Pak sci. ind. res., vol. 32, no. 2, February 1989

STUDY ON THE MICROBIOLOGICAL STATUS OF DIFFERENT VARIETIES OF LOCAL FOOD

M. Saleem, M. Jaffar , Zaka-ur-Rehman and Maqsood Ahmed

Nutrition Division, National Institute of Health, Islamabad

(Received July 19, 1987; revised February 14, 1989)

Different varieties of raw, cooked and pre-packed foods abundantly available from local food catering sources were tested for their microbiological status. The incidence study included, *Salmonella, Shigella, Escherichia coli,* Yersinia enterocolitica, *Pseudomonas, Vibrio cholerae* and related vibrios, *Vibro parahaemolyticus, Clostridium botulinum, Clostridium perfringens, Bacillus cereus, Staphylococus aureus, Streptococcus, Brucella, Mycobacterium* and *Lactobacillus acidophilus.* The most common micro-organism found in food samples was *Escherichia coli,* with a frequency of occurrence 48.5%. Foods in the 'raw food' class were found to be the contaminated upto 77.7%. This class included chicken, beef, fish mutton, vegetable, fruit, salad, chatt and canned food. This large scale microbiological contamination might be attributed to almost non-existing food regulatory standards and ill-maintenance of good hygienic conditions.

Key words: Food analysis, Microbiological status of foods, Food contamination.

INTRODUCTION

In recent years there has been considerable development in the field of food microbiology with a view to improve the existing hygienic standards and to combat health hazards arising from the consumption of contaminated food. It is well known that poisoning, spoilage and deterioration of the food products may serve to disseminate various pathogenic micro-organisms resulting in outbreak of epidemics.

Extensive incidents of outbreaks of food-borne diseases have been reported in the literature [1,2,4]. It is also reported that in recent years the incidence of Shigellosis appears to have increased in developing countries (4-6]. Food poisoning due to many pathogenic micro-organisms is also well documented [7-9]. Food borne septic sore and scarlet fever due to group A Streptococci have been reported by Bryan [10]. The biodeterioration of farm products and food stuffs has been evaluated in terms of the loss of many millions of tons of food per year [11].

In line with the above objectives, the present study was conducted to ascertain the present microbiological status of various types of local foods as to their suitability for human consumption. The foods included raw, cooked, prepacked and imported items consumed by a large section of our population. The food stuffs abundantly used such as meat and meat products, milk and milk products, prepared and ready-to-eat fast foods and raw products and other such foods were included in this investigation.

EXPERIMENTAL

Eighty nine food samples were collected from local markets, hotels, restaurants, bus stops, schools and railway canteens. The selected foods are summarized in Table 1. The following enrichment media were employed in the microbiological examination of food samples. Thioglycollate broth (Oxoid); Selenite-F-Enrichment broth

Table 1. Food samples examined for microbiological contamination.

Food	Number of samples		
	Raw	Cooked	Total
Skimmed mild (powder)	6	2	8
Yogurt (plain and spiced)	3	-	3
Sweet and chinese dish	3	3	6
Supplemental food	3	-	3
Meat	3	4	7
Fish	5	6	11
Eggs	-	2	2
Spaghetti	4	-	4
Chicken	2	6	8
Vegetable	-	2	2
Patty, samosa, kabab, cutlet, chatt, salad	-	10	10
Soft drink, water, squash, juice, jam, pickle	16	-	16
Biscuit, cake, chocolate, toffee and cherry puff	-	5	5
Roll and bread	-	4	4

(Difco); Cooked meat medium (Oxoid). The differential culture media, used for isolation and characterization of a large variety of aerobic and anaerobic micro-organisms were: Mac Conkey's Agar (Oxoid); *Salmonella-shigella* Agar (Oxoid); Staphylococcus medium No. 110 (Oxoid); Eosine-methylene-blue Agar (Difco): Triple sugar Iron Agar (Oxoid): Clostridial medium (Oxoid): Blood Agar. For enumeration of bacterial counts, nutrient agar was used. For emulsification of samples, physiological saline or phosphate buffered dilutions were used.

Food samples weighing approximately 50 g were homogenized and dilutions of appropriate concentrations were made by sterilized diluent. The aerobic plate count was found to be the most useful indicator of the microbiological status of a food. The types of tests included standardplate-counts and qualitative identification of organisms. Coagulase positive staphylococcus aureus were isolated on blood agar and identified by pigment production, mannitol fermentation and coagulase tests.

RESULTS AND DISCUSSION

The results of bacteriological tests are given in Table 2. Summary of findings is presented in Table 3. Out of 89 food samples 39 samples were found to be infected with one or mixed type of organisms. Cross contamination was also found to occur. Thus percentage of contaminated food was found to be 43.8% which reflected poor hygienic and bad cooking or manufacturing practices.

Table 2. Bacterial strains isolated from various food samples.

