Assessment of the Microbial Quality of Industrial Ready-to-Eat Salads Containing Meat Products

MOHAMMADREZA KOUSHKI*, PALIZ KOOHY-KAMALY, and SARA SOHRABVANDI

*Food Technology Research Department, Faculty of Nutrition Sciences and Food Technology, National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Abstract
Ready-to-eat foods are not usually treated sufficiently to eliminate the existing pathogenic bacteria in them before consumption; therefore, bacterial contamination in these foods requires due consideration. This study aims to detect Salmonella and Escherichia coli contamination and total microbial count in ready-to-eat salad samples containing meat products in Tehran in 2018. The microbial analysis of 136 samples including Olivier salad, Macaroni salad, and Sausage salad, collected by simple randomized sampling method from chain-stores, grocery and cooperative stores, was done according to the ISO international standards. Salmonella was not detected in any of the samples, and only 0.7% of the samples were contaminated with E. coli. The total number of microorganisms in 89.6% of the Olivier salad samples, 61.4% of the Macaroni salad samples and 97.7% of the Sausage salad samples was within the permitted limits of the Iranian National Standard. The average total number of microbes in the Olivier salad, Macaroni salad, and Sausage salad samples was obtained as 4.84, 4.23, and 5.34 log CFU/g, respectively. This study confirms the relatively satisfactory microbiological quality of ready-to-eat salads containing meat products in Tehran, Iran.

Introduction
Ready-to-eat foods are usually consumed immediately at the sale place without any preparation or treatment. They include raw, partially cooked, cooked, hot, cold and frozen foods. The Codex Alimentarius Commission (CAC) defines ready-to-
eat foods, as raw foods, or any foods manipulated, processed, mixed, cooked, or otherwise prepared and consumed without additional process. The presence of pathogens in ready-to-eat foods is a more serious threat to the public health than their presence in raw meat products because ready-to-eat foods do not usually receive additional treatments to eliminate these bacteria; meanwhile, they may contain native microflora including pathogenic bacteria of the raw material from which they are prepared. The most common bacteria in ready-to-eat foods are Salmonella, Listeria monocytogenes, Campylobacter jejuni, Staphylococcus aureus, Bacillus cereus, and Clostridium perfringens.

Since ready-to-eat foods are consumed without any additional treatment, the risk of foodborne outbreaks is high if they are improperly prepared or stored. Salmonella is a gram-negative bacilli of the Enterobacteriaceae family and one of the most important pathogens transmitted through food to humans. In addition, it is considered as a major cause of death and economic damage worldwide. Annually, 93.8 million cases of gastroenteritis of Salmonella types and 155,000 deaths occur throughout the world. It is estimated that 80.3 million of them are foodborne. So far, over 2,500 Salmonella serotypes have been identified, half of which are Salmonella enterica Serovar Typhimurium. The major transmission ways of Salmonella species are through chicken meat, ready-to-eat products, dairy products, fruits, and vegetables. Salmonellosis with acute symptoms emerges with fever, abdominal pain, diarrhea, nausea, and sometimes, vomiting. Symptoms of the disease appear within 6-72 h (usually 12-36 h) after ingesting Salmonella, and the disease continues for 2-7 days. Although the clinical symptoms of salmonellosis are relatively mild, in some cases, especially in children and elderly patients, dehydration due to salmonellosis is severe or may even cause death. Recently, the outbreaks due to the consumption of ready-to-eat foods are reported worldwide, most of which are caused by Salmonella.

Various studies have been conducted on the contamination with Salmonella and Escherichia coli (E. coli) in ready-to-eat foods in different countries, and different results have been reported. In some studies, Salmonella was detected in 39, 28.6, 16, 8, and 1.5% of the studied ready-to-eat food samples, while in other studies, Listeria monocytogenes and Salmonella were not detected in any of the ready-to-eat products.

