

Interrelationship between quality attributes of Ice-cream and their influence on purchasing decision by urban consumers

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Abstract

The demand for dairy products is steadily increasing due to the changing consumption habits, dynamic demographic patterns, urbanization, changing lifestyle, etc. There is a need to assess the demand for ice cream that helps the producers to understand the consumer's perception on quality attributes of ice cream and various factors that influence them to purchase. Taking all these factors into consideration, the present study was carried out to assess the interrelationship between quality attributes of ice cream and their influence on purchasing decision by urban consumers. A total sample of 200 dairy product consumers were selected by a simple random sampling method and a survey method was adopted for the collection of primary data with the help of well-structured and pre tested interview schedule. The factor analysis revealed that attributes such as product safety, quantity, shelf life and affordable price had loadings of 0.864, 0.767, 0.684 and 0.676, respectively, on factor-1 that could be interpreted as 'safety and economic factors' contributed to 28.99 per cent variation in consumers' perception on the quality of ice cream with the Eigen value of 8.126, followed by 'sensory factors' (Eigen value of 1.527) which implied that the safety and economic factors were the major attribute for purchasing ice cream. The Ordered probit results revealed that the estimated coefficients for the variable, family size and educational level of household head was statistically significant at one per cent level in taste, product safety, brand, shelf life and five percent significant in nutritional value whereas the variable – family income significantly influenced freshness, availability and value for money at one per cent level whereas significant at five per cent level in brand. This may increase the demand for ice cream in different segments of population, therein increase in production and maximization of profit.

Keywords: Ice cream, Quality Attributes, Purchase, Decision, Urban Consumers

Introduction

India has emerged as the largest producer of milk with 20.17 percent share in total milk production in the world (Animal Husbandry Policy Note, 2020-21). The milk group forms the bulk of the livestock GVA (Gross Value Added), and its value-output is growing at 13 per cent (Pai, 2020). The total milk production in the country was at 17 million tonnes in the year 1950-51 and there is a steady increase in production of milk and it reached 187.7 million tonnes in the year 2018-19 (Basic Animal Husbandry Statistics, 2019). Food consumption, over the recent years, has

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diversified itself as a result of rapid progress in the production of food which made India's food basket varied and rich with milk and milk products accounting for an increasingly larger share. Dairy products are considered as cheap and nutritious food to millions of people in India and the only acceptable source of animal protein for large vegetarian segment of Indian population (Amit and Monojit, 2015). Growing human population, increasing urbanisation, rising domestic incomes and changing lifestyles in the country have led to increasing demand for dairy products (Anita and John, 2001). Urbanization is closely linked with production and consumption of dairy products since

the demand for dairy products are tremendously rising and is highly income elastic. A number of factors can influence purchasing behavior of consumers. These can be economic (e.g., income and price changes), social (e.g., urbanization leading to dietary changes), cultural (e.g., is influenced by exotic lifestyles) and market development (Gandhi and Zhou, 2010). Among the dairy products, Ice-cream is widely taken by large percentage of population both vegetarians and Non-vegetarians as dessert. With this connection, the present study was undertaken to analyze the interrelationship between quality attributes of Ice-cream and their influence on purchasing decision by urban consumers.

Methodology

For this research work, 650 dairy product consumers were selected by a simple random sampling procedure for the study. The choice of place for the study is Chennai city. A survey method was adopted for the collection of primary data from consumers with the help of well-structured and pre tested interview schedule. The interview schedule had the demographic and socioeconomic details of the household consumers, factors influencing the purchase decision and their interrelationship with socioeconomics factors. The data collected from household consumers were tabulated and analyzed. The tools used for the analysis of the data are presented and discussed below.

Factor analysis

Factor analysis is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of the interrelated variables. In general, the first step of the analysis involves an examination of the interrelationships among the variables. Factor analysis assumes that the observed variables are linear combinations of some underlying (hypothetical) factors. Factor analysis was carried out in this study to detect the interrelationships for consumer's ratings (in five-point scale) on quality attributes of Ice-cream in Chennai city, Tamil Nadu. Factor influencing the consumption behaviour of household consumers for Ice-cream are taste, freshness, colour, odour/flavour, packaging, shopping environment, affordable price, product safety, quantity, brand – TANUVAS origin, nutritional value, availability in preferred quantity, value for money, staff attitude and shelf life and easy available.

