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A Bacteriological Study of Food Served at Various Hostels of Chandigarh: With Special Reference to E. Coli

KEYWORDS: Hostels, Microbial load, E. coli, Antibiotic Sensitivity test

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ABSTRACT *The present study was undertaken to assess the microbial load of foods served at 19 Hostels of Panjab University, Chandigarh. These foods were tested for their bacterial count and E. coli was isolated from them and from possible sources of contamination. The total bacterial counts ranged between 2.2x102- 1.2x106 CFU/gm/ml whereas the gram negative counts ranged between 2.0x101-8.0x103 CFU/gm/ml. E. coli was isolated in 83.33% of all the samples (food and sources of contamination) screened. It was observed that E. coli isolation from food samples was 91.57% whereas isolation from all sources of contamination was 80%. Antibiotic sensitivity of E. coli isolates from food and swab samples was maximum (80%) for Chloramphenicol. Salt aggregation test (SAT) for hydrophobicity revealed that 96% strains were hydrophobic. Using chi square test, a highly significant correlation was obtained between multi drug resistance and cell surface hydrophobicity. Hygiene and cleaning practices followed by food handlers at Hostels were also surveyed. It was observed that majority of food handlers washed hands before and after handling food (63.15%).*

Introduction:
The need for higher education is increasing in India. Eating establishments like hostels cater to a large population group comprising of students and teachers. Here food is prepared in large quantities, thus it is more susceptible to contamination. The major sources contributing to microbial contamination are the place of preparation, utensils for cooking and serving, raw materials, time and temperature abuse of cooked foods and personal hygiene[1]. It was also found that ignorance coupled with illiteracy of the personnel acts as a catalyst in the transmission of infectious organisms[2]. The risk of bacterial food borne also increases when food is prepared in communal kitchens, as in student accommodation, youth hostels and shared homes [3,4]. Priority must be given to these kitchens because food poisoning cases in these can affect a large number of population. The type of food served in healthcare settings should be selected to minimize the risk of food borne infection [5]. Escherichia coli, a normal inhabitant of human gut, are one of the most commonly found bacteria in the community[6]. Most strains of *E. coli* bacteria are harmless and live in the intestines of healthy humans and animals, yet several strains can produce powerful toxins and cause severe illness in humans[7].So a research was conducted for a bacteriological study of food served at Various Hostels of Chandigarh, with special reference to *E. coli.*

Sample Collection:
Nineteen hostels of Panjab University were surveyed for food samples (Rajmah, Kadhi, Arhar Dal, Channe, Rice, Water, Chapati, Curd) and swab samples (Serving area, Nail, Knife, Hand, Dishcloth, Chopping board and Cooking utensil). A questionnaire on cleaning practices in these kitchens was prepared and filled by the interview method.

Bacteriological Analysis:
Samples of food and swabs were aseptically collected from the hostels in sterilized tubes and immediately brought to the laboratory for further analysis. Standard plate count method was used to determine the total and gram negative counts of samples. The inoculums from the samples were grown on Mac Conkey's agar for 24 hours at 37°C.

Isolation and Identification of E. coli:
The dark pink, non-mucoid lactose fermenting colonies were picked up and the cultures were further purified by the plate streak method on EMB agar. The purified cultures were identified on the basis of colony morphology, gram staining and specific biochemical tests[8].

Bacterial Cell Surface Hydrophobicity:
Salt Aggregation Test was conducted to determine the hydrophobicity of *E. coli* isolated from food samples and swab samples from possible sources of contamination.

Antibiotic Sensitivity Test [9]:
E. coli isolates were tested to determine its susceptibility against different antibiotics.

Statistical Analysis:
Mean values of bacterial counts of various food samples were calculated to analyze the most and least contaminated food. In order to determine the correlation of multi drug resistance with cell surface hydrophobicity, the chi-square test was applied.

Results and Discussion:
The quality of hygiene of food served at hostel kitchens is an important public health concern to everyone. The food served gets easily contaminated, mainly due to negligence in the process of cooking, handling or serving of food. A total of 95 and 85 food and swab samples respectively were collected from the various hostels.

