

**FOOD AND ITS PREPARATION CONDITIONS IN HOTELS IN ACCRA,
GHANA: A CONCERN FOR FOOD SAFETY**

By

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ABSTRACT

Although a lot of work has been done on the safety of street foods in most developing countries, not much has been done with regards to the hotel industry. A pilot study to investigate food and its preparation conditions in ten selected hotels in Accra, the capital of Ghana with respect to food safety was therefore initiated in 2005/2006. A total of 184 samples; 105 swabs of kitchen working surfaces, cutlery and plates; 29, 30, and 20 samples of food, water and fruit juice respectively were taken for microbial analysis from ten highly patronized hotels between December 2005 and June 2006. Standard microbiological methods were used for isolation, enumeration, and identification of bacteria.

Thirty Seven (37) of the swab samples showed the presence of coliforms while *Escherichia coli* was absent in all the 105 samples. The total count of aerobic bacteria was high in the swabs from the working surfaces and cutting boards ($> 10^3$ cfu/ml). All the food samples tested negative for *Salmonella*, *Staphylococcus* and *E. coli*. Coliforms and *E. coli* were not detected in any of the 30 water samples tested, Ten of the fruit juice samples tested positive for coliforms although *E. coli* was absent in all the 20 samples. Most of the swabs that registered the presence of coliforms were from chopping boards, pastry and working tables suggesting that the method of cleaning these surfaces should be improved. The microbial quality of all the food samples tested was satisfactory with aerobic colony counts of less than 10^4 cfu/g and no pathogens detected in 25g of food sample, which is the standard for ready to eat foods. The water samples also met the satisfactory criteria of no coliforms detected in 100mls of water. No pathogens were detected in the fruit juice samples, but with the exception of ginger juice, all were contaminated with coliforms which suggests that, stringent measures be applied in the preparation and handling of these juices.

As a result of this study staff and management of these hotels are now implementing Good Hygienic Practices (GHP) and Hazard Analysis and Critical Control Points (HACCP).

Key words: Food, *Coliforms*, *Salmonella*, *Staphylococcus*

INTRODUCTION

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and or eaten according to its intended use. Millions of people fall ill and many do suffer from serious disorders, long-term complications or die as a result of eating unsafe food [1]. Food borne and waterborne diarrhea diseases are leading causes of illness and globally kill an estimated 2.1 million people annually, most of whom are children in developing countries [1].

Despite the availability of food safety strategies significance for public health and economic development in many countries, food safety policies, plan of actions and legislation have not been implemented especially in developing countries [1].

In recent times food safety issues have assumed a wider dimension because of the reliance on fast food whose preparation the consumer has no control over. Our busy way of life means that people eat more meals in restaurants, or from fast food outlets. If this food is not handled hygienically or not stored at the right temperature, food borne illnesses are bound to occur [2].

In developing countries a large proportion of ready to eat foods are sold on the street. This food is termed as 'street food' and the consumption is common among those in the low socioeconomic bracket. In Ghana, most of the street food vendors are illiterate or semi-illiterate thus the general perception is that their understanding of food safety issues is inadequate [3]. The general contention is that you buy such food at your own risk.

In contrast, people within the middle to high socioeconomic group as well as foreigners to Ghana prefer food from the hotels with the assumption that food sold from these hotels are prepared in good conditions because the food handler's are mostly literate (high school or university graduates) and thus would appreciate food safety issues better and ensure that food is prepared and served under good hygienic conditions.

A lot of work has been done on the safety of street foods in Ghana with the conclusion that most of them are prepared under unhygienic conditions [3-5]. However, not much work has been published in the country on hygiene and food safety with regards to the hotel industry. Few studies done elsewhere in the hotel and restaurant industry have found that food contact surfaces are a great source of contamination [6, 7].

This study was therefore conducted to assess the food and its preparation conditions in 10 highly patronized hotels by swabbing food contact surfaces (cutting boards, plates, cutlery and the palm of some staff) to determine the effectiveness of cleaning and hygienic practices in reducing their microbial load.

Food, water and fruit juice samples were also collected for microbial analysis to determine the possibility for cross contamination through the food preparation conditions.

MATERIALS AND METHODS

Study Area

The study was conducted entirely in the capital city Accra, a sprawling urban settlement of over four million people and growing at a rate of 4.3 % per annum [8]. Samples were collected from hotels that are highly patronized by the middle to high income earners as well as foreigners. The study involved ten of these hotels and samples were collected monthly between December 2005 and June 2006. Multiple samples were taken of each of the products. The study was explained to the Hotel managers and their consent sought.

