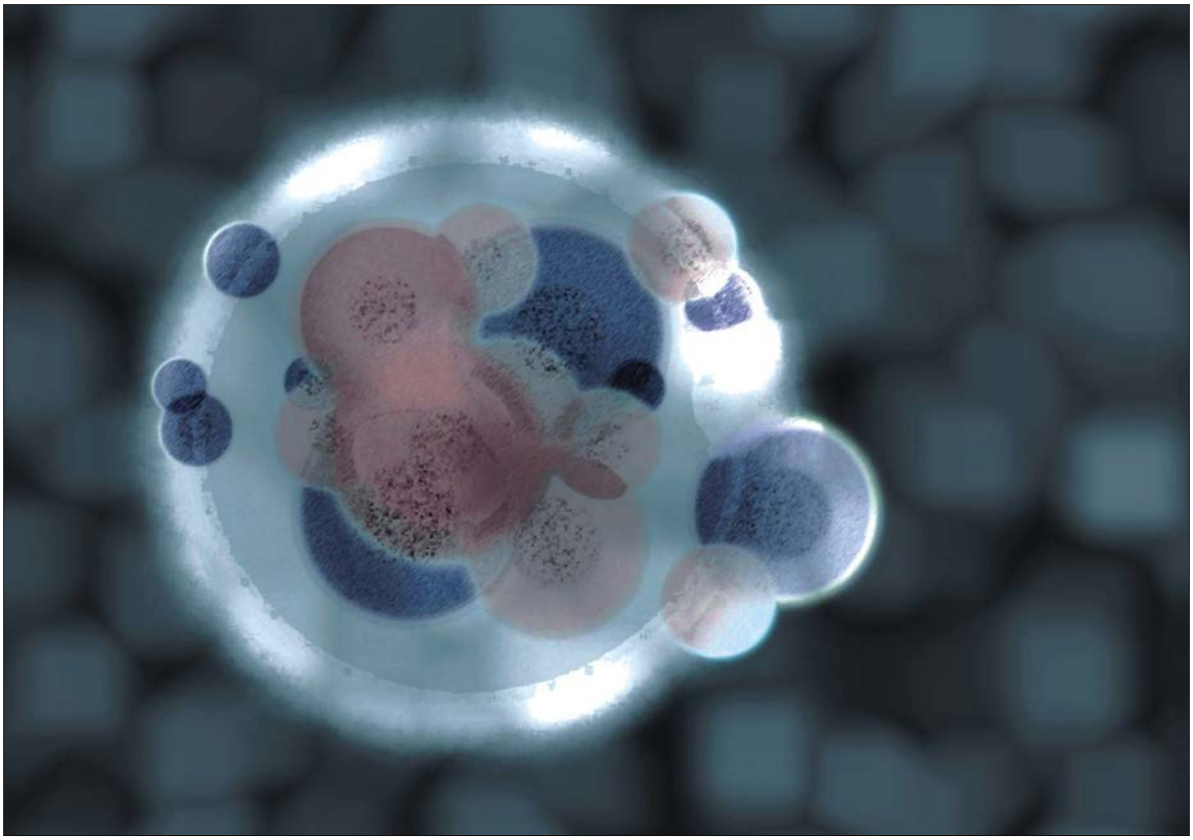

Journal of Biological Sciences

ISSN 1727-3048

Journal of Biological Sciences 12 (5): 263-271, 2012
ISSN 1727-3048 / DOI: 10.3923/jbs.2012.263.271

Nutritional Value of *Berchemia discolor*: A Potential to Food and Nutrition Security of Households

