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Legacy of the chameleon: Edible wild plants in the kingdom of Swaziland, Southern Africa. A cultural, ecological, nutritional study. Part IV - nutritional analysis and conclusions

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LEGACY OF THE CHAMELEON: EDIBLE WILD PLANTS IN THE KINGDOM OF SWAZILAND, SOUTHERN AFRICA. A CULTURAL, ECOLOGICAL, NUTRITIONAL STUDY. PART IV — NUTRITIONAL ANALYSIS AND CONCLUSIONS

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This paper presents proximate analysis, protein and mineral values for 29 important wild plant species consumed in Swaziland. Leaf protein ranged from 1.30-7.50 %; the highest values were from the genera *Grewia, Momordica* and *Pouzolzia.* High calcium sources were *Corchorus* spp., *Grewia* spp. and *Pouzolzia parasitica.* Plants with a high iron concentration included *Corchorus* spp., *Ipomoea* sp. and *Zantedeschia* sp. Wild leaves were the main dietary accompaniment to maize porridge in 39 % of 133 meals analyzed. The traditional Swazi method for preparing leaf side-dishes with cooking ash may remove vitamins of the B-complex and ascorbic acid.

Wild plants play an essential role in Swazi diet; more than 220 species are commonly consumed. Many plants are restricted ecologically to narrow ranges. The Highveld exhibited the greatest abundance of edible leaves; while the Lowveld had the greatest diversity of edible fruits. So-called edible "weeds-of-agriculture" were most prominent in the Middleveld. Swazi schoolchildren have maintained their familiarity with, and use of, edible wild species. This is because attending modern schools necessitates walking long distances between ecological zones or boarding within an ecological zone different than the family residence. Edible wild plants should be considered a vital component of Swazi diet. They contribute to maintaining nutritional quality throughout the nation.

KEY WORDS: Africa, edible wild plants, food habits, gathering, nutrition, proximate analysis, Swazi, Swaziland.

"— *We are now sick because we no longer eat wild, dug foods. Those were first class to our health* —".
"— *The wild foods you eat for the blood to function, not to fill the stomach* —".
(Swazi interviews)

INTRODUCTION

Previous papers in this series (Ogle and Grivetti, 1985a; 1985b; 1985c) have presented data on traditional Swazi diet, the identification, distribution and use of edible wild plants within four ecological zones of Swaziland, and cultural practices associated with the identification, procurement and preparation of wild plants as food. This paper presents data on the protein and mineral content for the most important wild edible plants in Swaziland. It assesses also the relative dietary importance of wild plants in Swazi diet. The place of edible wild plants in contemporary Swaziland, a nation that is undergoing rapid agricultural and technological development is discussed.

FIELD SETTING AND GENERAL METHODS†

The Kingdom of Swaziland, southern Africa, was selected for field work because the physical setting and cultural composition of the nation represents an exciting opportunity to investigate the environmental-cultural factors associated with food procurement and the role of edible wild plants in ethnic diet. Swaziland is culturally homogeneous; the population is 90 % ethnic Swazi. The country, however, is diverse ecologically and characterized, botanically, by four distinct vegetation zones: Highveld, Middleveld, Lowveld and Lubombo.

Botanical and food habit field sites were representative of each of the four ecological zones. Data were obtained from 211 adults and 140 school children. Botanical specimens for taxonomic identification and nutrient analysis were obtained by cash purchase from respondents, purchase from local vegetable vendors, donations from respondents obtained at time of interview and systematic specimen collection by the research team.

NUTRIENT ANALYSIS

Multiple specimens of the 29 most commonly consumed species (total sample number = 49) were collected and prepared for nutrient analysis. Samples included 44 green leafy vegetables, 3 fruits and 2 edible plant hearts or stalks. All specimens were considered representative and normal for consumption by Swazi respondents.

The total specimen weight was determined, then representative samples of 50-100 g were prepared. These were oven dried for 24 hours at 80°C. to determine the nutrient values on a moisture content basis. Dried residues were ground using a Wiley mill. Crude protein was determined by nitrogen analysis by Markham distillation apparatus and Micro-Kjeldahl technique (AOAC, 1970). All samples were analysed in duplicate and protein levels calculated using a conversion factor of 6.25.

The proportion of ash was determined in 1-12 g samples of ground plant material by standard techniques (ADAC, 1970) in a muffle furnace at 600°C. Ashed samples were transported to the University of California, Davis, where mineral analysis was conducted at the Crocker Nuclear Laboratory using an X-ray fluorescence technique (Becker, 1969).

RESULTS AND DISCUSSION

The moisture content of the edible leaves ranged from 26.5 % (*Grewia* sp.) to 6.7 % (*Portulaca oleracea*). Such variation is normal in leaf material depending on the stage of plant maturity and the ratio of leaf to stalk, stem or shoot (Table I).

The crude protein content of leaf samples varied considerably, ranging from 1.3-7.5 % with an average of 4.0 % (±1.34) for leafy vegetables. The relatively high values for *Grewia* spp. (5.6 %), *Momordica* spp. (7.5 % and *Pouzolzia parasitica* (6.1 %) were noteworthy. Low protein concentrations were reported for all samples of *Asclepias* spp. (2.2 %), *Portulaca oleracea* (2.1 %) and *Sonchus oleraceus* (2.2 %).

† Cultural and geographical details of the Kingdom of Swaziland, detailed field methods and sample selection are provided in Part One of this series (Ogle and Grivetti, 1985a).

TABLE I
Moisture and protein content of selected wild plants consumed in Swazilang (%)

Latin Term	Siswati Term	Zone	Specimen Description	Month Collected	Moisture %	Crude Protein[a] %	
Amaranthus spp.	Imbuya	HV	Immature leaves and shoots	October	11.06	5.06	
	Imbuya	LU	Immature leaves and shoots	November	11.78	4.29	
	Imbuya	LU	Immature leaves and shoots	November	12.72	3.87	
					11.85	4.41	MEAN
					± 0.68	±0.49	
Amaranthus spinosus	Imbuya batfwa	LU	Immature leaves and shoots	November	17.65	4.59	
Amaranthus flagelli-folia	Sibdhaze	HV	Leaves and stems	October	19.89	4.18	
	Sibdhaze	HV	Leaves and stems	October	20.93	3.33	
					20.41	3.76	MEAN
					± 0.52	±0.43	
Asclepias sp.	Umdzayi	LU	Young leaves	November	13.26	2.20	
	Umdzayi	MV	Mature leaves	December	14.74	2.14	
					14.00	2.17	MEAN
					± 0.74	±0.03	
Bidens pilosa	Chuchuza	HV	Young leaves		15.08	4.74	
	Chuchuza	HV	Leaves and shoots		11.96	3.98	
	Chuchuza	HV	Leaves and shoots		10.34	3.86	
					12.46	4.19	MEAN
					± 1.97	±0.39	
Chenopodium album	Imbillikicane	LU	Leaves only	November	12.48	4.42	
	Imbillikicane	MV	Mature leaves	December	16.78	4.29	
					14.65	4.36	MEAN
					± 215	±0.07	
Commelinacae africana	Lidzangaman	MV	Immature leaves	December	9.11	2.39	
Corchorus spp.	Ligusha	HV	Immature leaves	November	21.96	3.96	
	Ligusha	LU	Immature leaves	November	21.91	4.68	
	Ligusha	LU	Immature leaves	November	21.23	5.29	
					21.70	4.64	MEAN
					± 0.33	±0.54	
Grewia sp.	Liklolo	HV	Mature leaves	October	24.42	4.06	
	Liklolo	HV	Mature leaves	October	21.71	5.74	
	Liklolo	HV	Mature leaves	October	24.31	5.74	
	Liklolo	HV	Mature leaves	October	26.48	6.81	
					24.23	5.59	MEAN
					± 1.69	±0.98	

TABLE I continued

Hibiscus trionium	Inyawolenkukhu	HV	Immature shoots	October	13.06	3.29	
Ipomoea sp. prob. coscinosperma	Umdzandzabuka	LV	Mature leaves	December	14.18	3.65	
Laportea pedumentaris	Bubati/Lubati	MV	Mature leaves	October	15.88	4.78	
Momordica foetida	Inshubaba	HV	Mature leaves	October	15.61	5.77	
	Inshubaba	MV	Leaves and shoots	December	19.03	3.74	
					17.31	4.76	MEAN
					± 1.71	±1.02	
Momordica involucrata	Inkakha	LU	Leaves only	November	20.85	7.51	
Ophioglossum engelmannii	Sankunshane	HV	Immature leaves	October	9.64	3.58	
	Sankunshane	HV	Immatureleaves	October	12.61	3.56	
	Sankunshane	HV	Immature leaves	December	11.78	2.74	
					11.34	3.29	MEAN
					± 1.25	±0.39	
Peucedanum magelies-montanum	Sibhadze	HV	Leaves and stems	November	22.78	3.31	
Portulaca olearcea	Selele	HV	Immature leaves and shoots	November	6.89	2.20	
	Selele	LU	Immature leaves and shoots	November	6.70	2.07	
					6.80	2.14	MEAN
					± 0.10	±0.07	
Pouzolzia parasitica	Zombodze-mandundu	HV	Young leaves	November	13.94	6.10	
Riocreuxia sp.	Umshunko	HV	Young leaves	October	13.28	5.06	
Solanum nigrum	Umsobo	LU	Leaves and young shoots	November	13.60	4.64	
	Umsobo	LU	Leaves and young shoots	November	12.66	4.78	
					13.13	4.71	MEAN
					± 0.47	±0.07	
Sonchus oleraceus	Ingabe/Lihabe	LU	Young leaves, stems, flowers	November	13.59	2.76	
	Ingabe/Lihabe	LU	Young leaves, stems, flowers	November	13.28	2.73	
	Ingabe/Lihabe	MV	Leaves and stems	December	7.66	1.30	
	Ingabe/Lihabe	MV	Mature leaves	December	10.12	2.04	
					11.16	2.21	MEAN
					± 2.44	±0.60	
Zantedeschia sp.	Umdzebedzebe	HV	Mature leaves	October	12.42	3.33	
??	Sicibilinjawane	LV	Young leaves and shoots	December	17.91	3.73	
??	Umvukushane	LU	Young leaves	November	15.21	5.09	

