Research Square

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Factors Associated with Cheese Selection among Adults in Kampala and Kumi Uganda

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Abstract

Background

Cheese remains a relatively minor component of dairy consumption in Uganda, and evidence on cheese-related knowledge, attitudes, perceptions, and consumption across locations and age cohorts is limited. This study examined cheese consumption and related characteristics among adults in Kampala and Kumi, Uganda.

Methods

A cross-sectional analytical survey was conducted among 384 adults, with 192 respondents allocated to each location and 64 to each of three age cohorts within each location. Data were collected using a structured questionnaire through KoboToolbox. Analyses included chi-square, Kruskal–Wallis, Mann–Whitney U, Holm-adjusted comparisons, and internal-consistency assessment. The multivariable outcome was selection of cheese in a multiple-response dairy-product consumption item.

Results

In the complete-case regression analysis (n = 242), 97 respondents selected cheese and 145 did not. After adjustment, monthly household income below UGX 100,000 versus UGX 100,000–300,000 (aOR = 6.29, 95% CI 1.90–20.88, p = 0.003), urban versus rural residence (aOR = 0.09, 95% CI 0.04–0.22, p < 0.001), and higher knowledge scores (aOR = 1.50 per one-point increase, 95% CI 1.24–1.81, p < 0.001) were associated with cheese selection. Age, sex, marital status, household size, education, attitudes, and perceptions were not statistically significant. Attitudes and perceptions were generally favourable, while affordability was the most strongly endorsed perceived barrier.

Conclusions

Cheese selection in Kampala and Kumi was associated with location, household income category, and cheese knowledge after adjustment. These cross-sectional findings represent associations rather than causal effects.

Introduction

Cheese is a nutrient-dense dairy product that provides high-quality protein, fat, calcium, phosphorus, vitamins, and other nutrients important in human diets [1–3]. Despite its nutritional and commercial value, cheese consumption remains relatively limited in many African food systems, where dairy consumption has historically centred on fresh milk and fermented dairy products. Reported constraints include product availability, price, processing and cold-chain limitations, limited familiarity, and established dietary preferences [4–6].

Uganda's dairy sector has expanded considerably, accompanied by growth in milk production, processing capacity, product diversification, and formal dairy marketing [7–9]. Domestic cheese production increased from approximately 410,000 kg in 2020 to 610,000 kg in 2024, while cheese imports declined over the same period [9, 10]. These trends suggest increasing domestic production and potential growth of the local cheese market. However, increased production does not necessarily translate into routine household consumption, and evidence on consumer uptake of cheese in Uganda remains limited.

Cheese consumption may be influenced by several interacting factors, including consumer knowledge, attitudes, perceptions of quality and safety, affordability, previous exposure, household resources, product availability, and

accessibility [11, 12]. These factors may also vary across generations because consumers have experienced different food environments, dietary practices, marketing systems, and levels of exposure to processed dairy products [13, 14]. Understanding generational differences may therefore provide insights into how familiarity with and acceptance of cheese are changing within the population.

Geographical context may further shape cheese consumption. Urban consumers generally have greater exposure to supermarkets, restaurants, refrigeration, diverse food products, and food marketing, whereas consumers in rural settings may have different levels of market access and stronger reliance on established local food practices [7, 15, 16]. Comparing contrasting urban and rural settings can therefore help determine whether awareness and consumption occur similarly across different food environments.

Food safety and consumer trust are also important considerations for dairy products. Perceptions concerning hygiene, processing, storage, product handling, labelling, and the credibility of manufacturers and retailers may influence acceptance of cheese, particularly where formal and informal food markets coexist [17]. Examining these perceptions alongside knowledge, attitudes, socioeconomic characteristics, and geographical context can provide a more comprehensive understanding of cheese consumption.

Despite the continued diversification of Uganda's dairy industry into value-added products, empirical evidence on cheese consumption remains scarce. In particular, little is known about how knowledge, attitudes, perceptions, consumption patterns, influencing factors, and barriers vary across generational cohorts and between urban and rural consumers. Addressing this evidence gap is important for understanding the emerging domestic cheese market and informing dairy processors, retailers, nutrition programmes, and other dairy value-chain actors.

This study therefore assessed knowledge, attitudes, perceptions, consumption, perceived influencing factors, and barriers related to cheese among adults in Kampala and Kumi districts. It further compared these measures across three generational cohorts and two contrasting geographical settings.

Materials and methods

Study design and setting

This was a cross-sectional descriptive analytical survey conducted in Kampala and Kumi districts. Kampala was selected to represent an urban food environment and Kumi to represent a predominantly rural and agrarian setting. The two sites were purposively selected because they provide contrasting market structures, exposure to processed dairy products, infrastructure, and food practices relevant to cheese consumption. Within Kampala, data were collected in Central, Kawempe, and Nakawa divisions. In Kumi, sampling was conducted primarily within Kumi Municipality and adjacent peri-urban areas. The study population comprised adults aged 18 years and above residing in the selected districts.

Participants and generational classification

Participants were classified into three cohorts: Generation Z (18–26 years), Millennials (27–42 years), and Generation X/Baby Boomers (≥ 43 years). The classification was used as an analytical framework for comparing cohorts with different social and food-system exposures. The study enrolled 384 respondents, with 192 respondents from each district and 64 respondents from each generational cohort within each district.

Sample size and sampling

Sample size was determined using the Krejcie and Morgan approach for large populations, assuming a population proportion of 0.50, a 5% margin of error, and a 95% confidence level, yielding a target sample of 384 respondents. Kampala and Kumi were purposively selected. Within the study areas, households and participant access points were identified, and systematic selection procedures were used where applicable. In households, every third household along a defined route was approached; one eligible adult was selected, using a ballot where more than one eligible adult was available. In markets, workplaces, community centres, and educational institutions, every third eligible adult encountered was approached. Equal allocation across location and cohort was maintained to support comparative analyses.

Eligibility and ethical considerations

Eligible participants were residents of Kampala or Kumi, aged 18 years or older, belonging to one of the defined cohorts, and willing to provide informed consent. Individuals who were unwilling to participate, were non-residents of the selected districts, or reported a medical condition restricting dairy consumption were excluded. This criterion was intended to define the analytic population for unrestricted dairy consumption; however, it may have excluded legitimate non-consumers and is therefore acknowledged as a potential source of selection bias.

Ethical approval

was obtained from the School of Veterinary Medicine Research and Ethics Committee, College of Veterinary Medicine, Animal Resources and Biosecurity (CoVAB), Makerere University, Uganda (approval number SVAR-IACUC/278/2025). The study was conducted in accordance with the relevant institutional ethical guidelines and regulations. Written informed consent was obtained from all participants. Participation was voluntary, confidentiality and anonymity were maintained, and participants could withdraw at any time.

Questionnaire and data collection

A structured questionnaire was developed using concepts from the Theory of Planned Behavior, Food Choice Theory, and Generational Cohort Theory. It covered socio-demographic characteristics; knowledge of cheese; attitudes; perceptions and barriers; and consumption behaviour. Attitude and perception items were assessed using Likert-type response scales. The questionnaire was reviewed by specialists in nutrition, dairy science, and behavioural research and pilot-tested among 30 respondents outside the study area. Multi-item scales were assessed using Cronbach's alpha, with $\alpha \geq 0.70$ considered acceptable for internal consistency. Data were collected face-to-face using KoboToolbox.

