



Microbial and Physicochemical Analysis of Street Vended Fruit Juice in Sagay City, Philippines

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ABSTRACT

This study evaluated the microbial and physicochemical quality of street-vended fruit juices sold in selected barangays of Sagay City and determined their safety for public consumption. Microbial analysis focused on the detection of coliforms, total coliforms, fecal coliforms, and *Escherichia coli* using the Most Probable Number (MPN) standard. Physicochemical parameters analyzed included total soluble solids (TSS), pH, total dissolved solids (TDS), fat, protein, carbohydrate content, and total acidity expressed as citric acid. Samples were collected from various street vendors across the city. Physicochemical analyses were conducted at the Negros Prawn Producers Cooperative Analytical and Diagnostic Laboratory (NPPC), while microbial examinations were performed at the NONESCOST laboratory using the standard multiple-tube fermentation technique based on the Philippine National Standards for Drinking Water. The findings revealed elevated levels of coliform contamination in fruit juice samples obtained from Barangay Old Sagay, Barangay Poblacion 2, and Barangay Paraiso. The presence of high coliform counts indicates possible fecal contamination and suggests that the juices do not meet potable safety standards, posing potential health risks to consumers. In contrast, the physicochemical characteristics of the samples were found to be within acceptable limits and complied with established standards for safe consumption. These results indicate that although the nutritional and chemical properties of the fruit juices were satisfactory, microbial contamination remains a significant concern. The study highlights the need for regular monitoring, stricter sanitary practices, and the implementation of standardized assessment protocols for street-vended fruit juices. Furthermore, the findings serve as valuable information for public health authorities and consumers, particularly tourists, in promoting food safety awareness and reducing the risk of foodborne illnesses.

Keywords: *fruit juice, parameters, MPN*

How to Cite:

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INTRODUCTION

Fruit beverages have gained popularity worldwide as they offer nutritional benefits (Pinto et al. 2022). Fruit juice in moderate amounts can help children and adults meet daily recommendations for fruit consumption and nutrient intake (Lewis *et.al.*, 2009). However, improper preparation of these beverages can pose health risks due to the growth of microbes. These juices provide a source of readily available and affordable source of nutrients to many sectors of the population, including the urban poor. In the Philippines, contaminated ice, dirty water, and improper handling techniques are frequently connected to foodborne illness outbreaks from street-vended fruit juices (Aba et al., 2023). To ensure the protection of public health, manufacturing processes must adhere to significantly stricter guidelines (Ahmed et al. 2018).

Fresh fruit juice is an essential component of the human diet, and there is considerable evidence of health and nutritional benefits. The nature of the fruits used in juicing and unhygienic processes in the value chain may cause poor quality of juice (Nonga *et al.*, 2014). Traditionally, fruit products have been regarded as microbiologically safer than other unprocessed foods. However, many outbreaks of human infections have been associated with the consumption of contaminated fruit juices (Deptt, 2013). Poor sanitation, extraction, raw material contamination, and lack of both proper heat sterilization and adequate quality control during the processing of fruit juice (Nma & Ola, 2013).

Improper washing of fruits adds these bacteria to the extracts, leading to contamination. In addition, the use of unhygienic water for dilution, dressing with ice, prolonged preservation without refrigeration, unhygienic surroundings often with swarming houseflies and fruit flies, and airborne dust can also act as sources of contamination. Such juices are potential sources of bacterial pathogens, notably *E.coli*, species of Salmonella, Shigella, and *Staphylococcus aureus* (Buchmann *et al.*, 1999; Ryu *et al.*, 1998; Uljas *et al.*, 1998; Sandeep *et al.*, 2001), and because vendors lack adequate knowledge of food processing and handling practices (Essien *et al.*, 2011). Therefore, the source and state of hygiene of foods and drinks consumed have health implications. According to (INADA, 2016), contaminated groundwater and inadequate sanitation are major causes of waterborne illnesses among food sellers and communities in Sagay City, Negros Occidental. This study, therefore, investigates the common commercial street-vended fruit juices sold and consumed in public places in Sagay City using physico-chemical analysis and microbiological analysis of common bacterial contaminants of street-vended fruit juice as an index of evaluation using the Philippine National Standards for Drinking Water standard.