TABLE I continued

FRUITS						
Mimusops obuvata	Umpushana	LU	Ripe fruits, large	November	32.41	1.37
Mimusops zeyheri	Umpushana	LU	Ripe fruits, small	November	31.54	1.60
Sarcostemma viminale	emaphoti	LU	Pods, mature, large	November	11.97	1.36
OTHERS						
Aloe cooperii	Lisheshelu	HV	Stem, lower inner stalk	November	3.72	0.46
Aloe saponaria	Emahala	HV	Hearts, lower inner stalk	November	5.87	0.49

[a] % Crude protein of wet plant material: N% × 6.25.

Amino acid patterns were not determined in the present study. Santos Oliveira and Fidalgo de Varvalho (1975) and Shanley and Lewis (1969), however, reported on the following species in our collection: *Amaranthus caudatus, Amaranthus spinosus, Bidens pilosa, Corchorus tridens, Corchorus trilocularis* and *Portulaca oleracea.* Their data indicated that there were low levels of methionine and cystine, but relatively high levels of lysine in all species. Such a pattern would complement the composition of maize protein; and simultaneous consumption of these leafy vegetables with maize (*Zea mays*), the common Swazi staple, would improve the biological value of maize protein. Thus, while the overall concentration of protein in Swazi wild edible leafy vegetables may appear low, their dietary contribution may be significant, especially during the pre-harvest season when food supplies from cultivated or domesticated sources are minimal.

Individual and mean values for macro-nutrient and trace minerals of nutritional importance are presented in Table II. The Calcium content ranged from 25.7 mg/100g edible portion in *Aloe cooperii* to 922.7 in *Zantedeschia* sp. Comparatively high levels were also found in *Corchorus* spp. (340.8), *Grewia* spp. (341.9) and *Pouzolzia parasitica* (317.2). Species with relatively low calcium values included *Ophioglossum engelmannii* (29.7), *Portulaca oleracea* (54.5), and all the fruits and aloes analyzed.

Potassium levels were generally high in our leafy samples and ranged from 669.1 mg/100 grams edible portion for *Chenopodium album* to 161.0 mg in *Sonchus oleraceus.* Potassium content for *Zantedeschia* was too high to be recorded by the methods of analysis used.

Iron content of leaves varied greatly and ranged from 4.2 mg/100 grams edible portion in *Riocreuxia* sp. to a remarkably high 45.6 in *Zantedeschia* sp. Other high values were found in *Corchorus* spp. (42.7) and *Ipomoea* sp. (35.2). Low values were documented for *Ophioglossum engelmannii* (5.4) and *Portulaca oleracea* (6.4). Intra-species variation was especially large for iron and suggests wide differences in iron availability or plant uptake at different collection sites.

Selected trace minerals also varied widely. Zinc levels ranged from 0.44 mg/100 grams edible portion in *Portulaca oleracea* to 1.77 in *Annesorhiza flagellifolia.* Other high zinc species included *Grewia* spp. (1.70) and *Corchorus* spp. (1.60). Low zinc values included *Pouzolzia parasitica* (0.60) and *Riocreuxia* sp. (0.60). Manganese concentrations ranged from 0.28 mg/100 grams edible portion in *Ophioglossum engelmannii* to 5.59 in *Amaranthus spinosus.* Other species with a high manganese content were *Annesorhiza flagellifolia* (5.05) and the unidentified leaf called *umvukushane* (5.23). Low manganese species included *Portulaca oleracea* (0.37) and *Momordica foetida* (1.00). Copper levels were high in *Zantedeschia* sp. (0.64), *Grewia* spp. (0.58) and the unidentified leaf called *sicibilinjwane* (0.49).

With the exception of iron, these data compare well with previously published values (Leung, 1968; Fox, 1966; Lewis, Shanley, and Hennessy, 1971; Quin, 1959; Shanley and Lewis, 1969; and Wehmeyer, 1971). Iron values for species reported in Table II, however, were generally higher than those previously published.

Dietary Role and Nutritional Value of Edible Wild Species

Edible wild plants, whether the "edible weeds of agriculture" or bushland-forest species, generally receive only modest attention by scientists or administrators when surveying, evaluating and deciding issues of agricultural development and nutritional planning. Our results sugget that the dietary use of wild plants is not minor in

TABLE II
Mineral and trace element content of selected wild Swaziland edible plants. (mg/100g fresh, wet plant material)

Latin Terminology		Ash % D.M.	Calcium	Potassium	Iron	Copper	Zinc	Manganese	Chlorine	Sulphur	Chromium	Nickel	Molybdenum	Vanadium
LEAVES														
Amaranthus spp.		17.46	59.67	131.23	9.89	0.06	0.68	0.75	6.85	3.49	0.18	0.07	0.26	0.26
		21.36	249.30	238.28	8.99	0.22	1.17	1.01	26.43	21.73	0.54	0.2	0.85	0.83
		20.53	204.94	280.22	24.54	0.31	1.75	2.27	19.03	25.05	0.83	0.16	0.15	1.21
	Mean:	19.8	171.3	216.58	14.47	0.20	1.20	1.34	17.42	16.76	0.52	0.14	0.42	0.77
	±	1.68	80.99	62.73	7.13	0.10	0.44	0.66	8.09	9.48	0.33	0.07	0.38	0.48
Amaranthus spinosus		14.8	200.16	306.18	27.61	0.29	1.56	5.49	61.05	49.7	1.18	0.32	1.72	1.71
Annesorhiza flagelli-folia		9.8	247.74	278.14	13.07	0.32	1.50	4.08	88.18	15.29	0.37	0.17	0.48	0.55
		9.25	222.3	240.19	8.8	0.32	2.04	6.01	54.85	15.84	0.37	0.10	0.17	2.09
	Mean:	9.52	235.02	259.17	10.94	0.32	1.77	5.05	71.52	15.57	0.37	0.14	0.33	1.32
	±	0.28	12.7	18.98	2.14	0.00	0.27	0.97	16.67	0.28	0.00	0.05	0.22	1.08
Asclepias spp.		10.69	131.19	214.32	5.34	0.19	0.42	1.31	126.38	9.09	0.32	0.10	0.46	0.47
		12.43	162.65	276.95	21.10	0.23	0.65	2.75	161.41	13.15	0.60	0.25	0.33	0.42
	Mean:	11.56	146.92	245.64	13.22	0.21	0.54	2.03	143.9	11.02	0.46	0.18	0.4	0.45
	±	0.87	15.73	31.32	7.88	0.02	0.12	0.72	17.52	2.03	0.2	0.11	0.09	0.04
Bidens pilosa		11.65	123.47	349.24	13.52	0.56	1.54	2.55	30.8	15.96	0.38	0.15	0.51	0.94
		12.47	116.52	308.88	14.42	0.39	0.88	1.74	32.77	10.07	0.48	0.09	0.33	0.43
		12.49	91.11	247.67	14.64	0.33	1.11	1.16	11.29	9.48	0.18	0.15	0.21	0.37
	Mean:	12.20	110.37	301.93	14.19	0.43	1.18	1.82	24.95	11.84	0.35	0.25	0.35	0.58
	±	0.39	13.91	41.76	0.48	0.1	0.27	0.57	9.69	2.93	0.15	0.22	0.15	0.31
Chenopodium album		23.77	125.91	669.37	9.58	0.17	0.78	1.35	59.47	12.61	0.28	0.09	0.43	0.42
		20.45	125.27	602.91	12.58	0.24	0.56	3.25	41.62	9.11	0.38	0.15	0.32	0.56
	Mean:	22.01	125.59	636.14	11.08	0.21	0.67	2.3	50.55	10.86	0.33	0.12	0.38	0.46
	±	1.76	0.32	33.23	1.5	0.04	0.09	0.95	8.9	1.75	0.07	0.04	0.08	0.06
Commelineceae africana		17.54	81.10	287.59	10.69	0.13	0.64	1.01	28.61	14.34	0.34	0.14	0.47	0.5
Corchorus spp.		11.01	276.75	363.44	21.03	0.35	1.59	1.10	15.58	24.54	0.55	0.22	0.79	0.81
		10.64	453.68	325.10	42.91	0.53	1.69	3.37	24.99	45.59	1.39	0.43	1.99	3.84
		12.33	291.94	457.56	64.11	0.42	1.54	4.59	57.68	29.18	0.75	0.28	0.95	2.8
	Mean:	11.33	340.79	382.03	42.68	0.43	1.61	3.02	28.69	33.07	0.9	0.31	1.24	2.48
	±	0.73	80.07	55.65	17.59	0.07	0.06	1.45	12.49	8.98	0.44	0.11	0.65	1.54
Grewia spp.		10.39	296.05	363.62	16.3	0.61	1.45	3.01	50.17	48.38	0.65	0.26	0.74	0.96
		9.94	310.88	277.48	16.34	0.51	1.37	1.59	30.93	15.67	0.57	0.17	0.81	1.02
		8.70	355.76	299.31	11.49	0.51	1.55	2.55	49.24	26.73	0.6	0.25	0.87	0.99