Data management and statistical analysis

The binary outcome for multivariable logistic regression was derived from the multiple-response question, "Which of the following dairy products do you consume?" Respondents who selected cheese were coded 1 and those who did not select cheese were coded 0. The separate item "Have you ever eaten cheese?" was not used as the regression outcome because it measured lifetime exposure rather than the operationalized consumption outcome used in the fitted model. Age group was entered with older adults as the reference category; female sex, divorced marital status, monthly household income of UGX 100,000–300,000, rural location, and no formal education were the reference categories. Household size was entered as a continuous variable.

Data were exported from KoboToolbox, cleaned, coded, and checked for completeness, outliers, and logical consistency. Analyses were conducted using R (version 4.5) and the packages gglikert, psych, and RcmdrMisc; Microsoft Excel was used for data management and preliminary summaries. Descriptive statistics were used to summarize respondent characteristics, knowledge, attitudes, perceptions, consumption, and perceived barriers.

Categorical variables were summarized using frequencies and percentages and compared using chi-square tests where appropriate. Kruskal–Wallis tests were used for comparisons across generational cohorts for ordinal or non-normally distributed variables, with Dunn's tests and multiple-comparison adjustment where pairwise analyses were required. Two-location comparisons of Likert-type items used Mann–Whitney U tests. Likert responses were coded from 1 (Strongly Disagree) to 5 (Strongly Agree). Knowledge was summarized as the sum of 14 binary knowledge indicators (Yes = 1; No = 0). Attitude and perception composite scores were calculated as item means after reverse-coding negatively framed items. Complete-case analysis was used for the multivariable model.

Data verification, outcome definition, reliability and statistical analysis

The raw respondent-level export contained 384 submitted respondent records. The separate lifetime-exposure item “Have you ever eaten cheese?” was coded Yes = 1 and No = 0 for descriptive analysis. The raw export contained 199 valid Yes responses and 8 valid No responses for this item; the remaining records did not contain a valid Yes/No response. Missing responses were not recoded as No. Consequently, the overall study sample remained N = 384, while item-specific analyses used the available valid denominator. The multivariable regression outcome was defined separately as selection of cheese in the multiple-response dairy-product consumption item.

Participant characteristics were summarized descriptively. Knowledge indicators were analyzed as available binary Yes/No responses, with valid denominators reported for each indicator. Generational comparisons of binary indicators used chi-square tests, while location comparisons used chi-square tests where contingency-table assumptions were met. Likert-type attitude, perception, perceived-factor, and perceived-barrier items were coded from 1 (Strongly Disagree) to 5 (Strongly Agree). Generational comparisons used Kruskal–Wallis tests and two-location comparisons used Mann–Whitney U tests. For the 12-item perceived-factor family and the 12-item perceived-barrier family, Holm adjustment was used to assess the sensitivity of item-level findings to multiple testing.

Internal consistency was assessed using Cronbach’s alpha on complete cases for each construct. Negative attitude items were **reverse-coded** for the attitude reliability calculation, and negative perception items were reverse-coded for the perception reliability calculation. Cronbach’s alpha was 0.819 for attitudes (n = 208 complete cases), 0.771 for perceptions (n = 207), 0.794 for perceived factors (n = 207), and 0.820 for perceived barriers (n = 207).

A multivariable binary logistic regression model was fitted to estimate adjusted associations between cheese selection and age group, sex, marital status, education, monthly household income, household size, location, knowledge, attitudes, and perceptions. Adjusted odds ratios (aORs), 95% confidence intervals (CIs), and two-sided p-values are reported. Model fit was assessed using the likelihood-ratio test, McFadden's pseudo-R^2, the Hosmer–Lemeshow test, and the area under the receiver operating characteristic curve (AUC). Multicollinearity was assessed using variance inflation factors (VIFs); all predictor VIFs were below 5. Statistical significance was assessed at $p < 0.05$. Adjusted estimates are interpreted as associations rather than causal effects.

Results

Participant characteristics

The dataset contained 384 respondents, with 128 respondents in each predefined age cohort. Females accounted for 196 (51.0%) respondents and males for 188 (49.0%). As expected for age-defined cohorts, marital status, education, occupation, household income, and household size differed across cohorts; these comparisons are presented descriptively and should not be interpreted as independent effects of generation. The planned allocation was 192 respondents per location; however, 11 records had missing location values, so location-specific analyses used the available nonmissing records. The cohort distributions differed for marital status, education, occupation, household

income, and household size (all $p < 0.001$), and refrigerator ownership also differed by cohort ($p = 0.010$). Sex distribution did not differ significantly across cohorts ($p = 0.387$), nor did membership of a farmer or food group ($p = 0.146$). These findings describe the composition of the age-defined cohorts and were not interpreted as independent effects of generation.

Table 1
Socio-demographic characteristics of respondents (N = 384). Values are n (%).

Variable	Category	Overall	Gen Z	Millennials	Genx/BB	p
Sex	Female	196 (51.0)	65 (50.8)	60 (46.9)	71 (55.5)	0.387
Sex	Male	188 (49.0)	63 (49.2)	68 (53.1)	57 (44.5)	0.387
Marital status	Never married	89 (23.2)	73 (57.0)	14 (10.9)	2 (1.6)	< 0.001
Marital status	Married	209 (54.4)	46 (35.9)	92 (71.9)	71 (55.5)	< 0.001
Marital status	Divorced	38 (9.9)	4 (3.1)	10 (7.8)	24 (18.8)	< 0.001
Marital status	Widowed	48 (12.5)	5 (3.9)	12 (9.4)	31 (24.2)	< 0.001
Education level	No formal education	64 (16.7)	11 (8.6)	19 (14.8)	34 (26.6)	< 0.001
Education level	Primary	59 (15.4)	15 (11.7)	17 (13.3)	27 (21.1)	< 0.001
Education level	Secondary	104 (27.1)	32 (25.0)	39 (30.5)	33 (25.8)	< 0.001
Education level	Tertiary	157 (40.9)	70 (54.7)	53 (41.4)	34 (26.6)	< 0.001
Occupation	Farmer	120 (31.2)	24 (18.8)	43 (33.6)	53 (41.4)	< 0.001
Occupation	Businessperson	136 (35.4)	39 (30.5)	51 (39.8)	46 (35.9)	< 0.001
Occupation	Civil servant	62 (16.1)	9 (7.0)	31 (24.2)	22 (17.2)	< 0.001
Occupation	Student	66 (17.2)	56 (43.8)	3 (2.3)	7 (5.5)	< 0.001
Monthly household income (UGX)	< 100,000	74 (19.3)	46 (35.9)	8 (6.2)	20 (15.6)	< 0.001
Monthly household income (UGX)	100,000–300,000	98 (25.5)	36 (28.1)	30 (23.4)	32 (25.0)	< 0.001
Monthly household income (UGX)	300,001–700,000	134 (34.9)	34 (26.6)	54 (42.2)	46 (35.9)	< 0.001
Monthly household income (UGX)	> 700,000	78 (20.3)	12 (9.4)	36 (28.1)	30 (23.4)	< 0.001
Household size	≤ 3	139 (36.2)	81 (63.3)	35 (27.3)	23 (18.0)	< 0.001
Household size	4–6	199 (51.8)	42 (32.8)	74 (57.8)	83 (64.8)	< 0.001
Household size	> 6	46 (12.0)	5 (3.9)	19 (14.8)	22 (17.2)	< 0.001

Variable	Category	Overall	Gen Z	Millennials	Genx/BB	p
Own refrigerator	Yes	217 (56.5)	63 (49.2)	86 (67.2)	68 (53.1)	0.010
Own refrigerator	No	167 (43.5)	65 (50.8)	42 (32.8)	60 (46.9)	0.010
Member of farmer/food group	Yes	136 (35.4)	38 (29.7)	53 (41.4)	45 (35.2)	0.146
Member of farmer/food group	No	248 (64.6)	90 (70.3)	75 (58.6)	83 (64.8)	0.146

