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

M Yogesh, D Venkat Reddy, K Lahari Reddy, G Sri Mahitha and N Krishnaiah

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 (3.38×10⁸ CFU/gm) in burgers from street vendors, lowest (7.15×10⁶ CFU/gm) from reputed brands, whereas it is intermediate (4.58×10⁷ CFU/gm) from moderate fast food centres. The coliforms count and faecal coliform in the burgers collected from reputed brands, moderate fast food centres and street vendors was 1.01×10³ and nil, 2.86×10⁵ and 1.38×10⁶ and 9.55×10⁵ and 2.86×10⁶ CFU/gm respectively. The yeast and moulds counts were 2.2×10², 8.56×10² and 6.38×10³ 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 4.12×10⁴, 90% and 2.5×10⁴, 46.66% and 2.42×10⁵, 23.33% and 0.8×10³ and 23.33% and 0.9×10³ in samples from reputed brands, 90% and 3.56×10⁶, 83.3% and 3.56×10⁵, 80% and 4.32×10⁵, 50% and 1.2×10⁶ and 33.33% and 1.86×10⁶ from moderate fast food centres whereas, 100% and 2.5×10⁵, 100% and 5.65×10⁵, 90% and 3.12×10⁴, 60% and 2.8×10⁵ and 43.33% and 3.86×10⁶ 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). 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 Camphyllobacter 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°C 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 extent of faecal contamination. The microbial quality of fast foods like pizza and burger is scantly 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 and 1:1000000.

Preparation of media
Nutrient agar (TVC), MacConkey (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°C for 24 to 48 hrs, whereas for faecal coliforms were incubated at 44.5°C 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 (3.38x10^8 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.

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

<table>
<thead>
<tr>
<th>Source</th>
<th>TVC</th>
<th>Coliforms</th>
<th>Faecal Coliforms</th>
<th>Yeast and Mould</th>
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<tbody>
<tr>
<td>Reputed brands</td>
<td>7.15x10^7</td>
<td>1.01x10^7</td>
<td>0.8x10^7</td>
<td>2.2x10^7</td>
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<tr>
<td>Moderate fast food centers</td>
<td>3.58x10^7</td>
<td>2.86x10^7</td>
<td>1.38x10^7</td>
<td>8.56x10^7</td>
</tr>
<tr>
<td>Street vendors</td>
<td>3.38x10^4</td>
<td>9.55x10^6</td>
<td>2.86x10^6</td>
<td>6.38x10^10</td>
</tr>
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</table>

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 CFU/gm, 2.3x10^5, 2.3x10^6 and 4.8x10^4 CFU/gm were reported by El- Dosoky et al.(2013) [11]. Essa and Makar (2004), El- Mosaallami(2009) and Tudor et al. (2010) respectively. Oranusi et al. (2011) [32] reported low levels of Total viable count i.e.2.3x10^3, 2.8x10^2 and 5.4x10^1 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 coliform count in the burgers collected from reputed brands, moderate fast food centres and street vendors was 1.01x10^7, 2.86x10^7 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) [29], 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 CFU/gm, 2.5 log CFU/gm and 200/gm in different types of burgers were reported by El-Dosoky et al. (2013) [11], Mosupey and Holy (1999) [29] and Tashkaya et al.(2005) [36] respectively.

The faecal coliform count was 0.8x10^1,1.38x10^2 and 2.86x10^2 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 faecal 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 collected from reputed brands, moderate fast food centres and street vendors respectively in the present study was 2.2x10^2 and 8.56x10^2 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]. Lopasovsky et al. (2016) [17] reported counts of 8.2x10^2 and 2.1x10^2 CFU/gm in hamburger and hotdog respectively and Ibrahim et al. (2014) [16] reported a counts of 5.1x10^3 and 7.0x10^3 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 (6.38x10^3 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 et al. (2016) [20] 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

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<tbody>
<tr>
<td>Reputed brands</td>
<td>27 (90%)</td>
<td>24 (80%)</td>
<td>14 (46.66%)</td>
<td>7 (23.33%)</td>
<td>7 (23.33%)</td>
</tr>
<tr>
<td>Moderate fast foods</td>
<td>27 (90%)</td>
<td>27 (90%)</td>
<td>24 (80%)</td>
<td>15 (50%)</td>
<td>10 (33.33%)</td>
</tr>
<tr>
<td>Street vendors</td>
<td>30 (100%)</td>
<td>30 (100%)</td>
<td>27 (90%)</td>
<td>18 (60%)</td>
<td>13 (43.33%)</td>
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</table>

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. (1999) [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 samples 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 4.12x10³, 3.50x10³ and 2.56x10⁶ CFU/gm respectively, in the present study. Counts of 10.94x10³, 8.98x10³ and 2.17x10⁵ 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 8.3x10², 2.8x10² and 1.05x10³ to 2.3x10⁶ 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

<table>
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<tbody>
<tr>
<td>Reputed brands</td>
<td>4.12x10³</td>
<td>2.5x10³</td>
<td>2.42x10²</td>
<td>Nil</td>
<td>0.9x10¹</td>
</tr>
<tr>
<td>Moderate fast food centers</td>
<td>3.56x10³</td>
<td>3.56x10⁴</td>
<td>4.32x10³</td>
<td>1.2x10⁵</td>
<td>1.86x10²</td>
</tr>
<tr>
<td>Street vendors</td>
<td>2.5x10⁷</td>
<td>5.65x10⁵</td>
<td>3.12x10⁴</td>
<td>2.8x10⁴</td>
<td>3.86x10⁴</td>
</tr>
</tbody>
</table>

The *E. coli* counts in the present study were 2.15x10⁴, 3.56x10⁴ and 5.65x10⁵ 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 log₁₀ CFU/gm was observed by El- Dosoky et al. (2013) [11]. Cagney et al. (2004) reported counts of 3.04 log₁₀ CFU/gm and 4.03 log₁₀ 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 log₁₀ CFU/gm was reported by Bolton et al. (1996) [6].

The *Salmonella spp.* counts were 2.42x10², 4.32x10³ and 3.12x10⁴ 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 1.5x10² 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 log₁₀ 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,1.2x10² and 2.8x10⁴ CFU/gm from reputed brands, moderate fast food centres and street vendors respectively were observed in the present study. Very high counts of 6.5x10⁴ 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 0.9x10¹, 1.86x10² and 3.86x10⁴ 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.

References
35. Sultana S. Comparative study of the microbiological status of street, lower-mid, higher-mid and high level fast food shops and detection of multidrugresistant isolates (Doctoral dissertation, BRAC University), 2016.