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Review Paper

Wild vegetables in Northern KwaZulu Natal, South Africa: Current status of production and research needs

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South Africa is endowed with wide varieties of biodiversity among which are wild vegetable species of remarkable nutritious qualities like macro and micronutrients, minerals and vitamins. However, there is still a high prevalence of malnutrition; especially micronutrients deficiencies, a phenomenon described as hidden hunger, among low or marginal income bracket of the population. The use of wild vegetables has variously been proposed as part of the major solutions to solving the problems of micronutrient malnutrition among these populations. Unfortunately, the utilisation of wild vegetables among South Africans is in the decline due to over reliance on exotic species. The Agricultural Research Council of South Africa and other stake holders have conducted studies on some aspects of these vegetables. However, there are still a lot of information gaps in certain aspects of these important indigenous resources especially in northern KwaZulu, which need some research attention. Critical among these are: Population genetics of the species in the wild, agronomic evaluation under different growing conditions and phyto-chemical evaluation of these important species in order to encourage the overall use of these important indigenous resources.

Key words: Agronomy, chemical analysis, micronutrient deficiencies, northern KZN, population genetics, utilisation of wild vegetables.

INTRODUCTION

Hunger, malnutrition, diseases and rural poverty are some of the current challenges facing previously disadvantaged population in South Africa (Pauw, 2005). One of the major causes of malnutrition has been found to be vitamin and micronutrient deficiencies, a phenomenon described as hidden hunger (Tisdale et al., 1990). Usually the affected populations live in areas rich in highly nutritious wild vegetables which provide abundant nutrients which are also believed to have some medicinal values. South Africa is endowed with a wide variety of biodiversity (Reinten and Coetzee, 2002) among which is wild vegetable species of highly nutritious qualities like macro and micronutrients and vitamins (van den Heever, 1995). There is a general decline in the use of wild vegetables by many rural communities which may have resulted in increased incidences of nutritional deficiencies (van Rensburg et al., 2007; Modi et al., 2006; Madisa and Tshamekang, 1995). In Sub Saharan Africa, wild vegetables are important dietary components which are used to prepare sauces and relish that accompany carbohydrate staples like 'pap' in South Africa, 'sadza' in Zimbabwe, 'fufu' in West Africa and 'ugali' in east African countries.

Wild vegetables are locally available and therefore inexpensive for low income sectors of the economy. They are good sources of very important nutrients which play significant roles in nutrition, food security and serve as supplements for the management of nutrition related illnesses (Odhav et al., 2007; Steyn et al., 2001; van

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Rensburg et al., 2007; van Wyk and Gericke, 2000). In spite of the importance of these species in household food security in rural KwaZulu Natal (Modi et al., 2006), no information were found in literature about the production potential of wild vegetables in northern KwaZulu Natal. More empirical studies on the nutritional values of most utilised wild vegetable and their subsequent domestication may be an important step towards alleviating nutritional deficiencies among marginal input communities of the northern KwaZulu Natal (Mhlonto et al., 2007; Dovie et al., 2007).

The current work is a review of the production and utilisation status of wild vegetables in northern KwaZulu Natal with a view of suggesting potential research needs for these species in the region.

Socio-economic background of northern KwaZulu-Natal, South Africa

According to the National Census of 2001, KwaZulu Natal (KZN) Province has the highest population in South Africa, with 21.0% of the total population of the country. When the province's gross domestic product (GDP) was compared to its total share of the national population, it was revealed that the GDP is lower than the national average (Pauw, 2005; Mohamed, 2007). Agricultural households earn less than their non-agricultural counterparts, thus agricultural households are generally worse off. Poverty rates among agricultural households were found to be very high (81.2%) compared to non-agricultural households (49.5%). Poverty rates vary greatly between racial groups with the Africans (blacks) who constitute the bigger percentage of the population; and resident predominantly in rural communities of northern KwaZulu Natal, being the worst affected (poverty rate of 64.4%). Poverty is more in rural areas (78.2%) than in urban areas (28.9%). The province is still challenged by high level of poverty especially among the African communities. (Pauw, 2005; van den Heever, 1995; Modi et al., 2006)

