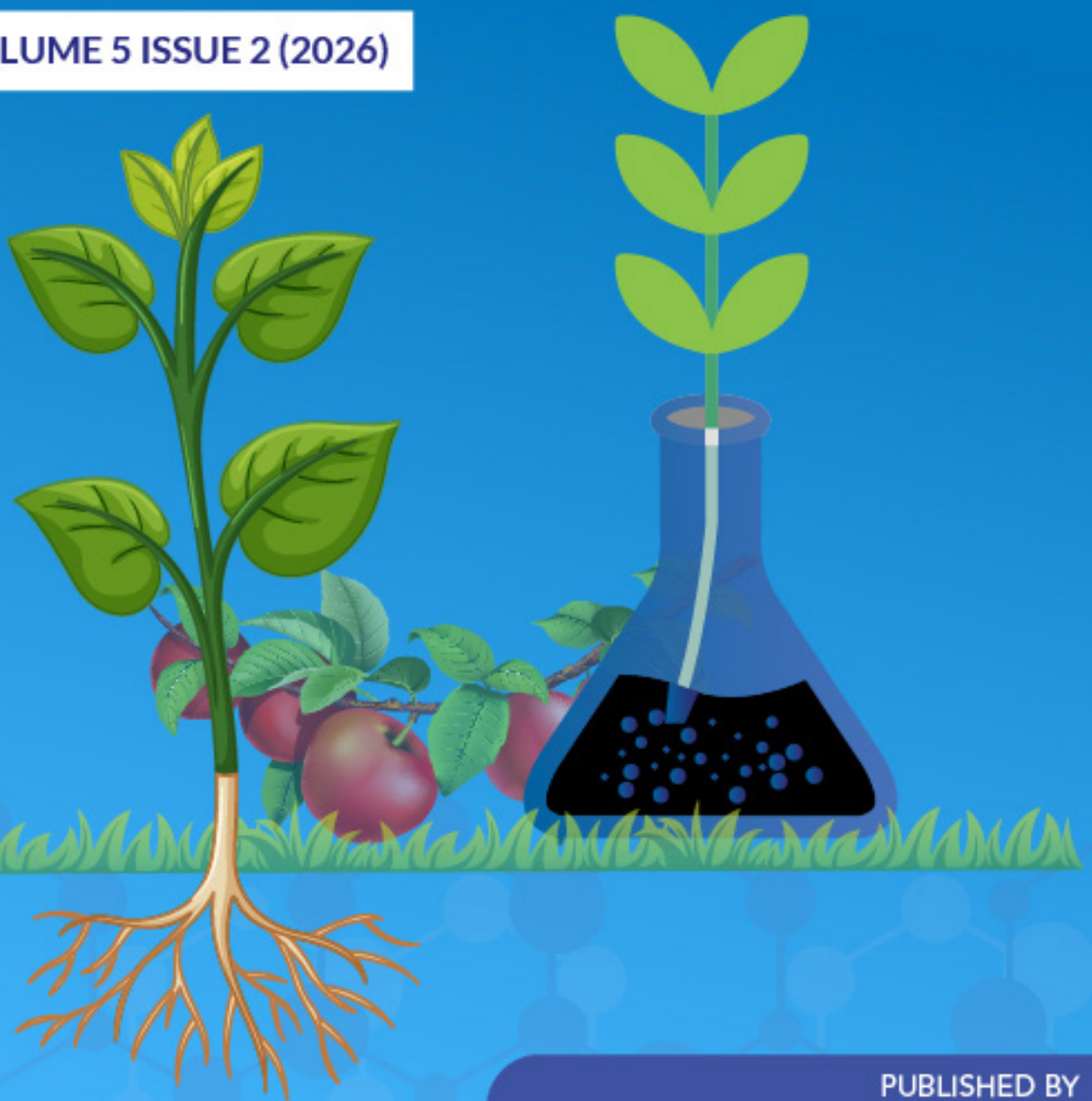




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Fresh Fruit Handling in Tamale and Sagnerigu Municipalities of Ghana: Challenges for Retailers and Implications on Consumer Health

