Faculty of Natural and Applied Sciences Journal of Applied Biological Sciences
Print ISSN: 3027-0685, e-ISSN: 3043-6494
www.fnasjournals.com
Volume 2; Issue 3; May 2025; Page No. 84-89.
DOI: https://doi.org/10.63561/jabs.v2i3.936

Microbiological Assessment of Sliced *Carica papaya* (Pawpaw) and *Citrullus lanatus* (Watermelon) Sold in Lafia Metropolis

[*1]Angbalaga, G.A., [1]Akeh, M.A., & [2]Anzene, A.A.
[1]Department of Microbiology, Federal University of Lafia
[2]Department of Science Laboratory Technology, Isa Mustapha Agwai 1 Polytechnic Lafia

***Corresponding author email**: gladysabelkuje@gmail.com

Abstract
Fresh fruits are essential components of a healthy diet due to their high content of vitamins, minerals, and antioxidants. Among these, *Carica papaya* (pawpaw) and *Citrullus lanatus* (watermelon) are particularly valued for their nutritional benefits. This study assessed the microbiological contamination of sliced pawpaw and watermelon sold in Lafia Metropolis using standard microbiological procedures. For *Carica papaya*, total bacterial counts (TBC) ranged from 3.4×10^4 to 3.8×10^4 CFU/g, while total fungal counts (TFC) ranged from 1.9×10^3 to 2.3×10^3 CFU/g. For *Citrullus lanatus*, the TBC ranged from 4.0×10^4 to 4.4×10^4 CFU/g, and the TFC from 2.9×10^3 to 3.2×10^3 CFU/g. A statistically significant association was observed across the variables for both fruits among the selected locations ($p < 0.001$). The bacterial isolates from *Carica papaya* included *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* spp., *Pseudomonas aeruginosa*, and *Bacillus cereus*, while fungal isolates included *Aspergillus niger*, *Penicillium* spp., *Candida* spp., *Fusarium* spp., and *Rhizopus stolonifer*. The bacterial profile of *Citrullus lanatus* was similar, except that *Listeria monocytogenes* was also isolated; fungal isolates were identical to those from *Carica papaya*. These findings highlight the need for stringent hygiene practices during the handling and sale of sliced fruits in Lafia Metropolis to safeguard public health. It is recommended that food regulatory bodies create awareness and educate the public on the health risks associated with consuming such contaminated fruits.

Keywords: *Carica papaya*, *Citrullus lanatus*, Food hygiene, Lafia Metropolis, Microbial Assessment.

Introduction

Fresh fruits are essential components of a healthy diet due to their high content of vitamins, minerals, and antioxidants. Among these fruits, *Carica papaya* (pawpaw) and *Citrullus lanatus* (watermelon) are particularly valued for their nutritional benefits. *Carica papaya* is rich in vitamins A, C, and E, and contains enzymes such as papain, which aid digestion (Jariyah et al., 2020). *Citrullus lanatus*, on the other hand, is a hydrating fruit packed with vitamins A and C, as well as lycopene an antioxidant associated with various health benefits, including a reduced risk of cardiovascular diseases (Perkins-Veazie et al., 2021). In Nigeria, especially in urban areas like Lafia Metropolis, these fruits are commonly sold in sliced form by street vendors (Nwachukwu et al., 2008). While slicing makes the fruits more appealing and convenient for immediate consumption, particularly in hot climates where watermelon's refreshing nature is highly sought after, it also increases the risk of microbial contamination (Bintsis et al., 2021).

Microbiological contamination can occur at various stages, including cultivation, harvesting, transportation, storage, and most critically, during slicing and selling (Abadias et al., 2008). The exposure of sliced fruits to the environment, coupled with improper handling practices, can lead to contamination by a variety of microorganisms,

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including bacteria, fungi, and viruses. This risk is further heightened by factors such as poor hygiene, inadequate sanitation, and the use of contaminated water (Alegbeleye et al., 2018; Sharma et al., 2022).

Several studies have documented the health risks associated with contaminated sliced fruits. For example, *Escherichia coli*, *Salmonella* spp., and *Staphylococcus aureus* common bacterial pathogens found on sliced fruits are linked to foodborne illnesses (Nguyen-The & Carlin, 1994; Sango et al., 2016). Additionally, fungi such as *Aspergillus* spp. and *Penicillium* spp. have been identified, raising concerns about mycotoxin production and associated health hazards (Barth et al., 2009). Given the nutritional importance of fruits, concerns about their microbiological safety are well justified. The safety of pawpaw and watermelon, especially in sliced form, is of particular concern because they are consumed raw, without any cooking process to eliminate microbial contaminants. In Lafia Metropolis, where sliced fruit vending is prevalent, understanding the extent and nature of microbial contamination is crucial for developing public health interventions.

