A Research Note

Microbial Profile of Cumin Seeds and Chili Powder Sold in Retail Shops in the City of Bombay

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ABSTRACT

A detailed evaluation of the microbial profile of 2 spices, viz. cumin seeds and chili powder, sold in retail shops in the city of Bombay, revealed high aerobic plate counts ranging from \(2 \times 10^6/g\) - \(2 \times 10^8/g\) for chili powder and \(1.0 \times 10^4/g\) to \(1.0 \times 10^8/g\) for cumin. Among the bacteria present, 50-95\% constituted sporeformers, which included amylolytic and proteolytic bacilli in both the spices. Aspergillus group was predominant among fungi in chili powder samples. No fungi were found in cumin seed samples examined. Salmonella, Shigella and Vibrio were completely missing from chili and cumin samples. However, Staphylococcus aureus and Bacillus cereus were found in chili powder.

Spices worth over 100 million dollars are exported every year from India (8). Although the Indian spices are very popular for their aroma and flavor, they are frequently reported to be highly contaminated with bacteria and molds (5-7,9,10). It has been a common experience that the spices available for local consumption show a wide range of quality to cater for consumers from all socioeconomic groups. No data are available on microbial quality of any of the spices sold in unpackaged form. Therefore, a survey was made of the microbial quality of two of the spices, viz. cumin seeds and chili powder, in unpackaged form and the effect of environmental conditions of storage and sale.

MATERIALS AND METHODS

Sample collection

To obtain representative samples from all over Bombay city, the city was divided into six zones. Three-kg samples of cumin seeds and chili powder in loosely packed forms were bought from three shops from each zone. The shops chosen were situated in different sanitary environments ranging from low to high. The shop conditions were as follows: temperature, 25-35°C; relative humidity, 60-80\%. The storage time was 4-6 months. Each of the samples was analyzed in triplicate. All samples were stored in clean, oven-sterilized glass jars in the laboratory at ambient conditions and analyzed for microbial quality within a week. This included determination of aerobic plate count, yeast and mold count, Escherichia coli count, Bacillus cereus count, Staphylococcus aureus count, anaerobic sporeformers, Salmonella, Shigella, Vibrio and enterococci count, all of which were done by the standard recommended procedures (3). Acidophilic count was taken as those organisms which could grow on potato dextrose agar plates at a pH of 5.6 ± 0.2. The isolated organisms were further identified using standard biochemical tests (2). Bacillus isolates obtained were tested for proteolytic activity using cascin agar and for amylolytic activity using starch agar (2). Fungi were identified by the lactophenol cotton blue staining method to determine the morphology of their mycelium, and a study of their colony characteristics.

RESULTS

Observations and results in Tables 1 and 2 summarize the detailed profile of chili powder and cumin seed samples collected randomly from different areas in the city of Bombay.

From data in Table 1, it is evident that all chili powder samples harbored high levels of bacterial and fungal contaminants. The gram-positive spore-bearers constituted between 50-95\% of the bacterial populations. Most of these sporeformers were of the proteolytic and amylolytic types. The potential for the presence of Bacillus cereus was also high. Eighty percent of the chili powder samples contained this Bacillus, with counts up to \(2.5 \times 10^2/g\). The enteric pathogens like Salmonella, Shigella, Vibrio, and enterococci could not be detected. E. coli was found in all of the samples; counts ranged from \(10^2/g\) to \(2 \times 10^2/g\). Clostridium was detected in only 20\% of the samples. Presence of S. aureus was insignificant being < \(10^1/g\).

Among the fungal flora whose count was as high as \(10^2/g\) in 15\% of the samples, Aspergillus sp. was predominant. Aflatoxin-producing Aspergillus flavus and Aspergillus parasiticus were detected in 88\% of the chili samples. Besides, Rhizopus, Mucor and storage fungi like Aspergillus niger were also found.
TABLE 1. Microbial profile of chili powder samples. 

