

Foodborne diseases regarding bacteria in Sudan: A review

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Abstract

Abstract: Food-Food-borne diseases, which is caused by agents entering the body through the intake of contaminated food materials, are one of the primary public health concerns.

Objective: This review's goal was to draw attention to bacterial contamination of food in Sudan as a contributing factor to foodborne illnesses and offer suggestions that would help medical professionals lower the dangers associated with this.

Methods: Using trustworthy publishing techniques, summaries of the most recent papers, electronic journals, and other titles that meet the goals of the foodborne disease research topic—with an emphasis on bacteria as one of the major food contaminants—were employed.

Study area: Sudan covers an area of 1.881,000 square km. It has land boundaries with Egypt, Libya, Ethiopia, Eritrea, Chad, Central African Republic, Southern Sudan and a coastline of 835 km. Sudan's only seaport (Port Sudan) is located on the Red Sea in the Northeast. The capital Khartoum is in the northern half of the country some 1000 km from the port. Sudan's economic development depends on agriculture, (1, 2)

Keywords: Food borne; Disease; Regarding *Bacteria*; Sudan; Review

1. Introduction

Many infectious diseases are caused by living organisms or their toxins that enter the body by eating contaminated foods. Foodborne diseases develop due to the physiological condition of humans, including those who are more susceptible such as pregnant women, young children, the elderly, and people with weakened immune systems (3), Foodborne bacterial poisoning occurs by eating food containing preformed bacterial toxins, such as toxins produced by *Staphylococcus aureus* and *Clostridium botulinum* and others food borne diseases related bacteria, resulting from the growth of bacteria in food or from eating food containing viable bacteria. *Salmonella* or *Listeria* which then grow and establish themselves in the host, resulting in illness, (4).

1.1. General causes of foodborne illnesses

Most foodborne infections are brought on by dangerous germs and viruses. The causes include certain parasites and chemicals, fungi, (5) improper personal hygiene, improper food handling practices, cross-contamination between raw and cooked foods, and other environmental factors like contaminated water and raw material contaminants, in addition to some unhealthy habits. (6, 7) .

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1.2. Foodborne illnesses infections

Foodborne illnesses are gastrointestinal tract infections or irritations brought on by food or drink that contains dangerous bacteria, parasites, viruses, chemicals, or fungi. Foodborne sickness symptoms include fever, chills, diarrhoea, vomiting, and stomach pain. Most people recover on their own without treatment since most foodborne infections are acute, which means they occur rapidly and last only a brief period. In rare cases, foodborne infections might result in more severe problems. (8) It is also can lead to dehydration, hemolytic uremic syndrome, and other complications. Acute foodborne illnesses may also lead to chronic or long-lasting health problems, (9) and irritable bowel syndrome, Guillain-Barré syndrome, which is a disorder characterized by muscle weakness or paralysis that begins in the lower body and progresses to the upper body. This syndrome may occur after foodborne illnesses caused by bacteria, (10). A recent study found that adults who had recovered from *E. coli* O157:H7 infections had increased risks of high blood pressure, kidney problems, and cardiovascular disease, (11).

2. . Food Safety and Foodborne Disease

Food safety ensures important health protection for the consumer from foodborne diseases. This is due to its impact on factors such as microbial, chemical, and nutritional change, biodiversity, water activity, climate change, and environmental hygiene, which affect food safety. (12) .

Among the features, foodborne pathogens are a prime harmful element to spoiling food's desirability for consumption, leading to foodborne disorders, Foodborne diseases are associated with pathogens and lead to serious health problems worldwide. The World Health Organization estimates that these pathogens are responsible for 23 million foodborne illnesses and 5000 deaths in Europe every year. The increasing cost of food disease raises medical costs, productivity losses, and illness-related mortality each year (13 ,14).

2.1. hazard analysis critical control point (HACCP) implementation in food processing

Due to the sharp rise in foodborne illness cases in many nations in recent years, health authorities were primarily motivated to adopt the Hazard Analysis and Critical Control Point (HACCP) system to ensure consumer food safety. For over two decades, the World Health Organization has acknowledged the value of Hazard Analysis and Critical Control Point (HACCP) in preventing foodborne illnesses (15). Research conducted in Sudan has indicated that the HACCP system is hindered by a lack of funding and human resources in small food factories. Other studies have confirmed the same conclusion, which had explicitly identified the obstacles that hindered the implementation of HACCP in Sudan, sometimes because of subpar facility construction (16).

2.2. Major types of food contamination

2.2.1. Physical Contamination

When a foreign object contaminates food, physical contamination occurs. It can happen at any point during the preparation and distribution of food. In addition to other potential issues, physical contamination can seriously injure the customer by causing things like choking or broken teeth, (17).

