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## Abstract

**Background:** Intestinal parasitic infections are among the most common chronic human infections in developing countries; particularly within the tropical and subtropical regions. An ethno-botanical survey was carried out to document medicinal plants used for the treatment of intestinal worms in Amathole District Municipality of the Eastern Cape Province (ECP), South Africa

**Materials and methods:** A questionnaire-guided interview of the indigenous people by random sampling was done with the help of an interpreter during the survey of the district.

**Results:** Medicinal plants mostly used for traditional management of intestinal worms were selected from 13 plant families: Alliaceae, Anacardiaceae, Asphodelaceae, Asteraceae, Crassulaceae, Dracaenaceae, Fabaceae, Hypoxidaceae, Lamiaceae, Longaniaceae, Punicaceae, Polygonaceae, and Verbenaceae. Out of these, *Hypoxis hererocallidea* (17%), *Strychnos henningsii* (14%), *Rumex lanceolatus* (12%), *Ozoroa mucronata* (9%) and *Acacia karoo* (9%) belonging to the families Hypoxidaceae, Longaniaceae, Polygonaceae, Anacardiaceae and Fabaceae respectively were found as the most cited, the least cited plant was *Coryledon orbiculata* (2%). Leaves and roots from these plants were found to be commonly used (36%), followed by the root (27%), bark (14%), the bulb and stem (9%), and rhizome collectively constitute (5%). Oral method of administration by decoction (50%) and infusion (39%) was however found to be a common method by respondents.

**Conclusion:** The current study however showed that ethno-pharmacological knowledge of the traditional healers in ECP largely depends on naturally growing species, documentation of which will go a long way in validating the therapeutic uses and safety of these plants as anthelmintic plants.

**Keywords:** Ethno-botanical survey, Eastern Cape Province, Amathole District, anthelmintic, indigenous recipes

## Introduction

The Eastern Cape Province (ECP) of South Africa is endowed with rich and diverse fauna and flora. The Province is surrounded by mountain areas covered by grassland and subtropical thicket, with vegetation type containing a number of succulent species which are useful for medicinal purposes. The people of the Eastern Cape tend to be more traditional with many aspects of traditional culture being part of their everyday life (Cocks and Møller, 2002). A large proportion of the population is reliant (to some extent) on natural resources for direct subsistence use or, indirectly, for generating income (Ainslie, 1999; Dold and Cocks 2000; Shackleton et al., 2002). The inhabitants of this Province have a long history of traditional plant usage for the treatment of various diseases (Grierson and Afolayan, 1999; Koduru et al., 2007). The ethno-pharmacological knowledge of the traditional healers in this Province depends largely on the naturally growing species.

These plants are being used by the people in this Province to treat various ailments because of the rich biodiversity of the flora, the cultural and social belief of the people. This explains the strength of traditional medicine and the wide varieties of medicinal recipe by traditional healers.