In Iran, the production and consumption of ready-to-eat foods are increasing. Therefore, due attention should be paid to the quality and health of ready-to-eat foods to prevent foodborne diseases. In this study, several types of ready-to-eat salads in the market are examined in terms of contamination to the main food borne pathogens including Salmonella and E. coli (as an index of fecal contamination of food) and total microbial count.

### Table 1: The main ingredients of ready-to-eat salads and their storage conditions at the market

| Type          | Ingredients                                                                 | Storage conditions |
|---------------|------------------------------------------------------------------------------|--------------------|
| Olivier salad | Meat (chicken or ham or Persian Mortadella), potato, Mayonnaise, pea, carrot, pickled cucumber, spices | Refrigeration      |
| Macarroni salad | Meat (chicken or ham or Persian Mortadella), cooked Macaroni, Mayonnaise, pickled cucumber, sweet corn, carrot | Refrigeration      |
| Sausage salad  | Sausage, tomato paste, bell pepper, spices(potato and mushroom depending on the type of sausage salad) | Refrigeration      |

### Materials and Methods

#### Samples Collection

Overall, 136 packed samples of three types of ready-to-eat salads containing meat products in Tehran food markets were collected. They included 44 Sausage salads (22 Bandari Sausage salads, 18 sausage and potato salads, and 4 sausage and mushroom salads with tomato sauce), 48 Olivier salads (23 Olivier salads with chicken, 6 Olivier salads with ham and 19 Olivier salads with Persian Mortadella), and 44 Macaroni salads (18 Macaroni salads with chicken, 13 Macaroni salads with ham and 13 Macaroni salads with Persian Mortadella) of 10 different brands. These samples were collected...
by simple randomized sampling method from the chain- stores, grocery and cooperative stores in Tehran in 2018. Then they were transported to the laboratory in icebox and refrigerated until the microbial tests were conducted. All salads were packed in polyethylene trays; the packages ranged in weight from 200 to 500 grams. According to the labels, the samples did not receive any special treatment and were certified by the Food and Drug Administration of Iran. The recommended storage condition for all salad samples was refrigeration temperature. The main ingredients of the ready-to-eat salad samples and their storage conditions at the market on the basis of the labels' information are presented in Table 1.

**Microbial Analysis**

Microbial tests including *Salmonella* and *E. coli* detection, and total microbial count were conducted according to the methods recommended by the ISO International Standard as follows:

**Salmonella Detection**

Twenty-five grams of each sample was added to 225 mL of buffered peptone water. After homogenization, the samples were incubated at 37°C for 18-24h, followed by selective enrichment in Rappaport-Vassiliadis medium with soya (RVS) broth at 41.5°C for 24h and Muller-Kauffmann tetrathionate-novobiocin (MKTTn) broth at 37°C for 24h. Then the Xylose Lysine Deoxycholate (XLD) agar and brilliant green agar plates were inoculated with the enriched cultures obtained from the RVS and MKTTn broths and incubated at 37°C for 24h. Typical isolated colonies on the XLD and Brilliant green agar plates were further confirmed using biochemical tests by inoculating in Triple Sugar Iron (TSI) agar slope, Urea Agar Christenson, L-Lysine Decarboxylation (LDC) medium and tryptone water (for indole test).

**E. coli Detection**

*E. coli* was detected by the most probable number (MPN) technique of ISO by enrichment of the homogenate in Lauryl sulfate broth at 37°C for 24h, followed by inoculating the EC broth tubes containing Durham tubes from previous enriched cultures and incubation at 44°C for 24-48h. The positive EC broth tubes (having turbidity and gas production) were cultured in tryptone water and incubated at 44°C for 24-48h. Then they were examined for indole production using Kovacs reagent.

**Total Microbial Count**

Aerobic mesophilic bacteria were enumerated by culturing the dilutions ranging from $10^{-2}$ to $10^{-7}$ in petri dishes containing plate count agar by pour plate method and incubation at 30°C for 72h.