TABLE II continued

		9.87	405.01	357.15	18.55	0.68	2.27	2.81	52.73	32.62	0.74	0.31	0.54	1.31
	Mean:	9.73	341.93	324.39	15.67	0.58	1.66	2.49	45.47	25.85	0.64	0.25	0.74	1.07
	±	0.62	42.54	36.88	2.58	0.07	0.36	0.54	8.66	6.26	0.07	0.06	0.14	0.16
Hibiscus trionium		13.5	200.08	342.44	10.04	0.37	1.01	1.69	99.65	13.19	0.46	0.19	0.34	0.68
Ipomoea sp. prob. *coscinosperma*		17.87	166.56	428.1	35.42	0.22	0.65	1.52	35.25	8.91	0.44	0.18	0.57	0.64
Laportea pedumentaris		14.67	300.23	258.21	15.45	0.10	0.65	1.90	64.47	18.87	0.46	0.19	0.34	0.67
Momordica foetida		9.42	74.53	270.67	19.7	0.17	0.49	0.81	12.23	9.40	0.23	0.06	0.3	0.39
		12.59	183.45	448.48	27.87	0.17	0.73	1.18	32.33	12.35	0.44	0.15	0.61	0.62
	Mean:	11.01	128.99	359.58	23.79	0.17	0.61	1.0	22.28	10.89	0.34	0.11	0.46	0.51
	±	1.59	54.46	88.91	4.09	0.00	0.12	0.19	10.05	1.48	0.15	0.06	0.22	0.16
Momordica involucrata		10.15	205.36	312.88	9.33	0.16	1.21	2.63	41.66	25.23	0.63	0.18	0.41	1.14
Ophioglossum engelmannii		11.72	33.31	251.31	8.36	0.17	1.04	0.41	55.44	6.21	0.11	0.06	0.2	0.2
		9.6	29.59	234.22	2.56	0.15	0.65	0.20	53.68	3.36	0.11	0.05	0.07	0.16
		8.75	26.08	170.73	5.19	0.14	0.33	0.24	41.36	6.63	0.15	0.06	0.22	0.22
	Mean:	10.02	29.66	218.94	5.37	0.15	0.67	0.28	50.16	5.41	0.12	0.06	0.16	0.19
	±	1.25	2.95	34.85	2.37	0.01	0.29	0.09	6.26	1.46	0.02	0.01	0.08	0.03
Peucedanum magalies-montanum		10.87	221.26	567.05	11.83	0.21	1.04	2.68	175.01	24.77	0.54	0.32	0.78	0.79
Portulaca oleracea		21.1	63.47	301.84	6.59	0.16	0.83	0.38	33.16	5.52	0.13	0.05	0.14	0.2
		22.93	45.57	288.95	6.23	0.14	0.04	0.35	24.85	13.41	0.3	0.18	0.44	1.1
	Mean:	22.02	54.5	295.4	6.41	0.15	0.44	0.37	23.63	9.47	0.22	0.12	0.29	0.65
	±	0.92	8.95	6.45	0.18	0.01	0.4	0.02	10.22	3.95	0.12	0.09	0.21	0.64
Pouzolzia parasitica		14.58	317.23	308.3	14.02	0.35	0.6	3.96	98.4	31.88	0.73	0.25	0.55	1.09
Riocreuxia sp.		10.75	95.65	258.89	4.17	0.24	0.6	2.33	27.76	8.59	0.19	0.04	0.1	0.27
Solanum nigrum		13.56	167.39	315.8	16.51	0.26	0.89	1.00	27.48	18.92	0.43	0.18	0.61	0.63
		14.35	152.82	235.01	32.33	0.36	1.78	1.49	52.4	8.38	0.98	0.48	0.5	0.74
	Mean:	13.96	160.11	275.41	24.42	0.31	1.34	1.25	39.9	13.65	0.71	0.33	0.56	0.69
	±	0.4	7.29	40.4	7.91	0.04	0.45	0.25	12.46	5.27	0.39	0.21	0.08	0.08
Sonchus oleraceus		12.1	196.02	665.04	18.98	0.5	1.66	2.88	255.56	11.77	0.27	0.06	0.33	0.42
		11.35	90.46	260.08	9.34	0.2	0.6	1.32	139.87	11.28	0.25	0.11	0.36	0.37
		17.95	101.27	160.99	4.89	0.14	0.29	0.21	151.12	21.49	0.14	0.08	0.1	0.21
		16.43	128.83	253.2	7.62	0.23	0.63	0.88	109.63	22.27	0.29	0.12	0.2	0.42
	Mean:	14.46	129.15	334.8	10.21	0.27	0.8	1.32	164.05	16.7	0.24	0.09	0.25	0.3
	±	2.8	41.07	194.62	5.31	0.14	0.52	0.98	54.97	5.19	0.07	0.03	0.12	0.12
Zantedeschia sp		13.07	922.78	a	45.59	0.64	5.53	44.44	512.35	50.08	1.06	0.39	2.73	1.58
Sicibilinjawane		15.15	137.83	505.76	29.78	0.49	1.37	4.14	35.78	38.44	0.82	0.57	0.87	1.19
Umvukushane		10.86	169.03	208.71	15.47	0.3	0.71	5.23	23.35	18.44	0.43	0.1	0.61	0.63

FRUITS													
Mimusops obuvata	2.43	31.67	136.01	2.6	0.04	0.1	0.43	41.99	3.4	0.08	0.02	0.1	0.11
Mimusops zeyheri	2.4	46.11	149.6	2.62	0.07	0.16	0.95	32.27	10.15	0.22	0.11	0.32	0.32
Sarcostemma viminale	7.66	53.86	196.26	2.5	0.09	0.21	1.85	21.07	10.29		0.24	0.1	0.39
OTHERS													
Aloe cooperii	13.52	25.72	98.46	1.15	0.06	0.15	1.2	61.21	3.91	0.09	0.08	0.06	0.12
Aloe saponaria	11.89	62.05	66.39	1.01	0.07	0.15	0.8	28.24	8.05	0.13	0.05	0.19	0.19

[a] Too high for recording in analysis.

TABLE III

Comparisons of the nutrient energy content of selected cultivated and edible wild plants consumed in Swaziland (per 100g edible portion)

CROPS	kJ	Energy Kcal	Moisture %	Protein %	Ash %	Calcium mg	Phos-phorus	Iron mg	Carotene mcg	Thiamin mg	Ribo-flav.	Niacin mg	Ascorbic acid, mg
Zea mays unsifted meal	1697	353	12.2	9.3	1.3	17	218	4.2	25	0.3	0.08	1.8	3
Brassica oleracea	125	26	91.4	1.7	0.8	47	40	0.7	100	0.04	0.04	0.3	54
Cucurbitaea pepo													
leaves	129	27	89.2	4.0	2.2	477	136	0.8	3600	—	0.06	0.32	80
fruit	110	23	92.6	1.0	0.8	25	32	1.4	3565	0.05	0.02	0.5	8
Solanum lycopersicum	101	21	93.5	1.0	0.5	10	24	0.6	450	0.06	0.04	0.6	26
Spinacia oleracea	125	26	90.6	2.1	1.8	61	46	1.7	—	0.03	0.27	—	46
amaranthus spp.[a]	202	42	88.25	4.41	2.4	171	103	14.5	5616	0.05	0.42	1.2	64
Bidens pilosa[a]	206	43	87.5	4.2	1.5	340	67	14.2	1800	—	—	—	—
Corchorus spp.[a]	278	58	79.3	4.6	2.5	360	122	42.7	6410	0.15	0.58	1.2	80

[a] Source of information, if not from present study, Leung, 1968.

Swaziland. Indeed, the Swazi exhibit a sustained dietary use of edible wild plants in traditional diet. To evaluate the nutritional importance of these species, however, an assessment must take into account four major factors:

Nutrient comparison of wild and domesticated species. The nutritive contribution of wild species can be directly compared to vegetables cultivated today in Swaziland, and especially against the Swazi dietary staple, maize. Table III reveals that the nutritional composition of *Amaranthus* spp., *Bidens pilosa* and *Corchorus* spp., is noteworthy and compares well with cultivated species such as pumpkin (*Curcurbitae pepo*) and spinach (*Spinacia oleracea*).