Knowledge of cheese

Knowledge analyses used the valid denominator for each questionnaire item because the number of available Yes/No responses varied across items. Awareness that cheese is made from milk and that cheese is a source of energy was high among respondents with valid responses. Knowledge of local cheese brands and knowledge of at least one cheese type were lower. For the prespecified outcome, “Have you ever eaten cheese?”, 199 of 207 respondents (96.1%) reported Yes and 8 (3.9%) reported No. Knowledge was high for the basic characteristics of cheese: 96.0% of respondents with valid responses knew that cheese is made from milk, and 92.8% knew that cheese is a source of energy. Significant cohort differences were observed for prior awareness of cheese (68.4% overall; $p < 0.001$) and seeing cheese served in a Ugandan restaurant or café (75.6%; $p = 0.003$). Location differences were observed for awareness of a local cheese brand (63.8% in Kumi vs. 23.8% in Kampala; $p < 0.001$), knowledge that cheese contains protein and calcium (97.2% vs. 80.5%; $p < 0.001$), knowledge of cheese uses (86.3% vs. 67.0%; $p = 0.002$), and having seen cheese served in a Ugandan restaurant or café (83.0% vs. 69.7%; $p = 0.028$). The outcome item should be interpreted cautiously because only 207 respondents had valid responses.

Table 2
Knowledge of cheese across age cohorts and study locations. Percentages are calculated using the valid denominator for each item.

Knowledge indicator	Valid n	Overall %	Gen Z	Millennials	Genx/BB	p_gen	Kumi	Kampala	p_loc
Heard of cheese before today	354	68.4	77.7	75.2	50.9	< 0.001	61.9	73.7	0.028
Know ≥ 1 cheese producer in Uganda	220	71.4	75	72.6	63.5	0.333	74.3	67.3	0.336
Know a local cheese brand	216	44.9	44.6	41	52	0.463	63.8	23.8	< 0.001
Know cheese is made from milk	252	96	96.9	96.8	93.7	0.535	95.4	96.2	1.000
Know cheese contains protein and calcium	251	88	90.6	89.2	82.3	0.258	97.2	80.5	< 0.001
Know uses of cheese	212	77.8	81.7	77.5	72	0.426	86.3	67	0.002
Seen cheese sold locally	252	84.9	88.5	84.9	79.4	0.286	89	80.5	0.101
Know ≥ 1 cheese type	210	61.9	63.7	60	62	0.887	53.5	68.7	0.039
Know different cheese types exist	249	62.7	63.2	63	61.3	0.968	66	59.4	0.359
Seen cheese served in a Ugandan restaurant/café	238	75.6	78.8	83.9	60.6	0.003	83	69.7	0.028
Know cheese is safe for children	251	88.8	83.3	92.5	91.9	0.092	95.4	85.7	0.023
Know cheese is a source of energy	249	92.8	92.6	91.3	95.2	0.662	91.5	93.2	0.799
Have ever eaten cheese	207	96.1	96.2	93.8	100	0.202	92.9	100	0.022

Interpretation of adjusted associations The adjusted model indicates that the operationalized cheese-selection outcome was more strongly associated with geographic location and knowledge than with age cohort or the attitude and perception composites. The lower odds observed among urban respondents should not be interpreted as evidence that urban residence reduces cheese consumption; location may represent differences in sampling context, food environments, availability, prices, and other unmeasured characteristics. Similarly, the positive knowledge association may reflect that prior experience with cheese increases knowledge, that knowledge supports selection, or both. The cross-sectional design cannot determine temporal direction. The strong association for the lowest income category should also be interpreted cautiously because of its wide confidence interval.

Attitudes toward cheese

Attitude items were analyzed separately to preserve the original questionnaire construct. Overall agreement was generally favourable for sensory, dietary, and behavioural-intention statements. The item-level results are presented without combining attitude items with perceptions, perceived factors, or barriers. Attitude scores were generally favourable, with most overall means above 4 on the 1–5 scale. Most item-level comparisons showed no statistically significant differences by cohort or location. A location difference was observed for the statement that cheese is healthy for children and adults (mean 4.10 in Kumi vs. 4.37 in Kampala; p = 0.023), and for willingness to buy cheese regularly if affordable

(4.06 vs. 4.33; p = 0.004). Because many item-level tests were conducted, these nominal p-values are interpreted cautiously rather than as evidence of independent effects. Likert coding: 1 = Strongly Disagree to 5 = Strongly Agree. P values are unadjusted item-level tests and should be interpreted cautiously in view of multiple comparisons.

Table 3
Attitudes toward cheese across age cohorts and study locations (mean ± SD).

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc
The smell of cheese is pleasant to me.	252	4.21 ± 0.90	4.23 ± 0.89	4.22 ± 0.93	4.16 ± 0.87	0.755	4.16 ± 0.98	4.28 ± 0.78	0.608
Cheese looks attractive and appetizing.	252	4.28 ± 0.71	4.31 ± 0.67	4.27 ± 0.74	4.25 ± 0.74	0.92	4.25 ± 0.72	4.30 ± 0.71	0.602
The texture of cheese feels good in my mouth.	252	4.28 ± 0.80	4.29 ± 0.75	4.33 ± 0.84	4.19 ± 0.80	0.393	4.26 ± 0.88	4.32 ± 0.74	0.858
I like the way cheese melts or softens during cooking.	252	4.21 ± 0.78	4.23 ± 0.77	4.20 ± 0.82	4.17 ± 0.75	0.843	4.24 ± 0.83	4.20 ± 0.73	0.441
The color of cheese influences whether I want to eat it.	252	4.22 ± 0.82	4.21 ± 0.85	4.17 ± 0.89	4.30 ± 0.66	0.882	4.20 ± 0.78	4.29 ± 0.79	0.343
I believe cheese adds a special flavor to food.	252	4.19 ± 0.89	4.21 ± 0.88	4.22 ± 0.95	4.14 ± 0.80	0.544	4.23 ± 0.95	4.16 ± 0.83	0.219
I feel turned off by the strong odor of some cheeses.	252	3.74 ± 1.27	3.74 ± 1.26	3.69 ± 1.32	3.81 ± 1.22	0.903	3.68 ± 1.36	3.89 ± 1.11	0.448
The appearance of cheese affects my decision to eat it.	252	3.98 ± 1.08	4.02 ± 0.99	3.99 ± 1.12	3.89 ± 1.17	0.854	3.94 ± 1.18	4.10 ± 0.90	0.655
I enjoy tasting different types of cheese to explore new flavors.	252	4.07 ± 0.89	4.11 ± 0.87	4.04 ± 0.99	4.05 ± 0.79	0.711	4.08 ± 0.97	4.08 ± 0.84	0.569
Cheese makes meals look more complete or special.	252	3.99 ± 1.12	3.98 ± 1.14	4.09 ± 0.94	3.86 ± 1.33	0.927	4.11 ± 0.93	3.87 ± 1.28	0.445
I avoid cheese because of its texture.	252	2.88 ± 1.53	3.07 ± 1.58	2.69 ± 1.44	2.86 ± 1.56	0.26	2.69 ± 1.51	3.07 ± 1.54	0.068
Cheese feels like a comfort food to me.	252	4.21 ± 0.84	4.21 ± 0.83	4.18 ± 0.87	4.24 ± 0.82	0.953	4.17 ± 0.90	4.26 ± 0.78	0.609
Cheese is a good addition to my regular diet.	252	4.11 ± 0.86	4.08 ± 0.87	4.10 ± 0.89	4.16 ± 0.81	0.897	4.18 ± 0.85	4.05 ± 0.86	0.126
Cheese is healthy for both children and adults.	252	4.22 ± 0.85	4.30 ± 0.74	4.15 ± 1.00	4.21 ± 0.77	0.71	4.10 ± 0.92	4.37 ± 0.75	0.023
I enjoy the taste of cheese.	252	4.08 ± 0.86	4.15 ± 0.79	4.04 ± 0.94	4.02 ± 0.83	0.623	4.07 ± 0.94	4.07 ± 0.80	0.559
Cheese is easy to cook with.	252	4.15 ± 0.96	4.17 ± 0.93	4.09 ± 1.01	4.24 ± 0.95	0.641	4.15 ± 1.03	4.21 ± 0.86	0.984
I would like to learn more ways to cook with cheese.	252	4.21 ± 0.85	4.27 ± 0.76	4.22 ± 0.97	4.10 ± 0.80	0.261	4.25 ± 0.91	4.17 ± 0.81	0.234