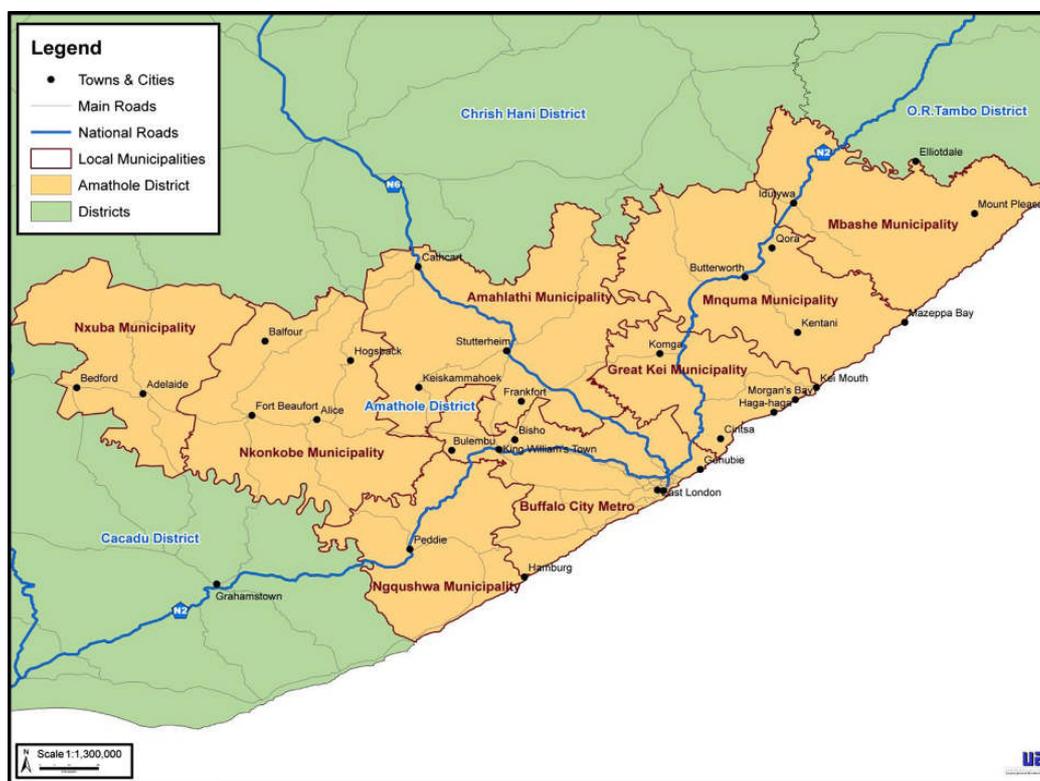
Though much inventory had been compiled on medicinal plants in Africa, further research is still necessary with regards to the treatment of helminthes in order to avert complications associated with the treatment of intestinal worms (Kona and Atindehou, 2008; Adamu et al., 2014). Intestinal parasitic infections are among the most common chronic human infections in developing countries, particularly in the tropical and subtropical regions. Parasitic infection may lead to the release of free radicals which may have severe consequences on cellular metabolism (Adamu et al., 2014). The major groups of parasites are geohelminths, schistosomes and protozoan; these are associated with malnutrition, iron deficiency, anaemia growth and cognitive development impairment which are caused by decreased appetite, nutrient loss, malabsorption and decreased nutrient utilization (WHO, 2005). Intestinal parasitic infections receive little attention as most are asymptomatic and generally considered to be of less clinical significance than bacterial and viral infections (WHO, 2005; Kwitshana et al., 2008). They cause intestinal obstruction, insomnia, vomiting, weakness, stomach pains and discomfort to their host (John and Williams, 2006). Worms may sometimes migrate into and block unusual sites such as the bile or pancreatic ducts, thereby causing acute and life-threatening disease (Ferreira and Cerri, 1998, Sandouk et al., 1997). The burden of disease falls disproportionately on the poor, where inadequate sanitation measures; overcrowding, low levels of education and lack of access to health care make them particularly susceptible (de Silva et al., 2003). It is thus, necessary to have a fairly-accurate picture of the degree to which some of the burden and inflammations of helminths could be addressed with medicinal plants.

## Materials and Methods

### Study Area

This study was carried out in Amathole local Municipality comprising of Nxuba, Nkonkobe, Ngqushwa, Amahlathi, Greet Kie, Buffalo, Mnguma and Mbashe local Municipality, Eastern Cape Province, South Africa. The Province falls within the latitudes 30°00'N to 34°15'S and

longitudes 22°45' to 30°15' E (Grierson and Afolayan, 1999). It is bounded by the sea in the East and the drier karoo (Semi-desert vegetation) in the West. The elevation ranges from the sea-level to approximately 2200 m in the North of the Province.



**Figure 1:** Map of Amathole District Municipality. Source: Urban-Econ, Eastern Cape, 2011.

The economy of the district is dominated by Buffalo City Municipality, comprising of the coastal city of East London, King William's Town, Mdansane and the Provincial administrative capital of Bisho. The area of the District is 21 595 square kilometers with majority of its inhabitants working as farmers, traders, public servants, manufacturers in automobiles, food processing, textile and clothing industries (Otang, et al., 2012).

### Ethno-Botanical Survey

Field survey for the study was conducted from May to August, 2013 in Amathole District Municipality. Information was obtained through a guided field-walk along the field and market area from rural dwellers, hawkers of medicinal plant preparations, herbalists and traditional healers who were trained practitioners of repute with the help of a semi-structured questionnaire and the use of an interpreter to translate the Xhosa language of communication to English (Bisi-Johnson et al., 2010; Wintola and Afolayan, 2010).

