

*Original Research***Studies on the Sensory and Microbiological Quality of Pizzas Sold in and around Greater Hyderabad Municipal Corporation****D. Venkat Reddy¹, M. Yogesh¹, G. Sri Mahitha¹, K. Lahari Reddy¹ and N. Krishnaiah²**

Department of Veterinary Public Health and Epidemiology, College of Veterinary Science, Rajendranagar, Hyderabad, INDIA

¹B.V. Sc. Scholar²Professor***Corresponding author:** dvr091996@gmail.com

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Abstract

A study was conducted to assess the organoleptic and microbiological quality of pizzas sold in various outlets in and around Greater Hyderabad Municipal Corporation Telangana State, India. The sensory scores were higher for reputed brands, least for street vendors and in between for moderate fast food shops. The total viable count was highest (8.8×10^6 CFU/gm) in burgers from street vendors, lowest (3.0×10^5 CFU/gm) from reputed brands, whereas it is intermediate (3.56×10^6 CFU/gm) from moderate fast food centers. The coliforms count and faecal coliform in the burgers collected from reputed brands, moderate fast food centers and street vendors was 4.0×10^3 and 1.2×10^3 , 4.2×10^4 and 2.1×10^4 and 4.8×10^4 and 9.8×10^3 CFU/gm respectively. The yeast and moulds counts were 1.9×10^4 , 2.6×10^5 and 2.0×10^6 CFU/gm 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 also noted.

Key words: Coliforms, Mould, Pizzas, Total viable count, Yeast

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Introduction

Changes in life style has changed food consumption resulting introduction of western food products and fast foods into the human life in India. Bakery products consumption has been increased recently and the quality of these products is doubtful. Their shelf life is limited due to microbial spoilage. Pizza and Italian products has sprung into Indian market which has stolen the hearts of youth and its market has been

expanded in a steady manner. Pizza base is made from dough and its quality is questionable in the market due to use of contaminated ingredients. The cheese used, as a layer on the base is one of the major source for contamination of pizza as the industry may acquire inferior quality of cheese from market at cheaper price. The sauce, prepared locally is generally used in pizza preparation, which also contribute some amount of contamination.

The materials used for toppings i.e., cabbage, tomato, mushroom, spinach *etc.*, whose quality from the market is double. Apart from the ingredients, processing will also play an important role causing survival of existing pathogens. Nowadays many small-scale operators entered into western products and the contamination after processing is huge due to unhygienic conditions during storage and distribution. Even though the quality from multinational and national companies is satisfactory but the products from middle and lower level of outlets is highly questionable. Presently very scanty work has been published on the acceptability and microbiological quality of pizzas available in the Indian market, so this work was undertaken to assess the sensory evaluation and microbiological quality of pizza available in different types of outlets.

Material and Methods

Sample Collection

30 pizza 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.

Preparation of Dilutions

About 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 serial dilutions of 1:100, 1:1000, 1:10000, 1:100000 and 1:1000000.

Preparation of Media

Nutrient agar (TVC), MacConkey (Coliforms), Potato Dextrose Agar (Yeast and Mould), Xylose lysine Deoxycholate Agar (*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 and sterilized. 1ml of dilutions serially from 1:100000 to repeat factor 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 biochemical tests.

Results and Discussion

Sensory Evaluation

The packed and stored pizza samples were assessed for sensory attributes by trained panel of judges for appearance, flavor, body and texture and overall acceptability. The sensory attributes were estimated using five point Hedonic scale ranging from 1 to 5, 5-Excellent, 4- Very good, 3- Good, 2- Fair and 1-Poor. A mean score of 2.5 and above is considered acceptable and below 2.5 needs to be evaluated for microbiological quality. The sensory scores were higher for reputed brands, least for street vendors and in between for moderate fast food shops. The pizza samples, which were unsold, might have been carried over in street vendor samples, which might have been the reason for low sensory scores. The sensory evaluation of pizza samples are presented in Table 1.

Table 1: Sensory Evaluation of Pizza samples from different sources.

Score/ Character	Reputed brands	Moderate fast Food shops	Street vendors
Appearance	4.28±0.12	3.86±0.25	3.02±0.25
Flavour	4.52±0.15	4.21±0.22	3.52±0.22
Body	4.28±0.52	4.01±0.18	3.28±0.28
Overall Acceptability	4.48±0.28	4.01±0.22	2.62±0.28

