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# **Market Dynamics and Consumer Insights for Value-added Pearl Millet Products: Empirical Evidence from Rajasthan, India**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The study provides an overview of the study on consumer preference and consumption patterns of value-added pearl millet products in Rajasthan. The research focused on identifying consumer preferences, understanding consumption patterns, and evaluating buying behavior based on individual preferences. The study includes various value-added pearl millet products such as cookies, cakes, bakery items, different varieties of batters, ready-to-eat items like khakhra, dhokla, puffs, and liquid items like lassi. Analysis was done using chi-square and weighted average method.

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Major findings from the study were that educated consumers showed a higher preference for pearl millet products. The largest consumer group had a monthly income of less than ₹10,000. Pearl millet cookies, cakes, and other bakery items were the most preferred products. The preferred channel for purchasing value-added pearl millet products was retail/grocery stores. Also, the most influential factor in consumer purchasing decisions was nutritional value. Factors such as price, flavor, packaging, and color had a relatively lower impact. This study offers guidance on consumers way of demand to businesses involved in the processed millet product industry.

**Keywords:** Value added pearl millet; consumer preference; consumption pattern; buying behavior.

## 1. INTRODUCTION

Millets are small-grained, warm-weather, annual cereals in the grass family. The three most significant millets grown in India are ragi (finger millet), pearl millet (bajra), and jowar (sorghum). Overall, the most significant millets grown in African and Asian nations are sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa frumentacea*), kodo millet (*Paspalum scrobiculatum*), proso millet (*Panicum miliaceum*), and little millet (*Panicum miliare*). Pearl millet (*Pennisetum glaucum*) is a vital cereal crop predominantly cultivated in arid and semi-arid regions of the world, particularly in Africa and South Asia [1,2]. It is highly esteemed for its resilience to extreme climatic conditions, including drought and poor soil fertility, which makes it a crucial food security crop in these areas [3,4]. Nutritionally, pearl millet is rich in proteins, fiber, and essential minerals such as iron and zinc, making it a valuable dietary component [5,6]. The crop's versatility extends beyond human consumption, serving as fodder for livestock and a raw material for various industrial applications like biofuel [7]. As such, pearl millet plays a significant role in the agricultural economies of the regions where it is grown, contributing to both food security and economic stability.

In India, pearl millet is the most abundant and productive of the millets. After rice, wheat and sorghum, pearl millet is the fourth most significant cereal in India. It offers inexpensive foods with comparatively greater nutrients for millions of people. The nutritional value of pearl millet is equivalent to or even higher than that of other cereals. Of all the Indian states, in the years 2020–21, Rajasthan had the highest area under the cultivation of bajra, with 4348.40 (in '000 Hectare). Additionally, it had the largest production, at 4561.47 (in '000 tones) [8].

Consumer studies are essential for understanding consumer behavior as they

provide insights into the motivations, preferences, and decision-making processes of individuals. By analyzing patterns in consumption, researchers can identify trends and shifts in consumer needs and desires [9]. This knowledge allows businesses to tailor their products and marketing strategies to better meet the demands of their target audience, enhancing customer satisfaction and loyalty [10]. Understanding consumer behavior helps in predicting future market trends, aiding in strategic planning and innovation [11]. Ultimately, consumer studies bridge the gap between market offerings and consumer expectations, fostering a more dynamic and responsive market environment [12].

Consumer preferences for value-added pearl millet products in urban and rural areas are influenced by various factors. In urban households, factors such as age, gender, awareness of millet benefits, taste perception, and perceived nutritional value play significant roles in increasing millet consumption [13]. On the other hand, in rural areas, factors like family income, family size, and age of individuals within the family are key influencers of consumer choice for millet-based value-added products [14]. Additionally, the sensory evaluation of pearl millet products, such as Bajra laddu and Bajra Mathari, has shown high acceptability among consumers, indicating a positive inclination towards these value-added products [15,16,17]. Understanding these factors is crucial for promoting the adoption of nutritious and sustainable pearl millet snacks in both urban and rural settings.

