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Development of high fiber products by using different leaves

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Abstract
The present study was done on different green leaves which are rich sources of fiber and other micronutrients whose consumption is very low in the general population due to lack of awareness or ignorance. Therefore, the effort was made to develop fiber-rich value-added products. Two commonly consumed products namely Pakora and Appe were developed from leaves. Beetroot leaves, Radish, and Taro leaves were taken 40 gm each. Acceptability evaluation of prepared recipes was performed by semi trained panel through 9 point Hedonic rating scale test. The result revealed that among the recipes (Pakora and Appe) prepared by adding 40 gm leaves in which beetroot leaves product were acceptable when compared to product developed by Radish and Taro leaves. This study concluded that these innovative value-added products can supplement fibre to a wide range of populations with effective utilization of low-cost leaves. The result of the Nutritive value indicated that Taro leaves had an appreciable amount of Protein, Energy, and fiber. Therefore, it can be concluded that products developed from Beetroot were acceptable by the panel member but nutritive value was found in taro leaves.

Keywords: Higher fiber, different leaves, products

1. Introduction
In recent years, epidemiological evidence as suggested that a reduction in dietary fiber is related to an increase in certain diseases such as diverticulosis and colonic cancer Dietary fiber acted as a bulking agent that increased intestinal motility and moisture content of feces. It was postulated that those effects were important in preventing disease of the colon. Other studies showed evidence that plant fiber could decrease serum cholesterol levels and improved oral glucose tolerance in humans. In view of the recently proposed physiological role and medical advantage of dietary fiber, along with the increasing interest demonstrated in the scientific and consumer world, it was the interest of food research and product development to examine more closely the application of fiber ingredients in commercial formulations the ingredients [1].

Dietary fiber is a heterogeneous mixture of carbohydrate polymers found in plant raw materials. It refers to a large number of substances that exhibit a wide variety of physicochemical properties, with a general division into water-soluble and insoluble compounds. However, the way of processing, e.g., cereals, reduces its content in products. There is a need to make preparations that can be added to enrich various products. In addition, DF has important health and technological functions in food production. The raw materials for the production of DF preparations are industrial fruit and vegetable waste (apple pomace, blackcurrant pomace, waste from the processing of carrots, and tomatoes) as well as bran, corn cobs, chaff and straw, and legumes (mainly soybeans and peas) [2].

In this era of global industrialization and the advancement of technologies, the lifestyle of the people has changed a lot. In this changing lifestyle, the demand for ready-to-eat foods like extruded foods has increased. Among ready-to-eat foods, junk foods form an important part of the Indian diet. These products are rich in starch, fat, and energy but depleted in fiber. Various epidemiological studies have shown that a diet lacking in fiber may be the cause of various gastrointestinal and cardiovascular diseases. Dietary fiber is currently considered a critical ingredient in food products. The present study deals with the development of fiber-rich recipes [3].

Appe and Pakora are one of the most common consumed food in the world. The affordable cost, good nutritional quality, availability in different tastes, and long shelf-life are the main reasons for wide consuming [4]. Currently, different types of cereals such as oat bran, wheat bran, and rice bran are utilized in bakery production to increase the fibre content [5]. However, the nutritional quality of dietary fibers in vegetables and fruits have a higher proportion of soluble dietary fiber and bioactive compounds than the cereals [6]. Therefore, developing snacks rich in fiber content by utilizing waste by-products is a healthy-promising approach and could decrease the negative environmental effects. The aim of the present research is to develop fiber-rich products from different leaves like beetroot leaves, radish leaves, and taro leaves and to evaluate their physiochemical, biochemical, and sensory characteristics.

2. Materials and Methods

The study was conducted to develop products using different leaves. A list of different leaves with high fiber content was using food consumption and exhaustive literature. Three leaves selected from the list were beetroot leaves, Radish leaves and Taro leaves. All these three leaves were collected from vegetable market of Pilibhit city. Then the leaves were wash under running tap water and cut in fine chops and then value-added products were made and sensory evaluation was done by panel members in the laboratory of the Department of Home Science, Pushp Institute of Science & Higher Studies Pilibhit.

