

Food Safety and Sanitation in Various Kinds of Restaurants Salads in Ramallah Al-Bireh Governorate, Palestine

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ABSTRACT

Food safety and sanitation is a major public health concern due to its importance to people's lives and their health; as many diseases are avoidable whenever food consumed was clean, safe, and in a good quality free of pathogens. Our fast life enforces majority of people to consume fast foods and meals outside homes, which if not appropriate, healthy and clean, will be a source of avoidable series of illnesses. Data were taken from the Central Laboratories in the Palestinian Ministry of Health; OPT, from the period (Jan, 2010- Sep, 2013). As excel data file, and we recoded variables and analyzed through SPSS version 17.0. Data was collected from 1265 salad samples of various kinds of salads among Ramallah-Al-Bireh district and examined for different indicators for detection of degree of pathogenicity of eight major microorganisms. From 2010 to 2013, the number of microorganisms samples graded as acceptable decreased for Fecal Coliforms, Mould, Salmonella, Staphylococcus aureus, Total aerobic count, Total Coliforms and Yeast (N= 1265, 14.3%). All the examined samples tested negative for *Listeria monocytogenes* ($\chi^2=0.75$, $P=0.386 >0.001$, $df=1$). Among the various kinds of salads examined, Hummus was the most contaminated kind of salad, followed by Arabic salad but luckily showed decrease in trend with time, and the kinds that were clear and free of microorganism, continued to be clean, and the microorganismal percentages also decreased with time. Healthy measurements and protocols seem to be applied, good governmental supervision, and hygienic protocols are the much possible applied among restaurants. Legislation and regulations are to be strict, clear and implemented to ensure a highest degree of food safety and quality is being provided to people. Furthermore, regular check-ups and monthly rather than yearly investigations should be done by responsible departments.

Keywords: Food Safety, Contamination, Pathogenicity, Restaurant Salads, Microorganism, Palestine.

INTRODUCTION

The consumption of vegetable salads has increased in recent years, partly due to the nutritional value of salads and also because of assumed beneficial health effects (1). However, it is known to serve as vehicle of foodborne pathogens and toxins, of which the principal sources of contamination are the cultivation, stages of processing and operations for preparation (2). Food borne illnesses are one of the major public health concerns; resulting from poor hygiene, poor compliance of people to self hygiene and safety protocols. The huge ignorance in sanitation and safety is a major leading cause of many com-

plicated consequences could be lethal and eventually fatal (3-6).

High prevalence of mortality, morbidity, disability and other variety of impediments are due to food contamination (7). Food contamination is one of relative matters; due to differences between a country and another in climate, regulations, food storage and handling, some modified strains of pathogens could emerge, people's degree of awareness, level of country's industrial development, and some chemical contaminants are taking place, in addition to level of public educations, awareness, general measurements of sanitation, plus a major concern taking place is the role of primary health care centers in

primary prevention, and accuracy of registries (8, 9).

Food and drug association (FDA) had set criteria for detection of food sanitation among many sectors; as in schools, in industry, in food handling and consumption, and a regular check through annual surveys so as to keep up-dated with consequences and to keep eye on population safety (10, 11).

Milk and dairy foods are considered to be one of the major foods to easily get infected and contaminated due to short-span of living bacteria which tend to rapidly get distorted and become pathogenic. Still, pasteurization has shown success in keeping milk and dairy food safe for human use for longer period than if not pasteurized under proper conditions of storage and handling (11). Moreover, there is evidence proven that overheating dietary process produce carcinogenic product called Furan, which cause hepatic cancer (12). Personal hygiene, as result of proper education and training, is a method in the right way towards an appropriate environmental sanitation and food safety principles, which had proven to be one of the successful preventive measures against contamination in food preparation, handling, cooking and even storing (13, 14).

Farmers markets in UK provide highly food quality regionally, safety food, and highly satisfied consumers. In spite of their temporary residency, had few facilities, their workers had elementary food hygiene training (15). In Turkey, researchers found high percentage of another kind of microorganism "Enterobacteriaceae, S.aureus and yeast and molds" due to the use of highly contaminated raw material, lack of good hygienic practices during processing and inadequate storage temperature and these reasons have led to the contamination in salads (16).

