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Organoleptic acceptability of value added products using drumstick leaves powder

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Abstract
Developed drumstick leaves powder was incorporated in various products i.e., *khakhra, panjiri, vadi, gatta* premix, *dahi vada* premix, spread premix and soup premix by various proportions (5% and 7%) in laboratory and evaluated by panel of semi-trained judges for sensory characteristics like colour, appearance, aroma, texture, taste and overall acceptability on nine point hedonic ranking scale. All the developed products were ranged between "liked moderately" to "liked very much" on the organoleptic parameters as judged on 9 point hedonic ranking scale. Results of sensory evaluation of products indicated that *khakhra* found to be most acceptable and scored 8.8 on 9 point hedonic ranking scale as compared to other products i.e. *panjiri* (8.6), *vadi* (8.5), *gatta* premix (8.6), *dahi vada* premix (8.4), spread premix (8.6) and soup premix (8.4).The mean score for overall acceptability of developed and control samples ranged from 8.4 to 8.8 on nine point hedonic ranking scale.

Keywords: *Khakhra, panjiri, vadi*, organoleptic, premix, *dahivada*

Introduction
Moringa oleifera is also an important food of trade used as a vegetable particularly in Pakistan, Hawaii, Philippines, Africa and India (Anwar *et al.*, 2005) [1] which has huge deliberation as the 'natural nutrition'. *Moringa oleifera* is the most widely cultivated species of a monogeneric family, the Moringaceae, that is native to the southern foothills of the Himalayan Mountains of India. India is the largest producer in the world with an annual production of 1.1 to 1.3 million tonnes of tender fruit (Jed, 2005) [5]. *Moringa oleifera* leaves have been used successfully in its dried state or powdered form to augment and make delicious meals and porridge diets for pregnant expectant mothers, nursing mothers, infants and young children as well as adults of all age groups. In Africa nursing mothers have been shown statistically to produce far more milk when they add *Moringa oleifera* leaves to their daily diets and malnourished children have made significant weight gains when nursing mothers and care-givers add them to their diets as well (Duke, 1982) [4]. Therefore it is necessary to increase the utilization of *Moringa* leaves consumption by the different communities. It should be consumed either fresh or dry. Dried leaves can be stored for a long time and can be used regularly. Many companies across the world are manufacturing various products of *Moringa* leaves such as *Moringa* Tea, *Moringa* Tablets, *Moringa* Capsules, *Moringa* Leaf Powder, *Moringa* Soaps and *Moringa* Face Wash. Some beverages are also available in market prepared using *Moringa* leaves (Mishra *et al.*, 2012) [6].

Reviews of Literature
Nambiar and Parnami (2008) [8] advocated food based strategies while a diet including easily accessible and inexpensive green leafy vegetables to reduce micronutrient deficiencies. The aim of the study was to standardize and organoleptically evaluated freshly blanched leaves of the drumstick incorporated into three recipes commonly consumed in India: *mung*, *kabuli chana* and *desi chana*. One serving of each of these recipes (30 g raw weight of pulses) could incorporate a maximum of 20 g of fresh drumstick leaves. All three recipes were found to be acceptable by the panel of judges (18 to 21 year old women).
Nwakalor and Chizoba (2014) [9] reported that blends of wheat flour and *Moringa oleifera* leaf powder or flour were processed into cookies in the following ratios 100:0, 90:10, 80:20, 70:30, 50:50. The sensory evaluation of the cookies samples from the blends was performed. The results of the sensory evaluation showed that there were significant differences in the different attributes that were determined such as in colour, crispiness, taste, flavour and general acceptability. The sensory general acceptability scores showed that the best *Moringa* flour substitution level for making cookies was 10% (90:10) and 20% (80:20).
Mouminah (2015) [7] reported that dried *Moringa oleifera* leaves powder were incorporated at

different levels (5, 10 and 15 %) in cookies and their sensory and nutritional properties were evaluated. The results revealed that the contents of protein, dietary fiber and minerals in cookies increased with incorporation of increasing levels of drumstick leaves powder. Sensory evaluation showed that cookies with acceptable quality and typical *Moringa* leaf flavor could be obtained by incorporating drumstick leaves powder up to 10 Per cent. Thus, the nutritional quality of cookies could be enhanced by incorporating drumstick leaves powder in a dose dependent manner.

