Consumer Preferences of Chia Products: A Conjoint Analysis

ABSTRACT

Chia (*Salvia hispanica* L.) is a nutrient-rich crop native to Mexico and Guatemala, valued for its high content of omega-3 and omega-6 fatty acids, protein, dietary fiber, vitamins, and antioxidants. While historically significant for the Aztecs and Mayans, chia has become a globally cultivated crop due to its health benefits. Introduced to India by CFTRI Mysore in 2015, it has gained substantial traction, particularly in Karnataka, where it has emerged as a key crop. This study investigates chia seed consumption among 80 urban consumers in Bangalore using purposive sampling and structured questionnaires. Conjoint analysis evaluates consumer preferences, while Garrett's ranking technique identifies critical factors influencing consumption patterns. The findings reveal that chia seeds are widely integrated into daily diets, with their whole form being universally consumed. Products such as chia pudding, beverages, and snacks are favored weekly. Key preferences are shaped by health benefits, dietary trends, and accessibility, with moderate to high socio-economic status consumers showing greater engagement. Awareness about chia seeds is primarily driven by social media and direct interactions at food festivals, whereas organized retail outlets and online platforms are the dominant purchase channels. The study emphasizes the growing relevance of chia seeds in urban diets, aligning with global health trends and sustainable agriculture practices. However, limitations include a focus on a specific geographic area and consumer segment, which may not capture the diversity of broader consumer behavior. Future research could explore rural consumption patterns and strategies for expanding chia's accessibility to diverse socio-economic groups, thereby enhancing its market potential and sustainability impact.

Keywords: Chia; garrett's ranking technique; conjoint analysis.

1. INTRODUCTION

Chia (*Salvia hispanica* L.), a member of the mint family Lamiaceae, has been a dietary staple for around 5,500 years, initially used by the Aztecs and Mayans for its medicinal, culinary, and artistic value. Rich in omega-3 and omega-6 fatty acids, high-quality protein, dietary fiber, vitamins, minerals, and antioxidants, chia seeds are renowned for their nutritional benefits and stability. Their high omega-3 content, constituting 55% of their oil, supports heart health, reduces inflammation, and enhances brain function.

Domesticated about 4,500 years ago in Mesoamerica, chia fell into relative obscurity but has recently gained prominence worldwide. Today, it is cultivated in countries like Mexico, Australia, Bolivia, and Colombia, with Mexico as the leading producer. Its popularity is also rising in Africa

and Asia due to its health benefits and resilience to drought. In India, chia is being cultivated in states such as Uttar Pradesh, Rajasthan, Andhra Pradesh, and Karnataka.

Approved as a novel food by the European Union in 2009, chia's versatility extends to various food applications, including as an egg substitute in baking. This adaptability and its alignment with modern health trends have made chia seeds highly sought after. They are valued for their contribution to heart health, weight management, and digestion, and are compatible with gluten-free, vegan, and low-carb diets. Their sustainability as a drought-resistant crop further boosts their appeal, making chia seeds a popular choice in the pursuit of a nutrient-dense, functional diet.

2. METHODOLOGY

2.1 Study Area

The study was conducted in Mysuru, Chamarajanagar, and Bangalore districts, combining urban and rural contexts.

2.2 Sampling Methods

Purposive sampling was used to select 80 urban and 80 rural consumers familiar with chia seeds.

2.3 Data Collection

Primary data was collected through structured questionnaires and interviews to analyze consumer preferences and factors influencing chia seed consumption.

2.4 Conjoint Analysis

Conjoint analysis is a multivariate analysis tool used to assess the consumer preference. Part-worth utility and relative importance are the two outcome of conjoint analysis test. It is a survey-based statistical technique used in market research that helps determine how people value different attributes (feature, function, benefits) that make up an individual product or service and it is particularly well suited for measuring human perceptions and preferences.

Using conjoint analysis, a researcher can analyze a heterogeneous product market and obtain results that can be highly disaggregated into homogeneous groups of buyers.

Alternatively, aggregating results for buyers who have similar preference or utility functions can be useful in modifying current products or services and in designing new ones for selected market segments. The additive conjoint model was used in this study. The model has been formulated as:

$$a^{n}i\text{-}a^{m}j=1\ V_{ij}X_{ij}$$

Where,

Y = Consumers' overall evaluation of the minor millet.