A neurotoxic carcinogenic substance called "acryl amid" triggered by heat was found in high concentrations in heated starchy food, fried foods, and bread in Sweden and Belgium (17).

Many of Arab countries suffer from food insecurity due to poverty, many of households living below the national poverty line.

For example; in Lebanon camps 15% of households suffer from severe food insecurity; this is associated with several factors. First, type of occupation when the head of the family works in an elementary occupation, he had more food insecurity than the professional career. Second, the studying years, who study more than 10 years schooling had low level of food insecurity. Third, the gender, when considering the women is the head of the family, households have severe food insecurity more than those with men as the head. Forth, the health status of each family member, households who have at least one ill person with a disease, either chronic or acute, or disability, reports severe food insecure than those families without illnesses. Moreover, families living in severe food insecurity ate fruits more than fresh meat products which is available less than once a week. Therefore, people living in poverty suffer from different mental health disorders (18, 19).

Microbial food safety remains a major economic and public health concern in Arab countries. Over the past several years, many of these countries have attempted to revise and upgrade food quality control and surveillance programs; however, these systems vary in scope and effectiveness. Many review articles had addressed the major reported food borne outbreaks and multidrug resistance of pathogenic microorganisms isolated from food products, results declared that: *Brucella* spp., *Clostridium botulinum*, *fecal coliforms*, *Escherichia coli*, *Listeria monocytogenes*, *Salmonella*, and *Staphylococcus aureus* were major pathogens isolated and located in food-contaminated samples (20-22,).

Well, regarding the Palestinian status, the Palestinian Food Industries Association (PFIA) is the coordinating and representative organization for the food industries in Palestine, which controls a variety of food industrial sectors; such as (confectionary, dairy, cold cuts, soft drinks and juices, snack foods, grain products, vegetables and fruits, pickling and canning, oils and ghee, traditional foods, and animal feed). This governmental body aims to improve the competitiveness of Palestinian processed-food products through assisting companies in improving their pro-

duction systems and complying with international standards, in general, and food-safety standards, in particular (23, 24).

In Palestine, restaurant licensing is a mandatory requirement for operating a restaurant. In addition, good planning helps to ensure a suitable infrastructure for the restaurant, including space and facilities for storing, food preparation, cooking, and food consumption, washing dishes and equipment, a warehouse, toilets, washbasins, in addition to the choice of a suitable location for the restaurant, establishing a clear food handling personnel. Despite, the ministry of health efforts in improving food quality, factors such as poverty and politics limited the ability of the Palestinian Authority in developing programs (25).

This study aimed at assessing and evaluating the quality of salads in various restaurants in Ramallah and Al-Bireh district in the state of Palestine through laboratory examining of samples collected by the Central Laboratories in the Palestinian Ministry of Health from Jan, 1st 2010 till Sep, 30th 2013.

Salads in restaurants are of cuisine favorite locally and regionally, and have privacy as they are not treated like the rest of the food served in restaurants. Thus they are susceptible to contamination if not given enough attention during the preparation and serving to clients. This study comes to highlight this privacy, and to be a mentor to stakeholders of officials especially in the Ministry of Health.

MATERIALS AND METHODS

A sample of 1258 of different kinds of salads was randomly collected by the Central Public Health Laboratory of the Ministry of Health for the Ramallah & Al-Bireh District, and was tested for 8 major kinds of microorganisms, and to other indicators. The study was conducted by the environmental health department investigators of the MoH in routine detection rounds during the study period. Salad samples taken randomly from different restaurants in Ramallah & Al-Bireh district, distributed were randomly chosen in the two cities, including towns, villages, and refugee camps, representing the whole district. Samples included: Hummus, Arabic salad, Turk-

ish, Parsley, Cabbage, Teheeneh, Marinated egg plant, Hummus salads, Cabbage with Mayonnaise salads, and other kinds. "Palestinian Central Public Health Laboratory" provided us with the data about Ramallah & Al-Bireh District / state of Palestine through laboratory examining specimens collected by the Central Laboratories in the Palestinian Ministry of Health from Jan, 1st 2010 till Sep, 30th 2013.

