Original Article

MICROBIAL QUALITY OF COOKED MEAT FOODS IN TEHRAN UNIVERSITY'S RESTAURANTS

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ABSTRACT

Objective: Evaluation of microbial load of cooked meat in university restaurants.

Methodology: Two hundred sixteen samples from four types of consumed foods in six clinical and educational centres were assessed for bacterial contamination by standard methods.

Results: There was no contamination with *Salmonella* and Listeria monocytogenes. Mean of total bacterial and coliform counts in grilled ground meat samples were 1.14×10^5 CFU/g and 1.98×10^2 CFU/g respectively. Twenty one (38.9%) out of 54 examined samples of grilled ground meat had *E.coli* contamination and *S.aureus* were found in 30 (55.6%) samples. Mean quantity of total bacterial contamination were 2.85×10^2 CFU/g for fish samples and there was no presence with coliforms or other pathogenic bacteria in this food.

Conclusion: Some foods (especially grilled ground meat) had contamination loads which were higher than accepted standards. Omitting grilled ground meat from food schedule, especially in warm seasons, may reduce the hazard of food poisoning.

KEY WORDS: Bacterial contamination, Food, University restaurants.

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INTRODUCTION

Food-borne diseases have been introduced as an imperative health problem in different countries. These diseases have the third incidence after respiratory and cardiovascular diseases in USA.[1] According to the reports from National Health Agencies, mean incidence of food born diseases in the European and developing countries are 38.3 and 915.8 in hundred thousand population, respectively. For example this rate has increased from 19 cases in hundred thousand population in 1985 to 62 cases in hundred thousand population in 2000 in Australia and from 30 cases in 1983 to 116 cases in hundred thousand population in 2001 in Spain.[2]

In developing countries like Iran, there is no precise data about the incidence of food born diseases, but seems to be higher in comparison with developed countries due to unfavourable settings of preparation, storage, distribution and consumption of foodstuffs and also low health educational level in these countries. In Iran, about 25% of foodstuffs decay, inattentiveness to the health issues and rules, and production of fraudulent products result in different epidemics every year.[3] World Health Organization (WHO) has reported that 50

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million children under five years of age get diarrhoeal diseases each year from which nearly three million die and 40% to 60% of these diseases have been reported to be due to contaminated water and foodstuffs.[2]

Food codex has classified meat and protein-rich foodstuffs and salads in high risk foods. Soriano, in a study of microbiological quality of lettuce served in University restaurants, the contamination rate of *E.coli, S. aureus*, A. hydrophila and *P. aeroginosa* were determined to be 25.7, 22.9, 10.4 and 2.8 percent respectively.[4] Hygienic and quality control of cooked foods especially in the university restaurants has been recommended in many countries. One of the most important methods for quality control is using microbial standards with microbiological examinations. These examinations include T.B.C, Coliform count and survey of pathogenic bacteria including *E.coli, S.aureus, Salmonella SPP, L.monocytogenes*, and *Cl.perfringens*.[5,6] Attention to health issues of the personnel of any institute is one of the most crucial responsibilities of the health authorities. Since consumption of healthy food is one of the significant factors affecting the health, such studies are extremely important and will be helpful in supervision and control of quality of foodstuffs, especially in university centres.

This study was conducted to evaluate the extent of bacterial contaminations of foodstuffs made available in one of Tehran Medical Sciences Universities. We also aimed to assess their contamination with coliforms and important pathogenic species of bacteria and compare them with current standards of Iran.

METHODOLOGY

This is a descriptive, analytical and cross-sectional study, in which six clinical and educational centres (A to F) of Baqiyatallah University of Medical Sciences were evaluated. In three consecutive episodes with two-month intervals, we collected samples of routinely consumed foods in these centres (grilled ground meat, chicken, grilled chicken and fish) (N=216) by using standard methods introduced by Iran national standard institute (Number 356, 437, 194 and 815). We transported all samples in sterile environment to the laboratory in the shortest possible time. By using American Public Health Association (APHA) standard guidelines, we performed the following examinations: bacterial total count, coliform count, *E. coli assay, Staphylococcus aureus assay* and counting and assessment of *Salmonella* and Listeria monocytogenes.[5] Statistical analysis was done using SPSS-13 statistical software package and ANOVA test. $P<0.05$ was considered as significant.

