



E-ISSN: 2278-4136

P-ISSN: 2349-8234

JPP 2019; 8(5): 2173-2181

Received: 19-07-2019

Accepted: 23-08-2019

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## Local plants for food and health security in Sahel countries: Case of an area in the layout of the great green wall of Burkina Faso

**Alphonsine Ramde-Tiendrebeogo, Esaie S Yanogo, Roger Zerbo, Sylvin Ouedraogo, Bakary Diakite and Innocent Pierre Guissou**

### Abstract

The increase in new health problems related to an unbalanced diet calls for promoting local plants with nutritional and therapeutic virtues. A study was conducted in the province of Oubritenga in central Burkina Faso to know these plants. Twenty five (25) nutritional species with therapeutic virtues and high use values (UVs  $\geq 0.50$ ) have been identified. Results also showed that leaves and fruits were the most consumed parts (48%). Leaves were also the most used in medicinal recipes (54%). The trunk bark and fruits were recommended at 28% and 7% respectively. The presence of numerous mineral elements, vitamins, proteins, lipids, carbohydrates and important chemical groups with well-known biological properties justify the use of these therapeutic food plants. Traditional foods can be an important track in finding solutions to chronic disease and malnutrition as well as ensuring food and health security in low-income countries.

**Keywords:** Malnutrition, Sahel, health security, medicinal plants

### Introduction

According to a recent report of United Nations, one-third (1/3) of the population of developing countries estimated at two thousand million persons are deficient in vitamins or in micronutrients. Particularly in sub-Saharan Africa, at least 237 million people suffer from chronic undernourishment [1]. Also, deforestation, drought, desertification caused by anthropogenic activities and climate change are causing accelerated land degradation and affecting the yield of staple food crops.

In addition to these worrisome environmental issues, global health security is threatened by new infectious diseases emerging or re-emerging, highly virulent and communicable such as Ebola, Dengue, Zika or Severe Acute Respiratory Syndrome which have occurred in recent decades and constitute real threats to public health [2]. World Health Organisation estimates that infectious diseases such as HIV, tuberculosis, malaria, viral hepatitis and neglected tropical diseases kill more than four (4) million people each year in some of the world's poorest countries [3, 4]. Huge challenges arise therefore to Sahelian countries of Africa, particularly in the field of food and health security [5].

Burkina Faso, with an area of 274 000 km<sup>2</sup>, is a landlocked country located in the heart of West Africa. The country has drought experienced since 1970 which has allowed desertification to gain ground every year. Burkina Faso is therefore confronted with an ecological crisis due mainly to the combination of climatic and anthropogenic factors supported by a strong demographic growth, inappropriate agricultural practices combined with extensive livestock farming and a strong exploitation of natural resources. Most of its population lives in rural communities and relies heavily on local plant products for their daily lives [6, 7].

Several works have succeeded to justify the importance of the use of traditional medicine by populations of developing countries. Various advances in scientific research have shown that some plants have important pharmacological properties due to the presence of chemical compounds they contain. Indeed, studies have shown that tannins by their astringency have antiparasitic, antibacterial, antidiarrheal properties [8, 9]. Flavonoids in plants have anti-inflammatory, antioxidant, antiradical effects [10, 11]. The presence of coumarins which are recognized for their antispasmodic and spasmolytic effects would justify the use of certain plants in the treatment of digestive disorders [12]. Thus, these active ingredients are used in various galenic forms such as infusions, syrups, decoctions, infused oils, essential oils, ointments and creams [13, 14]. Some plants, in addition to their therapeutic properties, have high

