Epidemiology & Pathogens

Background

Herbs and spices are derived from parts of many different plants.[1] Each plant and even each part varies in its potential for microbial contamination:

- bark - cassia;
- leaf - basil, thyme, oregano, savory, sage, rosemary, bay, mint, parsley, chervil, dill and tarragon;
- seed - sesame, poppy, cumin, nutmeg, coriander, caraway, cardamom, celery, dill, fennel, fenugreek and mustard;
- berry or fruit - allspice, vanilla, juniper, peppers and chilies;
- root or rhizome - onion, garlic, ginger and turmeric; and
- flower or flower bud - lavender and clove.

Like other agricultural products, the microflora present will be related to that of the surrounding environment (soil, wind, water, flora and fauna) and affected by the local growing conditions (temperature, humidity, rain and available sunlight).

However, in each case, employing good agricultural and harvesting practices can minimize the level of contaminating microorganisms. Examples of these practices include:

- providing a clean uncontaminated source for water;
- using no fertilizers vs using chemicals or other processed biological products vs using untreated wastes;
- controlling rodents, insects and other pests;
- employing mechanical vs hand harvesting;
- drying raw materials on racks vs on mats or on the ground; and
- utilizing mechanical vs open air drying.

In addition, utilizing good manufacturing practices during washing, chilling, drying, transporting, decontaminating, grinding, blending, packaging, and storage can minimize the level of contaminating microorganisms. The use of microbial reduction processes (irradiation, ethylene oxide, steam, etc.) will also reduce or eliminate the existing microflora.

In summary, as agricultural products, herbs and spices are exposed to widely varying natural environments and growing conditions that give rise to certain naturally - or unnaturally - occurring microflora. However, the use of good agricultural, harvesting and manufacturing practices throughout

the life of herbs and spices can minimize, reduce or eliminate contaminating microbes, including pathogens.

Potential for Foodborne Illness

Assuming pathogens are present and viable, they must be present in significant numbers[2] and overcome

- any antimicrobial properties a spice may inherently possess;
- the low level (<1%) spices are typically used in foods;[3]
- any cooking process the food may undergo;[4] and
- the immune system of the consumer.[5]

Outbreaks

Below is a summary of outbreaks, reportedly due to contaminated dried herbs and spices that have been recorded in the general literature in the last 30 years.

- An outbreak associated with white pepper contaminated with *Salmonella weltevreden* was reported in 1974 (Laidly et. al., Severs).
- In Norway, black pepper contaminated with *Salmonella oranienburg* was implicated in an outbreak affecting 126 individuals (Gustavsen et. al. 1984).
- Foods - potato chips and other snack foods - prepared with paprika contaminated with at least three serovars of *Salmonella (S. saintpaul, S. rubislaw,* and *S. javiana*) were implicated in an estimated 1000 illnesses in Germany. (Lehmacher et. al. 1995). Considered the largest documented outbreak due to contaminated spices, this event demonstrated that *Salmonella* adapted to the dried state were capable of causing illness even in very low numbers: 0.04 - 0.45 organisms per gram.

Observations

The total number of outbreaks attributed to contaminated spices in the last 30 years is low and no reported outbreak has occurred in the United States. Since several bacterial pathogens and pathogen indicators may at times be isolated from herbs and spices, such a low number of outbreaks may in part be attributed to the role of spices as ingredients, and the inhibitory or lethal effects of low water activity. The extensive use of treatments such as irradiation, ethylene oxide and steam treatments among others also likely plays a role in limiting outbreaks due to dried spices.

According to this list, the only outbreaks attributed to dried spices, one reported each of the last three decades, have been due to items contaminated with *Salmonella*. The low water activity of dried spices is stressful and eventually lethal to non-sporeformers, consequently limiting the chance of illness caused by these organisms. However, some strains of *Salmonella*, it appears, may be particularly adaptable to dry conditions.

Bacillus cereus and Clostridium perfringens

Because *C. perfringens* or *B. cereus* may survive cooking processes, if foods containing these sporeformers are inadequately cooled after they are cooked, an opportunity may exist for rapid growth to a concentration that might cause illness. In fact, Goepfert and others (1972) reported that meats and meat dishes seasoned with spices were the single most common cause of *B. cereus*-related foodborne illnesses in Hungary from 1960 to 1968. Further, *C. perfringens* has been isolated from a wide range of spices and herbs with counts typically less than 500 CFU/g (DeBoer et. al. 1983). However, these sporeformers require high numbers before causing illness (>10^5 CFU/g) and their related syndromes are relatively mild. This suggests that, though *B. cereus* and *C. perfringens* may be present in a food seasoned with spices, illnesses may be difficult to acquire. And when illness does occur, the symptoms may not be severe enough to warrant reporting or medical treatment. Therefore, the presence of these microorganisms in foods at low levels is not normally a health concern.

Clostridium botulinum

Although *C. botulinum* has been isolated from such dried spices as onion and garlic, outbreaks of botulism have only occurred with fresh spices (data not shown). While the viability of the sporeformers is not significantly affected by low water activity, germination is prevented. Therefore, the inability to germinate in a low water activity environment - even when anaerobic, such as an oil infusion - may account for the absence of botulism outbreaks attributed to dried spices. Also possible is that dried spices may not be used as commonly as fresh spices in applications that support the growth of *C. botulinum*.

Other Pathogens

Although *Listeria monocytogenes, Escherichia coli* O157:H7 and the parasites *Cryptosporidium parvum* and *Cyclospora cayetanensis* have been associated with a variety of foods, there has been no documentation of these pathogens in dried spices and herbs. Likewise, coagulase positive *Staphylococci* are typically not associated with spices (Powers et. al. 1975, Baxter et. al. 1982).

Footnotes:

[1]See ASTA for the list of herbs and spices officially recognized by the American Spice Trade Association.
[2]Some pathogens may cause illness with only a few cells, whereas others may require hundreds of thousands of cells before causing infection or intoxication.
[3]When contaminating pathogens are present, users can normally expect their numbers to be diluted below their infectious level. However, this is not always the case, nor should a user rely on it to be. The fact that outbreaks have occurred testifies to this fact.
[4]It is noteworthy that spices are often added to foods after cooking or to foods that do not require cooking. Further, bacterial spores may not be kill by many cooking processes, but instead may be stimulated to germinate and multiply, potentially to significant levels, if conditions again become favorable.
[5]Consumer age, pregnancy, disease, stress and other factors will significantly affect individual susceptibility to illness

References:

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