The whole methodology was divided into five phases.

Phase I: Collection of high fiber leaves like Beetroot leaves, Radish leaves, and Taro leaves.

Phase II: Formulation of high fiber products

Phase III: Sensory evaluation by using 9 9-point hedonic scale.

Phase IV: Calculation of nutritive value of the most accepted

Phase V: Statistical Analysis and report writing

2.1 Collection of Raw Material

On the basis of the preliminary screening of locally available green leafy vegetables were used for high fiber, Three leaves were selected on the basis of high fiber content.

Beetroot Taro Radish

Plate 1: Collection of raw material

2.2 Formulation of food products

2.2.1 Development of products

For the value-added iron-rich product development, a list of daily consumed food items was prepared from the magazines and recipes books. Out of them two commonly consumed preparations, Appe and Pakora were selected. The standardized recipes for these preparations were taken. The selected product was developed to enrich them with different high fiber incorporated in basic recipes respectively. Developed preparations were standardized in the laboratory of Home Science, Pushp Institute of Science & Higher Studies Pilibhit, and were evaluated using a 9-point Hedonic Scale.

Plate 2: Developed Appe

Plate 3: Developed Pakora

2.2.2 Standardization of products
The selected preparations *viz.* *A*ppe and Pakora were standardized in the laboratory for their portion size, cooking characteristics, and organoleptic characteristics. Leaves were added and incorporated at different levels. Ingredients used in the preparations were carefully balanced along with a procedure by repeated trials to obtain a standard product.

2.3 Sensory evaluation and acceptability of developed products
Sensory evaluation is considered to be an important analytical tool in the present-day competitive environment to judge the acceptability of food among the potential consumers. In the present study, the sensory evaluation was done by 9 9-point Hedonic scale presented in Table 1.

Table 1: Hedonic Scale for Organoleptic Evaluation

Quality description	Score
Liked extremely	9
Liked very much	8
Liked moderately	7
Liked slightly	6
Neither liked nor disliked	5
Disliked slightly	4
Disliked moderately	3
Disliked very much	2
Disliked extremely	1

2.4 Nutritional analysis of food products
Nutritional analysis was done by using food value Table of ICMR.

2.5 Statistical Analysis of the Data and Interpretation
The data was collected and presented in the results Average nutritional and sensory scores values of the enriched Appe and Pakora were statistically analyzed by using mean and standard deviation.

3. Results and Discussion
3.1 Development of greens mixture incorporated recipes
Dehydrated greens can be utilized in multiple ways by incorporating into existing products and formulation of nutrient-rich value-added products. It is essential to look for a sustainable, culturally acceptable, cost-effective strategy by which consumption of greens can be increased and thereby combating micronutrient deficiencies. The selection of recipes was done by keeping in mind the consumption pattern and changes in the lifestyle of modern households. The recipes were selected with the purpose to combat micronutrient deficiencies as well as increasing. The selected formulation of the green mixture was used in the preparation of various recipes was furnished in Table 2.

Table 2: Development of high green mixture in corporate recipes

Name of the Product	Ingredients used	Incorporation of green mixture (gm)
Beetroot leaves Appe	Beetroot leaves, Semolina, Curd	40
Radish leaves Appe	Radish leaves, Semolina, Curd	40
Taro leaves Appe	Taro leaves, Semolina, Curd	40
Beetroot leaves Pakora	Beetroot leaves, Besan	40
Radish leaves Pakora	Radish leaves, Besan	40
Taro leaves Pakora	Taro leaves, Besan	40