PREVIOUS STUDIES AND CURRENT STATUS OF WILD VEGETABLES IN NORTHERN KWAZULU-NATAL

Several wild plant species are utilised as vegetables in KwaZulu-Natal, especially among the rural population. Studies have been conducted on the nutritional composition of wild vegetables in KwaZulu-Natal (Zobolo et al., 2008; Odhav et al., 2007; Modi et al., 2006; Faber et al., 2002). Some of these studies were centred on the collection of plant samples from the wild and analysing for various nutritional indicators like proximate analysis and mineral elements (Ndlovu and Afolayan, 2008; Odhav et al., 2007; Modi et al., 2006; Shackleton, 2003). There is no clear indication of the age of the species before collection or the prevailing local soil and environmental factors that might have influenced variations in constituents of these vegetables compared with exotic species. An assessment of wild vegetables collected in KwaZulu-Natal by Odhav et al. (2007) revealed that 12 out of 20 wild vegetables provided mineral concentrations exceeding 1% of plant dry weight, which is much higher than concentrations found in exotic vegetables like cabbage and spinach. These vegetables (*Amaranthus dubius, Amaranthus hybridus, Amaranthus spinosus, Asystasia gengetica, Cucumis metuliferus, Cleome monophyla, Ceratotheca triloba, Galinsoga parviflora, Justicia flava, Mormodica balsamina, Physalis viscosa* and *Wahlenbergia undulate*) were therefore recommended for cultivation (Odhav et al., 2007). The same study indicated that wild vegetables had significantly high levels of proximate composition, high energy and protein, good sources of fat, high fibre contents and high micronutrients like zinc. Good levels of zinc in the diet have been reported to improve health in different studies (WHO, 2000; Lonnerdal, 2003; Oyedele et al., 2006; Mochegiani and Muzzioli, 2000; Baum et al., 2003); and the use several wild vegetable has been reported for the management diseases (Mackraj, 2007).

Despite the obvious importance of these species, their cultivation is very uncommon compared with exotic species (Odhav et al., 2007; van Rensburg et al., 2007) and the chemical elimination of wild vegetables which are often considered as weeds (Lewu and Afolayan, 2009; Shackleton, 2003) could make their survival in the wild more precarious. The conservation of genetic materials within indigenous and wild vegetables has received little attention in research and development programmes (Shackleton, 2003; Skikkerveer, 1995). This omission has contributed to genetic erosion of potentially important genetic materials (Vorster et al., 2007; Schippers, 2002). In our opinion, lack of prioritisation by African governments and other stakeholders in terms of research is the major reason for genetic erosion of this species (Shackleton, 2003; Adebooye and Opabode, 2004). The condition of genetic erosion is made worse by the fact that not too many users of the species (through wild collection) are prepared to cultivate them. Previous efforts in the promotion of wild vegetables by The Vegetable and Ornamental Plant Institute of The Agriculture Research Council of South Africa (ARC-VOPI) in collaboration with International Institute of Plant Genetic Resources Institute, (IPGRI) has been reported (van den Heever, 1995; Venter et al., 2007). This effort did not include any research in the collection, domestication and promotion of wild vegetable species in the northern KwaZulu Natal.

Previous studies on leafy vegetables have been conducted in universities and research institutes which

focused on routine cultivation of exotic crops (Keller et al., 2005). Although, some studies have been conducted on some aspects of wild vegetables, our literature search has revealed that these studies have been done at academic institutions based on the interest of researcher rather than a coordinated effort to domesticate and commercialise wild vegetables. For instance, our informal communication with the Agricultural Research Council and the genebank of National Department of Agriculture has indicated that there are very limited collections of wild vegetable accessions (e.g. *Corchorus olitorius*) from the whole country and there is no single genetic material on wild vegetables from northern KwaZulu Natal is held in the national genebank. There is equally no information on the morpho-genetic characterisation, agronomic and chemical evaluation of species and the effects of cooking and processing on chemical composition and nutritional value of these species. As a result, there are many gaps in knowledge with respect to production requirements of wild vegetables; and most importantly, the knowledge of the genetic pool of the species in this region is unknown. These gaps range from lack of germplasm from which genetic material for the development of new cultivars and improvement of current varieties can be obtained, to lack of information on germination requirements and agronomic practices. The worth of wild vegetables can only be fully appreciated if they are genetically and agronomically characterised. These basic empirical studies have not been documented for northern KwaZulu Natal.