Factor analysis model:

The basic assumption of factor analysis is that underlying factors can be used to explain complex

phenomenon. The goal of factor analysis is to identify the not directly observable factors based on a set of observable variables. The mathematical model for factor analysis appears somewhat similar to a multiple regression equation. Each variable is expressed as a linear combination of factors that are not actually observed. The factors useful for characterising a set of variables are not known in advance but are determined by factor analysis.

In general, the model for the i^{th} standardised variable is expressed as:

$$X_{(n \times 1)} = A_{(n \times m)} \times F_{(m \times 1)}$$

Where,

'X' is the matrix of variables;

'A' is the matrix of factor loadings (a_{ij});

'F' is the matrix of dimensions;

'n' is the number of variables; and

'm' is the number of dimensions.

Kaiser – Meyer – Olkin (KMO) measure:

The KMO measure of adequate sampling is an index for comparing the magnitude of observed correlation coefficients to the magnitude of partial correlation coefficients.

$$KMO = \frac{\sum_{i \neq j} \sum r_{ij}^2}{\sum_{i \neq j} \sum r_{ij}^2 + \sum_{i \neq j} \sum a_{ij}^2}$$

Where, r_{ij} – simple correlation coefficient between variables i and j .

a_{ij} - partial correlation coefficient between variables i and j .

Small values for the KMO measure indicate that a factor analysis of the variables may not be a good idea, since the correlations between pairs of variables cannot be explained by other variables. The KMO measure can range from 0 to 1.

Kaiser (1974) characterised the KMO measures of 0.90's as marvellous, in the 0.80's as meritorious, in the 0.70's as middling, in the 0.60's as mediocre and in the 0.50's as miserable and below 0.50 as unacceptable.

Ordered - Probit model:

Ordered- response models recognize the indexed nature of various response variables (Peng *et al.*, 2005). In this study, consumers' preferences towards quality attributes of Ice-cream were the ordered responses. In an Ordered Probit model (Table 1), the random error associated with this continuous descriptor is assumed to follow a normal distribution.

In this study, an individual consumers' utility function or preference ordering was hypothesized to be

represented by consumers' importance ratings R's on quality attributes of Ice-cream.

- R = 5 – mostly influencing
- R = 4 – influenced
- R = 3 – neutral
- R = 2 – not influenced
- R = 1 – mostly not influenced

The following Ordered Probit model specification was used here:

$$Y_n^* = \beta' Z_n + Z_n$$

Where,

- Y_n^* = latent and continuous measure of preference of respondent n in the study.
- β = a vector of parameters to be estimated.
- Z_n = a vector of explanatory variables describing the respondent,
- n = a random error term (assumed to follow a standard normal distribution).

The observed and coded discrete preference variable, Y_n^* was determined from the model as below:

$$Y_n = \begin{cases} 5 - \mu_4 \leq Y_n^* \leq \mu_5 & \text{(mostly not influenced)} \\ 4 - \mu_3 \leq Y_n^* \leq \mu_4 & \text{(not influenced)} \\ 3 - \mu_2 \leq Y_n^* \leq \mu_3 & \text{(neutral)} \\ 2 - \mu_1 \leq Y_n^* \leq \mu_2 & \text{(influenced)} \\ 1 - \infty \leq Y_n^* \leq \mu_1 & \text{(mostly influenced)} \end{cases}$$

Where, the μ_i 's are unknown threshold parameters of Y_n^* to be estimated with the parameter vector β .

The probabilities associated with the coded responses are as follows:

$$\begin{aligned} P_n(0) &= \text{Prob}(Y_n=0) = \Pr(Y_n^* \leq \mu_1) = \Pr(\beta' Z_n + \Sigma_n \leq \mu_1) = \Phi(\mu_1 - \beta' Z_n) \\ P_n(1) &= \text{Prob}(Y_n=1) = \Phi(\mu_2 - \beta' Z_n) - \Phi(\mu_1 - \beta' Z_n) \\ P_n(k) &= \text{Prob}(Y_n=k) = \Phi(\mu_{k+1} - \beta' Z_n) - \Phi(\mu_k - \beta' Z_n) \\ P_n(k) &= \text{Prob}(Y_n=k) = 1 - \Phi(\mu_k - \beta' Z_n) \end{aligned}$$

Where, n is an individual, k is a response alternative, $\Pr(Y_n = k)$ is the probability that the individual n responds in manner k and $\Phi(\cdot)$ is the standard normal cumulative distribution function. The interpretation of this model's primary parameter set β is that positive signs indicate higher preference as the value of the associated variables increase, while a negative signs reflects the converse.

