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Original article

Assessment of microbiological quality of ready-to-eat foods in institutions providing mass feeding

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Summary. *Objective:* This study was designed to evaluate microbiological quality of ready-to-eat foods in institutional mass feeding and to determine their risk for food poisoning. In the study, 275 ready-to-serve food samples were evaluated in institutional feeding. The food groupings in the Turkish Food Codex Regulation Supplementary Document I and parameters established in food safety criteria in Supplementary Document I and III were adopted. The samples were analyzed for parameters about coagulase-positive Staphylococci (TS EN ISO 6888-1/A1), *B. cereus* (TS EN ISO 7932), *E. coli* (TS ISO 16649-2), Staphylococcal enterotoxins (AOAC OMA) 2007.06 - VIDAS SET 2), *Salmonella spp*. (TS EN ISO 6579-1), *L. monocytogenes* (TS EN ISO 11290-1) and mold - yeast (TS ISO 21527-1/2) by reference methods. Of the samples analyzed, 250 samples (90.9%) were found appropriate for consumption while 25 samples (9.1%) as inappropriate according to Microbiological Criteria Regulation. It was concluded that meats served warm carry risk for *L. monocytogenes, B. cereus* and *E. coli* parameters while salads-appetizers served cool carry risk for *L. monocytogenes* and *Salmonella spp*. and deserts, particularly cream cakes, carry risk for *E. coli* and mold - yeast parameters.

Key words: ready-to-eat food, hygiene, microbiological quality, public health

Introduction

Nutrition, providing basis for maintaining life, is a process that involves intake, digestion, absorption and metabolizing nutrients required for function of body with foods (1, 2). Mass feeding defined as feeding of individuals out of home by foods and beverage planned and prepared from a center has become increasingly important (3-5).

There are several organizations serving food out of home. Food services previously given in restaurants and eating houses have evolved to mass feeding industry through provision of food services to employees with own kitchen and dining hall by institutions where substantial number of individuals employed and emergence of food factories providing food services to these institutions (4-6).

The demand for mass feeding is increased by increasing number of working individuals, participation of women into professional life, acceleration of urbanization, alterations in standards, economic and sociocultural environment, need for and interaction with comfort and ready-to-eat food (6-8).

The incidence of food poisoning is higher in institutions providing mass feeding when compared to home conditions since substantial amounts of food is produced in institutions providing mass feeding on contrary to home conditions (7, 8).

Products marketed in food stores and ready to consume instantly are termed as ready-to-eat food (9, 10). These foods are ready to consume as raw or cooked, cold or hot, or without additional heat treatment (9).

Based on data from previous studies, more than 70% of foodborne diseases are linked to food service or

catering sectors. Microorganisms that causes contamination during a cascade of processes ranging from food production to delivery to consumers can lead impaired sensory properties, economical losses and foodborne diseases by growing rapidly in case of suitable conditions (11-13). In this process, staff hygiene is one of the most important steps of chain of hygiene. In addition, other contamination sources include chopping boards, slicers, mixers, grinders, water and air used in the stages of food production and processing as well as waste, insects, rodents and pets that should not be in the production media (12).

In a study by Aksu et al., it was suggested that food poisoning caused by ready-to-eat foods mainly occurred in hotels, restaurants, school or student residence which provide food services (14).

Lack of microbiological safety of food remains to be a global public health issue. The attempts to take novel measures to improve food safety have been made in response to increase in foodborne diseases globally. Some arrangements have been made in regulations to establish a "Food Safety Management System" for manufacturers in the field of agriculture; as such, it is aimed to prevent foodborne outbreaks (15). In our country, the most recent regulation for this purpose is Turkish Food Codex Microbiological Criteria Regulation established by Republic of Turkey, Agriculture and Livestock Ministry (16).

The aim of this study is to investigate the microbiological quality of ready-to-eat meals offered in mass feeding institutions and to determine the risk of food poisoning.

Materials and Methods

In this study, 275 food samples were taken from ready-to-eat foods served in 15 institutions providing mass feeding in Ankara between December, 2018 and February 2019. Samples of ready-to-eat meals were taken from non commercial (school, workplace, etc.) and commercial nutritional institutions (restaurants, cafes, etc.).

