamin C. Steaming is considered the best way of cooking this herb, as all the vitamins are retained. The protein content in dried fenugreek leaves is almost equal to that in pulses. It is the famous spices in human food. The seeds and green leaves of fenugreek are used in food as well as in medicinal application that is the old practice of human history. It has been used to increase the flavoring and color, and also modifies the texture of food materials. (Meghwal and Goswami, 2012) [4]. Wheat flour (*Triticumaestivum*), Pearl millet (*Pennisetumglaucum*) and Buckwheat flour (*fagopyrumesculentum)* are the major cereals grown around the world. They are responsible for satisfying the hunger quest of a major chunk of the world's population. The multigrain products feature a combination of grains such as wheat, oat, barley, maize, rice, flax which provide opportunity for snack manufacturers to develop products within imaginative appearance, featuring new texture and colour with a beneficial nutritional profile.
Multigrain products can contribute to a healthy digestive system, help in weight control, reduce the risk of diabetes, reduce the risk of cardiac failures and prevent the chances of bowel cancer. Multigrain products also provide required quantity of thiamine, phosphorous, potassium, riboflavin, pantothenic acid, calcium, iron, zinc and copper. Therefore keeping above points in the mind the present study planned to developed micronutrient rich multigrain flavored snacks with the objective to prepare multigrain flavored snacks using fenugreek leaves, to assess its organoleptic quality, cost and nutritive value of the prepared products.

Materials and method
Multigrains (wheat, pearl millet and buck wheat), fenugreek leaves and other ingredients were purchased from local market of Allahabad, India. Materials were cleaned by removing dirt and damaged parts and leaflets was separated from branches and washed under running water.The standard procedure was slightly modified for the dehydration of fenugreek leaves.

a) Process for dehydration of fenugreek leaves

Leaves (fenugreek)
↓
Trimming of rough stem and stalks
↓
Washing
↓
Spreading on flat trays
↓
Tray drying in the oven at (60˚C-65˚C)
↓
Dehydration till the moisture becomes 6-8 percent
↓
Packaging in air tight container
↓
Storage

***Source*:** Srivastava and Kumar (2009)

Fig 1: Flow diagram for preparation of leaves powder.

b) Preparation of Multigrain Flour

Multigrain seed (wheat, pearl millet and buckwheat)
↓
Washing and cleaning
↓
Drying
↓
Grinding
↓
Sieving
↓
Multigrain flour
↓
Package and storing in cool dry place

***Sources*:** Sharma (2010)

Fig 2: Flow diagram for preparation of multigrain flour.

Dry Mini Samosa was prepared with the incorporation of prepared multigrain flour and dehydrated leaves for each product, the basic recipe (control T_0) had three variations namely, T_1, T_2, T_3, whereas the amount of multigrain flour and types of leaves were varied on the basis of sensory acceptability. All the treatment was replicated three times for each product. Dehydrated fenugreek leaves were used for the flavoring of prepared products and it is consider as treatment.

- **Control (T_0):** '*Dry Mini Samosa'* prepared from refined wheat floor.
- **Treatment (T_1):** '*Dry Mini Samosa'* prepared from mixture of refined wheat flour, pearl millet flour, buckwheat flour and fenugreek leaves powder in a ratio of 65:15:15:5.
- **Treatment (T_2):** '*Dry Mini Samosa'* prepared from mixture of refined wheat flour, pearl millet flour, buckwheat flour, and fenugreek leaves powder in a ratio of 63:15:15:7.
- **Treatment (T_3):** '*Dry Mini Samosa'* prepared from mixture of refined wheat flour, pearl millet flour, buckwheat flour, and fenugreek leaves powder in a ratio of 61:15:15:9.

Sensory evaluation of the prepared food product (*Dry Mini Samosa)* was evaluated by a panel of 5 judges selected from the Department of Food, Nutrition and Public Heath, Ethelind College of Home Science. Sensory attributes like color and appearance, body and texture, taste and flavour and overall acceptability of the prepared products were evaluated using 9 Point Hedonic Scale based score card (Srilakshmi, 2011) [7]. The nutritive values of the prepared products were calculated as the values of ingredients computed in food composition table given by (Gopalan *et al*., 2011) [1]. The cost of the prepared products was calculated taking into account the cost of individual ingredients used in the preparation of the food products at the prevailing market price.The data obtained from sensory evaluation were statistically analyzed by using Analysis of Variance technique (ANOVA), paired t-test and other appropriate statistical techniques (Gupta *et al.*, 2002) [2].

