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# Microbial quality and safety of ready-to-eat street-vended foods sold in selected locations in Kenya

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## ABSTRACT

**Objectives:** Street-vended foods (SVFs) are a major contributor to foodborne diseases, especially in developing countries, where their sale is largely uncontrolled. Foodborne diseases have often been linked to high morbidity and mortality in some developing countries such as Kenya, demonstrating their public health and societal significance. The objective of this study was to determine the microbial quality and safety of ready-to-eat (RTE) foods sold in selected locations within Thika town in Kiambu County, Kenya.

**Material and Methods:** A total of 199 food samples consisting of cereals, sliced fruits, salads, groundnuts, tubers, fruit juices, boiled deshelled eggs, smokies, and sausages were randomly collected for microbial analysis. Determination of total viable count (TVC), total coliform count (TCC), yeast and molds count (YMC), *Escherichia coli* counts, *Staphylococcus aureus* counts as well as the presence of *Salmonella* spp., and *Listeria monocytogenes* were determined following standard microbiological methods.

**Results:** Results revealed that plant-based foods had significantly ($P < 0.01$) higher TVC, TCC, YMC, and *S. aureus* counts compared to animal-based foods. The levels of TVC, TCC, YMC, *E. coli,* and *S. aureus* ranged from 6.590 ± 1.020 to 3.377 ± 1.764, 5.567 ± 2.233 to 1.594 ± 2.299, 5.052 ± 1.201 to 1.595 ± 2.146, 2.033 ± 1.229 to 0.000 ± 0.000, and 5.972 ± 1.170 to 1.888 ± 1.660 $Log_{10}$ CFU/g, respectively. At least nine food samples were contaminated with *E. coli* although the chance for contamination was significantly ($P = 0.0002$) higher (15 times) in plant-based foods compared to animal-based foods. At least one sample in each food type was contaminated with *S. aureus* with contamination levels above 1.888 ± 1.660 $Log_{10}$ CFU/g. *Salmonella* spp. was only detected in boiled arrowroots (25%), boiled deshelled eggs (5.6%), French fries (5.6%), juices (5.0%), and cereals (11.1%), while *L. monocytogenes* were not detected in any food sample.

**Conclusion:** These findings demonstrate that RTE SVFs sold in this region constitute a potential health hazard to consumers because of the presence of *Salmonella* spp., and high counts of *E. coli* and *S. aureus*. These foods are, therefore, microbiologically unsafe and unsuitable for human consumption as they may cause foodborne disease outbreaks.

**Keywords:** Food Safety, Hygiene, Microbial contamination, Pathogenic microorganisms, Ready-to-eat foods, Street-vended foods

## INTRODUCTION

Street-vended foods (SVFs) are ready-to-eat (RTE) foods and beverages that are mostly sold and sometimes prepared by vendors in streets and other public places. They are usually bought by consumers for immediate consumption or consumption at a later time without any further preparation or processing.[1] The vast growing urban population in the developing countries

has stimulated a rise in the number of street food vendors (SFVs) in many cities to satisfy the demand for affordable and accessible RTE meals. Street food currently offers millions of people a wide range of food products that are cheap, convenient, and easily accessible daily.[2] In addition, they offer the chance for self-employment with low capital investment and provide nutrition for many people in the developing world.[2,3] They have also been identified as suitable channels for food fortification.

Contrary to these potential benefits, the conditions for preparation, processing, preservation, and distribution of SVFs do not always ensure the necessary hygiene, quality, and safety standards.[4] Vendors often use inefficient vending structures, lacking running water, waste management systems, and accessible toilets. In many cases, hand washing before handling food or after handling money does not occur and safe storage temperatures for food are hardly maintained.[5] There is a great variation in terms of ingredients used, processing, marketing methods, and consumption of SVFs between countries and cultures. This diversity represents the increasing difficulty in ensuring the safety of SVFs.[2]