The results were obtained from Palestinian Central Public Health Laboratory after the ethical approval from the Ministry of Health to deal with data, and an approval letter from the Institute of Community and Public health in Birzeit University was taken in order to obtain the data.

The instrument used in the collected data was taking various salad kinds samples and send them to lab to get tested to check the degree of pathogenicity, contamination and microorganismal containment. Data were coded, and a guideline was prepared for that purpose after collection. The coded data of the samples were entered into the computer and analyzed using the Statistical Package for Social Sciences (SPSS) version 17.0.

Microbiological testing carried out over the collected samples to check the degree of pathogenicity and microorganismal containment. Microorganisms categorized into 8 major groups such as: Fecal Coliforms, Mould, and Salmonella, Listeria monocytogenes, Staphylococcus aureus, Total aerobic count, Total Coliforms and yeast.

The data were arranged into an excel document by the "Environmental Health Department personnel" and "Central Public Health Laboratory technicians" in MoH. After coding, data analyzed using SPSS, (Statistical Package for Social Sciences) version 17.0. Statistical analysis includes Cross- tabs between contaminated salad samples and type of detected microorganism is shown in Table 1. Dividing salad samples into acceptable (free from microorganisms) for individual ingestion, and unacceptable (contaminated with microorganisms) depend on food quality and sanitation guidelines of MoH from the Palestinian Standards Institution (26). Samples testing were according to

the Bacteriological Analytical Manual (BAM)(27). Figure 1 shows a schematic diagram of the salads sampling technique. Each sample is a sample number, date, time and place of sampling, description/ name applied to food, and name of owner/ restaurant. The sample is normally transmitted as soon as practicable after sampling. The samples are normally transported in cool boxes with sufficient ice packs and packing to ensure that the salad samples stay below 5°C. Other details of testing are according to the Bacteriological Analytical Manual (BAM)(27). The analysis was performed using the Statistical Package for Social Sciences (SPSS).

RESULTS

The number of collected samples of salads was 1258 distributed among various restaurants in Ramallah and Al-Bireh District, Palestine. Depending on sample size, during 4 years (2010-2013), a slightly rising in sample size was observed, in the year 2010, (N=318, 25%) samples, in the year 2011, (N=325, 26%) samples, and in the year 2012, (N=532, 42%) samples were taken. However, a major decreasing in sample size in the year 2013, (N=83, 7%) were observed before September. Data are presented in Tables 1-3. After Analysis we observed that since 2010 till 2013 contaminated Hummus had the highest percentage of the sample size (379, 30%). While, contaminated cabbage with mayonnaise, had the least percentages of salad samples (24, 2%).