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ABSTRACT

Fresh fruits are crucial sources of vitamins, minerals, and dietary fiber, but they encounter serious food safety hazards in developing urban environments. While fruit vending is widespread in Ghana, especially in the Tamale and Sagnerigu Municipalities, it generally involves informal practices, limited infrastructure, and poor knowledge of food safety standards. Such conditions increase the threat of microbial contamination, nutritional deterioration, and adverse health outcomes for consumers. This study addressed problems affecting retailers using fruit-handling practices found in Tamale and Sagnerigu to develop strategies to mitigate these risks affecting consumer health. The particular goals were to investigate handling practices and constraints, examine the health risks of poor handling, investigate consumers' perceptions and awareness of fruit safety, and examine the relationships among handling practices, retailer adversity, and consumer health outcomes. The study design was a mixed-methods cross-sectional study that aimed to collect data from subjects at one point in time. The survey was distributed to 120 fruit retailers (70 in Tamale and 50 in Sagnerigu) and 200 consumers (120 in Tamale and 80 in Sagnerigu). The direct observation of vending practices was combined with a laboratory study of 60 fruit samples (35 Tamale, 25 Sagnerigu). Quantitative analysis included descriptive statistics (summarizing details about the variables) and inferential statistics (drawing conclusions about the population from the sample), while qualitative data were obtained from interviews and thematic analysis (identifying similarities and themes). There was informal handling of fruit among retailers, most of whom (68%) did not have refrigeration, 74% had their fruit on display in open spaces, and 61% hand-washed with untreated water. Microbial analysis showed contamination, with *Escherichia coli* detected in 40% of samples and *Salmonella* found in 18%. Nutritional analysis found a 25–30% decrease in vitamin C content after 3 days when storage was under poor conditions. 82% of consumers valued fruits for nutritional benefits, but only 36% of consumers indicated being concerned that they may have contamination and used convenience and affordability in purchasing decisions. The challenges of dealing with fruits being handled in Tamale and Sagnerigu can be resolved with technical intervention and with policies. Recommended technical interventions include storage, hygiene training, and regular monitoring on laboratory sites. Policy interventions should emphasize regulatory strengthening, vendor licensing, and investment in market infrastructure. Adoption of these recommendations is anticipated to bolster food safety, protect public health, and restore confidence in local fruit markets.

INTRODUCTION

Fresh fruits are essential for vitamins, minerals, and dietary fiber, which are protective for human health and disease. Among the many fruits and vegetables commonly consumed in Ghana, some of the staple plant foods are oranges, mangoes, bananas, pawpaw, and watermelon, all widely consumed in rural and urban settings. Tamale, the northern region's capital, is a burgeoning city with active markets and street vendors stocking fresh fruits on a daily basis. However, the link between producers and consumers is one of retailers, ranging from smallscale vendors to large market operators, who play a vital role in ensuring a safe fruit supply. Yet Tamale fruit processing is often informal, poorly equipped, and lacking sufficient knowledge of food safety criteria (Kpekurah, 2025).

Population growth, urbanization, and heightened interest in healthful diets are driving the preference for fresh fruits in Tamale and Sagnerigu Municipalities. However, there are no current storage facilities, refrigeration systems, or

hygienic vending. Fruit vendors post in open-air markets, where they are at the mercy of dust, flies, and vehicle exhaust fumes. Fruit vendors also cut and pack a range of fruits without proper hygiene; many farmers and produce vendors cut and package fruits with contaminated water and unclean surfaces. The factors are that they are susceptible to bacterial contamination, spoilage, and loss of nutritional value (Kpekurah, 2023). Fruits are among the basic foods consumed by society, but handling them in Tamale has major public health consequences. Vended fruits contain a high microbial burden, such as *Escherichia coli* and *Salmonella*, both linked with food-borne diseases (Kpekurah, 2023).