OBJECTIVES OF THE STUDY

This study aimed to assess the microbial and physicochemical analysis of street-vended fruit juices in Sagay City. Specifically, this will answer the following:

1. What is the quality of street-vended fruit juice in terms of microbial and physico-chemical parameters?
2. What is the microbial load of ice water used in street-vended fruit juice based on the Philippine National Standards for Drinking Water (PDWS)?

METHODOLOGY

Sample collection

Fruit vended Samples was collected in three selected barangays in Sagay City only. Three vendors were chosen on the basis of sales of at least 50 – 100 glasses of juice/day. Based on the consumer demand, three types of juices were selected for microbial parameters and physicochemical parameters. All freshly vended fruit juice samples (150 ml each) were collected in sterile bottles



and transported to the laboratory in an ice box. Juices were analyzed within an hour of procurement. 150 ml was collected in sterile bottles and transported to the Negros Prawn Laboratory for physicochemical analysis. Table 1 shows the areas of collection of samples in selected barangays in Sagay City with the aid of a geographical positioning system (GPS).

Table 1

Fruit juice samples collected in selected areas in Sagay City

| Geographical Positioning Coordinates | | |
|--------------------------------------|---------------|----------------|
| Areas / Barangays | Latitude | Longitude |
| OLD SAGAY | N10°56'493" | E123°25'334" |
| POBLACION 2 | N10°53'40.24" | E123°24'51.89" |
| PARAISO | N10°53'32.52" | E123°21'21.08" |

Microbial parameters

This will be carried out by inoculating freshly prepared media in a culture tube with the fruit juice samples and incubating at 35 degrees Celsius for 24 hours, checking for any microbiological growth/acid-forming, and using the standard multiple-tube fermentation technique to enumerate positive presumptive, confirmed, and completed tests. The coliform, total coliform, fecal coliform, and *E.coli* was test in the study. This technique gives a most probable number (MPN) of coliforms present in a given sample of street-vended fruit juice in selected areas in Sagay City. Iced water samples were analyzed based on the Philippine National Standards for Drinking Water.

Physicochemical parameters

The collected street-vended fruit juice samples were analyzed for various physico-chemical parameters in Negros Prawn Producers Cooperative Analytical and Diagnostic Laboratory (NPPC), Bacolod City. The parameters were analyzed for pH, total dissolved solids, and total soluble solids. The analysis was based on the Philippine National Standards for Drinking Water. Nutritional properties were identified and analyzed for further investigation.

RESULTS AND DISCUSSION

Microbial analysis

Table 2 presents the results of the microbial analysis of street-vended fruit juice samples collected from selected areas in Sagay City. The findings revealed that samples obtained from Barangay Old Sagay, Barangay Poblacion 2, and Barangay Paraiso tested positive for coliforms, total coliforms, fecal coliforms, and *Escherichia coli* (*E. coli*). The presence of these microbial indicators suggests fecal contamination and poor microbiological quality, rendering the fruit juice samples non-compliant with potable safety standards and unsafe for consumption.

The detection of coliform bacteria and *E. coli* indicates possible contamination during the preparation, handling, storage, or vending processes. Such contamination may be attributed to inadequate sanitation practices, the use of contaminated water or raw materials, improper handling of fruits, and exposure to environmental pollutants during vending. According to Nma and Ola (2013), microbial contamination in fruit juices is often associated with poor sanitary conditions, contamination of raw materials, insect-damaged fruits, insufficient heat treatment, and inadequate quality control measures during processing. Furthermore, Essien et al. (2011) reported that many street food vendors lack sufficient knowledge of proper food processing and handling practices, which increases the likelihood of microbial contamination.

The presence of fecal coliforms and *E. coli* is of particular concern because these microorganisms are recognized indicators of fecal pollution and may signal the presence of other pathogenic organisms capable of causing foodborne illnesses. These findings emphasize the need for improved hygiene practices, proper sanitation measures, regular monitoring of street-vended beverages,



and food safety education programs for vendors to protect consumer health and ensure the microbiological safety of fruit juice products sold in Sagay City.

