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Full Length Research Paper

Antibacterial properties of some wild leafy vegetables of the Eastern Cape Province, South Africa

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Wild medicinal leafy vegetables are consumed by many rural villagers of the Eastern Cape, South Africa. These vegetables are easily accessible at no cost. This paper presents findings of a survey of plants used as vegetables and for medicinal purposes in the Eastern Cape Province. Regular consumers of these plants interviewed revealed that four out of the possible twenty species were reported to be used for medical purposes besides consumption as food. Plants that were consistently mentioned in all the places visited were collected to evaluate their antibacterial properties. The following four species were collected; *Bidens bipinnata, Physalis peruviana, Rumex obtusifolius,* and *Taraxacum officinale.* These were reported to cure the most common diseases in the study area. Antibacterial screening was done on all the four collected species. All the aqueous extracts from these plants showed some antibacterial properties at concentrations ranging from 1.0 to 7.0 mg/ml. Acetone and aqueous extracts of *B. bipinnata* and *P. peruviana* inhibited both Gram-positive and Gram-negative bacteria. This may justify the use of these plants for the treatment of minor ailments as a primary health care delivery system.

Key words: Wild vegetables, antibacterial, *Bidens bipinnata, Physalis peruvian, Rumex obtusifolius, Taraxacum officinale.*

INTRODUCTION

Utilization of leafy vegetables is part of Africa's cultural heritage and they play important roles in the customs and food culture of the African household. South Africa is a country with great biodiversity especially in the Eastern Cape region where many people are still using a wide variety of plants in their daily lives for food, shelter, fuel, medicine and other necessities of life (Odhav et al., 2006). Historical accounts of traditionally used wild medicinal leafy vegetables depict that different types of these vegetables were used as early as 500BC in the Transkei (Lelekal et al., 2008). These plants are known as *Imifino* in Xhosa.

Imifino are plant species with the leafy parts, which may include young, succulent stems, flowers and young fruits used as vegetables (Jansen van Rensburg et al., 2007). They may grow wild in some areas but can be protected and managed by some famers in other regions or sometimes include agricultural botanical crossovers (Ogle, 2001). However, availability of these wild vegetables has declined drastically because of the cultivation of field crops, which includes the chemical elimination of wild vegetables and habitat change (Odhav et al., 2006). Wild medicinal leafy vegetables are those herbaceous plants whose parts including leafy parts, young, succulent stems, flowers and very young fruits are eaten as supporting food or main dishes and they may be aromatic, bitter or tasteless and have medicinal value (Mensah et al., 2008; Jansen van Rensburg et al., 2007). Wehmeyer and Rose (1983) have identified more than 100 different plant species that are used as vegetables in South Africa. The Eastern Cape Province is endowed with a variety of traditional vegetables and different types are consumed by the various ethnic groups for different reasons (Mensah et al., 2008).

In the Eastern Cape Province, most people are aware that *Imifino* are wild edible plants but mostly the elderly women realize that these plants are highly nutritious and

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are also of medicinal importance (Mbangata et al., 1983). The use of wild medicinal leafy vegetables is an important component of the diet of people throughout sub-Saharan Africa as they are a rich source of micro-nutrients (Nesamvuni et al., 2001; Steyn et al., 2001). Consumption of these wild leafy vegetables can serve as the major source of vitamins and micro-nutrients for the people using only vegetarian diets rich in carbohydrates, either by choice or by prescription (Misra et al., 2008; Flyman and Afolayan, 2006). The actual value of these plants in the diet of an individual is dependent on a variety of factors, for example frequency of consumption, method of preparation or cooking, freshness and amounts eaten (Shackleton, 2003). However, these plants should be picked with care because some of their Xhosa names are interchangeable with those poisonous or inedible plants or because in some times of the year these plants are toxic, for example, some species of the genus *Solanum*, with special reference to *Solanum nigrum* with which the fruits are poisonous when unripe (Wehmeyer and Rose, 1983).

Most of these wild medicinal leafy vegetables are seasonal while some of them are available throughout the year and can be consumed as a side dish or mixed with maize meal. In some cases, the leaves can be dried in order to be preserved for use throughout the season of unavailability. This compensates shortages in food supply considering the recent economic climate and food prices. When drying leaves, they must not be exposed to the sun since some active compounds or nutrients may evaporate and this then means that they must be green in colour when dry (Bhat and Rubuluza, 2001).