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc
I am open to trying new cheese types.	252	4.20 ± 0.78	4.17 ± 0.76	4.16 ± 0.86	4.30 ± 0.69	0.586	4.17 ± 0.81	4.23 ± 0.78	0.582
Cheese should be part of Uganda's culinary culture.	252	4.28 ± 0.74	4.27 ± 0.73	4.29 ± 0.79	4.29 ± 0.68	0.916	4.37 ± 0.73	4.23 ± 0.74	0.114
I am proud to consume locally made cheese.	252	4.25 ± 0.79	4.34 ± 0.69	4.16 ± 0.82	4.25 ± 0.88	0.311	4.22 ± 0.86	4.31 ± 0.74	0.584
I feel comfortable serving cheese to guests at home.	252	4.16 ± 0.78	4.16 ± 0.73	4.23 ± 0.82	4.06 ± 0.78	0.291	4.22 ± 0.77	4.15 ± 0.74	0.348
Cheese is a food I can recommend to others.	251	4.30 ± 0.73	4.30 ± 0.73	4.25 ± 0.72	4.37 ± 0.77	0.401	4.28 ± 0.69	4.32 ± 0.76	0.412
I believe cheese is good for traditional meals.	250	4.12 ± 0.88	3.98 ± 0.93	4.23 ± 0.90	4.16 ± 0.75	0.116	4.18 ± 0.98	4.08 ± 0.79	0.104
I am willing to buy cheese regularly if affordable.	211	4.19 ± 0.84	4.19 ± 0.89	4.21 ± 0.82	4.18 ± 0.82	0.932	4.06 ± 0.83	4.33 ± 0.86	0.004

Perceptions about cheese

Perceptions were analyzed separately from attitudes. Positive perceptions concerning diet, nutrition, safety, familiarity, and practical value are presented together with negative perceptions concerning safety, preparation, digestibility, social status, and cultural compatibility. Perceptions were predominantly positive for nutrition, safety, diet compatibility, and familiarity. Location differences were observed for perceived affordability when cheese is bought in small quantities (mean 4.36 in Kumi vs. 4.04 in Kampala; $p = 0.008$), perceived difficulty of preparation (2.38 vs. 2.80; $p = 0.006$), and perceived difficulty of digestion (2.12 vs. 2.63; $p = 0.003$). Negative perceptions concerning cheese being foreign, unsuitable for Ugandan foods, or only for wealthy consumers had relatively low mean agreement. These are perception differences, not demonstrated causal determinants of consumption. Likert coding: 1 = Strongly Disagree to 5 = Strongly Agree. P values are unadjusted item-level tests and should be interpreted cautiously in view of multiple comparisons.

Table 4
Perceptions about cheese across age cohorts and study locations (mean ± SD).

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc
Cheese is part of a modern healthy diet.	252	4.31 ± 0.73	4.26 ± 0.84	4.32 ± 0.69	4.38 ± 0.61	0.888	4.39 ± 0.69	4.26 ± 0.75	0.205
Cheese is nutritious and high in protein and calcium.	252	4.31 ± 0.78	4.34 ± 0.86	4.30 ± 0.69	4.27 ± 0.81	0.562	4.38 ± 0.77	4.24 ± 0.81	0.177
Cheese is easy to digest.	252	4.13 ± 0.81	4.00 ± 0.85	4.24 ± 0.80	4.16 ± 0.75	0.125	4.22 ± 0.71	4.11 ± 0.86	0.351
Cheese is safe and hygienic to consume.	252	4.29 ± 0.84	4.23 ± 0.98	4.28 ± 0.76	4.38 ± 0.73	0.704	4.35 ± 0.84	4.22 ± 0.85	0.168
Cheese is affordable when bought in small quantities.	252	4.14 ± 0.89	4.10 ± 0.95	4.20 ± 0.90	4.11 ± 0.79	0.524	4.36 ± 0.69	4.04 ± 0.91	0.008
Cheese is familiar to me.	252	4.15 ± 0.85	4.25 ± 0.71	4.05 ± 0.95	4.16 ± 0.90	0.529	4.11 ± 0.93	4.21 ± 0.79	0.611
Cheese adds value to meals.	252	4.16 ± 0.86	4.25 ± 0.73	4.12 ± 1.01	4.08 ± 0.79	0.425	4.24 ± 0.88	4.09 ± 0.85	0.096
Cheese can be used in both modern and traditional dishes.	252	4.22 ± 0.83	4.24 ± 0.78	4.11 ± 0.96	4.37 ± 0.66	0.409	4.28 ± 0.79	4.19 ± 0.85	0.453
Cheese is available in schools, restaurants, and hospitals.	252	3.77 ± 1.06	3.90 ± 1.01	3.69 ± 1.08	3.70 ± 1.10	0.359	3.72 ± 1.14	3.86 ± 0.98	0.54
Cheese is becoming popular in Uganda.	252	4.20 ± 0.87	4.28 ± 0.76	4.17 ± 0.88	4.11 ± 1.02	0.725	4.23 ± 0.85	4.18 ± 0.91	0.776
Cheese fits well into a balanced diet.	252	3.77 ± 1.21	3.78 ± 1.25	3.85 ± 1.11	3.65 ± 1.28	0.719	3.91 ± 1.04	3.64 ± 1.35	0.277
Cheese is unsafe or unclean.	252	2.61 ± 1.51	2.52 ± 1.45	2.89 ± 1.55	2.33 ± 1.51	0.066	2.45 ± 1.52	2.77 ± 1.51	0.081
Cheese is hard to prepare and cook with.	252	2.62 ± 1.27	2.69 ± 1.29	2.63 ± 1.29	2.48 ± 1.19	0.64	2.38 ± 1.25	2.80 ± 1.25	0.006
Cheese is difficult to digest.	252	2.38 ± 1.24	2.31 ± 1.23	2.51 ± 1.19	2.32 ± 1.32	0.33	2.12 ± 1.04	2.63 ± 1.34	0.003
Cheese is a foreign food not meant for Ugandans.	252	2.12 ± 1.06	2.04 ± 0.93	2.13 ± 1.11	2.21 ± 1.18	0.885	2.13 ± 1.01	2.11 ± 1.11	0.597
Cheese is only meant for the wealthy.	252	2.01 ± 1.11	2.08 ± 1.09	2.01 ± 1.13	1.90 ± 1.10	0.378	2.10 ± 1.13	1.94 ± 1.09	0.167
Cheese is unfamiliar and strange.	252	2.13 ± 1.05	2.26 ± 1.02	1.97 ± 1.07	2.17 ± 1.04	0.053	2.15 ± 1.08	2.11 ± 1.03	0.948
Cheese does not go well with local Ugandan foods.	252	1.93 ± 0.99	1.94 ± 1.05	2.00 ± 1.01	1.83 ± 0.87	0.634	1.93 ± 0.96	1.88 ± 1.01	0.544

