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Product development and sensory evaluation of value-added foods using mango seed kernel powder

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Abstract
Sensory evaluation is a scientific discipline adopted to analyse the responses towards the color, taste, smell and touch of a food product. It helps to understand better the consumer preferences. Mango seeds usually discarded as waste, are actually a store house of nutrients. It is nutritionally enriched with vitamins and minerals. For this purpose, three products namely baked atta Mathri, biscuit and biscuit cake were prepared by incorporating 5 to 20 per cent level of mango seed kernel flour and further evaluated for its sensory attributes. Incorporation of mango seed kernel flour at 5 and 10 per cent level was organoleptically acceptable. The highest acceptability for biscuit and biscuit cake was at 5 per cent level and for baked atta Mathri was at 10 per cent level concentration of mango seed kernel flour. Overall baked atta Mathri was comparatively highly acceptable than other two products, so it could be recommended to food industries to develop more nutrient dense food product by using waste (mango seed kernel), which will also play an important role in food security.

Keywords: Product development, mango, sensory evaluation, value-added foods

1. Introduction
The process of designing a new product, producing it and bringing it to market is known as the new product development (NPD). Fuller defines NPD as "The presentation or rebranding by a company of an established product in a new form, a new package or under a new label into a market not previously explored by that company." For the development of new product, standardized procedures, models and appropriate tools are required. There is strong link between sensory evaluation and new product development. Sensory evaluation plays an important role to assess the quality of food product, expectations of consumers and their responses to the product. It is a very effective tool which can be used at many stages of the design process. In early 1900's, it was considered as a scientific discipline used to evoke measure, analyze and interpret reactions to those characteristics of foods and material as they are perceived by the senses of sight, smell, taste, touch and hearing." (Swiader. K and Marczewska. M, 2021) [7].

Sensory evaluation by the consumers helps in better understanding and opens up a space and inspires for innovations also. Hence, sensory evaluation is currently considered the most useful tool at different stages of new product development.

Mango - "King of Fruits" is one of the most sought-after seasonal fruits. Mango seed is discarded as waste after consumption of its pulp. But as mango seed is the site of nutrient storage, it is nutritionally much enriched part of seed. (Kaur and Brar, 2015) [9]. Researches have proven that mango seed is significant in treating several diseases. It is single, flat, oblong, fibrous and hairy on surface. Mango seed content ranges from 9% to 23% for different varieties of mangoes. Kittophoom (2012) stated that mango seeds have good amount of carbohydrates, vitamins and minerals (such as, potassium, magnesium, phosphorous, calcium and sodium). A seed is also good in crude protein which is known as body building block. Mango seed has capacity to reduce the oxidative stress of the body, due to the presence of antioxidant vitamins such as vitamin A, E & C.

The antioxidant activity of mango seed kernel is found to be higher in comparison to other fruit seeds such as in jackfruit, avocados and tamarind. This activity is high because of the presence of phenolic compounds - tannin and flavonoids (Kaur and Brar, 2015) [9].

Researchers have studied the processing of mango seed into flour/composite flour with wheat/refined wheat flour and its functional properties as ingredients. According to them, different types of value-added products can be developed by using mango seed kernel flour.
Hence, the present paper aims to identify the acceptability of baked products developed by incorporating mango seed kernel powder with the help of appropriate sensory tool.

2. Material and Methods

2.1 Procurement of mango seed and processing it into flour

2.1.1 Collection of sample

The fresh ripe mango was collected from local market of district Meerut (U.P), India during the favorable season (month of June/July/August).

2.1.2 Processing of mango seed into flour

Mango seed was washed thoroughly with water and then soaked for a minimum of 48 hrs. To reduce the anti-nutritional components such as tannins. Further it was sun dried. After drying the sample, it was roasted and then finely ground in grinder. It was sieved using muslin cloth to obtain fine powder. This powder was then stored in refrigerator in air tight container until use for testing/extract preparation.

2.2 Product development

Product development is a complex process needed to introduce a new or improved product to the market. Product development is completed in multiple stages and requires input from various teams.
A total of 3 products were developed. The recipes of the present study were based on home made products with different proportion. The criteria for selection were;

- Easy availability of ingredients.
- Consumed commonly by masses.
- Easy and simple to make with minimum expenditure.