Code	Food	Microbiological-contamination Test	Type of contaminating Organisms
FCM-1	Spaghetti (raw)	+	*Aspergillus niger*
FCM-2	Spaghetti (raw)	+	*Aspergillus niger*
FCM-3	Spaghetti (raw)	+	*Aspergillus niger*
FCM-4	Spaghetti (raw)	+	*Aspergillus niger*
FCM-5	Skimkmed milk (powdered)	-	- -
FCM-6	Skimmed milk (powdered)	-	- -
FCM-7	Meat (raw)	+	(i) *Escherichia coli* (ii) *Pseudomonas* (iii) *Aerobacter aerogenes* (iv) *Proteus mirabilis*
FCM-8	Fish (raw)	+	(i) *Escherichia coli* (ii) *Proteus mirabilis*
FCM-9	Fish (cooked)	+	(i) *Proteus mirabilis*
FCM-10	Eggs (boiled)	+	(ii) *Bacillus subtilis*
FCM-11	Soft drink	-	
FCM-12	Pickles	+	*Bacillus subtilis*
FCM-13	Sea fish (raw)	+	(i) *Proteus vulgaris* (iii) *Clostridium perfringens*
FCM-14	Sea fish (raw)	+	(i) *Escherichia coli* (ii) *Proteus vulgaris* (iii) *Clostridium perfringen*
FCM-15	Samosas (cooked)	+	(i) *Bascillus subtilis* (ii) *Staphylococcus enteritidis*
FCM-16	Soft drink	-	–
FCM-17	Fish (cooked)	+	(i) *Escherichia coli* (ii) *Clostridium perfringens*
FCM-18	Youghurt	+	(i) *Escherichia coli* (ii) *Micrococcus* sp.
FCM-19	Fish (raw)	+	*Escherichia coli*
FCM-20	Chicken (raw)	+	(i) *Escherichia coli* (ii) *Staphylococcus enteritidis*
FCM-21	Lamb meat (raw)	+	*Staphlococcus enteritidis*
FCM-22	Chicken (raw)	+	*Escherichia coli*
FCM-23	Milk (fresh)	-	-
FCM-24	Sweet dish	-	-
FCM-25	Chicken (cooked)	-	-
FCM-26	Vegetable (boiled)	-	-
FCM-27	Mutton (cooked)	-	-
FCM-28	Chicken (cooked)	-	-
FCM-29	Wheat (roasted)	-	-
FCM-30	Milk (fresh)	-	-
FCM-31	Chinese dish	-	-
FCM-32	Sweet dish	-	-
FCM-33	Mutton (cooked)	-	-
FCM-34	Water (drinking)	-	-
FCM-35	Vegetable (boiled)	-	-
FCM-36	Chicken (cooked)	-	-
FCM-37	Kabab (cooked)	-	-
FCM-38	Sweet dish	-	-
FCM-39	Water (drinking)	-	-
FCM-40	Milk (fresh)	-	-
FCM-41	Chinese roll (cooked)	-	-
FCM-42	Fish (cooked)	-	-
FCM-43	Beef (cooked)	-	-
FCM-44	Yoghurt (spiced)	-	-
FCM-45	Chicken (cooked)	-	-
FCM-46	Fish (cooked)	-	-

(continued...)

(Continued...)

(Table 2, continued)

FCM-47	Yogurt (cooked)	-		-
FCM-48	Milk (fresh)	-		-
FCM-49	Juice, orange	-		-
FCM-50	Water (drinking)	-		-
FCM-51	Cake	+		*Clostridium perfringens*
FCM-52	Cherry, puff	+		*Staphylococcus aureus*
FCM-53	Milk (fresh)	+		*Escherichia coli*
FCM-54	Chicken (cooked)	+	(i)	*Escherichia coli*
			(ii)	*Pseudomonas aerogeneus*
FCM-55	Fish (cooked)	+	(i)	*Escherichia coli*
			(ii)	*Clostridium perfringens*
FCM-56	Yogurt	+	(i)	*Escherichia coli*
			(ii)	*Micrococcus* sp.
FCM-57	Squashes, mango	-		-
FCM-58	Squashes, Kino	-		-
FCM-59	Squashes, orange	-		-
FCM-60	Squashes, lemon	-		-
FCM-61	Juice, tomato	-		-
FCM-62	Juice, mango	-		-
FCM-63	Baby food	-		-
FCM-64	Baby food	-		-
FCM-65	Nutritious food	-		-
FCM-66	Salad	-		-
FCM-67	Samosas (cooked)	-		-
FCM-68	Kabab (cooked)	+	(i)	*Escherichia coli*
			(ii)	*Corynebacterium* sp.
FCM-69	Cutluts (cooked)	+		*Staphlococcus* sps.
FCM-70	Biscuits	-		-
FCM-71	Bread	-		-
FCM-72	Cream rolls	-		-
FCM-73	Patties	+		*Micrococcus* sp.
FCM-74	Toffes	+		*Staphy lococcus enteritidis*
FCM-75	Peanuts	+		*Staphylococcus enteritidis*
FCM-76	Chocolates	+	(i)	*Bacillus subtilis*
			(ii)	*Staphylococcus enteritidis*
FCM-77	Soft drinks	-		-
FCM-78	Biscuits	-		-
FCM-79	Jams	-		-
FCM-80	Samosas	-		-
FCM-81	Eggs(cooked)	+		*Bacillus subtilis*
FCM-82	Dry milk infant food	+	(i)	*Proteus vulgaris*
			(ii)	*Bacillus subtilis*
FCM-83	Fish (raw)	+		*Lactobacillus*
FCM-84	Meat (raw)	+		*Escherichia coli*
FCM-85	Fish (cooked)	+		*Escherichia coli*
FCM-86	Toffees	+	(i)	*Escherichia coli*
			(ii)	*Protestretus vulgaris*
FCM-87	Patties	+		*Escherichia coli*
FCM-88	Cutlets (cooked)	+	(i)	*Pseudomeonas* sp.
			(ii)	*Aerobacter aerogenes*
FCM-89	Chat (cooked)	+	(i)	*Escherichia coli*
			(ii)	*Staphylococcus epidermidis*