V_{ij} = Partworth associated with ‘j’(1,2,3,m) of attributes, ‘I’ (1,2,3. attributes are given for consumers.

X_{ij} = Dummy variable representing the preference of the j^{th} level of i^{th} atribute.

For this study, profile describing alternatives was constructed by combining levels of six attributes. The attributes and their levels were identified through discussions with the consumers during the survey and also on consultation with marketing and food science specialists. (Arjuman

et al., 2022).

2.5 Garrett's Ranking Technique

Garrett's ranking technique was used to find out the most significant factor which influences the respondents. To analyze the reason for preferring of chia, factor influencing of consumer preference and constraints faced by consumer Garrett's ranking technique was used. According to this, respondents have been asked to assign the rank for all factors and the outcome of such ranking has been converted into score value with the help of the following formula

Per cent position = 100 (Rij– 0.5) / Nij

Where Rij = Rank given i^{th} item by j^{th} individual N = Number of items ranked by jth individual

The per cent position of each rank was converted in to scores by referring to Garrett table. Then for each factor, the scores of individual respondents were summed up and divided by the total number of respondents for whom scores were gathered. The mean scores for all the factors were ranked following the decision criteria that higher the value, more important is the constraint or most important reason for the beneficiaries. (Garrett and Woodworth, 1969).

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of Urban and Rural Consumers in study area

The socio-economic characteristics of urban and rural consumers presented in Table 1. In the study area, 43.33 per cent of urban consumers were male and 32.4 per cent were female, while rural consumers were 40 per cent male and 60 per cent female. Age distribution showed that 56.67 per cent of urban consumers were aged 20-35, compared to 33.75 per cent in rural areas. Urban consumers had higher educational attainment, with 55 per cent holding a Ph.D., whereas 50 per cent of rural consumers were illiterate. Occupation-wise, 72.5 per cent of rural respondents were farmers, while urban consumers were mainly students (41.67 per cent) and private employees (25 per cent). Rural families were predominantly joint (60 per cent), whereas 86.67 per cent of urban families were joint. Income-wise, 97.5 per cent of rural consumers earned up to ₹50,000, while 46.67 per cent of urban consumers fell into this income bracket. Food habits indicated that 86.25 per cent of rural consumers were vegetarian, compared to 36.67 per cent of urban consumers.

3.2 Consumer Pattern of Chia Seeds Products among Urban and Rural Consumers

The consumer patterns of chia seed products among urban and rural consumers outlined in Table 2. Urban consumers exhibited a strong preference for whole chia seeds, with 100 per cent consuming them daily. In contrast, only 25 per cent of rural consumers used whole chia seeds, and their consumption was occasional. Urban consumers also favored chia pudding (66.67 per cent weekly), chia seeds beverages (83.33 per cent weekly), and chia snacks (91.67 per cent weekly). Conversely, rural consumers did not use these products, with no consumption recorded for chia flour, chia pudding, chia oil, chia sprouts, chia baking mixes, chia seeds beverages, or chia snacks. Urban consumers had a varied use of chia products, whereas rural consumers had minimal or no usage of chia seed products.

3.3 Source of Information for Urban and Rural Consumer on Chia

Source of information for urban and rural consumer on chia is presented in Table 3. For urban consumers, social media had been the primary source of information on chia seeds, receiving an average score of 72.69 and ranking first. In contrast, rural consumers had favored mela/food

fests, which achieved an average score of 72.1, making it their top source. Among urban respondents, friend/relatives had been the third most influential source with an average score of 62.75, whereas, for rural consumers, they held the highest rank with a score of 68.2. The Agriculture University had been ranked fourth among urban consumers with a score of 57.52 and second among rural consumers with a score of 60.45. Retail shop displays and magazines were rated as less influential by both urban and rural consumers, with urban respondents assigning scores of 52.62 and 49.58 respectively, and rural consumers giving them scores of 55.3 and 50.4.

