Original Research Article

Analysis of consumption pattern of A2 milk in Bengaluru city of Karnataka

Abstract

The dairy sector in India, often referred to as the "milk bowl of the world," stands as a cornerstone of the nation's agricultural economy. This study investigates consumer awareness, preferences, and constraints regarding A2 milk. A2 milk, derived from native Indian cow breeds, is gaining popularity due to its perceived health benefits over conventional milk. The research aims to provide a comprehensive understanding of factors influencing A2 milk consumption in Bengaluru, addressing both consumer behaviour and market dynamics.The study employed a mixed-method approach, combining quantitative analysis through surveys and factor analysis. Data were collected from 80 respondents across Bengaluru city of Karnataka. Garrett ranking was utilized to identify key constraints faced by consumers, while the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test were applied to ensure data adequacy for factor analysis.Results indicate that 82.50% of respondents are aware that A2 milk is a good source of lactose, but awareness drops significantly for other nutritional benefits, with only 19.16% aware of its omega-3 fatty acid content. The overall awareness of A2 milk's health benefits is moderate, with 57.5% of respondents exhibiting a medium level of awareness. Factor analysis revealed that product quality and market considerations significantly influence purchasing decisions, while high cost and lack of awareness are major constraints. The high price is attributed to lower yield per cow and higher maintenance costs. Additionally, 90.50% of respondents highly accepted the taste of A2 milk, indicating strong sensory appeal.In conclusion, the study highlights the need for targeted awareness campaigns and pricing interventions to enhance consumer education and engagement. Addressing these constraints could improve market penetration and sustain consumer interest in A2 milk, promoting its health benefits and ensuring its competitive edge in the dairy market. The findings provide valuable insights for producers and marketers aiming to expand the A2 milk market in Bengaluru and similar urban areas.

Keywords:

A2 milk, Factor analysis, Bartlett's test, Garret's ranking, Dairy.

1. Introduction

The dairy sector plays a crucial role in India's agro-economic landscape by contributing significantly to the country's rural economy, employment generation and nutritional security.Dairy accounts for five per cent of the country's agricultural Gross Domestic Product (GDP) and directly supports more than 8 crore farmers (Balasubramanian,2024; Gayathri*et al.,* 2023). India is the top milk producer in the world, accounting for 23 per cent of all milk produced worldwide (FAO, 2023). From 146.31 MT in 2014–15, milk output in the nation increased at a Compound Annual Growth Rate (CAGR) of roughly 5.85 per cent to reach 230.58 MT in 2022–23 (GOI, 2023a).In the context of Karnataka, the state significantly contributes to India's overall milk production. Karnataka produced 12.503 MT of milk in 2022-23 (GOI, 2023b). This substantial contribution from Karnataka highlights the state's

essential role in supporting the national dairy sector and its integral part in ensuring the country's dairy self-sufficiency and economic prosperity.

Milk is the primary product of the dairy sector which is widely known for its nutritional richness, containing high-quality proteins, essential vitamins (A, D, B12), minerals (calcium, phosphorus) and fats (Kumar, 2024; Lambrini *et al.,* 2021; Scholz-Ahrens*et al.,* 2020). Casein, the chief component of milk proteins, consists of about 30-35% beta-casein, with A1 and A2 variants differing at amino acid position 67. Cows producing A1 milk are exotic breeds like Holstein, Friesian, and Ayrshire, while indigenous cows like Gir, Red Sindhi, and Sahiwal produce A2 milk(Chitra, 2022; Saba *et al.,* 2022; Ul Haq *et al.,* 2020; Rahman*et al.,* 2016). In recent years, the dairy sector in India has been increasing interest in A2 milk which was a new dimension to the nutritional landscape (Gurtu*et al.,* 2023).A2 milk suggest that this protein variant may be easier to digest for individuals who experience discomfort or digestive issues after consuming conventional milk containing A1 beta-casein.A2 milk claim various health benefits including improved digestion, reduced risk of lactose intolerance and potential alleviation of symptoms associated with conditions such as irritable bowel syndrome (IBS) and autism (Kaplan*et al.,* 2022; Kaskous, 2020; Bodnár*et al.,* 2018). The emergence of A2 milk has sparked a significant market trend, with dairy companies and farmers increasingly focusing on promoting indigenous cattle breeds and producing A2 milk products. This trend aligns with the broader movement towards traditional and natural food products, driven by consumer preferences for healthier and more sustainable options. The emergence of A2 milk represents a significant development in India's dairy sector, reflecting evolving consumer preferences and nutritional trends(Jeong *et al.,* 2023; Bentivoglio *et al.,* 2020; Schettini*et al*., 2020; Zeleke*et al.,* 2020; Nystrom*et al.,* 2016).