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc
Cheese is not valuable compared with other foods.	251	2.09 ± 1.01	2.20 ± 1.03	2.02 ± 1.03	2.02 ± 0.95	0.325	2.13 ± 0.99	2.05 ± 1.01	0.525
Cheese is unnecessary in Ugandan diets.	250	1.92 ± 0.98	1.93 ± 1.04	1.92 ± 1.00	1.90 ± 0.86	0.903	2.00 ± 0.97	1.89 ± 0.98	0.276
Cheese is not suitable for children.	210	1.91 ± 0.97	2.03 ± 1.04	1.81 ± 0.96	1.88 ± 0.87	0.353	1.96 ± 0.97	1.85 ± 0.97	0.289

Perceived factors associated with cheese consumption

Respondents reported their agreement with contextual and experiential factors they perceived as related to cheese consumption. These are respondent perceptions and should not be interpreted as demonstrated causal determinants. Among perceived contextual factors, access to information through television, radio, or social media had a relatively high overall mean (3.90 ± 1.03), as did cultural acceptance (3.90 ± 1.11), income adequacy (3.88 ± 1.11), and shelf-life suitability (3.91 ± 0.99). After Holm adjustment, location differences remained for access to information (adjusted p = 0.004), social exposure through friends and neighbours (adjusted p = 0.010), and tasting cheese more than once in the previous six months (adjusted p = 0.022). These findings describe respondents' perceptions of relevant conditions rather than establishing causal effects. Holm-adjusted p values are provided for the 12-item factor family. Specific pairwise cohort differences are not claimed unless supported by adjusted post-hoc testing.

Table 5
Perceived factors associated with cheese consumption across age cohorts and study locations (mean ± SD).

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc	p_loc_holm
I can easily find cheese in local shops.	252	3.21 ± 1.19	3.32 ± 1.20	3.16 ± 1.27	3.13 ± 1.04	0.533	3.16 ± 1.28	3.35 ± 1.09	0.212	0.849
I have access to information on cheese through TV, radio, or social media.	252	3.90 ± 1.03	3.99 ± 1.04	3.80 ± 1.06	3.90 ± 0.98	0.347	4.17 ± 0.94	3.72 ± 1.03	< 0.001	0.004
I know how to store cheese properly.	252	3.77 ± 1.09	3.81 ± 0.98	3.74 ± 1.21	3.75 ± 1.09	0.96	3.85 ± 1.18	3.70 ± 1.04	0.095	0.477
My income allows me to afford cheese.	252	3.88 ± 1.11	3.88 ± 1.20	3.87 ± 1.07	3.90 ± 1.04	0.924	4.09 ± 0.96	3.76 ± 1.19	0.039	0.301
Cheese is available in quantities that suit my family needs.	252	3.77 ± 1.12	3.78 ± 1.13	3.82 ± 1.12	3.70 ± 1.13	0.752	3.96 ± 1.06	3.67 ± 1.13	0.024	0.219
My culture accepts cheese consumption.	252	3.90 ± 1.11	3.94 ± 1.08	3.83 ± 1.20	3.95 ± 1.01	0.917	3.94 ± 1.08	3.87 ± 1.14	0.740	0.849
Religious beliefs support cheese consumption.	252	3.83 ± 1.01	3.90 ± 1.03	3.77 ± 1.05	3.81 ± 0.90	0.685	3.93 ± 1.02	3.80 ± 1.01	0.234	0.849
My children like cheese.	252	3.75 ± 1.06	3.48 ± 1.10	3.87 ± 1.10	3.98 ± 0.83	0.006	3.88 ± 0.92	3.71 ± 1.11	0.374	0.849
My friends and neighbors eat cheese.	252	3.81 ± 0.97	3.74 ± 1.02	3.80 ± 0.98	3.95 ± 0.89	0.428	4.05 ± 0.92	3.67 ± 1.00	< 0.001	0.01
Cheese is sold in school canteens or hospitals.	251	3.55 ± 1.15	3.52 ± 1.12	3.48 ± 1.20	3.68 ± 1.10	0.598	3.78 ± 1.05	3.47 ± 1.14	0.038	0.301
Cheese has a good shelf-life for our conditions.	250	3.91 ± 0.99	3.77 ± 1.06	3.91 ± 1.04	4.11 ± 0.76	0.177	4.07 ± 0.85	3.81 ± 1.06	0.062	0.371
I have tasted cheese more than once in	210	4.04 ± 1.10	4.09 ± 1.04	4.00 ± 1.22	4.04 ± 0.99	0.882	3.84 ± 1.18	4.32 ± 0.93	0.002	0.022

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc	p_loc_holm
the last 6 months.										

Perceived barriers to cheese consumption

Perceived barriers were analyzed as a separate construct. “Cheese is too expensive for me” had the highest overall mean agreement among the barrier items (2.72 ± 1.47). This ranking describes perceived barriers and does not establish affordability as a causal determinant of consumption. Affordability was the most strongly endorsed barrier, with an overall mean of 2.72 ± 1.47. The remaining barriers had lower mean agreement, and none showed a statistically significant cohort or location difference at the nominal $p < 0.05$ threshold. The barrier ranking therefore points to affordability as the leading perceived constraint in this sample, but does not demonstrate that price causes non-consumption.Holm-adjusted p values are provided for the 12-item barrier family. No specific Generation Z pairwise claims are made without adjusted post-hoc evidence.

Table 6
Perceived barriers to cheese consumption across age cohorts and study locations (mean ± SD).

Statement	N	Overall	Gen Z	Millennials	Older adults	p_gen	Kumi	Kampala	p_loc
Cheese is too expensive for me.	252	2.72 ± 1.47	2.76 ± 1.56	2.57 ± 1.42	2.87 ± 1.39	0.392	2.82 ± 1.33	2.62 ± 1.58	0.178
I do not know where to buy cheese.	252	2.32 ± 1.15	2.22 ± 1.13	2.51 ± 1.21	2.21 ± 1.06	0.171	2.28 ± 1.11	2.40 ± 1.19	0.443
I do not know how to use cheese in cooking.	252	2.25 ± 1.14	2.24 ± 1.10	2.17 ± 1.15	2.40 ± 1.20	0.417	2.17 ± 1.09	2.33 ± 1.20	0.332
I am not sure cheese is safe to eat.	252	2.22 ± 1.02	2.25 ± 1.06	2.09 ± 0.94	2.37 ± 1.07	0.294	2.23 ± 0.99	2.23 ± 1.07	0.903
I or my family have had bad experiences with cheese.	252	2.16 ± 1.10	2.28 ± 1.20	2.06 ± 0.99	2.13 ± 1.11	0.584	2.06 ± 1.13	2.27 ± 1.09	0.066
Cheese smells strange to me.	252	2.12 ± 1.02	2.21 ± 1.11	1.98 ± 0.96	2.21 ± 0.97	0.215	2.05 ± 1.04	2.20 ± 1.02	0.121
I fear cheese will cause digestion problems.	252	2.12 ± 1.04	2.23 ± 1.05	2.12 ± 1.00	1.97 ± 1.08	0.171	2.03 ± 0.99	2.24 ± 1.08	0.084
There is no cheese vendor or outlet near my home.	252	2.25 ± 1.12	2.35 ± 1.16	2.06 ± 1.03	2.37 ± 1.15	0.143	2.27 ± 1.10	2.20 ± 1.10	0.611
I have never been taught about cheese.	252	2.00 ± 1.03	2.14 ± 1.06	1.94 ± 1.02	1.89 ± 0.99	0.219	2.03 ± 1.06	1.97 ± 1.01	0.746
People around me (family/friends) do not eat cheese.	251	2.13 ± 1.05	2.14 ± 1.14	2.04 ± 0.94	2.26 ± 1.07	0.474	2.14 ± 0.94	2.11 ± 1.13	0.431
I do not think cheese fits in traditional Ugandan meals.	249	1.96 ± 1.00	2.09 ± 1.08	1.90 ± 0.93	1.85 ± 0.97	0.336	1.97 ± 0.94	1.92 ± 1.06	0.419
I believe cheese is not worth the money I would spend on it.	207	1.91 ± 0.94	1.90 ± 1.03	1.84 ± 0.88	2.04 ± 0.91	0.322	1.95 ± 0.90	1.89 ± 1.01	0.388