Consumer buying behavior for pearl millet is influenced by various factors such as price, taste, brand, promotional offers, and packaging [18]. Consumers show a willingness to pay a premium price for new pearl millet varieties, with factors like age, household composition, income, and awareness levels positively effecting their willingness to pay higher prices [19]. Additionally,

sensory evaluation methods and information on the health benefits of biofortified high-iron pearl millet (HIPM) play a significant role in consumer demand, with consumers preferring international branding and certification authorities for such products [20]. Understanding these aspects is crucial for market potential analysis and strategic planning to cater to consumer preferences and enhance the adoption of pearl millet products in the market.

## 2. METHODOLOGY

The method of investigation was descriptive examination of the sample. The goal was to acquire preliminary data that aided in achieving the study's goals and concluding. The objective was to study the consumer preference and consumption pattern of value-added pearl millet products.

Primary as well as secondary data was collected to meet the objectives of the study. Primary data needed for the study was collected through a structured questionnaire issued to consumers. Sample consists of consumers belonging to different occupations, category and age group. Judgmental sampling and convenience sampling were used to collect data, considering consumer accessibility and availability.

For achieving the proposed research purpose, the following research objectives were developed:

### **RO1: To identify consumer preferences of value-added pearl millet products**

The objective was to study which types of pearl millet value-added products are preferred by the consumers in the study area. And to know will they buy pearl millet substitutes for the products made from other ingredients that they generally prefer.

### **RO2: To understand consumption pattern of consumers in the area of study**

The goal was to examine the purchasing patterns of value-added pearl millet consumers in the study area and determine their preferred product type and amount. To know how much they spend, how they prefer to buy different products and what are the commonly preferred channels for purchasing. To understand the consumption patterns of consumers for the products under study, cross tabulation of various applicable factors, such as age and income were done. Chi-squared test was used for analysis.

### **RO3: To evaluate the buying behavior of consumers based on their individual preferences**

The objective was also to understand the most meaningful factor which influences the choice of value-added pearl millet products based on the individual preferences of consumers among various factors such as price, taste, availability, flavor etc. Weighted average was used to assign ranks to the factors that were more important.

## 3. RESULTS AND DISCUSSION

This section presents the key findings derived from the data analysis conducted for this study. The results are organized according to the research objectives outlined in the methodology section.

### **3.1 To Identify Consumer Preferences of Value-added Pearl Millet Products**

Value-added Pearl millet products are those that are created by performing various procedures on the original product (pearl millet) in order to enhance its value and significance. Pearl millet cookies, cakes, and other bakery items, different varieties of pearl millet batters, ready-to-eat items like pearl millet khakhra, dhokla, and puffs, and liquid items like pearl millet lassi were among the study area's major value-added products. Depending on their individual preferences, consumers either purchase or prefer these products.

Since preference influences actual decision and consumption as well as buying intentions [21], it is a crucial element of consumer research. As a result, a lot of research on preferences was conducted, which undoubtedly had a significant impact on demand. Today's consumers are concerned about their health and wellbeing. As a result, consumers started to consume more thoughtfully, develop a preference for local products, limit their purchases to reputable companies, and make more environmentally friendly decisions. Information was obtained about the consumers' preferred products during the research Pearl millet cookies, cakes, and other bakery items, different varieties of pearl millet batters, ready-to-eat items like pearl millet khakhra, dhokla, and puffs, and liquid items like pearl millet lassi were among the major products that were the subject of the survey. The most popular product categories out of these are displayed in Table 1 below.

**Table 1. Most preferred product categories**

<b>Preferred Product Categories</b>	<b>Number/ Percentage of Consumers</b>
Bajra cookies and cakes and other bakery products	57
Bajra batters of different types	11
Ready to eat products such as bajra khakhra, dhokla, puffs, etc.	27
Liquid products such as bajra lassi	5

*Source: Researcher's own computation from primary data*

Table 1 reveals that the most preferred product category by consumers of value-added pearl millet products in Bikaner, Rajasthan were pearl millet cookies, cakes, and other bakery items because of its easy availability and use as a snack therefore pearl millet cookies, cakes, and other bakery items accounts 57 per cent of total sample population preference, followed by Ready to eat products with 27 per cent, pearl millet batters of different types with 11 per cent and liquid products like pearl millet lassi with 5 per cent.