The market for A2 milk is rapidly expanding due to increasing consumer demand for its perceived health benefits. Several dairy units in India have started offering A2 milk at premium prices to consumers. The Karnataka boasts a rich agricultural heritage, with dairy farming being a vital part of traditional livelihoods. In recent years, to the emergence of around ten A2 milk firms in Bengaluru in the last five years. Several studies have explored the factors influencing A2 milk consumption and its health benefits.

This holistic approach aims to provide valuable insights into the intricate relationship between A2 milk production and consumption, shedding light on the broader implications for the dairy industry in the Bengaluru district of Karnataka, India. The findings of this study aim to contribute to informed decision-making among policymakers, dairy industry stakeholders and farmers. It also seeks investigating the factors driving consumer preferences for A2 milk in the Bengaluru city of Karnataka.In addition to economic considerations, socio-cultural aspects will be examined to understand how A2 milk aligns with the dietary patterns and traditions of the local population.

KarnatakastateisdevelopingthecattleandbuffalobreedinginfrastructureunderNationalProjectfo r Cattle and Buffalo Breeding. There is about 88 million livestock population inKarnatakasuchasCattle,Buffalo,Sheep,Goat,PigandCattle.
IndigenousbreedsofKarnatakaareHallikar,AmrithmahalinthesouthernpartandKhillar,KrishnavalleyandDeoniintheNorthernpart. All are draught purpose breeds. Malnad Gidda is a dwarf variety cattle found in Malnadregions of the State. Germplasm of these breeds are conserved. The breeds of desi cows areGir,Sahiwal,Ongole,Kankrej,Tharparkar,Rathi,HaryanviandGangatiri,Amritmahal*etc.*

Table 1: Population status of indigenous cattle in Karnataka

Breed	Population			% Share in totalindigenouscattleofKarnataka
	Pure	Graded	Total	
Amritmahal	105330	123617	228947	3.47
Deoni	49114	62080	111194	1.68
Hallikar	1148876	550559	1699435	25.73
Khillar	225207	495153	720360	10.91
KrishnaValley	3462	10919	14381	0.22
MalnadGidda	897888	147448	1045336	15.83

Source: 20th livestock census 2018-19.

2. Data and methodology:

The study makes use of both primary and secondary data. Secondary data was obtained from co-operative Milk Producers Federation Limited (KMF) and from private A2 milk dairies in Bengaluru. KMF is the Apex Body for the dairy co-operative movement in Karnataka.The state federation, KMF, has 15 milk unionsacross Karnataka covering 32 districts whichprocuremilkfromPrimaryDairyCooperativeSocieties(DCS)anddistributemilkto the consumers in various Towns/Cities/Rural markets in Karnataka. KMF sells varieties of dairyproducts such as milk, milk powder, ghee, butter, curd, and other fermented products, milksweets, UHT milk, chocolate, ice-creamdesserts, A2 milk through its outlets(https://www.icra.in/).While collecting primary data the present study is confined to Bengaluru city only. For the study, data was elicitedfrom 80consumers and fiveretailers drawn purposivelyfromthecity.Therequireddatawerecollectedfromtherespondents by personal interview method with the help of a pre-tested structured scheduleby snowball sampling and also through Google forms. The sample respondents were interviewed at modern retail formatsof A2 milk, college campuses, and at homes.