Food samples (100 g each) were taken into sterile containers in aseptic conditions and transferred to laboratory in transport vessels containing pack ice within 4 hours. The samples were analyzed within the same day by taking parameters established in food safety criteria in Turkish Food Codex Microbiological Criteria Regulation Document I and III into account. In our study, the ready-to-eat food samples analyzed were grouped according to section in 1.13 Ready-to-Eat Foods in Supplementary Document I of Turkish Food Codex Microbiological Criteria Regulation: 1.13.1. all kinds of ready-to eat cooked meat and vegetables etc. (grilled chicken thighs served with saffron rice, mexican chicken, meat sauteed, okra with meat, green peas with meat, beef barbecue, chicken schnitzel, roast beef, chicken thighs with broccoli and carrots, kebab with mashed potatoes, roasted meatballs); 1.13.2. all kinds of ready-to eat salads, delicatessen products and cold appetizers etc. (potato salad, amasra salad, coleslaw salad, olive oil bean, iceberg salad, mediterranean salad); 1.13.3. all kinds of ready-to-eat cooked bakery products including all kinds of pastry, pancake with spicy meat filling, pita, pizza, Turkish ravioli etc. (phyllo pastry stuffed with cheese, pasta with yogurt, pasta with basil sauce, rice pilaf, baked pasta with béchamel sauce and cheese, noodle with walnuts and cheese); 1.13.4 all kinds of ready-to-eat cooked deserts including pudding, milk pudding, cream cake, Noah's pudding and etc. (fruit cup, chocolate cake, tiramusu, eclair pie, pudding, rice pudding, semolina dessert with milk and chocolate). The samples were analyzed according to limits and parameters described in food safety criteria in Turkish Food Codex Microbiological Criteria Regulation Supplementary Document I and III. The parameters included coagulase-positive Staphylococci, *B. cereus, E. coli,* Staphylococcal enterotoxins, *Salmonella spp., L. monocytogenes* and mold - yeast. Reference methods were used for analyses, including TS EN ISO 11290-1 for *L. monocytogenes,* TS ISO 21527-1/2 for mold - yeast, TS EN ISO 6888-1/A1 for coagulase positive staphylococcus, TS EN ISO 7932-Mannitol Yolk Polymyxin (MYP) agar for *B. cereus* count, TS EN ISO 6579-1-Mini Vidas method for *Salmonella spp.* Count, Association of Official Analytic Chemists Official Methods of Analysis (AOAC OMA) 2007.06-VIDAS SET for Staphylococcal enterotoxins and TS ISO 16649-2 for *E. coli* count (16). Microbiological analyzes of ready-to-eat meals were carried out once.

In the microbiological analysis, the change in units (MPN/g or cfu/g) resulted from analytical methods. The methods were determined according to limits in Turkish Food Codex. If limit value was low (for example, <3 for E. coli), EMS method was used.

Results

Table 1 presents distribution of 275 ready-to-eat foods sampled for microbiological analyzes according to food groups. Of 275 samples, 64 (23.63%) were all kinds of ready-to eat cooked meat and vegetables etc. whereas 90 (30.72%) were all kinds of ready-to eat salads, delicatessen products and cold appetizers etc.; 25 (9.10%) were all kinds of ready-to-eat bakery products including all kinds of pastry, pancake with spicy meat filling, pita, pizza, Turkish ravioli and etc; and 79 (28.73%) were all kinds of ready-to-eat deserts including pudding, milk pudding, cream cake, Noah's pudding etc. (16).

Table 2 presents groupings of ready-to-eat foods according to Turkish Food Codex Microbiological Criteria Regulation (16) and their appropriateness. Of the food samples analyzed, 250 samples (90.9%) were found appropriate for consumption while 25 samples (9.1%) as inappropriate according to Microbiological Criteria Regulation.