Table 2

MPN 100/ml Microbial analysis test results

| AREAS | Day | SAMPLES | DATE/TIME | MPN/100 mL | | | | REMARKS |
|--------------------|-----|---------|-------------------|------------|-----|-----|-----|-------------|
| | | | | C | T C | F C | E C | |
| Old Sagay | 1 | BKJ | 6/4/2019 @ 2:15pm | >24 | 16 | 1.1 | <2 | Not Potable |
| | 2 | BKJ | 6/14/19 @ 2 pm | 16 | 16 | 1.4 | <2 | Not Potable |
| | 3 | BKJ | 6/19/19 @2:10pm | >24 | >24 | 1.4 | .2 | Not Potable |
| | 4 | BKJ | 6/26/19 @ 2:18pm | >24 | 16 | 1.1 | <2 | Not Potable |
| Poblacion 2 | 1 | MJ | 6/4/2019 @ 2:35pm | 16 | 16 | .8 | <2 | Not Potable |
| | 2 | PJ | 6/14/19 @ 2:30 pm | 16 | 16 | .8 | <2 | Not Potable |
| | 3 | MJ | 6/19/19 @2:33pm | >24 | 16 | 1.1 | <2 | Not Potable |
| | 4 | WMJ | 6/26/19 @ 2:45pm | >24 | >24 | 1.4 | .2 | Not Potable |
| Paraiso | 1 | MJ | 6/4/2019 @ 3:15pm | 16 | 16 | .8 | <2 | Not Potable |
| | 2 | MJ | 6/14/19 @ 3 pm | 16 | 16 | 1.1 | <2 | Not Potable |
| | 3 | MJ | 6/19/19 @ 3:20pm | >24 | >24 | 1.4 | .2 | Not Potable |
| | 4 | MJ | 6/26/19 @ 3:46pm | >24 | >24 | 1.4 | .2 | Not Potable |

Key terms: *BKJ- Buko Juice, *MJ- Mango Juice, *PJ- Pineapple Juice, WMJ- Water Melon Juice, C- Coliform, TC- Total Coliform, FC- Fecal Coliform, EC- *E. coli*

Iced- water microbial analysis

Table 3 presents the microbial analysis of the ice water used in the preparation of street-vended fruit juices in selected areas of Sagay City. The ice water sample collected from Barangay Old Sagay recorded a value of <2 Most Probable Number (MPN) per 100 mL of sample for coliforms, total coliforms, fecal coliforms, and *Escherichia coli*. Based on the Philippine National Standards for Drinking Water (PNSDW), this result indicates that the water sample met the microbial quality requirements and was considered potable and safe for consumption. The absence of detectable microbial contamination suggests that the water source used in this area was properly maintained and handled.

In contrast, the ice water sample obtained from Barangay Poblacion 2 showed a coliform count of >2 MPN per 100 mL, while the sample from Barangay Paraiso exhibited similar levels of contamination. Although total coliforms, fecal coliforms, and *E. coli* were recorded at >2 MPN per 100 mL, the detection of coliform bacteria indicates possible contamination and raises concerns regarding water quality and sanitary handling practices. According to the PNSDW, drinking water should be free from coliform contamination; therefore, the presence of coliforms in these samples suggests that the ice water does not fully comply with potable water standards.

These findings highlight the importance of ensuring the microbiological safety of water and ice used in fruit juice preparation, as contaminated water can serve as a potential source of microbial contamination, thereby posing health risks to consumers.



