

INDIGENOUS NAMIBIAN LEAFY VEGETABLES: A LITERATURE SURVEY AND PROJECT PROPOSAL

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ABSTRACT

The leaves of wild growing herbs consumed as spinaches are an important component of most rural Namibian diets. A large number of species are utilised in this way, but *Cleome gynandra*, *Amaranthus thunbergii* and *A. dinteri* are the most well known and widely used species. Little research has been done on this subject. This paper summarises the information available in the literature and identifies research needs in Namibia. A project to conserve and evaluate local germplasm and investigate the feasibility of cultivation of these species, will be embarked upon.

INTRODUCTION

The leaves of wild growing, indigenous plants are often used as vegetables by rural people (Van den Heever, 1995; Mpuchane and Gashe, 1998; Shackleton *et al.*, 1998; Matlhare *et al.*, 1999). Namibia is no exception. There are a large number of species that are used as leafy vegetables, but three species, viz. *Cleome gynandra*, *Amaranthus thunbergii* and *A. dinteri* are the most widely used in the entire country and among most ethnic groups (Dinter, 1912; Malan and Owen-Smith, 1974; Rodin, 1985; Van den Eynden *et al.*, 1992; Kakujaha-Matundu, 1996; Von Koenen, 1996; Sullivan, 1998).

In the predominantly carbohydrate-based diet of rural Namibians, protein, vitamins and minerals found in green leafy vegetables are often lacking, causing malnutrition and various health problems (Van den Heever, 1995; Auwalu and Tenebe, 1997; Madisa and Tshamekang, 1997; Mathenge, 1997; Blench, 1997). These wild vegetables usually appear at the first rains and are fast growing, so that they are available for harvest before the cultivated staple crops, thus filling a gap in food production (Matlhare *et al.*, 1999). Dietary patterns have changed considerably with urbanisation. Rural households consume indigenous leafy vegetables more frequently than urban households (Otto, 1979; Benhura and Chitsiku, 1991). Promotion of the consumption of leafy vegetables would thus serve to improve the nutritional status of rural people and the expansion of existing local trade would contribute to a higher standard of living (Hauptli and Jain, 1978). Cultivation, improved processing and storage and commercialisation of these species may lead to bigger markets in cities and towns (Otto, 1979).

Cultivation of exotic vegetables often requires more input than poor rural households can afford (van den Heever, 1995; Blench, 1997). There are a number of indigenous vegetables that do not require high inputs and are already known to rural people through harvesting from the wild. Development and more extensive use of these species should be encouraged.

This would then also contribute towards higher agro-biodiversity in crop systems, which is not only desirable from a conservation point of view, but increases food security at the household level (Blench, 1997).

Despite the evident importance of indigenous vegetable species, hardly any research has been done on them internationally (Hauptli and Jain, 1978; Chweya and Mnzava, 1997), and none in Namibia. It is for this reason that the author will start a research project on leafy vegetables in Namibia in the year 2000. This paper represents a summary of existing knowledge on the subject obtained from the literature and outlines the objectives of the proposed research.

CLEOME GYNANDRA L.

Cat's whiskers, spider flower (English); ombidi, omdidi (Oshikwanyama); omboga (Oshindonga); ombowa, ombowa yozongombe, ombowayozondu (Herero); !khauro.b, #hobo#hobo, !hunihai.b, gomabeb, goma|horo.b (Damara/Nama) (Malan and Owen-Smith, 1974; Rodin, 1985; Kakujaha-Matundu, 1996; Von Koenen, 1996; Sullivan, 1998; P. Craven, pers. comm.)

Cleome gynandra belongs to the family Capparaceae. There are 15 species of *Cleome* indigenous to Namibia, *Cleome gynandra* being the only white-flowered taxon among the yellow- and pink-flowered species (Craven, 1999) and the only species that is reported to be consumed by humans.

The species is not formally divided into subspecies or varieties, but there is some variation within the species. The most striking variation observed in Namibia is a difference in smell. Within one population of morphologically similar plants, aromatic and non-aromatic individuals may be found (H. Kolberg, pers. obs.; P. Craven, pers. comm.). It is strange that this has never been reported in the literature.

C. gynandra is a C₄ species, which are generally characterised by rapid growth and high dry matter production - three to five times more per unit leaf area and unit time than C₃ plants (Waithaka and Chweya, 1991). In *C. gynandra* this can partly be attributed to the diheliotropic leaf movements ensuring maximum exposure to sunlight for maximum photosynthesis (Rajendruru *et al.*, 1996). This is a mechanism commonly found in plants that need to complete their life cycle rapidly before the onset of drought (Rajendruru, 1996), as is the case in Namibia.