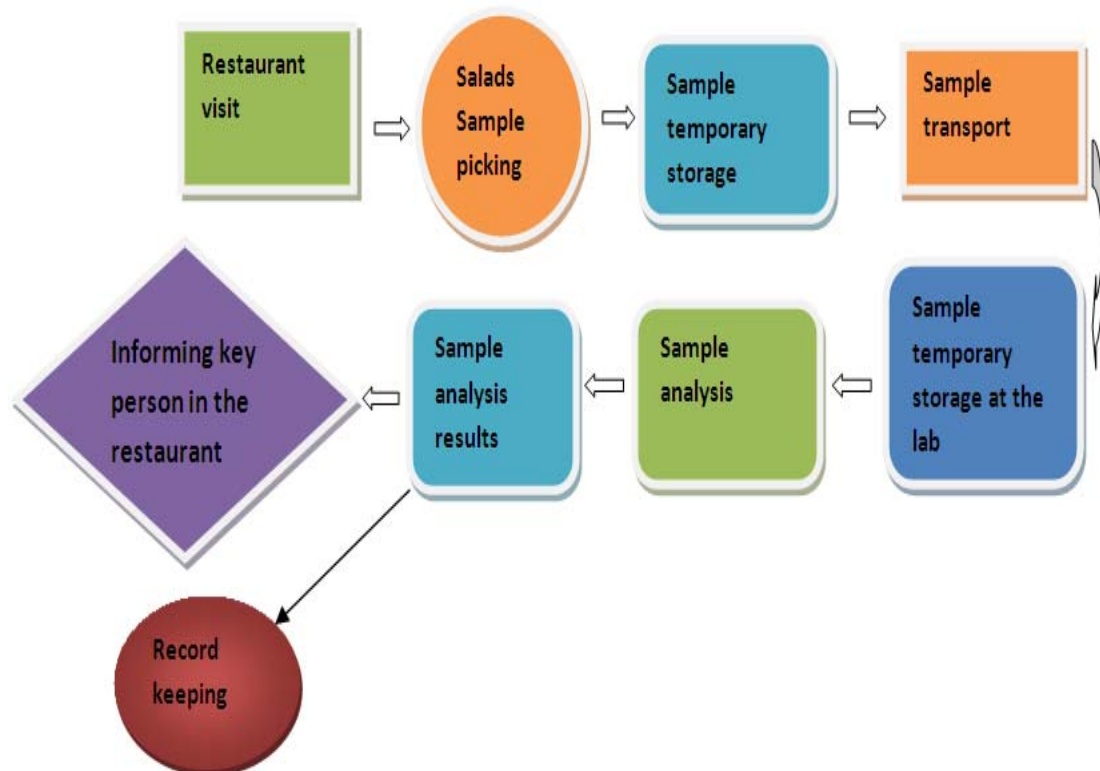


Figure (1): A schematic diagram of the salads sampling technique.

Coliforms and yeast. Besides, Arabic salads were moderately contaminated with pre-

Hummus was the most common contaminated with microorganisms such as Fecal Coliforms, Mould, and Salmonella, Staphylococcus aureus, Total aerobic count, total

ously mentioned microorganisms with a percentage of (137, 11%). Nevertheless, Turkish, Parsley, Cabbage, Teheeneh, Marinated egg plant, Humus (mixture), and Cabbage

with Mayonnaise salads were percentages: (45,4%), (52, 4%), (41,3%), (71, 8%), (71,6%), (74, 6%), (24, 2%) respectively.

Table (1): Salads samples contamination with different microorganisms for 2010-2013 (number and Percentage (N,%)).

	Fecal Coliforms	Listeria monocytogenes	Mould	Salmonella	Staphylococcus aureus	Total aerobic count	Total Coliforms	yeast
Hummus	379 (30%)	0 (0%)	378 (30%)	379 (30%)	379 (30%)	378 (30%)	378 (30%)	378 (30%)
Arabic Salad	137 (10.8)	0 (0%)	137 (10.9%)	137 (10.8%)	137 (10.9%)	137 (10.9%)	137 (10.9%)	137 (10.9%)
Turkish Salad	45 (3.6%)	1 (0.3%)	43 (3.4%)	45 (3.4%)	43 (3.4%)	43 (3.4%)	43 (3.4%)	43 (3.4%)
Vegetable Salad	92 (0.4%)	0 (0%)	92 (0.4%)	92 (0.4%)	92 (0.4%)	92 (0.4%)	92 (0.4%)	92 (0.4%)
Taheeneh Salad	71 (7.6%)	0 (0%)	71 (7.6%)	71 (7.6%)	71 (7.6%)	71 (7.6%)	71 (7.6%)	71 (7.6%)
Parsley Salad	52 (4.1%)	0 (0%)	52 (4.1%)	52 (4.1%)	52 (4.1%)	52 (4.1%)	52 (4.1%)	52 (4.1%)
Marinated Eggplant	71 (5.7%)	0 (0%)	71 (5.7%)	71 (5.7%)	71 (5.6%)	71 (5.7%)	71 (5.7%)	71 (5.7%)
Cabbage Salad	41 (3.2%)	0 (0%)	41 (3.3%)	41 (3.2%)	41 (3.3%)	41 (3.3%)	41 (3.3%)	41 (3.3%)
Cabbage with mayonnaise	24 (1.9%)	0 (0%)	23 (1.8%)	24 (1.9%)	23 (1.7%)	22 (1.8%)	23 (1.9%)	23 (1.9%)
Hummus Salad (mixture)	74 (5.8%)	2 (0.4%)	74 (5.9%)	74 (5.9%)	74 (5.9%)	74 (5.9%)	74 (5.9%)	74 (5.9%)
others	279 (26.9%)	0 (0%)	276 (26.9%)	272 (27%)	276 (26.9%)	277 (26.9%)	276 (26.9%)	276 (26.9%)
Total	1265 (100%)	3 (100%)	1258 (100%)	1258 (100%)	1259 (100%)	1258 (100%)	1258 (100%)	1258 (100%)