Results and Discussion

Interrelationship among ratings on quality attributes of Ice-cream

In addition to assessing the determinants of consumers' preferences for the attributes of Ice-cream, factor analysis was attempted to detect the interrelationship among consumers' ratings on each attribute of Ice-cream. Similar work on dairy products was carried out by Ananda and Babu (2014). The results of factor analysis showing the interdependence of the ice cream quality attributes are presented in Tables 2 and 3. The null hypothesis, that the population correlation matrix is an identity matrix, is rejected by the Barlett's test of sphericity. The approximate Chi-Square statistic was 2465.88 which is significant at p de 0.01. The value of the KMO statistic (0.853) was also large indicating the suitability of the collected data for factor analysis. Further, all the extracted

Table 1: Description of variables used in Ordered Probit analysis

Name	Explanatory variables	Levels	Specifications
FSIZE	Family size	Continuous	Consumption units in the household.
AGE	Age of the head of the household	Continuous	Age of the head of the household
EDU	Education of the head of the household	Four	0 – If illiterate 1 – If primary 2 – If secondary 3 – If college
INC	Income of the head of the household	Continuous	Income of the head of the household in Rs.
HINDU	Hindu	Two	1 – If household is a Hindu 0 – otherwise
CHRIS	Christian	Two	1 – If household is a Christian 0 – otherwise
CHILD	Child	Two	1 – If family had child (ren) below 14 years. 0 – otherwise
AGED	Household with aged persons	Two	1 – If household with aged person(s) above 60 years; 0 – otherwise
FDHBT	Food habit	Two	1 – If non – vegetarian 0 – otherwise
TYFMLY	Type of family	Two	1 – If nuclear family 0 – otherwise

communalities were acceptable and all variables were fit for the factor solution, as their extraction values were large enough.

All the first four components in the initial solution had Eigen values over one which accounted for about 74.10 per cent of the observed variation in the consumers' perception on ice cream milk quality attributes (Table 2).

Table 3 indicated that attributes such as product safety, quantity, shelf life and affordable price had loadings of 0.864, 0.767, 0.684 and 0.676, respectively, on factor-1. This suggested that the factor-1 was the combination of all these four factors and this factor could be interpreted as 'safety and economic factors' of the ice cream. Factor-1 independently contributed to 28.99 per cent variation (Table 2) in consumers' perception on the quality of ice cream.

The second factor explained 22.01% of variation in the consumers' preferences with the attributes such as colour, taste and odour/flavour which could be interpreted as the 'sensory' factors. The third factor explained 14.41% of variation in the consumers' preferences with the attributes such as nutritional value, brand, shopping environment and packaging that interpreted as 'extrinsic and health' factors.

Attributes such as staff attitude, freshness, value for money, easily available and available in preferred quantity were significantly loaded with

Table 3: Factor analysis for the quality attributes of Ice cream: Rotated Component Matrix

Attributes	Component			
	1	2	3	4
Safety and economic factors				
Product safety	0.864	0.305		
Quantity	0.767			
Shelf life	0.684			
Affordable price	0.676	0.445		
Sensory factors				
Colour		0.918		
Taste		0.849		
Odour/flavour	0.429	0.474		0.426
Extrinsic and Health factors				
Nutritional value			0.811	
Brand			0.713	
Shopping environment	0.353		0.723	
Packaging		0.396	0.518	
Consumer satisfactory factors				
Staff attitude				0.855
Freshness				0.827
Value for money	0.459			0.781
Easily available	0.359			0.730
Available in preferred quantity	0.542		0.640	

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization;
 Rotation converged in 7 iterations

Table 2: Factor analysis for the quality attributes of Ice cream: Explained total variance

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	Percentage of Variance	Cumulative percentage	Total	Percentage of Variance	Cumulative percentage
1	8.126	50.785	50.785	4.638	28.986	28.986
2	1.527	9.542	60.327	3.522	22.010	50.996
3	1.163	7.270	67.597	2.305	14.409	65.406
4	1.041	6.504	74.101	1.391	8.696	74.101
5	0.763	4.768	78.869			
6	0.720	4.499	83.369			
7	0.618	3.862	87.231			
8	0.395	2.470	89.701			
9	0.365	2.281	91.982			
10	0.309	1.933	93.915			
11	0.260	1.625	95.540			
12	0.213	1.334	96.874			
13	0.166	1.034	97.908			
14	0.128	0.802	98.711			
15	0.118	0.735	99.446			
16	0.089	0.554	100.000			

Extraction Method: Principal Component Analysis.