<table>
<thead>
<tr>
<th>Zones of sampling</th>
<th>Hygiene conditions</th>
<th>Aerobic plate count/g</th>
<th>Total fungal count/g</th>
<th>Acidophile count/g</th>
<th>B. cereus count/g</th>
<th>E. coli count/g</th>
<th>Clostridium count/g</th>
<th>S. aureus count/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>Poor</td>
<td>2.8 x 10^8</td>
<td>2.8 x 10^5</td>
<td>2.1 x 10^5</td>
<td>1.0 x 10^5</td>
<td>1.2 x 10^4</td>
<td>5.0 x 10^2</td>
<td>&lt;10</td>
</tr>
<tr>
<td>North</td>
<td>Poor</td>
<td>2.4 x 10^7</td>
<td>4.7 x 10^4</td>
<td>1.4 x 10^4</td>
<td>2.5 x 10^2</td>
<td>2.0 x 10^4</td>
<td>2.9 x 10^3</td>
<td>&lt;10</td>
</tr>
<tr>
<td>N. West</td>
<td>Poor</td>
<td>7.8 x 10^3</td>
<td>1.8 x 10^2</td>
<td>1 x 10^3</td>
<td>&lt;10</td>
<td>3 x 10^3</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>South</td>
<td>Mod Poor</td>
<td>2.5 x 10^7</td>
<td>3.2 x 10^2</td>
<td>2.5 x 10^5</td>
<td>1.2 x 10^2</td>
<td>2.4 x 10^2</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>East</td>
<td>Clean</td>
<td>1.1 x 10^7</td>
<td>2 x 10^3</td>
<td>10^3</td>
<td>&lt;10</td>
<td>1 x 10^1</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Central</td>
<td>Clean</td>
<td>2.7 x 10^6</td>
<td>1.7 x 10^2</td>
<td>3.6 x 10^4</td>
<td>1.6 x 10^2</td>
<td>1 x 10^1</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

*Each analysis is an average of nine individual determinations.

As shown in Table 2, in cumin seeds samples, the total bacterial count was comparatively lower than the chili powder samples, the average ranging from 1.6 x 10^7/g to 1.5 x 10^5/g, spor- bearing gram-positive bacilli and gram-positive cocci were present in almost equal numbers. Many of the bacilli were of the proteolytic and amylolytic types. E. coli, Clostridium and S. aureus were found in insignificant numbers. Fungi could not be detected in 98% of the samples examined.

**DISCUSSION**

Some interesting trends were observed in the microbiological screening of chili powder and cumin samples with respect to their environmental conditions and hygiene of the sampling areas.

For chili powder samples the exceptionally high total viable counts observed exceeded the International Commission for Microbiological Specifications of Foods (ICMSF) standards of 10^6/g, thereby suggesting a low standard of microbial quality. The high incidence of fungal contaminants, particularly Aspergillus spp. in chili powder, also reported by Christensen et al. (1), is significant since they may produce aflatoxins.

Presence of E. coli indicates fecal pollution and unhygienic handling of the spices during storage. The incidence of Clostridium spp. and S. aureus was low or negligible in some instances, which was very encouraging. We observed that in the hygienically poorer shops the total viable count of spices was higher than in the others. The same was true for the B. cereus count, E. coli count, Clostridium count and the fungal count. This indicates that there is a definite correlation between the environmental hygiene and microbial quality of the spices. Other factors like antimicrobial activity of the spice also control the number and type of contaminants.

In contrast to the excess contamination load in chili powder samples, cumin samples bought from the same dealers did not exhibit high counts and the microfloral pattern was also different. Absence of almost all pathogenic forms including fungi was an interesting finding for cumin. Inhibition of toxin-producing fungi by cumin has also been reported by Hitokoto (4), which is in agreement with the present findings. Here again, when the counts of different shops were compared, the most unhygienic shop showed the highest counts of total viable bacteria and acidophiles. The counts decreased proportionally with an increase in hygienic conditions of the environment. This again showed the role played by environmental and storage conditions in the microbial quality of the spice. The absence of E. coli, S. aureus, and Clostridium spp. can be attributed to the antimicrobial activity of cumin on these organisms. The presence of E. coli in one spice and absence in the other may also be due to unhygienic processing and handling methods.

This wide variation in the microbial profile of the two spices, could possibly be attributed to the chemical constitution of spices, antimicrobial factors, environmental conditions, and handling by various personnel involved. Proper sanitary conditions during harvesting, processing and storage, and proper packaging can give a spice of acceptable quality.

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