The project aims to document information gathered from rural dwellers of the O.R Tambo Municipality, Eastern Cape on wild leafy vegetables traditionally used as food and also as medicine. It also reports on the antibacterial properties of *Bidens bipinnata, Physalis peruviana, Rumex obtusifolius* and *Taraxacum officinale* which based on the information gathered, are the commonest plant species used for the treatment of various diseases.

MATERIALS AND METHODS

Ethnobotanical information

The collection of data was conducted within a period of 8 weeks in 2008. Prior to the study, most of the wild vegetable consumers were identified through a survey conducted among youth and elderly people from the study area. The survey was performed in seven sub municipalities of OR Tambo District which are Ntabankulu, King Sabata Dalindyebo, Nyandeni, Mhlontlo, Qaukeni, Port St Johns and Mbizana. Data collection was done in two phases; the first one was done through social conversation with some rural dwellers for familiarization. This facilitated the collection of baseline information on the use of wild plants as vegetables and other importance.

The second phase involved collection of information from consumers that included herbalists through general interviews and questionnaires. This included names of plants used as vegetables and medicine, the parts used, methods of preparation of plant material, personal experience of users as well as their perceptions on these traditional vegetables. Informed consent was always obtained before the start of every interview and appointments to conduct these were often made well in advance.

Collection of plant material

Plant materials were collected from their natural populations during organized tours through the fields while accompanied by herbalists or vegetable consumers. Only four plant species which were consistently identified as being used as vegetables and also as herbs to treat a particular ailment in several villages were collected. Photographs of some of those plants were taken and a comparison of the reported names and the actual plants was done. These plants were initially identified by their local names and proper identification was done using the Kei Herbarium of Walter Sisulu University. Voucher specimens (Jaca 01, Jaca 02, Jaca 03 and Jaca 04) were prepared and deposited in the Kei Herbarium.

Extraction of plant materials

Four plants namely, *B. bipinnata, P. peruviana, R. obtusifolius* and *T. officinale* were air dried without direct exposure to the sun to avoid evaporation of some active compounds. They were then ground into powder using a laboratory blender. The plant material was ground into powder to give 50 g before extracting separately by shaking for 30 min in 700 ml (Afolayan and Meyer, 1997) and 850 ml of distilled water. The extracts were filtered through Whatman No.1 filter paper (Kambizi and Afolayan, 2001), and evaporated to dryness in a Rotavapour with water extract at 60°C and acetone at 35°C. This was done in order to avoid destroying some active compounds or secondary metabolites that may be sensitive to high temperatures. Dried plant extracts were redisolved in their respective solvents to the required concentrations.

Preparation of agar-extract plates

Nutrient agar was prepared by dissolving 14.88 g into 480 ml of distilled water, thoroughly mixed, autoclaved and allowed to cool to about 60°C before the addition of the extracts. The agar medium of 5 ml each containing the extracts (acetone or aqueous) at final concentrations of 0.1, 0.5, 1.0, 5.0 and 7.0 mg/ml were poured into Petri dishes and carefully swirled until the agar began to set and then left overnight to cool and also for the solvents to evaporate (Abu-Shanab et al., 2004; Aboaba et al., 2006). Agar plates containing 0.5 ml of either acetone or water were used as controls respectively.

Bacterial assay

Six species of bacteria were used for testing, three gram-positive (*Escherichia coli, Proteus vulgaris, Seratia marcescens*) and three Gram-negative (*Bacillus subtilis, Micrococcus kristinae, Staphylococcus aureus*) obtained from National Health Laboratory Services, Mthatha Academic Hospital. Each organism was maintained on nutrient agar plate and was recovered for testing by growth in nutrient broth for 24 h. The culture was diluted 0.5:50 with fresh sterile nutrient broth before testing. The organisms were streaked in radial patterns on the agar plates (Kambizi and Afolayan, 2001) and incubated at 37°C for 24 h. For an extract to be declared active, complete growth suppression was required.

RESULTS

Ethnobotanical information

A total of seven sub-municipalities within the Eastern Cape were visited and 35 persons that included both adults and the youth were interviewed. This study revealed 30 plant species belonging to 14 different families that are commonly used as vegetables, out of which four plant species were consistently and frequently reported to be used for both food and medicine. Some of these plants are documented in the studies done by Bhat and Rubuluza (2001) and Wehmeyer and Rose (1983). Four plant species which were available during the course of this study were prepared for antibacterial assays.