Table 3

Ice water microbial test result

| AREAS | Day | SAMPLES | DATE/TIME | MPN/100 mL | | | | REMARKS |
|-------------|-----|---------|-------------------|------------|-----|-----|-----|-------------|
| | | | | C | T C | F C | E C | |
| Old Sagay | 1 | BKJ | 6/4/2019 @ 2:15pm | <2 | <2 | <2 | <2 | Potable |
| | 2 | BKJ | 6/14/19 @ 2 pm | <2 | <2 | <2 | <2 | Potable |
| | 3 | BKJ | 6/19/19 @2:10pm | <2 | <2 | <2 | <2 | Potable |
| | 4 | BKJ | 6/26/19 @ 2:18pm | <2 | <2 | <2 | <2 | Potable |
| Poblacion 2 | 1 | MJ | 6/4/2019 @ 2:35pm | <2 | <2 | <2 | <2 | Potable |
| | 2 | PJ | 6/14/19 @ 2:30 pm | .2 | <2 | <2 | <2 | Not Potable |
| | 3 | MJ | 6/19/19 @2:33pm | <2 | <2 | <2 | <2 | Potable |
| | 4 | WMJ | 6/26/19 @ 2:45pm | <2 | <2 | <2 | <2 | Potable |
| Paraiso | 1 | MJ | 6/4/2019 @ 3:15pm | <2 | <2 | <2 | <2 | Potable |
| | 2 | MJ | 6/14/19 @ 3 pm | .2 | <2 | <2 | <2 | Not Potable |
| | 3 | MJ | 6/19/19 @ 3:20pm | <2 | <2 | <2 | <2 | Potable |
| | 4 | MJ | 6/26/19 @ 3:46pm | <2 | <2 | <2 | <2 | Potable |

Key terms: *BKJ- Buko Juice, *MJ- Mango Juice, *PJ- Pineapple Juice, WMJ- Water Melon Juice, C- Coliform, TC- Total Coliform, FC- Fecal Coliform, EC- *E. coli*
 Physico-chemical analysis

Table 4 presents the physicochemical characteristics of the street-vended fruit juice samples collected from selected areas in Sagay City. The results showed that the measured parameters, including pH, total soluble solids (TSS), and total dissolved solids (TDS), were within the acceptable limits set by the Philippine National Standards for Drinking Water and other relevant food quality standards. The pH values indicated that the fruit juices possessed an appropriate level of acidity, which contributes to product stability and palatability. Similarly, the TSS values reflected the presence of naturally occurring sugars and dissolved substances that influence the taste and overall quality of the juices, while the TDS values remained within acceptable ranges, suggesting good physicochemical quality. These findings indicate that the fruit juice samples met the established physicochemical requirements and were considered safe for consumption based on these parameters.

Table 4

Physic-chemical analysis results

| AREAS | SAMPLES | | | | Remarks |
|-----------|---------|-----|-----|-----|---------|
| Old Sagay | BKJ | BKJ | BKJ | BKJ | |
| pH | 6.9 | 6.5 | 6.7 | 6.4 | Passed |



| | | | | | |
|--------------------|-----|-----|------|------|--------|
| TSD | 8.5 | 11 | 10 | 12.2 | - |
| TDS | 30 | 149 | 152 | 351 | Passed |
| Poblacion 2 | MJ | PJ | MJ | WMJ | |
| pH | 6.6 | 4.4 | 7 | 5.8 | Passed |
| TSD | 8 | 1. | 7.2 | 7.8 | - |
| TDS | 117 | 134 | 112 | 321 | Passed |
| Paraiso | MJ | MJ | MJ | MJ | |
| pH | 6 | 6.4 | 5.7 | 6.7 | Passed |
| TSD | 9.1 | 10 | 12.7 | 12 | - |
| TDS | 133 | 164 | 242 | 239 | Passed |

Key terms: *BKJ- Buko Juice, *MJ- Mango Juice, *PJ- Pineapple Juice, WMJ- Water Melon Juice, TSD- Total Soluble Solids, TDS- Total Dissolved Solids.

Table 5 shows the nutritional composition of the fruit juice samples in terms of fat, protein, carbohydrates, and total acidity expressed as citric acid. Among the analyzed nutrients, carbohydrates constituted the largest proportion, highlighting their role as the primary source of energy for consumers. Proteins were present in smaller amounts. Fat content was relatively low, which is consistent with the nutritional profile of most fruit-based beverages. The presence of citric acid contributes to the characteristic flavor of fruit juices and may help inhibit the growth of certain microorganisms. Overall, the nutritional analysis demonstrates that street-vended fruit juices can serve as a source of energy and essential nutrients.