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Abstract: Drylands have a multitude of livelihood problems where food insecurity is one of the serious impediments. Both transhumance and settled farmers make their living in the semiarid parts of east Shewa, Ethiopia. They adapt partly to food shortage by using natural resources. The study objective was to determine nutritional value of fruit of *Berchemia discolor* and analyse the use and management practices and associated indigenous knowledge. Data were collected from three study sites each in Fantalle and Boosat districts in East Shewa Zone. Before the laboratory analysis of fruit, the species was identified through focus group discussions and field observations. Mineral elements and phosphorus were determined in dry matter basis. Vitamin A and C were determined by spectrophotometer and redox titration respectively. Analysis of variance was done and means were separated by LSD at 0.05. *Berchemia discolor* is a candidate for dry land agroforestry and agrobiodiversity. Ten major uses of *B. discolor* (food, medicine, fuel wood and others) and food value were the highest. Total carbohydrates, crude protein, crude lipid, moisture and total ash contents of the fruit pulps ranged from 4.17-4.35%. The calculated energy from total carbohydrates was 314.50 kcal/100 g. Transhumance conserves Wild Edible Plants (WEPs) in pasture land and protect of vegetation, while settled farmers in traditional dryland agroforestry, in live fence and farm boarders. *Berchemia discolor* is one of the potential resources to enhance people's livelihoods. Technologies for improved use and market chain need policy attention.

Key words: Climate change, food security, nutritional value, wild edible plants

INTRODUCTION

In most parts of the world people continued to rely on wild plants from natural habitats to get a major portion of their food (Turner *et al*., 2011). People of the world have depended on wild plants for their diets for hundreds of thousands of years and many people continue to rely on these species to meet at least part of their daily food and nutritional needs. Different human groups living in similar or slightly different environments especially near natural forests and dryland woodland and savannas use different basket of species from wild edible plants (Turner *et al*., 2011; Feyssa *et al*., 2011a). These differences have been explained from habitat differences and different levels of availability of foods and diversity (Turner *et al*., 2011). An attitude is suggested to allow choices from the potentially available biodiversity of a set of species that are acceptable within a group and have acquired status within small human communities over time (Turner *et al*., 2011). Wild plant species, even for agrarian peoples or pastoralists who mainly used animal products, would have assumed a special importance during times of crop failure and famine (Turner, 2007). The consumption of wild edible plants is also common and widespread in food security areas and in species diverse areas (Tairo, 2007; Feyssa *et al*., 2010). They also recommended the need for further research in this area. Wild foods provide diversity of nutrients in the diet of many households, especially in semi-arid and humid tropics (Feyssa *et al*., 2010).

Therefore, wild edible plants play an indispensable role to humankind in multiple ways including food, fuel wood, medicine, construction material, forage for livestock, environmental services and other uses yet not identified or known by different local communities (Balemie and Kebebew, 2006; Teklehaymanot and

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Giday, 2010). Local farmers and transhumance pastoralists have accumulated Indigenous Knowledge (IK) about use and management of local plant resources and their various uses, conservation and management practices (Asfaw, 2009). This generation old indigenous practices of local communities could provide baseline information for development activities in sustainable resources utilization, management, promotion of WEPs of east Shewa and Ethiopia in general.

In spite of the food and other multipurpose uses of *Berchemia discolor*, research concerning the use, management and nutrition content of the species is inadequately documented in Ethiopia and obscure in the semiarid east Shewa. This needs focused research to quantify the potential of the species to food and nutrition security. Hence, there is a need to reverse the underutilization of the species by informing policy using research finding on the use, management and nutrient content of the species (Fentahun and Hager, 2009). Therefore, the focus of this study was to identify the use and management of *Berchemia discolor* and quantify the nutrient content and analyse implications to food security in drylands.

MATERIALS AND METHODS

Study area: The study was conducted in semiarid zone of east Shewa in Fantalle and Boosat districts located between 7°12'-9°14'N latitudes and 38°57'-39°32'E longitudes in the northern part of the Great East African Rifty Valley in Ethiopia. The climate of the area is hot with erratic, variable rainfall and unreliable for agricultural activities. Economic activities of the area are mostly livestock production but people in Boosat generally practice mixed agriculture consisting of livestock and crop production.