Biological availability of nutrients. The nutritional contribution of foods may be assessed against the biological availability of component nutrients. Plant foods, whether cultivated or wild, may contain factors that interfere with absorption of nutrients. Of specific importance is the relationship between oxalic acid content and calcium availability. Oxalic acid, present in many wild and domesticated green leafy vegetables, forms insoluble crystals with calcium, thus preventing absorption. Data have not been published on oxalic acid content of wild plants consumed in Swaziland. Inferences, suggesting probable high oxalate levels for a number of Swaziland species, may be based on studies from Nigeria by Oke (1966), the Philippines by Bendana-Brown and Lim (1958) and South Africa by Walker, Walker and Wadwalla (1975). Data presented in these papers suggest the probability of low calcium availability in many Swazi species, especially *Chenopodium album* and *Portulaca oleracea.* According to Watt and Breyer-Brandwijk (1962), the oxalic acid content of *Zantedeschia* spp. is sufficiently high to cause mouth and throat irritation if consumed in large quantities. One can speculate that a common Swazi Highveld complaint, that *Zantedeschia* "scratches the throat when swallowed," may be due, in part, to the irritating effects of calcium oxalates.

Thus, while specific compositional data are lacking, it is possible that consumption of certain edible wild leaves in large quantities could have an adverse effect on calcium availability. The effect, however, should be similar when greens from domesticated, cultivated species are consumed also in high quantity. We conclude that if edible wild plants are used in moderation, within a balanced dietary pattern typical of Swaziland today, the bioavailability of nutrients should not be adversely affected.

Frequency of consumption. During follow-up visits with 43 Swazi adults, dietary intake data representing 177 meals were obtained. Figure 1 plots respective food intake frequencies of eight food categories: cereals, fats, meat, fish, dairy, legumes, vegetables and other.

Food patterns based on discussion and two-day recall techniques revealed that the food most frequently consumed was *liphalishi* (stiff maize porridge prepared from equal amounts of maize meal and water). Swazi adults reported the use of *Amaranthus* spp., *Bidens pilosa* and *Corchorus* spp., with only minor reference to other wild leaves. Wild vegetables were reported as the principal accompaniment to maize porridge in 39 % of 133 main meals surveyed. Such consumption frequencies compare favorably with those for cultivated vegetables; wild food use was less frequent than tomatoes and onions, but more frequent than cabbage, potatoes, domesticated or cultivated spinach or pumpkin. Such a frequency pattern clearly demonstrates the important dietary role wild foods play in complementing the maize staple.

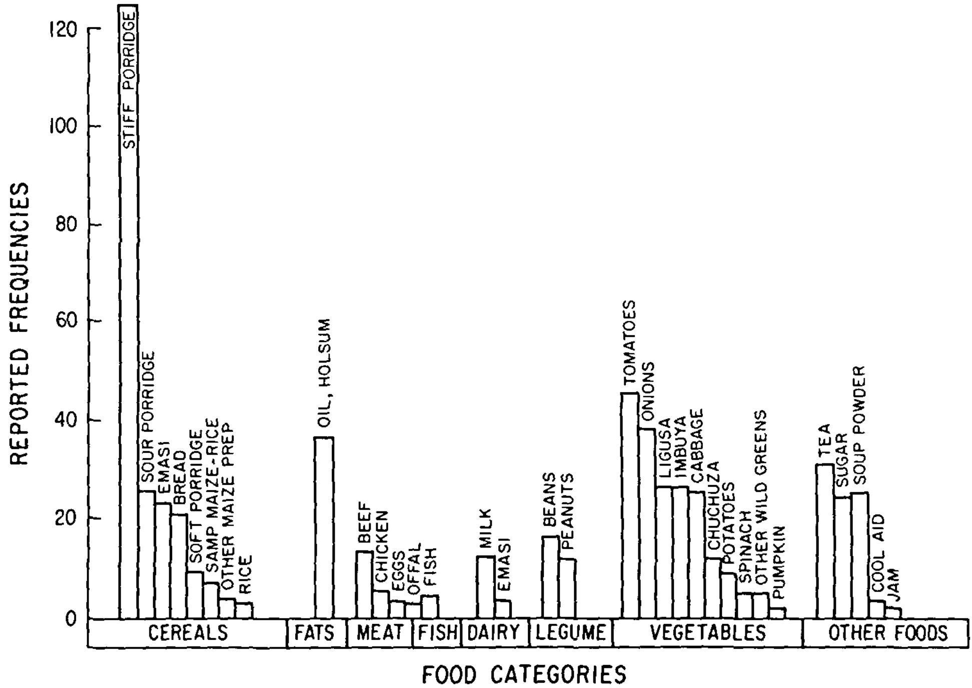

FIGURE 1 Food consumption frequency: 43 households (177 meals)

Quanities of edible plants consumed. Estimated quantities used per serving of green leafy vegetables are presented in Table IV. These data are based on amounts prepared by 65 women for their families. No adjustment has been made for variation in serving size between adults and children.

A significant difference appeared when comparing customary serving quantities of wild leafy plants prepared as *timbidvo* (plural *umbidvo*) and *ligusha.* (For differentiation and preparation technique, see Ogle and Grivetti, 1985a). On average, a serving of *umbidvo* contained 90.1 grams fresh leaf material; a serving of *ligusha* only 28.3 grams.

Typically, *umbidvo* is boiled for 15-30 minutes and served in the cooking water, thus conserving water-soluble vitamins, unless old and unusually bitter specimens were used. In such circumstances the water is discarded. More fibrous leaves, used traditionally to make *ligusha,* are softened by cooking in ash water or baking soda. While many of the species used to prepare *ligusha* relish have a high nutrient content, the Swazi method of preparation probably reduces nutrient availability, since adverse effects of ash or baking soda on ascorbic acid and B-complex vitamins are well documented (Griswold, 1962). Yet preparation of *ligusha* makes available edible plants that otherwise might be too fibrous or too hard in texture to be considered palatable. Ash, too, contributes trace elements to the diet.

The intake of wild fruits and their specific nutritional contribution to Swazi diet is difficult to quantify since most wild fruits are used as snacks. Fruits usually are consumed away from the homestead when working or walking in the bushveld. On the basis of the data of Ogle and Grivetti (1985b), and considering the overall Swazi diet, wild fruits appear to be a major source of ascorbic acid during winter

TABLE IV
Amounts of selected relishes consumed by 65 Swazi families (amounts per serving)

	N	Raw weight grams per serving
UMBIDVO: Leaves to be boiled for relish	65	
MEAN		90.9 (±45.1)
MEDIAN		85.0
Range		16.4-200
LIGUSHA: Leaves to be boiled with ash water or cooking soda	14	
Mean		28.3 (±9.0)
Range		10.0-43.3

and early summer. Furthermore, wild fruits serve as the typical snack food for children in all ecological zones, a dietary practice that should be encouraged.

Data presented in this four-part series illustrate how a stable agricultural population, largely dependent on small scale farming but increasingly supported by cash income, continues to exploit wild food resources. More than 220 wild species, from 56 botanical families, were currently consumed by respondents (Table V). Some green leafy vegetables, fruits and other plants are consumed frequently by the majority of Swazi and can only be classified as central, integral components of diet (Ogle and Grivetti, 1985b). Many edible leaves provide variety to the diet and supply essential nutrients that otherwise may be in short supply during spring and early summer months when few domesticated cultivars are ready for harvest. This important role of edible wild leaves, in relation to other dietary components, is clearly demonstrated by respondents who claimed no alternative plant foods were available during early summer. Certain genera including *Amaranthus*, *Bidens* and *Corchorus*, were used frequently by two thirds of the study population. Additionally, 20 leafy species were reported as being frequently used by at least 50 % of adults in at least one ecological zone.

High levels of plant recognition and use were reported by respondents; all consumed wild plants (n = 351). While a major dietary role clearly is played during spring and early summer by green foliage species, use of wild foods all year was reported by 56 % of the Swazi interviewed. Not infrequently, most favored species of wild plants were preferred over domesticated/cultivated alternatives.

Other edible wild plants filled a more peripheral dietary function. Some fruits and vegetables, familiar only to a few respondents, were consumed only occasionally. Nevertheless, the recognition value of these lesser species is valuable, since they can serve as food resources in times of need.

Area-specific food plants of major dietary importance were associated with each of the four ecological zones. The Highveld exhibited a great abundance of green leafy vegetables and other species. The temperate climate of this location delays the growth and harvest of domesticated cultivars; but early, abundant rain allows climatically adapted wild flora to complement food resources. More intense use of wild plants during spring and early summer, together with a higher than average frequency of vegetable and fruit purchases, currently maintains the food supply of Highveld residents.