Methods of selecting respondents depended upon the distribution of local people with folk knowledge. They were requested to collect specimens of the plants they know or to show the plant species on site. These informants were traditional healers themselves or had a tradition of healing in their families and knowledge of the medicinal use of the plants. The following information were collected on the plants used for the treatment of intestinal worm, the local name of the plant, life form, parts used, method of preparation, mode of administration, other uses and references for the uses. However, to avoid the mis-identification of the cited plant species, the traditional healers were asked to assist in the collection of the medicinal plants from the wild.

### Interview with Traditional Healers

This study adhered to the research guidelines and ethical protocols of the University of Fort Hare, South Africa. The ethno-botanical surveys conducted were carried out with the full consent of all participants with further verbal agreement and understanding that the research shall not be used for commercial purposes, but to serve as enlightenment on the diversity of medicinal plants used in the management of intestinal worms in the Eastern Cape Province. Eighty respondents, 54 of who were male and 26 females were interviewed; the respondents were selected by sampling, and were found in thirteen different sites, sampling was used because there was no other means of identifying respondents. The main objective of the sampling method was to identify knowledgeable respondents. Twenty respondents were interviewed once, the others (who were

healers) were interviewed three or four times. No interview schedule of questions was used but a more qualitative, conversational technique. Plants were collected when available to verify that the common names used by each respondent were the same as those recorded in the literature.

### Identification and Preservation of Medicinal Plant Specimens

Standard method was followed with regard to collection of plant materials, drying, preparation and preservation of plant specimens (Jain, 1976; Vijayalakshimi et al., 2011). The plants were initially identified by their vernacular names and later validated by Prof DS Grierson and the floristic works of South Africa (Dold and Cocks, 1999; Bhatt and Jacobs, 1995 and Van Wyk et al., 1997). Voucher specimens were also prepared and deposited at the Giffen's herbarium, in the Department of Botany, University of Fort Hare, South Africa. Further characterization of the plants and their previous usage was established by literature search (Togola et al., 2005; Otang et al., 2012) with the online databases available in the library of the University of Fort Hare, like Ebscos, Elsevier, Science Direct, Jstor, Springer links.

## Result and Discussion

### Demographic Information

In the present study, the medicinal plants were collected from Amathole District Municipality of the Eastern Cape (Figure 1). The medicinal plants cited (Table 1), were found to be used traditionally for the treatment of intestinal worms by the local communities. A total of 80 informants (54 males and 26 females), aged between 25-65 years participated in the study, including (40%) traditional healers, (20%) herbalist and (20%) rural elders. 10% of the respondents were younger than 41, while 55% were between 41-50, 10% were between 51-60, and those older than 60 are just about 5%. The fact that more than 50% of the informants are less than 50 years old implies that the use of herbal remedy in the study area is still not yet endangered most especially for the management of intestinal worms. The cultural practices of using herbs for healing are still prominent in Africa because of the easy accessibility, coupled with the uneven distribution of health personnel in the rural areas as compared to the urban area. The rural communities engage in traditional medicine practices because of the nearness to nature and the knowledge of the use of herbs obtained or passed from generation to generation (Lawal et al., 2014).

### Diversity of Medicinal Plant Used Against Worms

The results of the survey carried out on the use of medicinal plants in the management of intestinal worms are presented in Table 1 with the medicinal plants arranged in alphabetical order. Plant species which are used in traditional medicine are enumerated with their botanical and vernacular names, family and use of the plant parts in the various treatments. This is indicative of the large biodiversity flora of South Africa with its rich ethno-medicinal properties, serving as the main resource of phytotherapy for majority of the people. Given the rich biodiversity of South Africa, with up to 30,000 species of plants, about 3,000 species have been detected as being used as medicinal plants across the country (Van Wyk et al., 1997; Masika et al., 2000; Adamu et al., 2012). The cultural belief and accessibility of medicinal herbs makes it easy for the people to have access to affordable treatments which are provided by the traditional care givers.