Wild medicinal vegetables seem to be widely and frequently used by the black population of the Eastern Cape. Most of the participants in this research reported that young generation do not like *Imifino* at all and they do not recognize them when they are in the wild. In this study, it has been found that the elderly females do not always go with their children when collecting the plants, which might be the reason why these children do not know the variety of the wild vegetables. The four plants reported to have medicinal properties in the study area are, *B. bipinnata, P. peruviana, R. obtusifolius* and *T. officinale.* Most villagers in the Eastern Cape reported that these plants have medicinal properties especially in the treatment of diarrhea, high blood pressure, arthritis, which are common diseases as well as common flu, sore throats and constipation (Table 1).

Antibacterial activity

The four plants were tested against bacteria that cause diseases in humans, based on the availability of plant material during the period of the investigation. Aqueous extracts of *B. bipinnata* and *P. peruviana* inhibited the growth of all the bacteria tested. Acetone extracts of *B. bipinnata* and *P. peruviana* inhibited all the Gram-positive bacteria with the minimum inhibitory concentration (MIC) ranging from 5.0 to 7.0 mg/ml (Table 2). Aqueous and acetone extracts of *R. obtusifolius* showed partial activity against *Serratia marcescens* at a concentration of 5.0 and 7.0 mg/ml respectively.

The antibacterial testing of the four species with medicinal potential indicates that some of these plants have antibacterial activity. It is worth noting that acetone extracts inhibited *B. subtilis* at a concentration as low as 0.5 mg/ml. However, the susceptibility of the Gram-negative bacteria, *E. coli, P. vulgaris* and *S. marcescens* to the extracts was not unexpected as in general; this class of bacteria is more resistant than Gram-positive bacteria. Both aqueous and acetone extracts of *T.officinale* and *R. obtusifolius* did not show much activity. This does not mean that these two vegetables have no medicinal value although they were not active against the organisms tested in these assays.

Further research on these medicinal vegetables could be done on other bacterial species that cause diseases in humans. It appears that the organisms were not as sensitive to the acetone extract as compared to the aqueous extracts as determined by the screening method. The reason for this could be that the plant extracts were filtered just after 24 h of mixture with acetone, they could need more time for compounds to concentrate and separate, or that at a concentration of about 10 to 15 mg/ml of the plant extracts would be active. These results are consistent with observations by Abu-Shanab et al. (2004). Growth of bacteria was observed in all the control plates indicating that the solvents of extraction were not responsible for antibacterial activity exhibited in this study.

DISCUSSION

The majority of people who still realize the importance of the wild vegetables are the elderly people while the youth still shun the consumption of these plants. This may be due to the fact that, their elders tend to cook more than one kind of these vegetables in one pot although children like a variety of foods every day. It may be suggested that, these vegetables must be cooked in different pots, exceptions given only to those that do not have appealing taste. Rural dwellers of the Eastern Cape are heavily dependent on wild vegetables as they form part of their diet.

Consumption of leafy vegetables by the local people is plausible because they are a source of food and form part of a primary health care delivery system. The exponential rise in prices of basic commodities presents difficult challenges for some rural people in the Eastern Cape to survive; therefore the use of these plants may alleviate the economic hardships. All the elderly and the traditional healers who contributed one information or the other during our ethnobotanical survey of wild vegetables used as food and for alleviation of various ailments in the study area were adequately financially rewarded with further verbal agreement that this research shall not be for commercial purposes but to serve as an enlightenment information to the community and the entire Eastern Cape Province.

The fact that there is a continual consumption of these wild medicinal leafy vegetables such as *B. bipinnata* and *P. peruviana* in the study area warrants a further research on their nutritional value (or nutrient analysis). People of the Eastern Cape Province may be benefiting inadvertently in the treatment of various minor ailments as they consume these vegetables. Some of these vegetables serve as immunity boosters (Bhat and Rubuluza, 2001). Work is in progress to investigate the

Table 1. Medicinal leafy vegetables used in the Eastern Cape Province, South Africa.