Material and Mathods

1) Selection of panel members

Threshold test was used for selection of the panel member (Potter, 1987) [10]. Convenience, experience, knowledge, willingness, interest and sincerity were the criteria for consideration of panel members. Ten members were enlisted in the panel comprised of staff members of the College of Home Science, SKRAU, Bikaner.

2) Preparation of score card

Score card was developed for assessing acceptability of powders on the basis of certain qualities looked for in food preparation such as appearance, colour, aroma, texture and overall acceptability. Nine-point hedonic ranking scale was provided to the judges for scoring as suggested by Ranganna (1986) [11].

3) Organoleptic evaluation of developed products

Standardization of the developed products was carried out thorough organoleptic evaluation. The developed products evaluated for their sensory characteristics like colour, appearance, aroma, texture, taste and overall acceptability by selected panel of ten semi trained panel members.

4) Statistical Analysis

The data of the organoleptic acceptability, nutritional assessment and shelf life study was statistically analyzed to find out significance of the results (Chandel, 1997) [3].

The results are expressed as mean ± SD. The obtained data statistically analyzed by using SPSS statistics (Ver. 20) software using one way of analysis of variance (ANOVA) and significance of difference between means of tested parameters was carried out using Turkey Post hoc test. Differences were considered statistically significant at 1% and 5% level of significance.

Results and Discussion

Development and standardization of value added products

Value added products were developed and standardized by various proportions (5% and 7%) and evaluated by a panel of semi-trained judges for sensory characteristics like colour, appearance, aroma, texture, taste and overall acceptability on nine point hedonic ranking scale. Results of sensory evaluation of all developed products are depicted in Table 1 to VII.

1) *Khakhra*

Mean acceptability scores for organoleptic characteristics of *Khakhra* are given in Table 1. Sample I and II of *Khakhra* prepared using drumstick leaves powder along with control made by wheat flour sample were found to be organoleptically acceptable by the panellists.

The highest scores were achieved by sample control and sample I (5% drumstick leaves powder + 95% wheat flour) and "liked very much" by the panel member. The lowest scores 7.7 were achieved by sample II which had maximum amount of drumstick leaves powder i.e. 7%, and fell under category of "liked moderately". Mean organoleptic scores for the sensory parameters i.e. colour, appearance, flavour, texture, taste and overall acceptability were found to be highly significant at both 1 per cent and 5 per cent level.

Table 1: Organoleptic acceptability of *Khakhra*

S. No.	*KHAKHRA*	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	**Appearance**	**Aroma**	**Texture**	**Taste**	**Overall Acceptability**
1.	Control	8.8±0.42	8.8±0.42	8.7±0.48	8.7±0.48	8.6±0.69	8.8±0.42
2.	Sample I (5%)	8.7±0.48	8.7±0.48	8.5±0.70	8.4±0.69	8.6±0.51	8.7±0.48
3.	Sample II (7%)	8.0±0.66	8.2±0.63	7.7±0.48	8.1±0.31	7.7±0.82	8.1±0.31
	'F' Value	6.66*	3.82**	8.69*	3.28**	5.65*	8.41*

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

2) *Panjiri*

Two different types of *panjiri* prepared by incorporating drumstick leaves powder along with the control sample. Samples were found to be "liked moderately" to "liked very much" in terms of sensory evaluation (Table 2).

The control and sample I (5% drumstick powder and 95% wheat flour) were "liked very much" for the sensory parameters viz., colour, appearance, flavour, texture, taste and overall acceptability and ranging 8.4 to 8.7. The sample II of *panjiri* with maximum amount of drumstick leaves powder secured least scores ranging from 7.8 to 7.9 on 9 point hedonic ranking scale by the panel of judges. However the difference in the scores were found to be significant at 1 per cent and 5 per cent level of significant.

Table 2: Organoleptic acceptability of *Panjiri*

S. No.	*PANJIRI*	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	**Appearance**	**Aroma**	**Texture**	**Taste**	**Overall Acceptability**
1.	Control	8.6±0.51	8.7±0.67	8.6±0.51	8.4±0.51	8.7±0.48	8.6±0.51
2.	Sample I (5%)	8.7±0.48	8.7±0.48	8.5±0.52	8.5±0.52	8.5±0.52	8.5±0.70
3.	Sample II (7%)	7.9±0.73	7.8±0.63	7.6±0.69	7.8±0.42	7.8±0.78	7.8±0.78
	'F' Value	5.45*	7.43*	8.80*	5.95*	5.91*	4.10**

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

3) *Vadi*

Table 3 unfolds the data regarding organoleptic evaluation of *vadi*. Two different types of *vadi* prepared using drumstick leaves powder along with the control. Samples were found to be "liked moderately" to "like very much" in terms of sensory evaluation.