It was found that, of 25 ready-to-eat food product found to be inappropriate for consumption, 3 (4.6%) were cooked meat and vegetable dishes whereas 8 (8.9%) were salads, delicatessen products and appetizers; 2 (8.0%) were cooked bakery products) 11 (13.9%) were deserts (milk puddings, cream cakes, pudding etc.) and one (6.25%) were other foods (sauces, kashar cheese).

No coagulase positive Staphylococci or Staphylococcal enterotoxin was detected in 275 ready-to-eat food samples analyzed in our study. Table 3 presents distribution of 25 food samples found to be inappropriate for consumption according to food groups and microbiological parameters. Of these samples, 5 were found inappropriate according to L. monocytogenes while 2 according to *Salmonella spp*., 10 according to *E. coli,* one according to *B. cereus* and 7 according to mold - yeast parameters. Of samples found to be inappropri-

Table 1. Distribution of ready-to-eat food samples according to food groups

Food Group	Number of samples	%
All kinds of ready-to eat cooked meat and vegetables etc.	65	23.63
All kinds of ready-to eat salads, delicatessen products and cold appetizers etc.	90	32.72
All kinds of ready-to-eat cooked bakery products including all kinds of pastry, pancake with spicy meat filling, pita, pizza, Turkish ravioli etc	25	9.10
All kinds of ready-to-eat cooked deserts including pudding, milk pudding, cream cake, Noah's pudding and etc.	79	28.73
Other	16	5.82
Total	275	100.0

Table 2. Assessment of food groups according to results of analyses

Food Group	Sample	Appropriate		Inappropriate	
	Number	Number	%	Number	%
All kinds of ready-to eat cooked meat and vegetables etc.	65	6	95.4	3	4.6
All kinds of ready-to eat salads, delicatessen products and cold appetizers etc.	90	82	91.1	8	8.9
All kinds of ready-to-eat cooked bakery products including all kinds of pastry, pancake with spicy meat filling, pita, pizza, Turkish ravioli etc	25	23	92.0	2	8.0
All kinds of ready-to-eat cooked deserts including pudding, milk pudding, cream cake, Noah's pudding and etc.	79	68	86.1	11	13.9
Other	16	15	93.75	1	6.25
Total	275	250	90.9	25	9.1

Table 3. Distribution of inappropriate microbiological parameters in ready-to-eat foods according to food groups

Microbiological Parameter		***L. Monocytogenes***	***Salmonella Spp.***	***E.coli***	***B. cereus***	***Mold - yeast***
Food Group	**Sample Number**	**Analysis result/ Acceptable limit (in 25 g)**	**Analysis result/ Acceptable limit (in 25 g)**	**Analysis result/ Acceptable limit *<10 cfu/g - <3 MPN/g**	**Analysis result/ Acceptable limit 1.000 cfu/g**	**Analysis result/ Acceptable limit 1.000 cfu/g**
All kinds of ready-to eat cooked meat and vegetables etc.	3	Positive	-	10 cfu/g	3.800	-
All kinds of ready-to eat salads, delicatessen products and cold appetizers etc.	8	Posİtİve Posİtİve Posİtİve Positive	Posİtİve	320 cfu/g 30 cfu/g 30 cfu/g	-	-
All kinds of ready-to-eat cooked deserts including pudding, milk pudding, cream cake, Noah's pudding and etc.	11	-	Posİtive	3.6 MPN/g 7.4 MPN/g 9.2 MPN/g 23 MPN/g 20 MPN/g 1.100 MPN/g		>15.000 >15.000 >15.000 >15.000
All kinds of ready-to-eat cooked bakery products including all kinds of pastry, pancake with spicy meat filling, pita, pizza, Turkish ravioli etc	2	-	-	-	-	3.000 >15.000
Other (sauces, kashar cheese	1	-	-	-	-	9.600
Total (Number-%)	25 %100	5 20%	2 8%	10 40%	1 %4	7 %28

ate according to *E.coli;* 6 were desert samples while 3 were salad samples. Of samples found to be inappropriate for *L. monocytogenes* parameters, 4 were salad and appetizer samples while one were meat samples. Again, of the samples found to be inappropriate for mold - yeast parameters, 4 were desert samples while 2 were pasta-rice samples.

