



Formulation and organoleptic evaluation of high fiber low fat low calorie recipes suitable for diabetic and hypertension patients

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DOI: <https://doi.org/10.66856/ijfsn.2026.11.2.11072>

Abstract

The increasing prevalence of obesity, diabetes mellitus and hypertension has become a major public health concern worldwide. Unhealthy dietary habits, sedentary lifestyle, excessive intake of refined foods and lack of physical activity are some of the major factors contributing to these lifestyle disorders. These conditions not only reduce the quality of life but also increase the risk of serious complications such as cardiovascular diseases, kidney disorders, and metabolic abnormalities. Diet plays a significant role in the prevention and management of obesity, diabetes, and hypertension. Consumption of foods high in fat, sugar, and calories with low dietary fiber has been associated with poor glycemic control, weight gain, and elevated blood pressure. Therefore, there is a growing need to develop nutritious, low-fat, high-fiber, and acceptable food products that can help individuals manage these health conditions effectively. Traditional and locally available food ingredients such as sprouts, whole grains, pulses, and vegetables possess high nutritional value and therapeutic potential. However, many healthy foods are often rejected due to poor taste, texture, or lack of awareness regarding their health benefits. Hence, developing palatable therapeutic recipes that combine nutritional adequacy with sensory acceptability is essential for improving dietary adherence among obese and diabetic individuals. Keeping these concerns in view, the present study was undertaken to develop and evaluate healthy therapeutic recipes suitable for obese, diabetic and hypertensive patients. The study focused on assessing the organoleptic acceptability and nutritional suitability of the developed recipes to promote healthier dietary practices and better health outcomes. Various nutritious recipes such as Lotus Stem Cutlets, Sprouted Channa Chaat, Black Channa Casserole, Poha, Vegetable Idlis and Moong Dhal Stuffed Cheela were prepared using locally available ingredients rich in fiber and low in fat. The developed recipes were evaluated for sensory attributes including appearance, texture, taste, flavour and overall acceptability by a panel of ten judges and obese/diabetic patients using organoleptic evaluation methods. The nutritional analysis indicated that the recipes were nutritionally adequate, high in dietary fiber and low in fat, making them suitable for dietary management of obesity, diabetes and hypertension. Most of the developed recipes were highly acceptable among both judges and patients. The study concludes that healthy, low-cost, and palatable therapeutic recipes can improve dietary adherence and support better health outcomes among obese and diabetic individuals.

Keywords: Organoleptic evaluation, high fiber, low fat, low calorie, diabetic, hypertension

Introduction

Diabetes Mellitus and Hypertension are among the most prevalent non-communicable diseases globally, posing a major public health challenge. According to the World Health Organization (WHO) [1], the global prevalence of diabetes has been rising steadily, while hypertension affects a significant proportion of the adult population and is a leading risk factor for cardiovascular diseases. Both conditions are closely associated with lifestyle factors such as unhealthy dietary patterns, physical inactivity and obesity. As a result, dietary management has become a cornerstone in both prevention and treatment strategies.

A well-balanced diet tailored to the nutritional needs of individuals with diabetes and hypertension plays a crucial role in improving health outcomes. Diets rich in dietary fiber and low in fat and calories have been shown to be particularly effective. Dietary fiber, especially soluble fiber, helps regulate blood glucose levels by slowing gastric emptying and reducing the rate of glucose absorption in the intestine. This leads to improved glycemic control and enhanced insulin sensitivity. Furthermore, high-fiber diets promote satiety, thereby aiding in weight management,

which is essential for controlling both blood glucose and blood pressure levels [2].

Low-fat diets, particularly those low in saturated and trans fats, are equally important in reducing cardiovascular risk factors. Such diets help lower serum cholesterol levels and prevent the development of atherosclerosis, which is commonly associated with both diabetes and hypertension. Additionally, reducing overall caloric intake contributes to weight reduction and improved metabolic health. Sodium restriction, another key dietary component, plays a vital role in managing hypertension by helping to regulate blood pressure levels (American Heart Association, 2021 [3]; World Health Organization, 2020) [4].

Several studies support the effectiveness of these dietary approaches. Sylvetsky *et al.* (2017) [5] reported that high-fiber, low-fat diets are associated with significant weight loss and improved metabolic outcomes in individuals at risk of type 2 diabetes. Similarly, little *et al.* (1990) [6] demonstrated that dietary interventions incorporating low sodium, low fat and high fiber resulted in improved blood pressure control among hypertensive patients. Furthermore, the American Diabetes Association (ADA) recommends increased intake of fiber-rich foods such as whole grains,

legumes, fruits and vegetables as part of medical nutrition therapy for diabetes management.

