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ORIGINAL ARTICLE

Effect of hygiene of kitchen utensils and food handlers on microbial counts in Jumbo Ayahanda Iced Tea drinks, Medan City

Madeline Elisa Patricia Manalu[1], Fransiska Lalania Waruwu[1]*, Masryna Siagian[2], Victor Trismanjaya Hulu[2], Eka Lolita Eliyanti Pakpahan[2]

ABSTRACT

Food safety is a crucial aspect of public health, aiming to prevent diseases resulting from the consumption of contaminated food or beverages. This study employed a quantitative research design with an analytical observational approach. The analytical observational method was used to determine the relationship between two independent variables—kitchen utensils and food handler hygiene—and the dependent variable, the microbial count in jumbo iced tea beverages sold along Ayahanda Street, Medan. The quantitative approach was chosen for its ability to measure data numerically and statistically analyze the relationships among variables. Data collection was conducted through direct observation using standardized assessment sheets. The kitchen utensil variable included evaluation of the cleanliness of plastic cups, straws, cool boxes, and cup sealer machines; washing procedures; equipment storage; cleaning methods for stainless steel, glass, and food-grade plastic tools; as well as cleaning frequency. The food handler hygiene variable was assessed based on hand hygiene before and after beverage preparation, nail cleanliness, cleanliness of clothing and aprons during work, and the use of personal protective equipment such as masks and gloves. Microbiological testing involved determining the Total Plate Count (TPC) and comparing the results with established safety standards. Observational and laboratory data were processed and analyzed statistically using the Chi-Square test with a 5% significance level ($\alpha = 0.05$) to evaluate the effect of kitchen utensil conditions and food handler hygiene on microbial counts. The results showed that the majority of jumbo iced tea samples contained microbial levels within safe limits. Of the 30 samples tested, only 4 samples (13.3%) contained detectable microbes, while 26 samples (86.7%) showed no microbial growth based on the Total Plate Count method. There was no significant association between kitchen utensil cleanliness and microbial counts in jumbo iced tea sold on Ayahanda Street, Medan (p-value = 0.507). However, a significant relationship was found between food handler hygiene and microbial counts in the same products (p-value = 0.024).

Keywords: kitchen utensils, hygiene, microbes

Introduction

Food safety is a critical aspect and a major global concern in efforts to protect public health. In the Asian region, nine out of ten consumers in China have stated that food safety is their primary concern.[1] In Indonesia, the protection of food safety is regulated by the Law of the Republic of Indonesia Number 36 of 2009 concerning Health, which in Article 109 stipulates that all food and beverages produced and distributed must comply with safety standards for consumption.[2] Food deemed suitable for consumption is defined as food that does not contain hazardous substances—biological, chemical, or physical—that may pose a risk to

Affiliation
[1]Undergraduate Program in Public Health, Universitas Prima Indonesia
[2]Department of Public Health, Universitas Prima Indonesia

*Corespondence:
fransiskawaruwu8@gmail.com

human health.[3] Violations of these standards can lead to serious health problems, one of which is beverage poisoning.[4]

Beverage poisoning is a health issue resulting from the consumption of drinks contaminated with harmful agents, either microorganisms (bacteria, viruses, fungi) or chemical substances.[5] The scale of this problem is significant; the World Health Organization (WHO) estimates that nearly one in ten people globally—approximately 600 million cases—fall ill after consuming contaminated food or beverages, leading to around 420,000 deaths each year.[6] The main contributing factors to beverage poisoning include contaminated raw materials, inadequately cleaned kitchen utensils, and poor hygiene among food handlers, all of which substantially contribute to food and beverage contamination.[7]

Contamination in beverages can occur at various stages, including production, processing, storage, distribution, and serving.[8] Two major risk factors during the processing stage are equipment sanitation and food handler hygiene. Kitchen utensils that are not properly cleaned after use may serve as breeding grounds for microorganisms, which can subsequently transfer to beverages.[9] Similarly, food handlers who neglect fundamental personal hygiene practices, such as handwashing, further increase the risk of contamination.[10]