Overall, *L. monocytogenes* was found to be positive in 5 samples including one cooked meat sample and 4 salad-appetizer samples, which is not allowed in 25 g of food according to Turkish Food Codex Microbiological Criteria Regulation (16).

The *E. coli* count was found as 1.100 MPN/g in the tiramusu sample among 6 desert samples found to be inappropriate according to *E. coli* parameter. Among deserts, *E. coli* growth was detected particularly in cream cakes such as tres leche cake, chocolate chestnut cake and chocolate cream cake while no growth was detected in milky puddings and semolina desert. Of 3 salad-appetizer samples found to be inappropriate to consumption according to *E. coli* parameter, *E. coli* count was found as 320 cfu/g in potato salad. This was the highest *E. coli* burden in ready-to-eat foods. While preparing potato salad in stripping stage, staff with contaminated hand by microorganisms, particularly by coliform bacteria and coagulase positive Staphylococci, can cause contamination in potato salad.

Salmonella spp. was found to be positive in salad-appetizer (chickpea salad) and desert (chocolate brownie) samples.

B. cereus was found as 3,800 cfu/g in sautéed meat. Mold - yeast growth was found as >15,000 cfu/g in 4 deserts including chocolate cake, eclairs, and tiramisu samples whereas >15,000 cfu/g and 3,000 cfu/g in 2 bakery products including sandwiches and 9,000 cfu/g in a ready-to-eat sauce.

Discussion and Conclusion

In our study, it was found that proportion of ready-to-eat food with appropriate microbiological

quality was 90.9% while proportion of those found to be inappropriate was 9.1% in institutions providing mass feeding. It was also found that bacterial growth detected differed according to type of food. In a study by Ergül et al., it was shown that microbiological quality was good in ready-to-eat foods served in distinct places (92%). Authors reported that proportion of products inappropriate to consumption was 8% and that bacterial growth differed based on type of food (17). In our study, microbiological quality of ready-to-eat foods was found to be comparable to those reported in the study by Ergül et al.

In our study, it was concluded that ready-to-eat foods, particularly meat and vegetables, deserts and salads carried risk for *E. coli, Salmonella spp.,* and *L. monocytogenes* parameters. In addition, no coagulase positive Staphylococci, Staphylococcal enterotoxins and *S. aureus* was detected in foods analyzed, which was considered as favorable.

In several studies, it was seen that *Salmonella, E. coli 0157, L. monocytogenes* and *Campylobacter spp.* frequency was rather low in ready-to-eat foods (18, 19).

In a study by Yalçın and Can, 100 ready-to-eat foods were evaluated for parameters of *Salmonella spp., S. aureus, E. coli* and *B. cereus*. As similar to our study, it was reported that no *S. aureus* growth was detected in these samples (20). In that study, it was reported that there was *S. aureus* (1×10^2 - 4×10^2 cfu/g) in 8 samples, *B. cereus* (1×10^2 - 3×10^2 cfu/g) in 7 samples *E. coli* (1×10^2 - 2×10^2 cfu/g) in 6 samples analyzed. Of these foods, only those with *E. coli* growth showed incompliance to criteria defined in relevant regulation (20). In another study, microbiological features of 30 ready-to-eat doner kebap were investigated (21). In analyses, no *S. aureus* and sulfide-reducing anaerobic bacteria growth was detected in doner kebap samples while it was reported total aerobic mesophilic bacteria count ranged between 10^3 and 10^4 cfu/g, reaching up 10^6 cfu/g in some samples. In the same study, 36.6% of doner kebap samples was found to be negative for *Enterobacteriaceae* while 56.6% for *E. coli*. Bacteria counts were reported to be 10^4 and 10^3 cfu/g in samples with *Enterobacteriaceae* and *E. coli* growth, respectively. In both studies, it was shown that meat dishes can comprise risk for health due to poor hygiene applications despite they are served after cooking. In our study, *E. coli* was detected in a sample from meat meal and bacteria number was found as 10 cfu/g.