Bacteria and diseases affecting our gut such as diarrhea and typhoid fever — are potential risks for consumers buying fruit from street vendors or markets. Retailers also do not have sufficient information on food safety standards, increasing the problem. Moreover, economic constraints limit investment in adequate storage (Adamu,

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2021) and handling operations (Adamu, 2021). Retailers contend with challenges that include poor investment systems at retail levels, insufficient physical infrastructure, lack of training, and poor regulations for food safety enforcement. These challenges hinder both the sales of fruits, which are quality and cost-cutting factors of the fruits themselves, and diminish their confidence as well as demand among consumers in the local markets. In terms of public health, unsafe handling of fruits adds to the common burden that can be prevented, increases costs involved in healthcare, and defeats efforts to promote healthy eating habits.

To combat such problems, it is important to consider the practices of fruit retailers in Tamale and Sagnerigu Municipalities, the constraints these retailers encounter when selling their fruits, and its repercussions on consumer health. The study focused on healthy consumption approaches and retailer hurdles in relation to fresh fruit handling in Tamale and Sagnerigu, Ghana. The first aim was to investigate the retail management of fruits (storage, transporting, displaying, and hygiene) and identify the infrastructure, economic, and knowledge constraints for safe, high-quality supply provision. The second aim was to evaluate health hazards of improper handling, especially microbial pollution and nutrient depletion, and assess their influence on consumer well-being. The third aim was to investigate consumer perceptions and awareness of the safety of fruit, and how these perceptions and awareness then affect their purchasing and consumption. The ultimate aim was to empirically investigate the relationship among the use of handling methods, retailer problems, and consumer health, and to present evidence-based suggestions to strengthen fruit handling, improve food safety, and protect public health in Tamale and Sagnerigu Municipalities.

LITERATURE REVIEW

Theoretical Model

Food Safety Theory and HBM can be applied to analysing practices for fresh fruits as well as consumer health. Food Safety Theory stresses hygiene, infrastructure, and regulation to prevent contamination and ensure safe usage (WHO, 2020). The HBM provides an understanding of behavior that explores perceived susceptibility to foodborne illnesses, perceived health risks, and the benefits of avoiding harm; for instance, washing fruits before eating (Rosenstock, 1974). These models collectively help examine retailers' practices and consumer reactions in Tamale. Poor retailer management heightens the risk of contamination, and consumers' attitudes and awareness influence their protective actions.

Empirical Review

Several studies in Ghana and other developing countries show that fruit handling poses health risks. Kpekurah (2023) found that cut and vended fruits in Tamale had high microbial loads, such as *Escherichia coli* and *Salmonella*. Poor conditions, contaminated water, and

dust were responsible. Adamu (2021) similarly reported that Tamale's food joints in the local region often had inadequate food hygiene measures, and the enforcement of regulations was poor. These observations are consistent with similar findings in Sub-Saharan Africa, which demonstrate that street-vended food is contaminated with microorganisms and poses foodborne disease risks (Mensah *et al.*, 2002). Kpekurah (2025) observed that the bulk of fruit vendors in Tamale lack refrigeration, leading to rapid spoiling and loss of nutrition. Poor storage and hygiene were identified as other determinants of unsafe fruit supply in other countries such as Accra and Kumasi (Amoah *et al.*, 2009). In Nigeria and Kenya, lack of training and budgetary resources have prevented vendors from using safe handling practices (OseiTutu *et al.*, 2010). Consumer perceptions further complicate the situation. Among Tamale consumers, many recognize the nutritional potential of fruits. Unfortunately, knowledge of the risks associated with food safety is still low. According to Kpekurah (2023), consumers often buy cut fruits without taking into account the risks of contamination. We choose convenience and price. This mirrors the results from other African settings in which demand is sustained at the risk to a consumer's health due to unsafe vending practices (FAO, 2017).