The microbial quality and safety of SVFs are always uncertain. Microbiological analyses of SVFs across different countries suggest a high number of bacteria and a heightened risk of foodborne bacterial pathogens.[6] For instance, in Bharatpur, Nepal, a study on SVFs revealed contamination with 13 different bacterial species including *Salmonella* Typhi, *Salmonella* Paratyphi, *Bacillus cereus,* and *Staphylococcus aureus*.[7] In Benin city, Nigeria, Isara and Osagie[8] reported that poor handling practices among SFVs resulted in contamination with coliforms as well as *S. aureus* while in Kenya, Kariuki and Waithera Ng'ang'a[9] reported *Escherichia coli* and *Klebsiella pneumoniae* in a sample of boiled egg with a raw vegetable salad sold on the streets in Githurai and Gikomba markets. A major contributor to the spread of foodborne diseases in most developing countries is microbiologically contaminated street foods which often result in high morbidities and mortalities. However, in developing countries such as Kenya where street food vending is common, there is generally a lack of information on the incidence and prevalence of foodborne diseases linked to SVFs. Furthermore, information on the microbiological safety and quality of SVFs is scanty.

Considering the prevailing burden of infectious diseases, particularly in developing countries, the microbiological profile of these SVFs should be continuously assessed to increase awareness and prevent the occurrence of diseases associated with the ingestion of contaminated foods. Therefore, this study aimed at determining the microbial quality and safety of RTE SVFs sold in selected locations within Thika town, Kiambu County, Kenya. SVFs are common across Kenya and the results from this study may apply to other towns as well.

## MATERIAL AND METHODS

### Experimental design and study area

A cross-sectional study was conducted between September 2020 and February 2021 in six locations where street vending activities are high in Thika town, Kiambu County, Kenya. These areas included the area around Thika Level 5 Hospital, Juakali area, Kiandutu slums, Makongeni area, Ngoigwa area, and Thika Town center.

### Sampling of SVFs

Sampling was done for all food samples offered for sale by randomly selecting SFVs. Three samples of the same food type were obtained from each location for analysis. Between 200 and 300 g of each food, a sample was collected and bagged in a sterile 500 g plastic ziplock sample bag. Samples were immediately transferred into a cool box (4°C) for transportation to the laboratory for analysis. All analyses were carried out in the microbiology laboratory in the Department of Animal Science at Chuka University.

### Microbial analysis

#### *Sample preparation for microbial analysis*

Microbiological media were prepared according to the manufacturer's instructions. All microbiological media and supplements used in this study were manufactured by HiMedia Laboratories, India, except blood agar (Techno Pharmchem, India) and plate count agar (Titan Biotech Ltd.). A 25 g sample from each food was blended in 225 mL of peptone water and homogenized in a sterilized laboratory blender. Ten-fold serial dilutions were then prepared for subsequent microbial analysis. All microbiological analyses followed the methods outlined in the FDA bacteriological analytical manual.[10]

#### *Determination of total viable counts (TVC)*

From the diluted samples, 1 mL was poured plated on plate count agar in duplicate. Incubation was done at 35°C for 48 h after which all visible colonies were counted and recorded as the number of colony-forming units per gram (CFU/g).

#### *Determination of yeasts and mold counts*

From the diluted samples, 1 mL was pour plated onto chloramphenicol yeast extract agar in duplicate. Incubation of inoculated plates was done at 25°C for 5 days. Molds and yeasts were then counted and recorded as CFU/g.

### *Determination of total coliform count (TCC) and E. coli*

One milliliter of each diluted sample was poured plated onto violet-red bile agar in duplicate and incubated at 35°C for 24 h. Purple-red colonies that were 0.5 mm or larger in diameter and surrounded by a zone of precipitated bile acids were counted. To confirm coliforms, 10 representative colonies were transferred to a sterile brilliant green lactose broth tube containing Durham tubes and incubated at 35°C for 24 h. Gas positive tubes showing a pellicle were subjected to Gram staining to eliminate Gram-positive, lactose-fermenting bacilli. The coliform count was reported as the number of coliforms per gram. Determination of *E. coli* was done using tryptone-bile-glucuronide (TBX) agar as described by Vergine and Salerno.[11] Confirmation was done through the determination of the presence of cytochrome oxidase, the ability to ferment lactose, and the production of indole. In addition, the Voges–Proskauer test, methyl red test, and citrate test were done.

