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Studies on the microbiological quality of burgers sold in and around greater Hyderabad Municipal Corporation

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Abstract
A study was conducted to know the microbiological quality of burgers sold in various outlets in and around Greater Hyderabad Municipal Corporation. The total viable count was highest (3.38×10^8 CFU/gm) in burgers from street vendors, lowest ($7.15x10^6$ CFU/gm) from reputed brands, whereas it is intermediate ($4.58x10^7$ CFU/gm) from moderate fast food centres. The coliforms count and feacal coliform in the burgers collected from reputed brands, moderate fast food centres and street vendors was $1.01x10^2$ and nil, $2.86x10^5$ and $1.38\times 10^2$and $9.55x10^6$ and 2.86×10^3 CFU/gm respectively. The yeast and moulds counts were 2.2×10^2, $8.56\times 10^2$and 6.38×10^3 in samples from reputed brands, moderate fast food centres and street vendors respectively. The incidence and counts of *Staphylococcus spp., E. coli, Salmonella spp., Vibrio spp.* and *listeria spp.* were 90% and 4.12×10^3, 90% and 2.5×10^1, 46.66% and 2.42×10^2, 23.33% and $0.8\times 10^1$and 23.33% and 0.9×10^1 in samples from reputed brands, 90% and 3.56×10^5, 83.3% and 3.56×10^3, 80% and 4.32×10^3, 50% and 1.2×10^2 and 33.33% and1.86×10^2 from moderate fast food centres whereas, 100% and 2.5×10^6, 100% and 5.65×10^5, 90% and 3.12×10^4, 60% and $2.8\times 10^3$and 43.33% and 3.86×10^4 from street vendors respectively.

Keywords: Burgers, total viable count, coliforms count, faecal coliforms count, yeast and mould count and pathogenic microorganisms

Introduction
Food is chemically complex matrix, microorganisms will grow in any given food. Most foods contain sufficient nutrients to support microbial growth. Certain factors of food like moisture, pH, temperature, *etc* will affect the level of microbial growth (Smith and Fratamico,1995) [34]. The busy and hectic life schedule has opened the doors for fast food industry in developing countries. The traditional or conventional way of cooking is over and the fast food centres are visible everywhere. Fast food includes traditional fast items like pizza, burger or French fries but it also includes Chinese as well as Indian foods.

Worlds most popular fast food manufacturers include McDonalds, Pizza Hut etc. Ancient Roman cities had bread and olive stands, lat bread and falafel which are ubiquitous in the Middle East.

Some foods will be cooked prior to consumption others will be eaten raw. The inner tissues of healthy plants or animals are free of microorganisms, however the surface of raw vegetables and meat are contaminated with variety of microorganisms and this depends on condition of raw product, methods of handling, the time and condition of storage (Pelczar *et al.*,2006) [18].

Microbial food safety is an increase in public health concern worldwide. It is estimated that approximately 76 million foodborne illness occurring in the united states every year (Meng and Doyle, 1998) [27]. Contaminated, raw or undercooked poultry and red meats are particularly important in foodborne diseases. Microorganisms in fast and traditional fast foods are responsible for many human diseases. *Salmonella* is common cause of foodborne illness, particularly in chicken and undercooked eggs (Angelillo *et al.*, 2000) [2], where as *Listeria spp.* is common from chilled and frozen foods. Other foodborne microorganisms include *Camphylobacter spp, Staphylococcus spp., E. coli* and *Yersinia spp.*, whose incidence was reported by Kaneko *et al.* (1999) [24] and Pelczar *et al.* (2006) [18]. For ideal processing of food the centre of food should reach the temperature of 72℃ for two minutes (Makukutu and Guthrie, 1986) [26].

Raw food products will also give the source for spoilage microorganisms, which affects the shelflife of the product. Presence of coliforms will indicate the extinct of faecal contamination. The microbial quality of fast foods like pizza and burger is scanty and so the present work was undertaken to study the organoleptic and microbial quality of burgers.

Material and Methods

Sample collection

30 burger samples each from reputed brands, moderate fast food centers and street vendors were collected from in and around Greater Hyderabad Municipal Corporation (GHMC). Samples were collected aseptically in sterilized plastic pouches with self-sealing, kept in ice box and immediately transported to laboratory, Department of Veterinary Public Health and Epidemiology, College of Veterinary Science, Rajendranagar, Hyderabad. Samples were stored under refrigeration until further examination.