Different products were prepared by using optimized mango seed powder. In this process, a total five samples were prepared for a single product, by using different concentration of mango seed powder. One was control sample, known as standard and other four named A, B, C & D were test samples. The variation in test sample was of mango seed kernel flour - 5%, 10%, 15% & 20% respectively.

2.2.1 Standardize recipes for all three products

A set of written instructions used to consistently prepare a known quantity and quality of food for a specific is known as standardized recipe. It produces a product that is close/identical in taste and yield every time it is made, no matter who follows the directions.

- **Recipe of biscuit**

The preheated kadai was used for baking the biscuits. ½ cup ghee, 1 cup powdered sugar and vanilla essence was taken in a bowl and mixed well. Then 1 cup wheat flour and half cup semolina with pinch of baking soda and salt was mixed well and formed dough (with help of milk). Small portions were taken, rolled and flattened out. The design was created with the back side of knife. All prepared biscuits were arranged on greased plate and then put into preheated kadai for baking (20-25 min), till they got brown.

- **Recipe of Biscuit Cake**

10-12 biscuits were ground in a grinder after adding baking powder and 1 tsp sugar. Required milk was added into grinded powder of biscuits to prepare a batter, with continuous stirring. The batter was kept aside for at least 15 min. Meanwhile, the mold was greased and after 15 min the batter was poured into mold and baked in cooker for 30-35 min.

- **Recipe of baked atta mathri**

1 cup wheat flour, 1 tsp of kasoorimethi, ¼ tsp of turmeric, ½ tsp of red chili powder, 1 tsp salt, ½ tsp of ajwain and ¼ cup of refined oil/ghee, all ingredients were mixed well and dough was kneaded. The dough was kept aside for 10-15 min. Then the dough was rolled ¼ inch thick and was cut into rectangular shapes. After completing this, all mathri was arranged on plate and baked in preheated kadai with glass lid for 20-25 min.

2.3 Sensory evaluation

Sensory evaluation is the part of food product development and to launch the new products in the market. Product requires some measure of weather the products are liked or not by the appropriate consumers.

2.3.1 Method for selection of panel members

The selection of the panel members was done on the basis of their optimum health and vulnerability to do evaluation. In the present study, three categories of panel members were selected, Trained, Semi-trained and Untrained. The selection was based on random sampling method.

Trained panel

The trained panel generally comprises of a small number of people who do tasting of food in a controlled set up of the laboratory. These members are trained to taste the food products for flavor, texture and taste profile.

Semi-trained

They are generally familiar with qualities of various foods, and because of their experience, they are capable of giving impartial judgment. The panel size is around 25-30 people.

Untrained panel

The people who are the target group of the particular food product are untrained people. This panel usually comprises of large number of people (around 80-100).

2.3.2 Sensory evaluation by 9-point hedonic scale

This scale is also known as a degree of liking scale. The name hedonic scale for the 9-point was given by David Peryam to determine degree of liking for food products.
This scale is very simple to use and easy to implement. This scale has been shown to be useful in hedonic assessment of food. Wide range of studies has been proved its applicability, validity and reliability (Lawless Harry T). The phrases are for the 9-point hedonic scale for food acceptance testing -Like extremely, Like very much, Like moderately, Like slightly, Neither like nor Dislike, Dislike slightly, Dislike moderately, Dislike very much, Dislike extremely.
In the present study, the sensory evaluation was carried out on this 9-point hedonic scale, where the total number of panel members were 122 for each product. The individual panel member gave the responses on overall acceptability (taste, smell, texture and appearance) on each product's different

concentration.

2.4 Data presentation
The data is presented in percentage with the help of tables, graphs and pie chart.

3. Results and Discussion
3.1 Sensory evaluation of developed products
3.1.1 Biscuit Cake
Five samples were prepared using simply glucose biscuits for standard and for experimental samples. Mango seed kernel flour was incorporated at 5, 10, 15 & 20 per cent levels. The percentage scores of acceptability trials of biscuit cake are presented in Table 1. After control, highest score for likes were obtained by biscuit cake supplemented with mango seed kernel flour at 5% level range of 93.4%. The scores of B sample at 10% level were found comparable with sample A range of 92.6% respectively. It was noticed that incorporation of more than 10% level of mango seed kernel flour caused decline in acceptability. For dislike attribute, it was seen that for sample A & B was same with range of 2.45%. But increased with increasing amount of mango seed kernel flour. Therefore, sample A (5%) was selected as the most acceptable level for biscuit cake with mango seed kernel flour.