Traditional and locally available food ingredients such as sprouts, whole grains, pulses, and vegetables possess high nutritional value and therapeutic potential. However, many healthy foods are often rejected due to poor taste, texture, or lack of awareness regarding their health benefits. Hence, developing palatable therapeutic recipes that combine nutritional adequacy with sensory acceptability is essential for improving dietary adherence among obese and diabetic individuals. Keeping these concerns in view, the present study was undertaken to develop and evaluate healthy therapeutic recipes suitable for obese, diabetic and hypertensive patients. The study also assesses the sensory acceptability of these recipes to ensure their practicality and sustainability in daily diets.

Methodology

Research Design

The present study was conducted using an experimental research design to formulate and evaluate high-fiber, low-fat, low-calorie recipes suitable for individuals with Diabetes Mellitus and Hypertension. The study involved three major phases: recipe formulation, nutritional analysis and organoleptic evaluation.

Recipes Selected

Lotus Stem Cutlets, Sprouted Channa Chaat, Black Channa Casserole, Vegetable Poha, Vegetable Idlis, Moong Dal Stuffed Cheela.

Standardization of Recipes

Each recipe was standardized through repeated trials to achieve uniformity in ingredient quantities, consistency in the preparation method and desirable sensory characteristics such as texture, flavor and appearance. During the standardization process, modifications were made in ingredient proportions and cooking techniques until the most acceptable version of each recipe was obtained. Care was taken to ensure that the final products met the nutritional requirements of being high in fiber, low in fat and low in calories, while still maintaining palatability.

All ingredients were measured accurately using a digital weighing scale with an accuracy of ± 1 g, along with standard measuring cups and spoons to maintain precision and reproducibility. Cooking conditions, including temperature and duration, were carefully controlled and kept constant across trials to ensure consistency in the final product. This systematic approach helped in developing recipes that were both nutritionally appropriate and organoleptically acceptable.

Nutritional Analysis

The nutritional composition of each standardized recipe was calculated using standard food composition tables provided by ICMR [7]. The nutritive values were computed on a per-serving basis to ensure accuracy and relevance for dietary planning, particularly for individuals with Diabetes Mellitus and Hypertension. The parameters assessed included energy (kcal), carbohydrates (g), protein (g), fat (g) and dietary fiber (g). These parameters were selected to evaluate the suitability of the recipes for therapeutic diets focusing on glycemic control, weight management and cardiovascular health. The developed recipes were further evaluated against

specific nutritional criteria, wherein fiber content greater than 3 g per serving was considered desirable, fat content was maintained below 3 g per serving and total caloric value was controlled within 250 kcal per serving to align with dietary recommendations for the target population.

Organoleptic Evaluation

For organoleptic evaluation, a panel of 10 semi-trained judges comprising students and faculty members from the nutrition department as well as 10 obese/diabetic patients were selected. The selection of panelists was based on specific inclusion criteria, which included individuals without any known food allergies, willingness to participate in the study and a basic understanding of sensory evaluation techniques. This ensured reliable and consistent assessment of sensory attributes such as appearance, taste, texture, aroma and overall acceptability of the developed recipes.

Data Analysis

Hedonic Rating Scale

A 9-point hedonic scale was used to evaluate the sensory attributes of the developed recipes. This scale is widely employed in sensory evaluation studies to measure the degree of liking or disliking of food products. In the present study ten panelist was asked to assign a score based on their perception of attributes such as appearance, taste, texture, aroma and overall acceptability. The scale ranged from 1 to 9, where a score of 9 indicated "like extremely," reflecting the highest level of acceptance, while a score of 1 indicated "dislike extremely," representing the lowest level of acceptance. Intermediate scores represented varying degrees of preference, such as 8 for "like very much," 7 for "like moderately," 6 for "like slightly" and 5 for "neither like nor dislike." Similarly, scores from 4 to 2 indicated decreasing levels of dislike. This method allowed for a quantitative assessment of sensory qualities and helped in determining the overall acceptability of the recipes among the panelists.