The proportion of samples with unacceptable levels of *Listeria monocytogenes* showed an increase over the years 2010 to 2013 as shown in table 2. Moreover, it was only detected within two samples of hummus salad (mixture) and turkish salads with a percentage of 0.4% (table 1) during 2012- 2013. *Listeria monocytogenes* was not detected within other types of salads.

Table (2) shows an annual frequency and percentages of levels of contamination in salads products for the different tests conducted. From 2010 to 2013, the number of microorganisms samples graded as acceptable decreased for Mould, Salmonella, Staphylococcus aureus, Total aerobic count, Total Coliforms and Yeast. However, the number of microorganisms samples graded as unacceptable increased detected for Fecal Coliform, and *Listeria Monocyst*. Low numbers of samples in 2013 explains the presence

of high percentages of some microorganisms comparing to previous years.

Table (3) shows that A significant statistical relationship was not seen over the years (2010- 2013) between the contaminated salads samples (Hummus mixture and Turkish Salads) and the rising trends for *Listeria monocytogenes* ($X^2=0.750$, $p=.386$) detected within 3 samples.

While, the statistically significant relationship was seen among: Fecal Coliforms ($X^2=372.794$, $p< 0.001$), Mould ($X^2=370.918$, $p< 0.001$), Salmonella ($X^2=372.794$, $p<0.001$) and Staphylococcus aureus ($X^2=370.918$, $p<0.001$). Total aerobic count: ($X^2=372.886$, $P<0.001$) Total Coliforms: ($X^2=370.918$, $p<0.001$), and Yeast: ($X^2=370.918$, $p<0.001$) between the contaminated salads samples such as Humus, Arabic, Turkish, Parsley, Cabbage, Taheeneh, Marinated Egg Plant, Hummus mixture, and Cabbage with Mayonnaise Salads.

Table (2): Annual frequency of acceptable and unacceptable levels of contamination of Salads in routine inspections in Ramallah and Al-Bireh district, Palestine

Organism	2010		2011		2012		2013	
	No.	%	No.	%	No.	%	No.	%
Fecal Coliforms								
acceptable	1908	85.7%	1950	85.7%	3201	85.6%	499	93%
unacceptable	318	14.3%	325	14.3%	539	14.4%	83	7%
Listeria monocytogenes								
acceptable	2226	100%	2275	100%	3738	99.9%	581	99.99%
unacceptable	0	0%	0	0%	2	0.1%	1	0.01%
Mould								
acceptable	1908	60%	1950	1.3%	3415	66.7%	257	98.8%
unacceptable	318	40.0%	325	98.7%	325	33.3%	325	1.2%
Salmonella								
positive	318	0.7%	325	12.3%	539	0.6%	83	0.4%
negative	1908	99.3%	1950	87.7%	3201	99.4%	499	99.6%
Staphylococcus aureus								
acceptable	1908	97.4%	1950	87.7%	3208	96.7%	499	99.6%
unacceptable	318	2.6%	325	12.3%	532	3.3%	83	0.4%
Total aerobic count								
acceptable	1908	6.7%	1950	1%	3208	66.6%	499	67.2%
unacceptable	318	93.3%	325	99%	532	33.4%	83	32.8%
Total Coliforms								
acceptable	1908	35.8%	1950	34.8%	3208	69.7%	499	99.6%
unacceptable	318	64.2%	325	65.2%	532	30.3%	83	0.4%
Yeast								
acceptable	1908	20.4%	1950	1.6%	3208	66.7%	499	67.2%
unacceptable	318	79.6%	325	98.4%	532	33.3%	83	32.8%