### *Detection and enumeration of S. aureus*

From each diluted sample, 1 mL was poured plated onto Baird-Parker agar containing egg-yolk tellurite emulsion in duplicate. Plates were incubated at 37°C for 48 h. Grayblack shiny convex colonies surrounded by a zone of clearing, typical of *S. aureus* were subjected to the coagulase test for confirmation. Results were reported as the number of CFU of S. aureus/g of food.

### *Detection and identification of Salmonella spp*.

Pre-enrichment was done using a 25 g sample in 225 mL buffered peptone water followed by incubation at 37°C for 18 h. Afterward, enrichment was done by transferring 1 mL of pre-enrichment media into Rappaport-Vassiliadis media and incubated at 42°C for 24 h. After enrichment, culturing was done by streaking onto xylose lysine deoxycholate agar and incubating at 37°C for 24 h. Suspect colonies (red colonies with black centers) were tested for fermentation of glucose, decarboxylation of lysine, and $H_2S$ production using Triple sugar iron agar and lysine iron agar. Hydrolysis of urea was tested using urea agar containing urea 40% FD048 supplement while citrate hydrolysis was determined using Simon's citrate agar. In addition, the Voges–Proskauer test, 0.5% dulcitol fermentation test, indole test, as well as methyl red test were also carried out.

### *Detection and identification of Listeria monocytogenes*

A 25 g representative food sample was obtained and mixed in a laboratory blender with 225 mL buffered *Listeria* enrichment broth, modified (mBLEB). All samples were incubated at 30°C for 48 h. After enrichment, streaking was done onto modified *Listeria* Oxford agar containing *Listeria* selective Supplement II, modified (FD163) and incubated at 30°C for 48 h. Identification of *L. monocytogenes* was done after streaking purified colonies onto trypticase soy agar with 0.6% yeast extract (TSAYE). Colonies from TSAYE were inoculated onto 5% sheep blood agar by stabbing thickly poured plates that were dried well to perform the hemolysis test. Incubation was then done for 24 h at 35°C. In addition, Gram staining, motility test, catalase test, and carbohydrate fermentation tests using dextrose, maltose, mannitol, rhamnose, and xylose were carried out.

### Data analysis

Data were analyzed using statistical analysis system version 9.4 to perform analysis of variance and means separated using Tukey's honestly significant difference test. Significance was established at $P < 0.05$ level. Prevalence was reported as a percentage of positive samples. Results were reported as mean ± standard deviation $\log_{10}$ CFU/g for all SVF samples.

## RESULTS AND DISCUSSION

### Determination of TVC

There were highly significant differences ($P < 0.0001$) in TVC between the food samples as shown in [Table 1]. The highest contamination level was observed in cereals (6.590 ± 1.020 $\log_{10}$ CFU/g) while the lowest was in groundnuts (3.377 ± 1.764 $\log_{10}$ CFU/g). The second-highest level of contamination (6.564 ± 1.001 $\log_{10}$ CFU/g) was found in sliced watermelon samples. These contamination levels are comparable to findings reported by Mafune *et al*.[12] who observed the highest contamination in cereal-based foods (5.0845 $\text{Log}_{10}$ CFU/g) in a study investigating microbial safety of SVFs in Thohoyandou, South Africa. Similarly and consistent with the findings from this study, Oluboyo *et al*.[13] reported that watermelons were among the most contaminated foods (6.017 $\log_{10}$ CFU/g) among other RTE sliced fruits in Ado-Ekiti, Nigeria. The presence of such high microbial counts can be attributed to improper handling during preparation and inappropriate storage conditions for these products before sale.

Plant-based foods had significantly higher ($P < 0.0001$) TVC compared to animal-based foods as shown in [Figure 1]. For instance, the microbial quality of the water used in washing and preparation, as well as the length of time the foods stay before purchase could have a significant effect on the growth and proliferation of microorganisms in these foods.[14] In addition, some of the plant-based foods were prepared and consumed raw.

