Chapter six

Conclusion

Use of spices as microbial growth inhibitor in foods is often limited because of flavor considerations as effective antimicrobial dose may exceed the organoleptically accepted level (Pandit and Shelef 1994; Brull and Coote, 1999). Nonetheless, combinations of spices and other antimicrobial barriers could enhance the food shelf stability and microbial safety even in moderated levels. Due to this and due to the fact that spices are as GRAS, the antimicrobial properties of spices continue to be of interest (Pandit and Shelef, 1994). It is established that spices and their derivatives could be suitable alternatives for inclusion in food conservation systems and could act sometimes as main or adjuvant antimicrobial compounds. Before including spices and/or their derivatives in food conservation systems, some evaluations about microbiological quality, economic feasibility, and antimicrobial effect for a long time and toxicity should be carried out. But if extracts are expected to be widely applied as antibacterial and antifungal, the organoleptical impact should be considered as the use of naturally derived preservatives can alter the taste of food or exceed acceptable flavor thresholds. It is established that spices and their derivatives could be suitable alternatives for inclusion in food conservation systems and could act sometimes as main or adjuvant antimicrobial compounds.

The emergence of antimicrobial resistance is becoming a worldwide problem facing many if not all health professions. Technology has yet to put a halt to the evolutionary tactics of many new and old pathogens. The attempt to discover new natural therapeutics, has enticed scientists all over the world to embark on a search into the field of ethno botany, within which may lay vast and important ethnomedical remedies.

Food contamination is enormous public health problem, but it could be controlled by the use of natural preservatives such as extracts obtained from spices. The fact that many spice extracts possess antimicrobial activity has been proved by plenty of investigations in the recent years. The type and optimal concentration of extracts depend on the product used and against which species of bacteria or fungi it is to be used. The problem may occur if high concentrations required achieving
useful extracts antimicrobial activity, resulting in unacceptable levels of flavors and odors. The results of the present study suggest that these spices extracts possess compounds containing antibacterial properties that can potentially be useful to control food borne pathogens and spoilage organisms at acceptable concentration. It was observed that the active ingredients eugenol, cinnamaldehyde, thymol and anethol contained within the selected spices are effective antimicrobial agents that can inhibit and cause microbial death of various bacteria.

It has been found that **ethanol** extract of spices was most effective extract followed by acetone, methanol, cold water and hot water. As a result it was concluded that the organic extracts produced a greater inhibitory effect on the bacterial strains than the aqueous extracts.

**Ajowan** was found most effective antibacterial spice followed by cinnamon, bay leaf, tailed pepper and star anise during disc diffusion assay. Analysis of the agar well assay showed that **Ajowan** still remained the most effective spice followed by tailed pepper, cinnamon, star anise and bay leaf.

**E. coli O157: H7 ATCC 25922** was the most resistant of the eight microbes. The analysis concluded that the order of susceptibility exhibited by the various bacterial strains in descending order as follows:

*B. cereus* ATCC 11778, *E. coli* ATCC 43888, *B. subtilis* ATCC 6633, *E. coli* ATCC 43895, *S. aureus* ATCC 6538, *S. aureus* 25923, *E. coli* ATCC 8739 and *E. coli* ATCC 25922 in both disc diffusion and agar well diffusion assay. Though all the spice extract were effective against all the eight strains of food spoilage bacteria.

However, the overall analysis of the mean resulted inhibition zones showed that the gram positive microbes were more susceptible to the various extracts of the different spices. These spices could be used for food preservation to extend shelf life of cooked food.

From the total ANOVA results of the five spices, eight microbial species and five spice extracts tested, the investigation concluded that Gram-positive and Gram-negative bacteria exhibited successful inhibition during testing. The overall
analysis clearly indicated that Ajowan was found most effective antibacterial spice, *E. coli* ATCC 25922 was the most resistant of the eight microbes and Ethanol was determined as the most effective extract.