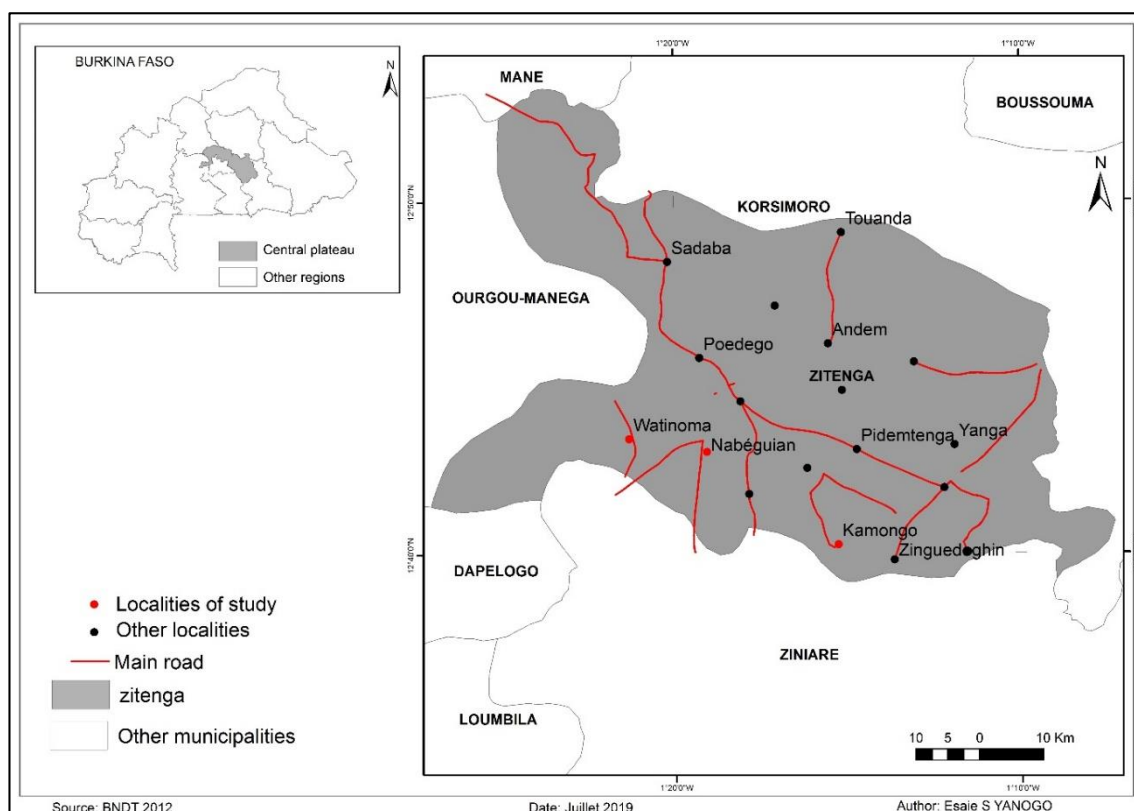
nutritional values. These traditional vegetables are rich in minerals elements (macro and oligo-mineral elements), vitamins, carbohydrates, fats and proteins that allow them to ensure good health and prevent various chronic diseases [15]. However, these plants are very little known. Traditional diets based on the consumption of cereals, vegetables, fruits are replaced by diets rich in fat with a high energy density and a significant amount of meat-based foods. In addition, there is unfortunately the abandonment of the production of local vegetables in favor of exotic ones (tomato, cabbage, pepper, etc.). It is therefore urgent to explore this category of plants, potential sources of new medicinal foods (or natural nutraceuticals) that would contribute to strengthen the resilience of populations to climate variability and extreme events. The aim of this study is to provide scientific documentation on both nutritious and therapeutic plants of the province of Oubritenga in central Burkina Faso.

## Materials and Methods

### Study environment

In order to promote sustainable land management and to restore degraded lands, Burkina Faso like ten other states in

the West African region, has also embarked on the project of the Great Green Wall for the Sahara and Sahel [16]. Thus, the province of Oubritenga located in the central plateau of Burkina Faso is beneficiary of this project. Located between the 11th and 16th parallel inside the Niger loop and straddling two climatic zones, the central plateau is composed of a Sudanese part with ferruginous soil, rich in iron oxide, sandy surface clayey deep and a Sahelian region which, due to lack of water for much of the year is mostly rich in salts and little iron with shallow brown soil (Containing iron) and gray when contain salts [17, 18]. The province of Oubritenga is limited to north-west by Passore, to north-east by Sanmatenga, to south by Kadiogo, to east by Ganzourgou and to west by Kourweogo. It has an area of 8453 Km<sup>2</sup> and seven departments (Absouya, Dapelogo, Loumbila, Nagreongo, Ourgou-Manega, Ziniare and Zitenga) with a provincial capital of Ziniare. Several activities are conducted in Oubritenga province mainly agriculture, trade and livestock. It is the second largest livestock producer in the central plateau region [19]. Three villages in Zitenga commune which are Watinoma, Nabeguian and Kamongo were concerned by the study (Figure 1).