Duplicate plates were used for microbial enumeration. The calculation of the total number of microorganisms was performed according to the ISO International Standard.

**Statistical Analysis**

This is a descriptive and cross-sectional study. Statistical analysis was performed on some of the variables based on Kruskal-Wallis test and one-sample t-test with SPSS 21. P-values less than 0.05 were considered significant. The results were interpreted in accordance with the standard limits in the Iranian National Standard (INS).

**Results and Discussion**

Overall, 136 packed ready-to-eat salad samples containing meat products including 48 Olivier salads, 44 Macaroni salads, and 44 Sausage salads were tested for *Salmonella*, *E. coli*, and total number of microorganisms. According to the INS, none of these salads should be contaminated with *Salmonella* and *E. coli*, and the maximum total number of microorganisms in them should be 5, 3 and 6 log CFU/g, respectively.

**Salmonella Contamination**

In this study, none of the salads was contaminated with *Salmonella* (Table 2). As a result, all samples of Olivier, Macaroni, and Sausage salads were in accordance with (INS). Various factors such as the use of preservatives, type of packaging, cold chain, detection method, and ingredients' antibacterial effect are involved in the detection of microorganisms in food. Therefore, the absence of *Salmonella* in the salad samples of this study does not necessarily mean the absence of *Salmonella*. In studying the survival of *Salmonella* in homemade mayonnaise, lemon juice has a greater inhibitory effect compared to wine vinegar. The INS has also authorized the use of some preservatives in Olivier, Macaroni, and Sausage salads. A recent study confirmed the presence of sodium benzoate and potassium sorbate in the Olivier salad and mayonnaise supplied in Kashan, Iran. The results of the present research are in agreement with the studies conducted in
Yazd,\textsuperscript{41} and Isfahan,\textsuperscript{26} Iran. In another study in the Sharjah markets in the United Arab Emirates, \textit{Salmonella} contamination was not detected in any of the samples.\textsuperscript{23} In 2009-2010, in a study on ready-to-eat salads,(120 samples from 34 kinds) in Istanbul, Turkey, \textit{Salmonella} and \textit{Listeria monocytogenes} were not detected.\textsuperscript{31} The results of a study in Poland indicated that none of the raw Sausage samples was contaminated with \textit{Salmonella}.\textsuperscript{29} In a research in Sweden, \textit{Salmonella} contamination was not detected in 141 ready-to-eat salad samples containing chicken, ham or smoked salmon.\textsuperscript{46}

| Table 2: Frequency distribution of \textit{Salmonella} contamination in the ready-to-eat salads supplied in Tehran, Iran according to the type of salad (2018) |

| Type of Salad       | Not contaminated no (%) | Contaminated no (%) | Total no (%) |
|---------------------|-------------------------|---------------------|--------------|
| Sausage salad       | 44(100)                 | 0(0)                | 44(100)      |
| Olivier salad       | 48(100)                 | 0(0)                | 48(100)      |
| Macaroni salad      | 44(100)                 | 0(0)                | 44(100)      |
| All salad types     | 136(100)                | 0(0)                | 136(100)     |

While evaluating the quality of ready-to-eat salads in Turkey, \textit{Salmonella} species were isolated from 8% of 261 samples supplied in the Turkish market.\textsuperscript{10} In the study of 50 salad samples (30 industrial samples and 20 traditional samples) presented in the sandwich shops of Shahrekord, Iran, \textit{Salmonella} contamination was reported in 9 samples (18%).\textsuperscript{47} In Hong Kong, \textit{Salmonella} isolated from 39% of 115 ready-to-eat samples of Char Sia (Chinese barbecued pork), meaning that secondary contamination is a very serious problem in these shops.\textsuperscript{9} In a national survey in China, 0.56% of the 359 sausage samples were contaminated with \textit{Salmonella}.\textsuperscript{13}