2.1. Factor analysis

Factor analysis is a class of procedure primarily used for data reduction and summarization. It is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. Factor analysis is a good way of identifying latent or underlying factors from an array of seemingly important variables. The observed variables are modelled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset.

The factor analysis was done to analyse the factor influencing purchase of A2 milk by consumers. The factors such as age, chemical free milk, freshness, nutritive value, thickness, colours, brand image, easy availability, health benefits, reasonable price, taste and flavour, lactose intolerance, and immunity booster.Factor analysis model isgiven by Kline in 2014.

$$\boldsymbol{X_i = A_{i1}F_1 + A_{i2}F_2 + A_{i3}F_3 + \cdots + A_{im}F_m + V_iU_i}$$

Where,

$\boldsymbol{X_i}$=ithstandardizedvariable

$\boldsymbol{A_{ij}}$ = standardized multiple regression coefficient of the variable on common factor j

$\boldsymbol{F}$ =common factor

$\boldsymbol{V_i}$ = standardized regression co-efficient of variable i on unique factor

$\boldsymbol{U_i}$=Uniquefactor forvariable i

$\boldsymbol{m}$ =numberofcommonfactors

Theuniquefactorsareuncorrelatedwitheachotherandwiththecommonfactors.

Thecommonfactorsthemselvescan be alinearcombinationoftheobservedvariables.

$$\boldsymbol{F_i = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + \cdots + W_{ik}X_k}$$

Where,

$\boldsymbol{F_i}$=estimateofith factor

$\boldsymbol{W_i}$ = weight or factor score co-efficient

K=numberofvariables

It is possible to select weights or factor score co-efficient so that the first factorexplains the largest portion of the total variance. Then the second set of weights can beselected so that the second factor accounts for most of the residual variance subject tobeing uncorrelated with the first factor. The same principle can be applied can be selectingadditionalweights for theadditional factors.

2.2. Bartlett's test of sphericity

It is a statistic test for examining the hypothesis for showing that the variables areuncorrelated in the population i.e., the population correlation matrix is an identity matrix.Bartlett's test of sphericity tests the hypothesis that a correlation matrix is an identitymatrix, which would indicate that the variables are unrelated and therefore unsuitable forstructuredetection.Eachvariablecorrelateperfectlywithitself(r=1)buthasnocorrelationwiththe other variables (r=0) (Tobias and Carlson, 1969).

2.3. Garrett's ranking technique

Garrett's ranking technique was used to analyze the consumer preference for A2milk over conventionalmilk and the constraintsfacedby the respondentswhile buyingA2 milk in the Bengaluru city of Karnataka. The order of merit given by the consumerswas changed into ranks by using the formula: the procedure given by Henry Garrett andWoodworthRS(1969).

$$\text{Per cent position} = \frac{\boldsymbol{R_{ij-0.5}}}{\boldsymbol{N_j}} \times 100$$

Where,

R_{ij} = Rank given for ith item by jth individual

N_j=Number ofitemsrankedbyjthindividual

The per cent position of each rank was converted into scores by referring to theGarrett table. Then for each factor, the scores of individual respondents were summed upand divided by the total number of respondents for whom scores were gathered. The meanscoresforallthe factorswereranked;thefactorshavingthehighestmeanvalueisconsideredtobethemostimportantfa ctorandrankedaccordingly(Dhanavandan,2016).

3. ResultsandDiscussions

3.1. LevelofawarenessofA2milkamongconsumers inBengalurucity

Awareness levels among consumers regarding the nutritional benefits of A2 milk is presented in table 2. It was observed that 82.50% of respondents are aware that A2 milk is a good source of lactose, while 17.50% are unaware of this fact. Additionally, 49.17% of respondents are cognizant of the presence of vitamins A, D, and B12 in A2 milk, contrasting with the 50.83% who are not. Regarding the hormone and antibiotic-free nature of A2 milk, only 25% of respondents were aware, whereas 75% were not. Furthermore, 75% of respondents recognized that A2 milk is rich in calcium, which is beneficial for bone health, while 25% were unaware. Awareness of the significant amount of omega-3 fatty acids in A2 milk, which reduce the risk of heart disease or stroke, was low, with only 19.16% of respondents acknowledging this benefit and 80.84% remaining unaware. Similarly, just 22.50% of respondents were aware that A2 milk can help prevent and treat osteoporosis, leaving 77.50% unaware. Finally, only 27.50% of respondents knew that A2 milk contains potassium, which aids in maintaining blood pressure, while 72.50% were not aware.

