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Microbial Analysis of Street-vended and Retort Processed Ready-to-eat Foods Available in the Markets of Kashmir Valley, India

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The present study was carried out to assess the microbiological quality of different ready-to-eat foods available in the markets of Kashmir valley. In this study, 5 different samples were studied for their microbiological quality by enumeration of total viable colony counts. The results suggest the poor microbiological quality of street-vended *Samosa*, *Chickenpatti* and *Rista*(meat balls) and better microbiological quality of retort processed *Alu mutter* and *Palakpaneer*. The poor microbiological quality of street-vended foods could be due to poor hygienic conditions maintained during their preparation because the street vendors are often unaware of good hygienic practices (GHPs) and good manufacturing practices (GMPs). On the other hand the better microbiological quality of retort processed foods might be due to proper hygiene and processing treatment given during their manufacturing. It thus becomes important to incorporate a provision to educate the street vendors and make them aware of GHPs and GMPs to avert the problems of food-borne illnesses or infections after consuming highly contaminated street vended foods.

Key words: Microbial analysis, Ready to Eat Foods, Aerobic plate count, Bacteria, Pathogens.

United States Department of Agriculture (USDA) has defined ready-to-eat (RTE) foods as "*food that is in a form that is edible without washing, cooking or heating by the consumer and that is reasonably expected to be consumed in that form*"(Muzzafar *et al*., 2013). Food Safety authority of Ireland defines ready-to-eat foods as "all composite foods which are purchased by or supplied to a consumer and do not require significant further processing other than re-heating or completion of a cooking process". These foods usually require refrigeration for extended shelf-life, if not consumed immediately(Muzzafar *et al*., 2013). The composition of ready-to-eat foods varies considerably with some foods containing ingredients that are uncooked e.g. sandwiches while some foods containing cooked ingredients (Tsang, 2002). Some of the common examples of RTE foods are: cheese, yogurt, cakes, pastries, pies, beef burgers, *kebabs*, sausage roll, scotch egg, bean curd, *bhaji*, *samosa*, chicken patties, *Rista*(meat balls), *Alu mutter*, *Palakpaneer*, washed cut fruits and vegetables,moin-moin, salad or coleslaw, fried meat, fried chicken, milk and milk products (Caserani and Kinston, 1974). In the past few years, there has been a greater mobility of people, increase in the number of itinerary workers and less home centered activities due to globalization which resulted in the shift of people's interest to RTE foods(Clarence *et al*., 2009). This in turn has resulted in an increase in the number of foodcompanies orvendors producing these RTE foods. In tropical countries like India, street-vended foods are common man's choice(Yadav *et al*., 2011) which is usually sold at public places

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and roadside shops.But these vendors rarely enforce good hygienic and manufacturing practices (GHPs and GMPs) (Musa *et al*.,2002). The consumption of food prepared by these vendors may cause food-borne disease. Food-borne diseases result from ingesting bacteria, toxins and cells produced by microorganisms in the food (Doyle *et al*., 1999).

RTE foods serve as a source of readily available nutrients but questions have been raised about the safety and microbiological quality of these food products (Mosupye and Holy,1999; Tony *et al*.,2001). Due to growing international trade, food safety has emerged as an important global issue. The increase in number of food-borne illnesses has put a stress on governing bodies all over the world to intensify efforts to improve food safety(Sudershan*et al*.,2009). In view of this, there are several laws which have been enforced to combat this problem. According to Leach*et al*. (2001), the choice of public while selecting a food is not affected by food safety but by psychological interpretation of food properties (Rozin*et al*.,1986). Food quality is an important factor in deciding the choice of food (Lewis, 1981). Consumers often use their senses in deciding the safety of food e.g. they feel that food that looks or smells bad should not be eaten but they cannot decide about the risk of food-borne illness because the extent of microbial contamination cannot be observed with senses (Roberts*et al*.,2003). Thus it is important to assess the microbial quality of RTE foods to ensure safety of the consumer and to prevent food poisoning outbreaks in future (Anonymous, 1988). The present study was carried out to evaluate the microbial quality and safety of consumption of different RTE foods available in the markets of Kashmir valley and to get the first hand information on the hygiene and sanitation conditions followed.