All the samples were subjected to testing for their total and gram negative counts. Table 1 shows the range of total bacterial count and gram negative counts taken from various food and swab samples collected from various hostels in Chandigarh. The gram negative counts ($2.0x10^1$-$8.0x10^3$ CFU/gm/ml) were lesser as compared to the total Bacterial Counts ($2.2x10^2$- $1.2x10^6$ CFU/gm/ml).

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The results of mean values of rice samples show highest values for both total bacterial and gram negative counts.

The trend of food contamination in decreasing order is as follows:

For total bacterial counts: Rice > Water > Chapati > Rajmah > Curd > Chana > Arhar dal > Kadhi.

For gram negative counts: Rice > Chapati > Rajmah > Curd > Water > Chana > Kadhi > Arhar dal.

E. coli are the commonest type of organisms which are reported to be growing in different types of food and their presence as an enteropathogenic strain has been implicated in almost all cases of infantile diarrhoea from different parts of India[10]. Out of 170 samples, *E. coli* was isolated in 155 samples (91.17%). Food samples exhibited higher percent isolation (91.57%) of *E. coli* as compared to *E. coli* isolated from swab samples i.e. sources of contamination (80%). Maximum isolation was observed in samples of curd and arhar dal (100%) while among swab samples, nail showed maximum isolation (92.3%). Isolation of *E. coli* from various food and swab samples taken from various hostels is shown in Table 1.

Table 1: Number of *E. coli* isolated from various hostel kitchens in Chandigarh.

Types of Hostel kitchens	Number of hostel kitchens	Total no. of food samples	**Number of *E. coli* isolated**	Total no. of swab samples	**Number of *E. coli* isolated**
Girls' P.U. hostel kitchens	9	45	42	40	33
Boys' P.U. hostel kitchens	8	40	38	35	30
Hostel kitchens of Home Science college	2	10	07	10	05
Total	19	95	87	85	68

One hundred fifty strains of *E. coli* were subjected to antibiotic sensitivity test. Table 2 shows maximum sensitivity of *E. coli* strains from food and swab samples were shown towards Chloramphenicol (80%) followed by Erythromycin (76%), Gentamycin (62%), Nalidixic acid (32%) while minimum sensitivity was observed towards Amplicillin (18%). The emergence of antibiotic resistance is an evolutionary process showing the enhanced ability of micro-organisms to survive doses of antibiotics that would have previously been lethal[11]. Table 2 also shows the distribution of multi-drug resistance strains isolated from food and swab samples.

Table 2: Antibiotic sensitivity of *E. coli* isolates from various sources of contamination and food samples and Multi-drug resistance of 150 *E. coli* isolates.

Antibiotics	Percent Sensitivity of *E. coli* (%)	Resistance against number of antibiotics	Percentage of *E. coli* exhibiting resistance (%)
Ampicillin 35 µg	18	None	7.33
Chloramphenicol 30 µg	80	One	21.33
Gentamycin 30 µg	62	Two	26
Erythromycin 30 µg	76	Three	22.67
Nalidixic Acid 30 µg	32	Four	14.67
		Five	1.33

Hydrophobicity allows the organism to approach negatively charged surface of the animal cells close enough to enable interaction of more specific binding molecules which play a significant role in infection[12]. A total of 150 strains of *E. coli* were subjected to the salt aggregation test (SAT) for determining the incidence and degree of cell surface hydrophobicity. Table 3 represents the percent distribution of *E. coli* from samples according to their cell surface hydrophobicity, taken at varying concentrations (0.02M, 0.2M, 1.8M, 3.2M) of ammonium sulphate. With the increase in concentration of ammonium sulphate, the rates of hydrophobicity also increased.

Table 3: Surface hydrophobicity of *E. coli* isolates from food and swab samples of various hostels at different concentrations of $(NH_4)_2SO_4$.