In the Lowveld, where agricultural production is difficult and yields frequently low, wild food resources serve an important dietary function. Here, low and unpredictable rainfall often causes a shorter than average growing season for cultivated

TABLE V
Swazi edible wild plants

Family	Latin Term	Siswati Term	Portion Used	Seasonality
SPECIMENS COLLECTED				
Agaricaceae	Psalliota campestris	Likhowe	Cap; Stem	Oct-Jan
Amaranthaceae	Alternanthera sessilis	Imbuya	Leaves, young shoot	Oct-Feb
Amaranthaceae	Amaranthus caudatus	Imbuya	Leaves, young shoot	Oct-Feb
Amaranthaceae	Amaranthus hybridus	Imbuya	Leaves, young shoot	Oct-Feb
Amaranthaceae	Amaranthus spinosus	Imbuya batfwa	Leaves, young shoot	Oct-Feb
Amaranthaceae	Amaranthus thunbergii	Insheke	Leaves, young shoot	Oct-Feb
Amaryllidaceae	Cyrtanthus bicolor	Ummpimpiliza	Flower	Sept
Amaryllidaceae	Cyrtanthus breviflorus	Ummpimpiliza	Flower	Sept
Amaryllidaceae	Cyrtanthus galpinii	Ummpimpiliza	Flower	Sept
Amaryllidaceae	Cyrtanthus stenanthus	Ummpimpiliza	Flower	Sept
Amaryllidaceae	Cyrtanthus tuckii	Ummpimpiliza	Flower	Sept
Anacardiaceae	Harpephyllum caffrum	Umgwenya	Fruit	Dec-Feb
Anacardiaceae	Lannea discolor	Sigaganyane	Fruit	Feb-April
Anacardiaceae	Lannea edulis	Umntfolkolovo	Fruit	Feb-April
Anacardiaceae	Rhus chiridensis	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus dentata	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus discolor	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus dura	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus eckloniana	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus ernestii	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus frasieri	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus gueninzii var. spinescens	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus intermedia	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus leptodictya	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus macowanii	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus montana var. gerrardii	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus natalensis	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus pentheri	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus pyroides	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus rogersii	Inhlangushane	Fruit	April-June
Anacardiaceae	Rhus transvaalensis	Inhlangushane	Fruit	April-June
Anacardiaceae	Sclerocarya bierrea caffra	Umganu	Fruit, Nut	Dec-Feb
Anonaceae	Annona senegalensis	Umtelemba	Fruit	Feb-May
Apogynacea	Carissa bispinosa	Umvusankunzi	Fruit	Dec-Feb
Araceae	Colocasia antiquorum	Umdzebedzebe	Young leaves	Sept-Oct
Araceae	Zantedeschia sp.	Umdzebedzebe	Young leaves	Sept-Oct
Asclepiadaceae	Asclepias adscendens	Umdzayana	Leaves	Sept-Oct
Asclepiadaceae	Asclepias affinis	Umdzayi	Leaves	Sept-Oct
Asclepiadaceae	Asclepias crispa	Umdzayana	Leaves	Sept-Oct
Asclepiadaceae	Asclepias densiflora	Umdzayana	Leaves	Sept-Oct
Asclepiadaceae	Asclepias sp.	Coyane	Root	Uncertain
Asclepiadaceae	Asclepias sp.	Sidzayi	Leaves	Sept-Oct
Asclepiadaceae	Brachystelma gerrardii	Sidzendza	Root	Uncertain
Asclepiadaceae	Raphionacme elata	Lubhuku	Fruit, poss. root	Sept-Oct
Asclepiadaceae	Raphionacme galpinii	Indzema	Fruit, poss. root	Uncertain
Asclepiadaceae	Raphionacme hirsuta	Indzema	Fruit, poss. root	Uncertain
Asclepiadaceae	Raphionacme procumbens	Indzema/Lubhuku	Fruit, poss. root	Sept-Oct
Asclepiadaceae	Riocreuxia burchelli	Umshunko	Leaves	Sept-Oct
Asclepiadaceae	Riocreuxia picta	Umshunko/ Umdzandzabuka wemahlatsi	Leaves	Sept-Oct
Asclepiadaceae	Sarcostemma viminale	Ingotjwa/Emaphoti	Stem, Pod, Fruit	August-Oct
Asclepiadaceae	Schizoglossum cordifolium	Sicadze	Root	Jan-Dec
Asclepiadaceae	Xysmalobium acerotiodes	Umdzayi	Leaves	Sept-Oct
Asclepiadaceae	Xysmalobium asperum	Umdzayana	Leaves	Sept-Oct

TABLE V continued

Asclepiadaceae	Xysmalobium undulatum	Umdzayi	Leaves	Sept-Oct
Boraginaceae	Ehritia amoena	Umklele/Lihungela	Fruit	Sept-Oct
Boraginaceae	Ehritia rigida	Umklele	Fruit	Mar-April
Burseraceae	Trichillia emetiça	Umkhuhlu	Fruit, Bud	Nov-Jan
Caesalpinioideae	??	Emanafu	Resin	Jan-Dec
Campanulaceae	Cyphia bolusii	Ligagajane	Root	Jan-Dec
Campanulaceae	Cyphia elata	Ligagajane	Root	Jan-Dec
Celestraceae	Maytenus mossambicensis	Umgungulutane	Fruit	Jan-Mar
Chenopodiaceae	Chenopodium album	Imbillikicane/ Timvutisalukati	Leaves	Oct-Jan
Compositae	Athrixia elata	Luphephetse	Leaves (tea)	Jan-Dec
Compositae	Athrixia phylicoides	Luphephetse	Leaves (tea)	Jan-Dec
Compositae	Bidens bipinnata	Chuchuza/Cadvolo	Leaves, Shoots	Sept-Feb
Compositae	Bidens pilosa	Chuchuza/Cadvolo	Leaves, Shoots	Sept-Feb
Compositae	Chichorium sp. prob. intybus	Ingabe/Lihabe/ Klabeklabe	Leaves, Stem, Flower	Sept-Feb
Compositae	Helichrysum nudifolium	Luphephetse	Leaves (tea)	Jan-Dec
Compositae	Lactuca sp. prob. capensis	Ingabe/Lihabe Klabeklabe	Leaves, Stem, Flower	Sept-Feb
Compositae	Sonchus oleraçeus	Ingabe/Lihabe Klabeklabe	Leaves, Stem, Flower	Sept-Feb
Compositae	Taraxacum officinale	Ingabe/Lihabe Klabeklabe	Leaves	Sept-Feb
Cucurbitaceae	Momordica clementidae	Inshubaba	Leaves	Oct-Feb
Cucurbitacead	Momordica faetida	Inshubaba	Leaves	Oct-Feb
Cucurbitaceae	Momordica involucrata	Inkakha	Leaves	Oct-Feb
Cucurbitaceae	??	Tswalabenoni	Fruit	Uncertain
Ebenaceae	Diospyros dicrophylla	Umchafutane/ Lomnyama	Fruit	Jan-Feb
Liliaceae	Aloe boylei	Lisheshelu	Leaves, Blades	Jan-Dec
Liliaceae	Aloe cooperi	Lisheshelu	Leaves, Blades	Jan-Dec
Liliaceae	Aloe hlangapies	Lisheshelu	Leaves, Blades	Jan-Dec
Liliaceae	Aloe integra	Lisheshelu	Leaves, Blades	Jan-Dec
Liliaceae	Aloe saponaria	Lihala	Heart	Jan-Dec
Liliaceae	Aloe vanbalenii	Lihala	Heart	Jan-Dec
Liliaceae	Aloe sp.	Emadzimu	Heart	Uncertain
Liliaceae	Dipcadi sp.	Ncamjolo	Bulb	Aug-Nov
Liliaceae	Dipcadi sp.	Umgcobane	Bulb	Jan-Dec
Liliaceae	Tulbaghia acutiloba	Lisela	Bulb	Aug-Feb
Liliaceae	Tulbaghia ludwigiana syn. T. alliaceae	Ingotjwa/Sikhwa	Leaves, Blades, Flower	Aug-Feb
Loganiaceae	Strychnos madagascariensis	Umkhwakhwa	Fruit	Aug-Dec
Loganiaceae	Strychnos spinosa	Umhlahla	Fruit	July-Nov
Moraceae	Ficus burkei syn. petersii	Inkhokhokho	Fruit, Leaves	Uncertain
Moraceae	Ficus capensis	Umkhiwa	Fruit, Leaves	Uncertain
Moraceae	Ficus caprifolia	Inkhiwane/Inyenye	Fruit	Jan-Feb
Moraceae	Ficus ingens	Inkhiwane	Fruit	Uncertain
Moraceae	Ficus salicifolia	Inkhiwane	Fruit	Uncertain
Moraceae	Ficus sonderii	Inkhokhokho	Fruit, Leaves	Uncertain
Moraceae	Ficus stuhlmannii	Inkhokhokho	Fruit, Leaves	Uncertain
Moraceae	Ficus sycomorus	Umkhiwabovane/ Umpandza	Fruit	Uncertain
Moraceae	Morus spp. (garden escape)	Liguncumence	Fruit, Leaves	July-Nov
Musaceae	Strelizia caudata	Inkhamango	Stem	Jan-Dec
Myrtaceae	Psidium guajava (garden escape)	Ligwava	Fruit	March-April
Myrtaceae	Syzygium cordatum	Umncozi	Fruit	Dec-March
Ophioglossaceae	Ophioglossum engelmannii	Sankunshane	Leaves	Aug-Nov
Olacaceae	Ximenia americana	Sikholojwane/ Umtfvunduluka	Fruit	Feb-April