MATERIALS AND METHODS

Sample collection and processing

Five different samples of ready-to-eat foods (*Samosa, Chicken patti, Rista, Palkpaneer and Alu mutter*) were procured from different markets of Kashmir valley. The samples were collected in sterile containers and were taken at 4^{o}C under aseptic conditions toa laboratory forimmediate microbial analysis.

The representative samples are shown in Table 1.

Microbiological analysis

For microbial analysis, 1 g of each sample was serially diluted to 10^{0}, 10^{-1} and 10^{-2} dilutions in saline (0.85% NaCl w/v). The total aerobic colony counts was determined by spreading 0.1 ml from each dilution (10^{0}, 10^{-1} and 10^{-2})on nutrient agar(MERCK) platesfollowed by incubation at 37^{o}C for 48 hours **(**Gilbert *et al*.,2000; Nayik *et al*., 2013)after which colonies were counted by colony counter (QUEBEC). The total aerobic colony count was reported as colony forming units per gram of food sample (cfu/g). The plates with colony forming units per ml (cfu/ml) ranging from 30-300 were considered for counting as the colonies less than 30 would have run into statistical inaccuracy and the colonies greater than 300 would have been tedious to count(Nayik *et al*., 2013).

RESULTS AND DISCUSSION

A total of 5 samples were analyzed for microbiological analysis out of which *Samosa, Chicken patti and Rista*were found to be of poor microbiological quality. The aerobic colony counts (ACC) for all the four samples are represented in Table 2 and their colony characteristics are shown in Table 3. As shown in Table 2, the aerobic colony counts (ACC) of *Samosa*, *Chickenpatti*

Table 1. Representative ready-to-eat food samples collected from different markets of Kashmir valley

S.No.	Sample	Brand name	Area of collection
1	*Samosa*	MTR	Srinagar, Kashmir
2	*Chicken patti*	MTR	Srinagar, Kashmir
3	*Rista*	Street-vended	Bus stand Panthachowk, Kashmir
4	*Alu mutter*	Street-vended	Awantipora, Kashmir
5	*Palakpaneer*	Street-vended	Awantipora, Kashmir

and*Rista*are within unacceptable limits i.e. ACC $>10^5$cfu/g whereas the ACC for *Allu mutter* and *Palakpaneer* are within acceptable limits i.e. ACC $>10^5$ cfu/g(Gilbert *et al*. 2000).

The reason for the poor microbiological quality of street-vended ready-to-eat foods (*Samosa*, *Chickenpatti* and *Rista*) could be because of the unhygienic practices maintained during their preparation and storage. Also as the samples were taken from street vendors, they are usually prepared and sold in an open environment in more crowded areas particularly bus stands, railway stations etc. So, there is much of the possibility of getting these foods contaminated with dust and insects thus rendering the food unacceptable for human consumption.On the other hand, the better microbiological quality of RTE retort processed foods (*Alumutter* and*Palakpaneer*)could be

Table 2. Aerobic colony count (ACC) of various RTE food samples

Sample	Dilution	Aerobic Colony Count (ACC) CFU/ml	Mean ACC (CFU/ml)	Mean Deviation
Samosa	10^0	Too Numerous to Count		
	10^{-1}	2.48×10^5	2.47×10^5	0.04
		2.42×10^5		
		2.5×10^5		
	10^{-2}	2.6×10^5	2.93×10^5	0.06
		3.4×10^5		
		2.8×10^5		
Chicken patti	10^0	Too Numerous to Count		
	10^{-1}	2.4×10^5	2.41×10^5	0.06
		2.35×10^5		
		2.47×10^5		
	10^{-2}	2.5×10^5	2.83×10^5	0.41
		2.7×10^5		
		3.3×10^5		
Rista(Meat balls)	10^0	Too Numerous to Count		
	10^{-1}	2.44×10^5	2.47×10^5	0.036
		2.32×10^5		
		2.49×10^5		
	10^{-2}	2.6×10^5	2.63×10^5	0.20
		3×10^5		
		2.7×10^5		
Alu mutter	10^0	3.6×10^3	3.6×10^3	0.4
		4×10^3		
		3.2×10^3		
	10^{-1}	Too Low to Count		
Palakpaneer	10^0	1.98×10^4	2.15×10^4	0.19
		2.12×10^4		
		2.36×10^4		
	10^{-1}	2.9×10^4	$2..67 \times 10^4$	0.20
		2.5×10^4		
		2.6×10^4		
	10^{-2}	Too Low to Count		