**Fig 1:** Location map of study villages

### Collection of data on food and therapeutic use of plants

The targeted study population was women and traditional healers. The approach consisted of first questioning women in the households and at the level of their groupings (women's associations) on the various local plants (woody and herbaceous) that they use for culinary purposes. Once the names of nutritional plants given in local language by women, we approached the traditional healers of the area to know or confirm the use in traditional medicine of these plants cooked by women. These traditional healers were identified through networks of traditional healers but also on the basis of information provided by local people. The interviews were based on a pre-tested questionnaire with specific questions

about the informant, the local name of the plant species, the edible parts and used in associated medical practices [20]. The interviews were recorded using a dictaphone. In total, 100 people (35 men and 65 women) with an average age of 45 were interviewed. The investigators were guided in the field by agents of Tiipaalga association. This association works in close collaboration with the Great Green Wall in the implementation of an assisted natural regeneration and defending program in order to recover degraded lands and protect the environment [21]. Tiipaalga association helps rural households to manage environmental resources efficiently. Investigators equipped with GPS (GPSmap 62 Garmin) with an accuracy of less than 2 m visited and geo-referenced

recovered sites. The location plan was done using Arcview GIS 3.2 software. Photos of plants of interest were taken. Samples of these plants were harvested and identified by the Botanical team of Ouaga 1 Pr. Joseph Ki-Zerbo University. APG III classification system was used [22]. A herbarium was made.

### Identification of mineral elements, vitamins and chemical groups of plants

A bibliographic research made it possible to know mineral substances (Macro and oligo-mineral elements), vitamins and chemical groups present in the identified plants.

### Data analysis

The importance of each specie was determined by calculation of its use value (*UVs*) according to the simplified formula of Cotton and Wilkie [23].

$$UV_s = \frac{U}{N}$$

U indicate the number of uses where the plant is mentioned and N is the number of informants who mentioned the plant. Data were treated and analyzed with Spss software version 15. The average utilization values of the main parts of plant were compared using one-way analysis of variance (One Way ANOVA). The differences are considered statistically significant for a value of "p less than 0.05".

### Results

Twenty five (25) species with both nutritional and therapeutic virtues have been identified. The information received concerns local name, edible parts, diseases frequently treated by these plants and the most used parts in medicinal recipes. The mineral elements, vitamins and chemical groups found in plants by literature are also shown in Table 1.