TABLE V continued

Olacaceae	Ximenia caffra	Umtfvunduluka	Fruit	Feb-April
Oxalidaceae	Oxalis corniculata	Simunyamunyane	Leaves	Sept-Feb
Oxalidaceae	Oxalis davyana	Simunyane	Leaves	Sept-Feb
Oxalidaceae	Oxalis obliquifolia	Simunyane	Leaves	Sept-Feb
Oxalidaceae	Oxalis smithiana	Simunyanmunyane	Leaves	Sept-Feb
Palmae	Phoenix reclinata	Lisundvu	Fruits, Shoot, Sap	Dec-Jan
Passifloraceae	Passiflora edulis (garden escape)	Liganandella	Fruits, Leaf	Dec-March
Pittosporaceae	Pittosporum viridiflorum	Umfusamvu	Fruit	Feb-April
Polygonaceae	Rumex sagittatus	Simunyane	Leaves	Sept-Feb
Portulacaceae	Portulaca oleracea	Selele	Leaves, Shoot	Sept-Feb
Portulacaceae	Portulaca quadrifida	Emayenjane	Leaves, Shoot	Sept-Feb
Rhamnaceae	Berchemia zeyheri	Umneyi	Fruit	Jan-Mar
Rhamnaceae	Ziziphus mucronata	Umphafa	Fruit	Jan-Mar
Rosaceae	Parinarium capense	Umkhuna	Fruit, Bud	Dec-Feb
Rosaceae	Parinarium curatellifolium	Umkhuna	Fruit, Bud	Dec-Feb
Rosaceae	Rubus niveus prev. intercurrens	Liguncumence	Fruit	Dec-Feb
Rosaceae	Rubus rosaefolius	Liguncumence	Fruit	Dec-Feb
Rubiaceae	Canthium ciliatum	Umvutfwamini/ Tinwutfane	Fruit	Jan-March
Rubiaceae	Canthium obuvatum	Umvutfwamini/ Tinwutfane	Fruit	Jan-March
Rubiaceae	Canthium ventosum	Umvutfwamini/ Tinwutfane	Fruit	Jan-March
Rubiaceae	Cephalenthus natalensis	Umfomfo	Fruit	Feb-April
Rubiaceae	Kraussia floribunda	Litsambo lenja	Fruit	March-April
Rubiaceae	Pachystigma macrolyx	Umphatsankhosi	Fruit	Feb-April
Rubiaceae	Pachystigma pygmeum	Umkhuna	Fruit	Feb-April
Rubiaceae	Plectrionella armata	Sangongongo	Fruit	Feb-April
Rubiaceae	Pygmaeothamnus chamaedendrum	Umgungulutane/ Umkhuna	Fruit	Feb-April
Rubiaceae	Vangueria cyanescens	Umntulu	Fruit	Feb-April
Rubiaceae	Vangueria esculenta	Umntulu	Fruit	Feb-April
Rubiaceae	Vangueria infausta	Umntulu	Fruit	Uncertain
Rubiaceae	Vangueria sp.	Santudlwana	Fruit	Feb-April
Rutaceae	Clausena anisata	Umnukelambiba/ Umbangadloti	Fruit	Feb-April
Salvadoraceae	Azima tetracantha	Umvusankunzi	Fruit	Uncertain
Sapindaceae	Allophylus melanocarpus	Inhlangushane	Fruit	Uncertain
Sapotaceae	Bequertiodendron megalies-montanum	Munumbela	Fruit	Dec-Feb
Sapotaceae	Mimusops obovata	Umpushana	Fruit	Dec-Feb
Sapotaceae	Mimusops zeyheri	Umpushana	Fruit	Nov-Feb
Scrophulariaceae	Halleria lucida	Umbinta	Fruit	Uncertain
Solanaceae	Physalis angulata	Gcumgcumu	Fruit	April-Aug
Solanaceae	Physalis peruviana	Gcumgcumu	Fruit	April-Aug
Solanaceae	Physalis viscosa	Gcumgcumu	Fruit	Oct-Feb
Solanaceae	Solanum nigrum	Umsobo	Leaves, Fruit	Sept-March
Solanaceae	Solanum retroflexum	Umsobo	Leaves, Fruit	Sept-March
Tiliaceae	Corchorus confusus	Ligusha	Leaves	Sept-April
Tiliaceae	Corchorus tridens	Ligusha	Leaves	Sept-April
Tiliaceae	Corchorus trilocularis	Ligusha	Leaves	Sept-April
Tiliaceae	Grewia bicolor	Umsiphane	Fruit	Feb-April
Tiliaceae	Grewia caffra	Liklolo	Leaves, Fruit	July-Oct
Tiliaceae	Grewia flava	Umsiphane	Fruit	Feb-April
Tiliaceae	Grewia flavescens	Liklolo	Leaves, Fruit	July-Oct
Tiliaceae	Grewia hexamita	Umsiphane	Fruit	Feb-April
Tiliaceae	Grewia micrantha	Umsiphane	Fruit	Feb-April
Tiliaceae	Grewia monticola	Umsiphane	Fruit	Feb-April

TABLE V continued

Tiliaceae	Grewia occidentalis	Liklolo	Leaves, Fruit	July-Oct
Tiliaceae	Grewia subspathulata	Umsiphane	Fruit	Feb-April
Tiliaceae	Grewia villosa	Umsiphane	Fruit	Feb-April
Tiliaceae	Sparmannia ricinocarpa	Hayihayi	Leaves	July-Oct
Ulmaceae	Celtis africana	Liklolo	Leaves	July-Oct
Umbelliferae	Annesorhiza flagellifolia	Sibhadze	Leaves, Shoots	Sept-Dec
Umbelliferae	Annesorhiza macrocarpa	Sibhadze	Leaves, Shoots	Sept-Dec
Umbelliferae	Peucedanum megalies-montanum	Sibhadze	Leaves	Sept-Dec
Urticaceae	Laportea peduncularis	Bubati/Lubati	Leaves	Aug-Nov
Verbenaceae	Lantana camara	Bukhwebeletane	Fruit	Nov-Feb
Verbenaceae	Lantana montevidensis	Bukhwebletane	Fruit	Nov-Feb
Verbenaceae	Lantana rugosa	Bukhwebeletane	Fruit	Nov-Feb
Verbenaceae	Lantana trifolia	Bukhwebeletane	Fruit	Nov-Feb
Vitaceae	Cyphostemma woodii	Inkhonyane	Uncertain	Uncertain
??	??	Imbinduvolo	Fruit	Jan-Feb
??	??	Likhowe	Cap, Stem	Oct-Jan
??	??	Linjata	Leaves	Oct-Feb
??	??	Sijobe	Fruit	Uncertain
??	??	Umhlahlakanye	Fruit	Feb-April
??	??	Umnovonovo	Resin	Uncertain
??	??	Ungcenga	Root	Jan-Dec
REPORTED EDIBLE: NOT COLLECTED				
Amaranthaceae	Amaranthus sp.	Imbuya yamahashi	Leaves	Sept-Dec
Asclepiadaceae	Pentharrinum insipidum	Umdzandzabuka	Leaves, Shoots	Sept-Feb
Asclepiadaceae	Pergularia daemia	Umdzandzabuka	Leaves, Shoots	Sept-Feb
Cactaceae	Rhipsalis baccifera	Damtikigi/ Lidolofiya	Fruit	Dec-Feb
Commelinaceae	Commelinaceae africana	Lidzangaman	Leaves	Sept-Feb
Commelinaceae	Commelinaceae modesta	Lidzangaman	Leaves	Sept-Feb
Commelinaceae	Cyanotis sp.	Lidzanga an	Leaves	Sept-Feb
Compositae	Galinsoga parviflora	Lachoza/Mavele-josimfanfikile/ mfanfikitolo/ mfikamuva	Leaves, Shoots	Sept-Feb
Convolvulaceae	Ipomoea coscinosperma	Umdzandzabuka	Leaves, Shoots	Sept-Feb
Convolvulaceae	Ipomoea obscura	Umdzandzabuka/ Liqondo	Leaves, Shoots	Sept-Feb
Convolvulaceae	Ipomoea plebeya	Umdzandzabuka	Leaves, Shoots	Sept-Feb
Convolvulaceae	Ipomoea sinensis	Umdzandzabuka	Leaves, Shoots	Sept-Feb
Ebenaceae	Euclea schimperi	Umbhubhuludla	Fruit	Jan-Mar
Iridaceae	Watsonia densiflora	Sidvwe	Corm, Leaf	Uncertain
Iridaceae	Watsonia latifolia	Sidvwe	Corm, Leaf	Uncertain
Iridaceae	Watsonia watsoniedes	Sidvwe	Corm, Leaf	Uncertain
Leguminosae	Vigna sp. (escape?)	Ngugudze/ Ngugungu/ Sigugudze	Leaves, Root	Nov-Feb
Liliaceae	Aloe affinis	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe bainesii	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe chabaudii	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe cryptopoda	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe dewetii	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe keithii	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe marlothii	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe parvibracteata	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe rupestris	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe sessiliflora	Inhlaba	Leaf (ash)	Jan-Dec
Liliaceae	Aloe suprafoliata	Inhlaba	Leaf (ash)	Jan-Dec