The sample I (5% drumstick powder and 95% green gram *dal* + *moth dal*) and sample II (7% drumstick leaves powder, 93% green gram *dal* + *moth dal*) were "liked moderately" to "liked very much" for the sensory parameters viz., colour, appearance, flavour, texture, taste and overall acceptability. The sample II of *vadi* with maximum amount of drumstick leaves powder i.e. 7 per cent drumstick leaves powder secured least scores ranging from 7.7 to 7.8 on 9 point hedonic ranking scale by the panel of judges. However, the difference in the scores were found to be significant at both 1per cent and 5 per cent of significant level.

Table 3: Organoleptic acceptability of *Vadi*

S. No.	*VADI*	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	**Appearance**	**Aroma**	**Texture**	**Taste**	**Overall Acceptability**
1.	Control	8.5±0.52	8.6±0.51	8.7±0.48	8.6±0.51	8.6±0.51	8.5±0.70
2.	Sample I (5%)	8.6±0.51	8.4±0.69	8.3±0.82	8.5±0.52	8.5±0.52	8.5±0.84
3.	Sample II (7%)	7.8±0.63	7.8±0.63	7.8±0.78	7.9±0.56	7.9±0.56	7.7±0.48
	'F' Value	6.03*	4.50**	3.97**	4.96**	4.96**	4.39**

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

4) *Gatta* premix

The data regarding sensory attributes of *gatta* premix have been depicted in Table 4. The control sample made from 100 per cent bengal gram flour had highest acceptability scores and ranged from 8.5 to 8.7 on the 9 point hedonic ranking scale which was rated as "liked very much" by the panel members. The *gatta* premix prepared by supplementation of 5 per cent (sample I) drumstick leaves powder was "liked very much" in terms of all sensory parameters whereas the *gatta* premix developed by supplementation of 7 per cent (sample II) drumstick leaves was "liked moderately" by the panelist.

Results of the present study revealed that both types of *gatta* premix (control and sample I) was highly acceptable by judges followed by sample II.

Table 4: Organoleptic acceptability of *Gatta* premix

S. No.	*GATTA*	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	**Appearance**	**Aroma**	**Texture**	**Taste**	**Overall Acceptability**
1.	Control	8.6±0.51	8.6±0.51	8.5±0.70	8.7±0.48	8.6±0.51	8.6±0.51
2.	Sample I (5%)	8.5±0.70	8.4±0.51	8.5±0.52	8.6±0.51	8.4±0.69	8.5±0.52
3.	Sample II (7%)	7.8±0.78	7.9±0.31	7.7±0.67	7.9±0.73	7.8±0.42	7.8±0.78
	'F' Value	4.10**	6.15*	5.18**	5.45*	5.57*	4.88**

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

5) *Dahi Vada* premix

The data on important sensory characteristics i.e. colour, appearance, texture, flavour, taste and overall acceptability of *dahi vada* premix prepared from black gram and composite flour containing 5 and 7 per cent levels of drumstick leaves powder are explicated in Table 5.

Dahi vada premix prepared from 100 per cent black gram kept as control was "liked very much" by the panelist and acceptability scores was 8.4 to 8.6. Sample I (5% drumstick leaves powder + 95% black gram) liked more as compared to the Sample II (7% drumstick leaves powder + 93% black gram) and the difference was found to be significant at 1 per cent and 5 per cent level. The acceptability scores of sample I and II secured 8.3 and 7.5 respectively and fell in the category of "liked very much" to "liked moderately". Similarly, *dahi vada* premix developed by Banka *et al.* (2015) using green gram, black gram and soyabean secured 8.3 and fell in the category of "liked very much".