Sample collection

Swabs

One hundred and five food contact surfaces such as cutting boards, plates, cutlery, working tables and the palm of some staff were swabbed after they had undergone the daily cleaning. The swabs were examined for the presence of indicator organisms (coliforms and *E. coli*).

Food

Twenty-nine samples of 50 g each of the food on the menu (rice, tomato stew, Garden egg stew, meat stew etc.) were placed in separate sterile containers. The samples were tested for the presence of the pathogenic organisms *Salmonella*, *Staphylococcus* and *E. coli*.

Water

Hundred milliliters each of 30 water samples in different forms; i.e. ice, flakes and tap water were collected in sterile bottles. They were tested for the presence of coliforms and *E. coli*.

Fruit Juice

Twenty milliliters each of twenty fruit juice samples (Pineapple, Mango, Orange, Punch and Ginger) prepared on site were collected into sterile bottles and tested for the presence of coliforms and *E. coli*.

Sample transportation

All samples were transported to the Bacteriology Department, Noguchi Memorial Institute for Medical Research, Accra, Ghana on ice immediately after collection and stored at 4°C until they were taken through bacteriological examination. All the samples were examined within 24 hours after they had been brought to the laboratory.

Bacteria Counts

Swab

Each swab stick was inserted into a sterile centrifuge tube containing 10 ml of phosphate-buffered saline (PBS, Oxoid Dulbecco ABR, UNIPATH, Basingstoke, England, pH 7.0). The tubes were vortexed to release the material on the stick in solution. The resultant solution (1:10) was then used for the analysis.

Food

Ten grams of food was weighed aseptically into sterile plastic stomacher bags and macerated. A 1:10 dilution was prepared by adding 90 ml of PBS to the sample. Plate count agar (PCA) was used for total plate count (TPC); MacConkey agar (MCA) for coliform count; Salmonella/Shigella agar (SSA) and Baird Parker agar (BPA) for isolation of *Salmonella/Shigella* and *Staphylococcus aureus* respectively.

Water

Ten milliliters of each water sample was transferred into 90 mls of PBS to get the 1:10 dilution.

Fruit Juice

Ten milliliters of each fruit juice was also transferred into 90 mls of PBS to get the 1:10 dilution.

Serial dilutions

Each 1:10 dilution was thoroughly mixed and further threefold dilution made by aseptically transferring 10ml of it into 90 ml of the diluent, and serially diluted in the same buffer solution from 1:10 to 1:10³. One millilitre volume of the dilutions were transferred onto various sterile Petri dishes and the pour plate method used to inoculate [9, 10].

Total mesophilic bacteria counts were carried out using PCA (Oxoid CM453); MCA (Oxoid CM7) was used for coliform and faecal coliform counts. BPA (Oxoid CM275) was also used for *Staphylococcus aureus*.

Isolation and identification

Ten milliliters portions of the 1:10 suspension were incubated and centrifuged at 10,000 rpm for 30 minutes in a refrigerated centrifuge (Hitachi 20PR-259, Tokyo, Japan). The supernatant was decanted and a loop-full of the pellets streaked on SSA (Oxoid CM533) and MCA for the detection of *Salmonella*, *Shigella*, *E. coli* and other *Enterobacteriaceae*. All incubations were done at 37°C under aerobic conditions for 18-24 hours. Portions of the pellets were also inoculated into selenite-lactose broth (SLB) (Oxoid CM395) and incubated for 18-24 hours for selective enrichment of *Salmonella* and *Shigella*. Two loop-fulls were streaked onto SSA and incubated at the same time for the detection of isolated colonies.

Reference cultures were used as control. Suspected colonies were identified by standard biochemical methods (Indole, Methyl Red, Voges-Proskauer and Citrate (IMVIC) reactions and Analytical Profile Index [API] for *Salmonella*, *Shigella* and *E.coli* while the catalase and coagulase tests were used for identification of *Staphylococcus aureus*). Plates that had between 30-300 colonies were selected for the determination of colony forming units per gram (CFU/g). Bacteria counts were carried out using colony-counting chamber (Gallenkamp, UK). The number of CFU/g was calculated by multiplying the number of bacteria by the dilution factor. Data was analyzed using EpiInfo version 6 software.

RESULTS

As shown in Table 1, all the swabs were negative for *E. coli*. However, coliforms were present on 75 % (3/4) of the pastry tables, 54 % (15/28) of the cutting boards, and 50 % (2/4) of the fruit juice dispensers, 22 % (2/9) of the plates, 30 % (8/27) of the working tables and 36 % (4/11) of the sampled staff's palms. Coliforms were absent in the sampled forks and teacups.

