Chapter V

Conclusions and recommendations

The red sorghum in this study is a condensed tannin sorghum variety that may further be classified under Type II or III sorghums (possessing a pigmented testa) whereas the white sorghum is a condensed tannin-free sorghum variety also further classified as Type I sorghums (without a pigmented testa). The condensed tannin sorghum in this study contains greater amounts of both total phenols and condensed tannins compared to the condensed tannin-free sorghum variety.

CPE from the bran of both sorghums exhibit antimicrobial activity due to the presence of phenolic compounds in these extracts. However, CPE from bran fractions of condensed tannin sorghum exhibit higher antimicrobial activity than that from condensed tannin-free sorghum because it contains higher amounts of phenolic compounds.

The antimicrobial activity of the sorghum CPE is dose-dependent, i.e. it increases as the concentration of the extract increased, due to higher levels of phenolic compounds.

Gram positive *B. cereus* ATCC 1178 and *L. monocytogenes* 7644 are susceptible to inhibition by the CPE while Gram negative *E. coli* ATCC 25922 is resistant. This is because *B. cereus* ATCC 1178 and *L. monocytogenes* ATCC 7644 bacteria may be lacking an outer membrane that would rather prevent the entrance of the CPE into the cell and hence prevent inhibition of bacterial growth.

In the determination of antimicrobial activity of sorghum CPE in this project, only one Gram-negative bacteria, *E. coli* ATCC 25922 was used as a test microorganism while only two Gram-positive bacteria *B. cereus* ATCC 1178 and *L. monocytogenes* ATCC 7644 were used. It would be appropriate that a wide range of bacteria, both Gram-negative and Gram-positive be used in the determination of antimicrobial activity. The use of a wide range of test microorganisms would permit one to make a proper conclusion on whether the condensed tannin and condensed tannin-free sorghum CPE are inhibitory against Gram-positive bacteria as compared to Gram-negative bacteria. The use of more than one technique for the evaluation of antimicrobial activity may also be

appropriate to allow proper comparison that will in turn lead to a satisfactory conclusion on the antimicrobial effect of sorghum CPE.

It is also recommended from this study that sufficiently higher concentrations of condensed tannin-free sorghum CPE be used in order to achieve sufficiently higher inhibitory effects on the test microorganisms, however, the insufficient yield of the soluble solids of the condensed tannin-free sorghum CPE may be a problem. Proper planning prior to preparation of the freeze-dried sorghum CPE and proper techniques are therefore required in the fractionation of sorghum grain such that higher yields of freeze-dried extracts from the bran fractions for use as antimicrobial agents can be obtained.

There is also a need to evaluate the antimicrobial activities of phenolic compounds from CPE from bran fractions of condensed tannin and condensed tannin-free sorghum on the growth of Gram-positive and Gram-negative bacteria in a practical food system. However, according to Hsieh, Mau and Huang (2001) the limitations in the use of naturally derived preservatives are due to associated flavours, which can change the taste of food, and as a result understanding of how these natural preservatives work and affect the growth of microorganisms can lead to new technologies for their use in maintaining the quality of foods. Haslam, (1989) also mentioned that polyphenols contribute significantly to taste and flavour of foods and that foodstuffs containing large quantities of polyphenols are generally described as astringent. It is therefore recommended from this study that the effects of sorghum polyphenols on the quality of food be evaluated.