Figure 1. *Cleome gynandra*

DISTRIBUTION AND HABITAT

The species is naturally widespread worldwide (most of Africa, Middle East, southern Asia) and has been introduced to almost all parts of the world (Chweya and Mnzava, 1997). In Namibia, it occurs practically throughout the country (Figure 2).

It can be considered a ruderal species that is commonly found where manure or household refuse accumulates (Dinter, 1912; Shackleton *et al.*, 1998) and may be abundant in cultivated fields (Rodin, 1985). Plants tolerate low temperatures but prefer temperatures of 18°C to 25°C. *C. gynandra* cannot tolerate excessive drought, which causes plants to flower while as small as 10cm high and produce only a few, small leaves (Waithaka and Chweya, 1991; H. Kolberg, pers. obs.).

USES

Leafy Vegetable

The leaves and young shoots are cooked and eaten (Dinter, 1912; Watt and Breyer-Brandwijk, 1962; Malan and Owen-Smith, 1974; Rodin, 1985; Von Koenen, 1996). *C. gynandra* is often cooked mixed with other species, e.g. *Sesuvium sesuvioides* or *Amaranthus* spp. (von Koenen, 1996). Studies in Namibia revealed that this dish is eaten up to three times per week (Kakujaha-Matundu, 1996) while studies in the Lowveld of South Africa report it being consumed six to seven times per week (Shackleton *et al.*, 1998).

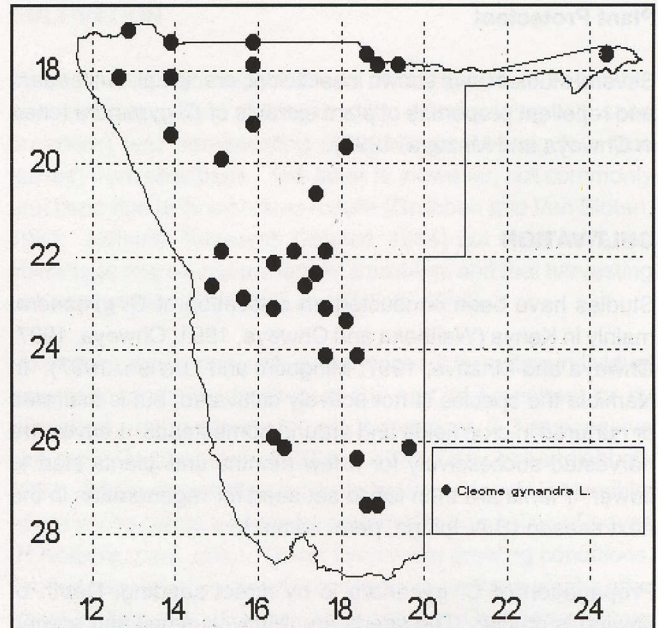


Figure 2. Geographical distribution of *Cleome gynandra* in Namibia.

Cooked leaves may be dried into flattened cakes (*omavanda*) and stored for consumption during the drier months or sale at markets (Malan and Owen-Smith, 1974; Rodin, 1985). In Namibia, as in other African countries, *C. gynandra* being sold on local markets, provides an income for the poor and unemployed, often women who are the only breadwinners of rural households (Kakujaha-Matundu, 1996; Chweya and Mnzava, 1997; Nekesa and Meso, 1997; H. Kolberg, pers. obs.).

Kakujaha-Matundu (1996) calculated a value of N\$1 131.36 per season (December to March) for a household of 16 heads. He based this calculation on the 1993 prices of commercially available spinach and a consumption of the vegetable three times per week. Shackleton *et al.* (1998) reported that vendors of dried leafy vegetables in the Lowveld of South Africa on average earned approximately R413 per month with the maximum found to be R2063.

Medicinal

There are numerous reports of medicinal use of *C. gynandra* leaves and seeds elsewhere, but in Namibia its use as a medicinal species is not widely known (Waithaka and Chweya, 1991; Chweya and Mnzava, 1997; Van den Heever, 1997, 1999). Von Koenen (1996) mentions that an infusion of the roots is used to ease childbirth.

Forage

The plant is browsed by livestock and game (Chweya and Mnzava, 1997; Sullivan, 1998; Matlhare *et al.*, 1999; H. Kolberg, pers. obs.). In other parts of the world, a polyunsaturated oil is extracted from the seeds and the oil cake fed to livestock (Chweya and Mnzava, 1997).

Plant Protectant

Several studies have shown insecticidal, aracidial, antifeedant and repellent properties of plant extracts of *C. gynandra* (cited in Chweya and Mnzava, 1997).