The total aerobic colony count (on PCA) for all the food samples was within acceptable limits for cooked foods ($> 10^4$ CFU/g). *Staphylococcus aureus*, *Salmonella* and *E. coli* species was not detected from any of the food samples (Table 2).

Table 3 shows that, there was less than one cfu/ml in all the water samples. Coliforms and *E. coli* were also absent. Coliforms were detected in all the juices except ginger (Table 4), the highest being pineapple juice 83 % (5/6) followed by mango juice 75 % (3/4) and orange 20 % (1/5) respectively.

DISCUSSION

Escherichia coli was not isolated from any of the swabs but 35 % of them were positive for other coliform bacteria. Almost all (70 %) of the swabs positive for coliforms were from either a cutting board or a working surface. Food contact surfaces are notorious when it comes to bacteria contamination [6]. It is an issue of great concern because of the possibility of cross contamination of food. In the present study none of the food samples tested positive for any of the food pathogens of

interest despite the presence of coliforms on most of the food contact surfaces. Coliforms are susceptible to heat and all the food tested were cooked foods so perhaps the issue of cross contamination would come in if uncooked foods such as salads had been tested. Most of these food contact surfaces are either made of plastic or wood thus offer a viable surface for bacteria to adhere, grow and multiply. Although all the surfaces swabbed, had been cleaned by washing with water it failed to eliminate the coliform bacteria. It has been suggested that the best way of treating these surfaces is to wash in a solution containing 1 part vinegar and 4 parts water [11].

The food samples tested negative for *Salmonella/Shigella*, *Staphylococcus aureus* and *E. coli*. Insignificant counts on PCA were also registered. This was expected since food is served hot in such hotels after customers have ordered their preferred dish and all of these pathogens are susceptible to heat.

There was no growth on the PCA for any of the water samples and *E. coli* as well as coliform bacteria were absent in all the samples. This is probably because water does not go through a lot of processes before it is ready to be used hence if it is safe from source it is very easy to avoid contamination.

All the fruit juice samples tested negative for *E. coli* but more than 50 % (8/15) of the samples were positive for other coliform bacteria with significant growth on the PCA for all the juices except ginger. Fruit juices could be contaminated by falling on contaminated ground; through the water used in washing (if it is contaminated); improper handling or unsterilized storage containers [11]. Freezing will not eliminate any contamination, as freezing temperature does not kill bacteria. The best method is to pasteurize by letting it boil for about 45 seconds and cooling it to room temperature before freezing [10]. However since fruit juice is preferred fresh by most people, the risk of illness associated with unpasteurised fruit juices can be reduced by controlling or preventing contamination either by removing or killing pathogenic bacteria by washing the fruit thoroughly; employing hygienic measures to avoid contamination when processing; and storing in sterilized containers [12].

The good microbiological quality of ginger juice as compared to the others is not surprising since various studies have shown that active constituents of ginger inhibit the multiplication of coliform bacteria and also inhibits the growth of *E. coli*, *Proteus*, *Staphylococcus aureus* and *Salmonella* [13, 14].

CONCLUSION

Our findings indicate that the assumption that foods served in hotels are generally safe could be true since no adverse findings resulted from the bacteriological examination of the food and water samples. However, most of the fruit juice sampled recorded significant growth as well as the presence of coliform organisms suggesting that methods employed in the preparation of these juices should be improved. The results cut across all the hotels investigated.

The presence of coliforms on most of the food contact surfaces suggests that cleaning methods should also be improved as they could be possible sources of contamination for foods like salad which is usually eaten raw [15]. There is therefore the need to for hotels to utilize Good Hygienic Practices (GHP) and to have Hazard Analysis and Critical Control Points (HACCP) systems implemented. Indicator organisms such as coliforms can be useful tools for indicating or verifying the efficiency and effectiveness of these programmes. The findings were not presented on individual hotel bases as the intention is to draw attention to the fact that food preparation conditions could be a concern for food safety even in hotels and not the situation in particular hotels. The names of the hotels were also not stated as the management gave their consent on condition of anonymity. One of the limitations of the study was our inability to sample hotel restaurants outside Accra.

The outcome of the study has served as a baseline data for the management of these Hotels in collaboration with the funding agency to conduct a comprehensive Good Hygiene Practice (GHP) and Hazard Analysis and Critical Control Points for Hotels in Accra and other parts of the country with active participation of the workers who own these plans. Particular attention has been focused on working surfaces since the data was very clear that these were the most contaminated with coliforms. The staff of these hotels are also taking personal hygiene seriously as the swabs of some staff palms were positive for coliforms.

