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Pathogenic Microbial Load Analysis of Ready-to-Eat Meat Products of Namak-Mandi Food Street Peshawar, Pakistan

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Abstract: A study was conducted to investigate the microbial quality of food (drinking water and processed meat) at popular food street (Namak-Mandi Peshawar Pakistan). For this purpose, 30 different food samples from different shops, including processed meat (Tikka Karahi (7), Meat Kari (Gosht Karahi) (7), Mutton kari (Mutton Karahi) (5), Chicken Karahi (6) and drinking water (5) were analyzed for *Escherichia coli*, *Salmonella* spp., *Shigella* spp., *Staphylococcus aureus* and fungi isolation. Total Viable Count for all samples was also determined. The drinking water samples showed the average percentage of 20, 100, 100 and 40 for *S. aureus*, *Salmonella*, *Shigella*, *E. coli* and fungi, respectively. The highest total viable count of water samples was 4.2×10^7CFU ml^{-1}. The processed meat samples showed 32.95, 51.81, 64.85 and 72.76% average presence of *S. aureus*, *Salmonella*, *Shigella*, *E.coli* and fungi, respectively. The highest Total Viable Count (2.5×10^9CFU ml^{-1}) observed in Tikka Karahi and Mutton Karahi.

Keywords: Namak Mandi; Processed Meat; *E. coli*; *S. aureu*; *Shigella*; *Salmonella*

Introduction

Food safety and drinking water quality has always been a major issue in developing countries (Committee, 1977; Akbar and Anal, 2014). Drinking water contaminated with pathogenic microbes or deleterious chemicals are unsafe for human consumption (Anderson and Davidson, 1997). Food related diseases continue to be one of the major health problems globally (Akbar and Anal, 2011). It has been estimated worldwide, that 80% of all

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illnesses are linked to the contaminated water (Muhammad et al., 2012) and food.

Meat as a source of protein is basic need of body nutrition(Chang et al., 1991). In most countries, meat consumption increases as an economic improvement (Fuller, 1996). Microbial contamination of meat is a serious concern for both meat producers and consumers (Jayathilakan et al., 2009). The microbiological quality of the raw meat and other ingredients, personal hygiene and any contamination during the process will determines the quality of end product in terms of microbial contamination (Elmali and Yaman, 2005). Studies conducted on the microbiological quality of ground meat showed that it is a good medium for microbial growth that leads to foodborne infections and food toxications due to pathogenic bacteria (e.g. *E. coli*, *S. aureus*, *Salmonella* spp. and sulphide reducing anaerobes) (Bensink and Boland, 1979; Jay, 1996).

Growing consumer interest in foodstuffs of high nutritional value that guarantee a health from toxicological point of view and proper hygienic conditions has prompted interest in edible offal, processed meat products (Varnam and Sutherland, 1995). Uncooked or processed foods represent the most common cause of infection (Meng and Doyle, 1997; Kathariou, 2002). Food production, processing and distribution differs from country to country (Jayathilakan et al.,, 2009). These practices depend on local consumer preference and the influence of practices in other countries on the local consumer's daily life (Sofos et al., 1999; Redmond and Griffith, 2003). Foodborne infections still remain as one of the important concerns of public health worldwide (Dallal, 2009). Controlling the transported to laboratory within 3 h of its collection in sterile sampling box maintaining the temperature below 4 ^{o}C by contamination of microorganisms to carcasses of poultry during slaughtering, processing, storage, handling and preparation is a complex challenge especially for locally and traditionally produced ones (Abamuslum et al., 2003).

Namak-Mandi food Street of Peshawar in the province of Khyber Pakhtoonkhwa of Pakistan is a well known venue for the consumers of processed meat such as, mutton, beef and chicken. But no significant work has been reported about the qualitative microbial analysis of ready to serve processed meat and drinking water of this place. The objective of this study was to understand the pathogens prevalence and contamination rate in ready to serve meal of the area. This study will also help the authorities and owners to improve the quality of food and water of the study area to reduce associated health risks.