The distribution of the plant families are as shown in table 2, these include Fabaceae, Asteraceae, Asphodelaceae, Verbenaceae, Crassulaceae, Lamiaceae, Anacardiaceae, Punicaceae, Polygonaceae, Dracaenaceae, Longaniaceae, Alliaceae and Hypoxidaceae. The families Asphodelaceae, Asteraceae and the Fabaceae were represented by two plant species each. Out of these, *Hypoxis hererocallidea* (11%), *Strychnos henningsii* (10%), *Rumex lanceolatus* (10%), *Ozoroa mucronata* (10%) and *Acacia karoo* (6%) belonging to the families Hypoxidaceae, Longaniaceae, Polygonaceae, Anacardiaceae and Fabaceae respectively were the most commonly cited, the least cited plant were *Cotyledon orbiculata*, *Helichrysum odoratissimum*, *Indigofera jucunda* and *Sansevieria hyacinthoides* (3%) as shown in figure 2. The relatively high frequency of citation of the Hypoxidaceae (11%), Longaniaceae (10%) and Polygonaceae (10%) species in the treatment of intestinal worms may reflect the likelihood of the presence of anthelmintic compounds within the plant species. *Hypoxis* as the most cited medicinal plant was a renowned ingredient in some African traditional remedies, the genus was used by most ethnic groups in Africa to heal various disorders mostly associated with internal tumor, abdominal pains and impotency. It was also used by different cultural groups in Africa to treat a suite of ailment (Watts and Breyer-Brandwijk, 1962). In Tropical Africa, boiled rhizomes of *H. urceolata* Nel are used as a purgative for new born babies (Wiland- Szymanska, 2001). In southern Africa, the species of *hypoxis*, *H. colchicifolia* and *H. hemerocallidea* are mostly used in traditional medicine to treat impotency, intestinal parasite, stomach pains, headaches, dizziness and mental disturbance (Hutching, 1996). It has been popular *muti* among the Zulus and the Xhosa's, and used as an emetic to treat dizziness and nervous disorder (Hutching, 1996; Dold and Cocks, 2002). *Hypoxis* species has been said to have lots of medicinal potential, which has encouraged the isolation of many compounds from the rhizomes and has therefore given it the name African potato. To assess the importance of a single species, it is reasonable to state that the greater the independent citation of a particle species for the treatment of a certain ailment category, the greater the cultural importance (Kisangau et al., 2007; Otang et al., 2012).

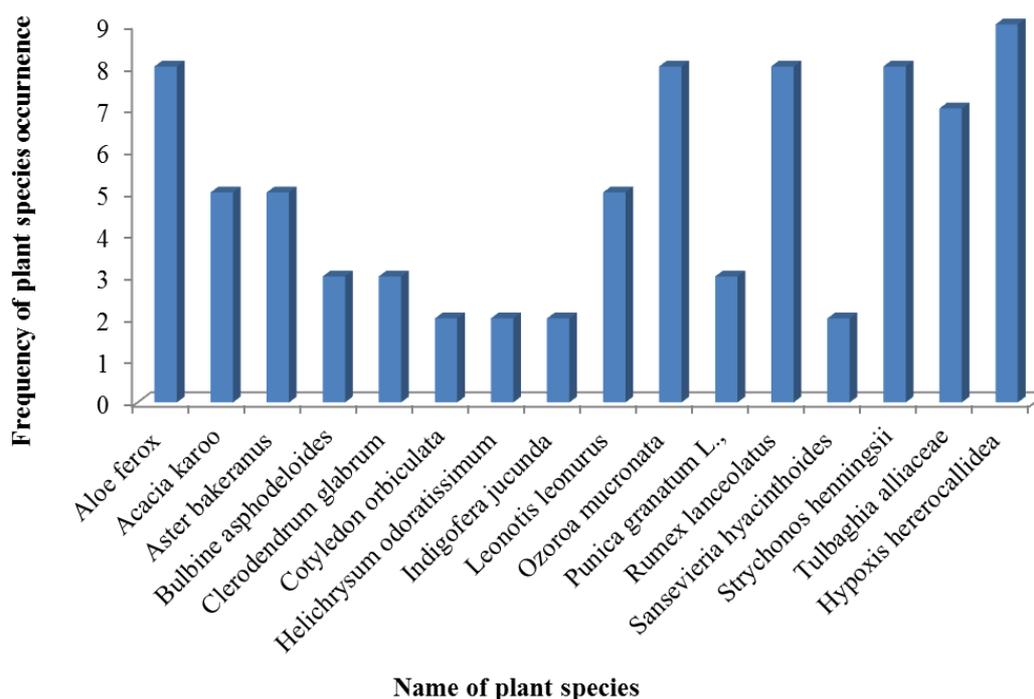
**Table 1:** Medicinal plants used in the treatment of worms in Amathole District Municipality, Eastern Cape Province, South Africa.