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Table 1: Identification of swab samples and number of samples with coliform or *E. coli* present

Swabs	Frequency	Coliform (Present)	E.coli (Present)
Pastry Table	4	3	0
Cutting Board	28	15	0
Staff Palm	11	4	0
Kitchen Knife	4	2	0
Working Table	27	8	0
Fruit Juice dispenser	4	2	0
Bowl	8	1	0
Fork	6	0	0
Teacup	4	0	0
Plate	9	2	0
Total	105	37	0

Table 2: The microbiological quality of different types of food collected from hotels in Accra, Ghana.

Food	Frequency	Total Count (mean cfu/g)	<i>Staphylococcus aureus</i> , <i>Salmonella</i> and <i>E.coli</i>
Tomato Sauce	11	7.0 X10 ³	Absent
Meat Stew	2	>1	Absent
Penne Arabiata Sauce	2	0.5 X10	Absent
Jollof Rice	3	3.3 X10 ³	Absent
Plain/Fried Rice	3	>1	Absent
Garden Egg Stew	2	1.1 X10 ²	Absent
Agushie Stew	1	>1	Absent
Soup	3	>1	Absent
Chicken piece	1	>1	Absent
Potato Croquettes	1	>1	Absent
Total	29	>1	Absent

Table 3: Identification of water samples and mean level of bacterial contaminants

Water	Frequency	Total Count (mean cfu/ml)	Coliform (Present)	E.coli (Present)
Ice Cubes	10	>1	0	0
Ice Flakes	9	>1	0	0
Water (Kitchen)	11	>1	0	0
Total	20		0	0

Table 4: Identification of fruit juice samples and mean level of bacterial contaminants

Fruit Juice	Frequency	Total Count (mean cfu/ml)	Coliform (Present)	E.coli (Present)
Pineapple	6	6.0×10^3	5	0
Orange	5	1.3×10^5	1	0
Ginger	4	>1	0	0
Mango	4	4.5×10^2	3	0
Punch	1	2.0×10^3	1	0
Total	20		10	0

REFERENCES

1. **WHO.** World Health Organization. Background paper: Developing a food safety strategy. WHO Strategic Planning Meeting, Geneva, 2001.
2. **Anonymous.** Food handler safety bytes, 2001.
3. **Mensah P, Yeboah-Manu D, Owusu-Darko K and A Ablordey** Street foods in Accra, Ghana: how safe are they? *Bulletin of World Health Organization* 2002; **80**: 546-554.
4. **Mensah P, Yeboah-Manu D, Owusu-Darko K, Ablordey A, Nkrumah FK and H Kamiya** The role of street food vendors in the transmission of enteric pathogens. *Ghana Medical Journal* 1999; **33**: 19-29.
5. **Agbodaze D, Nmai PNA, Robertson FC, Yeboah-Manu D, Owusu-Darko K and KK Addo** Microbiological quality of “khebab” consumed in the Accra metropolis. *Ghana Medical Journal* 2005; **39**: 46-49.
6. **Sneed J, Strohbahn C, Gilmore SA and A Mendonca** Microbiological evaluation of food service contact surfaces in Iowa assisted living facilities. *Journal of American Diet Association* 2004; **104**:1722-1724.
7. **Sagoo SK, Little CL, Griffith CJ and RT Mitchell** Study of cleaning standards and practices in food premises in the United Kingdom. *Commun Dis Public Health.* 2003; **6**: 6-17.
8. **WHO.** World Health Organization Document. Decentralization Policies and Practices: case study Ghana. Participants Manual, Module A, Geneva, 2003.
9. **Harrigan FW and ME McCance** Laboratory Methods in food microbiology. Academy Press, London, 1968.
10. **Thatcher PS and DS Clark** Microorganisms in foods: their significance and methods of enumeration. Volume1. University of Toronto Press, Toronto, 1968.
11. **Synder OP Jr** The Microbiology of cleaning and sanitizing a cutting board. Hospitality Institute of Technology and Management, 1997.
12. **Burnett SL and LR Beuchat** Human pathogens associated with raw produce and unpasteurized juices and difficulties in decontamination. *Journal of Industrial Microbiology and Biochemistry* 2000; **25**: 281-287.

13. **Nannapaneni JME and MG Johnson** Identification and characterization of two bacteriocin producing bacteria isolated from garlic and ginger root. *Journal of Food Protection* 1999; **62**: 899.
14. **Gugnani HC and EC Ezenwanze** Antibacterial activity of extracts of ginger (*Zingiber Officinale*) and African oil bean seed. *Journal of Communicable Diseases* 1985; **17**:233.
15. **Mensah P, Armar-Klemesu M, Hammond AS, Haruna A, Nyarko R.** Bacterial contaminants in lettuce, tomatoes, beef and goat meat from metropolitan Accra *Ghana Medical Journal* 2001; **35**:1-6.