TABLE V continued

Malvaceae	Hibiscus trionium	Inyanwolenkuku	Leaves	Oct-Feb
Malvaceae	Hibiscus sp.	Gcundza	Leaves	Sept-Feb
Moraceae	Ficus sandsibarica	Intfombe	Fruit	Uncertain
Moraceae	Ficus sp.	Libota	Fruit	Uncertain
Rubiaceae	Canthium guernzii	Sinwati	Fruit	Uncertain
Sapindaceae	Pappea capensis	Liletha	Fruit	Dec-April
Umbelliferae	??	Lomahanisi	Leaves	Sept-Dec
Urticaceae	Pouzolzia parasitica	Zombodze manundu	Leaves	Sept-Feb
Urticaceae	Urtica sp.	Imbabatane	Leaves	Sept-Feb
Verbenaceae	Lippia javanica	Umsutane	Leaves (tea)	Uncertain
Vitaceae	Rhoicissus tridentata	Sinwati	Fruit	Uncertain
??	??	Amehlokakati	Fruit	Uncertain
??	??	Emasondvo elinhashi	Leaves	Nov-Feb
??	??	Infolvane	Root	Uncertain
??	??	Indodenyama	Fruit	Feb-April
??	??	Ingwenyene	Fruit	Uncertain
??	??	Inkhowane	Cap, Stem	Dec-Jan
??	??	Inkhovo	Tuber	Jan-Dec
??	??	Intfondvo	Root	Jan-Dec
??	??	Kamquindi	Fruit	Uncertain
??	??	Klamuklese	Root	Uncertain
??	??	Lidvundvu	Leaves	Sept-Feb
??	??	Lidzelanyoka	Leaves	Sept-?
??	??	Likhondze/ Sikhonde	Root	Uncertain
??	??	Likhokhowane	Leaves	Aug-Sept
??	??	Lubolotsi	Fruit	Uncertain
??	??	Lubozane	Leaves	Uncertain
??	??	Lukholoshane	Fruit	Uncertain
??	??	Luhayi	Fruit	Uncertain
??	??	Magangoni	Leaves	Sept-Jan
??	??	Mahananandi/ Umhlozana	Fruit	Uncertain
??	??	Mbonjane	Fruit	Uncertain
??	??	Mbonkolo	Root	Uncertain
??	??	Mzimpufu	Fruit	Uncertain
??	??	Ncengane/Ncincane	Root	Uncertain
??	??	Ndladleni	Leaves	Uncertain
??	??	Qugiyane	Leaves	Nov-Feb
??	??	Santinyane	Fruit	Uncertain
??	??	Sanyoko	Leaves	Oct-Feb
??	??	Sicadzamanje	Fruit	Uncertain
??	??	Sicibilinjawane/ Umcikiciki	Leaves, Shoots	Oct-Feb
??	??	Sikhonjawane	Root	Uncertain
??	??	Sinyalala	Leaves	Sept-Dec
??	??	Umtenjwa	Root	Uncertain
??	??	Yihite	Stem	Aug-Oct
??	??	Zombodze/Betje	Leaves	Sept-Feb

vegetables, but warmer temperatures make the wild fruits here available earlier than in other ecological zones of Swaziland. Thus, while the domesticated food sufficiency is questionable and poses a serious supply problem in the Lowveld, Swazi living here maintain their dietary adequacy by continued exploitation of climatically adapted local wild plants.

Extensive land cultivation and population increases have contributed together to alter forever the indigenous flora of the Middleveld. Today Middleveld occupants, on average, are younger and participate in farming on a larger scale than elsewhere in Swaziland. Middleveld respondents, too, recognize the least number of wild food resources, and reported discontinuation/extinction of the highest number of local species (Ogle and Grivetti, 1985b).

The Middleveld, despite its population and extensive botanical disruption, presents a botanical-dietary paradox. Here, more varieties of edible wild leaves are consumed than elsewhere in Swaziland. Most Middleveld edible wild greens, however, are introduced species; many are the so-called "weeds of agriculture." Many of these species are native to continents other than Africa. Such vigorous herbaceous species associated with agriculture thrive in the same fields as domesticated crops or in fields left fallow; their presence at these localities, however, makes gathering easier. With concentration in the agricultural or fallow fields, collecting takes less time. Accordingly, more are gathered.

The Middleveld population, rather than halting the practice of gathering when specific indigenous wild species became scarce, or when time constraints prevented longer collection journeys, have changed their plant focus and have turned to the more easily accessible, but non-cultivated weeds of agriculture. Today, however, such weeds of agriculture come under adverse scrutiny by scientific, contemporary agronomists. The scientists — world wide — state that such plants compete with domesticated cultivars for soil nutrients and water needs. Thus, the weeds of agriculture force a difficult decision, not only in Swaziland but throughout traditional agricultural societies today. If edible weeds of agriculture are permitted to thrive, the result is continued dietary diversity and probable continued dietary quality, but sub-optimal yields from staple, domesticated plants. If, however, the weeds of agriculture are eliminated, it follows that dietary diversity will decline, with an increased possibility of a decline in nutritional quality; but yields from staple, domesticated plants will sharply increase.

A strong nutritional advantage is posed by the added dietary diversity represented by edible wild food resources. By gathering, the average Swazi adds over 50 different species/foods to the diet. This practice, at times when food stores are low or at the beginning of the agricultural year when few domesticated cultivars are available in gardens, contributes substantially to maintaining nutritional adequacy of Swazi diet.

The nutritional composition of some wild food plants may be superior to those of cultivated vegetables. Regular consumption of wild species analysed in this study demonstrates that when served with white maize, the Swazi dietary staple, the protein quality of maize meal is substantially improved. Furthermore, green leaves can be major dietary sources for minerals. Frequent seasonal consumption of wild greens, thus, may maintain adequate physiological levels of some nutrients such as iron, especially during spring and early summer.

Other virtues in continued exploitation of wild resources may be noted. The Swazi practice of gathering just before cooking ensures high quality fresh produce. The nutritional advantage of freshness may be balanced against purchasing commercial alternatives. Given modest, sometimes inadequate food storage facilities for fresh produce in many Swazi homes, freshly gathered wild foods, prepared in the Swazi manner, conserve water-soluble vitamins.

Associations between age and wild food consumption offer additional perspectives. Children in Swaziland have maintained high levels of recognition and consumption of wild foods. Indeed, children in the Middleveld region reported higher level of utilization than adult Middleveld respondents.

Within the traditional setting, training in recognition and gathering of wild plants was naturally integrated in overall Swazi education. From early childhood, recognition of edible wild species and distinction between safe and toxic forms were skills initially transferred from elders, later reinforced by experiences with older boys during years of cattle herding or with girls at play imitating domestic responsibilities. With recent emphasis on formal education, the traditional training period for gathering has been shortened. Although the initial transfer of information from parent and household members remains, the reinforcement of foraging skills during childhood has not been lost. The mechanisms that encourage and maintain foraging skills should be guarded; they are a heritage that once lost or abandoned, set into motion an ominous cycle that results in restricted, reduced dietary diversity and the potential for nutritional disaster.

We did not expect plant knowledge among Swazi children to be at their present high levels. Our finding that Swazi children have retained high levels of recognition and use of wild food plants may be explained, in part, through two lines of reasoning. First, there remains a strong sense of tradition among rural Swazi; while cultural, political and technological events swirl elsewhere in southern Africa, Swazi respect for cultural values, their land, their neighborhood, their nation and their past remain very strong. Such emphasis on the importance of Swazi culture contributes to the retention of culinary and dietary practices valued by past generations.

The second line of reasoning, however, is more curious, a paradox that planners and educators contributing to agricultural, social and technological development may wish to address. We suggest that the valued maintenance of wild plant knowledge by Swazi school children is due, paradoxically, to a shortage of schools. The resolution of the paradox does not lie in differences between traditional and formal education methods, but with locality — specific sites where schools are built. Fewer schools mean more children must walk long distances to attend, while others must board or reside during the school year in zones outside their immediate family residential areas. Such children are at an advantage over those attending school in their immediate neighborhood. The former are more widely exposed to the botanical kingdom when walking long distances or living outside their family compounds, especially if the home residence and distant school are located in two different ecological zones.

Following this reasoning we suggest that, as Swaziland develops its rural economy, as increased school construction leads to less walking or travel time, to less school children boarding at sites distant from the ecological niche of their birth, individual knowledge of edible wild plants will sharply decline.

To counter this potential problem, we suggest that botany and wild plant identification be considered themes for formal academic course work throughout primary school; that local field trips be encouraged as part of formal education in order to identify and reinforce knowledge of important edible species. To these ends, we suggest that the skills and educational talents of both school teachers and local elders knowledgeable in plant lore be blended.

In conclusion, we have shown that a systematic approach to evaluating agricultural and nutritional adequacy in Swaziland lies in a careful understanding of interrelationships between ecological zone, residency pattern and agricultural productivity. Productivity, however, is not merely a measure of production of subsistence or cash crops from domesticated cultivars. Production, too, is a measure of ability to recognize and use edible wild plants that are sustaining and nutritionally valuable. While domesticated crops remain dietary staples, important wild species should not be permitted to vanish from diet merely because they are viewed as old fashioned, are eliminated by herbacide use or exterminated merely to push forest margins back in the name of agricultural development. To do so would be agriculturally short-sighted and nutritionally disasterous.