Table 5: Organoleptic acceptability of *Dahi Vada* premix

S. No.	*DAHI VADA*	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	**Appearance**	**Aroma**	**Texture**	**Taste**	**Overall Acceptability**
1.	Control	8.6±0.51	8.3±0.67	8.4±0.69	8.5±0.52	8.4±0.69	8.4±0.69
2.	Sample I (5%)	8.3±0.67	8.2±0.63	8.3±0.67	8.2±0.63	8.2±0.78	8.2±0.78
3.	Sample II (7%)	7.8±0.42	7.5±0.84	7.7±0.48	7.7±0.48	7.7±0.48	7.6±0.51
	'F' Value	5.44*	3.61**	3.65**	5.37*	2.90**	3.77**

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

6) Spread premix

Mean acceptability scores for organoleptic characteristics of spread are showed in Table 6. All the two types of spread premix prepared from drumstick leaves powder along with control sample were found to be organoleptically acceptable by the panellists.

The highest scores 8.6 and 8.1 were achieved by control and sample I (5% drumstick leaves powder + 95% green gram and *moth dal*) ranging from "liked very much to liked moderately". The lowest scores 7.6 were achieved by sample II which had maximum amount of drumstick leaves powder i.e. 7 per cent but it also fell under category of "liked moderately". Although difference in mean organoleptic scores for the sensory parameters colour, appearance, flavour, texture, taste and overall acceptability were found to be significant at 1 per cent and 5 per cent level.

Table 6: Organoleptic acceptability of Spread premix

S. No.	SPREAD PREMIX	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	Appearance	Aroma	Texture	Taste	Overall Acceptability
1.	Control	8.6±0.51	8.5±0.52	8.4±0.51	8.5±0.52	8.6±0.51	8.6±0.51
2.	Sample I (5%)	8.1±0.73	8.3±0.82	8.2±0.91	8.0±0.66	8.2±0.78	8.1±0.73
3.	Sample II (7%)	7.8±0.42	7.8±0.42	7.6±0.51	7.7±0.67	7.7±0.82	7.6±0.69
	'F' Value	4.95*	3.44**	3.77**	4.16**	3.89**	5.76*

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significant

7) Soup premix

Table 7 reveals the lower mean scores of sample I obtained for colour (7.8), appearance (7.8), aroma (7.6), texture (7.7), taste (7.7) and overall acceptability (7.6). Mean scores of all sensory attributes of sample I was found in the category "liked moderately". Developed sample I obtained higher mean scores 8.1, 8.3, 8.2, 8.0, 8.2 and 8.1 for colour, appearance, aroma, texture, taste and overall acceptability whereas the highest scores of sensory characteristics of control sample was 8.6, 8.5, 8.4, 8.5, 8.6 and 8.6 respectively. Although difference in mean organoleptic scores for the sensory parameters colour, appearance, flavour, texture, taste and overall acceptability were found to be significant at 1 per cent and 5 per cent level.

Results of present study are corroborated with the results of Nwakalor and Chizoba (2014) [9] who developed value added cookies using drumstick leaves powder at various levels and found that cookies supplemented with 10 percent and 20 percent were most acceptable. Similarly, wheat bread was prepared by incorporation of drumstick leaves powder and concluded that significant improvement in nutritional composition but the acceptability of all bread samples decreased with increasing level of supplementation (Sengev *et al.*, 2013).

Table 7: Organoleptic acceptability of Soup premix

S. No.	SOUP PREMIX	Mean score of sensory characteristics on nine point hedonic ranking scale					
		Colour	Appearance	Aroma	Texture	Taste	Overall Acceptability
1.	Control	8.6±0.51	8.5±0.52	8.4±0.69	8.5±0.52	8.5±0.70	8.4±0.51
2.	Sample I (5%)	8.2±0.63	8.1±0.73	7.9±0.73	8.1±0.73	7.9±0.56	8.0±0.66
3.	Sample II (7%)	7.8±0.63	7.6±0.69	7.6±0.51	7.7±0.67	7.6±0.84	7.6±0.69
	'F' Value	4.50**	4.65**	3.76**	3.75**	4.10**	4.00**

Values are mean ±SD of ten panellists *significant at 1% significant **significant at 5%significat

Conclusion

The products included *khakhra, panjiri, vadi, gatta* premix, *dahi vada* premix, spread premix and soup premix were developed by supplementation of drumstick leaves powder. All the developed products were ranged between "liked modeartely" to "liked very much" on the organoleptic parameters as judged on 9 point hedonic ranking scale. Results of sensory evaluation of products indicated that *khakhra* found to be most acceptable and scored 8.8 on 9 point scale as compared to other products i.e. *panjiri* (8.6.), *vadi* (8.5), *gatta* premix(8.6), *dahi vada* premix (8.4), spread premix (8.6) and soup premix (8.4).

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