(continued...)

Table 3. Summary of observed microbiological contamination of various foods.

Types of food	No. of food samples showing no contamination	No. of food samples showing contamination	Percentage of contaminated samples
Cooked food samples Chicken, Mutton, Beef, Fish, Egg, Vegetable, Samosa, Kabab.	23	12	34.3
Raw Food Samples Chicken, Beef, Fish, Mutton, Vegetable, Fruit, Salad, Chatt, Canned Food	4	14	77.7
Milk (fresh, dry, infant)	6	2	25.0
Squash, jam, juice, pickle	7	2	22.2
Soft drinks	6	Nil	Nil
Snacks (patties, cutlets, rolls)	4	9	69.2

As is evident from the data, the most common microorganism found in food samples examined was *Escherichia coli*. The frequency of occurrence was 45.5%. This is by no means a satisfactory situation because the contribution of *E. coli* in diarrhoeal diseases has been established by epidemiological studies. Evidence gathered during past 30 years had clearly implicated certain serotype as causative agents of epidemic infantile enteritis in many countries, while more recent studies indicated that other serotype might be important in the pathogenisis of diarrhoea of elder children and adults [12]. However, *E. coli* is not always pathogenic. There are indications that food plays a significant role in the spread of this organism [13].

Contamination with *Staphylococus enteridis* was

found to an extent of 20.5% where as *Staphylococus aureus* at 2.6%. Present information indicated that upto 50% *Staphylo-coccus* aureus isolates were able to produce enterotoxins. Foods implicated in *Staphylococcus* food poisoning usually contain between 10^6 and 10^9 organisms per gram.

Clostridium perfringens was present in food samples to an extent of 12.8%. This micro-organism survives cooking and germinates when a suitable temperature is reached. Other pathogens isolatede and detected were *Proteus* sps, *Bacillus subtilis, Pseudomonas aeruginosa, Micrococcus* sp.; *Aerobacter aerogenes* and *Corynebacterium.* These were present at levels from 19.9 to 2.6%. No *Salmonella* and *Shigella* was found in any food samples.

Soft drinks showed no contamination. This is probably because of the fact that beverage industries use sterilized water, whereas juices and squashes normally contain preservatives.

The enumeration of microbial populations indicated excessive bacterial growth in these foods resulting from contamination, improper storage or both. Satisfactory results of such enumerations might indicate that some of the conditions that make food safe have been fulfilled, but give no assurance of the absence of pathogenic agents. The high temperature in warm season, together with poor hygiene in production, lack of transport facilities and refrigeration, inadequate processing units are major set back to the availability of wholesome fresh food. The extent of spoilage of local foods depended upon the type of organism, the particular condition under which raw foods were harvested, processed and stored. The overall situation appeared to be far from satisfactory and could only be attributed to poor food inspection and maintenance of adequate biological standards for food hygiene.

Acknowledgement. This work was done with FAO sponsorship under the project NOR/078/PAK.

REFERENCES

1. M.M. Wilson, E.F. Haekenzie, J. appl. Bact., **18,** 51 (1955).
2. K.W. Newell, J. Appl. Bact., **18**, 462 (1955).
3. P.C. Cravin, Lancet, **1,** 788 (1975).
4. Pan American Health Organization, PAHO, Scientific Publication, No. 283 (1974).
5. Pan American Zoonoses Centre Information Bulletin, 2(1975).
6. R.G.A. Sulton, J. Hygiene, **72,** 441 (1974).
7. T. Fujino, Journal of the Japanese Association of Infectious Disease, **25,** 11 (1951).
8. B.D. Chatterjee, Bulletin of the World Health Organization, **42,** 460 (1970).
9. R.J. Gilbert and A.J. Taylor, J. Appl. Bac., **242,** 103 (1979).
10. F.L. Bryan, *Food Born Infections* (New York Academic Press, 1969), pp. 224.
11. R.J. Gilbert, J. Hygiene, **70,** 755 (1972).
12. B. Rowe, Lancet, **1,** 1 (1970).
13. C. Hobbs, Post-graduate Medical J. **51,** 817 (1975).