**E. coli Contamination**

\textit{E. coli} contamination was detected in only 0.7% (1 out of 136) of the samples (one sample of Olivier salad with chicken) as shown in Table 3. This result is in agreement with the study of food-borne pathogens in Sweden, in which only 1 out of 141 samples of chicken salad was detected.\textsuperscript{46} In testing 634 samples of ready-to-eat foods collected from 47 stores in three different provinces of Korea, \textit{E. coli} and \textit{Listeria monocytogenes} were detected only in two samples.\textsuperscript{25} In the study on the microbiological quality of 120 samples of ready-to-eat foods in Barbados, WI, \textit{E.coli} was detected in 1.7% of the samples.\textsuperscript{33} When examining the microbial quality of ready-to-eat salads in Turkey, \textit{E. coli} was detected in 4% of the samples.\textsuperscript{10} In the United Arab Emirates, 20% of the 120 ready-to-eat food samples including four types of ready-to-eat salads had \textit{E. coli}, though in a low number of 1 log MPN/g.\textsuperscript{23} In a national survey in China, none of the 321 sausage samples was contaminated with diarrheagenic \textit{E. coli}.\textsuperscript{13}

| Table 3: Frequency distribution of \textit{E. coli} contamination in the ready-to-eat salads supplied in Tehran, Iran according to the type of salad (2018) |

| Type of Salad       | Sausage salad no (%) | Olivier salad no (%) | Macaroni salad no (%) | All salad types no (%) |
|---------------------|----------------------|----------------------|-----------------------|------------------------|
| Not contaminated    | 44(100)              | 47(97.9)             | 44(100)               | 135(99.3)              |
| Contaminated        | 0(0)                 | 1(2.1)               | 0(0)                  | 1(0.7)                 |
| Total               | 44(100)              | 48(100)              | 44(100)               | 136(100)               |

**Total Microbial Count**

As shown in Table 4, the mean total number of microbes in the studied Olivier salad (4.84 log CFU/g) is, in agreement with the standard limit and less than the maximum limit determined by the INS (5 log CFU/g).\textsuperscript{38} However, in the Macaroni salad samples, the mean total number of microbes (4.23 log CFU/g) is higher than the maximum limit.
determined by the INS(3 log CFU/g). The mean total number of microbes in the studied Sausage salads (5.34 log CFU/g) is within the standard range and less than the maximum limit determined by the INS(6 log CFU/g)\(^{39}\) (\(p = 0.001\)).

**Table 4:** Comparison of the mean total number of microorganisms according to the Iranian National Standard limits in ready-to-eat salads supplied in Tehran, Iran (log CFU/g)

| Count / Type       | Mean±SD | Standard limit | P value |
|--------------------|---------|----------------|---------|
| Olivier salad      | 4.84±5.36 | 5              | 0.361   |
| Macaroni salad     | 4.23±4.92 | 3              | 0.206   |
| Sausage salad      | 5.34±6.15 | 6              | 0.001*  |
| All salad types    | 5±5.91   |                |         |

**Table 5:** Descriptive statistics of the total number of microorganisms in the ready-to-eat salads supplied in Tehran, Iran according to salad type (log CFU/g)

| Type Count                          | Mean±SD | IQR** Median (Q\(_{1}\)-Q\(_{2}\)) | Range      | P value |
|-------------------------------------|---------|----------------------------------|------------|---------|
| Olivier salad                       | 4.84±5.36 | 3.26                            | 2.15-3.95 | 1.65-6.04 |
| Macaroni salad                      | 4.23±4.92 | 2.87                            | 2.58-3.73 | 1.51-5.74 | 0.564 |
| Sausage salad                       | 5.34±6.15 | 2.93                            | 2.45-3.77 | 1.36-6.97 |
| All salad types                     | 5±5.91  | 2.95                            | 2.46-3.81 | 1.36-6.97 |

* shows significant difference (\(P<0.05\)).  
**Interquartilerange

Various factors such as use of preservatives, type of packaging, cold chain, and food ingredients are involved in the control of microorganisms in food.