Analysis of major food substances

Collection and preparation of fruit sample for laboratory analysis: Prior to undertaking laboratory nutrient analysis on fruit sample, the species was identified through Focus Group Discussions (FGDs), interview and field observations as described by Martin (1995) and Cotton (1996) weather people use the fruits for food and other multiple uses were recorded (October, 2009 to September, 2010) in the study transects. Data on density and frequency was collected from 6 transects laid in the study area following Cook and Stubbendieck (1986) and Mueller-Dombois and Ellenberg (1974). Fruits were sampled from Fantalle (Galcha, Qobo and Dheebiti Kebeles) and Boosat (TriiBiretti, DigaluTiyo and Xadacha Kebeles). Fruit samples were harvested in sample bags and taken to the laboratory for both proximate and essential nutrient analysis.

In order to obviate the effects of different environmental factors and soil types in particular on nutrient contents, care was taken to obtain samples from replicate locations within and between districts following standard procedure (Armstrong and Hilton, 2004) for ripe fruits of, *B. discolor*. Fruits were oven dried in sample bags at 65°C for 72 h then further dried at 105°C for 4 h to constant weight following standard protocols of Association of Official Analytical Chemists (AOAC, 1990; Abuye *et al*., 2003). The fruits were ground into fine powder partly using pestle and mortar and F2-102 micro plant grinding machine to fine particles and sieved through a mesh sieve of 1 mm. For each replicate sample from the study sites, all dried sub-samples were pooled together and each composite sample from the localities were analysed in duplicate per land use, giving a total of 4 replicates.

Proximate analysis: Nutrient contents were analysed on dry matter basis including moisture, carbohydrate, ash, crude fat, crude fiber and crude protein (AOAC, 1990).

Determination of moisture and ash content: For moisture content determination, 2 g dry matter of fresh fruits of the sample in duplicates were weighed in petri-dishes and dried in an oven overnight for 12 h at 105°C (Osborne and Voogt, 1978; AOAC, 1990). The dried fruits and seeds were cooled in a desiccator and weighed. The percentage loss in weight was expressed as percentage moisture content. Total ash content was determined by the incineration of two grams of sample in a porcelain dish placed in a muffle furnace at 550°C for 4 h as described by Pearson (1976) and AOAC (1990). The percentage residue weighed was expressed as total ash content.

Determination of crude lipid and crude fibre content: Two grams of dried sample in duplicates were weighed into a porous thimble and its mouth plugged with cotton. The thimble was placed in an extraction chamber, which was suspended above a weighed receiving flask containing 100 mL diethyl ether (boiling point of 40-60°C) and below a condenser 1:30 to 2 h. The flask was heated on a heating mantle for 3 h to extract the crude lipid. After the extraction, the thimble was removed from the Soxhlet apparatus and the apparatus reassembled and heated over water bath for solvent recovery. The flask was heated on heating mantle for eight hours to extract the crude lipid. The receiving flask containing the crude lipid was disconnected, cleaned with a dry cloth, oven dried at 100°C for 30 min, cooled in a desiccator and weighed.

Crude fiber was estimated by acid-base digestion known as Coarse Fiber Analyzer, with 1.25% H_2SO_4 w/v) and 1.25% NaOH (w/v) solutions. The residue after crude lipid extraction was put into a 600 cm^3 beaker and 200 cm of boiling 1.25% H_2SO_4 added and washed with 25 cm^3 ethanol. The filter paper containing the residue was dried in an oven at 130°C to constant weight and cooled in a desiccator. The residue was scrapped into a pre-weighed porcelain crucible, weighed, ashed at 550°C for 2 h, cooled in a desiccator and reweighed. Crude fiber content was expressed as a percentage loss in weight on ignition.

Determination of crude protein and carbohydrate: Micro-Kjeldahl was used to determine the nitrogen content of the samples. One gram dried powdered sample was placed into a 100 cm^3 Kjeldahl digestion flask. A Kjeldahl digestion tablet and 10 cm^3 of concentrated sulfuric acid were added and the sample was boiled until frothing stopped and the digested sample became clear. Then 100 mL distilled water, 10 mL of the aliquot solution and 20 mL of 45% sodium hydroxide solution were added into a distillation flask containing the digested sample and steam distilled. The ammonia liberated was collected over 50 mL 4% boric acid-mixed indicator solution, cooled and titrated with standard 0.01 N HCl solution in order to obtain nitrogen content.