Table 4: Estimates of the Ordered Probit model on the important ratings of Ice cream attributes

EXPLAIN VARIABLE	Effects of important ratings on factors influencing the dairy product purchasing behaviour														
	Taste	Freshness	colour	Odour/Flavour	Packaging	Shop env	Price	Product safety	Quantity	Brand	Nutrition value	Available	Value for money	Staff attitude	Shelf life
X ₁ FSIZ	0.299** (0.074)	0.052 (0.081)	-0.183 (0.073)	-0.155 (0.081)	-0.226 (0.066)	-0.574 (0.075)	-0.266 (0.068)	0.305** (0.074)	-0.227 (0.071)	-0.240** (0.064)	0.197* (0.069)	-0.159 (0.067)	-0.125 (0.072)	-0.083 (0.066)	0.239** (0.070)
X ₂ AGE	0.005 (0.011)	0.013 (0.011)	-0.011 (0.010)	0.003 (0.011)	0.002 (0.009)	0.010 (0.011)	-0.011 (0.010)	0.004 (0.011)	-0.011 (0.010)	0.001 (0.009)	-0.009 (0.010)	0.009 (0.010)	0.006 (0.011)	0.007 (0.010)	0.008 (0.011)
X ₃ EDU	0.317** (0.072)	-0.068 (0.076)	0.396** (0.072)	0.201 (0.077)	0.126 (0.064)	-0.149 (0.075)	0.399** (0.071)	0.337** (0.072)	0.401** (0.071)	0.139 (0.064)	0.402** (0.071)	0.248** (0.068)	0.296** (0.072)	0.176 (0.066)	0.335** (0.071)
X ₄ INC	0.081 (0.081)	0.619** (0.093)	0.024 (0.080)	-0.146 (0.093)	0.063 (0.070)	-0.005 (0.073)	-0.098 (0.073)	0.057 (0.082)	-0.034 (0.077)	0.608** (0.199)	-0.031 (0.077)	0.285** (0.074)	0.869** (0.242)	-0.014 (0.072)	0.037 (0.078)
X ₅ HINDU	0.088 (0.202)	-0.090 (0.209)	-0.113 (0.192)	0.454 (0.232)	-0.189 (0.173)	-0.193 (0.145)	0.009 (0.143)	0.081 (0.149)	0.011 (0.143)	-0.088 (0.127)	0.040 (0.143)	-0.065 (0.137)	-0.096 (0.144)	0.109 (0.135)	0.143 (0.148)
X ₆ CHRIS	0.015 (0.155)	-0.183 (0.159)	-0.333 (0.153)	-0.406 (0.164)	0.305 (0.139)	0.318 (0.386)	0.702 (0.391)	0.592 (0.260)	0.371 (0.261)	0.237 (0.223)	0.371 (0.261)	0.266 (0.245)	0.461 (0.266)	0.592 (0.239)	0.495 (0.255)
X ₇ CHILD	0.007 (0.267)	-0.076 (0.278)	-0.250 (0.258)	0.602 (0.297)	-0.203 (0.226)	1.480** (0.172)	-0.306 (0.154)	0.711** (0.153)	-0.320 (0.154)	0.286 (0.140)	0.265 (0.245)	0.017 (0.239)	-0.216 (0.251)	-0.137 (0.230)	-0.146 (0.241)
X ₈ AGEED	-0.155 (0.249)	-0.485 (0.230)	-0.185 (0.242)	-0.268 (0.221)	-0.314 (0.214)	-0.529 (0.210)	-0.210 (0.244)	-0.104 (0.273)	-0.137 (0.233)	-0.208 (0.199)	-0.177 (0.229)	-0.045 (0.186)	-0.155 (0.228)	-0.400 (0.228)	0.063 (0.228)
X ₉ FDHBT	0.642** (0.151)	-0.089 (0.163)	0.511** (0.154)	0.281 (0.162)	0.254 (0.133)	-0.197 (0.308)	-0.215 (0.295)	-0.049 (0.157)	0.326 (0.148)	0.208 (0.128)	0.315 (0.148)	0.096 (0.140)	0.011 (0.149)	0.034 (0.136)	-0.183 (0.148)
X ₁₀ TYFVML	-0.304 (0.124)	0.061 (0.129)	-0.115 (0.121)	-0.064 (0.131)	0.036 (0.108)	0.337 (0.307)	-0.041 (0.295)	-0.116 (0.143)	-0.199 (0.136)	0.064 (0.121)	-0.215 (0.136)	-0.008 (0.131)	-0.125 (0.139)	0.130 (0.130)	-0.162 (0.140)
Log likelihood	818.84	689.42	723.43	660.77	1306.72	665.74	755.15	811.37	730.89	1307.79	755.52	834.80	671.03	1082.57	830.66
Model χ^2	61.32**	57.17**	66.90**	28.18*	37.33**	124.72**	55.18**	68.79**	59.44**	36.26**	55.62**	40.00**	38.02**	29.29*	50.31**
No. of obs	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