Table 5 indicates that the total number of microorganisms in the three studied salad types was not significantly different (\(p = 0.564\)). In Hong Kong, in a study on the microbial quality of 115 ready-to-eat food samples, the mean total number of aerobic microbes was 5.05 log CFU/g,\(^9\) which is consistent with the results of this study. In a survey on 634 ready-to-eat food samples collected from 47 stores in three different provinces of Korea, the total number of aerobic microbes had a relatively large range of 1.0-7.9 log CFU/g,\(^{25}\) which was much more than the present research results.

**Table 6:** The total number of microorganisms in the studied salads in terms of compatibility with the Iranian National Standard

| Type Status | Maximum standard limit† (log CFU/g) | Compatible no (%) | Incompatible no (%) | Total no (%) |
|-------------|-------------------------------------|-------------------|---------------------|-------------|
| Olivier salad | 5                                    | 43(89.6)          | 5(10.4)             | 48(100)     |
| Macaroni salad | 3                                    | 27(61.4)          | 17(38.6)            | 44(100)     |
| Sausage salad  | 6                                    | 43(97.7)          | 1(2.3)              | 44(100)     |

† According to the Iranian National Standard Limits.\(^{38-40}\)
In the present study, 43 samples (89.6%) of the Olivier salads matched the total number of microorganisms determined by the INS, and only five samples (10.4%) failed to match the standards. While in the Macaroni salads, 27 samples (61.4%) were compatible with the INS and 17 samples (38.6%) were not compatible. Forty-three samples (97.7%) of the Sausage salads matched the total number of microorganisms determined by the INS, and only one sample (2.3%) failed to match the standards (Table 6).

Conclusion
Considering that Salmonella was not detected in any of the tested salad samples, and E. coli was detected only in 0.7% of the samples, and that most of the Olivier, Macaroni and Sausage salad samples were consistent with the INS limits in terms of the total number of aerobic mesophilic microorganisms, the relatively favorable microbial quality of ready-to-eat salads containing meat products supplied in Tehran is confirmed. It is worth noting that various factors such as use of preservatives, detection method, antibacterial effect of ingredients and cold chain are involved in the growth and detection of microorganisms in food products.

Acknowledgements
The authors are grateful for the financial support of this project provided by the National Nutrition and Food Technology Research Institute (NNFTRI), Shahid Beheshti University of Medical Sciences (Tehran, Iran).

Funding
This publication presents the results of a research project (code 0450/1459, 2018) supported by the NNFTRI, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Conflict of Interest
The authors declare that there is no conflict of interest.

