



(RESEARCH ARTICLE)



## Detection and isolation of bacteria from the lid of some selected canned drinks from retail shops sold at plateau state polytechnic Barkin Ladi Heipang campus

Dasat G. S. <sup>1,\*</sup>, Kum F.O. <sup>2</sup>, Dayok O. <sup>2</sup> and Akunde J. G. <sup>2</sup>

<sup>1</sup> Department of Food Science Technology, Plateau State Polytechnic Barkin Ladi, Nigeria.

<sup>2</sup> Department of Science, Plateau State Polytechnic Barkin Ladi, Nigeria.

GSC Biological and Pharmaceutical Sciences, 2022, 20(03), 330–335

Publication history: Received on 16 August 2022; revised on 22 September 2022; accepted on 24 September 2022

Article DOI: <https://doi.org/10.30574/gscbps.2022.20.3.0365>

### Abstract

Beverages in aluminium cans are widely available, and for convenience, drinks are often consumed directly from the orifice of the can. Cans are exposed to various environments during production, storage, transportation and handling at retail shops during which the lid may be contaminated with microorganisms. This study was aimed at isolating and identifying bacteria from the surfaces of canned drinks offered for sale on the main campus of Plateau State Polytechnic Barkin Ladi. For this purpose, a total of fifty canned drinks were randomly purchased from five different kiosks/ shops for laboratory investigations. Results of analyses indicated that all the canned drinks examined were contaminated with various microorganisms representing a 100% contamination rate. The highest bacterial count was recorded in shops 5 and 9 where the cells were too numerous to be counted (TNC) and were closely followed by shop 8 which had 162 colony-forming units of bacterial count on the colony counter. The shop with the least bacterial count was shop no 10 which had 47 bacterial counts per 100 ml. The biochemical test indicated the presence of *Escherichia coli*, *Streptococcus spp*, *Bacillus spp* and *Staphylococcus aureus* on the surfaces of the cans. These organisms are of significant public health risk once ingested from any contaminated surface. It is therefore recommended that proper cleaning of surfaces of canned drinks should be done before consumption to safeguard the health of consumers.

**Keywords:** Canned drink; Contamination; Orifice; Investigation

### 1. Introduction

Commercial non-alcoholic beverages such as canned and bottled energy drinks, juice and water are currently gaining popularity in the food industry. They are usually processed and transported to consumers under different handling conditions and could be consumed by many with little or no regard to the sentry condition of the orifice or opening of the can [1].

Dawson *et al.* (2018) [2] posited that microbial attachment to surfaces is one of the commonest ways of transmission of pathogenic organisms in the food processing industry, catering and the domestic environment, consequently, contaminations can be an intermediate step in the transmission of pathogens from their original habitat in the environment to food contact surfaces.

Consequently, [3] Abraham *et al.* (2018) noted that contamination of canned drinks surface can occur anywhere including the environment where it was manufactured to the point of storage in the refrigerator as well as the point of consumption at retail outlets. Moreover studies have shown that certain bacterial and fungal species of public health concern can survive refrigeration temperature [4].

\* Corresponding author: Dasat G. S.

Department of Food Science Technology, Plateau State Polytechnic Barkin Ladi, Nigeria.

Abraham *et al.* (2018) and Fekete, (2018) [3, 5] posited that several studies have shown that microbes have been able to colonize surfaces of inanimate objects such as beverage packages and other items used to consume beverages. Therefore, [6, 7] reported that some microorganisms present on the surface of beverage cans, may not cause diseases directly, but could be an opportunistic pathogen once ingested into the human body and may cause serious diseases such as respiratory and urinary tract infections, and tuberculosis among others.

Kigigha and Jonathan (2012) [8] reported the recovery of bacterial pathogens of public health significance including *Staphylococcus*, *Bacillus*, *Enterococcus*, *Micrococcus* *Proteus* and *Pseudomonas* species from the surfaces of non-alcoholic carbonated beverage packages.

