



# Evaluation the Safety and Quality of Ready-to-Eat Sandwiches: Short Communication

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## Abstract

Increase in the consumption of ready-to-eat foods such as sandwiches, raises concerns about its microbial safety and quality. The aim of the study was to evaluate the microbial safety and quality of different type of sandwiches. In total 60 of chicken shawarma (15), normal chicken (15), eggs (15) and meat (15) sandwiches were purchased from different cafes and evaluated microbiologically for total bacterial and *Enterobacteriaceae* counts and incidence of *Salmonella* sp. The results showed that the total bacterial counts were  $5.48 \pm 1.01$ ,  $5.53 \pm 1.11$ ,  $5.58 \pm 0.97$  and  $6.72 \pm 0.77$  log<sub>10</sub> CFU g<sup>-1</sup> in the chicken shawarma, normal chicken, eggs and meat sandwiches respectively, whereas, the counts of *Enterobacteriaceae* in chicken shawarma, normal chicken, eggs and meat sandwiches were  $3.56 \pm 1.02$ ,  $1.63 \pm 1.30$ ,  $2.48 \pm 1.76$  and  $3.64 \pm 1.81$  log<sub>10</sub> CFU g<sup>-1</sup> respectively. *Salmonella* sp. was suspected in 10% of the sandwiches. In conclusion, all most sandwich types were found at satisfactory level except meat sandwiches which were found at marginal level. Microbial contamination and hygiene handling status indicated that almost all sandwich types were at marginal level except normal chicken sandwiches which were found at satisfactory level. Strictly implementation of food safety laws and further studies were recommended to clarify the safety and quality of the sandwiches.

**Keywords:** Sandwiches; Food Safety; Microbial Quality; Total Bacteria; *Enterobacteriaceae*; Salmonella

**Abbreviations:** RTE: Ready-to-Eat Foods; FSANZ: Food Standards Australia and New Zealand; USFDA: United States Food and Drug Administration; ISO: International Organization for Standardization.

## Introduction

One of the consequences of the lifestyle changes now days is the interaction between people and their foods which shows increases trends in eating of ready-to-eat foods (RTE) such as sandwiches [1]. Shawarma is a Middle Eastern Arabic typical style sandwiches or a kabab fast food that is popular worldwide, and it's it is usually prepared from meat or chicken with bread and other ingredients of sandwiches such

as salad. Due to its content of bread, certain microorganisms such as *Bacillus* sp. and several genera types of molds such as *Rhizopus stolonifer*, *Neurospora sitophilie* could be commonly found [2].

Sandwich ingredients, processing, handling and storage significantly contribute to sandwiches normal microbiological load which could risk its safety. It is quite accepted that food handlers might be carrying some pathogenic bacteria during the preparation of the sandwiches, besides improper cooking and storage temperatures which allow the growth of foodborne pathogens which that could lead to food poisoning outbreak similarly to any other food [3]. In fact, several bacterial species that normally causes foodborne

diseases such as *Salmonella* sp., *Escherichia coli* O157:H7, *Listeria* sp., *Shigella* sp., *Clostridium* sp., and *Campylobacter* sp. were found in meat shawarma sandwiches [4].

Moreover, according to El-Fakhrany, et al. [5], found that out of 66 samples, chicken shawarma sandwiches were found with the highest mean values of mesophilic count e.g.  $10.37 \log_{10}$  CFU  $g^{-1}$  whereas, burger sandwiches were heavily loaded by with Enterobacteriaceae count e.g.  $6.67 \log_{10}$  CFU  $g^{-1}$ . As it was reported by Jang, et al. [6], 0.2% of 1120 samples were tested positive for *Salmonella* sp. The aim of the study was to evaluate the microbial safety and quality of different type of sandwiches served different cafes.

## Materials and Methods

### Sandwich Samples

Sixty sandwich samples as: 15 of chicken shawarma (grilled chicken), 15 of normal chicken (boiled chicken), 15 of meat (beef) and 15 of egg sandwiches were purchased from different cafes, Oman from June, 2022 to October, 2022 during sandwiches preparation and serving at the sites and brought for analyzing within 2 hours.

### Microbial Analyses

Total aerobic bacteria were enumerated according to the USFDA Standard Manual [7]. Briefly, 25g of sandwich was mixed with 225 ml of maximum recovery diluent (HI Media, India) and blender blended for 1 min. After serial dilutions, 0.1 ml was plated on tryptone soya agar (Oxoid, UK) and the plates were incubated at  $37 \pm 2$  for 48 hours. Similarly, Enterobacteriaceae were enumerated on violet red bile glucose agar (Oxoid, UK) and plates were incubated at  $37 \pm 2$

for 24 hours according to the ISO Standard [8].

*Salmonella* sp. was enumerated according to the ISO Standard [9]. Briefly, 25g of sandwiches were blended with 225 ml of buffer peptone water (Oxoid, UK) and the mixture was incubated at  $37 \pm 2$ , for 18-24 hours. After that, 0.1 ml of the sample was inoculated into 10 ml of Rappaport vassiliadis (Oxoid, UK) and incubated at  $42 \pm 2$  for 48 hours. Finally, 0.1 ml of inoculated Rappaport vassiliadis broth was plated on xylose lysine deoxy cholate agar (Oxoid, UK) and the plates were incubated at  $37 \pm 2$  for 24 hours. The black-centered colonies were presumably considered as salmonella colonies as per Oxoid instruction.