	Scientific name	Local name	Family	Part used	Method of preparation	Frequency of citation (n=80)	Other uses	Botanical reference
1	<i>Aloe ferox</i> Mill.	Ikhala	Asphodelaceae	Leave	Decoction	8	Constipation	Maphosa et al., 2012
2	<i>Acacia karoo</i> Hayne	Umnga	Fabaceae	Bark, leaf	Decoction	5	Diarrhoea	Dold and Cock, 2000; McGaw et al., 2008
3	<i>Aster bakeranus</i> Burtt Davy ex C.A.Sm.	Unozixekana	Asteraceae	Root	Decoction	5	Emetic, purgative, snake bite remedy	Watt and Breyer-Brandwijk, 1962; Van Wyk et al., 1997.
4	<i>Bulbine asphodeloides</i> (L.) Wild.,	Uyakayakane	Asphodelaceae	Leaf, tuber	Decoction	3	Rashes, dysentery, diarrhoea	Iwalewa et al., 2007; Shahid, 2012
5	<i>Clerodendrum glabrum</i> E. mey, synonym: <i>C. rehmannii</i>	Umqangazani, Uqangazana, Umqangazane	Verbenaceae	Leaf	Infusion	3	Bloody stool, chest infection, snake bite	Watt and Brayer-Brandwijk, 1962; Roberts, 1990; Bisi-Johnson et al., 2010
6	<i>Cotyledon orbiculata</i> L.	Imphewula	Crassulaceae	Leaf juice	Eaten, topical	2	Ear ache, tooth ache, inflammation	Van Wyk et al., 1997
7	<i>Helichrysum odoratissimum</i> (L.) Sweet	Imphepho	Asteraceae	Root	Infusion	2	Wound, cough	Van Wyk et al., 1997
8	<i>Indigofera jucunda</i> Schrire syn	Impingele	Fabaceae	Root	Decoction	2	Infertility, menstrual cramps	Coates-Palgrave, 2002
9	<i>Leonotis leonurus</i> (L) R. BR.	Umfincamfincane	Lamiaceae	Leaf, stem	Decoction and infusion	5	Helminthis influenza, bronchitis, high blood pressure, dysentery and headache	Scott, 2004; Maphosa and Masika, 2010 Maphosa et al., 2012
10	<i>Ozoroa mucronata</i> (Bernh. Ex. C. Krauss) R. Fern & A. Fern	Umpheмба, Uzintlwa	Anacardiaceae	Root	Decoction	8	Diarrhoea, stomach problem	Yamagiwa et al., 1987; Shahid, 2012
11	<i>Punica granatum</i> L.,	Umkakase	Punicaceae	Root, stem Bark	Decoction	3	Diarrhoea, stomach ache	Watt and Breyer-Brandwijk, 1962; Iwu, 1993; Van Wyk et al., 1997