Preparation of dilutions

9 ml distilled water in test tubes were serially arranged and sterilized in autoclave. 1 gram of sample was mixed with first test tube of distilled water which makes 1:10 dilution. 1 ml of this is transferred to second and so on to make dilutions of 1:100, 1:1000, 1:10000, 1:100000 and 1:1000000.

Preparation of media

Nutrient agar (TVC), MacConckey (Coliforms), Potato Dextrose Agar (Yeast and Mould), Xylose lysine DeoxycholateAgar (*Salmonella*), Eosin Methylene Blue Agar (*E coli),* Mannitol Salt Agar (*staphylococcus*), Thiosulfate-Citrate-Bile salts –Sucrose agar (*Vibrio*), Listeria Selective Agar Base (*Listeria*) were prepared as per the instructions of supplies (Hi media) and sterilized.1ml of dilutions serially from 1:100000 to 1:100000 for total viable count, 1:10 to 1:10000 for Coliforms and specified dilutions for different microorganisms were transferred to petridishes and respective liquid media in sufficient quantity were added and allowed to set. Petridishes for TVC, coliforms and other pathogens were incubated at 35℃ for 24 to 48 hrs, whereas for faecal coliforms were incubated at 44.5℃ for 24 to 48 hrs and counts were made with the help of colony counter. The incubation period for Yeast and Moulds was 3-5 days. The pathogenic microorganisms are confirmed with various bio chemical tests.

Results and Discussion

The Total Viable Count, Coliform count and Yeast and Mould counts are presented in table 1. The total viable count was highest (3.38×10^8CFU/gm) in burgers from street vendors, lowest ($7.15x10^6$CFU/gm) from reputed brands, whereas it is intermediate ($4.58x10^7$CFU/gm) from moderate fast food centres.

Table 1: Total viable count, coliform count, faecal coliform count and yeast and mould counts in burgers from different sources (CFU/gm)

Source	TVC	Coliforms	Faecal Coliforms	Yeast and Mould
Reputed brands	7.15×10^6	1.01×10^2	0.8×10^1	2.2×10^2
Moderate fast food centers	4.58×10^7	2.86×10^5	1.38×10^2	8.56×10^2
Street vendors	3.38×10^8	9.55×10^6	2.86×10^3	6.38×10^3

Sultana (2016) [35] reported total viable count of $3.3x10^5$-$2.2x10^7$ CFU/gm from street level samples, which was less than the samples from street vendors in the present study and a count of ($1.9\ x10^6$ CFU/gm) was reported from lower mid-level samples which was almost similar to the samples from reputed brands in the present study. The count of $4.58x10^7$ CFU/gm in the samples from moderate fast food centres in the present study was almost similar to the counts ($2.3x10^7$ CFU/gm) observed by Sultana (2016) [35] in the burgers from higher-mid level and high level centres.

Low counts of 3.5 $\log_{10}$ CFU/gm, $2.3x10^3$, $2.3x10^4$ and $4.8x10^4$ CFU/gm were reported by El-Dosoky *et al.*(2013) [11], Essa and Makar (2004), El- Mossalami(2009) and Tudor *et al.* (2010) respectively. Oranusi *et al.* (2011) [32] reported low levels of Total viable count i.e,$2.3x10^3$, $2.8x10^3$ and $5.4x10^5$ CFU/gm in hot dogs collected from reputed brands, moderate fast foods and street vendors respectively which are lower than the counts observed in the present study from respective sources.

The coliforms count in the burgers collected from reputed brands, moderate fast food centres and street vendors was $1.01x10^2$, $2.86x10^5$ and $9.55x10^6$ CFU/gm respectively. Oranusi *et al.* (2011) [32] observed a count of 1 to $5x10^2$ CFU/gm from different sources which are almost similar to the counts observed in the reputed brands in the present study. Lotfi *et al.*(1990) [25], Essa and Makar (2004) and Min *et al.* (2013) [28] reported counts of $9.3x10^2$, $5.8x10^2$ and $2.25x10^2$ CFU/gm respectively, which were almost similar to the counts observed in the present study from the reputed brands. Very low counts of 3 $\log_{10}$ CFU/gm, 2.5 $\log_{10}$ CFU/gm and 200/gm in different types of burgers were reported by El-Dosoky *et al.* (2013) [11], Mosupye and Holy (1999) [29] and Tashkaya *et al.*(2003) [36] respectively.

