

Original Research Article

Organoleptic evaluation of foxnut protein powder

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Abstract

This study highlights the nutritional value and culinary potential of Foxnut (Makhana) protein powder as a versatile functional food ingredient. Foxnut, rich in carbohydrates (75.04%), moderate in protein (11.16%) and low in fat (0.5%), offers a range of health benefits, including antioxidant, antimicrobial, antifungal, anti-diabetic and stress-relieving properties, while supporting heart and liver health. The sensory evaluation demonstrated that incorporating Foxnut protein powder significantly enhanced the taste, texture and overall appeal of various recipes. For the *banana strawberry milkshake, 93.33% of participants rated the experimental version as "Excellent," compared to 40% for the standard version. Similarly, the shrikhand with Foxnut protein powder was rated as "Excellent" by 80% of participants, compared to 33.33% for the standard version. The oats phirni also performed exceptionally well, with 93.33% of participants giving it an "Excellent" rating, while only 20% rated the standard version. In the case of custard, 80% of participants rated the experimental version as "Excellent," with the remaining 20% rating it as "Very Good."

Keywords Foxnut, protein powder, hedonic test, melon seeds, almond, plant based, organoleptic

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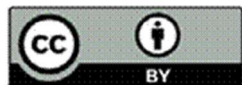
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Introduction

There is a significant association between health and nutrition. Since ancient times, Ayurveda has emphasized on the principles of nutrition, providing detailed guidance on the proper diet necessary for optimal health growth, and development of individuals. Food is obtained either from plants or animals that provides nutrients to maintain different functions in the body. Nutrient delivery can be done in the form of powder, granules, tablets, capsules, liquids, gels etc^[1].

Pumpkin seeds

Pumpkins are nutrient-dense, offering vitamins, minerals and antioxidants. Their seeds are rich in antioxidants, phenolic compounds and minerals. Pumpkins are also a good source of fatty acids like oleic and linoleic acid and vitamins. Common preservation method of pumpkin seeds is drying, which improves its shelf life as well as makes storage and transportation easier^{[1] [2] [3]}.

Melon seeds

Water melon seeds are becoming very popular due to their health benefits. These can be used in sauces and snacks.

Rationale of the study

Present study aims to explore the potential health benefits of various seeds, focusing on their antioxidant properties, enzyme inhibition activities, and their role in promoting overall health. By examining seeds like Makhana, almonds, pumpkin seeds, watermelon seeds, and muskmelon seed flours, this research was planned to contribute to understanding their bioactive compounds and therapeutic potential^[5]. As demand for functional foods and nutraceuticals increases, these seeds could offer sustainable and accessible alternatives for disease prevention and health promotion.

Objective

The present study was proposed to be taken with the following specific objectives

- To develop protein powder of Foxnut (Makhana)
- To assess protein powder by organoleptic methods
- To develop the recipe booklet of Foxnut protein powder

Research Methodology

Methodology has been presented under the following headings:

1. Selection of the product
2. Development of recipes from foxnut (makhana)
3. Conduct sensory evaluation by hedonic
4. Development of recipe booklet on foxnut (makhana)

1. **Selection of the Product**

Bhilwara district in Ajmer division was selected using purposive sampling method because due to moist climatic conditions Foxnut (Makhana) was found easily. So, Foxnut (Makhana) was selected for the present study.

2. **Development of recipes using Foxnut (Makhana) Protein Powder**

In this section, following recipes were developed using Foxnut protein powder.

Recipe	Strawberry Banana protein powder milkshake recipe	Protein Powder Shrikhand	Foxnut powder Cakes	Foxnut Oat Phirni	Foxnut powder Custard
Ingredients	1 cup fresh or frozen strawberry	2 cups Greek yogurt	1 cup whole wheat flour	1/2 cup rolled oats: Ground into coarse powder,	1 scoop foxnut powder

	1 scoop foxnut powder	1 scoop foxnut powder	1 scoop foxnut powder	1 scoop foxnut powder	1/2 cup milk
	1/2 banana	1/4 cup powdered sugar	1/2 cup jaggery	4 cups milk	1/2 tablespoon corn-starch
	1tsp honey or maple syrup (optional)	1/2 tsp cardamom powder	1/2 cup milk	1/4 cup jaggery, 1/2 tsp cardamom powder,	1 teaspoon vanilla extract
	1/2 tsp vanilla essence	Saffron strands soaked in 1 tbsp warm milk	1/4 cup Greek yogurt	Saffron strands soaked in 1 tbsp warm milk,	Sweetener
		1/4 cup chopped nuts	1/4 cup vegetable oil	1/4 cup chopped nuts	Toppings
			1 tsp baking powder		
			1/2 tsp baking soda		
			1 tsp vanilla extract		
			Pinch of salt		
Method of preparation	Combine Ingredients, Place blueberries, protein powder, banana, Greek yogurt, chia/flax seeds, sweetener and vanilla extract in a blender.	Mix Greek yogurt, foxnut powder, sugar, cardamom, saffron & milk until smooth.	Preheat to 175°C.	Bring milk to a boil in a saucepan. Add ground oats, stir continuously for 10-15 minutes until thickened. Add jaggery, stir until dissolved.	Combine ingredients in a small saucepan, whisk together the protein powder, milk, cornstarch and vanilla extract until smooth.