## Results and Discussion

Table 1 shows the mean values of total aerobic bacterial count in different sandwiches types which could be considered as an indicator of microbial quality of foods. Meat sandwiches showed the highest total bacterial count while the chicken shawarma sandwiches showed the lowest total microbial count. Table 2 shows the mean values of Enterobacteriaceae counts. As it can be seen, the highest Enterobacteriaceae count was found in meat sandwiches and the lowest was found in chicken sandwiches. According to the Food Standards Australia and New Zealand (FSANZ) [10], which limits a total bacterial count for fully cooked sandwiches with salads to be  $< 6.0 \log_{10}$  CFU  $g^{-1}$  as satisfactory and a count of  $> 6.0 \log_{10}$  CFU  $g^{-1}$  -  $< 7.0 \log_{10}$  CFU  $g^{-1}$  as marginal limit, most of sandwich types were found at satisfactory level in the current study except meat sandwiches which were found to be the in a marginal level. This high microbial count could be attributed to the microbial contamination of different ingredients of the sandwiches such as salads as well as the degree of sandwiches handling.

**Table 1:** Total bacterial count in different sandwiches.

Sandwich Type	Mean, $\log_{10}$ CFU/g	Max, $\log_{10}$ CFU/g	Min, $\log_{10}$ CFU/g
Chicken shawarma (15)	5.48±1.01	7.48	3
Normal chicken (15)	5.53±1.11	6.98	3.74
Eggs (15)	5.58±0.97	7.23	4.02
Meat (15)	6.72±0.77	7.48	4.74

**Table 2:** Enterobacteriaceae count in different sandwiches.

Sandwich Type	Mean, $\log_{10}$ CFU/g	Max, $\log_{10}$ CFU/g	Min, $\log_{10}$ CFU/g
Chicken shawarma (15)	3.56±1.02	5.05	1.70
Normal chicken (15)	1.63±1.30	3.73	0.00
Eggs (15)	2.48±1.76	5.26	0.00
Meat (15)	3.64±1.81	5.48	0.00

Enterobacteriaceae count is considered as a good indicator of microbial to evaluate the hygienic status in food preparation. Moreover, the presence of Enterobacteriaceae is an indicator for intestinal and fecal contaminations either directly or indirectly from food handlers or sandwich ingredients and some the Enterobacteriaceae groups are pathogenic that might cause severe foodborne diseases (El-Fakhrany, et al., 2019). According to FSANZ, Enterobacteriaceae count  $> 4.0 \log_{10} \text{CFU g}^{-1}$  is considered as unsatisfactory,  $> 2.0 \log_{10} \text{CFU g}^{-1} < 4.0 \log_{10} \text{CFU g}^{-1}$  as marginal and  $< 2.0 \log_{10} \text{CFU g}^{-1}$  as satisfactory. Based on these criteria, almost all sandwich types in the current study were found at marginal level except normal chicken sandwiches which were found at satisfactory level from Table 2. It could be understood from these results that most of the sandwiches were either exposed to the microbial contamination prior to preparation or cooked and handled at improper temperature and handled at unhygienic practices. In comparison with other studies, the total bacterial count

in chicken shawarma sandwiches in the current study was higher than that was found in Saudi Arabia study by Alharbi, et al. [11] and Ahmed, et al. [12]. However, our findings of chicken shawarma total bacterial count closely agreed with that were found in Egypt by El Zekaty, et al. [13]. In other sandwich types, total bacterial count in normal chicken sandwiches was lower than that was found in Bangladesh by Hasan [14]. The discrepancy in total bacterial count among studies could be attributed mainly to the initial bacterial count in sandwich raw materials, cooking temperature and hygienic status of sandwiches handling after preparation. For instance, sandwiches raw chicken and salads possibly contributed to vary the bacterial count among the sandwiches in the previous studies. *Salmonella* sp. was suspected in meat sandwiches which represented 10% of the total sandwiches (Table 3). Although, *Salmonella* sp. was not confirmed, vehicles such as food handlers could contribute to this pathogen incidence in foods [15].

**Table 3:** Detection of *Salmonella* sp. in different sandwiches.

Sandwich type	<i>Salmonella</i> sp.	Remark
Chicken shawarma (15)	0/15	
Normal chicken (15)	0/15	
Eggs (15)	0/15	
Meat (15)	6/15	Suspected based on colonies morphology

## Conclusion

In general, most of the sandwiches were found at the satisfactory microbial quality level with an exception of meat sandwiches. Moreover, most of the sandwiches were found at the marginal level of contamination and hygienic status with an exception of normal sandwiches. *Salmonella* sp. was suspected in 10% of the total sandwiches. This study showed the need for more studies to clarify the microbial safety and quality and urged to strictly implement of food safety laws.

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