The faecal coliform counts was 0.8×10^1,1.38×10^2 and 2.86×10^3 CFU/gm in the samples from reputed brands, moderate fast food centres and street vendors respectively in the present study. Westhoff and Feldstein (1976) [39] reported faecal coliform count of 10 MPN /gm in beef burgers, whereas more than 110 MPN/gm in meat patties was reported by Tuttle *et al.* (1999) [38]. The feacal coliform count varied from different sources i.e 2-3 MPN/gm from retail shops, 0.9 MPN/gm from processing shops and 0.8 MPN/gm from slaughter processing shops Westhoff and Feldstein (1976) [39].

The yeast and mould count in the burgers in the present study was 2.2×10^2 and 8.56×10^2 CFU/gm from reputed brands and fast food centres respectively, which were almost similar to the counts of 5x102 CFU/gm in cheese burger reported by Lopasovsky *et al.*(2016) [17]. Lopasvosky *et al.* (2016) [17] reported counts of $8.2x10^3$ and $2.1x10^3$ CFU/gm in hamburger and hotdog respectively and Ibrahim *et al. (*2014) [16] reported a counts of 5.1×10^3 and 7.0×10^3 CFU/gm in the burgers prepared with halal and non halal beef respectively, which were almost similar to the counts observed in the samples from street vendors (6.38×10^3 CFU/gm) in the present study.

Incidence of Pathogens

The incidence of different pathogens in the burger samples in present study were presented in table -2.

The incidence of *staphylococcus spp.* in the burger samples was very high from all the sources in the present study i.e. 90%, 93% and 100% from reputed brands, moderate fast food centres and street vendors respectively. Very low incidence (12%and 15%) in burger samples was reported by Saleh *et al.* (2010) [20] and El-Dosoky *et al. (*2013) [11] respectively, whereas very low incidence (5.12%) was reported by El Shrek and Ali (2012) [10] in cooked meat products. Moderate

incidence of 29.6% in uncooked products and 35% in hotdogs were reported by El Shrek and Ali (2012) [10] and Oranusi *et al.* (2011) [32] respectively, which were far less than the incidence in the present study from any source.

Table 2: Incidence of different pathogens in burger samples from different sources

Source	*Staphylococcus spp.*	*E. coli*	*Salmonella spp.*	*Vibrio spp.*	*Listeria spp.*
Reputed brands	27 (90%)	24 (80%)	14 (46.66%)	7 (23.33%)	7 (23.33%)
Moderate fast foods	27 (90%)	27 (90%)	24 (80%)	15 (50%)	10 (33.33%)
Street vendors	30 (100%)	30 (100%)	27 (90%)	18 (60%)	13 (43.33%)

The incidence of *E. coli* in burger samples was 100% from street vendors followed by moderate fast food centres (90%) and least from reputed brands (80%) in present study. Very low incidence (10%) than the present study was reported by El-Dosoky *et al.* (*2013*) [11] in beef burger. An incidence of 20% and 14% and 5.71% were reported by Edris (1993*)* [9], Mousa *et al.* (1993) [30] and Ibrahim *et al.* (2009) respectively, which are far less than the incidence observed in the present study in the burger samples.

The incidence of *Salmonella spp*. in burger samples in the present study was least from reputed brands (46.66%), high from street vendors (90%) and in between (80%) from moderate fast food centres. Very low incidence of salmonella (1.56 and 12.9%) was observed in uncooked and cooked products by El Shrek and Ali (2012) [10].

The incidence of *Vibrio spp.* was 23.33%, 50% and 60% in the burger samples from reputed brands, moderate fast food centres and street vendors in the present study. Azwai *et al.* (2016) [3] reported an incidence of 50% and 46.6% from uncooked and cooked meat sample sources respectively, which was almost similar to the incidence in the samples from moderate fast food centres. Jaksic *et al.* (2002) [23] reported an incidence of 19.6% which was almost similar to the incidence in present study from reputed brands, whereas very low level of incidence (1.6%) was reported by Ripabelli *et al.* (1999) [33].

The incidence of *Listeria spp* from reputed brands, moderate fast food centres and street vendors was 26.0%, 36.6% and 46.6% respectively in the present study. Min *et al.* (2013) [28] has reported no incidence of listeria in the burgers samples.The incidence of 30.4% and 33.3% in cooked beef and chicken patties were reported by Wong *et al.* (2007) [40] which was almost similar in the present study for samples from moderate fast food centres. An incidence of 22.9% in beef patties was reported by Wong *et al.* (2007) [40] which was almost similar to the incidence in reputed brands in the present study, whereas they reported very high incidence (75%) in frozen products.