CULTIVATION

Studies have been conducted on cultivation of *C. gynandra*, mainly in Kenya (Waithaka and Chweya, 1991; Chweya, 1997; Chweya and Mnzava, 1997; Mingocho and Luchen, 1997). In Namibia the species is not actively cultivated, but is tolerated or nurtured in crop fields and around homesteads. Leaves are harvested successively for a few months until plants start to flower. Plants are then left to set seed for regeneration in the next season (S.A. Ipinge, pers. comm.).

Propagation of *C. gynandra* is by direct seeding. Depth of sowing is crucial. The seeds are relatively small and sowing them too deep will result in uneven emergence (Waithaka and Chweya, 1991; Chweya and Mnzava, 1997). Seed is either broadcast or drilled in rows. Seedlings emerge 6-8 days after sowing. About three weeks after emergence, plants are thinned. The uprooted seedlings can be used as vegetable (Waithaka and Chweya, 1991; Chweya and Mnzava, 1997). Leaves are harvested successively about 4-6 weeks after emergence (Chweya and Mnzava, 1997). Cutting back or pinching will result in branching and delay of flowering, thus giving a higher and longer yield of leaves. Harvest may last up to five weeks (Chweya and Mnzava, 1997). With the application of manure, cumulative leaf yields of up to 30 t ha⁻¹ were achieved with maximum weekly yield being reached about seven weeks after emergence (Chweya and Mnzava, 1997).

AMARANTHUS THUNBERGII MOQ. AND AMARANTHUS DINTERI SCHINZ

Ethnobotanical studies carried out in Namibia, generally have found one common name for all the species of *Amaranthus*.

Pigweed, cockscomb (English); /horob, =/khaubeb ||hâube.s, ||gâ ube.s, =/aube, |hai ||gâube.b (Nama/Damara); embodilityaana, ekwakwa (Oshikwanyama); mboga (Kwangali); ombowa yakozondu, ombowa yozongombe, omunandi (Herero); !oe!oeha (Kung) (Dinter, 1912; Malan and Owen-Smith, 1974; Rodin, 1985; Van den Eynden *et al.*, 1992; Von Koenen, 1996; Sullivan, 1998; P. Craven, pers. comm.)

A. thunbergii and *A. dinteri* are morphologically very similar herbs belonging to the family Amaranthaceae. In Namibia, these two species both seem to be used. The most reliable characteristic in distinguishing these two species is the presence of long crisped hairs on at least the younger parts of *A. thunbergii* - even though they may be very sparse (Brenan, 1981). There are eight species of *Amaranthus* in Namibia, of which four are naturalised aliens (Craven, 1999).

Like *C. gynandra*, *Amaranthus* spp. also use the C₄ carbon fixation pathway which makes them adapted to high light



Figure 3. Seedlings of *Amaranthus thunbergii*.

intensities and temperatures and drier conditions (National Research Council, 1984; Zheleznov *et al.*, 1997). According to Blunden *et al.* (1999), the genus *Amaranthus* is also a betaine accumulating genus. Betaines aid adaptation to saline and dry conditions. *Amaranthus* is probably the vegetable that can produce the highest amounts of protein and dry matter per unit area per unit time - about 1.6g protein.m⁻².day⁻¹ (Messiaen, 1994).

DISTRIBUTION AND HABITAT

The genus *Amaranthus* is common worldwide. In the tropics and subtropics of both the Old and New World, it is often cultivated, but is also a common weed in cultivated fields (Brenan, 1981). In more temperate regions it may also be found as a sporadic weed (Townsend, 1988). While the grain amaranths originated in the New World, the vegetable types have their origin in the Old World (Hanelt, 1967).

A. thunbergii is widespread in Africa, from Ethiopia southwards to South Africa. It has also been introduced into Europe and

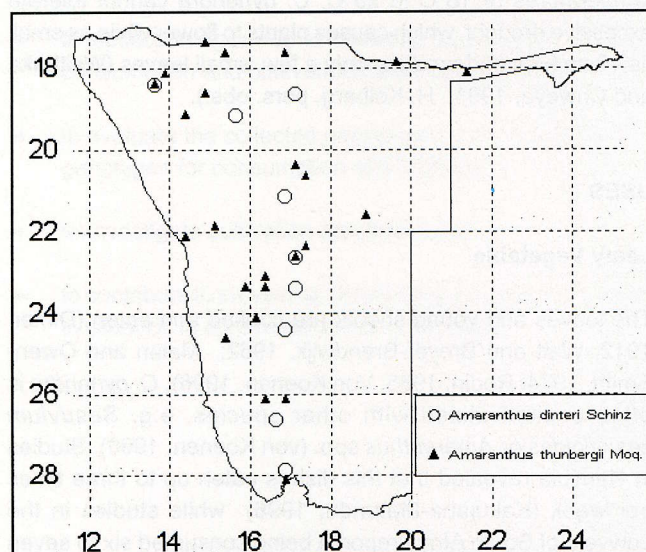


Figure 4. Geographical distribution of *Amaranthus thunbergii* and *A. dinteri* in Namibia.