Crude protein was computed from sample percentage nitrogen content as determined by the Kjeldahl procedure, multiplied by a factor (6.25) for conversion of nitrogen to protein from the fact that most proteins contain approximately 16% nitrogen. The general factor of 6.25 is used to calculate protein in items that do not have a specific factor (AOAC, 1990). Carbohydrate was obtained by difference, subtracting the sum of moisture, protein, fat and ash from 100% Dry Weight (DW) sample (AOAC, 1990).

Minerals, phosphorus and vitamins analysis: The mineral elements comprising sodium, calcium, potassium, magnesium, iron, zinc and phosphorus were determined according to the method of Shahidi *et al.* (1999), AOAC (1990) and Nahapetian and Bassir (1975). Two gram of each of the processed samples was weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a muffle furnace. The resultant ash was dissolved in 5 mL of $HNO_3/HCl/H_2O$ (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5 mL of de-ionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100 mL volumetric flask by filtration through Whatman No. 42 filter paper and the volume was made to the mark with de-ionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10 cm long cell was used and concentration of each element in the sample was calculated on percentage of dry matter, i.e., mg/100 g sample. Phosphorus content of the digest was determined calorimetrically according to the method described by Nahapetian and Bassir (1975).

For tannin determination samples were dried at a maximum of 60°C immediately after collection to minimize any chemical changes and extracted with 50% v/v acetone and the same extract is used for determination. Determination is by a modification of the vanillin method of Ranganna (1977) and Broadhurst and Jones (1978), which utilizes the formation of coloured complexes between vanillin and condensed tannins and Catechin is used for the standard and results are expressed as catechin-equivalents.

Determination of energy value: The sample calorific value was calculated in kilocalories (kcal) multiplying by physiological energy factor composition (4, 4 and 9) of percentage proteins, fats and carbohydrates were used, respectively (FAO, 1968, 2011; USDA, 1999; Asibey-Berko and Tayie, 1999).The conversion factors are for physiological energy, which is the energy value remaining after losses due to digestion and metabolism and deducted from gross energy (USDA, 1999) where one kcal equals 4.184 kJ. Organic carbon (OC) in the fruit was obtained by subtracting total ash) mineral) from 100 (Adams *et al.*, 1951). Determination of vitamin A was carried out by spectrophotometer (Davies, 1976; AOAC, 1990). Ascorbic acid (vitamin C) was determined by redox titration following (Pearson, 1976; Helmenstine, 2007).

Data analysis: Nutrient composition of *B. discolor* was calculated mg/100 g DM basis following AOAC (1990) and Sundriyal and Sundriyal (2004). Accordingly values of moisture, total dry matter, crude protein, mineral, crude fiber and crude fat and total carbohydrates and five macro nutrients (P, Ca, Na, K and Mg) and four micro (Fe, Zn, Cu and Mn) nutrient contents of the edible part and tannin were reported in mg/100 g DM basis. The sample calorific value was calculated (in kcal) by multiplying the percentages of carbohydrate, proteins and crude lipid of fruits by factors (4, 4 and 9, respectively) as used by FAO (1968, 2011), Ranganna (1977), USDA (1999), Asibey-Berko and Tayie (1999) and AOAC (1990). Organic Carbon (OC) in the fruit was calculated using formula:

$$OC (\%) = (\%VS/1.8)\times 100$$

Where:

$$VS (\%) = (100-\%Ash)$$

following (Adams *et al*., 1951). Statistical analysis for nutritional content was done through analysis of variance and means were separated by LSD at 0.05 using GnStat. Ethnobotanical information was described in descriptive statistics and qualitatively under specific items following procedures of Martin (1995) and Cotton (1996).