3.2 Sensory Evaluation of developed products
3.2.1 Product
Appe is a snack consumed mostly in India. It is an extruded product with a good texture and appearance colors add to the qualities of food whether it is acceptable or refutable by the consumers. Beetroot leaves Appe (with 40gm of fresh beetroot leaves) was liked very much while Radish leaves Appe (with 40 gm of fresh leaves) was liked moderately. Whereas Taro leaves Appe (With 40gm of leaves) was neither liked nor disliked. A significant difference was found in the taste among these products. Beetroot leaf appe was most acceptable to more than other leaf appe due to taste. The texture of Beetroot Appe was most accepted among other leaf Appe such as Radish and Taro. A difference was found in appearance among all the appe. A particular food should have a particular flavor and it should not be overlapping with another product. The beetroot leave appe was liked extremely (8.56±0.50) while Radish leave (6.56±0.50) was liked monetarily by the panelist. The overall acceptability score revealed that Beetroot leaf appe was liked very much by the panelist (Table 3). These data suggested that incorporation of fresh leaf up to 40gm to enrich the appe with high fiber found acceptable by the judges. Moreover, an overall acceptability of beetroot appe was maximum in comparision with another products (Figure 1).

Table 3: Sensory acceptability score of developed Appe

Attributes	Beetroot's Appe	Radish's Appe	Taro's Appe
Colour	7.96±0.55	6.5±0.50	5.83±0.87
Taste	8.73±0.44	6.76±0.67	5.5±0.50
Texture	8.46±0.50	6.50±0.50	22.5±0.50
Appearance	8.33±0.54	6.53±0.50	7.46±0.50
Flavour	8.43±0.50	6.46±0.50	5.56±0.50
Overall	8.56±0.50	6.56±0.50	5.46±0.50

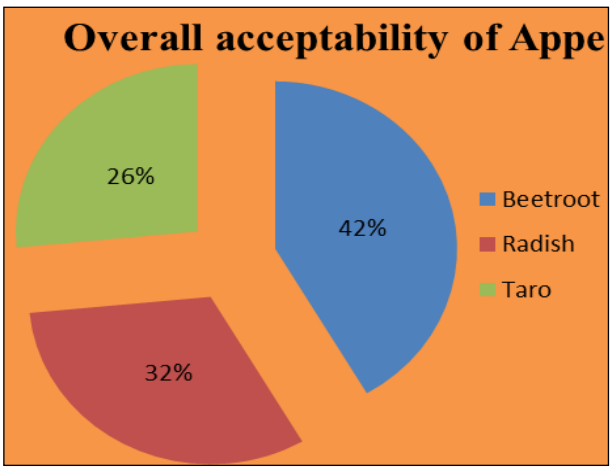

Fig 1: Sensory Evaluation of overall acceptability of developed Appe

3.2.2 Product 2: Pakora

Pakore is one of the traditional South Indian dishes made by gram flour. Overall acceptability was judged to evaluate the overall sensory quality of the product. The mean acceptability score of Pakora (Table No. 4) was prepared from Beetroot (8.56±0.50), Radish (6.6±0.49), and Taro (5.53±0.50) respectively. Table 4.2.2 also indicated that the product developed by using beetroot leaves was liked very much, product developed from radish was liked moderately and products developed by using taro leaves was disliked moderately. Significant differences were found in all sensory attributes. The overall acceptability score revealed that Beetroot leaf product was liked very much by the panelist (Figure 2).

Table 4: Sensory acceptability score of developed Pakora

Attributes	Beetroot's Pakora	Radish's Pakora	Taro's Pakora
Colour	8.13±0.81	6.63±0.49	5.9±0.95
Taste	8.63±0.49	6.6±0.49	5.56±0.50
Texture	8.43±0.50	6.4±0.49	7.53±0.50
Appearance	8.13±0.73	6.5±0.50	7.53±0.50
Flavour	8.7±0.46	6.4±0.50	5.6±0.49
Overall	8.56±0.50	6.6±0.49	5.53±0.50