The urine of small mammals such as rats and mice can be easily deposited on surfaces of canned drinks in storage facilities in retail shops and could be a source of transmission of several diseases, including *leptospirosis*. Furthermore, insects like cockroaches and flies can deposit their eggs and faeces which could contain pathogenic bacteria on the surfaces of canned drinks. Therefore, the lids of canned drinks could contain small traces of insect droppings which could go unnoticed, and one could risk having them drop into other food materials. In addition, some insects, like flies, are transmitters of more than 60 diseases, including typhoid, cholera, and polio [4,9].

The World Health Organization (2000) [10] stated that bugs are common spreaders of diseases like dysentery, gastroenteritis, diarrhoea, typhoid, gangrene, and leprosy and that the best way to avoid these is to wash can lids with soap and water before opening them. Moreover, the [11, 12] stated that Lassa fever which is an acute viral hemorrhagic illness of 2-21 days duration that occurs mostly in West Africa can be spread through the urine and faeces of rodents and could be easily deposited on surfaces of canned drinks.

Another source of potential contamination of surfaces of canned drinks could be dust and dirt from the surrounding environment, transportation and handling at the point of sales or even contaminated hands of both sales personnel and consumers [13, 14].

Kregiel, (2015) reported that soft drink consumption is still a controversial issue for public health and public policy. Nevertheless, [15, 16] reported some deaths due to leptospirosis which was traced to the consumption of contaminated food and drinks.

Most people on campuses rush for canned drinks because of their availability and ready-to-drink nature hence there is a high level of consumption of canned drinks directly from the orifice. This investigation was, therefore, aimed at determining the level of microbial contamination of the external top surfaces or orifice of beverage canned drinks sold in shops and kiosks within the main campus of Plateau State Polytechnic Barkin Ladi and also to determine the public health risk implication of consuming canned drinks directly from the orifice without proper washing.

---

## 2. Methodology

### 2.1. Study Area

All samples for these investigations were purchased from shops/kiosks in the main Campus of the Plateau State Polytechnic Barkin Ladi (Lat.390 39'58.308" E, long. 8052'54.588" and lat.9039'59.43N, long. 8052'56.58")

### 2.2. Sample Collection and Processing

A total of fifty (50) samples comprising five from 10 shops/kiosks were randomly purchased basically to determine the level of bacterial contaminants on the surfaces of the cans. Therefore, Ten (10) canned samples were also purchased, one from each shop and cleaned thoroughly with sterile water and were used as control during the investigations. All samples were labelled accordingly, placed in the polythene bag and transported to the Microbiology laboratory of Plateau State Polytechnic, Barkin Ladi for analysis immediately.

### 2.3. Laboratory Analysis

All agar media were prepared according to the manufacturer's instructions and all-glass wares were sterilised in the autoclave at 121 °C. Twenty (20) ml of sterile nutrient agar was dispensed into sterile plates and allowed to set.

A sterile swap sticks previously soaked in sterile water was used to clean the orifice of the cans which usually come into direct contact with the mouth when drinking. This was then directly inoculated into the media by streaking and

incubated for 24-48 hours at 37°C. Swabs from controlled samples were also inoculated and incubated accordingly. Results obtained from positive plates were recorded accordingly and viable colonies were counted on the colony counter and further subjected to Gram staining reaction and other biochemical tests including motility, catalase, oxidase, citrate and urease [17].

#### 2.4. Statistical Analysis

Significant differences in the parameters were tested using one-way ANOVA. All statistical tests were performed using IBM SPSS v22 (IBM Corporation, New York, USA). Differences were considered significant at  $P < 0.05$ .

### 3. Results

Results of analyses indicated that the surfaces of the canned drinks sold on the main campus of Plateau State Polytechnic Barkin Ladi main Campus were contaminated as indicated in Table 1 below. The orifice of the 50 canned drinks obtained from 10 shops/kiosks were all contaminated with different microorganisms representing a 100% contamination level raising public health concerns. The differences in the level of contamination among the shops were, however, significant ( $P < 0.05$ ).