According to the Centre for Food Safety,[15] foods that are satisfactory for human consumption should have aerobic colony counts lower than 3.0 $\text{Log}_{10}$ CFU/g. Foods with counts of 5.0 $\text{Log}_{10}$ CFU/g or more are categorized as unsatisfactory

**Table 1:** Microbial quality of street-vended food samples sold in selected locations in Thika town, Kenya.

| Food type | Total viable counts ($log_{10}$ CFU/g) | Total coliforms ($log_{10}$ CFU/g) | Yeasts and mold count ($log_{10}$ CFU/g) | *Escherichia coli* ($log_{10}$ CFU/g) | *Staphylococcus aureus* $log_{10}$ CFU/g) |
|---|---|---|---|---|---|
| Arrowroots | 5.589±0.611$^{abc}$ | 4.907±1.370$^{a}$ | 4.602±0.442$^{ab}$ | 2.033±1.229$^{a}$ | 4.807±1.156$^{ab}$ |
| Boiled deshelled eggs | 4.559±1.428$^{bcd}$ | 1.647±2.307$^{d}$ | 1.840±2.055$^{cd}$ | Nil$^{c}$ | 2.459±2.613$^{cd}$ |
| French fries | 5.140±1.805$^{abcd}$ | 3.866±2.279$^{abcd}$ | 3.243±1.977$^{abcd}$ | 0.279±1.185$^{bc}$ | 5.035±1.960$^{ab}$ |
| Groundnuts | 3.377±1.764$^{d}$ | 1.594±2.299$^{d}$ | 1.595±2.146$^{d}$ | Nil$^{c}$ | 1.905±1.638$^{d}$ |
| Juices | 5.968±1.016$^{ab}$ | 4.807±2.329$^{ab}$ | 5.052±1.201$^{a}$ | 0.801±1.433$^{abc}$ | 3.664±2.530$^{bcd}$ |
| Cereals | 6.590±1.020$^{a}$ | 5.567±2.233$^{a}$ | 4.581±2.515$^{ab}$ | 1.445±2.163$^{abc}$ | 5.972±1.170$^{a}$ |
| Salads | 5.830±1.210$^{ab}$ | 5.295±1.070$^{a}$ | 3.287±2.118$^{abcd}$ | 0.105±0.315$^{bc}$ | 4.688±1.250$^{abc}$ |
| Sausages | 4.508±2.470$^{bcd}$ | 2.285±2.828$^{bcd}$ | 2.300±2.504$^{bcd}$ | 0.243±1.030$^{bc}$ | 3.011±2.959$^{bcd}$ |
| Sliced pineapples | 5.311±1.279$^{abc}$ | 3.588±2.381$^{abcd}$ | 4.048±2.180$^{abc}$ | 0.483±1.459$^{bc}$ | 1.888±1.660$^{d}$ |
| Sliced watermelons | 6.564±1.001$^{a}$ | 5.431±1.785$^{a}$ | 4.853±1.737$^{a}$ | 0.805±1.443$^{abc}$ | 5.055±1.809$^{ab}$ |
| Smokies | 3.900±2.109$^{cd}$ | 1.985±2.737$^{cd}$ | 1.857±2.185$^{cd}$ | Nil$^{c}$ | 2.076±2.343$^{d}$ |
| Sweet potatoes | 5.956±1.456$^{ab}$ | 4.473±2.938$^{abc}$ | 4.339±1.567$^{ab}$ | 1.556±2.823$^{ab}$ | 4.819±2.059$^{ab}$ |

*Data presented as mean±standard deviation $log_{10\ CFU/g}$. Means having different letters in each column are significantly different (P<0.05)*