In a study by Arıcı et al. (22), it was found that coliform bacteria and *E. coli* were detected in most of ready-to-eat salad samples analyzed and that bacteria number were 10^2-9.2×10^6 and 25-10^4 cfu/g, respectively. In addition, authors reported that *S. aureus* number ranged between 1.2 and 2.8×10^3 cfu/g. In our study, *E. coli* was detected in samples from salad group and bacteria number was found to range from 30 cfu/g to 320 cfu/g. In our study, *L. monocytogenes* was found in 4 and *Salmonella spp.* in one of 90 samples. The high bacterial burden and consequent hygiene risks are well-known in raw vegetables and salads using these vegetables. Chopping and rasping of vegetables during salad preparation will not only promote growth of already present microorganisms but also lead contamination with microorganisms. Thus, salads could be considered as risky foods in term of public health.

In a study by Can and Yalçın (20), microbiological evaluation was performed in 50 cake samples (23). Based on analysis, no *Salmonella spp*. and *L. monocytogenes* was detected in the samples. In our study, no *L. monocytogenes* was detected in cake samples in the desert group and *Salmonella spp*. was found to be positive in only one sample. In our study, 11 desert samples were found to be inappropriate, including cake, eclairs, tiramisu, chocolate brownie, tres leche cake and chocolate chestnut cake. In that study, it was reported that *E. coli* was detected in 4 of cake samples and that bacteria number ranged from 9 to 21 cfu/g. In our study, *E. coli* was detected in 6 of cake samples in the desert group and microorganism number was found as 3.6-1,100 MPN/g.

In the study by Hilal Çolak et al. (24), coliform bacteria was detected in 28 (30.4%) of 92 samples including 7 (28%) of meat meal samples, 3 (20%) of 15 meat-free vegetable meal samples, 6 (30%) of 20 rice samples, 3 (20%) of pasta samples and 9 (52.9%) of 17 mashed potato samples with levels ranging from 5.5×10^2 to 6.2×10^4 cfu/g (24). In our study, *E. coli* was detected 10 (3.6%) of 275 samples including one (1.5%) 65 meat meal sample, 6 (7.6%) of 79 desert samples and 3 (3.3%) of 90 salad-appetizer samples with levels of 10 cfu/g -320 cfu/g and 3.6 MPN/g-1,100 MPN/g. in our study, it was seen that proportion of ready-to-eat food in which *E. coli* was detected was lower. This may

be due to differences in hygiene procedures of institutions and level of knowledge of staff about hygiene.

In a study by Ildız and Çiftçioğlu (25), *E. coli* was detected in 4 (7.69%) of 52 soup samples and 8 (15.09%) of 53 meat meal sample. In our study, ineligibility rate was found as 4.6% in meat dish group, 8.9% in salad-appetizer group, 8% in bakery product group and 13.9% in desert group when assessed regarding ineligibility to all parameters. The ineligibility rates in our study were lower than those reported in the study by Ildız and Çiftçioğlu.

In a study by Aksu (14), coliform bacteria was detected in 15 rice samples (<10-5.4 x 10^4 cfu/g) and 5 pasta samples (3.6 x 10^2 cfu/g -1.6 x 10^3 cfu/g) while *E. coli* was detected in one rice sample containing meat and vegetable. In that study, it was reported that *E. coli* was isolated up to 30% of meat-rich products. In our study, mold - yeast was found as >15,000-3,000 cfu/g in 2 samples from bakery products but no *E. coli* was detected. This may be due to fact study by Aksu dated previous period and novel industrial hygiene and disinfection products are being used to ensure food and personal hygiene during this period. Presence of coliform microorganisms in ready-to-eat food is considered as a marker for failure of heat treatment or recontamination following heat treatment. In addition, coliform microorganisms can also be found in these foods as a result of inappropriate sanitation procedures (26). Presence of *E. coli* in ready-to-eat foods is an indicator for fecal contamination.

In our study, *S. aureus* was detected in none of samples analyzed. Lack of *S. aureus* in the samples was considered as beneficial for public health. In the contamination of foods with *S. aureus*, the most important is food processing in poor conditions and it generally contaminates foods via staff involved in food services and surfaces having contact with foods (chopping board, knife etc.) (27). Another important way is cross-contamination between raw and cooked foods (26).