Figures in parentheses indicate standard errors

*Significant (P < 0.05), ** Significant (P < 0.01)

coefficient values of 0.855, 0.827, 0.781, 0.730 and 0.640, respectively and formed the fourth factor by explaining 8.70 per cent of variation of consumers' perception. The fourth factor named as 'consumer satisfactory factors'.

The Eigen value for the first factor (8.126), 'safety and economic factors' was almost seven times more of the second factor, 'sensory factors' (1.527) which implied that the safety and economic factors were the major attribute for purchasing ice cream. The analysis indicated that safety, economic and sensory were the major factors influencing the consumers' preferences for ice cream attributes.

Factors influencing the consumers' preferences for quality attributes of Ice-cream

Ordered Probit models were fitted for analyzing the socio-economic, geographic and demographic factors determining the consumers' preference ratings of quality attributes of Ice-cream. Estimation results of the fifteen separate Ordered Probit models fitted for the attributes of ice cream, viz., taste, freshness, colour, odour/flavour, packaging, shopping environment, price, product safety, quantity, brand, nutritional value, availability, value for money, staff attitude and shelf life are presented in Table 4. The log-likelihood ratios and Chi-Square test results indicated that all the fifteen models fitted were good fits.

The estimated coefficients for the variable, family size was statistically significant at one per cent level in taste, product safety, brand, shelf life and five percent significant in nutritional value. As the family size increased, consumers seemed to prefer ice cream with good taste, nutritious product, safety in use, good brand and good shelf life so as to satisfy the consumer needs with the available disposable income.

The estimated coefficients for the variable, educational level of household head was statistically significant at one per cent level in taste, colour, price, product safety, quantity, nutritional value, availability, value for money and shelf life. The positive sign of the coefficient of this variable in all the attribute models indicated that as the education level of the household head increased, consumers' attitude shifted towards high quality ice cream with good taste, good colour, affordable and reasonable price, nutritious, good shelf life, easily available in preferred quantity and satisfy for the amount paid. The results implied that educated consumers were both quality, sensory and safety conscious.

The variable- family income significantly influenced freshness, availability and value for money at one per cent level whereas significant at five per cent level in brand. The results implied that consumers were more concerned on safety and sensory attributes. As income

rose, choose better brands for higher satisfaction.

The dummy variable for having children in the family was significant at one per cent level in the models fitted for shopping environment and product safety. The positive coefficients on these attributes indicated that household having children below 14 years gave more importance ratings on these safety and convenience attributes and thus placed a higher value on these attributes compared to the households without children.

The variable, food habit of consumers was significant at one per cent level in the models fitted for taste and colour. The positive sign of this variable pointed out that the non-vegetarians gave more importance on sensory attributes.

The religion variables, the Hindu and Christian, age of the head of the household and the dummy variable – type of family and presence of aged persons were not significant in any of the models, showing that the consumers of different age and religions, either belonging to joint family or nuclear family were indifferent to their preferences towards quality attributes of ice cream.

Conclusion

The study on assessing the interrelationship between quality attributes of Ice-cream and their influence on purchasing decision by urban consumers revealed that attributes such as product safety, quantity, shelf life and affordable price had loadings of 0.864, 0.767, 0.684 and 0.676, respectively, on factor-1 that could be interpreted as ‘safety and economic factors’ contributed to 28.99 per cent variation in consumers’ perception on the quality of ice cream with the Eigen value of 8.126, followed by ‘sensory factors’ (Eigen value of 1.527) which implied that the safety and economic factors were the major attribute for purchasing ice cream. The Ordered probit results revealed that the estimated coefficients for the variable, family size and educational level of household head was statistically significant at one per cent level in taste, product safety, brand, shelf life and five percent significant in nutritional value whereas the variable – family income significantly influenced freshness, availability and value for money at one per cent level

whereas significant at five per cent level in brand. Since the perception about the quality attributes of dairy products are linked to the demographic characteristics of the consumers, the marketing strategy should focus on identifying the different segments of the consumers who prefer different quality attributes in their consumption. This may increase the demand for dairy products in different segments; therein increase in production and profit maximization.

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