Table (3): Chi-Square (X^2) test for the detected microorganisms included in the survey.

Microorganism	Pearson Chi-Square	df	Asymp. Sig. (2-sided)
Fecal Coliforms	372.794	213	0.000
Listeria monocytogenes	0.750	1	0.386
Mould	370.918	213	0.000
Salmonella	372.794	213	0.000
Staphylococcus aureus	370.918	213	0.000
Total aerobic count	372.886	216	0.000
Total Coliforms	370.918	213	0.000
Yeast	370.918	213	0.000

There is no statistically significant associations at level p-value = 0.001 between restaurant salads and multiplication of microorganisms. We can conclude that Restaurant's

Salads such as Humus, Arabic, Turkish, Parsley, Cabbage, Taheeneh, Marinated Egg

Plant, Hummus mixture, and Cabbage with Mayonnaise are a good media for multiplication of microorganisms such as Fecal Coli-

forms, Mould, Salmonella, Staphylococcus aureus, Total aerobic count, Total Coliforms, and Yeast.

DISCUSSION

There are many restaurants in Ramallah and Al-Bireh. It is found that most of restaurant utilized high number of salads such as Arabic salad, Cabbage salad, Cabbage with Mayonnaise salad, Taheeneh salad, Hummus, Hummus salad, Lettuce salad, Turkish salad, Marinated Eggplant, Parsley Salad, vegetables salad, etc under unsanitary conditions which constitute a great danger on the health of diners in Palestine. We take the results of 1258 specimens of salad taken from several restaurants in Ramallah and Al-Bireh from Central Public Health Laboratory of the Ministry of Health.

This study in Ramallah and Al-Bireh district showed relatively high rates of contaminated kind of salad with all kinds of microorganism detected. In spite of taking the results eight major kinds of microorganisms were detected such as fecal Coliforms, Salmonella, and Staphylococcus aureus, Total aerobic count etc, also find *Listeria monocytogenes* just in two kinds of salads (Hummus salad, Turkish salad). This contamination was related to deficiency in cleaning this is due to many factors: lack of awareness of the acuteness of microorganism, food handlers will smoke when they prepare the food so their breathing will transfer some contaminants from mouth to hand and causes food contamination, another reason that food handlers may work while he is sick so microbes can be transmitted to food through sneezing and coughing during work, availability of hair covers and clothes are few, deficiency of clean water (hot & cold water), which is necessary for hand washing and sanitizing of food equipment, presence of insects, rodents, birds or other animals may carry microorganism (28, 29).

Fecal Coliforms is a facultative anaerobic, non-speculating bacterium and capable of growth in the presence of bile salts or similar surface agents, are oxidized negative, and produce acid and gas from lactose within 48 hours. The assay is intended to be an indicator of fecal contamination; more specifically

of *E. coli* which is an indicator microorganism for other pathogens that may be present in feces. Presence of fecal Coliforms in water may not be directly harmful, and does not necessarily indicate the presence of feces (30). It transfers through the water contaminated with fecal material of humans or other animals found in large ratio in hummus (30%) and Arabic salad (10.8%) (31). *Listeria monocytogenes* is the bacterium that causes the infection listeriosis.