References
1. United States Food and Drug Administration. Recommendations of the United States Public Health Service, Food and Drug Administration, FDA Food Code 2009: Chapter 3 Food Available at http://fda.gov/food/fda-food-code/food-code-2009, Accessed 20/1/2020.
2. Codex Alimentarius Commission, Risk Assessment of Listeria monocytogenes. In Ready-to-Eat Foods Guidelines. FAO/WHO Microbiological Risk Assessment, 2004 Series 4. Food and Agriculture Organization, Rome, Italy.
3. Osaili T. M., Alaboudi A. R., Nesar E. A. Prevalence of Listeria spp. and antibiotic susceptibility of Listeria monocytogenes isolated from raw chicken and ready-to-eat chicken products in Jordan. Food Control. 2011; 22(3-4):586-590. 1016/j.foodcont.2010.10.008
4. Francis G. A., Thomas C., O’Beirne D. The microbiological safety of minimally processed vegetables. Int J Food Sci Tech. 1999;34(1):1-22. doi:10.1046/j.1365-2621.1999.00253.x
5. Christison C. A., Lindsay D., von Holy A. Microbiological survey of ready-to-eat foods and associated preparation surfaces in retail delicatessens, Johannesburg, South Africa. Food Control. 2008; 19(7): 727-733. doi:10.1016/j.foodcont.2007.07.004
6. Chung M. S., Kim C. M., Ha S. D. Detection and enumeration of microorganisms in ready-to-eat foods, ready-to-cook foods and fresh-cut produce in Korea. J. Food Saf. 2010; 30(2): 480-489. doi:10.1111/j.1745-4565.2010.00221.x
7. Esfami A., Gholami Z., Nargesi S., Rostami B., Avazpour M. Evaluation of microbial contamination of ready-to-eat foods (pizza, frankfurters, sausages) in the city of Ilam. Environ Health Eng Manag. 2017; 4(2):117-122. doi:10.15171/ehem.2017.16
8. Fallah A. A., Saei-Dehkordi S. S., Mahzounieh M. Occurrence and antibiotic resistance profiles of Listeria monocytogenes isolated from seafood products and market and processing environments in Iran. Food Control. 2013; 34(2):630-636. doi:10.1016/j.foodcont.2013.06.015
9. Ng Y. F., Wong S. L., Cheng H. L., Yu P. H. F., Chan S. W. The microbiological quality of ready-to-eat food in Siu Mei and Lo Mei shops
in Hong Kong. *Food Control.* 2013; 34(2):547-553. doi:10.1016/j.foodcont.2013.05.018

10. Gurler Z., Pamuk S., Yildirim Y., Ertas N. The microbiological quality of ready-to-eat salads in Turkey: A focus on *Salmonella* spp. and *Listeria monocytogenes.* *Int J Food Microbiol.* 2015; 196:79-83. doi:10.1016/j.ijfoodmicro.2014.11.021

11. Hassanain N. A., Hassanain M. A., Ahmed W. M., Shapaan R. M., Barakat, A. M., El Fadaly, H. A. M. Public health importance of foodborne pathogens. *World Journal of Medical Sciences.* 2013; 9(4): 208-222. doi:10.5829/idosi.wjms.2013.9.4.8177

12. Sergelidis D., Abrahim A., Anagnostou V., Govaris A., Papadopoulos T., Papa A. Prevalence, distribution, and antimicrobial susceptibility of *Staphylococcus aureus* in ready-to-eat salads and in the environment of a salad manufacturing plant in Northern Greece. *Czech J Food Sci.* 2012; 30(3): 285-291.

13. Yang S., Pei X., Wang G., et al. Prevalence of food-borne pathogens in ready-to-eat meat products in seven different Chinese regions. *Food Control.* 2016; 65:92-98. doi:10.1016/j.foodcont.2016.01.009

14. Al-Rafai R.H., Chaabna K., Denagamage T., Alali W.Q. Prevalence of non-typhoidal *Salmonella* enterica in food products in the Middle East and North Africa: A systematic review and meta-analysis. *Food Control.* 2020; 109:106908.

15. Caponigro V., Ventura M., Chiancone I., Amato L., Parente E., Piro F. Variation of microbial load and visual quality of ready-to-eat salads by vegetable type, season, processor and retailer. *Food Microbiol.* 2010; 27(8): 1071-1077. doi:10.1016/j.fm.2010.07.011

16. Hur J., Jawale C., Lee J. H. Antimicrobial resistance of *Salmonella* isolated from food animals: A review. *Food Res Int.* 2012; 45(2):819-830. doi:10.1016/j.foodres.2011.05.014

17. Keithlin J., Sargeant J. M., Thomas M. K., Fazil A. Systematic review and meta-analysis of the proportion of non-typhoidal *Salmonella* cases that develop chronic sequelae. *Epidemiol Infect.* 2015; 143(7):1333-1351. doi:10.1017/S0950268814002829

18. World Health Organization, *Salmonella*-(non-typhoidal), https://www.who.int/news-room/fact-sheets/detail/Salmonella-(non-typhoidal) 2019, Accessed 3/13/2019.