3.4 Reasons for Preferring Chia Seeds by Consumers

The Reasons for Preferring Chia Seeds by Consumers presented in Table 4**.** revealed that the primary reason for consumer preference was the abundant presence of Poly Unsaturated Fatty Acids (PUFAs), with the highest average score of 74.25. This was followed by the prevention of heart disease risk and chronic anti-inflammatory properties, with scores of 67.8 and 65.67, respectively. Other significant factors included the enhancement of bone health (64.37), fulfilling nutritional requirements (64.04), and being rich in antioxidants (62.98). The richness in dietary fibers also played a role, scoring 62.27, while blood sugar level control (54.64) and aiding in weight loss (50.16) were ranked lower. The least prioritized reason was chia's role as a source of plant-based protein, with a score of 32.17.

Table 1. Socio-economic characteristics of urban and rural consumers in study area

Please check this highlighted table section

Sl. No.	Particulars	Respondents (80)	Per cent	Respondents (80)	Per cent
I	**Gender**				
a	Male	26	43.33	32	40
b	Female	54	32.4	48	60
II	**Age**	**0**			
a	20-35	34	56.67	27	33.75
b	36-50	36	60	45	56.25
c	Above 51	10	16.67	8	10
III	**Education**				
a	Illiterate	0	0	40	50
b	Primary	2	3.33	34	42.5
c	Secondary	3	5	4	5
d	PUC	2	3.33	2	2.5
e	Degree	4	6.67	0	
f	Post graduate	16	26.67	0	0
e	Ph.D.	33	55	0	0
IV	**Occupation**				
a	Government Employee	8	13.33	0	0
b	Private Employee	15	25	0	0
c	Student	25	41.67	0	0
d	Business	10	16.67	0	0
e	farmer			58	72.5
f	Home maker	2	3.33	22	27.5
V	**Family type**				
a	Nuclear	8	13.33	32	40

b	Joint	52	86.67	48	60
VI	**Annual Income**				
a	Up to 50,000	28	46.67	78	97.5
b	51000-100000	21	35	2	2.5
c	Above 100000	9	15	0	0
VII	**Food habit**				
a	Vegetarian	22	36.67	69	86.25
b	Non-Vegetarian	38	63.33	11	13.75

Table 2. Consumer pattern of chia seeds products among urban and rural consumers

Sl. No.	Chi seed products	Urban (80)			Rural (80)		
		Numbers	Per cent	Frequency of consumption	Numbers	Per cent	Frequency of consumption
1.	Whole chia seeds	80	100	daily	20	25	Occasionally
2.	Flour	40	33.33	occasionally	0	0	-
3.	Chia pudding	60	66.67	weekly	0	0	-
4.	Chia oil	40	33.33	occasionally	0	0	-
5.	Chia Sprouts	65	75.00	daily	0	0	-
6.	Chia baking mixes	50	50.00	weekly	0	0	-
7.	Chia seeds beverages	50	83.33	weekly	0	0	-
8.	Chia snacks	55	91.67	weekly	0	0	-

Table 3. Source of information for urban and rural consumer on chia

Sl.no.	Particulars	Urban (80)		Rural (80)	
		Average score	Rank	Average score	Rank
1.	Social media	72.69	I	65.3	V
2.	Mela/food fest	69.36	II	72.1	III
3.	Friend/relatives	62.75	III	68.2	I
4.	Agriculture University	57.52	IV	60.45	II
5.	Retail shop display	52.62	V	55.3	IV
6.	Magazine	49.58	VI	50.4	VI

Table 4. Reasons for preferring Chia Seeds by consumers

Sl.no.	Particulars	Average score	Rank
1	Abundant Poly Unsaturated Fatty Acids (PUFA's)	74.25	I
2	Prevention of heart disease risk	67.8	II
3	Chronic anti- inflammatory properties	65.67	III
4	Enhance bone health	64.37	IV
5	Fulfil Nutritional requirements	64.04	V
6	Rich in antioxidants	62.98	VI
7	Rich in dietary fibers	62.27	VII
8	Blood sugar level control	54.64	VIII
9	Aids in weight loss	50.16	IX
10	Source of plant-based protein	32.17	X

3.5 Level of Awareness Regarding Chia Seeds among Urban and Rural Consumers

Level of awareness regarding chia seeds among Urban and rural consumers presented in Fig. 1**.** Rural and urban consumers demonstrated differing levels of awareness about chia seeds. Among rural consumers, 24.16 per cent had complete awareness, while only 6.67 per cent of urban consumers reached the same level. A majority of rural consumers, 67.84 per cent, were moderately aware, compared to just 13.33 per cent of urban consumers. Conversely, low awareness was far more prevalent among urban consumers, with 80 per cent falling into this category, whereas only 8 per cent of rural consumers were similarly uninformed. This analysis revealed a notable gap in awareness, with rural consumers being generally more informed about chia seeds than their urban counterparts.