These findings indicate that for five out of the seven indicators assessed, the majority of consumers in Bangalore city are unaware of the health benefits of A2 milk. This suggests a pressing need for producers and marketers of A2 milk to implement awareness campaigns. Such initiatives could not only attract new customers but also help retain the existing customer base by enhancing their understanding of the product's health benefits.

Table2: Extentofawarenessof A2milkconsumers

S. No.	AwarenessLevel	Aware		NotAware	
		Frequency	Percent	Frequency	Percent
1.	Goodsourceoflactose	99	82.50	21	17.50
2.	ItcontainsvitaminA,DandB 12	59	49.17	61	50.83
3.	Freeofhormonesandantibio tics	30	25.00	90	75.00
4.	Itcontainsanabundanceofca lciumwhichstrengthen the bones	90	75.00	30	25.00
5.	Itcontainsasignificantamo untofomega-3 fatty acid which reduces therisk ofheart disease orstroke	23	19.16	97	80.84
6.	It helps topreventand tr	27	22.50	93	77.50
7.	ThepotassiumpresentinA2 milkbenefitsyourbloodpres sure	33	27.50	87	72.50

Source: Authors' computations based on primary survey.

Table 3 reveals the overall extent of awareness of A2 milk among consumers in Bengaluru. The findings indicate that more than one-third (57.5%) of respondents exhibit a medium level of awareness regarding the health benefits of A2 milk. This is followed by 22.5% of respondents who have a low level of awareness, and 20% who possess a high level of awareness.

Table3: Overallextentofawarenessof A2milk byconsumers

Category	Respondents(n=120)	
	Frequency	Percent
Low	27	22.50
Medium	69	57.50
High	24	20.00

Source: Authors' computations based on primary survey.

3.2. Factorsinfluencingthepurchaseof A2milk byconsumers

The attributes influencing the purchase decision of A2 milk were analyzed using factor analysis. The initial step involved assessing the suitability of the data for factor analysis using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test, as presented in Table 4.

Table 4:KMO and Bartlett's test for variance among variables.

KMOandBartlett'sTest		
Kaiser-Meyer-OlkinMeasureof SamplingAdequacy		0.882
Bartlett'sTestofSphericity	Approx.Chi-Square	1598.055
	Degrees of freedom	171
	Significance	0.000

Source: Authors' computations based on primary survey.

The KMO score of 0.882 indicated adequate sampling adequacy, and the significance level for Bartlett's Test being below 0.01 suggested a strong correlation within the data. Therefore, we proceeded with the factor analysis to identify the determinants of consumer purchase decisions.

Product quality, which includes qualities like freshness, nutritional value, thickness, color, health advantages, and lack of adulterants, has been shown to be a major factor affecting consumer behavior when it comes to buying A2 milk (eigenvalue greater than 1). Market factors, which included medical recommendations, taste and flavor, trendiness/fashionability, simple availability, fair pricing, and compatibility for lactose sensitivity, were the second important element. All of these elements together have an impact on customers' choices to buy A2 milk. Family characteristics, including age and the ratio of family consumption to household income, were shown to be the third factor that influenced consumer purchasing behavior (Table 5).