Multiple studies provide strong evidence of a direct correlation between poor sanitation and microbial contamination across various environmental and food production contexts. Bintsis[11] revealed that foodborne disease outbreaks frequently originate from contaminated sources, with pathogenic bacteria spreading through multiple routes including animal interactions, irrigation water, and improper waste management. Bartz et al.[12] quantitatively demonstrated that when *E. coli* was present on farmworkers' hands, handled produce was nine times more likely to contain the same pathogen. Muoki et al.[13] specifically found that poor hygiene practices led to high coliform counts and confirmed presence of dangerous pathogens like *E. coli* and *Salmonella* in food and water samples. Ovuru et al.[14] further reinforced these findings, noting that inadequate sanitation creates environments conducive to pathogen growth and transmission.

Despite the evident risks, field observations indicate that many street beverage vendors, particularly small-scale businesses such as *es teh jumbo* (iced tea) sellers along Ayahanda Street, Medan, have yet to implement proper personal hygiene and sanitation practices. In this area, beverage preparation often occurs without appropriate cleaning of utensils or adherence to hygiene protocols, such as handwashing or glove use. Such practices increase the likelihood of microbial contamination in *es teh jumbo*, posing potential health risks to consumers.

Based on these field observations, a preliminary laboratory analysis was conducted on two randomly collected samples of *es teh jumbo* from vendors along Ayahanda Street, Medan. The samples were tested using the methodology stipulated in the Ministry of Health Regulation No. 2 of 2023 concerning Ready-to-Serve Processed Foods.[15] The results showed that both samples contained *Escherichia coli* with concentrations of 2.2 and 1.1 MPN/100 mL, respectively. The presence of this pathogenic microorganism indicates contamination likely originating from poor personal hygiene practices and unclean equipment use. Therefore, further research is warranted to determine the extent to which kitchen utensil cleanliness and food handler hygiene influence microbial counts in *es teh jumbo* sold along this area.

Method

This study was designed as a quantitative research employing an analytical observational approach. This approach was selected to examine the influence of two independent variables—kitchen utensil cleanliness and food handler hygiene—on the dependent variable, namely the microbial count in jumbo iced tea. The specific research design used was a cross-sectional study, in which data on both independent and dependent variables were collected simultaneously to assess the association among them.

Data collection was conducted from May to June 2025. The research site consisted of street vendors and small beverage stalls selling jumbo iced tea along Ayahanda Street, Sei Putih Tengah District, Medan City, North Sumatra. The study population included all 30 active jumbo iced tea vendors in the specified area. Samples were selected using a purposive sampling technique. The inclusion criteria were as follows: (1) vendors selling jumbo iced tea along Ayahanda Street during the study period, (2) vendors who prepared and served the beverage on-site (not factory-processed products), and (3) vendors who agreed to participate and provided beverage samples for laboratory analysis.

Primary data were collected through three methods: observation, interview, and laboratory examination. Secondary data were obtained through literature review, including documents, reports, and journal articles relevant to the research topic. The first independent variable, kitchen utensil cleanliness, was

defined as the hygienic condition and suitability of kitchen utensils used in the preparation of jumbo iced tea. This variable was measured using an observation checklist assessing five aspects: utensil cleanliness, washing method, storage condition, material of the utensil, and cleaning frequency. Each aspect was scored (Good = 3, Fair = 2, Poor = 1), with total scores categorized as "Good" (12–15 points), "Fair" (9–11 points), or "Poor" (5–8 points) on an ordinal scale. The second independent variable, food handler hygiene, referred to the level of personal cleanliness and hygienic behavior of the vendors while handling beverages. It was measured using an observation form assessing five aspects: hand cleanliness, nail hygiene, clothing cleanliness, use of protective equipment (mask/gloves), and behavior during beverage preparation. Each aspect was rated (Hygienic = 3, Moderately Hygienic = 2, Unhygienic = 1), and total scores were categorized as "Hygienic" (12–15), "Moderately Hygienic" (9–11), or "Unhygienic" (5–8) using an ordinal scale.