Table 1: Organoleptic scores for biscuit cake (in %)

Scale	Likes	Neither like nor Dislike	Dislikes
S	97.5	1.63	0.81
A	93.4	4.09	2.45
B	92.6	4.91	2.45
C	82.7	9.83	7.37
D	83.6	10.65	5.73

*S = standard: A (5%), B (10%), C (15%) & D (20%) were experimental samples with mango seed kernel.

3.1.2 Biscuit
Five samples of the biscuits were prepared using wheat flour for control and for experimental samples; wheat flour was supplemented with mango seed kernel flour at different levels i.e. 5, 10, 15 & 20%. The acceptability scores for sensory evaluation of biscuits are presented in Table 2. With the addition of mango seed kernel flour the percentage score went down at every next level. It was observed that the standard scored higher than the experiments. Therefore, it was highly acceptable and selected for comparison between three of products.
A study by Kaur A and Brar J.K, 2015 stated that the biscuits developed with blend of refined wheat flour and mango seed kernel flour was fairly acceptable till 30 per cent level concentration of mango seed kernel flour.

Table 2: Organoleptic scores for Biscuits (in %)

Scale*	Like	Neither like nor Dislike	Dislike
S	93.4	2.45	4.09
A	90.1	4.09	5.73
B	83.6	5.73	10.65
C	74.5	7.37	18.03
D	80.32	11.47	8.19

*S= standard: A (5%), B (10%), C (15%) & D (20%) were experimental samples with mango seed kernel.

3.1.3 Baked atta mathri
Similar to the above two products, five samples were prepared having one standard/control sample and other four was experimental. Mango seed flour was used as an experimental ingredient at different percentage level (5, 10, 15 & 20%). The overall acceptability of baked atta Mathri from all three panels is presented in Table 3. The table mentioned the degree of liking, neither like nor dislike and dislike. No dislikes were observed for sample A. It represents that incorporation of mango seed kernel flour in Mathri was more successful than other products.
Mathri supplemented with mango seed kernel flour at 10% level was liked very much among other experimental samples.

Table 3: Organoleptic scores for baked atta mathri (in %)

Scale*	Likes	Neither like nor Dislike	Dislikes
S	95.9	4.09	0
A	95.9	0	0
B	95.9	1.63	2.45
C	87.7	8.19	4.09
D	79.5	15.5	1.63

*S= standard: A (5%), B (10%), C (15%) & D (20%) were experimental samples with mango seed kernel.

Menon *et al*., 2014 [5] studied on the development of composite flour bread by using mango seed kernel. They reported that the taste and flavor of composite flour bread were improved with incorporation of mango kernel flour (MKF). However, at 30% level of MKF, the bread had slight bitter taste. This bitterness was due to the high polyphenol and tannin content in mango seeds.
Results given by the study of Yatnatti S & Vijayalaksmi D, 2017 [8] stated that addition of polyphenol extract from mango seed, incorporated into water melon squash was only good scored at 0.1% level. Conclusively mango seed extract was not successful in watermelon squash.
Abdel-Razik *et al*., 2012 [1] developed muffin by using mango seed butter in place of commercial butter. This research reported that there were no significant difference between the contol muffins and muffins prepared from batter containing of 50% mango seed kernel butter.

3.2 Comparative overview of the baked products at different concentration levels
During the research, three different products have been developed in similar manner at various concentrations of mango seed kernel flour. These were named as A, B, C and D having concentration 5, 10, 15 and 20 percent respectively. Fig 1 shows comparative view of likes given by panel members for each concentration of sample of every product. This bar indicates that biscuit cake sample A & B (at 5 & 10 % level) both were equally liked. On the other hand, for sample C & D (at 15 & 20% level), bar was comparatively smaller than sample A & B. In case of biscuit, sample A (at 5% level) was most liked. Sample A & B for baked atta mathri was almost equally liked as standard than other two experimental samples. This figure depicts the most liked sample from each product category. According to figure sample A for biscuit and biscuit cake; and for baked atta mathri, B sample was most liked.