Statistical Analysis

Data analysis was performed using basic statistical methods. Mean scores for each sensory attribute were calculated to determine their average level of acceptability. These mean values provided a clear understanding of the overall sensory performance of each recipe and facilitated comparison among them.

Results & Discussion

The present study focused on the formulation and standardization of six high-fiber, low-fat, low-calorie recipes and their organoleptic evaluation for suitability in individuals with Diabetes Mellitus and Hypertension. The results obtained from nutritional analysis and sensory evaluation are presented and discussed below.

The nutritional composition of the formulated recipes revealed that all preparations met the desired criteria of being low in fat, moderate in energy and high in dietary fiber. The energy content of the recipes ranged from 96.6 kcal (Lotus Stem Cutlets) to 250.3 kcal (Black Channa Casserole), indicating suitability for calorie-controlled diets. Protein content was highest in Black Channa Casserole (13.3 g) and Moong Dal Stuffed Cheela (10.88 g), reflecting the inclusion of legumes and dairy products as good protein sources.

Dietary fiber content was particularly high in Lotus Stem Cutlets (8.4 g) and Sprouted Channa Chaat (5.08 g), highlighting the effective use of vegetables, sprouts, and whole legumes. Low fat content was maintained across all recipes, with values ranging from 0.39 g to 2.9 g, which aligns with dietary recommendations for cardiovascular health and weight management.

These findings are consistent with the guidelines of the American Diabetes Association (2022)^[2], which emphasizes the inclusion of high-fiber, low-fat foods in the dietary management of diabetes, and the World Health Organization (2020)^[4], which recommends reduction of fat and energy-dense foods for chronic disease prevention.

Table 1: Summary of the Recipe with Nutritive Value/Serving

Sr. No.	Recipe	Nutritive Value/Serving
1	<p>Lotus Stem Cutlets</p> <p>Ingredients:</p> <ul style="list-style-type: none"> ▪ Lotus stem – 30 g ▪ Spinach – 5 g ▪ Cabbage – 10 g ▪ Peas – 15 g ▪ Onion – 10 g ▪ Green chillies – 1/2 ▪ Salt – to taste <p>Method</p> <ol style="list-style-type: none"> 1. Scrape and cut lotus stem into thin slices and boil in salted water until tender. 2. Remove from the fire, cool and mash. 3. Add boiled peas and chopped vegetables and spices to lotus stem. Mix well. 4. With hands moistened in cold water, shape the mixture into flat rounds. 5. Place in a moderately heated oven till golden brown. 	<ul style="list-style-type: none"> ▪ Energy – 96.6 Kcal ▪ CHO – 20.12 g ▪ Protein – 2.94 g ▪ Fat – 0.46 g ▪ Fibre – 8.4 g <ul style="list-style-type: none"> ▪ Number of serving – 1 ▪ Number of cutlets – 2
2	<p>Sprouted Channa Chaat</p> <p>Ingredients</p> <ul style="list-style-type: none"> ▪ Sprouted Bengal gram – 15 g ▪ Sprouted green gram whole – 10 g ▪ Radish – 20 g ▪ Radish leaves – 20 g ▪ Onion – 10 g ▪ Tomatoes – 20 g <p>Method</p> <ol style="list-style-type: none"> 1. Sprout whole green gram and Bengal gram. 2. Pressure cook the sprouted legumes for 5 minutes. 3. Chop onions, tomatoes, radish and radish leaves finely. 4. Add finely chopped vegetables to the sprouted legumes. 5. Add salt and mix thoroughly and serve. 	<ul style="list-style-type: none"> ▪ Energy – 108 Kcal ▪ CHO – 18.32 g ▪ Protein – 6.22 g ▪ Fat – 0.69 g ▪ Fibre-5.08 g <ul style="list-style-type: none"> ▪ Number of serving – 1
3	<p>Black Channa Casserole</p> <p>Ingredients</p> <ul style="list-style-type: none"> ▪ Black channa – 50 g ▪ Carrots – 30 g ▪ Capsicum – 30 g ▪ Beans – 20 g ▪ Paneer – 20 g ▪ Hung curd – 2 tbs (20 g) ▪ Salt – to taste ▪ Black pepper – to taste <p>Method</p> <ol style="list-style-type: none"> 1. First, soak the black channa overnight. The next day, pressure cook the soaked channa in a sufficient amount of water along with a pinch of salt until it becomes soft. Once cooked, mash the channa properly. 2. In a pan, heat about half a teaspoon of oil and sauté the chopped capsicum, carrots and beans. Add salt and black pepper according to taste and cook until the vegetables are slightly tender. 3. In a separate bowl, mix hung curd with a little salt and black pepper. Spread a layer of this curd mixture evenly in a baking dish. Over this, add a layer of mashed black channa, followed by a layer of sautéed vegetables. Finally, top it with grated paneer. 4. Place the dish in a preheated oven and bake for about 15 minutes. Once done, remove from the oven and serve hot. 	<ul style="list-style-type: none"> ▪ Energy: 250.3 kcal ▪ CHO -42.72g ▪ Protein – 13.3 g ▪ Fat- 2.9 g ▪ Fibre- 2.97g <ul style="list-style-type: none"> ▪ Number of serving – 1
4	<p>Poha</p> <p>Ingredients</p> <ul style="list-style-type: none"> ▪ Rice flakes – 30 g ▪ Onion – 20 g ▪ Cabbage – 20 g ▪ Spinach – 20 g ▪ Peas – 20 g ▪ Green chillies – 1–2 	<ul style="list-style-type: none"> ▪ Energy – 173.10 Kcal ▪ Carbohydrates (CHO)–30.4 g ▪ Protein – 4.2 g ▪ Fat – 0.51 g ▪ Fibre – 3.8 g <ul style="list-style-type: none"> ▪ Number of Servings-1