The dependent variable, microbial count, was defined as the number of microorganisms present in the jumbo iced tea samples. Measurements were conducted in a microbiology laboratory using the Total Plate Count (TPC) method on a ratio scale, which was subsequently categorized nominally based on regulatory standards. The TPC procedure involved taking 1 mL of the jumbo iced tea sample, followed by serial dilution in 0.1% buffer peptone water (BPW) up to a 10^{-6} dilution. Subsequently, 1 mL of the diluted sample was transferred into a sterile Petri dish, mixed with liquid plate count agar (PCA), homogenized, and allowed to solidify. The Petri dishes were then incubated at 37°C for 48 hours, after which all colony-forming units were enumerated. According to the Indonesian Ministry of Health Regulation No. 2 of 2023, a result of <1.8 MPN/100 mL indicates the absence of bacterial growth, whereas a result ≥2.2 MPN/100 mL indicates bacterial presence.

After the data collection phase, data processing was performed in five stages: editing (verifying data completeness and accuracy), coding (converting qualitative data into numeric form), processing (inputting data into SPSS software), cleaning (rechecking entered data), and tabulating (presenting the data in frequency distribution tables). Data analysis was carried out in two phases. First, univariate analysis was used to describe the characteristics of each research variable in terms of frequency and percentage distributions. Second, bivariate analysis examined the relationship between the independent variables (kitchen utensil cleanliness and food handler hygiene) and the dependent variable (microbial count). Since all variables were categorical (ordinal and nominal scales), the statistical test employed was the Chi-Square test, with a significance level set at p-value < 0.05.

Results

This study involved 30 respondents who were jumbo iced tea vendors operating along Jalan Ayahanda, Medan. The demographic characteristics of respondents and the frequency distribution of research variables are presented in Table 1. The majority of respondents were female (60.0%) and within the productive age range of 21–30 years (60.0%). Most respondents (76.7%) were new vendors who had been selling for 12 months or less, and nearly all (96.7%) worked for more than 8 hours per day.

Table 1. Respondent characteristics and distribution of study variables (n=30)

Characteristic	Category	Frequency (n)	Percentage (%)
Respondent Demographics			
Gender	Male	12	40
	Female	18	60
Age	< 20 years	10	33.3
	21–30 years	18	60
	≥ 30 years	2	6.7
Duration of Trading	≤ 12 months	23	76.7
	> 12 months	7	23.3
Sales Duration	≤ 8 hours	1	3.3
	> 8 hours	29	96.7
Univariate Variables			
Kitchen Utensil Condition	Poor	10	33.3
	Fair	10	33.3
	Good	10	33.3
Food Handler Hygiene	Not Hygienic	11	36.7
	Moderately Hygienic	9	30
	Hygienic	10	33.3
Microbial Count	Present	4	13.3
	Absent	26	86.7

Univariate analysis of the research variables (Table 1) showed an even distribution for the *kitchen utensil* condition variable, with "Poor," "Fair," and "Good" categories each accounting for 10 respondents (33.3%). For the *food handler hygiene* variable, the largest category was "Not Hygienic" (36.7%), followed by "Hygienic" (33.3%) and "Moderately Hygienic" (30.0%). The most critical finding was observed in the dependent variable—*microbial count*. Although the majority of samples (86.7%) showed no detectable microbes, 4 out of 30 samples (13.3%) tested positive for microbial presence.

A bivariate analysis was conducted to examine the relationship between the independent variables (*kitchen utensil condition* and *food handler hygiene*) and the dependent variable (*microbial count*). The results of the Chi-Square test for both variables are summarized in Table 2.

