



Tannin content of leaf extracts of 53 trees used traditionally to treat diarrhoea is an important criterion in selecting species for further work



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ABSTRACT

Aim of the study: In southern Africa many plant species are used to treat different ailments and diseases related to infections. Diarrhoea is not only an important disease of humans but also causes large losses in the animal production industry. The antimicrobial activity of many of these species may however, be based on their tannin content. Even though high tannin content may be therapeutically effective against pathogens causing diarrhoea, nutritional side effects limit its prophylactic use in animal production. The aims of the study were two-fold. In the first place it was to compile a list of species used traditionally to treat diarrhoea. The second aim was to identify and remove those species where a potential antidiarrhoeal activity may be due to tannins, because it would be counterproductive to use in production animal systems.

Materials and methods: After a literature study, 53 tree species used to treat diarrhoea or dysentery in humans or animals in southern Africa were identified. Plant material was collected and dried powdered leaves were extracted with acetone. To select plants with potential use as prophylactics against diarrhoea, the tannin content was determined by a radial diffusion method of precipitation of bovine serum albumin in agar and expressed as gallic acid equivalents.

Results: Based on our literature research plant species from at least 37 tree families are used traditionally to treat diarrhoea in southern Africa. Most of the species were from the Fabaceae (9), Euphorbiaceae (6), Anacardiaceae (3) and Combretaceae (3). The highest tannin content of 11.3 mg/ml gallic acid equivalents was detected in leaf extracts of *Combretum molle* and *Sclerocarya birrea*. About 40% of the species tested contained no tannin based on the assay used.

Conclusions: As other authors have found, the tannin content within a family varied strongly. Therefore it is dangerous to make any conclusions on the tannin content of the same plant family. About 42% of the species had no detectable tannin content and another 25% contained 0–2 mg/ml gallic acid equivalent tannins. In general it appears that in most cases tannins do not play a major role in treating diarrhoea in southern African ethnomedicine. If aqueous extracts were used, the situation could have been different.

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1. Introduction

Diarrhoea often leads to reduced growth of animals or even to their death, as well as to high treatment costs and an economic loss for the farmer. To address this problem, antibiotic feed additives were developed. However selective pressure exerted by the use of antibiotics as growth promoters in food animals appears to have created large reservoirs of transferable antibiotic resistance in these ecosystems (Witte, 2000). This has led to the ban of antibacterial growth promoters that might interfere with human chemotherapy in European Union countries (Witte, 2000). The European Parliament and Council Regulation (EC) No 1831/2003 lays down provisions phasing out the authorisation of antibiotic feed additives as from 1 January 2006 (Anonymous, 2003). Therefore a significant opportunity for the development of alternative

feed additives was created. Moreover, following the ban, countries outside the EU will find it difficult to continue exporting animal products such as poultry and pork meat. This opens up new opportunities for developing alternative feed additives.

Diarrhoea causes the death of many children in developing countries of the world, but is also important in animal production. Due to weak immune systems, especially in young stock, the occurrence of diarrhoea poses a big threat to animal health and productivity (Houe, 1999). For economical animal production, many obstacles have to be mastered, including the prevention or effective treatment of diarrhoea. One of the most important causes of diarrhoea is infection with bacteria (e.g. *Escherichia coli*), but fungal and parasitic infections can also cause diarrhoea.

Since many plant extracts have antimicrobial activities, scientists have focused on testing different species for their antimicrobial activity. However, the selection of these species has been mostly based on traditional use in past decades and a system to recommend species for further in depth investigation could be useful for scientists. An important aspect that should be taken into account when selecting species for

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further study is that the plant should contain low concentrations of tannin. This is important because tannins bind to proteins. Extracts from these plant species may therefore be useful to treat acute diarrhoea but because the protein binding has an antinutritional effect on growth of the animals, it may not be useful in treating chronic diarrhoea in animal production systems. Tannins generally should not be administered simultaneously with any medication or nutrient because of their potential for reduced absorption and activity (Wynn and Fougère, 2007). Furthermore tannins can cause nausea which is perhaps a result of protein binding within the stomach and duodenum, and high levels of tannins absorbed into the bloodstream can cause serious constipation and hepatotoxicity and damage to other organs. Tannins are also frequently bitter and may affect palatability of stock feed. Ruminants are particularly susceptible to these effects (Wynn and Fougère, 2007).