SUGGESTIONS FOR FUTURE RESEARCH NEEDS

Genetic evaluation and taxonomic studies

The collection of germplasms of cultivated plant species and their wild relatives are essential to plant breeding research. However, the replacement of local varieties by exotic species has been identified as a major source of genetic erosion of indigenous species (FAO, 1998). Presently, there are very limited conservation efforts conducted on wild vegetables in northern KwaZulu-Natal.

Genetic evaluation will facilitate establishment of genebanks from where breeders can obtain the accessions to breed improved varieties. There is very little information on genetic variability, areas cultivated or propagation methods. Non-availability of genetically improved seed has been reported to be a major constraint to the few wild vegetables that are presently under cultivation elsewhere (Adebooye et al., 2005). Morpho-genetic evaluation could therefore, aid in selection for desirable traits. For instance, if astringency, (which is an undesirable trait) can be linked to certain morphological traits, then selection against astringency becomes simplified. Morphological descriptors for wild vegetables are also not available and this makes it difficult for morphological characterization. There is need, therefore, for a systematic and comprehensive genetic evaluation of all the wild vegetable species to facilitate crop improvement and to develop genebanks and information databases for use by scientists.

The local taxonomy of wild vegetables varies greatly but they are collectively known as ‘imfino’ in ‘isiZulu’ (van Rensburg et al., 2007). However, the name ‘imfino’ is also used to identify certain species of these wild vegetables as well as domesticated vegetables like cowpeas (*Vigna unguiculata*) and pumpkins (*Cucurbita* spp.). For instance, in our preliminary studies around Melmoth in northern KwaZulu-Natal, respondents identified *Bidens pilosa* as ‘imfino’; yet in other villages, it is known as ‘uqadolo’ and the name ‘imfino’ is a collective term for all wild vegetables. This is a clear indication that local nomenclature of wild vegetable species varies from place to place or between communities in the same locality within northern KwaZulu Natal. It is important that wild vegetables are correctly identified by their botanical and local names. The correct classification of these species could form the basis for the identification of variation in nutrients among cultivars within a species (Smith and Ezyaguirre, 2007).

Agronomic studies

Agronomic evaluation could lead to better understanding of the best cultural practices for increased yields and improved nutritional values. Little is known about the response of these species to fertilisers’ requirements and other agronomic practices (Dzerefos et al., 1995). The assumption that the production of these species under improved agronomic practices would enhance the nutrition of promising cultivars is worth proper empirical studies. Research in other crops have indicated that mineral fertiliser can lead to improved quality in terms of proximate and chemical composition; but the effects of fertiliser on chemical composition of most wild vegetables especially in the rural marginal soils of northern KwaZulu Natal is not known due to lack of research. As a result, published information on the production of wild vegetables in the region is not known. A study on *Gynandra gynandropsis* by Chweya (1995) indicated that fertiliser application significantly improved field establishment and increased leaf yield. Fertiliser (organic and inorganic) increased crude protein content, although it decreased beta carotene, ascorbic acid and iron. The challenge posed by the increase and drop in the chemical composition of these species needs further studies to better understand best practices for optimal genetic performance of wild vegetables.

On-and-off-season production and processing studies

There is a dearth of literature on the response of wild

vegetables to season of production as most of these species do not readily grow during winter in the sub-tropics. In fact, no single literature is available on the potential of these species in the cropping systems of northern KwaZulu Natal. However, some of these wild vegetables are found on irrigated plots occurring as weeds during winter. This could possibly be a typical case of well adapted accessions with great potential for off-season production. These few naturally occurring accessions could be collected as potential germplasms for further evaluation for winter season production in the region.

