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RESEARCH NOTE

MICROBIOLOGICAL STATUS OF BAKERY PRODUCTS AVAILABLE IN ISLAMABAD

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ABSTRACT: A small scale survey of Islamabad bakeries was conducted to determine the microbial contamination in the most commonly consumed bakery products i.e., biscuit, cake, and bread. Samples were randomly collected from 12 sectors (main markets and sub-sector markets). These samples were analyzed for total plate count (TPC), total coliforms, fecal coliforms, *E. coli*, yeasts and moulds. None of the sample was found contaminated with *E. coli*, contamination of moulds was also negligible. TPC ranged from $1.0x10^2$ to $1.0x10^4$ cfu g^{-1} except in three cases, whereas total coliform ranged from 0 to 93 except in two cases, where yeast was 0-1600 g^{-1} and mould upto 250 g^{-1}. All these samples were within permissible limits except one bread sample from I-9 and one cake sample from G-7 in which coliform count was higher than the permissible limit.

Key Words: Bread; Cake; Biscuit; Microbial; Contamination; E.coli; Pakistan.

INTRODUCTION

In Pakistan baking industry comprises an important portion of food industry. Another source of baking foods is food service industry including restaurants and hospitals. Bakery products are an important part of a balanced diet and today, a wide variety of such products can be found on the supermarket shelves (Smith et al., 2004). Several studies in both industrialized and developing countries showed that bakery products provide a considerable portion of energy intake (Vanelli et al., 2005; Bartrina et al., 2004; Agte et al., 2002).

Differentiated from the quickly perishable bakery products are cake, bread and biscuits. These products may be distributed over a wider area from manufacturing industry. Microorganisms play a useful role in the production of bakery products (consistency, formation of flavoring). However microorganisms also attack bakery products and cause damage or even spoilage (Ponte, 1987).

In addition to bacteria, moulds and yeasts are the main cause of such spoilage. Freshly baked products are sterile and do not contain viable microorganisms but soon become contaminated upon exposure to air and surfaces. Contamination also occurs, after baking process, during the production steps such as cooling, slicing (unhygienic handling), transport, and packing as well as storage.

Within this production and storage chain, the bakery products are contaminated with moulds, yeasts and occasionally by bacteria such as the rope-causing heat-resistant endospore-forming *Bacillus subtilis* (Earle and Putt, 1984). Mould spores are killed in the baking process (Knight and Menlove, 1961), leaving often contamination to be the source of spoilage problems. Contaminants of bread are mainly *Penicillium* but *Cladosporium* and *Aspergillus* also occur (Legan and Voysey, 1991), the latter especially in warmer climates. *Penicillium* tends to be more important in sour dough breads and in breads stored at cooler temperatures. *Bacillus* spores are very heat resistant and can survive baking in the interior of bread loaves and then germinate and start growing as the bread cools (Legan, 1993). Mould spores are also present in the air. Extremely high level of air contamination is due to the naturally high spore content of flour, old bread deposits, contaminated air conditioning system etc. Air conditioning system, in particular, spreads spores to all production and storage area. This results in considerable contamination of the bakery products with fungal spores.

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Moulds and fungi also produce different types of "mycotoxin" (poisons), which have been scientifically linked to many different diseases including cancers, diabetes, internal organ damage etc. Even small quantities of these fungi can multiply exponentially inside the body and produce large quantities of disease and death causing mycotoxins. Very few medical professionals recognize the cause and effect connection between bread, mould, fungi and disease. Most medical doctors have almost no formal training in these issues. Some mycologists are a valuable exception (Reiss, 1981).

In many bakery products, water activity is the most important single factor affecting the type and rate of spoilage (Horner and Anognostopoulos 1973). Microorganisms (bacteria, yeast and mould) can grow well when water activity or moisture content is high.

Some strains cause a defect called ropiness, a soft sticky texture caused by starch degradation and slimy exopolysaccharides often accompanied by a fruity odor. Yeast may also be involved in spoilage of breads and fruitcakes, causing a chalky appearance on surfaces and off odors.

High sugar content of cake also favors moulds over other spoilage microbes but some species of yeasts and bacteria may also attack cakes. Bakery products containing cream and/or fruit filling are targets of other spoilage organisms (Peppler, 1977).

E. coli 0157 has been considered to be an important pathogen that can cause serious illness. It is a typical organism of the intestinal tract; it is transmitted through contaminated hands and is reported to be the cause of diarrhoea (Karnali, 1989).

The main objective of this study was to determine the microbial contamination in the most commonly consumed bakery products i.e. cake, biscuits and bread available in different bakeries of Islamabad.

MATERIALS AND METHODS

Bakery samples were randomly collected from three sub sector markets of 12 sectors i.e., F-6, F-7, F-8,F-10, G-6, G-7, G-8, G-9, G-10, I-8, I-9 and I-10 and samples were analyzed in triplicate. Total plate count, coliform, *E. coli*, yeast and moulds were determined (FAO, 1992). According sample was homogenized with Butterfield's phosphate buffer (pH 7.2). Serial dilution of the sample was prepared, 1 ml volumes were transferred to petri dishes with plate count agar and mixed with medium in triplicate. After incubation at 35^0C for 48 h colonies formed on the surface and in the medium were counted. The total plate count was calculated from the mean count of triplicate of petri dishes, taking the dilution into consideration.

Similarly yeast growth was checked on plate count agar + chloramphenicol (added as antibacterial agent) Petri plates were incubated at 25ºC. Moulds were checked on potato dextrose agar. Coliform and *E. coli* were determined by Most Probable Number (MPN) method (FAO, 1992).