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APPENDIX A

Previously analysed wild food resources: Summary of literature review

Latin Terminology	Source [a]	kJ	Energy kcal	Moist %	Protein %	Fat %	Total CHO %	Fibre %	Ash %	Calcium mg	Phosp mg	Iron mg	Betacarotene mcg	Thiamin mg	Riboflav mg	Niacin mg	Ascorbic acid mg
GREEN LEAVES (100g fresh material)																	
Amaranthus hybridus	Fox			85 0	4 73											1 27	
Amaranthus spp	Fox	175 7	42	86 0	3 7	0 8	5 9	1 5		313	74	5 6	1600	0 05	0 24	1 2	65 0
Amaranthus spp	Fox	238 5	57	80 6	4 5	0 6	8 5	1 6		321	71	18 0	14190[b]	0 01	0 24	1 1	81 0
Amaranthus spp	Leung	175 7	42	84	4 6	0 2	8 3	1 8	2 9	410	103	8 9	5616	0 05	0 42	1 2	64
Amaranthus spp	Oomen	179 9	43	84 8	5 2			1 0		340		4 1	7700				120 0
Amaranthus spp (Cooked)	Leung	179 9	43	84 5	4 0	0 9	7 1	1 3	3 5	506	62	1 7					
Amaranthus spinosus	Shanley			75 0	5 84											1 72	
Amaranthus spinosus	Oliviera	234 3	56	79 0	5 99	0 9	7 2	2 2	4 64	377	90						
Annesorhiza flagel lifolia	Beemer	238 5	57	85 7	2 74					50	85						
Bidens pilosa	Leung	179 9	43	85 1	3 8	0 5	8 4	3 9	2 2	340	67		1800				
Bidens pilosa	Quin																40 0
Bidens pilosa	Oliviera	209 2	50	83	4 15	0 69	4 1	2 1	2 6	292 6	46 4					0 8	
Bidens pilosa	Shanley			84	2 3											0 8	
Bidens pilosa (Cooked)	Leung	138 1	33	88 6	2 8	0 6	6 4	1 3	2 0	111	39	2 3					
Chenopdoium album	Leung	255 2	61	75 9	7 4	1 0	9 8	1 6	5 9	371	80						
Chenopodium album	Fox	125 5	30	89 6	3 7	0 4	2 9	0 8		150	45	6 0	2808[b]	0 01	0 12	0 8	32
Chenopodium album	Fox	234 3	56	75 7	7 36	1 02	6 8	1 6	5 9	371	80						
Chenopodium album	Fox	179 9	43	84 3	4 2	0 8	5 2	2 1		309	72	1 2	6960	0 16	0 44	1 2	80
Chenopodium album	Shanley			81	3 0											1 17	
Chenopodium album (Boiled)	Fox	133 9	32	88 9	3 2	0 7	3 3	1 8		258	45	0 7	5820	0 1	0 26	0 9	37
Colocasia antiquorum	Lewis			86	3 6											0 88	
Colocasia antiquorum	Oliviera	154 8	37	87	3 5	1 04	3 51	1 9	2 0	129 1	52						
Corchorus tridens	Oliviera	246 9	59	81	4 5	0 64	10 2	1 6	2 1	363 3	59						
Corchorus trilocularia	Fox	96 2	23	91 1	2 42	0 35	3 1	0 9	1 35	163	54						
Corchorus spp	Leung	242 7	58	80 4	4 5	0 3	12 4	2 0	2 4	360	122	7 2	6410	0 15	0 58	1 2	80
Corchorus spp	Oliviera	292 9	70	78	6 7	1 06	10 9	1 7	1 7	314	64						
Corchorus sp (Cooked)	Leung	142 3	34	92	1 5	2 6	2 3	0 2	1 6	51	40	3 4					6

APPENDIX A continued

Ophioglossum engelmannii	Fox			85.0	3.58											1.3	
Portulaca oleracea	Leung	96.2	23	90.6	2.4	0.3	4.2	0.8	2.5	104	31	1.4		0.03	0.15		58
Portulaca oleracea	Fox	108.8	26	90.5	2.4	0.6	2.9	1.3		111	45	14.8	3820	0.1	0.22	0.7	29
Portulaca oleracea	Fox	87.9	21	92.5	1.7	0.4	2.9	0.9		103	39	3.5	2500	0.03	0.1	0.5	25
Portulaca oleracea	Oliviera	96.2	23	91	3.1	0.5	2.3	0.94	2.23	187	70						
Portulaca oleracea (Boiled)	Fox	62.8	15	94.7	1.2	0.3	2.0	0.8		86	24	1.2	2100	0.02	0.06	0.4	12
Portulaca quadrifida	Fox	129.7	31	85.8	1.65	0.8	3.7	1.9	4.1	146	65						
Solanum nigrum	Beemer	238.5	57	86.7		2.6				269	363						
Solanum nigrum	Leung	159.0	38	87.2	4.3	0.8	5.7	1.3	2.0	442	75	1.0	3660				20
Solanum nigrum	Fox	284.5	68	82.2	5.9	1.0	8.9			410	70	20.5					11
Solanum nigrum	Fox	113.0	27	88.3	3.5	0.48	2.61	1.5	2.2	244	80						
Solanum nigrum	Fox	188.3	45	85.0	5.0	0.8	6.0	1.4		199	60	9.9	230	0.18	0.35	1.0	61
Solanum nigrum	Oomen	184.1	44	85	4.6			1.1		215		4.2	1700				30
Sonchus oleraceus	Leung	75.3	18	93.2	1.9	0.3	3.0	0.4	1.6	131	37	3.1	1425		0.13	0.8	
Sonchus oleraceus	Wehmeyer			89	2.0											0.46	22

[a] References: Beemer, 1939
Leung, 1968
Fox, 1966
Lewis, Shanley and Hennesst, 1971
Oliviera, see Santos Oliviera and de Carvalho, 1975
Oomen, see Oomen & Grubben, 1977
Quin, 1959
Shanley, see Shanley and Lewis, 1969
Wehmeyer, 1971
[b] Converted from I.U. Factor used 0.6.

APPENDIX B

Previously analysed wild fruits and other portions: Summary of literature review

Latin Terminology	Source [a]	kJ	Energy kcal	Moist %	Protein %	Fat %	Total CHO %	Fibre %	Ash %	Calcium mg	Phosp mg	Iron mg	Betacarotene mcg	Thiamin mg	Riboflav mg	Niacin mg	Ascorbic acid mg
Bequertiodendron magaliesmontanum	Wehmeyer	334 7	80	77 7	0 9	0 4	19 2	1 3	0 5	20	11 7	0 69		0 07	0 03	1 64	14 1
Bequertiodendron magaliesmontanum	Watt																40 0
Ficus capensis	Leung			85													3 0
Lannea edulis	Leung																14 0
Opuntia sp	Leung	259 4	62	82 9	1 0	0 4	15 4	3 9	0 3	31	27	0 3					20
Passiflora edulis	Leung			79						25	48			0 03	0 10		
Physalis peruviana	Fox	364 0	87	82 9	1 8	0 26	11 1	3 2		10	67	2 0	2380	0 05	0 02		49
Psidium guajava	Leung	267 8	64	82 2	1 1	0 4	15 7	5 3	0 6	24	31	1 3	290	0 06	0 04	1 3	326
Sclerocarya birrea	Leung	125 5	30	91 7	0 5	0 1	7 5	0 5	0 2	6	19	0 1		0 03	0 05	0 2	68
Strychnos pungens	Wehmeyer																
Close seed				66 8	1 6	0 7	21 4	8 6	0 9	30 9	23 3	0 91		0 1	0 74	2 31	21 6
Close shell				70 9	0 8	0 1	20 8	6 2	1 2	45 5	31 5	0 18		2 74	0 8	1 8	
Strychnos spinosa	Leung	301 3	72	79 7	1 6	0 6	17 1	0 6	1 0	28	42	0 7		0 11	0 17	1 9	18
Strychnos spinosa	Fox			65 4	2 1	1 0				42		6 0		0 17	0 16	1 9	2
Syzygium guinenese	Leung			88 1													50
Ximenia caffra	Leung			66 4													49
Ximenia caffra	Wehmeyer			67 2	3 1	1 3	26 3	0 7	1 4	5 9	14 5	0 2	221	0 04	0 04	0 81	22 5
OTHER PORTIONS																	
Coleus sp (tuber)	Fox			66 4						26	75	1 0					
Sclerocarya birrea	Leung																
Kernel		2527 2	604	3 9	24 6	57 5	9 2	2 7	4 8	143	1248	0 4		0 04	0 12	0 7	
Sclerocarya birrea kernel	Fox	2815 9	673	3 6	23 9	60 7	7 7			140	690	8 0					

[a] References Leung, 1968
Fox, 1966
Watt and Breyer-Brandwijk, 1962
Wehmeyer, 1971