RESULTS

Habitat, abundance and densities of *Berchemia discolor* in the study area: The major habitats for *B. discolor* include acacia wood lands, grasslands, riverine vegetation mainly following Awash and Kesem Rivers and small streams and Gorgy areas. Key informants indicated that there is tendency to conserve the species at farm boarders, live fences and enclosed pasture (kalo) areas. The relative abundance and densities of *Berchemia discolor* across land uses indicated it is reasonably abundant in the study area. Relative frequency and densities in Boosat districts are 30.30 and 1.27%, respectively while 18.18 and 0.93%, respectively for Fantalle district. Generally, *B. discolor* grows in abundant compared to 90 species of trees and shrubs in the area However, harvesting its fruits for human use overlap with livestock as it is also preferred especially by camels and goats. *Berchemia discolor* was observed in the study area with flowers and fruits across eight months, May to December except between January to April. In the main rain season the vegetative growth is more prominent. This seasonal abundance of the fruit signifies its contribution to supplement to household food supply and coping with food shortages.

Drivers threatening *Berchemia discolor* in the study area: According to the key informants, *B. discolor is* most affected by deforestation and overgrazing /browsing and overharvesting (Table 1). This result provides a foundation for participatory resources management planning based on the local people's IK. Preference ranking across land uses indicated that both transhumance and settled farmers have relatively similar preference for fruits of *B. discolor* as a food (p>0.05) (Table 2).

Preference of *B. discolor* relative to WEPs based on their taste for food: In terms of food taste, key informants from 6 study sites *B. discolor* demonstrating the potential of the species for food priority from a community perspective (Table 3).

Comparison of means of nutrient contents of the fruit trees across land use systems: Proteins and carbohydrates *B. discolor* were 18.21-19.59%, 16.72-16.89% for *B. discolor*. There was a significant interactive effect (p<0.05) between different land uses and nutrient contents for all the parameters, DM, Moisture, CF, CP and EE (Table 4). Thus, land use had significant effect on the nutritional content of *B. discolor* indicating that land use should be considered as one factor of production and domestication of the species.

Essential nutrient content of *Berchemia discolor* across land uses: The nutrients contents of fruits contents significantly varied vary for all variables analysed except for copper (Cu) and Condensed Tannin (CT) (Table 5). Phosphorus, Calcium, Zinc, Magnesium, Manganese are relatively higher in a fruits collected from transhumance

Table 1: Averaged pooled summary of values for *B. discolor* across district affected by different factors

WEP	Def	Agri	HCF	WF	OH	OG/OB	LK	Drought
B. discolor	15	13	20	32	1	2	16	21

Def: Deforestation, Agri: Agricultural expansion, HCF: Human caused fire, WF: Wild fire, OG/OB: Overgrazing/browsing, LK: Livestock, OH: Overharvesting

Table 2: Preference ranking of *B. discolor* for household food in two districts

Preferred WEP	District of the respondent						
	Boosat	Fantalle	Total	Rank	Mean±SEM	χ^2	Sig
B. discolor	28	36	64	4th	0.53±0.046	1.205	0.272^{ns}

ns: Not significant

Table 3: Average pooled summary of values of *B. discolor* based on food taste as perceived by informants

WEP	Key informants										
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}	Total
B. discolor	4.67	4.17	4.50	4.17	4.00	4.33	4.50	4.00	4.17	4.33	34.34

5: Best and 1: Least, R_1-R_{10} = Rank 1-10

Table 4: Interaction effect of *B. discolor* in percentage across land use system