The easy perishability of wild vegetables poses major challenges with their storage, distribution and marketing (van Rensburg et al., 2007; Medisa and Tshamekang, 1995). In South Africa, drying is the major method of processing leafy vegetables to make them available during periods of scarcity (Vorster et al., 2007). Whilst drying solves the problem of perishability, it does not satisfy the needs of a large population of consumers, particularly urban dwellers who prefer freshly harvested vegetables (Smith and Ezyaguirre, 2007). Effect of prolonged cooking and drying on the nutritional status of all the species also need urgent research attention. In other vegetable species, especially the exotic cultivars, it is well documented that drying and storage for longer periods destroys vitamin C. Other constituents that are destroyed or altered are yet to be established. If processing has the potential to impair the composition of these vegetables, there is need to explore ways of propagating these wild vegetables during the off-season so that fresh wild vegetables are always available (Vorster et al., 2007). A study by Modi et al. (2006) at Ezigeni, KwaZulu –Natal revealed that the availability of wild vegetables suddenly declined in May and became scarce between July and August and only increased as the season progressed from August to October. The sudden manner in which these vegetables become unavailable leaves many vulnerable families exposed to hunger between the months of May to November. There is, therefore, need to explore the feasibility of cultivating different wild vegetables throughout the year in order to ensure continuous availability.

Chemical composition studies

There is a need for chemical analysis of conventionally edible plants parts of these species. This study could be compared with other parts of the shoot. For instance, if the stem contains more nutrients than leaves then consumers could be advised to consume the young tender stem as well as the leaves. This study could be linked to the effect of plant age on chemical composition. It is suggested that chemical analysis includes phenols, proximates, mineral elements, tannins and antinutritional factors like phytate. Vegetables may be rich in mineral nutrients but these nutrients are not easily available (bio-availability) due to antinutritional factors like phytate and tannins. Studies have shown that the mineral contribution of vegetables to human nutrition is limited due to the presence of antinutrients (Lewu et al., 2009). The most common antinutritional factors in indigenous leafy vegetables are phytate, tannins, hydrocyanic acid and oxalic acid (Akwaowo et al., 2000). In plants, phosphorus is mainly stored in the form of phytate and is therefore abundant. Phytate has the ability to bind with polyvalent mineral ions like Zn^{2+}, Fe^{2+} and Ca^{2+} to form an insoluble precipitate. As a result of this precipitate, these ions are not absorbed into the bloodstream (Lonnerdal, 2003; Gupta et al., 2006). This suggests that while laboratory results might indicate that vegetable leaves are rich in certain elements, these elements may actually not be able to contribute to the nutrition of humans. Wild vegetables need to be characterized on the basis of antinutritional factors and where possible, molecular markers could be used to aid in the selection for low antinutritional levels and other undesirable characteristics.

CONCLUSIONS

Wild vegetables are highly nutritious and have great potential to alleviate malnutrition in marginal sectors of the community and also to enhance nutrition among communities with better income level. They have the potential for commercialisation if comprehensive studies on their production practices are undertaken. Some research work has been undertaken in South Africa on some aspects of wild vegetables production but more research is needed if the worth of these wild indigenous species is to be fully realised. There is need for coordinated research on wild vegetable in South Africa, which focuses on well established objectives for optimum utilization of the species. We have suggested some areas for research need but this is not an exhaustive study. Many other areas will come up as these vegetables are increasingly grown; for example, plant pests and diseases problems germination studies and nursery requirements and postharvest technology are many areas that could help improve use of the species. There is also need to promote these vegetables among the youth and urban folks and change the perception that they are food for the poor and hard times only. There is practically no work conducted on the wild vegetables in northern KwaZulu Natal. Effort to put together a coordinated research in this direction will help improve the nutrition of the communities under review.

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