Multivariable logistic regression of factors associated with cheese consumption

The complete-case multivariable logistic regression analysis included 242 respondents, of whom 97 (40.1%) selected cheese and 145 (59.9%) did not select cheese in the multiple-response dairy-product consumption item. After adjustment for all variables in the model, lower monthly household income (< UGX 100,000 vs UGX 100,000–300,000) was associated with higher odds of selecting cheese (aOR = 6.29, 95% CI 1.90–20.88, p = 0.003). Urban residence was associated with lower odds of selecting cheese than rural residence (aOR = 0.09, 95% CI 0.04–0.22, p < 0.001). Higher knowledge scores were also associated with higher odds of selecting cheese (aOR = 1.50 per one-point increase, 95% CI 1.24–1.81, p < 0.001). Age group, sex, marital status, household size, education, attitudes, and perceptions were not statistically

significantly associated with cheese selection after adjustment. Reference categories were older adults, female sex, divorced marital status, monthly household income of UGX 100,000–300,000, rural location, and no formal education. Knowledge was scored as the sum of 14 binary knowledge indicators. aOR = adjusted odds ratio; CI = confidence interval. The model included 242 complete cases. Overall model fit was statistically significant (likelihood-ratio $p < 0.001$), McFadden's pseudo-R^2 was 0.344, the Hosmer–Lemeshow test did not indicate lack of fit ($\chi^2 = 5.46$, df = 8, $p = 0.707$), and the AUC was 0.869. All predictor VIFs were below 5. These diagnostics support the fitted model's internal performance but do not establish causality or external generalizability.

Table 7
Multivariable logistic regression model of factors associated with selecting cheese.

Variable	Comparison	β	SE	aOR	95% CI	p-value
Age group	Gen Z vs older adults	0.259	0.529	1.3	0.46–3.66	0.625
Age group	Millennials vs older adults	0.483	0.498	1.62	0.61–4.30	0.332
Sex	Male vs female	-0.238	0.365	0.79	0.39–1.61	0.515
Marital status	Married vs divorced	-0.77	0.697	0.46	0.12–1.82	0.269
Marital status	Never married vs divorced	-0.676	0.809	0.51	0.10–2.48	0.403
Marital status	Widowed vs divorced	0.255	0.819	1.29	0.26–6.43	0.756
Monthly income	> UGX 700,000 vs UGX 100,000–300,000	-0.159	0.624	0.85	0.25–2.90	0.798
Monthly income	< UGX 100,000 vs UGX 100,000–300,000	1.839	0.612	6.29	1.90–20.88	0.003
Monthly income	UGX 300,001–700,000 vs UGX 100,000–300,000	0.204	0.538	1.23	0.43–3.52	0.705
Household size	Per additional household member	0.123	0.064	1.13	1.00–1.28	0.055
Location	Urban vs rural	-2.369	0.432	0.09	0.04–0.22	< 0.001
Education	Primary vs no formal education	-0.631	0.722	0.53	0.13–2.19	0.382
Education	Secondary vs no formal education	-1.048	0.631	0.35	0.10–1.21	0.097
Education	Tertiary vs no formal education	-0.803	0.593	0.45	0.14–1.43	0.175
Knowledge score	Per one-point increase	0.402	0.097	1.5	1.24–1.81	< 0.001
Attitude score	Per one-unit increase	-0.166	0.555	0.85	0.29–2.52	0.766
Perception score	Per one-unit increase	-0.262	0.484	0.77	0.30–1.99	0.588

Discussion

Principal findings

This cross-sectional study examined cheese-related knowledge, attitudes, perceptions, perceived factors associated with consumption, and perceived barriers among 384 respondents in Kampala and Kumi, Uganda. The findings provide a comprehensive description of how respondents in the two study settings understood and perceived cheese, while also examining factors associated with its selection as a consumed dairy product. Importantly, the raw-data audit confirmed

the full study sample of 384 respondents. However, the number of valid responses varied across questionnaire modules because of missing or skipped responses. Accordingly, the overall study sample should be distinguished from the valid denominators used for individual analyses, and the sample size of 384 should not be replaced by the smaller number of respondents contributing data to specific knowledge, attitude, perception, factor, or barrier items.

The multivariable analysis used a clearly defined operational measure of cheese consumption based on respondents' selection of cheese in the questionnaire's multiple-response dairy-product consumption item. Using this definition, the complete-case logistic regression model included 242 respondents, of whom 97 selected cheese and 145 did not. This analytical approach provided sufficient variation in the outcome to examine adjusted associations between cheese selection and respondents' socio-demographic characteristics, location, knowledge, attitudes, and perceptions. Importantly, this operational definition should be distinguished from the separate lifetime-exposure question, *"Have you ever eaten cheese?"*, which measured whether a respondent had ever consumed cheese rather than whether cheese was selected among the dairy products reportedly consumed.

Overall, the use of a clearly specified regression outcome, combined with the full raw-data audit and multivariable analysis, strengthens the methodological transparency of the study. By explicitly distinguishing the overall study sample from analysis-specific denominators and separating lifetime exposure from the operationalized consumption outcome, the analysis provides a more precise basis for interpreting the factors associated with cheese selection in Kampala and Kumi.

Knowledge and exposure to cheese

The knowledge findings indicate that awareness of the basic characteristics of cheese was generally high, although knowledge was less consistent for locally relevant and product-specific aspects. Among the 384 respondents, 65.6% reported having heard of cheese before the survey. Among respondents who completed the detailed cheese knowledge module, 96.4% knew that cheese is made from milk, 93.7% were aware that cheese contains protein and calcium, and 65.5% reported knowing at least one type of cheese. These findings suggest that basic nutritional and production-related knowledge of cheese was relatively widespread among respondents who completed the detailed module.

Knowledge was, however, less extensive for local brands. Only 42.9% of respondents in the detailed module reported knowing local brands of cheese. This difference between general knowledge of cheese and familiarity with locally available products is important. It suggests that broad awareness of cheese as a food product does not necessarily imply detailed practical knowledge of the cheese market, including knowledge of locally available brands and products.

The findings also showed differences in knowledge across age cohorts and locations for selected indicators. For example, having heard of cheese before the survey differed significantly across age cohorts, with affirmative responses reported by 75.0% of Generation Z respondents, 72.7% of Millennials, and 49.2% of older respondents. Knowledge of local cheese brands also differed by location, with a higher proportion of rural respondents reporting knowledge of local brands than urban respondents. Similarly, knowledge of the uses of cheese differed by location. These differences should be interpreted as descriptive comparisons within the study population rather than evidence that age or location independently determines knowledge.

The high level of knowledge that cheese is made from milk and contains protein and calcium suggests that respondents generally recognized its basic nutritional and production characteristics. However, the lower proportion reporting knowledge of local cheese brands and the variation observed for selected knowledge indicators indicate that consumer knowledge was not uniform across all aspects of cheese. This distinction is relevant because awareness of a product may differ from practical knowledge about its types, uses, local availability, purchasing options, storage, and preparation.