It is therefore important that plants to be further investigated for their potential therapeutic or prophylactic antibacterial or antiparasitic

efficacy should have a low tannin content. In this study leaf extracts of 53 trees traditionally used to treat diarrhoea in southern Africa were selected for evaluation of their tannin content. To promote the sustainable use of resources only leaves of trees were examined in this study. Investigation of species from different families may also indicate which families contain a high concentration of tannins (Bate-Smith and Metcalfe, 1957) and should not be investigated because the traditional use may be based on a high tannin content. The aim of this study is therefore to serve as a preliminary screen for selecting plant extracts that could be potentially used as prophylactic anti-diarrheal agents in animal production.

2. Material and methods

Leaves of 53 tree species were selected for this study based on their reported medicinal use in the treatment of diarrhoea (Hutchings et al.,

Table 1

Selected plants for antibacterial screening (Hutchings et al., 1996; Bossard, 1993; Bryant, 1966) percentage of dry powdered leaf material extracted by acetone, gallic acid equivalent content in mg/ml and standard deviation. (PMDB voucher specimen numbers refer to voucher specimens of the Phytomedicine database accessible in PRU.)

Plant species	Family	Voucher specimen	Medicinal use in Zulu medicine	Yield	mg/ml gallic acid eq.	SD
<i>Acacia karroo</i> Hayne	Fabaceae	PMDB160	Diarrhoea/dysentery	1.4%	1.67	1.00
<i>Acacia sieberiana</i> var. <i>woodii</i> DC	Fabaceae	421310	Diarrhoea	1.3%	0.00	0.00
<i>Albizia adianthifolia</i> (Schuhmach.) W.F. Wight	Fabaceae	10635	Dysentery	2.7%	0.00	0.00
<i>Annona senegalensis</i> Pers.	Annonaceae	583793	Diarrhoea/dysentery	1.4%	0.00	0.00
<i>Antidesma venosum</i> E. Mey. ex Tul.	Euphorbiaceae	3210	Dysentery	1.8%	0.00	0.00
<i>Berchemia zeyheri</i> (Sond.) Grubov	Rhamnaceae	280012	Dysentery	1.2%	0.00	0.00
<i>Bridelia micrantha</i> (Hochst.) Baill.	Euphorbiaceae	251928	Diarrhoea	2.7%	0.00	0.00
<i>Buddleja salvifolia</i> Lam.	Loganiaceae	335	Diarrhoea	2.9%	0.00	0.00
<i>Capparis tomentosa</i> Lam.	Capparaceae	418913	Diarrhoea	2.0%	0.67	0.58
<i>Cassine aethiopica</i> Thunb.	Celastraceae	114685	Diarrhoea/dysentery	3.1%	0.00	0.00
<i>Cassine transvaalensis</i> (Burt. Davy) Codd	Celastraceae	PMDB269	Diarrhoea	7.1%	7.33	0.58
<i>Cassinopsis ilicifolia</i> (Hochst.) Kuntze	Icacinaeae	PMDB280	Dysentery	3.1%	3.00	1.73
<i>Cassinopsis tinifolia</i> Harv.	Icacinaeae	114707	Dysentery	2.3%	1.33	1.15
<i>Clausena anisata</i> (Willd.) Hook. F. ex Benth.	Rutaceae	30749	Dysentery	4.2%	4.00	0.00
<i>Clerodendrum glabrum</i> E. Mey.	Verbenaceae	PMDB728	Diarrhoea	3.6%	0.00	0.00
<i>Combretum molle</i> R. Br. ex G. Don	Combretaceae	3770	Diarrhoea	2.9%	11.33	0.58
<i>Combretum zeyheri</i> Sond.	Combretaceae	324770	Diarrhoea	3.5%	4.33	1.53
<i>Curtisia dentata</i> (Burm. F.) C.A. Sm.	Cornaceae		Diarrhoea	6.6%	3.33	1.53
<i>Deinbollia oblongifolia</i> (E. Mey. ex Arn.) Radlk.	Sapindaceae	PMDB410	Diarrhoea/dysentery	2.5%	0.00	0.00