RESULTS AND DISCUSSION

According to WHO standard (1994) the maximum permissible limits in baked products (cake, bread and biscuits) for total plate count (TPC) is $2.0x10^5$ cfu g^{-1}, coliform bacteria <200 MPN g^{-1}, *E. coli* absent, yeast and mould is $<1.0x10^4$ cfu g^{-1}. Results are expressed as mean value of 9 sample (Table 1).

Total plate count was high in biscuit sample received from F-6 while in cake and bread other counts (coliform, fecal coliform, yeast and mould) were within range. In biscuit and bread samples collected from F-7 sector, all the parameters were within range but in cake only TPC was high, while remaining parameters were within permissible limits.

Biscuit and cake samples collected from F-8 sector were within acceptable limit but bread sample had higher bacterial count while other counts were within range. Results of TPC, total coliform, *E. coli*, yeast and mould of G-8, G-9 and G-10 were satisfactory because all these parameters were within limits, except in cake sample collected from G-7 in which coliform and fecal coliform were higher than the range.

Samples collected from I-8, I-9, and I-10 were fit for consumption because their TPC, coliform, *E. coli*, yeast and mould were within permissible limits. Total coliform

and fecal coliform in bread sample obtained from I-9 were higher than the acceptable limit.

Overall, TPC was high in 3 samples out of 36 samples. *E. coli* was nil in all bakery samples. Coliform and fecal coliform were present in 2 out of 36 samples. Yeast and mould in these samples were also within permissible limits. Unacceptable levels of bacteria might result from temperature abuse and poor hygienic practices and the use of equipment (Food Standards Australia Newzealand, 2002).

It has been reported that chemical profile such as pH, water activity and moisture content are the most important factors influencing the microbiological quality of these products. High moisture products, those with a high water activity, are most likely to present food safety concerns

Table 1. Microbial contamination in commonly consumed bakery products

(Results are mean values of 9samples)

Sector	Commodity	TPC (cfu g^{-1})	Coliform (MPN g^{-1})	Fecal coliform (MPN g^{-1})	E. coli (MPN g^{-1})	Yeast (cfu g^{-1})	Mould (cfu g^{-1})
F-6	Biscuit	$8.7x10^5$	9	9	nil	150	nil
	Cake	$2.7x10^4$	<3	<3	nil	nil	nil
	Bread	$1.2x10^4$	<3	<3	nil	1600	250
F-7	Biscuit	$7.7x10^3$	<3	<3	nil	150	nil
	Cake	$2.7x10^5$	<3	<3	nil	nil	nil
	Bread	$1.2x10^5$	<3	<3	nil	250	nil
F-8	Biscuit	$1.6x10^5$	<3	<3	nil	nil	nil
	Cake	$5.5x10^4$	23	23	nil	150	nil
	Bread	$4.7x10^5$	21	21	nil	250	nil
F-10	Biscuit	$3.2x10^4$	9	9	nil	150	nil
	Cake	$5.3x10^4$	23	23	nil	200	nil
	Bread	$3.2x10^4$	93	93	nil	250	nil
G-6	Biscuit	$8.3x10^2$	<3	<3	nil	nil	nil
	Cake	$6.2x10^2$	<3	<3	nil	nil	nil
	Bread	$7.4x10^3$	23	23	nil	250	nil
G-7	Biscuit	$5.9x10^4$	93	93	nil	nil	nil
	Cake	$5.1x10^4$	460	240	nil	nil	nil
	Bread	$3.6x10^4$	23	23	nil	nil	nil
G-8	Biscuit	$3.4x10^4$	9	9	nil	nil	nil
	Cake	$8.1x10^3$	4	4	nil	nil	nil
	Bread	$7.7x10^4$	23	23	nil	nil	nil
G-9	Biscuit	$4.4x10^4$	23	23	nil	50	nil
	Cake	$3.7x10^4$	9	9	nil	nil	nil
	Bread	$3.6x10^4$	<3	<3	nil	nil	nil
G-10	Biscuit	$2.6x10^4$	<3	<3	nil	nil	nil
	Cake	$3.5x10^4$	<3	<3	nil	nil	nil
	Bread	$2.8x10^4$	<3	<3	nil	nil	nil
I-8	Biscuit	$6.8x10^4$	28	4	nil	nil	nil
	Cake	$3.4x10^4$	<3	<3	nil	nil	nil
	Bread	$4.2x10^3$	<3	<3	nil	nil	nil
I-9	Biscuit	$5.8x10^3$	9	7	nil	nil	nil
	Cake	$3.3x10^4$	15	15	nil	nil	nil
	Bread	$5.5x10^3$	460	460	nil	nil	nil
I-10	Biscuit	$2.7x10^4$	11	11	nil	nil	nil
	Cake	$5.7x10^4$	75	23	nil	nil	nil
	Bread	$2.7x10^3$	28	12	nil	nil	nil

Permissible limits of bakery products: Colony count<$2.0x10^5$ g^{-1}, coliform count, <200 g^{-1}; yeast and mould count,<$1.0x10^4$ g^{-1} and E. coli, 0 g^{-1} (WHO, 1994).

as they support the growth of a wide range of bacteria, yeasts and moulds. Some high moisture/low acid components of bakery products provide an environment that is highly conducive to the growth of pathogenic bacteria. Intermediate moisture products generally only support the growth of spoilage organisms such as osmophilic yeasts and moulds (Smith et al., 2004).

Data differed widely depending upon the location from where these samples were collected. These results are based on a limited number of random sampling which do not indicate the true situation. Therefore, it is required that comprehensive survey should be conducted according to standard statistical procedures to get a clear picture of the existing microbial contamination in baked products that is being consumed by the people. These initial investigations do indicate the need for continuous monitoring of the status of the bakery products sold in different bakeries. The present study can be used as base line by health management authorities and also may enable the concerned authorities to pay attention to this important issue of common man's concern.

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