Table 2. Bivariate analysis of the effect of kitchen utensil condition and food handler hygiene on microbial count

Independent Variable	Category	Microbial Count – Present (n, %)	Microbial Count – Absent (n, %)	Total (n)	p-value
Kitchen Utensil Condition	Poor	2 (20.0)	8 (80.0)	10	
	Fair	2 (20.0)	8 (80.0)	10	0.507
	Good	0 (0.0)	10 (100.0)	10	
Food Handler Hygiene	Not Hygienic	4 (36.4)	7 (63.6)	11	
	Moderately Hygienic	0 (0.0)	9 (100.0)	9	0.024
	Hygienic	0 (0.0)	10 (100.0)	10	

The first bivariate analysis (Table 2) indicated no statistically significant association between the cleanliness of kitchen utensils and microbial counts in jumbo iced tea ($p = 0.507$, $p > 0.05$). Although descriptively, no microbial presence was found in the "Good" category of kitchen utensils, the difference was not statistically significant.

Conversely, a statistically significant association was observed in the second variable (Table 2). *Food handler hygiene* was significantly associated with microbial presence ($p = 0.024$). This finding demonstrates that hygiene practices of food handlers have a meaningful impact on microbial contamination in beverages. Specifically, all four cases (36.4%) in which microbial presence was detected originated from respondents classified as "Not Hygienic," whereas no contamination (0%) was observed among the "Moderately Hygienic" and "Hygienic" groups.

Discussion

This study's findings provide critical insights into the microbial safety of jumbo iced tea, a popular street-vended beverage in Medan. The central finding is the statistically significant association between food handler hygiene and the presence of microbes in the iced tea. This result is strongly supported by a large body of research identifying food handlers as a primary vector for microbial contamination in ready-to-eat foods and beverages.

The observation that all contaminated samples (13.3% of the total) originated exclusively from vendors classified as "Not Hygienic" underscores a direct link between personal practices and product safety. This aligns with findings from numerous studies. For instance, a study on street-vended beverages in Kuala Lumpur, Malaysia, also identified improper handling and poor personal hygiene as key contributors to microbial contamination.[16] Similarly, research on street food in Ethiopia highlighted that food handlers with inadequate hygiene training and practices were significantly more likely to vend contaminated food.[17]

The hands of food handlers, in particular, are well-documented sources of pathogens. The fact that 36.7% of vendors in this study were classified as "Not Hygienic" suggests that practices such as infrequent hand washing, handling money and food simultaneously, or using contaminated cloths are likely prevalent. These practices can easily transfer microorganisms like *E. coli* or *Staphylococcus aureus* from the handler directly into the beverage or onto ice and utensils.[18] This study's significant p-value reinforces that interventions targeting personal hygiene are paramount for improving food safety in this sector.

Conversely, this study did not find a statistically significant relationship between the condition of kitchen utensils and microbial count. This finding is somewhat surprising and contrasts with other research, which has identified food contact surfaces and utensils as significant sources of cross-contamination. For example, a study on street-vended milk and fruit juices found that the sanitation status of serving utensils and containers was significantly associated with higher microbial loads.[19] Another study on street vendor hygiene also demonstrated that appropriate utensil sanitation was linked to lower levels of contamination.[20]

Several factors might explain this discrepancy. First, our sample size (n=30) was small, which may have limited the statistical power to detect a real, but smaller, effect. Second, the "Poor," "Fair," and "Good" categorization of utensil condition was evenly distributed (33.3% each), but this visual assessment may not accurately reflect the *microbial* cleanliness. A utensil that appears "Good" could still harbor a biofilm of microorganisms, while one that appears "Poor" (e.g., stained or scratched) might be hygienically safer if recently washed with soap. Descriptively, it is noteworthy that no microbes were detected in the "Good" category, suggesting a potential trend that a larger study might confirm. It is also possible that in this specific context, the direct and immediate contamination from the food handler's hands (a significant finding) is a far more dominant factor, masking the more subtle contribution from utensils.

Conclusion

In conclusion, this study identifies food handler hygiene as the most critical control point for mitigating microbial contamination in street-vended jumbo iced tea on Jalan Ayahanda, Medan. While utensil condition should not be ignored, our findings strongly suggest that interventions must prioritize the vendors themselves. We recommend that local health authorities develop and implement targeted, accessible food safety training programs for street vendors, with a practical emphasis on handwashing protocols and the safe handling of ice. Given the demographic profile, this training should be simple, visually based, and perhaps integrated into the business registration process to capture new vendors.

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