Research Gap

Current research contributes critical information regarding microbial contamination, poor sanitation, and poor infrastructure. But few studies integrate retailer practices, consumer attitudes, and health outcomes in a single framework. The bulk of studies examine microbes on fruits or food safety in general, without linking health impacts in Tamale. There is also not much rigorous analysis of the links between handling practices and health risks. This gap underscores the necessity for research that is founded in theory, empirical evidence, and consumer perspective to improve policies and interventions. Conceptual Framework. This study's framework links retailer practices with problems associated with them, consumer attitudes, and health outcomes. The control of storage, movement, and hygiene in fruit retail can influence fruit quality and safety. Problems of infrastructure, finance, and expertise restrict these measures. How consumer perception influences the purchasing of fruit is significant. The unsafe handling and awareness of food safety increase health risks that lead to infections and nutrient loss. By illustrating the relationship between these factors, this framework serves as a means of analyzing how struggles experienced by retailers in Tamale and Sagnerigu municipalities affect consumer health.

MATERIALS AND METHODS

Research Design

The research conducted across May – August 2023 used a mixed-methods approach, utilizing quantitative surveys, qualitative interviews, and laboratory assessments of fruit

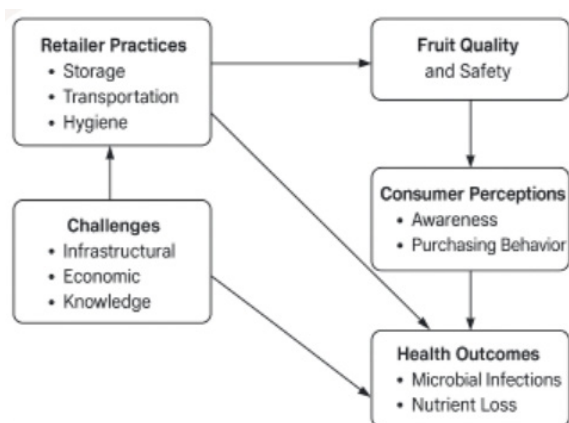


Figure 1: Framework Linking Fruit Handling to Health Outcomes (Authors construct, 2025)

handling techniques, retailer problems, and consumer health effects in an integrated project. It was a cross-sectional design, which is very popular in food safety research to represent a behavior and an outcome at a single point in time (Creswell & Creswell, 2018). Such a design enabled triangulation of the data and increased its validity and reliability (Yin, 2017).

Study Area

The study was conducted in Tamale and Sagnarigu Municipalities of Ghana's Northern Region. Municipalities that were chosen based on vibrant, fresh fruit markets, high consumer demand, and high levels of street vending are well characterized for their urban and peri urban fruit handling contexts (Adamu, 2021; Kpekurah, 2025).

Target Population

The study covered the market for fruits, by vendors/hawkers and shop owners, consumers to whom they sold, and fruit samples to investigate. This is in line with the existing food safety studies which focus on seller and buyer (Mensah *et al.*, 2012).

Sampling Approach and Number of Samples

Using a multi-stage sampling technique (with mixed methods at various points for each stage), this study was conducted. The sampling of the major markets and vending points in Tamale and Sagnarigu Municipalities was strategic (intentionally chosen) to represent varying fruit vending environments. Retailers were sampled randomly on those sites (randomly) between market stalls, roadside vendors, and small shops to capture variety in vending sites. As a result, consumers were targeted in systematic random sampling, i.e., at checkout points, by each *n*th person to represent different purchasing behavior. A total of 120 fruit retailers were sampled: 70 from Tamale and 50 from Sagnarigu. Another 200 consumers were also surveyed, consisting of 120 from Tamale and 80 from Sagnarigu. Sixty fruit samples were taken for laboratory analysis in addition to the survey data. Of these, 35 were

from Tamale and 25 from Sagnarigu. Thus, this integrated sample contained 320 individuals and 60 fruit samples in both municipalities (retailer population and consumers), including both samples, so both municipal areas were fairly representative. Statistical adequacy provided for both retailer and consumer surveys was shown by the use of Cochran's formula in sample size quantification (Cochran, 1977).