Interactions (%)	DM	Moisture	Ash	CF	CP	EE	NFE	CHO	OM	N	OC	OC/N
SF×*B. discolor*	40.47	59.54	4.26	9.41	16.81	0.31	69.21	78.62	95.74	2.69	53.21	19.769
TH×*B. discolor*	40.49	59.51	4.24	9.74	16.79	0.34	68.89	78.63	95.76	2.68	53.183	19.811
SEM	0.08	0.08	0.03	0.08	0.02	0.08	0.07	0.03	0.03	0	0.01	0.02
SD	0.29	0.29	0.09	0.27	0.06	0.27	0.25	0.11	0.09	0.01	0.05	0.07
LSD (5%)	0.3829	0.3829	0.1129	0.2757	0.0771	0.064	0.2371	0.1426	0.1129	0.01233	0.0627	0.0875
SED	0.1718	0.1718	0.0506	0.1237	0.0346	0.0287	0.1064	0.064	0.0506	0.00554	0.0281	0.0393
Significance	0.703*	0.703*	0.372*	0.018*	0.23*	0.748*	0.009**	0.923*	0.372*	0.23*	0.372*	0.307*

*Significant at 0.05, **Significant at 0.01, SF: Settled farmers, TH: Transhumance

Table 5: Nutrient contents of *Berchemia discolor* across land uses

Nutrient contents (mg/100 g DW)	P	Ca	Fe	Zn	Cu	Na	K	Mg	Mn	CT
	Nutrient and tannin contents									
SF×*B. discolor*	83.475	97.61	84.475	2.105	0.205	16.575	1241.1	52.532	0.715	1331.5
TH×*B. discolor*	84.375	98.413	83.485	2.31	0.2002	15.527	1238.4	53.485	0.91	1332.85
SEM	0.2602	0.2318	0.286	0.0594	0.0025	0.3024	0.797	0.2754	0.0568	0.56
SD	0.5204	0.4635	0.5721	0.1187	0.0049	0.60479	1.595	0.5507	0.1135	1.121
LSD (5%)	0.1521	0.06888	0.1254	0.04811	0.02152	0.02405	1.774	0.154	0.07757	4.243
SED	0.0354	0.01601	0.0292	0.01118	0.005	0.00559	0.412	0.0358	0.01803	0.986
Sig*	0.002*	<.001*	<.001*	0.003*	0.438^{ns}	<.001*	0.023*	0.001*	0.008*	0.304^{ns}

SF: Settled farmers, TH: Transhumance land uses, Cu: Copper, Na: Sodium, K: Potassium, Mg: Magnesium, Mn: Manganese, CT: Condensed tannin, *Significant at 0.05 level, ns: Not significant

Table 6: Vitamin contents of *B. discolor* across land uses

Vitamins content across land uses	Vitamin A (REs)	Vitamin C (mg/100 g)
SF×*B. discolor*	66.93	45.45
TH×*B. discolor*	99.60	45.20
Mean	83.27	45.33
SEM	9.43	0.43
SD	18.86	0.21
LSD (5%)	2.068	2.119
SED	0.481	0.492
% CV	0.6	1.1
Sig*	<.001*	0.662^{ns}

*The mean difference between WEPs species is significant at 0.05 level, Vitamin A (Beta-carotene), Vitamin C (reduced Ascorbic acid), REs: Retinol equivalents, SF: Settled farmers, TH: Transhumance, ns: Not significant

Table 7: Nutrient composition of some major Ethiopian farm crops vs. *B. discolor*

Species	Energy (kcal/100 g)	Moisture	Protein	CHO	Fiber	Ash	Fat
		Nutrients (%)					
H. vulgare L., bread	158.00	52.20	4.1	36.00	2.90	1.70	1.00
Z. mays L., bread	192.00	52.00	4.5	40.60	1.30	0.80	1.90
Sorghum bicolor porridge	104.00	73.40	2.3	23.50	0.70	0.40	0.40
Ergrostis tef, injera*	166.00	56.30	4.9	36.30	2.20	1.30	1.00
Triticum aestivum bread	208.00	44.80	6.6	45.60	1.70	2.30	0.70
B. discolor	146.54	59.53	16.8	19.09	9.57	4.25	0.33

Source: EHNRI-FAO, 1995:1-33), CHO: Carbohydrate, *Local Ethiopian thin spongy bread

land use than settled farmers land use while iron is relatively higher from fruits collected from settled farmers land use.