Material and Methods

All the samples were collected aseptically and brought to the laboratory, Department of Microbiology, Kohat University of Science and Technology in Kohat, Khyber Pakhtoonkhwa, Pakistan, and processed accordingly. The methodology used was same as described by Elmacioglu et al. (2010) with slight modifications.

Collection of Samples

Samples of drinking water (200 mL) and processed meat pieces (each of about 200 g) were collected from various hotels at Namak-Mandi Food Street of Peshawar (Pakistan). These samples include drinking water (5), Tikka Karahi (7), Gosht Karahi (7), Mutton Karahi (5) and Chicken Karahi (6), were collected separately in sterile glass bottles aseptically. All the samples were keeping ice pads inside the box. All the samples were labeled and processed further for bacterial count.

Isolation of Pathogenic Bacteria

Selective media i.e. *Salmonella Shigella* Agar (SSA) (Oxoid, UK) for *Salmonella* and *Shigella*, Mannitol Salt Agar (MSA) (Himedia, India) for *Staphylococcus aureus*, Eosin Methylene Blue agar (EMBA) (Himedia) for *Escherichia coli*, Sabroud Dextrose Agar (SDA) (Himedia) for fungus and Nutrient Agar (NA) (Merck, Germany) for total viable count were used for isolation of target microbes by spread plate technique following Akbar and Anal (2013). Inoculated plates were incubated at appropriated temperature (37 ^{o}C) for 24-48 hours.

Total Viable Count

Dilutions (10 fold) of the samples in sterile distilled water were prepared and mixed well. An amount 1 mL from each dilution was spread over nutrient agar. The inoculated nutrient agar plates were incubated at 37 ^{o}C for 24 h. Following the incubation visible colonies were observed, counted and CFU ml^{-1} was calculated for total viable count in these samples.

Biochemical Identification and Confirmation of Bacteria

Presumptive visible colonies on the specified media (SSA, MSA, EMBA) were further identified with the help of morphology (Gram's staining) and subjected to a series of biochemical tests including (Oxidase test, Catalase test, Indole Test, Citrate Test, Motility Test, Voges Proskeure Test, Urease test).

Results and Discussions

The results of this study showed that all the pathogenic bacteria under consideration in the study were present in the ready to serve meal and water. It was found that 32.95% of *S. aureus*, 51.81% of *Salmonella* and *Shigella*, 64.85% of E. coli and 72.76% of Fungi were present in the samples analyzed (Fig. 1).

The highest contamination of pathogenic bacteria was found in water with average of 76% presence of all type of microbes under study. Similarly, Tikka Karahi, Gosht Karhai, Mutton Karahi and Chicken Karahi showed an aggregate presence of 57.14%, 45.71%, 52% and 43.33% respectively. The total viable counts observed for each type of microorganism were found in the ranges from 5.0 x 10^1 to 2.5 x 10^9 CFUml^{-1}, details are enlisted in Table 1.

It was observed in our study, that the highest rate of contamination in the ready to serve meal was due to unawareness, little food safety and hygiene knowledge of serving and preparing staff. Majority of the cooking and catering staff at Namak-Mandi food street was found nominally educated with limited food safety awareness and training exposure during their work period. Respective authorities are less attentive toward implementation of food safety laws and regulation to provide proper guidance on good hygienic practices. In the ready to serve cooked food, contamination may occur due to the inadequate cooking, washing with contaminated unsafe water, unhygienic handling and cross contamination from unprocessed food materials. The poor sanitary condition can also be a contributing agent. Little et al., (2002) reported that pathogenic bacteria including *S. aureus*, *E. coli* and *Salmonella* in restaurants would transfer to cooked foods from handling staff or dishes.