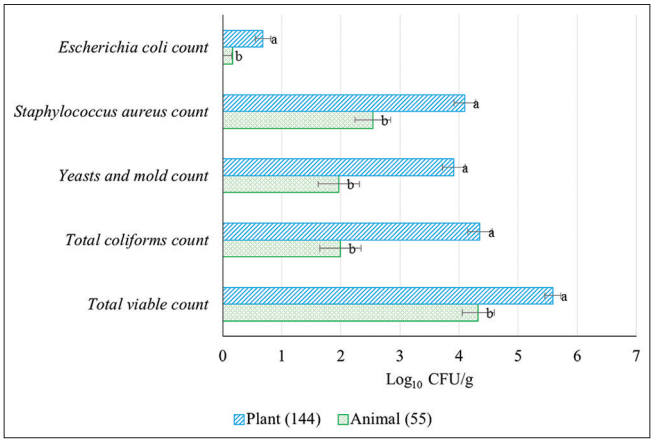


**Figure 1:** Comparison of microbiological quality between plant-based and animal-based street-vended foods sold in Thika town, Kenya.

while borderline cases are those with counts from 3.0 to 5.0 $Log_{10}$ CFU/g. Following these guidelines, on average, none of the foods assessed in this study could be categorized as satisfactory. This is worrying from a food safety standpoint considering that many consumers depend on these foods for their meals daily.[2]

### Determination of TCC

There were highly significant differences ($P < 0.0001$) in TCCs between the food samples as shown in [Table 1]. TCCs were highest in cereals (5.567 ± 2.233 $Log_{10}$ CFU/g) although this level of contamination was not significantly different from that observed in arrowroots, French fries, juices, salads, sliced pineapples, sliced watermelons, and sweet potatoes. The lowest TCC was observed in the groundnuts (1.594 ± 2.299 $Log_{10}$ CFU/g) [Table 1]. These levels are comparable to those reported in salads (4.12 $Log_{10}$ CFU/g) by Were, Were[16] in a study investigating hygiene practices and microbial contamination of SVFs around Kenyatta University in Kenya. This variation could be attributed to the differences in SFV practices. Whereas only vendors with pushcarts were involved in their study, the diversity of SFVs in this study was large including SFVs who were mobile or established in specific vending locations, who were found vending RTE foods. Bohara[17] reported comparable coliform contamination levels ranging between 2.1 and 5.2 $log_{10}$ CFU/g in all SVFs sold in Mahendranagar, Far Western, Nepal, that were studied. The presence of high counts of TCC suggests that SVFs were not prepared under hygienic conditions.

### Determination of yeasts and mold counts

There were highly significant differences ($P < 0.0001$) in yeasts and mold counts (YMCs) between the food samples as shown in [Table 1]. YMCs were highest in the juices at a level of 5.052 ± 1.201 $log_{10}$ CFU/g as well as watermelons at 4.853 ± 1.737 $log_{10}$ CFU/g. Plant-based foods had significantly ($P < 0.0001$) higher YMC as shown in [Figure 1]. This was expected since most fruits have a lower pH which favors the growth of yeasts and molds. Molds and yeasts are generally acid-tolerant, and as a result, they are linked to the deterioration of acidic foods. Molds may grow in a pH range of 2–8.5 although they prefer an acid pH, while yeasts can thrive in a pH range of 4–4.5.[18] The presence of molds in SVFs poses a food safety concern since some mold species have been reported to produce mycotoxins which are of food safety concern to human health.[19]

### Determination of *E. coli*

There were highly significant differences ($P < 0.0001$) in *E. coli* counts between the food samples as shown in [Table 1]. *E. coli* counts were highest in arrowroots (2.033 ± 1.229 $log_{10}$

CFU/g) but absent in boiled deshelled eggs, groundnuts, and smokies. All arrowroot samples were contaminated with *E. coli* while 44.4% of cereals were contaminated as shown in [Table 2].

Higher contamination levels with *E. coli* have been reported in SVFs. For instance, Birgen and Njue[20] reported contamination levels of 2.67 $\log_{10}$ CFU/g in RTE chicken in a study investigating the microbial quality of street-vended chicken products sold in Nairobi County, Kenya. This was expected since contamination levels with *E. coli* depend majorly on food hygiene practices which may differ from one region to another.