Unless otherwise mentioned, all the experiments were carried out in triplicates. The data presented in the results represents the average of triplicate readings ± Standard deviation. The Statistical Analysis was carried out by one Way ANOVA (Bhat et al., 2008; Nayik et al., 2013).

attributed to good hygienic and manufacturing practices (GHPs and GMPs) in the processing area. These two samples were taken from MTR brand which might be maintaininggood hygienic practices during the manufacturing of products.The difference betweencfu/g for all the samples at different dilutions studied, as mentioned above was not significant ($P < 0.05$).

The traditional processing methods for the preparation of RTE foods,inappropriate holding temperatures and poor personal hygiene of food handlers by street vendors could be some of the reasons for poor microbiological quality of street-vended RTE foods. Vendors are often uneducated, unlicensed, and unaware of food hygienic practices to be followed during the manufacture of these RTE foods and they usually work under crude insanitary conditions with little or no knowledge about the causes of food-borne diseases. It is known that most of the street-vended foods are not well protected from the flieswhich may carry food-borne pathogens and thus could lead to some food-borne illnesses or infections in humans after consuming such highly contaminated foods. However,RTE foods which are retort processed are manufactured under hygienic conditions by well educated, licensed and trained food manufacturers or food business operatorsfollowing good hygienic practices (GHPs) and good manufacturing practices (GMPs) during the manufacture of such products.

Table 3. Characteristics of colonies obtained on nutrient agar plates inoculated with different RTE food samples

Sample	Characteristics					
	Shape	Size (Diameter) cm	Color	Margin	Elevation	Texture
Samosa	Circular	0.05 – 0.25 cm	White, Light yellow and dark yellow	Entire	Flat	Dry
Chicken patti	Circular	0.05 – 0.015 cm	White, Light yellow	Entire	Flat, few raised	Dry, Moist
Rista	Circular	0.05 – 0.1 cm	White, Light yellow	Entire	Flat	Dry, viscous
AluMattur	Circular	0.1 – 0.15 cm	White	Entire	Flat	Moist
Palakpaneer	Circular, Irregular	0.1 – 0.7 cm	White and dark yellow	Entire, Wavy	Flat, few raised	Dry

CONCLUSION

Among the various RTEfood samples analyzed for microbial analysis, the highest microbial contamination was found in street vended RTE foods (*Samosa, Chicken patti, Rista*) than RTE retort processed foods (*Alu mutter* and *Palakpaneer*) with *Samosa* having the highest (2.47×10^5 to 2.93×10^5 cfu/g) and *Chicken patti* the least (2.41×10^5 to 2.83×10^5 cfu/g) ACC, according to the guidelines for microbiological quality of RTE foods. On the basis of our results, the street-vended RTE foods (*Samosa, Chicken patti, Rista*) possess unsatisfactory microbial quality while as retort processed RTE foods (*Palakpaneer* and *Alumutter*) possess acceptable and satisfactory microbial quality.

Street-vended RTE foods did not meet microbial quality standards while as retort processed RTE foods possess good microbial quality which could be mainly due to poor water quality used for preparation of street-vended foods and poor hygienic practices followed during their preparation, washing of utensils, poor personal and domestic hygiene. In Kashmir valley, street-vended foods are popular, but due to their poor microbiological quality they have become a potential health hazard to human health. Hygienic measures should be improved in order to minimize the microbial contamination of street-vended RTE foods. A provision should be made to educate street vendors about the good hygienic and manufacturing practices to be followed during the manufacturing of any food item by them.