Vitamin content of *Berchemia discolor* across land uses: Vitamin A content of *B. discolor* significantly varied across land uses ($p<0.05$) with higher mean value from sample collected from transhumance land use systems. There was no significant variation in Vitamin C content across land uses ($p>0.05$) (Table 6). Therefore, land use is a factor to be considered in domestication of the species. Moreover, the high vitamin C indicates the potential that consumption of the fruits can enhance metallic nutrients absorption such as iron. These two vitamins are also among the critical vitamins focused by current human nutrition security.

Nutrition and energy of *Berchemia discolor* compared with conventional crops: The results of the current study of *B. discolor* fruits from east Shewa were compared with data on some Ethiopian major food crops and indicated the superiority of the nutritional quality and their potentials for adoption in dryland agroforestry. In terms of energy, the four WEPs are greater than *Sorghum bicolor* porridge, which is the stable food of semiarid people. Also percentage CHO, crude fat and ash were (>50%) higher than the farm crops (Table 7). This indicates the possibility of integrating the production of WEPs and farm crops to get improved household nutrition/food security.

DISCUSSION

Nutritional value of fruit of *Berchemia discolor*: Driven by hunger, our ancestors ate whatever fruit at hand. Some were acid, or high in tannins or even mildly toxic until very ripe. But the vitamin C content was often high and sometimes extremely high. There would have been times of year when fruit was either not available at all, or scarce. Tairo (2007) has indicated the importance of *B. discolor* in Tanzania.

For our ancestors, fruit contributed to the required 'mix' of energy food, protein, minerals, vitamins and gums, fibre and phytochemicals. Most fruit are relatively poor sources of vitamins (other than vitamin C and vitamin A) and minerals (other than potassium), but fruit, along with leaves and roots, are most important for supplying protectant phytochemicals and ascorbic acid (vitamin C) (*Berchemia discolor* is among indigenous species of social and economic importance which include food from fruit of the trees. Feyssa *et al.* (2011b) has reported the neutraceutical importance of the species.

The comparative analysis demonstrated that wild fruits have high potential as sources of vital nutrients especially for children who are prone to malnutrition and who are the key fruit collectors. Thus, where cereals which form the major part of the food intake are unavailable, the variety and quality of the diet, especially for children, would be reduced essentially to carbohydrates. The data suggested that wild fruits in the study area and almost certainly elsewhere, have great potential not only to bridge the hunger gap but also to supply essential nutrients during times of need.

Contribution of WEPs to household food security and maintenance of biodiversity: The findings of this research have featured the use, management and nutritional composition of *B. discolor*. The fruit is rich in valuable nutrients and is accessible year-round with significant overlap of fruit abundance at times of acute food and nutritional scarcity (Johns and Eyzaguirre, 2002). However, the potential nutritional contribution of wild fruits to the people diets remains largely underutilized. In order to remedy this situation, a wider and sustained acceptance of wild fruits as important dietary components must be fostered through appropriate integration of WEPs in development policy and extension services.

Yet, the potential for more intensively using and possibly further domesticating, a wide diversity of wild-growing plant species is immense (Turner *et al*., 2011). The richness and diversity of wild foods, their contributions to local economies and their diverse modes of preparation are emphasized. Wild food plants contribute more than nutrients; for many people and ethnic groups, the use of wild foods is a source of cultural identity, reflecting a deep and important body of knowledge about the environment, survival and sustainable living known widely as traditional ecological knowledge (Balemie and Kebebew, 2006) . The pattern of the use of wild food plants is strongly affected by culture.

The multiple uses of *B. discolor* as vital component of natural vegetation are environmental and socio-cultural. It contributes to ecosystems diversity and provides habitats for several fauna. The major environmental function of a tree is ecosystem stability, particularly in times of climate change; climate amelioration as shade, soil improvement and water conservation and carbon sink. The major socio-cultural value of a tree is in maintaining traditional lifestyles (building and furnishing houses, traditional celebrations), providing important secondary forest products and medicine and aesthetic practices (Guinad and Lemessa, 2000; Teklehaymanot and Giday, 2010). Hence, *B. discolor* is essential component of this vegetation with multiple uses and services. Knowledge of the effects of anthropogenic factors and land use changes will also help the future management interventions. Wondimu *et al*. (2006) and Balemie and Kebebew (2006) reported that socioeconomic and cultural issues were central in utilization of WEPs in Arsi area and south Ethiopia respectively in Ethiopia.