Plant-based foods had significantly ($P$ = 0.006) higher *E. coli* counts compared to animal-based foods as shown in [Figure 1]. Fisher's exact test revealed that there was a significant relationship ($P$ = 0.0002) between the type of food and the presence of *E. coli*. Whereas most of the plant-based foods were reported to be contaminated with *E. coli*, among all the animal-based foods tested, only 5.56% of sausages were found to be contaminated with *E. coli*. This could be attributed to poor hygiene practices such as vending from contaminated environs, using contaminated packaging materials, handling foods with bare hands, and handling money while serving food without washing hands during the preparation, storage, and service of SVFs.[5]

### Determination of *S. aureus*

There were highly significant differences ($P$ < 0.0001) in *S. aureus* counts between the food samples as shown in [Table 1]. *S. aureus* counts were highest in cereals (5.972 ± 1.170 $\log_{10}$ CFU/g) although this was not significantly different from arrowroots, French fries, salads, sliced watermelons, and sweet potatoes. This may be attributed to poor hygiene practices that resulted in contamination of RTE food with *S. aureus*. *S. aureus* is ubiquitous in the environment and is often found contaminating food surfaces, hands, and equipment.[21] At least one sample in each type of sample was found to be contaminated with *S. aureus* as shown in [Table 2]. All arrowroots, cereals, and salads were contaminated with *S. aureus*. Nemo and Bacha[6] reported lower *S. aureus* prevalence (29.38%) in a microbiological quality and safety of SVFs study in Jimma Town, Southwestern Ethiopia. Similarly, the lower prevalence was also reported by Asiegbu *et al*.[22] while studying the microbial quality of RTE SVFs sold in the Johannesburg Metropolis, South Africa. Compared to these findings, the contamination rate in this study was extremely high which poses significant health concerns to the consumers. This can be attributed to poor hygiene and safety practices during the preparation and sale of SVFs in the areas included in this study.

Plant-based foods had significantly ($P$ < 0.0001) higher *S. aureus* counts as shown in [Figure 1] compared to animal-based foods. Fisher's exact test revealed that there was a highly significant relationship ($P$ < 0.0001) between the type of food and the presence or absence of *S. aureus*. The odds for a positive sample were 5.56 times higher for plant-based foods as compared to animal-based foods. The relative risk was 1.63 indicating that the chance for a positive sample was higher for plant-based foods as compared to animal-based foods. Plant-based foods could have been exposed to contamination before preparation or during preparation unlike some of the animal-based foods such as smokies and sausages that were exposed to minimal handling since they were already preprocessed and vacuum packaged by the manufacturer.

Boiled deshelled eggs, groundnuts, juices, sausages, sliced pineapples, and smokies were categorized as borderline while all the other foods were unsatisfactory. Unacceptable

**Table 2:** Prevalence of *Escherichia coli, Staphylococcus aureus, Salmonella* spp., and *Listeria monocytogenes* in street-vended food samples sold in selected locations in Thika town, Kenya.

| Food type | Number of samples | *Salmonella* spp. (%) | *Escherichia coli* (%) | *Staphylococcus aureus* (%) | *Listeria monocytogenes* |
|---|---|---|---|---|---|
| Arrowroots | 4 | 25.0 | 100.0 | 100.0 | Absent |
| Boiled deshelled eggs | 18 | 5.6 | 0.0 | 50.0 | Absent |
| French fries | 18 | 5.6 | 5.6 | 94.4 | Absent |
| Groundnuts | 18 | Absent | 0.0 | 61.1 | Absent |
| Juices | 20 | 5.0 | 30.0 | 80.0 | Absent |
| Cereals | 18 | 11.1 | 44.4 | 100.0 | Absent |
| Salads | 19 | Absent | 10.5 | 100.0 | Absent |
| Sausages | 18 | Absent | 5.6 | 55.6 | Absent |
| Sliced pineapples | 19 | Absent | 10.5 | 68.4 | Absent |
| Sliced watermelons | 18 | Absent | 33.3 | 94.4 | Absent |
| Smokies | 18 | Absent | 0.0 | 50.0 | Absent |
| Sweet potatoes | 11 | Absent | 27.3 | 90.9 | Absent |