Materials and Methods

Sample collection: Five (5) samples of sliced *Carica papaya* and *Citrullus lanatus* each were collected from five different vending locations in Lafia and were appropriately labelled. The samples were well packaged by the vendor and were transported in ice pack (4 °C) under aseptic conditions to the Microbiology Laboratory at the Federal University of Lafia, where further processing was performed. Sample analysis: 25 grams of sliced *Carica papaya* and *Citrullus lanatus* were weighed and transferred into a sterile blender and 225 mL of sterile saline was added. The mixture was homogenized for 2 minutes to ensure even distribution of microorganisms. After homogenization, serial dilutions were done by transferring 1 mL of the homogenate to 9 mL of sterile diluent in a new sterile tube. Then 0.1 mL of the diluent was poured into Nutrient agar and MacConkey agar then it was incubated at 37 °C for 24hrs. Determination of bacterial load: The pour plate method was used for each sample. A 0.1 mL aliquot of the 10^{-5} dilution was aseptically transferred into a sterile Petri dish. Sterilized molten Nutrient Agar (cooled to approximately 45 °C) was poured aseptically into the dish and gently swirled to ensure even distribution of the sample. The plates were allowed to solidify, then incubated at 37 °C for 24 hours. After incubation, the total bacterial count was determined by counting the colonies formed using a colony counter. The results were expressed as colony-forming units per gram (CFU/g).

Determination of fungal load: The pour plate method was used for fungal enumeration. One milliliter (1 mL) of the stock solution (10^{-1} dilution) was serially diluted, and 0.1 mL of the 10^{-3} dilution was aseptically inoculated into appropriately labeled sterile Petri dishes. Molten Potato Dextrose Agar (PDA), cooled to approximately 45 °C and supplemented with chloramphenicol then, it was poured aseptically into the dishes and gently swirled to ensure even distribution. The plates were incubated at room temperature (25 °C) for 72 hours. After incubation, fungal colonies were counted using a colony counter, and the total fungal load was expressed in colony-forming units per gram (CFU/g) (Cheesbrough, 2006).

Characterization of bacterial isolates: The bacterial isolates were characterized using standard microbiological procedures as described by Cheesbrough (2006). Tests conducted included Gram staining, coagulase test, catalase test, oxidase test, urease test, and motility test.

Characterization of fungal isolates: Fungal isolates were characterized following the method described by Cheesbrough (2006), which involved microscopic examination using the tease mount technique.

Data analysis and presentation: Data from this study were analyzed using the IBM SPSS (version 27). Appropriate statistical analysis was applied to data that are quantitative, while chi-square test was used to ascertain the statistical association between the variables at 95% confidence interval.

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Results

Table 1: Total Bacterial Count in Sliced *Carica papaya* (pawpaw) and *Citrullus lanatus* (watermelon)

Sample code	TBC (x10⁴ CFU/g)	TFC (x10³ CFU/g)
P1	3.6	2.3
P2	3.4	1.9
P3	3.7	2.2
P4	3.8	2.0
P5	3.5	2.1
W1	4.2	3.0
W2	4.0	2.7
W3	4.3	3.2
W4	4.1	2.9
W5	4.4	3.1
P (Mean ± SD)	3.60 ± 0.16	2.10 ± 0.16
W (Mean ± SD)	4.20 ± 0.16	2.98 ± 0.19
p-value (χ^2 test)	< 0.001	< 0.001

P: Pawpaw, **W:** Watermelon, **TBC**: Total Bacterial Count, **TFC**: Total Fungal Count

Table 2: Identification of bacterial isolates from sliced pawpaw (*Carica papaya*) and watermelon *Citrullus lanatus*)

Sample code	Suspected organism	Gram stain	Morphology
P1	*E. coli*	-	Rod-shaped
P2	*S. aureus*	+	Cocci
P3	*B. cereus*	+	Rod-shaped
P4	*P. aeruginosa*	-	Rod-shaped
P5	*Salmonella* spp.	-	Rod-shaped
W1	*E. coli*	-	Rod-shaped
W2	*S. aureus*	+	Cocci
W3	*B. cereus*	+	Rod-shaped
W4	*P. aeruginosa*	-	Rod-shaped
W5	*L. monocytogenes*	+	Rod-shaped

P: Pawpaw**, W**: Watermelon

Table 3: Identification of fungal isolates from sliced pawpaw (*Carica papaya*) and watermelon *Citrullus lanatus*)