3.6 Consumer Preference of Chia

The comparison of chia seed preferences between urban and rural consumers revealed that both groups preferred low prices, with rural consumers showing a greater aversion to high prices (Table 5). Urban consumers favored black chia seeds and sweet taste, while rural consumers preferred white chia seeds and also favored sweet taste. Nutritional quality improvements were highly valued by both groups. Urban consumers preferred raw chia seeds and natural aroma, while rural consumers showed a similar preference but placed slightly more importance on white color and scented aroma. Overall, urban consumers had a total utility score of 40.57 and rural consumers 39.12, with a slight edge in relative importance for rural consumers. High Pearson's rank correlations (0.887 for urban and 0.855 for rural) indicated strong agreement in preferences, while moderate Kendall's correlations (0.628 for urban and 0.600 for rural) suggested moderate alignment in ranking attributes.

Fig. 1. Level of awareness regarding chia seeds among Urban and rural consumers

Table 5. **Consumer preference of chia**

Sl. No.	Attribute	Attribute Level	Utility (Urban)	Relative Importance (Urban)	Utility (Rural)	Relative Importance (Rural)
1	Price	High	-7.33	34.11	-9.5	38
		Low	-3.62	-4.8	-3.62	-4.8
2	Color	Black	-2.64	16.45	-3.39	13.48
		White	-3.39	10	-2.64	16.45
		Combined Color	-2.92	14.47	-3.01	13.48
3	Taste	Pungency	-0.3	8.28	-1	5
		Sweet	-0.71	-1.5	-0.3	8.28
4	Nutritional Quality	Maintain Same	5.11	17.12	3.5	15
		Further Improve	10.34	7	5.11	17.12
5	Form	Raw	-6.53	12.18	-8.5	8
		Value Added	-9.41	-12	-6.53	12.18
6	Aroma	Natural	-0.26	4.79	-0.6	3
		Scented	-0.62	-1.2	-0.26	4.79
7	Acceptability	Acceptable	-0.65	7.07	-0.9	5
		Not Acceptable	-1.23	-1.7	-0.65	7.07
Total			**40.57**	**-39.2**	**39.12**	**-38.12**
Pearson's Rank Correlation			**0.887**	**0.785**	**0.855**	**0.79**
Kendall's Rank Correlation			**0.628**	**0.543**	**0.6**	**0.56**

Note: Significant at 5 per cent

Table 6. Constraints in consumption of Chia seed consumers

Sl. No.	Particulars	Average score	Rank
1.	High Cost	74.95	2
2.	Quality issues	82.65	1
3.	Less availability	57.92	5
4.	Limited knowledge about preparation and consumption	69.57	3
5.	Lack of availability certified chia seeds	62.75	4
6.	Health and Allergies	51.56	6
7.	Taste and texture	48.69	7

3.7 Constraints in Consumption of Chia seed Consumers

The constraints in chia seed consumption, ranked by their average scores. (Table 6.) The high cost (74.95) is the second major barrier, limiting accessibility. Limited knowledge about preparation and consumption (69.57) ranks third, highlighting the impact of inadequate information on usage**.** Lack of availability of certified chia seeds (62.75) follows, influencing consumer trust and accessibility. Less availability (57.92) in local markets is the fifth constraint, with health and allergies (51.56) and taste and texture (48.69) being less significant but still relevant factors.

4. CONCLUSION

The conclusion of the study emphasizes the increasing recognition of chia seeds as a valuable nutritional product, driven by their health benefits. The findings reveal that urban consumers have a more frequent consumption pattern and better access to information about chia seeds, likely due to their exposure to modern marketing channels and a higher level of awareness about health trends. In contrast, rural consumers are generally aware of chia's benefits but consume it less often, possibly due to limited availability, lack of preparation knowledge, and the higher cost of chia seeds compared to other staple foods. These factors create significant barriers to widespread adoption, particularly in rural areas.