Data Collection Methods

1. Questionnaires: Structured questionnaires were conducted with retailers to capture data regarding product handling practices (how fresh foods are handled and stored), infrastructure and economic problems (e.g., storage and transportation problems, financial burdens), and food safety knowledge (knowledge of safe food handling methods and their associated health issues). Customers were asked about their perceptions (what the quality is of food), knowledge (whether food contains safety dangers), or purchasing behaviors (what was important in their purchasing decisions) according to Kpekurah, 2023. ,

2. Observational sheets: Direct observation at vending sites, for example, such as hand washing and glove use, storage conditions (temperature control and cleanliness), and protection for food from dust and pests. These criteria were evaluated by FAO in 2017.

3. Laboratory Tests: Fruit samples were tested for microbial contamination (including dangerous organisms like *Escherichia coli* and *Salmonella*), and for nutrients (vitamin C). These testing protocols were performed following the World Health Organization (WHO) food safety procedures (WHO, 2020). 4. Key informant interviews: The interview with the municipal health officers and the market leaders provided some insight into regulatory enforcement and infrastructural difficulties (Adamu, 2021).

Data Analysis

Quantitative material was coded and performed in SPSS (Statistical Package for the Social Sciences). Descriptive statistics (e.g., means and frequencies) were used to describe handling practices and perceptions of consumers. Relationship analysis (inferential statistics: chi-square tests) was conducted to assess associations between retailer practice and consumer health (Field, 2013). The laboratory results were compared to food safety requirements laid down by the World Health Organization (WHO, 2020). Data from interviews and observations qualitative data were thematically analyzed (patterns and themes) from the interviews and observations (Braun & Clarke, 2006) to interpret contextual knowledge.

Ethical Considerations

Informed Consent was obtained from all participants, and confidentiality and voluntariness of participation were guaranteed. Fruit samples were gathered appropriately in a way that would not disturb the supply chain of vendors.

RESULTS AND DISCUSSION

Socio Demographic Aspects of Respondents

A total of 320 respondents were interviewed, including 120 fruit retailers and 200 consumers in Tamale and Sagnarigu. Among Tamale respondents, 190 were present and for Sagnarigu, 130 respondents participated. Most of the respondents were aged between 25 and 40, with an average age of 34.2 years in Tamale and 36.7 years in Sagnarigu. The sex distribution also displayed that Tamale had slightly more males (54%) than Sagnarigu (49%) and females (46% and 51%, respectively). Education levels were also low; in Sagnarigu, almost half the respondents had only a basic education compared with 41% in Tamale. Collectively, the sample included a youthful population with modest educational attainment, features that conditioned both vending behavior and consumer knowledge.

Fruit Handling Practices, Retailer Constraints, and Fruit Availability

In this study, 70 of the retailers participated in Tamale. Most (65%) of them stored fruits at ambient temperature, but only 15% had refrigeration. Of the 50 retailers in Sagnarigu, 72% used ambient storage, and only 8 percent refrigeration was provided. On the whole, 68% of all retailers did not have cold storage. Transport consisted predominantly of head pans, bicycles, and motorbikes, leaving the fruits exposed to dust and the hot weather. Display practices were also problematic: 74 percent of the stores displayed fruits in the open, often next to refuse dumps or busy roads. Hygiene was poor, with 61% using untreated water for washing fruit and surfaces. Fruits were the most available types that included mangoes, oranges, bananas, pawpaw, and watermelon. In Tamale, mangoes (82% of retailers) and oranges (76%) were the most widely used (followed by bananas (65%), pawpaw (58%), and watermelon (54%)). In Sagnarigu, most of the fruit available were oranges (80%) and mangoes (78%), with bananas (60%), pawpaw (55%), and watermelon (50%) also sold. Mango and orange were the most often sold fruits from both municipalities, owing to their seasonal abundance and consumer interest. Retailers repeatedly identified infrastructure constraints (45%) and financial ones (32%) as barriers, and knowledge challenges (23%) as obstacles to safe care. For a female vendor in Tamale, she stated, “We wash the fruits with any water available, sometimes the roadside tap” (Female, 29, Tamale). A male vendor in Sagnarigu said, “I cannot afford a fridge; I just keep those under shade” (Male, 41, Sagnarigu). These stories highlight structural problems that prevent even the most readily available fruits from being handled safely.