Samples	**No. of *E. coli* isolates**	**No. of *E. coli* isolates showing aggregation at different concentrations of $(NH_4)_2SO_4$**			
Total samples	150	0.02M	0.2M	1.8M	3.2M
		71	107	130	144

The *E. coli* strains isolated were subjected to varying concentrations (20 µg /ml, 40 µg /ml, 60 µg /ml, 80 µg /ml, and 100 µg /ml) of silver nitrate and mercuric chloride to determine their minimum inhibitory concentration towards *E. coli*. At lowest concentrations of metal ions tested (20µg/ml), 91.33% and 92.67% strains were resistant towards silver nitrate and mercuric chloride respectively. At the highest concentration tested (100µg/ml), 22.67% and 24.67 % strains were found resistant to silver nitrate and mercuric chloride respectively.

Table 4 shows a highly significant correlation between multi-drug resistance with cell surface hydrophobicity at 33.393 chi square value. This implies that those two characteristics may be located on the same plasmid as all these properties are plasmid mediated.

Table 4: Correlation of multi-drug resistance with cell surface hydrophobicity.

Test	Yes	No	Total	Pearson Chi-Square	Df	p-value
Hydrophicity	144	6	150	33.393	1	.000**
	96%	4.0%	100.0%			
Muti drug	107	43	150			
	71.3%	28.7%	100.0%			

**p-value<0.01=highly significant

The employees of various hostels were interviewed regarding cleaning and hygienic practices followed by them. Workers of only 7 kitchens (36.84%) had training in food hygiene. 63.15% of the kitchens were safe against rodents and insects. A large number of hostels, that is, 14 out of 19 (73.68%) used dustbin with a lid. Furthermore daily cleaning schedule was followed by 11.11% of hostels.

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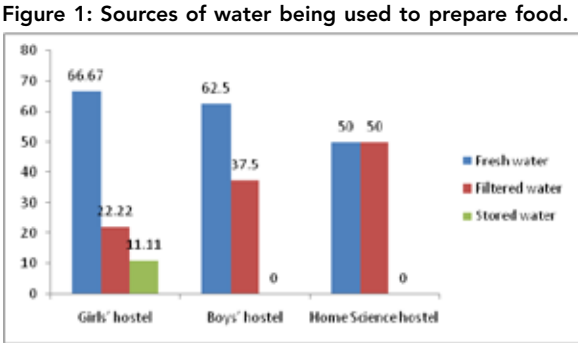
For wiping purposes, most of the food handlers (63.15%) used cloth duster. Usage of soap/ detergent and water was noticed in 42.1% of food handlers for washing hands. Majority of food handlers washed hands before and after handling food (63.15%). Work surface was cleaned everytime after using it by 36.84% food handlers and two times a day by 42.1% of food handlers. The serving area was cleaned before and after serving everytime by 9 out of 19 (47.36%) in the Hostels.

Figure 1 shows the comparison of sources of water being used to prepare food. 66.67% of Girls' Hostel kitchens used fresh, 22.22% used filtered and 11.11% used stored water for preparing foods. 62.5% of Boys' hostel kitchens used fresh water and 37.5% used filtered water while 50% Hostel kitchens of Home Science College used fresh and 50% used filtered to prepare food.

Figure 1: Sources of water being used to prepare food.



Summary and Conclusion:

Food can easily transmit diseases from person to person as well as serve as a growth medium for bacteria that can cause food poisoning. Food-borne diseases are certain to occur if cleanliness and sanitation aspects are not given priority. Food served in eating establishments like hostels play a major role in a student's well being. Both rice and water samples showed counts between 10^1 to 10^6 CFU/gm/ml. The samples of rajmah, kadhi, arhar dal and chana had the counts between 10^2 to 10^5 CFU/gm, 10^2-10^3 CFU/gm, 10^2 to 10^4 CFU/gm, 10^1 to 10^3 CFU/gm respectively. Samples of curd were seen to have counts between $5.0x10^1$ and $1.9x10^5$ CFU/gm/ml. *E. coli* was isolated in 87 out of 95 food samples and 68 out of 85 swab samples. In our study, high contamination was seen in hands, nails, dishcloths and chopping boards of food handlers. The manifestation of disease is an outcome of offending properties of host and virulence attributes of a pathogen. Therefore, the virulence characteristics of the *E. coli* isolates from various food and swab samples were screened for cell surface hydrophobicity, resistance to common antibiotics and heavy metal ions. The best way to ensure safety of food is by strict control and hygiene at all stages of manufacture and distribution coupled with consumer education.

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