Family	Species name	Xhosa name	Habitat	Typical consumption
Asteraceae	*Sonchus asper*	Irhwabe lenyoka	Cultivated land	Regularly
Solanaceae	*Solanum nigrum*	Umsobo	Disturbed land, field	Regularly
Amaranthaceae	*Amaranthus paniculatus*	Unomdlomboyi, Umambumbu	Cultivated land	Regularly
Apiaceae	*Centella coriacea*	Unongotyozana	Cultivated land	Regularly
Asteraceae	*Bidens pilosa*	Umhlabangubo	Cultivated land, field	Regularly
Asteraceae	*Bidens bipinnata*	Uvelemampondweni, Uvelegoli	Cultivated land, field	Regularly
Brassicaceae	*Raphanus nasturtio aquatica*	Uwatana, chapani	River	Regularly
Urticaceae	*Urtica urens*	Ububazi	Forest	During famine
Scrophulariaceae	*Physalis viscosa*	Iguzu	Wild in disturbed areas	Regularly
Scrophulariaceae	*Physalis peruviana*	Igquzu	Cultivated land	Regularly
Acanthaceae	*Hypoestes aristata*	Uhlalani	River banks	Regularly
Urticaceae	*Obelia tenax*	Ugcamchi, uluzi	Forest	Occasionally
Polygonaceae	*Rumex obtusifolius*	Idololenkonyane elibabayo	Cultivated land, close to river and moist areas	Regularly
Polygonaceae	*Rumex ecklonianus*	Idololenkonyane Elincane	Shady areas	Occasionally
Polygonaceae	*Rumex lanceolatus*	Idololenkonyane	Swampy areas and alongside dams and rivers	Regularly
Polygonaceae	*Rumex sagittatus*	Undenze	Disturbed areas	Occasionally
Asteraceae	*Taraxacum officinale*	Uqudalele	Shady areas, cultivated land	Regularly
Asteraceae	*Lactuca indica*	Intshebe yebhokwe	Cultivated land	Regularly
Cucurbitaceae	*Cucubis sp.*	Intshuku, uselentaka	Cultivated land, field	Regularly
Brassicaceae	*Raphanus raphinastrum*	Isiqwashumbe	Cultivated land	Regularly
Chenopodiaceae	*Chenopodium album*	Imbikicane	Cultivated land	Regularly
Asteraseae	*Galinsoga parviflora*	Unompontshane	Disturbed and cultivated land	Occasionally
Asteraceae	*Erigeron bonariensis*	Umva wamadodada	Disturbed areas	Occasionally
Amaranthaceae	*Amaranthus asper*	Isinama	Disturbed areas and in forests	Occasionally
Amaranthaceae	*Amaranthus dubius*	Imbuya	Cultivated lands	Regularly
Celastraceae	*Catha edulis*	Igwaka	Fields and forest	Occasionally
Solanaceae	*Solunum retroflexum*	Umsobo wehlathi, Umsotyana	Forest and along forest margins	Occasionally
Convolvulaceae	*Convolvulus arvensis*	Ibopha	Forests	Occasionally
Cyperaceae	*Mariscus cangestus*	Umkhwane	Disturbed areas and cultivated lands	Regularly
Araceae	*Zantedeschia aethiopica*	Intebe	Stream banks and damp areas	Regularly
Solanaceae	*Solanum nodiflorum*	Umsobosobo	Cultivated lands	Regularly

Table 2. Antibacterial activities of aqueous and acetone extracts of *B. bipinnata* (BB), *P. peruviana* (PP), *T. officinale* (TO) and *R. obtusifolius* (RO).

Bacterial species	Gram+/-	Extracts' [1]MIC (mg/ml)							
		Aqueous				Acetone			
		BB	PP	TO	RO	BB	PP	TO	RO
B. subtilis	+	1.0	5.0	7.0	na	0.5	Na	na	na
M. kristinae	+	7.0	5.0	5.0	na	1.0	Na	7.0	na
S. aureus	+	1.0	1.0	5.0	na	na	7.0	na	na
E. coli	-	1.0	5.0	1.0	na	5.0	7.0	na	na
P. vulgaris	-	1.0	1.0	5.0	na	5.0	5.0	na	na
S. marcescens	-	1.0	5.0	1.0	5.0	5.0	7.0	5.0	7.0

na: not active, [1]minimum inhibitory concentration (mg/ml).

possibility of synergistic effects of the medicinal vegetables against various bacteria.

Conclusion

This study revealed 30 species belonging to 14 different families that are commonly used as vegetables, out of which four plant species were consistently and frequently reported to be used for both food and medicine. Most of the participants in this research reported that young generation do not like wild vegetables despite their valuable use as food and herbal remedies. Most of the extracts used in this investigation exhibited great antibacterial potential. All the aqueous extracts from the selected plant species showed high antibacterial properties at concentrations ranging from 1.0 to 7.0 mg/ml. This may justify the use of these plants for the treatment of minor ailments as a primary health care delivery system in the Eastern Cape. This study indicates the potential of medicinal vegetables in the delivery of primary health care to the poor people who are facing the harsh economic crisis, in the advent of high cost of food and medical expenses.

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