	<ul style="list-style-type: none"> ▪ Coriander leaves – for garnishing ▪ Lemon juice – ½ tsp <p>Method</p> <ol style="list-style-type: none"> 1. Wash rice flakes thoroughly under running water and keep aside. 2. Finely chop onion, spinach, cabbage and green chillies. Shell and boil peas. 3. Heat a pan and crackle mustard seeds. 4. Add chopped vegetables and sauté till they become tender. 5. Add soaked rice flakes along with required spices and mix well. 6. Cook while stirring occasionally until done. 7. Sprinkle lemon juice and garnish with fresh coriander leaves. Serve hot. 	
5	<p>Vegetable Idlis</p> <p>Ingredients</p> <ul style="list-style-type: none"> ▪ Suji – 25 g ▪ Curd – 25 g • Spinach – 20 g (finely chopped) ▪ Carrots – 10 g (grated) ▪ Peas – 10 g (boiled) ▪ Coriander leaves – for garnishing ▪ Eno – ¼ tsp ▪ Salt – as per taste <p>Method</p> <ol style="list-style-type: none"> 1. Roast suji on a slow flame until it turns light brown. 2. Beat the curd and mix it thoroughly with the roasted suji. 3. Add grated carrots, boiled peas and finely chopped spinach to the mixture. 4. Add Eno and salt; mix well. 5. Pour the batter into an idli mould and steam for 10–15 minutes. 6. Serve hot with tamarind chutney. 	<ul style="list-style-type: none"> ▪ Energy-113.55 kcal ▪ Carbohydrates (CHO)- 23.08 g ▪ Protein- 4.43 g ▪ Fat- 0.39 g ▪ Fibre- 0.6 g <ul style="list-style-type: none"> ▪ Number of servings: 1 ▪ Number of idlis- 2
6	<p>Moong Dhal Stuffed Cheela</p> <p>Ingredients</p> <ul style="list-style-type: none"> ▪ Batter ▪ Green gram whole – 30 g ▪ Green chilli – 1 ▪ Salt – to taste ▪ Turmeric powder – ¼ tsp Filling ▪ Cauliflower – 30 g ▪ Peas – 20 g ▪ Black gram dhal – 5 g ▪ Onion – 15 g ▪ Salt – to taste ▪ Curry leaves – few <p>Method</p> <ol style="list-style-type: none"> 1. Soak green gram dhal overnight or for 5–6 hours and grind into a fine paste along with green chilli. Add salt and turmeric powder. 2. Add water to prepare a thick batter and keep aside. 3. Sauté onions using a little water. Add black gram dhal, curry leaves and salt. Add cauliflower and peas, mix well and cook till soft. 4. Pour a ladleful of batter on a hot pan and spread like a dosa. When cooked on one side, place the prepared stuffing and roll like a dosa. 5. Serve hot with chutney. 	<ul style="list-style-type: none"> ▪ Energy – 153.9 Kcal ▪ Carbohydrates (CHO) – 27.76 g ▪ Protein – 10.88 g ▪ Fat – 0.61 g ▪ Fibre – 2.49 g <ul style="list-style-type: none"> ▪ Number of Servings- 1 serving