The study identifies key constraints that hinder the consumption of chia seeds, including the relatively high price point, which limits its affordability, and a lack of knowledge regarding how to incorporate chia into everyday meals. Additionally, limited availability in local markets further exacerbates the challenge. For chia seeds to gain a larger market share and increase consumer acceptance, efforts must be made to address these constraints. This could include improving awareness programs, lowering costs through subsidies or local production, and enhancing distribution channels, especially in rural areas. By focusing on these areas, there is a significant opportunity to increase the consumption of chia seeds, contributing to both consumer health benefits and the growth of a sustainable agricultural market.

5. POLICY RECOMMENDATION

To enhance chia consumption, policies should focus on ensuring quality standards and reducing costs through subsidies or incentives for local production. Educational campaigns could increase consumer knowledge about the health benefits and usage of chia seeds. Strengthening supply chains to improve availability in retail outlets and online platforms is also essential. Additionally, promoting certification and labeling for chia products can build consumer trust and encourage more widespread adoption.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

- 4o mini

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Alekhya, & Raj, S. (2019). Buying behavior of consumers towards millet-based food products in Hyderabad district of Telangana. *International Journal of Current Microbiology and Applied Sciences, 8*(10), 223–236.

Annunziata, A., & Pascale, P. (2009). Consumers' behavior and attitudes toward healthy food products: The case of organic and functional foods. *European Association of Agricultural Economists, 4*(1), 98–105.

Arjuman Banu, Ganapathy, M. S., Siddayya, M. R., Girish, M. H., Shankara, S., Shamashad Begum, V. G. G., & Mohan Kumar, T. L. (2022). Consumer preferences for the products of minor millets in Tumakuru district of Karnataka, India. *International Journal of Environment and Climate Change, 12* (11), 2231–4784.

Brown, M. R., & Smith, K. A. (2019). Global consumer behavior toward organic and sustainable food. *Journal of International Food & Agribusiness Marketing, 31*(4), 285–303.

Deshmukh, D. S., Pawar, B. R., Yeware, P. P., & Landge, V. V. (2010). Costs, returns, and profitability of pearl millet production. *International Journal of Commerce and Business Management, 3*(1), 95–99.

Garrett, E. H., & Woodworth, R. S. (1969). *Statistics in psychology and education.* Vakils, Feffer and Simons Private Limited.

Janes, J. S., & Forbes, M. J. (2021). Consumer preferences for sustainable food products: A review of global trends. *International Journal of Consumer Studies, 45*(3), 345–358.

Kaur, I., & Singh, S. (2014). Consumer behavior regarding the purchase of processed cereal food products in Punjab. *IOSR Journal of Business and Management, 16*(2), 47–57.

Kilewela, B. A. K., Richard, J., Mongi, C., Kaale, A. L. D., Kibazo, O., & Rweyemamu, L. M. (2022). Sensory profile, consumer acceptability, and preference mapping of cassava-chia seeds composite porridges. *Applied Food Research, 1*(1), 1–8.

Liu, S., & Zhao, Y. (2020). The impact of information and product attributes on consumers' choices for plant-based food products: Evidence from the U.S. and European markets. *Food Quality and Preference, 80,* 103–110.

Naveena, K. P., Shaikh, M. M., & Bellundagi, V. B. (2016). Economic importance and consumer preferences for neglected and underutilized crop species in Karnataka. *Economic Affairs, 61*(1), 135–140.

Nguyen, T. H., & Miller, R. M. (2017). A study of consumer preferences towards alternative protein sources in the EU. *Food Control, 72,* 112–118.

Ranjita Devi, et al. (2016). Ready-to-cook millet flakes based on minor millets for the modern consumer. *Journal of Food Science and Technology, 53*(2), 123–135.

Sathyanarayanan, P., & Dharshani, B. P. (2023). A study on consumer preferences towards edible oil purchasing decisions in central Chennai district. *International Journal for Innovative Research in Multidisciplinary Field, 9*(2), 44–50.

Thompson, S., & Mie, A. (2018). Exploring consumer preferences for functional foods: A comparative study across countries. *Journal of Food Science, 83*(9), 2331–2340.

Toklu, I. T. (2017). Consumer preferences for the attributes of sunflower oil: An exploratory study with conjoint analysis. *International Journal of Academic Research in Business and Social Sciences, 7*(1), 39–55.