2.2.2. Viruses

Numerous illnesses in both people and animals are brought on by viruses that are spread by faces in food. Norovirus, astrovirus, rotavirus, and hepatitis viruses (hepatitis A and E) are the viruses that are most frequently discovered in food and are linked to foodborne illness. Numerous illnesses in both people and animals are brought on by viruses that are spread by faces in food. At that point, the case is affected by eating food tainted with such microorganisms. Other viruses, including adenoviruses, coronaviruses, and several more, can occasionally cause severe illnesses that endanger both the lives of the person and society. (18) .

2.2.3. Bacteria

One of the most common microorganisms in nature and on food is bacteria. Under ideal circumstances, they can produce vast, noticeable quantities and proliferate quickly, which makes it relatively simple to isolate and examine them. Excess acidity in food systems cause bacterial cells and their cell walls to be destroyed. The amount of bacterial destruction in food is also increased by the ratio of organic and inorganic acid content. Temperatures between 70 and 85 °C destroy most germs in 7.5 to 15 minutes. The effects are not entirely stopped by temperatures below 0 °C; they simply postpone treatment or spoiling, (19).

The most common bacteria causing foodborne illness. Examples include

- The bacterium *Salmonella* is present in a wide range of foods, such as raw and undercooked meat, poultry, dairy products, shellfish, eggshells, and the inside of eggs.
- *Campylobacter jejuni* (*C. jejuni*), which is present in unpasteurized milk and raw or undercooked chicken.
- *Shigella*. These bacteria are prevalent in the feces of sick individuals and can transfer from person to person through unsanitary behavior, contaminated water, and field goods. If they spread, they pose a risk to public health.
- *Escherichia coli* (*E. coli*), which comprises several strains, only a small number of which are harmful to humans. The strain that causes the most serious infection is *E. coli* O157:H7. Fresh produce, unpasteurized milk, and fruit juices, and raw or undercooked hamburgers are common causes of *E. coli*.
- *Listeria monocytogenes* (*L. monocytogenes*), which has been detected in unpasteurized milk, soft cheeses, raw and undercooked meats, and hot dogs and deli meats that are ready to eat. A bacterium called *vibrio* has the potential to infect fish and shellfish.
- The bacteria *Clostridium botulinum* (*C. botulinum*), which can contaminate foods that have been incorrectly canned as well as salted and smoked fish. (20, 21).

2.3. Food safety compliance in developing countries

The 1990s saw the introduction of new food safety laws in wealthy nations, raising questions about how these laws will affect exporters from developing nations. Perishable goods, which presented additional difficulties for food safety management, were the growth sectors for high-value exports in tandem with new laws. Reducing food-borne illnesses and hazards will be the most significant connection between food security and food safety. Even though high-value markets have a favourable impact on livelihoods, only a tiny percentage of households will ultimately benefit from them. It is anticipated that indirect public health effects on domestic food supplies will be minimal, at least initially. (22, 23).

2.4. Food inspection in Sudan

Food inspection in the Federal Republic of Sudan is the responsibility of the Federal Ministry of Health (Directorate of Environmental Health and Food Control – FOOD CONTROL SECTION) through Public Health Officers and their assistants. Food inspection is part of the responsibility of Public Health Officers, who are also responsible for environmental health services in their specified areas. Public Health Officers beside officers from other authorized institutions are responsible for the inspection of food at all stages. Concerning the legal frame, Sudan depends for a long time on the Public Health Act 1939 which covers all aspects of public health with a very few and centralized articles dealing with food hygiene issues. Each State has its own Environmental Health Ordinance, which regulates all activities of environmental health including food safety inspection and control, (24).

2.5. Bacterial food contamination in Sudan

30.1% of food handlers in the city of Omdurman and its suburbs were carriers of one or more disease-causing organisms, the most significant of which were *S. aureus*, *S. typhi*, *S. boydii*, *E. histolytica/dispar*, and *G. Lamblia*, according to the findings of some studies that were previously carried out in Sudan with the aim of assessing the prevalence of carriers of some pathogenic bacteria. and in between. Of them, *Staphylococcus aureus* and *G. lamblia* are present in the noses of 92.3% and 21.6% of the individuals, respectively., which is significantly greater than the rate among Sudanese hospital employees (13.2%). According to the study, store proprietors had a greater prevalence of *Staphylococcus aureus* carriers (44.6%). By analysing stool samples, the study also demonstrated that the intestinal parasite *G. lamblia* was present in 20.5% of the samples, with a higher prevalence among warehouse owners (43.8%), restaurant employees and bakers (25.0% each), and butchers. 6.3%. Additionally, 2.6% of patients had a diagnosis of *E. histolytica/dispar*. (24.).