Sample code	Fungal species identified	Spore type	Colony morphology
P1	*A. niger*	Conidial	Black, powdery colonies
P2	*Penicillium* spp.	Conidial	Blue-green colonies
P3	*Rhizopus stolonifer*	Sporangial	White, cottony colonies
P4	*Candida* spp.	Blastospore	Creamy, smooth colonies
P5	*Fusarium* spp.	Conidial	Pinkish colonies
W1	*A. niger*	Conidial	Black, powdery colonies
W2	*Penicillium* spp.	Conidial	Blue-green colonies
W3	*Rhizopus stolonifer*	Sporangial	White, cottony colonies
W4	*Candida* spp.	Blastospore	Creamy, smooth colonies
W5	*Fusarium* spp.	Conidial	Pinkish colonies

P: Pawpaw**, W**: watermelon

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Discussion

The microbial assessment of sliced *Carica papaya* and *Citrullus lanatus* sold in Lafia Metropolis revealed notable differences in microbial load and species diversity between the two fruits. The average bacterial load for sliced *Carica papaya* ranged from 3.4×10^4 to 3.8×10^4 CFU/g, whereas *Citrullus lanatus* exhibited a slightly higher range of 4.0×10^4 to 4.4×10^4 CFU/g. The fungal load on *Carica papaya* was 2.1×10^3 CFU/g, while *Citrullus lanatus* recorded 3.0×10^3 CFU/g. These findings align with previous studies reporting higher microbial loads in fruits with greater water content and larger surface areas, such as watermelon, which may promote microbial growth due to its moist environment (Alegbeleye et al., 2018).

The fungal loads in this study (~10^3 CFU/g) are lower than some previous reports (Uzor & Dick, 2022). However, the results differ from those of Olu-Taiwo et al. (2021), who recorded markedly higher bacterial loads in watermelon (2.6×10^5 to 8.1×10^5 CFU/g) compared to pawpaw (~3.7×10^4 CFU/g). Uzor and Dick (2022) also reported significantly higher fungal loads (~1.74×10^8 to 2.35×10^8 CFU/g). These discrepancies may be attributed to factors such as geographic location, vendor hygiene, and sample handling practices. In this study, the observed bacterial loads (~10^4 CFU/g) were lower than those reported for many street-vended produce, but the relative pattern of higher counts in watermelon compared to pawpaw remained consistent. This may reflect better handling practices, reduced fungal proliferation, or differences in sampling conditions.

A Chi-square test revealed a statistically significant association in microbial load (both TBC and TFC) between sliced *Carica papaya* and *Citrullus lanatus* ($p < 0.001$). The suspected bacterial species identified from both fruits included *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, and *Pseudomonas aeruginosa*. These findings are consistent with Abdulkareem and Odeh (2021), who isolated *Escherichia coli*, *Salmonella* spp., *Pseudomonas* spp., *Staphylococcus aureus*, *Shigella* spp., and *Mucor* spp. Similarly, Odebisi-Omokanye et al. (2015) reported the presence of *Shigella* spp. in pre-cut fruits sold in Ilorin, Kwara State. These bacteria are frequently isolated from fruits sold in open environments, where contamination can occur via contact with contaminated surfaces, utensils, and hands (Abadias et al., 2008). The detection of *Listeria monocytogenes* in watermelon is of particular concern due to its ability to cause listeriosis, a serious foodborne illness, especially in immunocompromised individuals (EFSA, 2019).

The fungal species identified included *Aspergillus niger*, *Penicillium* spp., *Rhizopus stolonifer*, *Candida* spp., and *Fusarium* spp. These fungi are commonly associated with fruit spoilage and can pose health risks if ingested, particularly in individuals with weakened immune systems. The presence of *Aspergillus niger* in both fruits is noteworthy, as it can produce mycotoxins that raise significant food safety concerns (Reddy et al., 2010).

Conclusion

The microbiological assessment of sliced *Carica papaya* and *Citrullus lanatus* in Lafia Metropolis revealed that both fruits are susceptible to microbial contamination, with watermelon showing higher levels of bacterial and fungal contamination. The presence of pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Salmonella* spp., and *Listeria monocytogenes*, along with spoilage fungi including *Aspergillus niger*, *Penicillium* spp., and *Fusarium* spp., indicates a potential health risk for consumers, especially since these fruits are consumed raw. A statistically significant association in microbial load was observed between the two fruits, highlighting the influence of factors such as water content, handling practices, and environmental exposure. These findings underscore the urgent need to implement stricter hygiene measures among vendors during processing, handling, and sale to reduce the risk of foodborne illnesses linked to sliced fruit consumption in the area.

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Recommendations

Based on the microbiological assessment of *Carica papaya* and *Citrullus lanatus* sold in Lafia Metropolis, the following are recommended:

1. Vendors should adopt strict hygiene practices during the slicing and handling of fruits to minimize microbial contamination. This includes regular handwashing, using clean and sanitized utensils, and maintaining a hygienic working environment.
2. Local health authorities should carry out regular microbial assessments of fruits sold in markets to ensure compliance with food safety standards and safeguard public health.
3. Vendors should consider refrigeration or other cooling methods to slow microbial growth on sliced fruits, particularly during hot weather conditions.
4. Public awareness campaigns should be implemented to educate consumers on the health risks associated with consuming contaminated sliced fruits and to promote safe handling and storage practices at the point of purchase and consumption.