19. Eun Y., Jeong H., Kim S., et al. A large outbreak of *Salmonella* enterica serovar Thompson infections associated with chocolate cake in Busan, Korea. *Epidemiol Health.* 2019; 41:e2019002. doi:10.4178/epih.e2019002

20. Luna S., Taylor M., Galanis E., *et al.* Outbreak of *Salmonella* chailey infections linked to precut coconut pieces—United States and Canada, 2017. MMWR Morb. Mortal. Wkly. Rep. 2018; 67(39):1098-1100. doi:10.15585/mmwr.mm6739a5.

21. Nurses M. M., Kota A. L. A. D. A., Caldas E. D. Investigation of food and water microbiological conditions and foodborne disease outbreaks in the Federal District, Brazil. *Food Control.* 2013; 34(1): 235-240. doi:10.1016/j.foodcont.2013.04.034

22. Vestrheim D. F., Lange H., Nygard K., *et al.* Are ready-to-eat salads ready to eat? An outbreak of *Salmonella* Coeln linked to imported, mixed, pre-washed and bagged salads, Norway, November 2013. *Epidemiol Infect.* 2016; 144(8):1756-1760. doi:10.1017/S0950268815002769

23. Almualla N. A., Laleye L. C., Abushelaibi A. A., *et al.* Aspects of the microbiological quality and safety of ready-to-eat foods in Sharjah supermarkets in the United Arab Emirates. *J Food Prot.* 2010; 73(7):1328-1331. doi:10.4315/0362-028X-73.7.1328

24. Campos J., Mourão J., Pestana N., Peixe L., Novais C., Antunes P. Microbiological quality of ready-to-eat salads: An underestimated vehicle of bacteria and clinically relevant antibiotic resistance genes. *Int J Food Microbiol.* 2013; 166(3):525-529. doi:10.1016/j.ijfoodmicro.2013.08.005

25. Cho J. I., Lee S. H., Lim J. S., Koh Y. J., Kwak H. S., Hwang I. G. Detection and distribution of food-borne bacteria in ready-to-eat foods in Korea. *Food Sci Biotechnol.* 2011; 20(2): 525-529. doi:10.1007/s10068-011-0073-y

26. Jalali M., Abedi D., Pourbakhsh S. A., Ghoukasian K. Prevalence of *Salmonella* spp. in raw and cooked foods in Isfahan-Iran. *J Food Saf.* 2008; 28(3): 442-452. doi:10.1111/
27. Kochakkhani H., Dehghan P., Moosavy M. H. Molecular detection of *Salmonella* enterica serovar typhimurium in ready-to-eat vegetable salads consumed in restaurants of Tabriz, North-West of Iran. *J Food Qual Hazards Control*. 2018; 5(4):140-145. doi:10.29252/jfqhc.5.4.5

28. Kotzekidou P. Microbiological examination of ready-to-eat foods and ready-to-bake frozen pastries from university canteens. *Food Microbiol*. 2013; 34(2):337-343. doi:10.1016/j.fm.2013.08.035

29. Modzelewksa-Kapit M., Maj-Sobotka K. The microbial safety of ready-to-eat raw and cooked sausages in Poland: Listeria monocytogenes and *Salmonella* spp. occurrence. *Food Control*. 2014; 36(1):212-216. doi:10.1016/j.foodcont.2013.08.035

30. Neri D., Antoci S., Iannetti L., et al. EU and US control measures on Listeria monocytogenes and *Salmonella* spp. occurrence. *Food Control*. 2014; 36(1):212-216. doi:10.1016/j.foodcont.2013.08.035

31. Öz V., Karadayi S., Çakan H., Karadayi B., Çevik F. E. Assessment of microbiological quality of ready-to-eat foods in Istanbul, Turkey. *J Food, Agric Environ.* 2014; 12(3-4):56-60.