There is also another study conducted on food handlers in hospitals, the result of which was that the percentage of positive samples for swabs from workers' hands was 56%. *Pseudomonas*, *E. Coli*, and *Staphylococcus* SSP were predominant. (25). based on a different study that was carried out among 390 healthy food handlers and was titled The Prevalence and Antibiotic Susceptibility of *Salmonella* Species among Food Handlers in Khartoum State. According to the study's findings, roughly 49.4%. *Salmonella* testing amongst food handlers was performed on stool samples (4.4%). The most prevalent was *Para typhi* B (3.6%). *Salmonella* and *cholera* (0.3%) and *Salmonella typhi* (0.5%) came next This study also showed strong statistical significance between the health requirements of food handlers and the outbreak of *Salmonella* bacteria ($P > 0.05$), Another investigation demonstrated that *Salmonella* was recovered from fish and that 6.2% of the samples contained the bacteria. 30.1% of food workers were found to be *Salmonella* carriers in prior studies on the subject. (,26).

Also, in 2018, a study was conducted by collecting 30 samples from chicken carcasses, and the project proved the existence of salmonella in 30% of the samples. (27) Also, there was a study conducted in another city in Sudan, which is the capital of Gezira State, which was entitled Bacterial contamination of food handlers. n carcasses are more susceptible to contamination during the manufacturing process than in storage, Restaurants in the city of Wad Medani, Sudan. Their results showed that the percentage of contamination in all samples (100 samples) The positive bacteria were 78% of all samples (G+ve cocci 63%/ G+ve bacilli 15% and gram-negative bacteria 09%. All samples (G -ve cocci 03% / G -ve bacilli 06%). (28) .

Out of the 30 farms examined in another study on risk estimation in primary production (farms), 16 farms (53.3%) had high levels of *E. coli* contamination, whereas 7 farms (23.3%) had medium levels. Over 50% of the farms did not clean their poultry buildings, whereas the remaining seven farms showed minimal contamination. This result showed a high estimation of risk and a substantial impact on the *E. coli* count (p value 0.004). Nine farms (30%) exhibited cracks in their walls, which were deemed to be of medium risk and substantially correlated with the *E. coli* count (p < 0.05). The *E. coli* count with high-risk estimation was considerably (p < 0.01) impacted by the negligence of personal hygiene on sixteen (53.3%) farms. Additionally, 50% of the farms that did not implement the required program were deemed to be at high risk. *E. coli*'s overall risk assessment in primary production was high. (29).

A second investigation by Hamid and colleagues in 2020 indicated that animal items including vended red meat were a substantial source of *E. coli* and other infections connected to foodborne diseases out of 75 random samples of raw meat collected from diverse sites in Khartoum, Sudan. Several species were isolated, with *E. coli* accounting for 20%, *E. vulneris* for 6.6%, *E. albertii* for 5.3%, and *E. fergusonii* for 4% of the 36% incidence. (30).

Another study used 250 samples of broiler chicks that were sold by retailers and used as food in Khartoum State's fast-food establishments. According to the study, 38% of the population was contaminated with *Listeria* spp. There were 400 participants in another study that was carried out in the state of Khartoum (100 for milk, 100 for meat, 100 for fish, and 100 for cheese). It was discovered that 263 of the samples contained microorganisms. *S. aureus* accounted for 137 isolates (34.25%), and milk had the highest percentage of staph among the various meals (63%), while cheese had the lowest percentage (20%). (32 ,33).

3. Conclusion

One of the major public health concerns is food poisoning and outbreaks of foodborne diseases, particularly in Sudan's emerging and underdeveloped nations, where regulations and monitoring are necessary to safeguard consumers. *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* are the most common types of bacteria that cause food-borne diseases in Sudan. These bacteria can cause diseases with potentially harmful complications. This is evident from the numerous studies that were reviewed in these reviews, which included a variety of methods like laboratory tests and questionnaires.

Recommendation

- All regions must be included in the food inspections and monitoring program.
- Training employees on behavioral work requirements in the food industry, particularly for those working in sensitive areas with high public interaction; stressing the importance of routine medical examinations for employees.
- Creating and outfitting labs for food safety; supporting the appropriate authorities in their inspections and surveillance of enterprises and establishments that produce food and meat.
- Health professionals working in the food industry must prepare bulletins outlining the necessary health conditions for their jobs.

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