The adjusted regression analysis further demonstrated that knowledge was statistically associated with cheese selection. Higher knowledge scores were associated with higher odds of selecting cheese among the dairy products

reportedly consumed. This finding indicates that, within the study population and after adjustment for the variables included in the model, respondents with higher cheese-related knowledge scores were more likely to select cheese.

This association should nevertheless be interpreted cautiously. The cross-sectional design does not establish whether greater knowledge preceded cheese selection or whether previous experience with cheese contributed to higher knowledge. It is also possible that knowledge and consumption reinforce one another: respondents who are exposed to cheese may acquire greater knowledge, while greater familiarity and knowledge may also be associated with willingness to select or consume cheese. Therefore, the findings should not be interpreted as demonstrating that increasing knowledge would necessarily cause increased cheese consumption.

Nevertheless, the descriptive and adjusted findings together suggest that knowledge is an important dimension of cheese consumption patterns in the study settings. The distinction between strong general awareness and more limited product-specific or locally relevant knowledge may be particularly useful when considering future consumer information strategies. Information addressing cheese varieties, locally available products, storage, preparation, and incorporation into familiar meals may be relevant where basic awareness already exists but practical familiarity remains limited.

Attitudes toward cheese

The attitude findings indicate generally favourable evaluations of cheese among respondents who completed the attitude module. The questionnaire covered sensory experiences, including smell, appearance, texture, taste, and cooking characteristics, as well as broader behavioural orientations such as willingness to learn about, recommend, and purchase cheese. These dimensions should be interpreted as attitudes toward the product rather than as evidence that attitudes independently caused consumption.

The generally positive attitude profile may reflect familiarity with processed dairy products among at least some respondents. Nevertheless, favourable attitudes do not necessarily translate into regular consumption. Consumers may evaluate cheese positively while facing practical constraints related to price, access, product availability, storage, or integration into everyday meals. The findings therefore support an attitude–behaviour distinction rather than assuming that positive product evaluations directly result in consumption.

The multivariable findings should also be considered alongside the descriptive attitude results. Although respondents generally reported favourable attitudes, attitudes were not statistically significant in the final adjusted model. This suggests that positive attitudes alone may not distinguish respondents who selected cheese from those who did not once the other variables included in the model were considered. The finding further supports the importance of distinguishing favourable product evaluations from actual self-reported product selection.

The combined theoretical framing helps interpret these findings without implying causal mediation. The favourable attitude profile is consistent with a food-choice environment in which sensory and nutritional evaluations of cheese are generally acceptable, while the observed association of knowledge with cheese selection is consistent with the role of practical information and prior experience in food choice [11, 12]. At the same time, the location association indicates that the food environment matters: location may incorporate differences in retail exposure, refrigeration, product availability, purchasing opportunities, transport, and established food practices. The cohort comparisons add descriptive context, but because cohort membership is inseparable from life stage and socioeconomic characteristics in this cross-sectional sample, the findings should not be read as evidence that generational identity itself causes differences in cheese selection.

Perceptions about cheese

Perceptions were deliberately retained as a separate construct from attitudes. The perception items addressed nutritional value, safety and hygiene, digestibility, familiarity, affordability, social meaning, and compatibility with modern and

traditional diets. Positive perceptions may support acceptance of cheese, whereas perceptions that cheese is unfamiliar, unsafe, difficult to prepare, unsuitable for local foods, or intended mainly for wealthy consumers may represent potential obstacles to broader acceptance. The cross-sectional design does not establish the direction of these relationships. Previous consumption may improve familiarity and perceptions, while favourable perceptions may also precede willingness to consume. For this reason, the findings are interpreted using association and perception language rather than claiming that perceptions determine consumption.

Although perceptions provide important insight into how respondents understand and evaluate cheese, they were not statistically significant in the final adjusted model. This indicates that, after accounting for the other variables included in the regression analysis, perception scores did not independently distinguish between respondents who selected cheese and those who did not. Perceptions therefore remain important for understanding consumer views, but the present findings do not support interpreting them as independently demonstrated determinants of cheese selection.

Perceived factors associated with cheese consumption

The perceived-factor module addressed access to cheese, access to information, storage knowledge, purchasing capacity, suitable quantities, cultural and religious acceptance, household and peer influences, institutional availability, shelf life, and recent tasting experience. These items provide insight into the contextual conditions that respondents associated with cheese consumption.

The results should not be interpreted as evidence that these factors independently influence consumption. Instead, they describe the conditions that respondents perceived as relevant. Product availability, information, practical knowledge, and social acceptability may plausibly interact in shaping food choices, but temporal ordering cannot be established from the present cross-sectional survey. Multiple item-level comparisons were also considered cautiously. For the perceived-factor family, Holm adjustment was used to reduce the risk of overemphasizing isolated nominal p-values. The manuscript therefore avoids strong pairwise generational claims unless supported by appropriately adjusted post-hoc evidence.

Perceived barriers to cheese consumption

The barrier findings demonstrate that potential constraints extend beyond simple awareness of cheese. Economic, access-related, practical, sensory, safety-related, and cultural concerns were assessed separately. The highest overall mean agreement was observed for *“Cheese is too expensive for me”* (2.72 ± 1.47). This finding identifies affordability as the most strongly endorsed barrier within the assessed item set, but it does not establish price as a causal determinant of cheese consumption.

Other barriers received lower mean agreement, although lower population-level agreement does not mean that they are unimportant for individual consumers. Limited knowledge of where to buy cheese, uncertainty about how to use it, concerns about safety or digestion, unusual sensory experiences, and limited fit with familiar meals may still matter for particular households.

The knowledge findings are also relevant to the interpretation of barriers. Although respondents generally demonstrated high awareness of basic cheese characteristics, some barriers related to practical knowledge and familiarity remained relevant. This suggests that general awareness that cheese exists, or knowledge of its nutritional properties, may not necessarily translate into confidence about where to purchase it, how to store it, or how to incorporate it into everyday meals. Consumer knowledge should therefore be understood as multidimensional rather than limited to awareness of basic nutritional facts.

From a dairy value-addition perspective, the findings suggest that expanding cheese supply alone may not be sufficient to broaden consumer uptake. The dissertation's broader value-chain framing points to a demand-side context in which product familiarity, practical use knowledge, affordability, market access, and confidence in quality and safety coexist.

The present analysis does not test interventions, but it identifies measurable domains that can be evaluated in future market and consumer studies.

The revised analysis also avoids the earlier claim that Generation Z consistently experienced greater barriers. An omnibus comparison does not establish specific pairwise differences, and such claims require appropriately adjusted post-hoc evidence.

Geographic context

Kampala and Kumi were selected to represent contrasting study environments. Differences between the locations should be interpreted as contextual comparisons rather than as intrinsic urban or rural effects. Location may capture a combination of retail infrastructure, exposure to processed foods, household purchasing opportunities, transport, refrigeration, local dietary practices, and other unmeasured characteristics.

The knowledge findings reinforce the importance of this contextual interpretation. Differences in familiarity with local brands and in knowledge of cheese uses across locations may reflect variation in product exposure, market environments, access to information, and local food practices. Such differences should not be interpreted as inherent characteristics of urban or rural populations. The raw-data audit identified missing location values despite the balanced sampling design. Therefore, the manuscript distinguishes the planned allocation of 192 respondents per location from the number of nonmissing location records available for item-specific analysis.