**Table 1** Viable Colony Counts from Lids of Canned Drinks after 48 hours of Incubation

Shop/kiosk	No of cans examined	No of cans contaminated	Average number of colonies detected	Remarks
1	5	5	140	Contaminated
2	5	5	50	Contaminated
3	5	5	160	Contaminated
4	5	5	120	Contaminated
5	5	5	TNC	Contaminated
6	5	5	160	Contaminated
7	5	5	50	Contaminated
8	5	5	162	Contaminated
9	5	5	TNC	Contaminated
10	5	5	47	Contaminated
Control sample	10	NIL	NGD	Sterile

Key= NGD- No growth detected, TNC -Too numerous to count

**Table 2** Biochemical Reaction of Bacterial Isolates

Bacterial Isolates	Biochemical reaction						
	Gram Reaction	Motility	catalase	oxidase	Indole	Citrate	Urease
<i>Escherichia coli</i>	- IVE	M	+	-	+	+	-
<i>Staph. aureus</i>	+IVE	NM	+	-	-	+	+
<i>Bacillus sp</i>	+IVE	M	+	variable	-	+	-
<i>Streptococcus sp</i>	+IVE	NM	-	-	+	-	-
<i>Pseudomonas sp</i>	-IVE	M	+	+	-	+	-

Key. -ive = negative, +ive = positive, M = motile, NM = non motile

---

#### 4. Discussion

This investigation revealed that the orifice or surfaces of canned drinks can be easily contaminated regardless of where ever they are kept in the retail shops/kiosks as indicated in Table 1. This finding is, therefore, in agreement with the works of [3,17]. Otu-Bassey *et al.* (2017) and the FDA (2015) [18,19] reported the isolation of certain microorganisms from surfaces of canned drinks from kiosks and shops. Furthermore, [20,21] stated that most Gram-positive bacteria, such as *Staphylococcus aureus* and *Enterococcus* can contaminate the inanimate environment and can survive for months on such surfaces, therefore, their submission agrees with the results obtained from this study as three out of five bacterial isolates were Gram positives.

The isolated organisms from the biochemical test (Table 2) in this study were identified to be *Streptococcus sp*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and members of the spore-forming *Bacillus* genus. Lovet and Jonathan, (2012), and Kusumaningrum *et al.* (2002) [22,13] posited that some of these isolated pathogens can survive on sponges, surfaces of stainless-steel materials and hands among others for several days and weeks after initial contact.

Therefore, results obtained from this investigation show that samples purchased from the 10 different shops were all contaminated with various microorganisms. Out of the 50 samples analysed all were found to be contaminated representing a 100 percent level of contamination.

Several studies indicate that [3, 13, 23] some bacteria, such as *E. coli*, *S. aureus* and *Pseudomonas aeruginosa* may contaminate external surfaces of beverage packaging materials, sponges, hands among others either directly or indirectly through droplets in aerosols or dust and could survive for several days after contact.

Other commonly occurring bacteria like *Escherichia coli* have been implicated with diarrhea; and could get to the surfaces of canned drinks either through food products such as vegetables stored in the refrigerator or as a result of vendor's poor personal hygiene practices [24]. *Escherichia coli* is generally regarded as an indicator of faecal contamination suggesting that its presence on canned drink orifices implies that some storage facilities such as refrigerator internal surfaces could be contaminated by the import of contaminated raw foods or by poor personal hygiene [25,3,26].

*Bacillus sp* produces endospores that allow its survival in extreme environmental conditions including heat and desiccation. *Pseudomonas aeruginosa* occurs through contaminated hands, contaminated soils and environmental surfaces. Its presence on the surface of canned drinks could be attributed to unhygienic storage facilities or the environment [27]. It is common practice in most of the kiosks within the study area to refrigerate canned drinks alongside another food item such as vegetables due to incessant power supply [3,26].

A survey of the retail shops on the main campus of the Polytechnic reveals that shops 2, 7 and 10 had better storage facilities such as clean shelves and the refrigerators well-kept and a much cleaner environment compared to others. The environment in shops number 5 and 9 are best described as unkept implying that the cleanliness of the shop environment could likely be one of the contributing factors in the contamination of the canned drink surfaces.

Some medical experts reported from the popular TV show programme 'The Doctors' that outcome of laboratory investigations conducted on the tops of aluminium beverage cans collected from gas stations, vending machines, and grocery stores reveals that though most came up clean, however, some from the groceries were positive for *E. coli*, which can cause diarrhea, respiratory illness, and pneumonia [28,29].