It is a facultative anaerobic bacterium, capable of surviving in the presence of oxygen. It can grow and reproduce inside the host's cells and is one of the most virulent food-borne pathogens, with 20 to 30 percent of clinical infections resulting in death. It is recognized as a significant cause of neonatal sepsis and meningitis it's only found in hummus salad (0.4%) and Turkish salad (0.3%). Mould is a fungus that grows in the form of multicellular filaments called hyphae. Molds are a large and taxonomically diverse number of fungal species where the growth of hyphae results in discoloration and a fuzzy appearance, especially on food (32). The network of these tubular branching hyphae, called mycelium, is considered a single organism, then it developing through many stages and give the spores which are colored, making the fungus much more obvious to the human eye at this stage in its life-cycle. Some diseases of animals and humans can be caused by molds, usually as a result of allergic sensitivity to their spores or caused by toxic compounds produced as molds grow (33). They can reduce moisture levels that can facilitate mold growth. Salmonella they are chemoorganotrophs, obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes. It is closely related to the *Escherichia* genus and are found worldwide in cold- and warm-blooded animals (including humans), and in the environment (31). They cause illnesses such as typhoid fever, paratyphoid fever, and food borne illness. It can be transferred between humans and nonhuman animals. Many infections are due to ingestion of contaminated food found in large ratio in hummus (30%) and Arabic salad (10.8%). *Staphylococcus aureus*: is a bacterium that is a member of the Firmicutes, and is frequently

found in the human respiratory tract and on the skin. Although *S. aureus* is not always pathogenic, it is a common cause of skin infections (e.g. boils), respiratory disease (e.g. sinusitis), and food poisoning (31). It can spread through contact with pus from an infected wound, skin-to-skin contact with an infected person by producing hyaluronidase that destroys tissues, and contact with objects such as towels, sheets, clothing, or athletic equipment used by an infected person. Total Coliforms: Coliforms can be found in the aquatic environment, in soil and on vegetation; they are universally present in large numbers in the feces of warm-blooded animals (34). Yeast: are unicellular, although some species with yeast forms may become multicellular through the formation of strings of connected budding cells known as pseudohyphae, or false hyphae. Other species of yeasts, such as *Candida albicans*, are opportunistic pathogens and can cause infections in humans (35).

We noted a rising trend of percentage of microorganism through the second year of the study (2011). For example mould increases from (40.0%-98.7%), *Salmonella* from (0.7%-12.3%), *Staphylococcus aureus* from (2.6%-12.3%), Total aerobic from (93.3%-99%), yeast from (79.6%-98.4%), but we found a decreased level of microorganism in the third and fourth year of study. In 2013 we see a remarkable increasing in fecal Coliforms levels (45.7%). This may be due to increasing the contamination in salad. So we can prevent this increasing by wash hands, food preparation surfaces and utensils cleans, keep refrigerated foods below 40 degrees F, serve hot foods immediately or keep them heated above 140 degrees F, heat canned foods thoroughly before tasting, when in doubt, throw it out (36). In Turkish study for example, they found high percentage of another kind of microorganism "Enterobacteriaceae, *S.aureus* and yeast and molds" due to the use of highly contaminated raw material, lack of good hygienic practices during processing and inadequate storage temperature and these reasons have led to the contamination in salads in our country (36).

CONCLUSIONS

There are some steps that can be taken to improve the situation. One is the development and making planning from health ministry to make testing of salad samples to include all months of the year, especially the summer ones because the microorganism will reproduce and grow much more than any season. Restaurant employees should be directed to be careful and wary about cleans, they need an adoption of hygienic practices by food handlers to decrease the risks of transmission of microorganism through salads. Hygienic rules must be implemented to avoid contamination. Efforts must be employed to ensure that this kind of salads does not become contaminated before final packaging.

Legislations and regulations are to be thoroughly implemented and watched that are implanted the proper way, and punishment system is an effective way in ensuring so.

The major limitation of this study was that data were not accurately coded in the central laboratories in MoH, and some data were wrongly coded, in addition to scarcity of data provided for the year 2013, and inconsistency in data numbering. After publishing, this research will be sent to the related persons in the Ministry of health to overcome the abovementioned limitations.

CONFLICT OF INTERESTS

Authors declare no conflicts of interest.

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