In our study, *B. cereus* was detected in one (0.36%) of 275 samples in meat meal group at a level of 3,800 cfu/g. In a study, Ayçiçek et al. (27) reported that *B. cereus* was detected in none of ready-to-eat food samples from different food groups. In our study, rate for *B. cereus* was lower than those reported by Aksu and comparable to those reported by Ayçiçek et al.

In a study on microbiological quality of ready-to-eat raw seafood such as sashimi and sushi, analyses were performed by 8 foodborne pathogen (*B. cereus, E. coli O157: H7, Listeria monocytogenes, Salmonella spp., S. aureus, Vibrio cholerae, V. parahaemolyticus* and *Vibrio vulnificus*) and unacceptable growth levels were detected. Ready-to-eat raw seafood such as Sashimi and sushi can be readily contaminated by bacteria originated from water environment and human reservoirs, comprising risk for food poisoning (28).

In conclusion, it was found that microbiological quality is generally sufficient (90.9%) in ready-to-eat foods analyzed. It was seen that type of parameters in which ready-to-eat foods were found to be ineligible varied according to food type.

In our study, ready-to-eat foods marketed and served hot carried risk for *L. monocytogenes, B. cereus* and *E. coli* parameters while products served cool such as salad-appetizer carried risk for *L. monocytogenes* and *Salmonella spp*. parameters and cream cakes in desert group carried risk for *E. coli* and mold - yeast parameters. Presence of *E. coli, Salmonella spp., L. monocytogenes* and *B. cereus* in ready-to-eat foods at varying levels is considered as risk for public health.

To eliminate these risks, one should adopt measures of food and personnel hygiene and adequate disinfection and cleaning of equipments and tools used in kitchen should be performed. The awareness of hygiene should be improved by training kitchen staff about hygiene.

Core temperature should reach up to 75˚C - 80˚, which is considered as safe temperature during cooking phase. In re-heated foods, core temperature should also reach up to 75˚C - 80˚ which must be maintained for 2 minutes. Chafing food for warm service can be maintained maximum 2 hours and temperature should not fall below 63˚C. In foods undergoing cooling process, temperature should be cooled rapidly as being 21˚C within 2 hours and <4˚C within 4 hours.

References

1. Baysal, A. Beslenme. Hatipoğlu Yayınevi, 18. Baskı, Ankara, 2018, p.9-12.
2. Kutulay, Merdol, T., Dağ, A., Baş, M. et al. Genel Beslenme.

