CHAPTER 5

General Discussion

In general, plant extracts have low antibacterial activity though many of them are used in traditional medicine. McGaw *et al.* (2002) found that the minimum inhibitory concentration of the leaf extracts of *Schotia brachypetala* was lower than 10.0 mg ml^{-1} for both Gram positive and Gram-negative bacteria. A high antibacterial activity was recorded for *Helichrysum odoratissimum* with a MIC of 0.01 mg ml^{-1} against Gram-positive bacteria (Mathekga and Meyer 1998). *Compretum zeyheri* and *C. erythrophyllum* were reported to contain compounds with antibacterial activity higher than that of the antibiotics chloramphenicol and ampicillin (Kotze and Eloff 2002). The antibacterial activity of the extracts of the three plants (*Drimia delagoansis, Petalidium oblongifolium* and *Ipomoea* anadioides) investigated in this study varied. The minimum inhibitory concentration (MIC) values of their extracts were higher than 10.0 mg ml^{-1} for Gram-negative bacteria. The antibacterial activity of the extract from *U. lydenburgensis* was so low that it was decided not to proceed with isolation of bioactive compounds from it.

The isolated compounds are also of moderate antibacterial activity except for the one isolated from *P. oblongifolium* which could not be identified and has a MIC value of 10.0 µg ml^{-1}aginst *E. ruminantium.* This compound has some cumulative effect in that when it is applied sequentially its MIC decreases to 2.5 µg ml^{-1}. This can be of benefit to browsing animals if the concentration of the compound increases in the circulatory system of the animals provided it does not reach toxic levels. The other isolated compounds were not tested against *E. ruminantium* because they had relatively low activity when compared to tetracycline hydrochloride and because the bacterium is so difficult to culture.

An effective compound against a rickettsial pathogen can possibly be useful for humans also since it is not only livestock that become infected with these organisms. Rickettsial diseases also affect humans (Vincent and Angeloni (1994). The rickettsial organisms are maintained in nature by a cycle involving an animal reservoir, an insect or arthropod vector that equally infests as well as humans.

Major tick-borne Ehrlichiae and Rickettsiae diseases of dogs are: canine monocytic ehrlichiosis, canine granulolytic ehrlichiosis, cyclic canine thrombocytopenia and Rocky Mountain spotted fever (Varela 2003). In dogs the tetracycline and oxytetracycline drugs used for the treatment of the diseases are currently being replaced with doxycycline and minocycline (Varela 203).

Animals benefit from eating plants in addition to the nutritional requirements that they get. Plants contain many compounds in addition to the major nutrients (carbohydrates, lipids and proteins), vitamins and mineral nutrients. These compounds include the terpenoids, phenolics and alkaloids. Phenolics are hydroxylated derivatives of benzoic and cinnamic acids.

Phenolic compounds are found in both edible and non-edible plants. They have multiple biological effects, including antioxidant activity. They improve the nutritional quality of foods by retarding oxidative degradation of lipids. Antioxidant constituents of plant material are important for the maintenance of health and protection from coronary heart diseases and cancer. Flavonoids and other phenolics are important for the plant growth and defense against infection and injury. The phenolics act as reducing agents, hydrogen donators, singlet oxygen quenchers and they have metal chelation properties (Cos *et al*. 2001, Kähkönen *et al*. 1999, Park *et al*. 2000, Shahat *et al*. 2002).

A plant-derived cure for heartwater will benefit resource-poor small-scale livestock keepers, especially when the plant is browsed and liked by the animals.

The cure might involve a combination of plants (*Ipomoea adenioides* and *Petalidium oblongifolium*). This will not only benefit people in underdeveloped countries but also in developed ones. It will play a crucial role in organic farming where the use of synthetic chemicals is prohibited.

Such cures can become additives for animal feed, commercially available without processing. These will without doubt need to be scientifically validated like the D'Ayu-Relief product (Silver 2004). The product is a polyherbal compound that contains ten Eastern Indian herbs. It is used for the management of acute diarrhea in cats and dogs. The formulation is said to enhance benefits and minimize detrimental side effects. It contains herbs with antimicrobial and antiprotozoal activity as well as herbs that help to alleviate diarrhea and to assist in mucosal maintenance and repair. The product was given to thirty-four American and Canadian veterinarians for evaluation. 23% of the veterinarians found the product excellent; 62% found it moderately well to good and 15% found it to be poor. Such validation of ethnoveterinary medicines will bring ethnoveterinary medicines to the same level as orthodox veterinary medicine.

The trend of a preference for organically produced food is increasing. This gives a chance for the revival of ethnoveterinary medicines and anti-tick ethno-practices where tick-repellent plants are used; zero-grazing is practised; and taking animals to grazing between 10:00 and 15:00 when tick activity is at its lowest (Wanzala). When everybody demands organically produced food, civilization will have completed a full cycle. The prediction of Van Wyk and his colleagues (2000) shall have been fulfilled that medicinal plants belong to the future.

5.1 References

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CHAPTER 6

Summary

The antibacterial activity of the crude extracts of the ethnobotanically selected plants, *Drimia delagoensis, Petalidium oblongifolium* and *Ipomoea adenioides* varied. *P. oblongifolium* had the highest antibacterial activity, with respective MIC's of 1.0 mg ml^{-1} against Gram-positive bacteria and 20.0 mg ml^{-1} against Gram-negative bacteria. *D. delagoensis* had the lowest antibacterial activity with respective MIC's of 20.0 mg ml^{-1} against Gram-positive bacteria and 40.0 mg ml^{-1} against Gram-negative bacteria. *I. adenioides* had intermediate antibacterial activity.

Using the antibacterial activity of the crude extracts as a guide, bioactive compounds were isolated from *P. oblongifolium* and *I. adenioides*. The compound isolated from *P. oblongifolium* could not be identified. It is the most bioactive of the isolated compounds with a MIC of 2.5 µg ml^{-1} against *Ehrlichia ruminantium*, the causative agent of heartwater. The compounds isolated from *I. adenioides* were the flavonoids quercetin-3-rhamnoside, quercetin-3-galactoside and quecetin-3-arabinoside and the phenolics caffeic acid and its ethyl ester derivative. Caffeic acid has a lower antibacterial activity than the ethyl ester, with respective MIC's of 0.8 mg ml^{-1} against Gram-positive bacteria and 1.0 mg ml^{-1} against Gram-negative bacteria. The ethyl ester has respective MIC's of 0.4 and 0.6 mg ml^{-1} against Gram-positive and Gram-negative bacteria. There is an antibacterial synergy between these compounds. When combined in equal amounts the antibacterial activity increases with respective MIC's of 0.2 and 0.4 mg ml^{-1} against Gram-positive and Gram-negative bacteria.

The *in* vitro results of this preliminary study show that some plants like *P. oblongifolium*, can probably be used effectively in ethnoveterinary medicine in the treatment of heartwater, while others like *D. delagoensis* might not be as effective. The antibacterial activity of plant extracts might not be attributed to individual or single compounds. A combination of one or more compounds might bring about the effect. A complete analysis of the chemical constituents of the plants is necessary to give an indication of the potential of the plants in ethnoveterinary medicine.