	Add Ice: Add ice to get a thick texture	Add Nuts: Fold in chopped nuts.	Mix all dry ingredients together.	Add foxnut powder. Add cardamom powder and saffron milk. Add chopped nuts	Heat slowly, place the saucepan over low to medium heat. Stir to prevent lumps and heat evenly. Heat until the mix is thickened. Add sweetener
		Refrigerate for 1-2 hours & serve after garnishing with nuts/ fruits	Mix wet ingredients together. Mix wet and dry ingredient gradually to get a smooth texture		

Table 1: Development of recipes

3. Sensory Evaluation

Sensory evaluation to find out acceptability of the recipes using hedonic scale as shown below -

Record sheet

Hedonic Rating scale

Food Characteristics

Appearance colour, Taste/Flavour, Smell/Odour, Texture/Mouthfeel, Sweetness

Score Value Assigned

Liked extremely=9, like very much=8, like moderately=7, like slightly=6, neither like nor dislike=5, dislike slightly=4, dislike moderately=3, dislike very much =2, dislike extremely=1

	Tester					Total Score	Total Score (Total score/ number of panelists)
	1	2	3	4	15		
Appearance (colour, shape)							
Taste\ flavour							
Smell\ odour							
Texture\ mouthfeel							
Sweetness							

Table 2: Sample table of hedonic scale test for sensory evaluation [6]

1. Development of recipe booklet on foxnut

Recipes developed were published in the form of a book for easy reference of the general population and with the purpose of bringing research from lab to land.

2. Statistical analysis

For analysis of collected data suitable statistical methods were applied. The following statistical tests were used for interpreting the data. Frequency and percentage: This method was used to analyze the data regarding background information, knowledge of respondent and sensory evaluation.

Results and discussion

Results have been divided into following categories

1. Development of recipes from foxnut
2. Conduct sensory evaluation by hedonic test
3. Development of recipe booklet on foxnut

1. Conduct sensory evaluation by hedonic scale test

Sensory evaluation of *Foxnut* recipes was conducted using a 9-point hedonic scale to assess attributes such as appearance, taste, texture, aroma and overall acceptability. The results indicated high acceptability across all products. Recipes like *Foxnut* Oats Phirni and *Foxnut* Shrikhand Cake received the highest overall acceptability scores, reflecting their strong preference among evaluators. Other recipes, including *Foxnut* Custard, Cake and Banana strawberry milkshake also performed well with scores indicating consistent quality and favorable sensory characteristics. The evaluation highlights the appeal of *Foxnut* recipes and provides valuable insights for enhancing their consumer appeal and marketability.

Foxnut powder banana strawberry milkshake						
S. No.	Category	Score	Standard		Sample	
			f	%	f	%
1.	Poor	0-3	0	0	0	0
2.	Good	4-7	2	13.33	1	6.6
3.	Very good	8-11	7	46.66	0	0
4.	Excellent	12-15	6	40	14	93.33

Table 3: Categorization of recipe according to their sensory evaluation (n-15)

Table 3 shows the quality assessment of samples of the sensory evaluation of the Foxnut banana strawberry milkshake revealed a distinct preference for the sample recipe over the standard one. Among the 15 participants, none rated the milkshake as "Poor," indicating a baseline level of acceptability. While 13.33% of participants rated the standard recipe as "Good," only 6.6% did so for the sample recipe, suggesting the sample recipe

surpassed initial expectations. The "Very Good" category showcased a significant difference, with 46.66% of participants favoring the standard recipe, while none rated the sample recipe in this range. However, the most striking result came from the "Excellent" category, where 93.33% of participants gave the sample recipe the highest score, compared to 40% for the standard recipe. This demonstrates the sample recipe's superior appeal, likely due to the harmonious blend of Foxnut powder, banana and strawberry, enhancing its taste, texture, and overall quality. These findings highlight the promising potential of using Foxnut powder in milkshake formulations to achieve heightened sensory acceptance and consumer satisfaction.

Categorization of recipe Foxnut powder shrikhand as per sensory evaluation n-15

Foxnut protein powder shrikhand						
S. No.	Category	Score	Standard		Sample	
			f	%	f	%
1.	Poor	0-3	0	0	0	0
2.	Good	4-7	0	0	0	0
3.	Very good	8-11	10	66.66	3	20
4.	Excellent	12-15	5	33.33	12	80

Table 4: Sensory evaluation of foxnut powder cake

Sensory evaluation of the Foxnut powder shrikhand (Table 4) revealed a clear preference for the sample recipe over the standard version. None of the participants rated either recipe as "Poor" or "Good," indicating that both versions were well-accepted. However, a significant difference was observed in the higher scoring categories. While 66.66% of participants rated the standard recipe as "Very Good," only 20% of participants placed the sample recipe in this category, showing a tendency for higher satisfaction with the sample. Notably, the "Excellent" category saw a dramatic difference, with 33.33% of participants rating the standard recipe as excellent compared to an impressive 80% for the sample recipe. This result demonstrates that the addition of Foxnut powder

significantly enhanced the sensory qualities of the shrikhand, particularly its flavor, texture and overall appeal. These findings highlight the potential of Foxnut powder to elevate traditional desserts, making them more appealing and acceptable to consumers.