RESULTS

Total bacterial and coliform counts (mean ± SD) in samples of grilled ground meat were calculated as $1.14 \times 10^5 \pm 1.51 \times 10^2$ (CFU/g) and $1.98 \times 10^2 \pm 0.94 \times 10$ CFU/g, respectively (Table-I&II). Total bacterial count in fish samples was $5.59 \times 10^4 \pm 8.07 \times 10$ CFU/g and no contaminations with coliforms or other pathogenic bacteria were found in this food. *E.coli* was found in 27 (12.5%) out of 216 food samples evaluated in this study and *staphylococcus aureus* contamination was confirmed in

Table-I: Mean total bacterial contamination (CFU/g) in 4 different foods served in the study centres

Centre	*Grilled ground meat*	*Chicken*	*Fish*	*Grilled chicken*
A	1.26×10^3	1.67×10^3	2.29×10^3	2.91×10^3
B	*2.91×10^5	4.64×10^4	5.91×10^4	8.22×10^4
C	6.59×10^4	6.01×10^4	4.26×10^4	6.39×10^4
D	*2.2×10^5	4.19×10^4	5.2×10^4	6.43×10^4
E	2.67×10^2	3.46×10^2	5.67×10^2	2.25×10^3
F	9.67×10^4	2.09×10^4	*1.79×10^5	*1.58×10^5
Total mean	1.14×10^5	2.85×10^4	5.59×10^4	6.23×10^4

*Higher than standards contamination load

Table-II: Mean total coliform contamination (CFU/g) in four different foods served in the study centres

Centre	*Grilled ground meat*	*Chicken*	*Fish*	*Grilled chicken*
A	5.5×10^1	0	0	0
B	* 3.02×10^2	*2.07×10^2	0	*2.17×10^2
C	* 2.64×10^2	*1.06×10^2	0	1×10^2
D	*2.51×10^2	0	0	*1.58×10^2
E	* 1.16×10^2	0	0	*1.58×10^2
F	* 2.01×10^2	5.8×10^1	0	0
Mean	1.98×10^2	6.1×10^2	0	1.05×10^2

*higher than standards contamination load

30 (13.8%) samples (Table-III). Twenty one of 27 *E.coli* positive samples were derived from grilled ground meat and six samples were of chicken and grilled chicken. All 30 *Staphylococcus aureus* positive samples were taken from grilled ground meat. We did not find any contamination with *Salmonella* or Listeria monocytogenes in 216 evaluated samples. In this study, we compared mean total bacterial counts of different foods derived from six different university centres. Total bacterial count of grilled ground meat and grilled chicken samples of centres B and F had significant differences ($p< 0.05$) compared with samples taken from other centres (Table-I). Assessment of total coliform count was only feasible for grilled ground meat samples, which did not show any significant difference (Table-II). Comparison of the evaluated centres in this study demonstrated that samples taken from centre B (for coliform and *Staphylococcus aureus* contaminations) and centre F (according to total bacterial count) had the higher contamination loads while samples taken from centre A and E showed the least contamination.

DISCUSSION

According to CDC and NHA reports foodborne diseases are among the most important health problems in both developed and developing countries.[1] In countries like Iran, foodborne diseases have higher prevalence and incidence comparing with developed countries.[7] This study demonstrates that grilled ground meat has the highest contamination load according to the total bacterial count, total coliform count and the presence of pathogenic bacteria like *E.coli* and *S.aureus* (Table-III). We use plate count method for bacteriological tests (TBC and Coliform count), although Paulsen believes automated MPN method can be suitable alternative.[8] *E.coli* was found in 27 (12.5%) out of 216 food samples evaluated in this study while 21 of these samples were taken from grilled ground meat. All 30 *S.aureus* positive samples were also among grilled ground meat samples. Contamination of fish, chicken and grilled chicken samples were higher than acceptable standards in centre F. This finding showed a significant difference in comparison with other centers ($p<0.05$). According to the

Table-III: Comparison of the assessed consumed foods according to the contamination with bacteria

Food type	Sample size	E. coli contamination (%)	Staphylococcus aureus contamination (%)	Salmonella contamination (%)	Listeria monocytogenes (%)
Grilled ground meat	54	38.9	55.6	0	0
Chicken	54	5.6	0	0	0
Fish	54	0	0	0	0
Grilled chicken	54	5.5	0	0	0
Mean		12.5	13.8	0	0

coliform contaminations, center A found to be in the standard range (10^2 CFU/g) while other centres had higher contamination loads. Grilled chicken samples taken from centre B, E and D and chicken samples taken from centre B and C were also contaminated higher than the standard range.