Australia (Townsend, 1988). In Namibia, it occurs practically throughout the country (Figure 4). *A. dinteri* seems to be confined to South Africa, Namibia and Botswana (Brenan, 1981). In Namibia it has thus far been recorded from the central and western parts only, excluding the eastern Kalahari areas, Okavango and Caprivi (Figure 4). *A. thunbergii* is found at altitudes from sea level to 1400m (Townsend, 1988). Both species often occur in disturbed soil, cultivated land or seasonally wet areas (Townsend, 1988). Both species are often found in association with *Cleome gynandra* in fields or cattle pens where manure accumulates (H. Kolberg, pers. obs.).

USES

Leafy Vegetables

A number of *Amaranthus* spp. are being used as leafy vegetables worldwide (Sauer, 1967; Campbell and Abbott, 1982; Mapes *et al.*, 1997). In Namibia, this use has been recorded for both *A. thunbergii* (Malan and Owen-Smith, 1974; Rodin, 1985; Kakujaha-Matundu, 1996) and *A. dinteri* (Dinter, 1912; Van den Eynden *et al.*, 1992; Von Koenen, 1997), but it is possible that only one of them is used and that both species are recorded due to misidentification. It is recorded that stems and leaves or young, 5-6-leaved seedlings are eaten, cooked in salted water or dried after cooking for later consumption (Van den Eynden, 1992; Von Koenen, 1997). *Amaranthus* spinach is supposed to be preferred over spinach from *Cleome gynandra* by the Herero (Kakujaha-Matundu, 1996). Malan and Owen-Smith (1974) report it to be a delicacy among the Herero-speaking peoples of the Kaokoveld and that dried cakes may be traded.

Fodder

Watt and Breyer-Brandwijk (1962), Malan and Owen-Smith (1974) and Sullivan (1998) report that *A. thunbergii* is eaten by cattle and goats.

Leaf Protein Isolates

The protein in *Amaranthus* leaves is reported to be easily extractable and can be refined to provide a high quality protein concentrate. This is, however, species dependent and needs further investigation (National Research Council, 1984).

Plant Protectant

Blunden *et al.* (1999) report the presence of betaines in several *Amaranthus* species. Application of betaines in low concentrations to plants, enhance their ability to resist fungi and root knot nematodes considerably.

Medicinal

Watt and Breyer-Brandwijk (1962) report that *A. thunbergii* is used by Tswana to stimulate delayed childbirth. Kakujaha-Matundu (1996) lists crushed *A. thunbergii* leaves as being used like a plaster on wounds. Sullivan (1998) summarises non-Namibian medicinal uses.

CULTIVATION

Three commonly used methods of cultivation of vegetable amaranths are direct sowing in rows, direct sowing with seed broadcast and transplanting of seedlings (bearing four true leaves) from seedbeds. The latter is, however, not commonly practised due to its laborious nature (Grubben and Van Sloten, 1981; National Research Council, 1984) but does have the advantage that weeds are less of a problem and that harvesting can start earlier (Campbell and Abbott, 1982).

Harvesting can be done either successively by cutting individual leaves or ratooning (cutting of top part of branches) or by uprooting young plants (single harvest or 2-3 successive harvests) (Grubben and van Sloten, 1981; Campbell and Abbott, 1982). When *Amaranthus* is harvested from the wild in Namibia, whole young plants seem to be preferred to harvesting of leaves (H.Kolberg, pers. obs.). Under favourable growing conditions, the first harvest of young plants can be done three weeks after transplanting or four weeks after sowing (Grubben and van Sloten, 1981).

In hot climates *Amaranthus* is a fast growing crop which can potentially yield up to 40 t ha⁻¹ of fresh leaves in as little as 3-5 weeks after sowing (Grubben and van Sloten, 1981; National Research Council, 1984). Average yields are between 4 and 14 t ha⁻¹. In the tropics, harvests can last for up to 6 months (National Research Council, 1984).