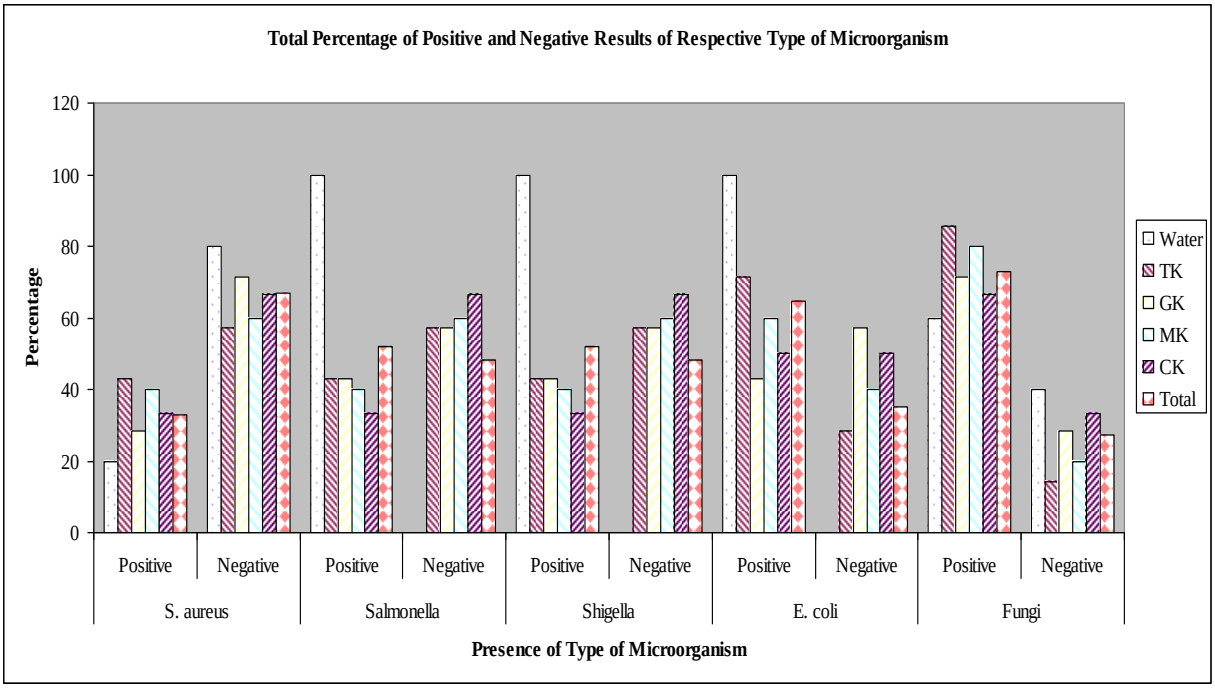

Fig 1. Total percentage of positive and negative results of respective type of microorganism

Table 1. Microbial analysis of drinking water and processed meat of Namak-Mandi food street.

Drinking Water						
Lab #	***S. aureus***	***Salmonella***	***Shigella***	***E.coli***	**Fungi**	**TVC (CFU ml^{-1})**
W–1	-ve	+ve	+ve	+ve	+ve	1.4×10^3
W–2	-ve	+ve	+ve	+ve	-ve	1.7×10^5
W–3	+ve	+ve	+ve	+ve	-ve	4.2×10^7
W–4	-ve	+ve	+ve	+ve	-ve	1.3×10^3
W–5	-ve	+ve	+ve	+ve	+ve	2.0×10^2
Tikka Karahi						
TK–1	-ve	+ve	+ve	+ve	+ve	1.4×10^3
TK–2	+ve	+ve	+ve	+ve	+ve	3.4×10^4
TK–3	-ve	-ve	-ve	+ve	+ve	2.0×10^3
TK–4	+ve	-ve	-ve	+ve	+ve	2.5×10^9
TK–5	+ve	-ve	-ve	+ve	+ve	2.0×10^2
TK–6	-ve	+ve	+ve	-ve	-ve	4.5×10^5
TK–7	-ve	-ve	-ve	-ve	+ve	4.0×10^6
Gosht Karahi						
GK–1	+ve	-ve	-ve	-ve	+ve	6.0×10^2
GK–2	-ve	+ve	+ve	-ve	+ve	3.0×10^2
GK–3	+ve	+ve	+ve	-ve	-ve	1.3×10^3
GK–4	-ve	+ve	+ve	-ve	+ve	2.1×10^4