Table5:Factors influencingtheconsumerpurchasedecisionof A2milk

Factor	ProductQuality	MarketFactors	Household Characteristic
Age	0.072	0.114	**0.819**
Chemicalfreemilk	**0.895**	0.226	0.004
Freshnessofmilk	**0.912**	0.158	0.088
Nutritivevalueofmilk	**0.932**	0.177	0.023
Thicknessofmilk	**0.915**	0.252	0.072
Colour ofmilk	**0.805**	0.414	0.113

Brandimage	0.478	**0.68**	-0.017
Easyavailability	0.268	**0.637**	-0.262
Healthbenefits	**0.823**	0.408	0.014
Reasonableprice	0.109	**0.841**	-0.054
Noadulterants	**0.746**	0.509	0.05
Trendy/Fashionable	0.195	**0.829**	0.088
Lactoseintolerance	0.574	**0.625**	0.093
Immunitybooster	0.622	0.579	0.05
Tasteandflavour	0.622	**0.631**	0.19
Doctorrecommendation	0.558	**0.608**	-0.009
Proportionof consumption/Income	-0.075	0.151	**-0.786**

Source: Authors' computations based on primary survey.

These results are consistent with those of Srivastava (2013), who investigated the variables influencing the purchasing decisions of consumers for Fast-Moving Consumer Goods (FMCG) in unauthorized colonies. The present research's results are backed up by Srivastava's study, which examined socioeconomic characteristics, product preferences among generic and branded categories, explanations for such preferences, and the overall factors influencing purchase behavior.

3.3. ConstraintsfacedbytheconsumerswhilebuyingA2milk

The constraints faced by consumers while purchasing A2 milk in Bengaluru city were analyzed using Garrett ranking, and the results are depicted in Table 6. According to the majority of respondents, the primary constraint is the high cost of A2 milk, which has a mean score of 62.53. This is followed by consumer ignorance of A2 milk, with a mean score of 59.87, and the lack of online access to certain brands such as Gatti Gaushala and Pyramid Organic, which has a mean score of 57.59. Additionally, the limited availability of organic stores selling A2 milk (mean score of 52.91) and the lack of advertising programs for A2 milk (mean score of 47.97) were also significant constraints.

The higher price of A2 milk compared to conventional milk can be attributed to several factors. The yield of A2 milk per cow is lower, and maintaining native Indian breed cows incurs substantial costs, requiring high-quality care and advanced infrastructure. These cows need a nutrient-rich diet, including plant mixes, wheat bran, and crushed soybeans. Furthermore, marketing costs are elevated due to the perishable nature of the product and exclusive supply chain models used for transporting and selling of A2 milk. Consequently, these factors contribute to the higher price of A2 milk.

The second major constraint is the lack of awareness among consumers regarding the health benefits of A2 milk, largely due to insufficient advertising programs. This lack of awareness hampers consumer education and engagement, thereby affecting the overall market penetration of A2 milk. These findings underscore the need for targeted strategies to address these constraints, including pricing interventions, improving accessibility, and enhancing consumer awareness through effective advertising campaigns.

Table6: ConstraintsfacedbytheconsumerswhilebuyingA2milk.

		Garrett'sValues

S.No.	Constraints	MeanScore	Rank
1.	Thehigh price ofA2 milk	62.53	I
2.	LackofawarenessonhealthbenefitsofA2milk	59.87	II
3.	Lackofonlineaccessofsomeofthebrand	57.59	III
4.	AvailabilityofasmallernumberoforganicstoresforA2 milk	52.91	IV
5.	LackofAdvertisementprograms	47.97	V

Source: Authors' computations based on primary survey.

3.4.PreferenceforA2milk overtheconventionalmilk

Table 7 presents the preference for A2 milk over conventional milk by consumers inBengalurucityofKarnataka.ThemajorityoftherespondentspreferA2milkduetoitsnutritivevalue (mean score of 84) when compared to conventional milk because A2 milk contains anabundance of calcium, which helps the body grow and repair bones. It also helps prevent andtreat osteoporosis, or the weakening of bones followed by brand image (mean score of 62.50)because for consumers brand is very crucial.

It creates an impression and it enables consumersto make an easier, quicker buying decision and most of the consumers prefer because A2 milkis organic by nature (mean score of 60.50) out of regard for consumer needs such nutritionvalue, flavor, freshness, and appearance as well as safety, human health, and environmentalconcerns, followed by attractive packaging(mean score of 54.75) of A2 milk is an importantconsiderationforrespondentswhichcouldbeoneofthereasonsforpreferenceofA2milk, consumersbelievesthat attractivepackagingdeliverasenseofqualitywhilealsoreflectingtheproduct's brand image and the rest of the respondents prefer A2 milk because they do not careabout the price of the milk(mean score of 42.75) even if the price is high they will still preferA2milk becauseofits nutritivevalue.