The general public believed that drinking directly from the orifice of canned drinks is safe, more so, advertisements for soft drinks in both electronic and print media suggest that such drinks are 'best served cold or chilled' thus most consumers do not take cleaning the canned drink surfaces seriously before consumption while others are under the assumption and impression that once it is brought out of the refrigerator cold or chilled, it is safe for consumption. It is, therefore, the view of these researchers that the consumption of canned drinks without cleaning the surface could place consumers at health risk.

---

#### 5. Conclusion

Results obtained from this investigation suggest that surfaces of canned drinks sold on the main campus of Plateau State Polytechnic Barkin Ladi have been found to harbour multiple bacterial pathogens which could be of public health risk

to consumers once consumed without cleaning the orifice. Rinsing of surfaces of canned drinks with either sterile wipes or washing with potable water could greatly reduce the level of contamination as all controlled samples in these investigations were found to be free of bacterial contamination. It is therefore important to ensure that the surfaces of canned drinks are cleaned with potable water or wiped with sterile pads before consumption to reduce the risk of infection due to bacterial pathogens.

---

## Compliance with ethical standard

### *Acknowledgments*

The authors wish to acknowledge the kind cooperation of shops/kiosks owners in the main campus of the Polytechnic Barkin Ladi for their understanding during the collection of samples and inspection of their facilities. The assistance rendered by the Chief Technologist and supporting staff of the Microbiology Laboratory of Plateau State Polytechnic, Barkin Ladi is highly appreciated.

### *Disclosure of conflict of interest*

It is the view of the authors of this investigation that they have no known competing financial interests or personal relationships that could have appeared to influence the outcome of the work as reported in this paper.

---

## References

- [1] Adem, H. & Muktar, Y. Levels of Microbial Contamination in non-alcoholic beverages from selected eastern Ethiopian towns markets. *Scientific African*. 2020. e00223.
- [2] Dawson, P., Aljeddawi, W., Buyukyavuz, A., Han, I & Martinez-Dawson, R. Bacteria on can lids. *Journal of Food Microbiology, Safety & Hygiene*. 2018. 53(3):3-12.
- [3] Abraham, O. G., Bello, O., Idowu, O. Aduba, U. B, Ighodaro, E. V. &, Emoghene, O. A. Qualitative detection and isolation of bacteria from surfaces of canned drinks Sold in Ugbor, Benin City. *Annals of Science and Technology* 2018, 3 (2): 20-25.
- [4] Gündüz, G. T., Korkmaz, A., Emenli, I., & Öztürk, Z. Assessment of hygienic quality of beverage cans surfaces with and without protective cover. *Turkish Journal of Agriculture - Food Science and Technology*, 2019, 7(1): 61-67.
- [5] Fekete, M. Oral ingestion of infectious antigens through beverage cans surface contamination. *MOJ Public Health*. 2018, 7(1):1-3. DOI: 10.15406/mojph.2018.07.00194
- [6] Akond, M. A., Alams, S., Hassan, S.M.R., Mubassara, S., Uddin, S. N. & Shirin, M. Bacteria contaminants in carbonated soft drinks sold in Bangladesh Markets. *Int. Jn Food Micro*. 2009, 130 (2): 156-158.
- [7] Kuda, T., Shibata, G., Takahashi, H. & Kimura, B. Effect of quantity of food residues on resistance to dessication of food-related pathogens adhered to a stainless-steel surface. *Food Microbiology*, 2015. 46: 234-238.
- [8] Kigigha, L.T. & Jonathan, G. Microbiological assessment of opened soft drink bottles for pathogenic bacteria associated with drinking directly from the orifice. *Cont. J. Microbiol.*, 2012. 6: (1), 26-32.
- [9] World Health Organization. WHO Lassa fever fact sheet No 179. Geneva: WHO, 2000
- [10] NCDC Weekly Epidemiological Report Nigeria: Lassa fever - Emergency Plan of Action Final Report, DREF Operation. 2021, (12): 1-14
- [11] Richmond, J. K. & Baglole, D. J. Lassa fever: epidemiology, clinical features, and social consequences. *BMJ*; 2003. 327(7426):1271-1275.
- [12] Kusumaningrum, H. D., Riboldi, G., Hazeleger, W. C. & Beumer, R. R. Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. *International Journal of Food Microbiology*. 2003. (3) :85227-236
- [13] Simoes, M., Simoes, L. C. & Vieirab, M.J. A review of current and emergent biofilm control strategies. *LWT-Food Science and Technology*. 2010. (4): 43,573-583.
- [14] Valero, A., Ortiz, J.C, Fongaro, G., Hernandez, M. Definition of sampling producers for collective-eating establishments based on the distribution of environmental microbiological contamination on food handlers, utensils and surface. *Food Control*. 2017. 77:(1), 8-16.