Pathogenic microorganisms counts

The counts of the pathogenic microorganisms was presented in Table -3. The counts of *Staphylococcus spp*. in the burger samples from reputed brands, moderate fast food centres and street vendors were $4.12x10^3$, $3.50x10^5$ and $2.56x10^6$ CFU/gm respectively, in the present study. Counts of $10.94x10^3$, $8.98x10^3$ and $2.17x10^3$ CFU/gm were reported by El-Sherif *et al.* (1983), Essa and Makar (2003) [14] and Saleh *et al.*(2010) [20] respectively which were almost similar to the counts observed from reputed brands in the present study. Low counts of $8.3x10^2$, $2.8x10^2$ and $1.05x10^2$ to $2.3x10^2$ CFU/gm) were observed by Ali and Abd-El-Aziz (2009), El-Mossalami *et al.* (2009) and Min *et al.* (2013) [28] respectively. Very low counts of less than 10 CFU/gm in hamburgers, cheese burgers and hot dogs were reported by Lopasovsky *et al.* (2016) [17].

Table 3: Pathogenic microorganisms counts (CFU/gm) in burgers from different sources

Source	*Staphylococcus spp.*	*E. coli*	*Salmonella spp.*	*Vibrio spp.*	*Listeria spp.*
Reputed brands	4.12×10^3	2.5×10^1	2.42×10^2	Nil	0.9×10^1
Moderate fast food centers	3.56×10^5	3.56×10^4	4.32×10^3	1.2×10^2	1.86×10^2
Street vendors	2.5×10^6	5.65×10^5	3.12×10^4	2.8×10^3	3.86×10^4

The *E. coli* counts in the present study were $2.15x10^1$, $3.56x10^4$ and $5.65x10^5$ CFU/gm from reputed brands, moderate fast food centres and street vendors respectively. Min *et al.* (2013) [28] observed no incidence of *E. coli* in chicken and beef burgers, whereas only 3 $\log_{10}$ CFU/gm was observed by El- Dosoky *et al.* (2013) [11]. Cagney *et al.* (2004) reported counts of 3.04 $\log_{10}$ CFU/gm and 4.03 $\log_{10}$ CFU/gm, in fresh and stored beef burgers, which was almost similar to the counts observed in moderate fast food centres in the present study, whereas very low counts of 0.5 to 0.6 $\log_{10}$ CFU/gm was reported by Bolton *et al.* (1996) [6].

The *Salmonella spp.* counts were $2.42x10^2$, $4.32x10^3$ and $3.12x10^4$ CFU/gm in the burger samples from reputed brands, moderate fast food centres and street vendors respectively. Very low *Salmonella spp*. counts of 1 CFU/gm in beef burgers was reported by Bosilevac *et al.* (2009) [7], whereas a count of 1.0 to $1.5x10^2$CFU/gm was reported by Baker *et al.* (1982) in chicken burger, which was almost similar to the count of reputed brands in the present study. Guillier *et al.* (2013) [15] reported Salmonella count of 3.2 $\log_{10}$ MPN/gm in beef burgers which was almost similar to the counts in the present study from moderate fast food centres.

The *Vibrio spp*. counts of Nil,$1.2x10^2$ and $2.8x10^3$ CFU/gm from reputed brands, moderate fast food centres and street vendors respectively were observed in the present study. Very high counts of $6.5x10^4$ CFU/gm was reported by Azwai *et al.* (2016) [3], which was very much higher than the samples in present study from all the three sources.

The *Listeria spp*. counts were $0.9x10^1$, $1.86x10^2$ and $3.86x10^4$ CFU/gm from reputed brands, moderate fast food centres and street vendors respectively. Min *et al.* (2013) [28] observed no incidence of listeria in chicken and beef burgers. Wong *et al.* (2007) [40] reported listeria counts of 75 and 43 MPN/gm in beef and chicken patties respectively, which are higher than the counts from the reputed brands and lower than the counts observed from moderate fast food centres and street vendors in the present study.

Conclusion

The microbiological counts, incidence and counts of pathogenic microorganisms are less in burger samples from reputed brands but very high counts in the samples from

moderate fast food centres and street vendors. Unless strict hygienic measures are taken from the sources pose public health problems.

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