### **3.2 Loyalty of Consumers towards Pearl Millet Products**

There is high customer acquisition cost of any business, companies burn their huge amount of cash to acquire customers [22]. Indian customers have a greater tendency to switch to the alternative brands and products if their preferred product is not available at the store for a short period of time especially in the value-addition industry [23]. This survey asked the question to the consumer if they will purchase substitutes prepared from different ingredients if the pearl millet products, they want to buy are not available. This question revealed the fact that the consumer was loyal or had stickiness or not towards his/her preferred product.

**Table 2. Loyalty of consumers towards preferred products**

<b>Loyalty of Consumers</b>	<b>Number/ Percentage of Consumers</b>
Yes	29
No	71

*Source: Researcher's own computation from primary data*

Table 2 shows that 29 per cent consumers under study would stick to their choice and are loyal because they will not buy substitute products prepared from ingredients other than pearl millet. The rest 71 percent consumers would not stick to

their preferences and are not loyal because they will buy substitute products as per availability.

### **3.3 To understand Consumption Pattern of Consumers in the Area of Study**

Consumption refers to the items (commodities) consumed, as well as their uses and services, such as food and beverages the collection of traits, quantities, activities and inclinations that characterises a community's or consumer group's use of resources for comfort and enjoyment and the way aspects of consumption are combined to generate a level of consumption as a whole is referred to as consumption pattern. There are several ways to describe consumption levels.

### **3.4 Impact of Age and Monthly Income on Monthly Spending of Consumers on Value-added Pearl Millet Products**

Various studies have shown that demographics have relation with the consumption pattern of consumers [24,25]. For the purpose of enquiring for the same fact, cross-tabulation and Chi-square test was done of demographic factors like age and monthly income with monthly spending of consumers of value-added pearl millet products to check the following hypothesis. The results found, the age group and monthly income are related to monthly spending of consumers for value-added pearl millet products.

Hypothesis 1. Age group and monthly spending on value-added pearl millet products

H0 (Null hypothesis) = Age group of the consumer does not significantly impact consumers' monthly spending on value-added pearl millet products.

H1 (Alternative hypothesis) = Age group of the consumer significantly impacts consumers' monthly spending on value-added pearl products.

**Table 3. Cross tabulation of age group and monthly spending of consumers**

Age			18-25	25-35	35-45	45 and above	Total
Monthly Spending	<500	Count	35	14	6	2	57
		Expected Count	31.4	16.0	6.8	2.8	57.0
	500-1000	Count	16	11	4	1	32
		Expected Count	17.6	9.0	3.8	1.6	32.0
	1000-1500	Count	2	2	1	1	6
		Expected Count	3.3	1.7	.7	.3	6.0
	1500-2000	Count	2	1	1	0	4
		Expected Count	2.2	1.1	.5	.2	4.0
	2000-2500	Count	0	0	0	1	1
		Expected Count	.6	.3	.1	.0	1.0
	Total	Count	55	28	12	5	100
		Expected Count	55.0	28.0	12.0	5.0	100.0

Source: Researcher's own computation from primary data

Table 3 provides the information about the observed cell counts and (the expected cell count) for each cell.

**Table 4. Chi-square test results for age group and monthly spending of consumers**

Contingency Coefficient	.440
Pearson Chi-Square (p value)	.021

Source: Researcher's own computation from primary data

The p-value came out to be 0.021 so the null hypothesis (H0) was rejected and the alternative hypothesis was (H1) accepted, that means age group of the consumers' significantly impacts

consumers' monthly spending on value-added pearl millet products.

Hypothesis 2. Monthly income and monthly spending on value-added pearl millet products

H0 (Null hypothesis) = Monthly income of the consumers does not significantly impact consumers' monthly spending on value-added pearl millet products.