The total viable count was highest (8.8×10^6 CFU/gm) in pizza samples from street vendors, lowest (3.0×10^5 CFU/gm) from reputed brands, whereas it is intermediate (3.56×10^6 CFU/gm) from moderate fast food centres. Eromo *et al.* (2016) reported total viable counts of 6.3×10^4 CFU/gm from street level samples which were less than the samples from different sources in the present study. A count of 2.0×10^3 CFU/gm in pizza samples was reported by Faruk and Akhter (2011) which was less than the counts from the street vendors. Singh *et al.* (2012) reported $6.65 \log$ CFU/gm in unbaked pizza, which was less than the counts from street vendors in the present study. The count of 3.5×10^6 CFU/gm in the samples from moderate fast food centres was almost similar to the counts of 8.8×10^6 CFU/gm observed by Kneifel and Berger (1994) in pizza mixture. High counts of 10 - 10^9 CFU/gm, 3×10^8 CFU/gm, 1.78×10^4 CFU/gm were reported by Saifullah *et al.* (2015), Sengul (2006), Machala (1961) in pizza, pizza cheese and pizza samples respectively, which were higher than the levels of total viable counts observed in the present study in the samples from any of the three sources. The low counts in pizza samples collected from reputed brands might be due to the hygienic practices followed by the handlers (Dickson, 1987). The Total Viable Count, Coliform count and Yeast and Mould counts are presented in Table 2.

Table 2: Total viable count, Coliform count, Faecal coliform count and Yeast and Mould counts in pizza samples from different sources (CFU/gm)

Source	TVC	Coliforms	Faecal Coliforms	Yeast and Mould
Reputed brands	3.0×10^5	4.0×10^3	1.2×10^3	1.9×10^4
Moderate fast food centers	3.56×10^6	4.2×10^4	9.8×10^3	2.6×10^5
Street vendors	8.8×10^6	4.8×10^4	2.1×10^4	2.0×10^6

The coliforms count in the pizza samples collected from reputed brands, moderate fast food centres and street vendors were 4.0×10^3 , 4.2×10^4 and 4.8×10^4 CFU/gm respectively. Eromo *et al.* (2016) reported coliform counts of 1.4×10^3 CFU/gm in pizza samples which were slightly less than the counts in the present study from street vendors. Machala (1961), Faruk and Akhter (2011) and Saifullah *et al.* (2015), reported coliform counts of Nil, 1.85×10^2 and 10^1 CFU/gm in pizza samples, which were less than the coliform counts from reputed brands in the present study, whereas higher counts of 4.2×10^4 CFU/gm in Turkish cheese were reported by Sengul (2006). The Faecal coliform counts was 1.2×10^3 , 9.8×10^3 and 2.1×10^4 CFU/gm in the samples from reputed brands, moderate fast food centres and street vendors respectively in the present study. Faruk and Akhter (2011) reported faecal coliforms counts of 15 CFU/gm in pizza samples, which were less than the samples from any of the three sources in the present study.

The Yeast and Mould counts was 1.9×10^4 , 2.6×10^5 and 2.0×10^6 CFU/gm in the samples from reputed brands, moderate fast food centres and street vendors respectively. High counts of 2.1×10^6 CFU/gm were reported by Sengul (2006) in pizza cheese samples, which were higher than the samples from any source in the present study. Pinho and Furlong (2006) reported higher counts of 2.9×10^6 CFU/gm in precooked pizza samples.

Incidence of Pathogens

The incidence of *Staphylococcus spp.* in the Pizza samples was very high from all the sources in the present study *i.e.*, 90%, 93.33% and 100% from reputed brands, moderate fast food centres and street vendors respectively. An incidence of 13.6% and 3% in hamburger patties and meatballs were reported by Aycicek *et al.* (2005) which were far less than incidence observed in the present study in the pizza samples from all the three sources. Low incidence of 3%, 6.4%, 12% in pizza samples, hamburger patties, vegetable salad than the incidence from all the three sources in the present study was reported by Gutiérrez *et al.* (2012). The incidence of different pathogens in the burger samples in present study are presented in Table 3.

Table 3: Incidence of different pathogens in pizza samples from different sources

Source	<i>Staphylococcus spp.</i>	<i>E.coli</i>	<i>Salmonella spp.</i>	<i>Vibrio spp.</i>	<i>Listeria spp.</i>
Reputed brands	27 (90%)	15 (50%)	19(63.3%)	6 (20%)	6 (20%)
Moderate fast foods	28 (93.3%)	24 (80%)	24 (80%)	13 (43.3%)	7 (23.33%)
Street vendors	30 (100%)	30 (100%)	27 (90%)	16 (53.33%)	12 (40%)

The incidence of *E. coli* in burger samples was 100% from street vendors followed by moderate fast food centres (80%) and least from reputed brands (50%) in present study. An incidence of 0.8% in fully cooked food samples was reported by Balzaretto and Marzano (2013), which was far less than the incidence observed in the present study in the pizza samples from all the three sources, whereas no incidence was reported by Pinho and Furlong (2000). The incidence of *Salmonella spp.* in pizza samples in the present study was least from reputed brands (63.33%), 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 *et al.* (2012).

