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The occurrence of *Salmonella* contamination in food in Iran during 2012 to 2022; a review

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ABSTRACT

Salmonella infection is a main public health difficult in the world. This zoonotic bacterial disease in most parts of the world, specifically in developing countries have so more importance. Treatment of *salmonella* infection be more difficult versus past years. The aim of this review is determining provinces that reported the most amount of contaminated food samples and the antibiotics that had the most and least resistance against *salmonella* in Iran. The data were collected from Scopus, PubMed, Google Scholar and Science Direct. The selected keywords were “*Salmonella*” and “Iran” in both English and Persian languages. The percentage of contamination by *Salmonella* was in a range from 68.8% to 0% and resistance against *Salmonella* bacteria were observed in a range from 100% resistant (Pleuromutilins, Penicillins & Macrolides) to 100% sensitive in (Aminoglyco-sides & Cephalosporins). Resistance to antibiotics is an important alarm for public health because of their application in treatment human salmonellosis cases.

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1. Introduction

Diseases transmitted through food still have a significant impact on people's health as one of the most vital health problems (1). Travel Increasing, development of tourism, consumption of food outside

the home, consumption of prepared and packaged foods; caused Foodborne diseases have been raised as a major problem in global health (2). The most common cause of diseases transmitted by food are

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toxins, viruses, bacteria and parasites (3). Salmonellosis is responsible for the most cases of the deaths caused by food-borne diseases in the world and is a fundamental problem in developing countries as well as in developed countries (4). The natural habitat of *salmonella* is the digestive system of mammals (5). The sewage inflow into aquaculture waters or the usage animal fertilizers can induce to an increase in possibility of food contamination with *salmonella* (6). The three most common types of disease caused by *Salmonella* in humans include enteric fever, enteritis, and extra-intestinal infection (7). This bacterium causes an average of twenty-five million infections and about two hundred thousand deaths worldwide (8). CDC approximates *Salmonella* bacteria cause about 1.35 million infections, 26,500 hospitalizations, and 420 deaths in the United States every year and food is the source for great part of these illnesses (9). Despite the identification more than 2500 serotypes of *Salmonella* the infection caused by that in humans is a small number of its serotypes. *Salmonella enteritidis* and either *Salmonella typhimurium* have shown the most cases of isolation from food in the America and Europe outbreaks (10). According to the statistics of the last decade, Jakarta, India, Pakistan and Nepal are the most polluted areas in the world with *salmonella* (11). Epidemiological studies in different parts of the world indicate an increase in infections caused by *Salmonella* serovars, which have very high drug resistance (12). The most infections of *salmonella* have occurred due to the contamination of foods with animal origin, poultry, red meat and their products so foods are considered as a factor for *salmonella* transmission to humans (13). Since *Salmonella* are sensitive to sunlight and dryness, their survival in the environment depends on

temperature and humidity (11) so if enough temperature and cooking time are applied, it will be destroyed. But in the food such as mushrooms, red meat or chicken meat and vegetables if the heat not to be enough, *salmonella* will survive especially when they have a high initial contamination (14).

Mindful the importance of *Salmonella* serotypes in human public health is the purpose of this review to access determining the percentage of *Salmonella* contamination in tested foods located in the states of Iran. Determining the states which had the most contaminated food samples and the antibiotics that had the most and least resistance against *salmonella* by way of a survey of accomplished articles in Iran.

2. Methods

2.1. Ethical approval, study method and search strategy
This is a review of the published studies and ethical approval is not needed for this study.

The current study is a comprehensive review on the prevalence of *Salmonella* in foods that consumed by people in Iran from 2012 to 2022. In 2022, a comprehensive methodical search was executed in 4 valid international databases include Scopus, PubMed, Google Scholar and Science Direct. The selected keywords were "*Salmonella*," and "Iran" in both English and Persian languages. A total of 529 articles were considered. After revising the titles of the articles, 101 relevant articles were known and entered the qualitative evaluation stage of the articles. Finally, at the end of this stage, 33 articles stayed.

2.2. Inclusion-exclusion criteria and data extraction
Amongst drew out studies, some of them were kept out from the archive of received ones: rundown of presented articles at the congress, the studies that

abstract and full texts were not accessible, review articles, studies with no patently stated data and studies that are not original. Additionally, articles were excluded if samples were collected from non-edible stuff. From each article, some information including study's location and date, type of food and packaging, percentage rate of positive cases, the type of antibiotics and the percentage of resistance to *Salmonella* bacteria were entered into the pre-designed tables. Then, the data were categorized and analyzed; statistically.

2.3. Statistical investigation

Data investigation was done by use of SPSS software, version 25. The diagrams were drawn in Excel 2019 software.

3. Identified studies

In current study, the contamination rates were analyzed in 20 geographical regions of Iran. *Salmonella* detection have done by use of different Methods.

Respectively, the highest percentage of contamination by *Salmonella* was 68.8% in Nikshahr and the lowermost contamination rate was 0% (in Maragheh, Mahabad, the provinces of Azarbaijan and Mazandaran).

Also, the highest and lowest rates of *Salmonella* contamination have been reported in Tahini (75%) and raw goat milk (2%), respectively.

Although the percentage of *Salmonella* infection was variable in the decade of research, generally; it increased from 8% to 45% (chart No. 1).

The highest and lowest levels of antibiotic resistance against *Salmonella* bacteria were observed in Ardabil city and Tehran city, respectively. The amount of antibiotic resistance in the samples which isolated *Salmonella* bacteria were tested; observed in a high

range resistant about Pleuromutilins, Penicillins & Macrolides to a high range sensitive about Aminoglycosides & Cephalosporins.