Table 5

Nutritional value of street-vended fruit juice

| AREAS | SAMPLES | | | |
|--------------------|---------|-----|-------|-------|
| Old Sagay | BKJ | BKJ | BKJ | BKJ |
| Fat | 1.52% | 2% | 1.45% | 2.42% |
| Protein | 3.8% | 30% | 5.6% | 4.4% |
| Carbohydrates | 6.9% | 19% | 17.5% | 12.6% |
| TA | 4.6% | 3% | 3.7% | 1.6% |
| Poblacion 2 | MJ | PJ | MJ | WMJ |
| Fat | 4.6% | 3% | 1.01% | 9% |
| Protein | 3.8% | 5% | 3.8% | 1.9% |
| Carbohydrates | 7.25% | 3% | 12.7% | 7.35% |
| TA | 4.4% | 3% | 2.9% | .8% |



| Paraiso | MJ | MJ | MJ | MJ |
|---------------|-------|------|-------|-------|
| Fat | 1.69% | 1.4% | 9.2% | 1.44% |
| Protein | 5.6% | 4% | 3.8% | 5.6% |
| Carbohydrates | 15.8% | 17% | 19.2% | 10.1% |
| TA | 3.8% | 3% | 3.1% | 1.4% |

Key terms: *BKJ- Buko Juice, *MJ- Mango Juice, *PJ- Pineapple Juice, WMJ- Water Melon Juice, TA- Total Acidity

CONCLUSION

The study concludes that while the physicochemical properties of street-vended fruit juices in Sagay City were within acceptable standards for consumption, their microbial quality raises significant public health concerns. Elevated levels of coliforms, total coliforms, fecal coliforms, and *Escherichia coli* detected in samples from Barangay Old Sagay, Poblacion 2, and Paraiso indicate possible contamination resulting from poor handling practices, inadequate sanitation, or the use of contaminated water during juice preparation. These findings suggest that the fruit juices from these areas do not meet potable safety standards and may pose a risk of foodborne illnesses to consumers.

Therefore, strict adherence to hygienic food preparation practices, regular microbial monitoring, and the establishment of standardized quality assessment protocols are essential to ensure the safety of street-vended fruit juices. Strengthening food safety education among vendors and increasing regulatory oversight can further help reduce contamination risks and protect public health. Overall, the study underscores the importance of comprehensive quality evaluation in safeguarding consumers, particularly residents and tourists who frequently purchase street-vended beverages.

RECOMMENDATIONS

The findings of this study indicate the need to strengthen food safety practices among street-vended fruit juice vendors in Sagay City. Vendors should be provided with training on proper food handling, personal hygiene, and sanitation to reduce the risk of microbial contamination during juice preparation and sale. The use of potable water for washing fruits, preparing juices, and cleaning equipment should be strictly observed to ensure product safety.

Regular monitoring and inspection by local health authorities are necessary to assess compliance with food safety standards and to identify potential sources of contamination. The establishment and implementation of standardized quality assessment protocols for street-vended fruit juices are also recommended to ensure consistent evaluation of both microbial and physicochemical parameters.

Furthermore, public awareness programs should be conducted to educate consumers, particularly tourists and frequent buyers, about the importance of choosing beverages prepared under sanitary conditions. Vendors should also be encouraged to improve their facilities and equipment by maintaining clean work areas, using sanitized utensils, and storing products appropriately to prevent contamination.

Future research should expand the scope of investigation by including a larger number of samples, assessing seasonal variations, and examining additional microbiological indicators to provide a more comprehensive understanding of the safety and quality of street-vended fruit juices. These measures can contribute to improved public health protection and enhance consumer confidence in street-vended beverages.

Conflict of Interest

This article was authored by a member of the journal's editorial/review team. An independent editor handled the manuscript, and external reviewers evaluated it to ensure transparency and avoid conflict of interest.

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