H1 (Alternative hypothesis) = Monthly income of the consumers significantly impacts consumers' monthly spending on value-added pearl millet products.

**Table 5. Cross tabulation of monthly income and monthly spending of consumers**

			Monthly Income					Total
			Less than 10,000	10,000-20,000	20,000-30,000	30,000-40,000	40,000 and above	
Monthly Spending	<500	Count	33	4	4	5	11	57
		Expected Count	23.9	6.8	6.8	6.8	12.5	57.0
	500-1000	Count	7	5	4	7	9	32
		Expected Count	13.4	3.8	3.8	3.8	7.0	32.0
	1000-1500	Count	1	2	2	0	1	6
		Expected Count	2.5	0.7	0.7	0.7	1.3	6.0
	1500-2000	Count	1	1	2	0	0	4
		Expected Count	1.7	0.5	0.5	0.5	0.9	4.0
	2000-2500	Count	0	0	0	0	1	1
		Expected Count	0.4	0.1	0.1	0.1	0.2	1.0
	Total	Count	42	12	12	12	22	100

Source: Researcher's own computation from primary data

**Table 6. Chi-square test results for monthly income and monthly spending of consumers**

Contingency Coefficient	.480
Pearson Chi-Square (p value)	.019

Source: Researcher's own computation from primary data

The p-value came out to be 0.019. Therefore, the null hypothesis (H0) was rejected, and the alternative hypothesis was (H1) was accepted, that means monthly income of the consumers significantly impacts consumers' monthly spending on value-added pearl millet products.

### 3.5 To Evaluate the Buying Behavior of Consumers Based on their Individual Preferences

Consumer buying behavior is the study of individuals, teams, or organizations, along with all actions associated with the acquisition, consumption, and disposal of goods and services, as well as how a consumer's feelings, attitudes, and preferences effect their purchasing behavior. Organizations benefit from

understanding this process because it enables them to better align their marketing strategies with those that have successfully influenced consumers to make purchases in the past.

### 3.6 Attributes Responsible for the Purchase of Value-added Pearl Millet Products

Individual Preference is a means for an individual or a family to play a more active role in selecting the product categories/ brands that best match their specific needs.

Numerous options are available to consumers. Before selecting a choice, they must balance the advantages and disadvantages of numerous possibilities. When a buyer purchases a product, he takes into account the following factors.

Numerous factors that consumers take into account when making purchases. Based on the mean weighted scores for the enumerated weighted variables, rankings were assigned. The outcomes are displayed in Table.

**Table 7. Responsible attributes for value-added pearl millet products purchase**

S. No.	Particulars	Not at all important	Slightly important	Moderately important	Very important	Extremely important
1	Flavor	6	17	27	30	20
2	Taste	9	6	20	42	23
3	Color	23	28	30	14	5
4	Packaging	8	16	40	23	13
5	Manufacturing & expiry date	4	5	11	20	60
6	Nutritional value	4	4	12	21	59
7	Price	8	8	27	29	28
8	Availability	5	10	23	34	28

Source: Researcher's own computation from primary data

**Table 8. Weighted average and ranks assigned for different factors**

Factors	Weighted Average	Ranks assigned
Flavor	3.41	6
Taste	3.64	4
Color	2.5	8
Packaging	3.17	7
Manufacturing and expiry date	4.27	2
Nutritional Value	4.27	1
Price	3.61	5
Availability	3.7	3

Source: Researcher's own computation from primary data

According to Table 8, the characteristics that have the most impact on consumer purchasing decisions nutritional value, manufacturing and expiry date, availability and taste since these attributes were given a rating between 1 and 4 for factors impacting millet products. As a result, the elements that effected the ranking of 5 to 8 were modest, including price, flavor, packaging and color.

### 3.7 Nutritional Content- A Major Preference Criteria or Not?

The consumers were asked the question that whether they consider the nutritional content of pearl millet value-added products while buying them or not? The results are shown in the Table 9.