Table 2: Scores of Organoleptic Evaluation of the Recipes

Sr. No.	Recipe	Reponses	Appearance	Texture	Taste Flavour	Flavour	Overall Acceptability
1	Lotus Stem Cutlets	By Panel of Judges	5.1±0.78	5.5±0.48	6.0±0.34	5.8±0.51	6.5±0.67
		By Obese/ Diabetic Patients	5.3 ±0.45	5.5±0.89	5.5±0.56	5.8±0.32	6.0±0.34
2	Sprouted Channa Chaat	By Panel of Judges	5.4 ±0.76	6.4 ±0.8	6.4 ±0.45	6.6±0.4	7.5±0.87
		By Obese/ Diabetic Patients	5.6 ±0.7	6.4 ±0.45	6.4 ±0.34	6.0±0.5	8.8±0.34
3	Black Channa Casserole	By Panel of Judges	6.1 ±0.80	6.0 ±0.76	6.5 ±0.65	6.0±0.5	6.8±0.45
		By Obese/ Diabetic Patients	6.5 ±0.4	6.0 ±0.32	6.5 ±0.23	6.0±0.12	7.4±0.23
4	Poha	By Panel of Judges	5.8 ±0.52	5.8±0.34	6.0±0.5	5.4±0.67	8.6±0.45
		By Obese/ Diabetic Patients	5.8 ±0.98	5.4±0.67	5.4±0.89	5.0±0.34	9.6±0.53
5	Vegetable Idlis	By Panel of Judges	5.7 ±0.4	5.7±0.7	5.7±0.4	5.8±0.45	8.0±0.23
		By Obese/ Diabetic Patients	6.4 ±0.32	6.4±0.63	6.0±0.56	5.5±0.32	8.6±0.34
6	Moong Dhal Stuffed Cheela	By Panel of Judges	6.1 ±0.13	6.1 ±0.1	5.8 ±0.14	6.1±0.74	7.5±0.34
		By Obese/ Diabetic Patients	6.1 ±0.45	5.8 ±0.45	5.8 ±0.3	6.3±0.21	8.2±0.26

The organoleptic evaluation scores of the developed recipes revealed good acceptability among both the panel of judges and obese/diabetic patients. Among all the recipes, Sprouted Channa Chaat received the highest overall acceptability

score from obese/diabetic patients (8.8±0.34), while the panel of judges also rated it highly (7.5±0.87). The recipe scored well in texture, taste and flavour, indicating that sprouted channa was highly preferred due to its appealing

sensory characteristics and nutritious value. Similarly, Poha obtained excellent overall acceptability scores from both judges (8.6 ± 0.45) and patients (9.6 ± 0.53), suggesting that it was one of the most preferred recipes because of its familiar taste, pleasant appearance and easy digestibility.

The sensory scores of Vegetables Idlis also indicated high acceptability among patients, with overall acceptability recorded as 8.6 ± 0.34 compared to 8.0 ± 0.23 by the panel of judges. The recipe was appreciated for its soft texture and balanced flavour. Moong Dhal Stuffed Cheela achieved good ratings in appearance, texture and flavour, with overall acceptability scores of 7.5 ± 0.34 by judges and 8.2 ± 0.26 by patients. This indicates that protein-rich recipes were well accepted when prepared with suitable seasoning and texture. Black Channa Casserole showed moderate to good acceptability, with overall scores of 6.8 ± 0.45 by judges and 7.4 ± 0.23 by patients. The recipe scored comparatively higher in taste and appearance, suggesting that the preparation method enhanced its sensory quality. Lotus Stem Cutlets received comparatively lower scores than other recipes, though the scores still indicated acceptable sensory quality. The overall acceptability was 6.5 ± 0.67 by judges and 6.0 ± 0.34 by patients. Lower scores may be due to unfamiliarity with lotus stem as a food ingredient or variation in texture preference among respondents.

Conclusion

The developed recipes were found to be nutritionally adequate, high in fiber, low in fat and acceptable in sensory properties. These characteristics make them suitable for inclusion in dietary interventions for individuals with diabetes and hypertension. The study highlights the importance of integrating nutrition science with practical food preparation techniques to develop sustainable therapeutic diets to improve dietary adherence and promote better health outcomes among obese and diabetic individuals.

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