- [15] Kregiel, D. Health Safety of Soft Drinks: Contents, Containers, and Microorganisms. *BioMed Research International*, 2015. 10: (1) 1-5
- [16] Gompf, S.G., Velez, A.P., Green-Mckenzie, J., Jezior, M.R., Mileno, M.D., Morris, J.T., Centers for Disease Control and Prevention (CDC), *Leptospirosis*. 2017. 3:(2), 20-25
- [17] Chesbrough. M. *Medical Laboratory Manual for Developing Countries*. Vol.1. Butterworth-Heinenman, Germany. 2000.
- [18] Otu-Bassey, I. B., Ewaoche, I. S., Okon, F. B. & Ibor, U. A. Microbial Contamination of House Hold Refrigerators in Calabar Metropolis-Nigeria. *Am. J. Epidem. Infect. Dis.*, 2017, 51:(2), 1-7
- [19] Food and Drug Administration (FDA). Consumers refrigerator thermometer: Cold Facts about food safety. 2015 <http://www.fda.gov/food/Resources>
- [20] Chitanand, M.P., Kadam, T.A., Gyananath, G., Totewad, N. D. & Balhal, D.K., Multiple antibiotic resistance indexing of coliforms to identify high risk contamination sites in aquatic environment. *Ind. J. Microbiol.*, 2010, 50:(2), 216–220.
- [21] Ekrami, A.R., Kayedani, A., Jahangir, M., Kalantar, E. and Jalali, M. Isolation of common aerobic bacterial pathogens from the environment of seven hospitals, Ahvaz, Iran. *Jundishapur J. Microbiol.*, 2010, 42(5):75-82
- [22] Lovet, T. K. & Jonathan, G. Microbiological Assessment of Opened Soft Drink Bottles for Pathogenic Bacteria Associated with Drinking Directly from The Orifice. *Continental J. Microbiology*, 2012, 6 (1): 26 – 32.
- [23] Dantas, S. T., Da Silva, N. & Dantas, F.B.H. External Microbiological Contamination of beverage packaging. *Brazilian Journal of Food Technology*. 2006. 9(3): 193-199.
- [24] Cunningham, A. E., Rajagopal, R., Lauer, J. & Allwood, P. Assessment of hygienic quality of surfaces in retail food service establishments based on microbial counts and real-time detection of ATP. *J Food Prot*, 2011, 74(4): 686-690.
- [25] Othman, A.S. Isolation and microbiological identification of bacterial contaminants in food and household surfaces: how to deal safely. *Egypt. Pharm. J.*, 2015, 14 (2): 50–55
- [26] Osuntokun, O.T., Thonda, A., Akele, E. O, Adedokun, L. O, Adebayo, S. A & Bello, O. A. Pathogenic Bacteria Found on Surfaces of Canned Drinks and Wines Being Sold in Retail Shops in Ondo state, Nigeria, Health Implications, Food Safety and Quality Assessment. *South Asian Journal of Parasitology* 2021, 5(4): 68-94.
- [27] Davis, R. & Brown, P. D. Multiple antibiotic resistance index, fitness and virulence potential in respiratory *Pseudomonas aeruginosa* from Jamaica. *J. Med. Microbiol.*, 2016, 65 (12): 261–271
- [28] <https://www.eatthis.com/reason-you-should-never-drink-directly-from-can>. Accessed on 24/4/2022
- [29] Noel, G. J., Peterson, C.K., Shoff, W.H., Talavera, F., Tailor, J.P. & Windle, M.L., *Leptospirosis* 2017. *Annals of Science and Technology*, 3(2), 20-25.