REFERENCES

1. Anonymous. Bacteriological quality. *Available at http://www.dsp-psd.pwgsc.gc.ca/collection/H48-10-1-3-1991E.pdf.*, 1988.
2. Bhat, S. V., Melo, J., Chaugule, B.B., Dsouza S. F. Biosorption characteristic of uranium (VI) from aqueous medium on to *Catenellarepens*, a red algae. *J. Hazard. Mater.*, 2008; **158**: 628-655.
3. Caserani, V., Kinston, R., Practical Cookery.*4th edition Edward Arnold publishers London*, pp 1974; 1-10.
4. Clarence, S. Y., Nwinyi, O. C., Chinedu, S. N.Assessment of bacteriological quality of ready-to-eatfood (Meat pie) in Benin City metropolis, Nigeria. *Afr. J. Microb. Res.*, 2009; 390-395.
5. Doyle, M. P., Evans, P. D. Food borne pathogens of recent concern. *Ann. Revised Nutr.*, 1999; **6**: 25-41.
6. Fang, T. J., Que-King W., Chia-Wei, L., Min-Ju, H., Tzu-Hui, W. Microbiological quality of 18 jC ready-to-eat food products sold in Taiwan.*Int. J. Food Microbiol*, 2001; 241-250.
7. Ireland, Food Safety Authority of. *Guidelines for the Interpretation of Results of Microbiological Analysis of Some Ready-To-Eat Foods Sampled at Point of Sale- Guide Note 3.* Dublin: Food Safety Authority of Ireland Abbey Court Lower Abbey Street Dublin 1, 2001.
8. Leach, J., Mercer, H., Stew, G., Denyer, S. Improving food hygiene standards - acustomer focused approach. *Brit. Food J.*, 2001; **103**(4): 238-252.
9. Lewis, R.C. Restaurant advertising: appeals and consumer intentions. *J. Advertising Res.*, 1981; **21**(5): 67-74.
10. Maheshwari, D. K., Dubey, R. C.*Practical Microbiology.* New Delhi: S. Chand & Company Ltd., 2002.
11. Mosupye, F. M., Von, H. A. Microbiological quality and safety of ready-to-eat street-vended foods in Johannesburg, South Africa.*J. Food Prot.*, 1999; **62**: 1278-1284.
12. Musa, O. I., Akande, T. M.. Effect of health education intervention or food safety practice among food vendors in Ilorin. *Sahel Med. J.*, 2002; **5**:120-124.
13. Muzzafar, K., Amin, T., Bhat, S. V. Maintenanace of microbiological quality of ready-to-eat foods. *Indian Hort. J.*, 2013; **3**(1-2): 46-50.
14. Nayik, G. A., Amin, T., Bhat, S. V. Microbial analysis of some fruit juices available in the markets of Kashmir valley, India.*Asian J. Microb., Biotechn. Environ. Sci.*, 2013 (*In Press*).
15. Roberts, T., Buzby, J., Lichtenberg, E. Economic consequences of food-borne hazards. In *Food Safety Handbook*, by R.H.Schmidt and G.E. Rodrick, 89-124. New Jersey: John Wiley and Sons, Inc.,, 2003.
16. Rozin, P., Pelchat, M.L., Fallon,A.E. Psychological factors influencing food choice.*In: R.C. Gofton and J. McKenzie (Eds)*, 1986; 85-106.
17. Sundershan, R. V., Rao, P., Polasa, K. Food safety research in India: a review. *Asian J. Food Agro-Industry*, 2009; **2**(3): 412-433.
18. Tsang, D. Microbiological guidelines for ready-to-eat food.*Road and Environmental Hygiene Department Hong Kong*, 2002; 115-116.
19. Yadav, N., Saini, P., Kaur, D. Srivastava, N., Pandey, D.Microbial quality and safety of ready-to-serve street foods vended in Allahabad City, India. *Internet J. Food Safety*, 2011: 6-10.