GK–5	-ve	-ve	-ve	+ve	+ve	2.6×10^3
GK–6	-ve	-ve	-ve	+ve	+ve	2.1×10^4
GK–7	-ve	-ve	-ve	+ve	-ve	4.0×10^3
Mutton Karahi						
MK-1	-ve	-ve	-ve	+ve	+ve	5.0×10^1
MK-2	-ve	-ve	-ve	+ve	+ve	4.2×10^7
MK-3	+ve	+ve	+ve	+ve	+ve	4.3×10^2
MK-4	-ve	-ve	-ve	-ve	-ve	4.5×10^5
MK-5	+ve	+ve	+ve	-ve	+ve	2.5×10^9
Chicken Karahi						
CK–1	+ve	+ve	+ve	-ve	-ve	2.1×10^8
CK–2	-ve	-ve	-ve	+ve	+ve	2.7×10^3
CK–3	-ve	-ve	-ve	-ve	+ve	3.1×10^6
CK–4	-ve	-ve	-ve	+ve	-ve	1.9×10^3
CK–5	+ve	+ve	+ve	+ve	+ve	3.9×10^2
CK–6	-ve	-ve	-ve	-ve	+ve	2.1×10^7

Tavakoli and Riazipour (2008) showed in their study possibility for the cooked foods to be contaminated with coliform and pathogenic bacteria including *E. coli* and *S. aureus*. They reported 50% coliforms contamination of 216 samples examined in their study. They also reported *S. aureus* and *E. coli* contaminations 14.2% and 12.6% of the examined samples respectively. These results are in agreement in our study results. Tavakoli and Riazipour (2008) reported contamination in meat meals offered in clinical centers of Shahid Beheshti University, Medical Sciences and reported that mean total bacterial count were 2.04×10^5, 2.16×10^2, 2.45×10^4 and 2.25×10^4, CFU ml^{-1} in samples of grilled ground meat, grilled chicken, chicken and hamburger, respectively. They also reported bacterial contamination in different meat and chicken. They found 28/61 (46%) samples contaminated with *S. aureus*, which showed higher contamination as compared to our study results (32.95%) (Fig. 1).

Muhammad et al. (2012) reported 100% coliforms presence in water samples from shallow wells in northern Pakistan. Our results are in agreement with their results. The possible means of contamination are agreeable with (Aziz, 2005), they suggested in their study that faecal coliforms presence in the consumer's tap and distribution line might be due to contamination of water from the sewerage from where the damaged distribution line passes. Drinking water quality in both, urban and rural areas of Pakistan was not being managed properly. Results from various investigations provided evidence that most of the drinking water supplies were faecally contaminated (Akbar et al., 2013).

Food handlers play an important role in food safety and in its contamination, as they may introduce pathogens during production, processing, distribution and/or preparation (Green et al., 2005). According to (Taylor et al., 2000), evidence from food industry confirmed that cross contamination from handlers during food processing, due to poor personal hygiene after visiting the lavatory is one of the prominent cause of food contamination. *Escherichia coli* and *S. aureus* are amongst the most common pathogens found on hands (Shojaei et al., 2006). Further studies regarding handling after cooking of different type of foods are needed to better understand the contribution of food handlers in contamination of each

food product and for remedial plans (Aycicek et al., 2005).

It is concluded from the study that the ready to serve food of Namak mandi foodstreet of Peshawar are contaminated with different food borne pathogens. The source of these pathogens induction in food is supposed to be the post cooking unhygienic handling, contaminating utensil and contaminated water. The contamination can be reduced with proper handling, provision of safe water and health hygiene awareness of the workers. Implementation of food safety laws and intervention of food and public health related authorities can help in reduction of foodborne illness and hospitalization related to unsafe water and food.

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