<i>Dichrostachys cinerea</i> subsp. <i>africana</i> (L.) Wight et Arn.	Fabaceae-Mimosoidae	563160	Diarrhoea	1.3%	0.33	0.58
<i>Dombeya rotundifolia</i> (Hochst.) Planch.	Sterculiaceae	754696	Diarrhoea	1.4%	0.00	0.00
<i>Ekebergia capensis</i> Sparman	Meliaceae	3141	Dysentery	2.1%	0.00	0.00
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels	Fabaceae	391207	Diarrhoea/dysentery	2.9%	0.00	0.00
<i>Faidherbia albida</i> (Del.) A. Chev.	Fabaceae	423557	Diarrhoea	2.4%	1.33	1.15
<i>Faurea saligna</i> Harvey	Proteaceae	371255	Diarrhoea	13.7%	1.67	1.00
<i>Ficus sur</i> Forssk.	Moraceae	36664	Diarrhoea/dysentery	1.9%	2.67	1.15
<i>Flueggea virosa</i> (Roxb. Ex. Willd.) Pax & K. Hoffm.	Euphorbiaceae	PMDB48	Diarrhoea	1.4%	0.00	0.00
<i>Hippobromus pauciflorus</i> (L. F.) Radlk.	Sapindaceae	273761	Diarrhoea/dysentery	1.4%	8.00	1.15
<i>Jatropha curcas</i> L.	Euphorbiaceae	3186	Diarrhoea	2.7%	1.00	0.00
<i>Kigelia africana</i> /Kigelia <i>pinnata</i> (Jacq.) DC	Bignoniaceae	566356	Dysentery	1.3%	0.00	0.00
<i>Lankea discolor</i> (Sond.) Engl.	Anacardiaceae	PMDB565	Diarrhoea	2.0%	4.00	0.00
<i>Lippia javanica</i> (Burm. f.) Spreng.	Verbenaceae	113001	Diarrhoea/dysentery	1.9%	0.00	0.00
<i>Lonchocarpus capassa</i> Rolfe	Fabaceae	PMDB613	Dysentery	1.4%	0.00	0.00
<i>Olea europaea</i> subsp. <i>africana</i> (Mill.) P.S. Green	Oleaceae	PMDB306	Diarrhoea	5.7%	0.00	0.00
<i>Oncoba spinosa</i> Forssk.	Flacourtiaceae	PMDB62	Dysentery	3.7%	1.33	1.15
<i>Ozoroa obovata</i> (Oliv.) R. & A. Fernandes	Anacardiaceae	PMDB248	Dysentery	3.9%	3.33	1.53
<i>Peltophorum africanum</i> Sonder	Fabaceae	PMDB301	Diarrhoea	1.1%	6.00	1.73
<i>Pittosporum viridiflorum</i> Sims	Pittosporaceae	3702	Dysentery	2.3%	0.00	0.00
<i>Ricinus communis</i> L.	Euphorbiaceae	PMDB	Diarrhoea	2.3%	3.00	1.73
<i>Schotia brachypetala</i> Sond.	Fabaceae	114741	Diarrhoea/dysentery	1.2%	4.67	1.00
<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	Anacardiaceae	PMDB130	Diarrhoea/dysentery	3.7%	11.33	0.58
<i>Spirostachys africana</i> Sond.	Euphorbiaceae	271399	Diarrhoea/dysentery	3.3%	0.00	0.00
<i>Strychnos spinosa</i> Lam.	Loganiaceae	841522	Diarrhoea/dysentery	2.2%	0.00	0.00
<i>Syzygium cordatum</i> Hochst. Ex Krauss	Myrtaceae	PMDB77	Diarrhoea	3.6%	4.00	0.00
<i>Tecomaria capensis</i> (Thunb.) Spach	Bignoniaceae	PMDB362	Diarrhoea/dysentery	2.9%	5.67	2.08
<i>Terminalia phanerophlebia</i> Engl. & Diels	Combretaceae	3086	Diarrhoea	2.2%	0.67	0.58
<i>Tetradenia riparia</i> (Hochst.) Codd	Lamiaceae	573263	Diarrhoea	1.6%	0.00	0.00
<i>Thespesia acutiloba</i> (Bak. F.) Exell & Mendonca	Malvaceae	114692	Dysentery	3.9%	0.33	0.58
<i>Trema orientalis</i> (L.) Blume	Ulmaceae	362949	Dysentery	4.0%	5.67	0.58
<i>Trichilia emetica</i> Vahl	Meliaceae	PMDB87	Dysentery	0.8%	0.33	0.58
<i>Vangueria infausta</i> subsp. <i>infausta</i> Burchell	Rubiaceae	PMDB89	Diarrhoea	1.2%	4.08	1.04
<i>Ximenia caffra</i> Sond.	Olacaceae	PMDB586	Diarrhoea	3.9%	4.00	0.00
<i>Ziziphus mucronata</i> Willd.	Rhamnaceae	850284	Diarrhoea/dysentery	1.2%	0.67	0.58

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