The percentage of cumulative contamination in food samples during the decade under study according to the provinces that have conducted *Salmonella* detection test is given in Chart No. 2. It should be noted that in some examples Such as Tahini, non-pasteurized ice cream, pasteurized cream, pasteurized milk, Dough, raw camel milk, buffalo milk, butter, rice pudding, yogurt and frozen fish *Salmonella* infection was zero percent.

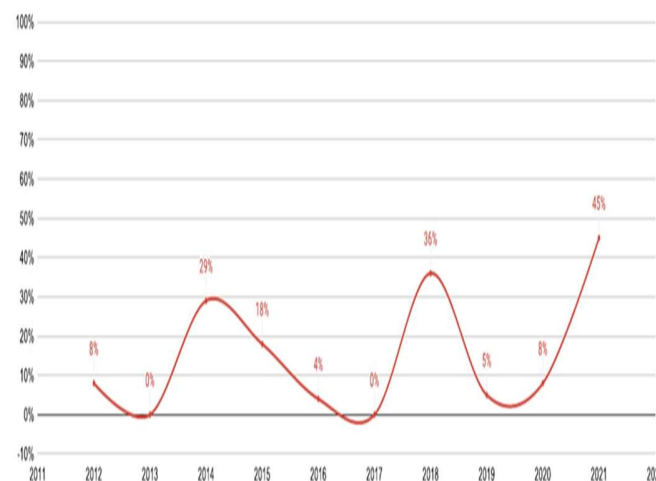


Figure 1. The average percentage of contamination in the research decade (2012-2022) (11, 14-45).

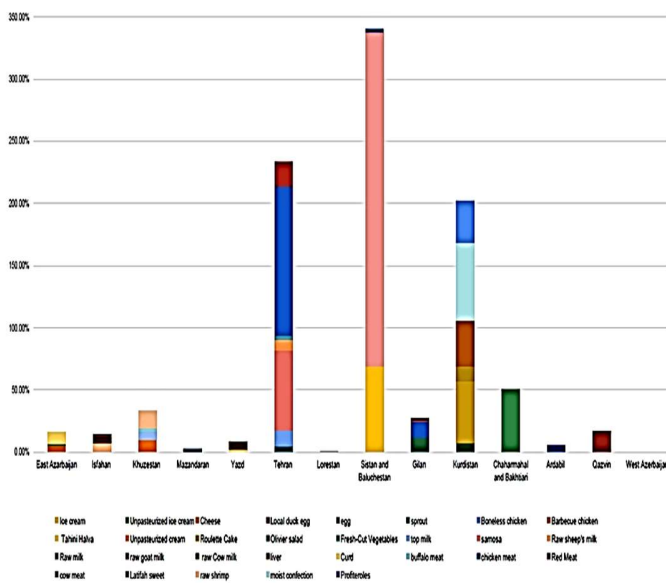


Figure 2. The cumulative of *Salmonella* contamination in food samples in the research decade (2012-2022) (11, 14-45).

4. Review recent studies

Salmonella isolates are among the most important food-borne pathogens that are largely transferred to humans via intake of deferent food substances. We conducted this revision to probe the prevalence of *Salmonella* contamination in food that used in Iran from different edible stuffs and provinces. In this study, cities with the highest and lowest levels of contamination to *Salmonella* were identified. The range of contamination in food was also determined from 75% to 0%. Unfortunately, this review showed an increase in the amount of pollution in the decade under study.

Similar results to our study; several independent studies in Iran showed that *Salmonella* strains isolated from deferent foods. For example the survey on Occurrence of *Salmonella* contamination in consumed eggs in Iran showed that the highest rate of

contamination went to the industrial eggs (7.49%). The total prevalence

of *Salmonella* contamination in consumed eggs of Iran using culture of microbial, molecular-serological, molecular, culture-molecular, culture-serological, and culture-molecular-serological methods was shown 11.33%, 5.52%, 0.37%, 1.91%, 5.52%, and 0.73%, respectively. Occurrence in the twenty-one geographical zones, where studies have been piloted, alternated from 0% to 29.06% (46).

Another study on Multidrug-unaffected by *Salmonella* strains from food animals in Iran revealed that totally, 105 *Salmonella* isolates were gained from chicken meat (70.0%), beef (19.0%), lamb (11.0%), and human stool (1.7%). *S. Infantis* (40.9%), *S. Enteritidis* (29.5%), and *S. Paratyphi B* (8.6%) were the greatest prevalent serotype. Totally 59.1% of the isolates were multidrug-unaffected by great resistance to nalidixic acid (67.6%), tetracycline (62.9%), and trimethoprim-sulfamethoxazole (42.3%) were saw (47).

5. Conclusions

Conducting regular epidemiological studies can be helpful to monitor the occurrence of *salmonella* cases and develop strategies to prevent this disease. The outcomes of this revision showed a high percentage of contamination in food samples in different provinces of Iran with different weather conditions and food culture.

Immethodical use of antibiotics does not reduce the overall percentage of food contamination with *Salmonella*, but also causes the antibiotic-resistant strains and their transmission to humans, financial costs and irreparable damage to the health of society.

simple and practical hygiene measures is recommended to prevent salmonellosis; such as well-done cooked animal products, washing hands after handling raw meat or unwashed vegetables, disinfection and cleaning of equipment and not consuming unpasteurized foods. Also, wider studies is recommended to determine the dimensions of this challenge and pay attention to the rational use of antibiotics.

Author contributions

M.S.D was responsible for the methodology, software, validation and formal analysis, visualization, E.M.A was responsible for conceptualization, methodology, edition and M.P was responsible for the investigation, resources, data curation, writing, editing, organization and project running.

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Data accessibility statement

The collected data is based on the sources mentioned in the references section. These resources can be accessed by searching the databases, freely.

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Conflicts of interest

The writers declare no conflicts of attention.

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