**Table 3:** Prevalence of *Escherichia coli, Staphylococcus aureus*, *Salmonella* spp., and *Listeria monocytogenes* in the six study locations.

| Sampling locations | Number of samples | *Salmonella* spp. (%) | *Escherichia coli* (%) | *Staphylococcus aureus* (%) | *Listeria monocytogenes* |
|---|---|---|---|---|---|
| Hospital | 31 | Absent | 12.9 | 74.2 | Absent |
| Juakali | 32 | 6.3 | 15.6 | 90.6 | Absent |
| Kiandutu | 31 | 6.5 | 16.1 | 67.7 | Absent |
| Makongeni | 35 | 2.9 | 17.1 | 80.0 | Absent |
| Ngoigwa | 35 | Absent | 22.9 | 77.1 | Absent |
| Thika | 35 | 2.9 | 14.3 | 71.4 | Absent |

handling practices, such as displaying RTE food in the open air, handling by vendors with dirty hands, and unhygienic food contact surfaces, may be to blame for the unsatisfactory *S. aureus* contamination levels. The presence of high levels of *S. aureus* is worrying since S. aureus can produce heat-resistant toxins that are responsible for various diseases such as toxic shock syndrome, necrotizing pneumonia, staphylococcal scalded skin syndrome, or deep-seated skin infections.[23]

### Detection of *Salmonella* spp.

*Salmonella* spp. were only detected in boiled arrowroots, boiled deshelled eggs, French fries, juices, and cereal-based foods. The highest prevalence was observed in arrowroots (25%) followed by cereals (11.1%). Juakali, Kiandutu, Makongeni, and Thika town centers recorded at least one sample that was contaminated with *Salmonella* spp. The highest prevalence was recorded in Kiandutu (6.5%) followed by the Juakali area (6.3%) as shown in [Table 3]. The overall prevalence of *Salmonella* in this study was 3.02%. This was low compared to the findings of Nemo and Bacha[6] who reported a prevalence of 13.13% in SVFs sold in Jimma Town, Southwest Ethiopia. Inadequate cooking, contamination from an unsanitary environment as well as food handlers, and poor food handling methods have all been linked to the occurrence of this pathogen.[24] Although the sources of the raw materials for foods contaminated with *Salmonella* spp. were not examined in this study, the presence of these pathogens could be due to contamination during handling of food, especially if the raw materials were already contaminated with the bacteria. In addition, food handlers have been identified as mechanical vehicles of *Salmonella* contamination from raw foods such as vegetables, meat, or the environment through utensils and other cooking vessels.[25]

## CONCLUSION

The findings of this research demonstrate that SVFs sold in the streets of Thika Town in Kenya constitute a potential health hazard to consumers. TVC, coliform, *E. coli*, and yeast and mold counts in all SVFs were generally high, making most of these foods unsatisfactory and unsafe for human consumption. The presence of *E. coli* in RTE foods was indicative of poor hygiene and safety practices among SFVs which have the potential to cause health issues to both consumers and the SFVs on consumption. Pathogenic bacteria such as *Salmonella* spp. and *S. aureus* were also isolated from the SVFs. The presence of these pathogenic bacteria in RTE foods indicates a major risk to the SFVs as well as the consumers of SVFs since they can cause microbiological foodborne diseases. Consequently, there is a need to regulate the informal food processing and marketing channels, to enhance the quality and safety standards of SVFs. The public health sector should enhance awareness among SFVs and consumers on food hygiene and safety through education and/or training. In addition, the provision of basic infrastructure for enhancing hygiene among SFVs has the potential to improve their food preparation and selling conditions/environments, thus contributing to the production and sale of quality and safe foods.

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### Declaration of patient consent

Patient consent is not required as there are no patients in this study.

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### Conflicts of interest

There are no conflicts of interest.

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