Sensory evaluation of Foxnut powder cake and standard cake recipes n-15

Foxnut powder cake						
S. No.	Category	Score	Standard		Sample	
			f	%	f	%
1.	Poor	0-3	0	0	0	0
2.	Good	4-7	0	0	1	6.67
3.	Very good	8-11	3	20	6	40
4.	Excellent	12-15	12	80	8	53.33

Table 5: Sensory evaluation of foxnut powder cake

Table 5 is showing that for the standard sample, 80% of participants rated it as Excellent, 20% rated it as Very Good, and none rated it as Poor or Good. In contrast, the experimental sample showed a slightly different distribution, with 53.33% of participants rating it as Excellent, 40% as Very Good, and 6.67% as Good. None of the participants rated the experimental sample as Poor, indicating a generally positive reception for both the standard and experimental cakes, with the standard cake receiving a slightly higher overall preference.

Categorization of Foxnut powder oats phirni according to sensory evaluation n=15

Foxnut powder oats phirni						
S. No.	Category	Score	Standard		Sample	
			f	%	f	%
1.	Poor	0-3	0	0	0	0
2.	Good	4-7	0	0	0	0
3.	Very good	8-11	13	80	1	6.67
4.	Excellent	12-15	2	20	14	93.33

Table 6: Sensory evaluation of foxnut powder oats phirni

Table 6 is showing the sensory quality assessment of samples. Results of the sensory evaluation of Foxnut powder oats phirni showed that for the standard sample, 80% of participants rated it as Very Good, and 20% rated it as Excellent. Meanwhile, the experimental sample received a higher percentage of Excellent ratings, with 93.33% of participants categorizing it as Excellent, and only 6.67% rated it as Very Good. None of the samples were rated as Poor or Good, indicating an overall favorable acceptance of the product.

Sensory evaluation of custard (standard and foxnut powder recipe) n-15

Foxnut powder custard						
S. No.	Category	Score	Standard		Sample	
			f	%	f	%
1.	Poor	0-3	0	0	0	0
2.	Good	4-7	0	0	0	0
3.	Very good	8-11	3	20	3	20
4.	Excellent	12-15	12	80	12	80

Table 7: Sensory evaluation of foxnut powder custard

Table 7 is showing the quality assessment of custard made of foxnut powder. The evaluation revealed that none of the samples fell into the "Poor" (score 0-3) or "Good" (score 4-7) categories, indicating an overall positive reception. In the "Very Good" category (score 8-11), 3 samples (20%) were rated, while the majority, 12 samples (80%), were classified as "Excellent" (score 12-15). This indicates a high level of acceptance and preference for the foxnut powder custard among the panelists.

Development of Recipe booklet on using foxnut powder

The development of a recipe booklet on Foxnut focused on showcasing the culinary versatility and health benefits of this unique ingredient. Known for its cooling properties, nutritional value and distinct texture, Foxnut is an ideal addition to a variety of traditional

and modern dishes. The booklet aimed to educate readers on its origins, uses and health benefits, while providing a diverse range of recipes across categories such as beverages, desserts, snacks, and innovative fusion dishes. Each recipe includes step-by-step instructions, preparation tips, and vibrant images to enhance usability and appeal. Additionally, the booklet highlights Foxnut's role as a health-boosting ingredient, offering dietary tips and suggestions for incorporating it into everyday meals. By promoting awareness and creative use of Foxnut, this booklet serves as both an educational resource and a practical guide, encouraging healthier eating habits.

Conclusion

This study highlights the nutritional value and culinary potential of foxnut powder as a versatile functional food ingredient. Foxnut, rich in carbohydrates (75.04%), moderate in protein (11.16%) and low in fat (0.5%) offers a range of health benefits. The sensory evaluation demonstrated that incorporating foxnut powder significantly enhanced the taste, texture and overall appeal of various recipes. For the banana strawberry milkshake, 93.33% of participants rated the experimental version as "Excellent," compared to 40% for the standard version. Similarly, the shrikhand with Foxnutprotein powder was rated as "Excellent" by 80% of participants, compared to 33.33% for the standard version. The oats phirni also performed exceptionally well, with 93.33% of participants giving it an "Excellent" rating, while only 20% rated the standard version similarly. In the case of custard, 80% of participants rated the experimental version as "Excellent," with the remaining 20% rating it as "Very Good." Additionally, the study led to the development of a recipe booklet showcasing the culinary versatility and health benefits of foxnut. This booklet provides innovative ways to incorporate foxnut into daily meals, promoting its therapeutic potential and cultural significance. In conclusion, this research validates foxnut powder as a sustainable and nutritionally valuable ingredient. It's ability to enhance sensory qualities and promote health makes it an ideal candidate for functional food and nutraceutical applications, addressing the growing consumer demand for innovative and health-focused dietary solutions.

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