Result and Discussion

The table 1 shows that mean scores of *Dry Mini Samosa (Fenugreek leaves)*, in relation to colour and appearance which indicates that T_2 (8.61) had highest score followed by T_0 (8.60), T_1 (7.80) and T_3 (7.60) respectively. Scoring shows that the treatment T_2 was liked very much while T_0, T_1 and T_3 were moderately liked by the panel of judges.

Table 1: Average sensory scores of control and treated sample of *Dry Mini Samosa (Fenugreek leaves).*

Control and Treatments	Colour and Appearance	Body and Texture	Taste and Flavor	Overall Acceptability
T_0	8.60	8.26	8.06	8.14
T_1	7.80	7.80	7.86	7.76
T_2	8.61	8.46	8.73	8.41
T_3	7.60	7.00	7.00	7.48
F calculated	41.5	31.75	42.10	12.76
F tabulated	4.76	4.76	4.76	4.76
Result	S	S	S	S
C.D	0.34	0.488	0.475	0.50

The table 2 showsthe comparison between the nutritive values of control and the best treatment of '*Dry Mini Samosa (fenugreek leave)'* per 100g. On applying the t-test, significant difference was found between energy, calcium, iron, phosphorus and carotene content of control and best treatment. As the calculated value of 't' was more than the table value of 't' for energy, calcium, iron, phosphorus and carotene at 5 percent level of significance whereas non-significant difference was found for carbohydrate, protein, fat and fibre content of control and best treatment.

Table 3: Composition in the nutritive values of control and the best treatment '*Dry Mini Samosa (fenugreek leaves)'* per 100g.

Nutrients	T_0	T_2	$T_0 - T_2$	t.cal.	t.tab (5%)	Result
Energy (kcal)	511	508	3	3.67	2.92	S
Carbohydrate(g)	49.4	47.68	1.72	2.10	2.92	NS
Protein (g)	10.1	10.53	-0.43	0.52	2.92	NS
Fat (g)	30.3	30.80	-0.5	0.61	2.92	NS
Calcium (mg)	24.2	86.23	-62.03	75.97	2.92	S
Iron (mg)	2.5	4.94	-2.44	2.98	2.92	S
Fibre (g)	0.4	1.96	-1.56	2.64	2.92	NS
Phosphorus(mg)	136.4	173.22	-36.82	45.09	2.92	S
Carotene (µg)	42.6	58.03	-15.43	18.94	2.92	S

At 5% level of significance

Table 4 shows that the total cost of '*Dry Mini Samosa(fenugreek leaves)'* per 100g of dry ingredients at the prevailing cost of the raw materials was T_0 is Rs. 13.5 for treatment, T_1 is Rs. 16.9, T_2 is Rs. 16.86 and T_3 is Rs. 16.82. It is therefore concluded that the control T_0 has the lowest cost and T_1 has the highest cost because the incorporation level of refined wheat flour and refine oil did increase the cost of the prepared products marginally.

Table 4: Cost of the prepared products namely *'Dry Mini Samosa (fenugreek leaves)'*

Ingredients	Actual rate/kg (Rs)	T_0		T_1		T_2		T_3	
		Amt. (g)	Cost (Rs)	Amt. (g)	Cost (Rs)	Amt. (g)	Cost (Rs)	Amt. (g)	Cost (Rs)
Pearl millet flour	60	-	-	15	0.9	15	0.9	15	0.9
Buck wheat flour	240	-	-	15	3.6	15	3.6	15	3.6
Refined wheat flour	36	100	3.6	65	2.3	63	2.2	61	2.1
fenugreek leaves	30	-	-	5	0.15	7	0.21	9	0.27
Gram flour	85	50	4.25	50	4.25	50	4.25	50	4.25
Refined oil	95	60	5.7	60	5.7	60	5.7	60	5.7
Total amount (Rs.)			13.5		16.9		16.86		16.82

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