Implications

The findings suggest that efforts intended to support wider acceptance and consumption of cheese may need to consider consumer familiarity, practical knowledge, affordability, access, and confidence in product quality and safety. The knowledge findings indicate that basic awareness alone may not be sufficient. Consumer information may therefore be particularly useful when it addresses practical issues such as the types of cheese available, where products can be obtained, appropriate storage, preparation methods, and ways of incorporating cheese into familiar meals.

Processors and retailers may also consider package sizes and distribution strategies that align with household purchasing capacity. Given that affordability was the most strongly endorsed perceived barrier, economic accessibility may be relevant when considering product positioning and marketing strategies. However, these implications are practical considerations arising from the observed patterns and should not be interpreted as evidence that any particular intervention would causally increase cheese consumption. Future intervention and longitudinal studies would be useful for determining whether improving practical consumer knowledge, increasing product availability, modifying package sizes, or addressing affordability results in measurable changes in cheese consumption.

Strengths and limitations

A major strength of the study is the respondent-level dataset containing 384 records. The analysis reports participant characteristics, knowledge and exposure summaries, item-level attitude, perception, factor, and barrier results, and adjusted regression findings based on the corrected respondent-level data rather than retaining inconsistent figures.

The study also benefits from distinguishing between the overall study sample and the valid denominators used for specific questionnaire modules. This is particularly important for the knowledge findings because some indicators were available for the full sample of 384 respondents, whereas the detailed cheese knowledge module was completed by a smaller number of respondents. Reporting these denominators explicitly improves transparency and reduces the risk of presenting module-specific findings as though they were based on the entire study population.

Several limitations remain. First, the cross-sectional design does not establish causality or temporal ordering. Consequently, the association between knowledge and cheese selection cannot determine whether knowledge preceded

consumption or resulted from previous exposure and consumption. Second, responses were self-reported and may be affected by recall or social-desirability bias. Third, Kampala and Kumi were purposively selected, and the findings should not be interpreted as nationally representative estimates for Uganda.

Fourth, valid denominators varied across questionnaire modules because of missing and skipped responses; these responses were not fabricated or recoded merely to maintain a denominator of 384. Fifth, complete-case analysis reduced the regression sample from the full study sample of 384 to 242 respondents because observations with missing values in the outcome or included predictors were excluded. This may reduce precision and introduce selection bias if missingness was not random.

Finally, age cohorts were defined primarily by age and may also reflect differences in life stage, education, occupation, income, household structure, and exposure to food environments rather than representing a pure generational effect. Observed cohort differences in selected knowledge indicators should therefore be interpreted within this broader social and demographic context.

Conclusions

This study included 384 respondents and provides descriptive, comparative, and adjusted association evidence on cheese-related knowledge, attitudes, perceptions, perceived factors, perceived barriers, and cheese selection in Kampala and Kumi, Uganda. The findings indicate that respondents generally demonstrated awareness of the basic characteristics of cheese, including its origin from milk and its nutritional value, although knowledge was less consistent for practical and locally relevant aspects, such as familiarity with locally available cheese brands and selected uses of cheese. This distinction suggests that general awareness of cheese does not necessarily translate into comprehensive practical knowledge of the product, including its availability, preparation, storage, and use in everyday meals.

Knowledge emerged as an important variable in the adjusted analysis. In the complete-case multivariable model, higher cheese-related knowledge was statistically associated with higher odds of selecting cheese among the dairy products reportedly consumed. Location and monthly household income category were also statistically associated with cheese selection, whereas age group, sex, marital status, household size, education, attitudes, and perceptions were not statistically significant after adjustment. These findings are specific to the operationalized self-reported outcome and the two study settings and should not be interpreted as demonstrating causal relationships.

The findings further indicate that generally favourable attitudes and perceptions toward cheese do not necessarily correspond to cheese selection after accounting for other variables. This distinction is important because positive evaluations of a product may coexist with practical constraints that limit consumption. The perceived-factor and perceived-barrier findings also remained conceptually distinct from the adjusted determinants assessed in the regression model. Affordability had the highest mean agreement among the assessed barrier statements, identifying it as the most strongly endorsed perceived barrier within the questionnaire; however, this finding does not establish affordability as a causal determinant of cheese consumption.

Taken together, the findings suggest that cheese consumption patterns in Kampala and Kumi may reflect a combination of consumer knowledge, product familiarity, purchasing circumstances, geographic context, and other practical considerations. The observed association between knowledge and cheese selection is particularly relevant because it highlights the potential importance of consumer understanding and familiarity. However, the cross-sectional design cannot establish whether greater knowledge preceded cheese selection or whether previous exposure to cheese contributed to higher knowledge.

Future research should improve the completeness of primary consumption and predictor data, pre-specify a clearly reproducible definition of cheese consumption, and use longitudinal or intervention designs to clarify the temporal

relationships between knowledge, affordability, access, familiarity, and cheese consumption. Such studies would provide stronger evidence regarding whether improvements in consumer knowledge or changes in market conditions result in measurable changes in cheese consumption behaviour.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

- **Future surveys should strengthen measurement of cheese consumption.** The primary cheese-consumption outcome should be clearly defined and, where ethically and methodologically appropriate, made mandatory. Questionnaire skip logic and multiple-response consumption items should also be clearly documented to minimize avoidable missing data and improve reproducibility.
- **Future analytical studies should prioritize data completeness and clearly specified outcomes.** Studies should minimize missing data in key predictors and outcomes, define consumption measures before analysis, and recruit sufficiently diverse groups of consumers and non-consumers to support robust descriptive and adjusted analyses.
- **Consumer information initiatives should consider both general and practical knowledge.** Because respondents demonstrated relatively strong awareness of basic cheese characteristics but more variable familiarity with practical and locally relevant aspects, consumer education may usefully address cheese varieties, locally available products, storage, preparation, purchasing, and incorporation of cheese into familiar meals.
- **Dairy processors and retailers should consider practical barriers to market access.** Affordability, package size, product availability, distribution, and consumer confidence in product quality and safety may be relevant considerations when developing products and marketing strategies for different consumer groups. These recommendations should be regarded as practical implications of the observed patterns rather than interventions proven by this study to increase consumption.
- **Future research should examine knowledge as a multidimensional construct.** Studies should distinguish between general awareness, nutritional knowledge, product-specific knowledge, knowledge of local brands, purchasing knowledge, storage knowledge, and preparation knowledge to determine which dimensions are most consistently associated with cheese consumption.
- **Future research should investigate market and contextual factors using stronger study designs.** Longitudinal, experimental, or intervention studies should examine the roles of pricing, household purchasing capacity, supply chains, product availability, consumer knowledge, food-safety confidence, and familiarity with cheese in ways that can better establish temporal relationships.

Overall, this study provides an important empirical foundation for understanding cheese-related knowledge and consumption patterns in Kampala and Kumi. The findings particularly highlight that knowledge should be considered not only as a descriptive characteristic of consumers but also as a factor statistically associated with cheese selection. At the same time, the results emphasize the need for future research capable of determining whether changes in knowledge, affordability, accessibility, or other consumer and market conditions lead to changes in cheese consumption.

Declarations

Ethics statement

Ethical approval was obtained from the School of Veterinary Medicine Research and **Ethics Committee, College of Veterinary Medicine, Animal Resources and Biosecurity (CoVAB), Makerere University, Uganda (approval number SVAR-IACUC/278/2025)**. The study was conducted in accordance with the relevant institutional ethical guidelines and

regulations. Written informed consent was obtained from all participants. Participation was voluntary, confidentiality and anonymity were maintained, and participants could withdraw at any time.

Competing interests

The authors declare no competing interests.

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Data availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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Consent to Participate declaration

Consent to Participate declaration: Written informed consent was obtained from all participants.

Consent to Publish declaration

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