References

Abadias, M., Usall, J., Anguera, M., Solsona, C., & Vinas, I. (2008). Microbiological quality of fresh, minimally processed fruit and vegetables, and sprouts from retail establishments. *International Journal of Food Microbiology*, 123(1-2), 121−129.

Abdulkareem, T. O., & Odeh, J. E. (2021). Microbial analysis of sliced watermelon, pineapple and pawpaw from five location markets in Ilorin. *Global Scientific Journal, 9*(4), 3003–3014. https://www.globalscientificjournal.com

Alegbeleye, O. O., Singleton, I., & Sant'Ana, A. S. (2018). Sources and contamination routes of microbial pathogens to fresh produce during field cultivation: A review. *Food Microbiology*, 73, 177−208.

Barth, M., Hankinson, T. R., Zhuang, H., & Breidt, F. (2009). Microbiological spoilage of fruits and vegetables. *Compendium of the Microbiological Spoilage of Foods and Beverages*, 135−183. https://doi.org/10.1007/978-1-4419-0826-1_6

Bintsis, T. (2021). Microbial pollution and food safety. *AIMS Microbiology*, 4(3), 377−396. https://doi.org/10.3934/microbiol.2018.3.377

Cheesbrough, M. (2006). *District laboratory practice in tropical countries* (2nd ed., Part 2, pp. 434–438). Cambridge University Press.

European Food Safety Authority. (2019). *Listeria monocytogenes* contamination of ready-to-eat foods and the risk for human health in the EU. *European Food Safety Authority Journal*, 17(1), e05554. https://doi.org/10.2903/j.efsa.2019.5554

Jariyah, R., Kusumaningtyas, E., & Budiono, T. (2020). The potential of papaya (*Carica papaya*) leaves as an anti-dengue herbal remedy: A literature review. *Journal of Health Research*, 34(1), 39−45.

Nguyen-The, C., & Carlin, F. (1994). The microbiology of minimally processed fresh fruits and vegetables. *Critical Reviews in Food Science and Nutrition*, 34(4), 371−401. https://doi.org/10.1080/10408399409527668

Nwachukwu, E., Ezeama, C. F., & Ezeanya, B. N. (2008). Microbiology of polyethylene-packaged sliced watermelon (*Citrullus lanatus*) sold by street vendors in Nigeria. *African Journal of Microbiology Research*, 2(8), 192−195.

Odebisi-Omokanye, M. B., Oke, M. A., Ahmed El-Imam, A. M., Ajijolakewu, A. K. & Salaudeen, B. I. (2015). Microbiological Quality and Safety of pre-cut fruit retailed in Ilorin, Kwara State, Nigeria. *Fountain Journal of Natural and Applied Sciences*, 4(1), 19 – 26.

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Olu-Taiwo, M., De-Graft, B. M., & Forson, A. O. (2021). Microbial quality of sliced pawpaw (*Carica papaya*) and watermelon (*Citrullus lanatus*) sold on some streets of Accra Metropolis, Ghana. *International Journal of Microbiology, 2021*, Article 6695957. https://doi.org/10.1155/2021/6695957

Perkins-Veazie, P., Collins, J. K., & Davis, A. R. (2021). Watermelon consumption increases plasma arginine concentrations in adults. *Nutrients*, 13(8), 2874.

Reddy, K. R. N., Reddy, C. S., & Muralidharan, K. (2010). Detection of *Aspergillus* spp. and aflatoxin B1 in rice in India. *Food Microbiology*, 27(1), 30−34.

Sango, D. M., Abuga, R. O., & Obonyo, M. (2016). Microbial quality and safety of fresh fruits and vegetables: The Kenyan perspective. *African Journal of Food Science*, 10(8), 162−170. https://doi.org/10.5897/AJFS2015.1468

Sharma, M., Lakshmanan, S., Rice, E. W., & Bae, J. (2022). Sources of microbiological contamination of fresh produce: Implications for research and education on agricultural best practices. *Critical Reviews in Food Science and Nutrition*, 62(4), 769−784. https://doi.org/10.1080/10408398.2020.1818076

Uzor, C. A., & Dick, A. A. (2022). Bacteriological assessment of sliced fruits (pawpaw, pineapple and watermelon) sold in Rumuokwuta Market. *Direct Research Journal of Agriculture and Food Science, 10*(5), 126–130. https://doi.org/10.26765/DRJAFS11832443

Cite this article as:
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