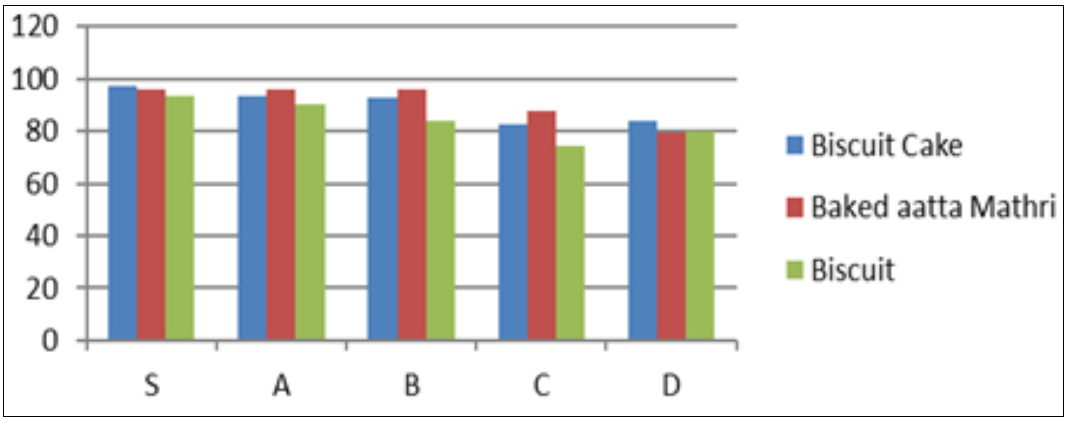

Fig 1: Comparative view of most acceptable sample from each baked products

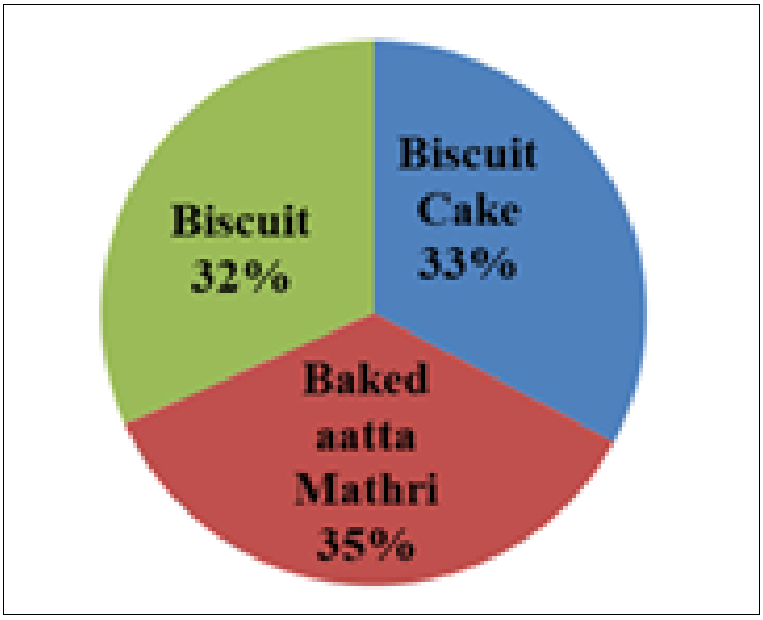

Fig 2: Most acceptable product by panel members

In order to elaborate the highest acceptable product, the comparison was made between highest acceptable concentrations of mango seed kernel from each product. Figure 2 indicates that baked atta mathri was highly acceptable in comparison to biscuit and biscuit cake, with range of 35% higher than 33 and 32% (out of total number of panel members-35% voted for baked atta mathri). So, baked atta mathri was the most accepted product out of the three.

4. Conclusion

Incorporation of mango seed kernel flour as a supplement ingredient in baked products was liked by the consumers. Their responses were positive towards the product as majority of panel liked them. All three products were liked; but baked attamathri was liked the most (up to 10% level). Therefore, it is suggested that mango seed kernel flour could become a potential source of additional nutrients for value added food products/functional foods.

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