Public Health Risk due to Inappropriate Handling

Laboratory analysis of 60 fruit samples—35 from Tamale and 25 from Sagnarigu—confirmed major microbial contamination. In Tamale, *Escherichia coli* was found in 38%, and *Salmonella* in 20% of samples. These results indicate that contamination from some microorganisms was widespread. In Sagnarigu, *E. coli* was found in 42%

of samples while *Salmonella* was found in 16%. In the aggregate, 40% of the samples contained *E. coli* and 18% *Salmonella*. Nutritional analysis had proven that Vitamin C content decreased by 25 to 30% in three days under poor storage conditions. Many consumers complain about gastrointestinal illness after eating cut fruits. On cut watermelon, one of the men from Tamale reported, “After eating cut watermelon, I get stomach pain and diarrhea” (Male, 33, Tamale). “Sometimes the fruits taste sour quickly, but we still eat them,” a young woman from Sagnarigu said (Female, 27, Sagnarigu). This finding reveals the double risk of infection and nutrient depletion of unhealthy fruit handling.

Perceptions and Awareness of the Consumer

In Tamale, 120 consumers were surveyed, and 85% appreciated fruits for their nutritional value, but just 39% reported that they worry about contamination. In Sagnarigu, 78 percent of respondents valued nutrition, whereas 32 percent worried about contamination. Of those in both fields, nutritional value was recognized by 82 percent and safety had only 36% concern. Convenience and prices led to purchases; 58 percent said cut fruits were preferred despite the risks. Insights revealed poor awareness and poor behavioral change. A Tamale young woman stated, “I buy cut fruits because they are cheap and ready to eat” (Female, 22, Tamale). “We actually just wash with water and never think about germs,” said a man in Sagnarigu (Male, 35, Sagnarigu). These quotes highlight the distance between knowing and feeling, the convenience versus safety that many consumers prefer.

Analysis of Relationships and Associations

Results indicated that retailers’ practices had statistically significant associations with consumer health risks. Microbial contamination was strongly associated with poor hygiene practices ($p < 0.05$), and nutrient loss was associated with the lack of refrigeration ($p < 0.01$). Consumer awareness mediated purchase behavior but did not significantly impact health risks because consumers were still purchasing unhealthy fruits even if they knew they had been contaminated. This approach showed, as a result of the analysis that was analyzed, that retailers facing both infrastructural and economic disadvantages were directly driving unsafe practices, which increased consumers’ health risk exposure. A Tamale female acknowledged: “Even if I understand that the fruit is not clean, I still buy because it’s convenient” (Female, 30, Tamale). A male vendor in Sagnarigu underscored the systemic problem that the issue affects as he added, “We vendors hope to get better; but without support, hardly anything can change” (Male, 40, Sagnarigu). These results point to connections among retailer challenges, consumer perceptions, and health.

Discussion

The objective of this study was to examine fresh fruits and fresh fruit handling in the Tamale and Sagnarigu Municipalities in Ghana with a focus on retailer issues

and health implications for consumers. More precisely, this study aimed to investigate fruit-handling practices among retailers, evaluate the health risks of poor handling practices, investigate consumers' perceptions and awareness of fruit safety, and explore the relationships between handling practices, retailer hardships, and health consequences. The results showed that the fruit handling practices in both municipalities were predominantly informal with storage at ambient temperature, transfer with unsafe and hygiene requirements in all cases. Such findings are in line with previous studies in Ghana and other Sub-Saharan African countries that described similar difficulties in fruit vending scenarios (Mensah *et al.*, 2012; Amoah *et al.*, 2009).