NUTRITIONAL VALUES

A number of studies have compared the nutritional value of *C. gynandra* and *Amaranthus* spp. with that of exotic vegetables (Chweya, 1985; Waithaka and Chweya, 1991; Chweya and Mnzava, 1997). Table 1 summarises the findings of nutritional studies done on uncooked leaves. Several other constituents have been isolated from leaves, the most important being listed in Table 2.

Amaranth leaves are reported to have a very mild taste and are often preferred above other wild vegetables, which may have a strong taste (National Research Council, 1984). Because of the high dry-matter content of amaranth leaves, an equivalent amount often provides 2 to 3 times the amount of nutrients than that of other leaf vegetables (National Research Council, 1984). Like most dark green leafy vegetables, amaranths also contain some antinutrients like oxalic acid (National Research Council, 1984). Nitrate and oxalic acid content of amaranth leaves is, however, comparable to that of other, commonly eaten leafy vegetables (Grubben and van Sloten, 1981). Cooking breaks down most of the nitrates while oxalic acid is dissolved in the cooking water (National Research Council, 1984).

The methods of preparation, drying and storage should be investigated to minimise the loss of nutrients in the process (Rodin, 1985; Waithaka and Chweya, 1991) and minimise contamination with bacteria and fungi which were found at high levels in dried leaf cakes in Botswana by Mpuchane and Gashe (1998).

Table 1. Nutritional composition of *Cleome gynandra* and *Amaranthus* spp. compared to exotic vegetables

Vegetable	Vit. A mg/100g	Vit. C mg/100g	Iron mg/100g	Calcium mg/100g	Protein g/100g
<i>Cleome gynandra</i>	6.7 - 18.9	127 - 484	1 - 18.8	213 - 434	3.1 - 7.7
<i>Amaranthus</i> spp.	5.3 - 8.7	92 - 159	4.1	288 - 800	4.0 - 4.3
Spinach	2.8 - 7.4	1 - 59	0.8 - 4.5	60 - 595	2.3 - 3.1
Cabbage	tr. - 4.8	20 - 220	0.5 - 1.9	30 - 204	1.4 - 3.3
Lettuce	0.2 - 7.8	3 - 33	0.5 - 4.0	17 - 107	0.8 - 1.6
Pumpkin leaves	2.4 - 5.3	170 - 172	2.1	40	3.1 - 4.2

Adapted from: Arnold *et al.*, 1985; Chweya, 1985; Wehmeyer, 1986; Waitthaka and Chweya, 1991; Chweya and Mnzava, 1997; Mnzava, 1997.

Table 2. Composition of *Cleome gynandra* and *Amaranthus* spp. leaves

Nutrient	<i>Amaranthus</i> spp. range of values	<i>Cleome gynandra</i> range of values
Crude fibre (%)	2.6	1.3 - 1.4
Carbohydrates (%)	3.7	4.4 - 6.4
Potassium (mg /100g)	351	410
Magnesium (mg/100g)	124	86
Sodium (mg/100g)	13.3	33.6
Phosphorus (mg/100g)	62.1	12
Zinc (mg/100g)	0.72	0.76
Copper (mg/100g)	0.26	0.46
Oxalate (mg/100g)	-	8.8
Total phenolics (mg/100g)	-	520 - 910

From: Arnold *et al.*, 1985; Wehmeyer, 1986; Chweya and Mnzava, 1997

RESEARCH NEEDS

Various authors have identified gaps in existing research internationally (National Research Council, 1984). For Namibia, however, no research on these species has been done and some basic aspects need to be researched whereas some adaptive research, using results from other species or different environments, needs to be done.

- Collection and screening of germplasm is one aspect that needs attention in Namibia. Local material has to be conserved and evaluated for its agronomic potential.
- The ethnobotany of these species in Namibia has been researched on a superficial level. More information may be available from yet unstudied ethnic groups or areas and on aspects of nurturing of these species similar to a crop.
- Cultivation practices known from elsewhere should be investigated for their adaptability to the Namibian environment.
- New or alternate uses of these species, or developing them into a multi-use crop, need to be investigated.
- Methods of processing and storage need to be studied to minimise the loss of nutrients.

- The feasibility of marketing of these vegetables in urban areas needs to be looked at.

OBJECTIVES OF RESEARCH PROJECT

The objectives of this research project are:

- to collect and conserve germplasm of *Cleome gynandra* and *Amaranthus thunbergii* and *A. dinteri* from their entire distribution area in Namibia,
- to collect indigenous knowledge associated with the consumption and cultivation/nurturing of these species,
- to evaluate the collected germplasm, identifying superior genotypes for consumption and cultivation,
- to investigate cultivation practices, and
- to contribute to improving, diversifying and sustaining rural livelihoods in communal areas of Namibia.

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