The incidence of *Vibrio spp.* was 20%, 43.33% and 53.33% in the pizza samples from reputed brands, moderate fast food centres and street vendors respectively in the present study. Azwai *et al.* (2016) reported an incidence of 50% and 46.6% from uncooked and cooked meat sample respectively, which was almost similar to the incidence in the samples from moderate fast food centres. Jaksic *et al.* (2002) 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). The incidence of *Listeria spp.* from reputed brands, moderate fast food centres and street vendors was 20%,23.33% and 40% respectively in the present study. High incidence of 78% in ready to eat soft cheese samples was reported by Oyinloye (2016),56.3% and 86.4% in chicken legs and ground meat were reported byFarber *et al.* (1989) respectively, than the samples collected from all the three sources in the present study. An incidence of 6.5% in meat and meat products was reported by Jalali and Abedi (2008) which was far less than the incidence from the samples collected from any sources in the present study.

Pathogenic Microorganisms Counts

The counts of *Staphylococcus spp.* in the pizza samples from reputed brands, moderate fast food centres and street vendors were 6.12×10^3 , 8.38×10^4 , 3.63×10^6 CFU/gm respectively. Counts of 3.12 log CFU/gm, 3.0-4.3 log CFU/gm, 2.6 log CFU/gm and 2.8-3.5 log CFU/gm were reported by Aycicek *et al.* (2005),Gonul *et al.*(1996), Dickson(1987) and Gutiérrez *et al.* (2012) respectively in Russian salad , hamburger patties, pizzas samples respectively, which were less than the counts observed from reputed brands in the present study. Counts of 10.94×10^3 , 8.98×10^3 and 2.17×10^3 CFU/gm were reported by El-Sherif

et al. (1983), Essa and Makar (2004) and Saleh *et al.* (2010) respectively which were almost similar to the counts observed from reputed brands in the present study. The counts of the pathogenic microorganisms in pizza samples from different sources are presented in Table 4. The *E. coli* counts in the present study were 1.82×10^2 , 8.56×10^3 and 4.68×10^5 CFU/gm from reputed brands, moderate fast food centres and street vendors respectively. Counts of $3.37 \log$ CFU/gm from frozen pizza samples and 1.5 - $2.6 \log$ CFU/gm in frozen salami were reported by Dickson (1987) and Faith *et al.* (1997) respectively, which were less than the counts observed from the reputed brands in the present study.

Table 4: Pathogenic microorganisms counts in pizza samples from different sources (CFU/gm).

Source	<i>Staphylococcus spp.</i>	<i>E.coli</i>	<i>Salmonella spp.</i>	<i>Vibrio spp</i>	<i>Listeria spp.</i>
Reputed brands	6.12×10^3	1.82×10^2	3.26×10^3	1.1×10^1	1.28×10^1
Moderate fast food centers	8.38×10^4	8.56×10^3	5.6×10^3	2.8×10^2	2.86×10^2
Street vendors	3.63×10^6	4.68×10^5	8.38×10^4	8.68×10^3	1.28×10^3

The *Salmonella spp.* counts were 3.26×10^3 , 5.6×10^3 and 8.38×10^4 CFU/gm in the pizza samples from reputed brands, moderate fast food centres and street vendors respectively. Dickson (1987), observed counts of 3.6 - $4.5 \log$ CFU/gm in frozen pizza samples, which were, less than the counts observed from the reputed brands in the present study. Balzaretto and Marzano (2013) reported nil counts of *salmonella spp.* in pizza samples.

The *Vibrio spp.* counts of 1.1×10^1 , 2.8×10^2 and 8.68×10^3 CFU/gm were from reputed brands, moderate fast food centres and street vendors respectively, in the present study. Higher counts of 4.2×10^5 , 4.2×10^7 , 6.1×10^6 and 4.6×10^6 in tomatoes, chicken samples, pizza and burgers samples were reported by Mrityunjoy *et al.* (2013) which are higher than the counts in the samples from street vendors in the present study. Counts of 1.1×10^3 in frozen meat samples were reported by Mrityunjoy *et al.* (2013) which were similar to the counts from the samples from moderate fast food centres in the present study. The *Listeria spp.* counts were 1.28×10^1 , 2.86×10^2 and 1.28×10^3 CFU/gm from reputed brands, moderate fast food centres and street vendors respectively in the present study. Counts of 3.0 - $4.3 \log$ CFU/gm were reported by Ünalán *et al.* (2013) which were higher than the counts from three sources in the present study. Any food items sold under strict personal and environmental hygienic conditions will have low incidence and counts of pathogens. This might have reflected higher counts in the pizza samples sold by street vendors and minimum counts in the pizza samples sold by reputed brands. The hygienic conditions maintained in the retailers of moderate fast food centers were better than street vendors and less than that of reputed brands and so the incidence as well as pathogenic counts were moderate.

Conclusion

The microbiological counts, incidence and counts of pathogenic microorganisms are optimum 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 at these sources, public health problems will arise.

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