12	<i>Rumex lanceolatus</i> Thunb.	<i>Idololenkonyane,</i> <i>Idlonyaya</i>	Polygonaceae	Root	Infusion	8	Vascular diseases, internal bleeding, wound and sore	Watt and Breyer- Brandwijk, 1962; Pujol, 1990; Rood, 1994; Hutchings 1996; Van Wyk et al., 1997; Dold and Cock, 2000
13	<i>Sansevieria</i> <i>hyacinthoides</i> (L.) Druce	<i>Isikholokotho</i>	Dracaenaceae	Leaf, root	Infusion and squeezing	2	Tooth-ache, hemorrhoids, ulcer	Watt and Breyer- Brandwijk, 1962;
14	<i>Strychnos</i> <i>henningsii</i> Gilg	<i>Umnonono</i>	Longaniaceae	Bark	Decoction	8	Dysentery	
15	<i>Tulbaghia</i> <i>alliaceae</i> L.f	<i>Umwelela,</i> <i>ivimbampunzi, Sikwa</i>	Alliaceae	Bulb	Infusion	7	Fever, as a remedy for tuberculosis and influenza	Watt and Breyer- Brandwijk, 1962; Treurnicht, 1997; Bisi- Johnson et al., 2010.
16	<i>Hypoxis</i> <i>hererocallidea</i> Fisch., C.A.Mey.& Ave- Lall	<i>Nongwe</i>	Hypoxidaceae	Rhizome	Infusion, Decoction	9	Tuberculosis and cancer. Diabetes	Watt and Breyer- Brandwijk, 1963; Smith, 1966; Van Wyk., 1997; Van Wyk et al., 2000

**Table 2:** Distribution of the representative of the plant families and their percentage occurrences

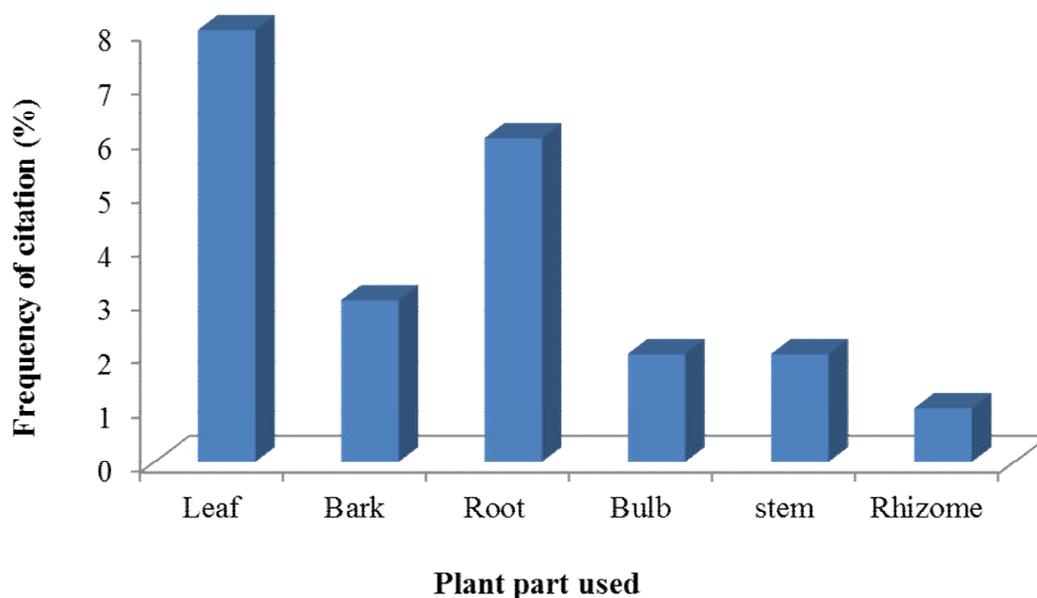
Family	No of plant species	% occurrence
Asphodelaceae	2	13
Fabaceae	2	13
Asteraceae	2	13
Verbenaceae	1	6
Crassulaceae	1	6
Lamiaceae	1	7
Anacardiaceae	1	7
Punicaceae	1	7
Polygonaceae	1	7
Dracaenaceae	1	7
Longaniaceae	1	7
Alliaceae	1	7
Hypoxidaceae	1	7