32. Rodríguez M., Valero A., Carrasco E., Pérez-Rodríguez F., Posada G. D. Zureira G. Hygienic conditions and microbiological status of chilled ready-to-eat products served in Southern Spanish hospitals. *Food Control*. 2011; 22(6):874-882. doi:10.1016/j.foodcont.2010.11.015

33. Hull-Jackson C., Mota-Meira M., Adesiyun A. Bacteriological quality and the prevalence of *Salmonella* spp. and *E.coli* O157:H7 in ready-to-eat foods from Barbados, WI. *J. Food Saf.* 2019; 39(3):216-226.

34. International Organization for Standardization. Microbiology of the food chain — Horizontal method for the detection, enumeration and serotyping of *Salmonella* — Part 1: Detection of *Salmonella* spp. ISO 6579-1 (2017).

35. International Organization for Standardization. Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of presumptive *Escherichia coli* — Most probable number technique, ISO 7251 (2005).

36. International Organization for Standardization. Microbiology of the food chain — Horizontal method for the enumeration of microorganisms -- Part 1: Colony count at 30°C by the pour plate technique. ISO 4833-1 (2013).

37. International Organization for Standardization. Microbiology of food and animal feeding stuffs -- General requirements and guidance for microbiological examinations. ISO 7218 (2007).

38. ISIRI. Olivier Salad—Specification & Test Methods. Institute of Standards and Industrial Research of Iran; Karaj, Iran, 2014, ISIRI no 17813, 1st edition, [in Persian].

39. ISIRI. Macaroni Salad—Specifications & Test Methods. Institute of Standards and Industrial Research of Iran; Karaj, Iran, 2015, ISIRI no 19256, 1st edition, [in Persian].

40. ISIRI. Salads—Specifications & Test Methods. Institute of Standards and Industrial Research of Iran; Karaj, Iran, 2019, ISIRI no 22666, 1st edition, [in Persian].

41. Keerthirathne T. P., Ross K., Fallowfield H., Whiley H. A review of temperature, pH, and other factors that influence the survival of *Salmonella* in mayonnaise and other raw egg products. *Pathogens*, 2016; 5(4). doi:10.3390/pathogens5040063

42. Zhu J., Li J., Chen J. Survival of *Salmonella* in home-style mayonnaise and acid solutions as affected by acidulant type and preservatives. *J Food Prot.*, 2012; 75(3):465-471. doi:10.4315/0362-028X.JFP-11-373

43. ISIRI. Sausages—Specifications & Test Methods. Institute of Standards and Industrial Research of Iran; Karaj, Iran, 2005, ISIRI no 2303, 3rd edition, [in Persian].

44. Chaleshtori F. S., Arian A., Chaleshtori R. S. Assessment of sodium benzoate and potassium sorbate preservatives in some products in Kashan, Iran with estimation of human health risk. *Food Chem Toxicol.*, 2018; 120:634-638. doi:10.1016/j.fct.2018.08.010

45. Kaseb F., Shiranian M., Abdar M., Aminalroayaei H., Fallahzadeh H. The Prevalence of *Salmonella* and *Staphylococcus aureus* in Industrial Olivier Salad in Yazd in 2013. *TolooBehdasht*, 2015; 14(3):51-59 [in Persian].
46. Soderqvist K., Lambertz S. T., Vagsholm, Boqvist S. Foodborne Bacterial Pathogens in Retail Prepacked Ready-to-Eat Mixed Ingredient Salads. *J Food Prot*, 2016; 79(6): 978-985. doi:10.4315/0362-028x.jfp-15-515

47. Tajbakhsh F., Tajbakhsh E., Momeni M. Detection of *Staphylococcus aureus* and *Salmonella Typhimurium* in Traditional and Industrial Olivier Salads in Shahrekord City. *Journal of Food Microbiology*, 2015; 2(1):39-48.