T.C. Anadolu Üniversitesi Yayını No:2768. 3. Edition. 2018, p.45-60.
3. Brown, J.E. Nutrition Now. West Publishing Company, 8 th Edition, 2017, p.1.3-1.7.
4. Kutluay, Merdol. T. Temel Beslenme ve Diyetetik. Güneş Tıp Kitapevleri.2015, p. 423-425.
5. Ninemeier, J. D. Planning and Control for Food and Beverage Operations. Eighth Edition, Educational Instıtute American Hotel and Motel Association, 2013, p.11-13.
6. Davis, B., Lockwood, A., Pantelidis, İ., Alcott, P. Food and Beverage Management. 6th Edition. 2018, p.1-2
7. Beyhan, Y. Toplu Beslenme Sistemlerinin Yönetim ve Organizasyonu. Nobel Tıp Kitapevleri, 2018, p.383-384
8. Palacio, P.J., Theis, M. Food Service Managemet Principles and Practices.13th Edition. 2016, p.4, 38-39, 65-67.
9. Alyaaqoubi SJM, Sani NA, Abdullah A, Rahman RDA. Microbiological quality of selected ready-to-eat food at Hulu Langat district, Malaysia. Prosiding Seminar Kimia Bersama UKM-ITB VIII 9-11 June 2009, Pp. 422.
10. Oranusi US, Braide W. A study of microbial safety of ready-to-eat foods vended on highways: Onitsha- Owerri, South East Nigeria. Int Res J Microbiol, 2012; 3(2): 66-71.
11. Bilgin B, Erkan ÜC. Bir Hazır yemek işletmesinde HACCP sisteminin kurulması. Tekirdağ Zir Fak Derg, 2008; 5(3): 268-81.
12. Fidan F, Ağaoğlu S. Ağrı bölgesinde bulunan lokantaların hijyenik durumu üzerine araştırmalar. YYÜ Vet Fak Derg, 2004; 15(1-2): 107-14.
13. Afshin J, Reza Z, Saeid S. Microbiological study of cocktail sausage during shelf life. Middle-East J Sci Res, 2011; 7(6): 1056-1056.
14. Aksu H. İstanbul'da tüketime sunulan bazı hazır yemeklerin mikrobiyolojik kalitesi üzerine araştırmalar. V. Ulusal Halk Sağlığı Kongresi Kitabı, İstanbul, 1996.
15. Jacxsens L, Kussaga J, Luning PA, Van der Spiegel M, Devlieghere F, Uyttendaele M. A microbial assessment scheme to measure microbial performance of food safety management systems. Int J Food Microbiol, 2009; 134: 113–25.
16. Anonymous. Türk Gıda Kodeksi Mikrobiyolojik Kriterler Yönetmeliği. Ankara: T.C. Gıda Tarım ve Hayvancılık Bakanlığı, 2011.
17. Ergül Ş. S, Sarı H, Ertaş S, Berberoğlu U, Cesaretli Y, Irmak H. Tüketime sunulan çeşitli hazır yemek ürünlerinin mikrobiyolojik kalitesinin belirlenmesi. Türk Hij Den Biyol Derg, 2015; 72(3):199-208.
18. Hosein A, Muñoz K, Sawh K, Adesiyun A. Microbial load and the prevalence of Escherichia coli, Salmonella spp. and Listeria spp. in ready-to-eat products in Trinidad. The Open Food Sci J, 2008; 2: 23-8.
19. Anonymous. Guidelines for assessing the microbiological safety of ready-to-eat foods placed on the market. http://www.hpa.org.uk/ webc/hpawebfile/ hpaweb_c/1259151921557. 31.12.2013.
20. Yalçın H, Can ÖP. Tüketime hazır bazı et yemeklerinin mikrobiyolojik kaliteleri. Erciyes Üniv Vet Fak Derg, 2013; 10(1): 1-6.
21. Bostan K, Yılmaz F, Muratoğlu K, Aydın A. Pişmiş döner kebaplarda mikrobiyolojik kalite ve mikrobiyel gelişim üzerine bir araştırma. Kafkas Univ Vet Fak Derg, 2011; 17(5): 781-6.
22. Arıcı M, Gümüş T, Şimşek O. Hazır salataların hijyenik durumu. Gıda, 2003, 28(6): 571-7.
23. Can ÖP, Yalçın H. Mersin'de tüketime sunulan kremalı pastaların mikrobiyolojik kalitelerinin değerlendirilmesi. Gıda Teknol Elektr Derg, 2011; 6(3): 42-8.
24. Çolak H, Ulusoy B, Bingöl B, Hampikyan H, Muratoğlu K. Tüketime sunulan bazı hazır yemeklerin mikrobiyolojik kalitelerinin incelenmesi. Turk Mikrobiyol Cem Derg, 2007; 37(4): 225-33.
25. Ildız F, Çiftçioğlu G. Toplu tüketim amacıyla üretilen gıdaların patojen mikroorganizmalar yönünden incelenmesi. İ.Ü. Veteriner Fak Derg 1997;23(2):405-412
26. Uğur M, Nazlı B, Bostan K. Gıda Hijyeni. İstanbul: Teknik Yayınları, 2002.
27. Aycicek H, Sarimehmetoğlu B, Cakiroğlu S. Assessment of the microbiological quality of meals sampled at the meal serving units of a military hospital in Ankara, Turkey. Food Control 2004; 15: 379- 384.
28. Kim H.W., Hong Y J., Jo J I., Ha S.D., Kim S.H., Lee H.J., Rhee M.S. Raw ready-to-eat seafood safety: microbiological quality of the various seafood species available in fishery, hyper and online markets. Lett Appl Microbiol. 2017 Jan;64(1):27-34.

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