Table7: PreferenceforA2 milkovertheconventionalmilk

S.No.	Particulars	Garrett'sValues	
		MeanScore	Rank
1.	A2milkismorenutritiousthan commercialmilk.	84.00	I
2.	IpreferA2milkforitsnutritious value	76.75	II
3.	Brandimageismost important whilebuying	62.50	III
4.	Iprefer organicto inorganic	60.50	IV
5.	Attractive packagingisthemostimportantconsiderationwhilebuyingA2 milk	54.75	V
6.	Idon'tcareabout thepriceofmilk	42.75	VI

Source: Authors' computations based on primary survey.

3.5. AcceptanceofA2milkamongtheconsumers

Table8presentstheacceptanceofA2milkamongconsumersBengaluru.ThetasteofA2milkishigh

lyacceptedbyrespondents(90.50 %) because consumers feel that A2 milk tastes just like milk that contains the A1 protein,making it possible to enjoy consumers' favorite milk-laden treats without risking digestivediscomfortorcompromisingonthetasteofconsumers.Followedbyaroma(88.50%),appearance (87.75 %),thickness (87 %), color (86.25 %), and odor (85.75 %). These werethe sensory attributes of A2 milk which is accepted and well-liked by the respondents. Theacceptanceof A2 milk ishigh amongthe respondentsdue to its healthbenefits.

Table8: AcceptanceofA2milkamongtheconsumers

S.No.	Particulars	Totalscore	Averagescore	Percent
1.	Appearance	351	4.39	87.75
2.	Aroma	354	4.43	88.50
3.	Taste	362	4.53	90.50
4.	Colour	345	4.31	86.25
5.	Thickness	348	4.35	87.00
6.	Odor	343	4.29	85.75

Source: Authors' computations based on primary survey.

4. Conclusion

This study provides a comprehensive analysis of the consumption patterns of A2 milk in Bengaluru city, Karnataka. The findings reveal a significant awareness gap among consumers regarding the nutritional benefits of A2 milk. While a majority of respondents (82.50%) are aware of its lactose content, awareness of other health benefits such as the presence of vitamins A, D, and B12, hormone and antibiotic-free nature, omega-3 fatty acids, and potassium remains low. This lack of awareness underscores the need for targeted awareness campaigns to educate consumers about the health benefits of A2 milk, which could enhance market penetration and consumer retention. The study also identifies key factors influencing consumer purchase decisions through factor analysis. Product quality, including freshness, nutritional value, and the absence of adulterants, emerged as the most significant factor. Market considerations such as brand image, availability, price, and medical recommendations also play crucial roles. Household characteristics, including age and income, further influence purchasing behavior, aligning with previous research by Srivastava (2013).Constraints faced by consumers, analyzed using Garrett ranking, highlight high costs and lack of awareness as primary barriers. The higher price of A2 milk is attributed to lower yield per cow, substantial maintenance costs, and exclusive supply chain models. Insufficient advertising exacerbates consumer ignorance about A2 milk's benefits. Addressing these constraints through pricing interventions, improving accessibility, and enhancing consumer education via effective advertising is imperative for market expansion. Consumer preferences indicate a strong inclination towards A2 milk due to its nutritive value, brand image, organic nature, and attractive packaging. Despite higher costs, consumers prioritize health benefits, indicating a willingness to pay a premium for quality. The sensory attributes of A2 milk, such as taste, aroma, appearance, thickness, color, and odor, are highly accepted, reinforcing its market potential.

In conclusion, while A2 milk is favoured for its health benefits and sensory attributes, overcoming price and awareness barriers is crucial. Strategic initiatives focused on education,

pricing, and accessibility can foster broader acceptance and consumption of A2 milk in Bengaluru, ultimately promoting healthier dietary choices among consumers.

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