However, the current study complicates by contrasting Tamale and Sagnarigu and, despite that, also notes that Tamale has slightly higher refrigeration (15%) than Sagnarigu (8%); the level is still critically lower in both cases. This shows the infrastructural disparity between even neighboring municipalities. Microbial contamination was a key health concern, with *Escherichia coli* found in 40% of fruit samples and *Salmonella* in 18% of fruit samples. Such findings agree with Kpekurah (2023), who found that cut fruits sold in Tamale contained high microbial loads, and the FAO (2017), which concluded that street-vended foods can be subjected to contamination. The loss of nutrients, particularly vitamin C, is also reflected in earlier studies that suggested that poor storage conditions contribute to spoilage and nutritional restriction (WHO, 2020). The current study adds to the literature by measuring the decline of nutrient ratio (25–30% in three days), which has not usually been addressed in previous studies that generally concentrated on microbial contamination.

Consumer views and awareness were also low, with only 36% of respondents being concerned about contamination, but many respondents had well accepted these findings as fruits have a nutritionally vital role. This discovery is in contrast to Rosenstock's (1974) Health Belief Model, which asserts that perceived susceptibility and severity are predictors of protective responses. Convenience and cost were prioritized above safety considerations in practice, in line with Adamu (2021), who suggested that economic constraints determine consumers' choices in Tamale.

Qualitative information from the study, such as users' own statements of purchasing unhealthy fruits on purpose, adds qualitative context to the quantitative results. The detailed examination validated that infrastructural and economic challenges imposed on retailers are the factors driving unsafe habits among consumers, which in turn increase consumers' exposure to health risks. This comprehensive perspective tackles a critical research void: although prior research explored microbial contamination and consumer behavior in isolation, there are few studies that systematically connect store practices, consumer attitudes, and health outcomes into one category of evidence (Kpekurah, 2025). Integrating quantitative and

qualitative evidence from two municipalities, this study is the first to provide a holistic view of the fruit safety challenges facing the Northern Ghana market.

A comparative analysis of Tamale and Sagnarigu was undertaken; microbial and nutritional assessments were applied, and consumer perceptions were examined alongside retailer practices. This fills a gap in the existing literature where fruit safety has typically been viewed as a purely microbiological problem that ignores socioeconomic and behavioral dimensions. Here, we propose a conceptual framework showing that retailer challenges are interrelated to consumer awareness and health outcomes, allowing empirical evidence to inform policy and intervention.

Study Limitations

Two limitations were noted. First, the crosssectional design prevented the establishment of causality between handling practices and health outcomes. To mitigate this impact, triangulation was used to enhance the validity of associations by integrating surveys, observations, and laboratory analyses. Second, selfreported data on consumers were also subject to the risk factors of recall and social desirability bias. This was resolved by supplementing survey responses with the results of our own observations (and laboratory testing of fruit) so that the findings were not restricted to the subjective accounts of respondents.

CONCLUSION

The research focused on how fresh fruit is handled in Tamale, a brief description of retailer practices, consumer perceptions, and health outcomes. Majority of stores had uneven floors, with garbage piled high outside the door and no protection for exposed food inside, signs of compromised hygienic practices. Along with microbial contamination and nutritional losses attributable to poor hygiene, inadequate storage facilities and weak infrastructure were the primary contributors. Consumers go for price and convenience with minimal regard paid to safety, and the study reflects their low awareness of food infection risks. Retailers are economically and infrastructurally disadvantaged, even as unsafe practices in handling food expose them to unnecessary health hazards.

Technical solutions such as low-cost cold storage, temperature-controlled transport, and solar-powered refrigeration could diminish microbial growth and the loss of nutrients caused by insect infestation. Hygiene training for retailers that includes the use of clean water and cutting boards in addition to regular laboratory inspections would further enhance safety. Consumers should be warned of the risks from sliced fruit and vegetarian dishes. Comprehensive government policies, frequent inspections, and licensing that mandates health- and safety training will raise the standards of practice. This is also the time for investments in modern waste management systems and clean food vending facilities.

Partnerships among municipalities, non-governmental organizations (NGOs) and vendors' associations have been the delivery model for sustainable interventions. A two-pronged strategy, technological advances and policy enforcement is needed. A clearer path to food safety, lower rates of gastroenteritis, and consumer confidence in local markets for up-to-date produce will follow.

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