Local coping and adaptation strategies to climate change and WEPs: Semiarid people of east Shewa have developed various mechanisms of adaptation to climate change. Substituting expensive food with less expensive food, migration in search of pasture and water and self employment seeking are common strategies emerging by the transhumance. The wealthier groups also reduced gifts in bad years, as these strategies are less effective as more people are involved and social returns get very low. Diversifying livelihoods to enable people live on their skills, environment, assets, culture; some may depend primarily on livestock and agricultural production (FAO/IAEA, 2008). Nori *et al*. (2005) stated that, "in order to address these extreme agro-ecological features, pastoralists build their lives around satisfying the needs of their livestock, following rainfall and fodder over vast distances and across national borders, often covering thousands of kilometers in a single year.

Berchemia discolor is perceived to be of high nutrition value but its consumption is not well promoted by the formal production system. Amusa *et al*. (2010) recommended a holistic approach that includes the involvement of the local people in the management of woody species of WEPs. The consumption is very low in Ethiopia compared both in Oromiya National Regional State and Ethiopia compared to 1.3 up to 37.4 kg capita^{-1} year^{-1} for sub-Saharan Africa (Ruel *et al*., 2005) and South Africa, wild fruit consumption per household per year may be about 104 kg (Shackleton and Shackleton, 2004). Developed countries have already promoted their WEPs (Gillman, 2008). This is an indication that Ethiopia needs to work more on sustainable utilization and management of *B. discolor* and other WEPs to improve the food security of rural populations to adapt to climate change. Study report in south Ethiopia by Balemie and Kebebew (2006) strongly support this result. Rural communities depend on wild edible woody plants to meet their food needs in periods of food crisis and the use of wild edible plants in different localities provide optimum source of nutrients (Emmanuel *et al*., 2011). Wild plants are nutritious having adequate vital nutrients. Although, there is no single plant that can provide all adequate level of nutrients required by human being, yet the wild food plants contain many essential nutrients like carbohydrate, protein, ash, crude fibre and moisture content (Emmanuel *et al*., 2011).

The use of wild edible herbs, or wild leafy vegetables, is an important component of the diet of people throughout sub-Saharan Africa (Shackleton, 2003). It offers opportunities to enhance food and livelihood security and poses threats if unsustainably used and possible consequent loss of biodiversity. Therefore, promoting sustainable utilization can contribute to food security and environmental integrity.

CONCLUSIONS

Berchemia discolor is nutritionally rich WEP in terms of major food substances (carbohydrates, proteins, minerals, crude lipids), essential macro and micronutrients. Therefore it can significantly contribute to human nutrition and ecosystem services to enhance human wellbeing. It provides livelihoods in terms of nutrition, income generation, fuel wood, timber, fodder and medicine. However, *B. discolor* is left to the natural forest except the relic tress that are conserved near agricultural and enclosed pasture (kalo) lands. Also, the use of fruits from *B. discolor* is yet dominated by more emphasis given to farm managed crops in settled farmers areas. Hence, there is an increasing tendency to conserve it *in situ* and *ex situ*. Therefore, there is a need to support the local communities to properly utilize the species to enhance the adapting capacity to food insecurity and climate change in drylands.

ACKNOWLEDGMENTS

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)-Rockefeller foundation and IDRC are acknowledged for funding the research. Jimma University, College of Agriculture and Veterinary Medicine (JUCAVM), Ethiopia for providing laboratory and ICT facilities and field vehicles and University of Nairobi for hosting the researchers. People of Boosat and Fantalle district in Ethiopia are acknowledged for valuable information they provided.

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