In this investigation, since 44.4% of 27 E. coli positive samples belonged to centre F, 33.3% to centre B, nine out of 30 *S. aureus* positive samples were taken from centre B and six positive samples from centre F. This demonstrates poor sanitary conditions in these centres. Considering the *S. aureus* contamination standards (10^2 CFU/g), samples taken from grilled ground meat of centre B and C (mean = 2×10^2 CFU/g) and samples taken from grilled ground meat of centre F (mean = 1.05×10^2 CFU/g) were found to be contaminated a little higher than the recommended standards.

This study shows that this is possible for the cooked foods to be contaminated with coliforms and pathogenic bacteria including *E.coli* and *S.aureus*, as 50% of the 216 samples examined in this study showed to have coliform contamination. *S.aureus* and *E.coli* contaminations were found in 14.2% and 12.6% of the examined samples respectively. Tessi evaluated 101 samples of cooked and prepared foods in a university centre in Argentina. They found that these samples had a mean bacterial contamination of 3.63×10^4 CFU/g and a mean coliform contamination of 1.90×10^2 CFU/g. They also reported E. coli contamination in 6.34% of food samples.[9] Fung evaluated 164 samples of prepared meat foods in a scientific centre in Taiwan and found that 27.5%, 17.9%, 7.9% and 4.98% of the samples had coliform, *Staphylococcus aureus,* E. coli and Bacillus cereus contaminations, respectively. In this study samples had higher coliform and *Staphylococcus aureus* contaminations and lower E. coli contamination as compared to our results.[10] *Soriano,* assessed 342 food samples taken from 16 university restaurants and showed that 8.8%, 7.6% and 13.7% of the samples were contaminated with *E. coli*, *Staphylococcus aureus* and group D *Staphylococcus*, respectively.[4]

Food samples had lower contaminations in comparison with our results but they didn't find any contamination with Salmonella or *L. monocytogenes* too. Lengthy gaps between preparation and consumption of foodstuffs and lack of attention to the essential temperature required for cooking foods are among the most important reasons of food contamination. Reglier found *E.coli* and *B.cereus* in 12% of foods prepared for hospital patients. In all positive samples there were more than two hour gaps between the preparation and consumption of the meals.[11] In our study we found that, the longer duration between the preparation and consumption of the foods, is related to center F and B. Our results were in line with previous studies conducted in Iran.

Salek conducted an assessment on 100 samples taken from meat foods offered in clinical centres of Shahid Beheshti University of Medical Sciences. Mean total bacterial count were 2.04×10^5, 2.16×10^2, 2.45×10^4 and 2.25×10^4 CFU/g in samples of grilled ground meat, grilled chicken, chicken and hamburger, respectively. In this study like our study, grilled ground meat had the highest bacterial contamination. They also found that 28 out of 61 *S.aureus* positive samples were from grilled ground meat.[12] Our data also showed that grilled ground meat was the most contaminated food, but more it may be due to poor sanitary conditions in restaurants of this university.

Tokassian, assessed contamination of 476 cooked and raw samples of meat, chicken, fish, and lettuce for *Salmonella.* In this investigation 32 (6.8%) samples had *Salmonella* bacterium from which seven samples were from grilled ground meat.[7] Nichols also showed that pathogenic bacteria including *S.aureus, E.coli* and *Salmonella* in restaurants would transfer to the cooked foods by contaminated staffs' hands or dishes.[13] It is necessary to use HACCP system in restaurants for prevention of food-borne diseases. *Cenci-Goga*, determined the effect of the implementation of HACCP on the microbiological quality of foods at a university restaurant. In this study 894 samples were examined

for T.B.C. and pathogens *(S.aureus, B.cereus, Salmonella spp., and L.monocytogenes).* He showed the implementation of the HACCP system, together with training in personnel hygiene, lowered aerobic plate counts and contamination of bacterial pathogens in all samples studied.[6] Soriano by microbial evaluation of cooked meat samples in University restaurants in Valencia suggest that some handling practices should require more attention, and HACCP program should be developed and implemented. Microbiological analyses of food samples resulted in aerobic plate counts from <1.00 to 2.90 and from <1.00 to 6.04 log10CFUg(-1), respectively. Total coliforms ranged from <3 to 43 most probable number (MPN)g (-1) and from <3 to >2,400 MPN g(-1) for Spanish potato omelette and meat products, respectively. *E. coli* O157:H7, *Salmonella spp.*, and *Shigella spp.* were not detected.[4,14,15]

CONCLUSIONS

Omitting grilled ground meat as a high risk food from food schedules especially in warm seasons, improvement of the cooking and processing methods by using sophisticated instruments, prevention of secondary infections and continuous supervision and control on food centres and performing complementary assessments seems to be the most important strategies to improve food safety. Moreover especially HACCP application are necessary for reduction of microbiological contamination of foods served in the university restaurants.

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