**Figure 2:** Frequency of occurrence of the medicinal plant species

### Plant Part Used in the Treatment of Worm

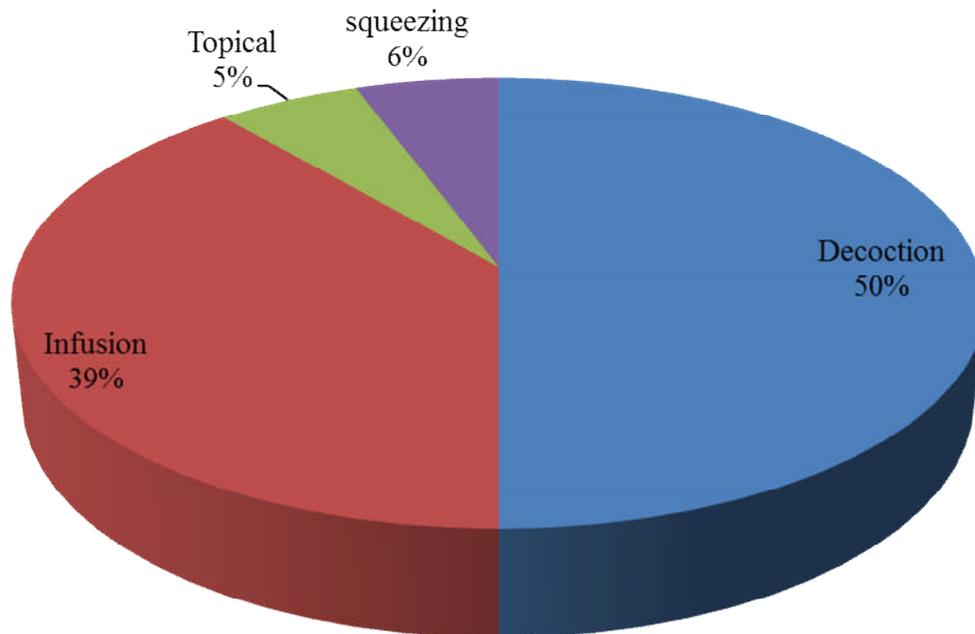
The plant part used and its frequency of citation of used part for the management of worms showed that the leaf (36%) and root (27%) were the most cited, followed closely by the bark (14%), the bulb and stem (9%) and lastly, the rhizome was cited (5%) as shown in Figure 3. Leaves were the most cited plant part used by the healers for the preparation of traditional medicines. This finding was in line with the results of other ethno-medicinal studies in Africa and other parts of the world where leaves were the most cited plant part used in remedy preparations (Yineger and Yewhalaw, 2007).



**Figure 3:** Frequency of plant parts used for treating intestinal worms infestation

### Route of Administration

Oral routes of administration such as decoction (50%) and infusion (39%) were the most cited means of administration of herbal formulations in the treatment of worms as shown in figure 4. Decoction and infusion are highly reputed and valued by the traditional healers in that it provides a more active relief and cure in the treatments of diseases generally (Watt and Breyer-Brandwijk, 1963; Hutching, 1996; Olajuyigbe and Afolayan, 2012) Decoctions and Infusions are the simplest forms of herbal preparation, and undoubtedly the oldest, decoctions are in most respects similar to infusions, and are employed for plant material too tough to yield their active constituents efficiently in an infusion, the high temperature also sterilizes the extract, hence minimizing the chances of contamination (Jabeen, 2011). These plants are prepared and administered orally in different ways, except *Cotyledon orbiculata* L with topical (5%) and *Sansevieria hyacinthoides* (6%) with squeezing application as additional route of application alongside oral administration (Figure 4). Hence the role of ethno-botanical surveys and field work was of crucial importance as some miraculous medicines for incurable diseases are known to the local communities and aboriginals. The acquired knowledge of the significant use of medicinal plants was usually passed on from generation to generation as a guarded secret of families. Therefore it was necessary to popularize and identify utility of these medicinal plants.



**Figure 4:** Frequency of different preparation methods for treating intestinal worm infestation

## Conclusion

The findings from this survey indicated abundant availability of rich biodiversity of medicinal flora in the study area which can be used for the management of intestinal worms. This rich and diverse knowledge of traditional remedies still forms part of the cultural heritage of the community. The study documents anthelmintic plants in the district to preserve the traditional knowledge of plants. The documented plants could form the basis for further research in related discipline. These recipes could be used for the treatment of intestinal worm by the people of Amathole and the entire South Africa. This study reasoned that even though accessibility to western medicine for simple and complicated diseases are available; many people in Amathole district still continue to depend on medicinal plants because it is easily obtainable and affordable.€

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**Wintola et al., Afr J Tradit Complement Altern Med. (2015) 12(4):112-121**

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