**Table 9. Consideration of nutritional quality by consumers while purchasing**

Consideration of Nutritional Quality by Consumers	Number/ Percentage of Consumers
Yes	90
No	10

*Source: Researcher's own computation from primary data*

Table 9 clearly shows that 90 per cent of the consumers under study consider nutritional quality of the value-added products while making the purchases while only 10 per cent consumers don't pay much attention to this attribute.

## 4. CONCLUSION

The whole study is based upon the Consumer Preference and Consumption Pattern of Value-Added Pearl Millet Products in Bikaner District of Rajasthan. Pearl millet cookies, cakes, and other bakery items, different varieties of pearl millet batters, ready-to-eat items like pearl millet khakhra, dhokla, and puffs, and liquid items like pearl millet lassi were the major products which were taken into consideration for the research. Study was based on consumer preference and consumption pattern of value-added pearl millet products which serves a great idea regarding influence of individual preferences in making choices among various available varieties of products, their preferred purchasing channels, monthly spending etc.

- Majority (55%) of the consumers belong to the age group 18 to 25, Subsequently, 27

per cent belonged to the age group of 25 to 35 years. 13 per cent people were from the age group 35 to 45 and only 5 per cent consumers were above the age of 45 thus marketer should focus on this segment of elderly consumers more.

- There was about 58 per cent of male and 42 per cent of female. Among which majority of respondents were unmarried (68%) because unmarried people buy more of such products like bakery items.
- Majority of consumers were post graduated consumers with 47 per cent, followed by 46 per cent consumers who were graduates, 5 per cent consumers were falling under the category of up to 12th and 2 per cent consumers had other educational qualification it can be seen that the more educated consumers realize the benefits of pearl millet products and they tend to consume them more.
- Most of the respondents were student and service persons with 42 per cent, 31 per cent respectively.
- Major group which was with 42 per cent of consumer earns less than 10,000 monthly, 22 per cent consumers had monthly income of 40,000.
- Most preferred products by consumers of value-added pearl millet products in Bikaner, Rajasthan are of the category pearl millet cookies, cakes, and other bakery items because of its easy availability and use as a snack therefore pearl millet cookies, cakes, and other bakery items accounts 57 per cent of total sample population preference, followed by Ready to eat products with 27 per cent, pearl millet batters of different types with 11 per cent and liquid products like pearl millet lassi with 5 per cent.
- 29 per cent consumers under study would stick to their choice and will not buy substitute products prepared from ingredients other than pearl millet. The rest 71 percent consumers would not stick to their preferences and will buy substitute products as per availability.
- Most of the consumers spend <₹500 per month because the majority consumers prefer to buy products such as cookies and bakery products which are easily available under this amount. It is also observed that there are 32 per cent consumers who spend ₹500 to ₹1000 monthly and only 1 per cent who spend more than ₹2000 for the same.



- Most preferred channel for purchasing of value added pearl millet products by consumers was Retail/ grocery store with 49 per cent consumers purchasing from the channel because retail outlets are convenient, are being visited frequently and available nearby, followed by Supermarket with 27 per cent of consumers and 24 per cent of consumers from online channel.
- Chi-square test revealed that the age group of the consumers' significantly impacts consumers' monthly spending on value-added pearl millet products and means monthly income of the consumers significantly impacts consumers' monthly spending on value-added pearl millet products.
- The weighted average scores revealed that the characteristics that have the most impact on consumer purchasing decisions nutritional value, manufacturing and expiry date, availability and taste since these attributes were given a rating between 1 and 4 for factors impacting millet products. As a result, the elements that effected the ranking of 5 to 8 were modest, including price, flavor, packaging and color.
- The main reason why the consumers prefer value-added pearl millet products over those prepared with other ingredients is the health and nutritional benefits that these products offer. 40 per cent of the consumers under study consider it to be the most crucial factor while 20 per cent said that the reason for buying is taste, 15 per cent have the reason of availability of these products, 13 per cent due to price and the rest 12 per cent buy them to just follow the ongoing trends.
- 90 per cent of the consumers under study consider nutritional quality of the value-added products while making the purchases while only 10 per cent consumers don't pay much attention to this attribute.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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