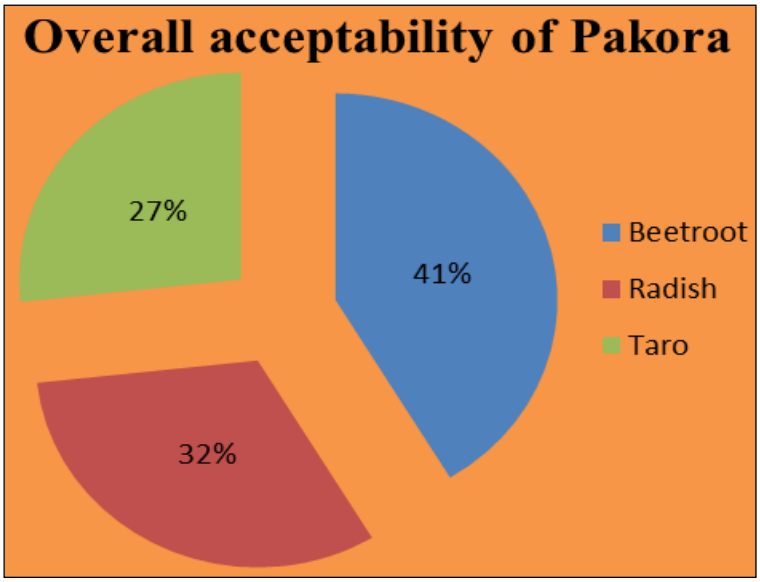

Fig 2: Sensory Evaluation of overall acceptability of developed Pakora

3.3 Nutritive value of accepted Appe and Pakora

Data shown in Table 5 showed that the calculative Nutritive value of Energy, Protein, and Fiber by using values from the food composition Table of ICMR result revealed that Products developed by using Taro leaves was highest in all the attributes in comparison with products developed by using Radish and Beetroot leaves i.e. Energy (227.4 kcal), Protein (4.26 gm) and fiber (1.46 gm). Data shown in Table 5 showed that the calculative Nutritive value of Energy, Protein, and Fiber by using values from the Food composition Table of ICMR result revealed that Products developed by using Taro leaves was highest in all the attributes in comparison with products developed by using Radish and Beetroot leaves i.e. Energy (293.3 kcal), Protein (17.24 gm) and fiber (8.72 gm).

Table 5: Nutritive value of developed Appe using different leaves

Name of products	Ingredients	Amount (gm)	Energy (kcal)	Protein (gm)	Fiber (gm)
Standard Appe	Semolina	70	243	2.08	0.14
	Curd	20	12	0.64	0.16
	Total	90	225	2.72	0.3
Beetroot Appe	Semolina	70	243	2.08	0.14
	Curd	20	12	0.64	0.16
	Beetroot Leaves	40	1.84	1.36	0.28
	Total	130	256.84	4.06	0.58
Radish Appe	Semolina	70	243	2.08	0.14
	Curd	20	12	0.64	0.16
	Radish Leaves	40	11.2	1.52	0.4
	Total	130	266.2	4.22	0.7
Taro leaves	Semolina	70	243	2.08	0.14
	Curd	20	12	0.62	0.16
	Taro Leaves	40	22.4	1.56	1.16
	Total	130	277.4	4.26	1.46

Table 6: Nutritive value of developed Pakora using different leaves

Name of Products	Ingredients'	Amount (gm)	Energy (kcal)	Protein (gm)	Fiber (gm)
Standard Pakora	Besan	70	270.9	15.68	7.56
	Total	70	270.9	15.68	7.56
Beetroot Pakora	Besan	70	270.9	15.68	7.56
	Beetroot Leaves	40	1.84	1.36	0.28
	Total	110	270.74	17.04	7.84
Radish Pakora	Besan	70	270.9	15.68	7.56
	Radish Leaves	40	11.2	1.52	0.4
	Total	110	282.1	17.2	7.96
Taro Pakora	Besan	70	270.9	15.68	7.56
	Taro Leaves	40	22.4	1.56	1.16
	Total	110	293.3	17.24	8.72

4. Conclusion

Biodiversity, a human-managed natural ecosystem consisting of a habitat of species diversity and species richness. In order to create more robust and resilient production system, we have to depend upon biodiversity. Green leafy vegetables can strengthen our nutritional security and commercial cultivation of these lesser-known underutilized greens will not only help in improving the economic and nutritional condition of people but also help in conserving the valuable and endangered biodiversity. The chemical composition of different products prepared by using different leaves provides a good source of phytochemicals and dietary fibers. Thus addition of different leaves purchased from the local market could be utilized for the preparation of other products with improved functional and nutraceutical properties.

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