**Table 1:** Food plants of therapeutic interest Bibliographic data

Species and family	Local names	Edible parts	Diseases treated	Used parts in medicinal practices	Mineral elements Vitamins and others	Chemical groups found in the plant	References
<i>Acacia macrostachya</i> Rchb. ex DC. Fabaceae-Mimosoideae	Zamanega	Fruit Leaf	Stomach aches Fever	Leaf Trunk bark	Fe, Mg, V, Na, Ca, Vita P	Catechins Saponins Tannins Alkaloids	[24, 25]
<i>Azalia africana</i> Smith Fabaceae-Caesalpinioideae	Kankalga	Fruit Leaf	Hypertension Diabetes	Trunk bark	Vita P	Mucilage Coumarins Tannins Flavonoids	[26, 27]
<i>Adansonia digitata</i> L. Malvaceae	Tohega	Leaf Fruit	Stomach aches Diarrhea	Fruit	Ca, Fe, P, Na, Vita A, Vita B1, Vita B2 Vita B3, Vita C Vita P, Lipids Proteins Carbohydrate	Citric acid, Malic acid, Oxalic acid Mucilage, Pectins Coumarins Catechins Tannins	[28, 29]
<i>Annona senegalensis</i> Pers Annonaceae	Barkudga	Fruit	Edema Fever Snake bites Fractures Sprains	Leaf	Vita C Vita P	Mucilage Pectins Coumarins Tannins	[30, 31]
<i>Balanites aegyptiaca</i> (L.) Delile Zygophyllaceae	Kyegelga	Fruit Leaf	Hypertension Children's wounds Stomach aches	Fruit Trunk bark	Vita B1 Vita B3 Vita C Vita E	Anthocyanins Sterols Triterpenes Tannins Saponins	[28, 30]
<i>Bombax costatum</i> Pellegr. & Vuillet Malvaceae	Voaka	Calyx Leaf	Children's mycosis	Flower	Vita P Vita E	Mucilage Para-coumaric acid Anthocyanins	[32, 33]
<i>Cassia tora</i> Linn. Fabaceae-Caesalpinioideae	Sogoda	Leaf Fruit	Stomach aches Itching	Leaf	Vita A, Vita B1 Vita B2 Vita B3, Vita C	Mucilage Xanthonnes Flavonoids	[34, 35]
<i>Capparis sepiaria</i> Linn. Capparidaceae	Kalyanga	Fruit Leaf	Stomach aches Fever	Trunk bark	Ca, Mg, Vita C Proteins, Gum Carbohydrate Resin	Flavonoids Steroids, Tannins Alkaloids Anthraquinones	[36, 37]
<i>Cleome gynandra</i> L. Brassicaceae	Kiennebdo	Leaf	Diarrhea Cold Fever	Leaf	Fe, Vita F	Para-coumaric acid Gallic acid Vanillin Caffeic acid	[38, 39]
<i>Corchorus olitorius</i> L. Malvaceae	Bulvaka	Leaf	Diarrhea	Leaf	Vita A Vita B2 Vita B3 Vita C	Mucilage Quercetin Caffeoylquinic acid, Glycosids	[40, 41]
<i>Crataeva adansonii</i> DC. Capparidaceae	Kalguem-tohega	Leaf	Jaundice, Fever	Leaf	Vita A, Vita B2, Vita C	Tannins Flavonoids Triterpenoids	[42, 43]
<i>Diospyros mespiliformis</i> Hochst. ex A.DC. Ebenaceae	Gaaka	Fruit Leaf	Vomiting Diarrhea	Trunk bark Fruit	Vita P	Pectins, Tannins Lupeol Betulinic acid Betulin Lupenone	[30, 44]
<i>Hibiscus sabdariffa</i> L.	Biito	Calyx	Diabetes	Leaf	Ca, Fe, P, Vita B1,	Citric acid, Malic acid, Oxalic	[45, 46]

Malvaceae	Wegdo	Leaf	Malaria		Vita B3, Vita P Vita C	acid, Mucilage, Pectins	
<i>Lannea microcarpa</i> Engl. et K. Krause Anacardiaceae	Sabga, Siibi	Fruit Leaf	Stomach aches Diarrhea	Leaf Trunk bark	Vita C	Xanthons, Tannins Terpenoids Steroids Anthocyanins Flavonoids	[30, 47]
<i>Leptadenia hastata</i> (Pers.) Decne. Apocynaceae	Lelongo	Leaf	Malaria	Leaf	Al, Ca, Fe, V Vita A Vita C	Tannins, Favonoids Proantho- cyanidins Alkaloids Saponins	[48, 49]
<i>Maerua angolensis</i> DC (Forsk) Capparidaceae	Zilgo	Leaf	Epilepsy Stomach aches Diarrhea Dysentery	Trunk bark	Ca, Vita C	Flavonoids Tannins Cardiac glycosides Steroids Terpenoids	[50, 51]
<i>Moringa oleifera</i> L. Moringaceae	Arzan-tiiga	Leaf	Hypertension Malaria Diabetes	Leaf Fruit Trunk bark	Ca, Cr, Fe, P, V Vita A, Vita B1 Vita B2, Vita B3 Vita C	Para-coumaric acid, Zeatin Tannins Quercetin, $\beta$ -sitosterol Caffeoylquinic acid, Kaempferol	[52, 53]
<i>Parkia biglobosa</i> (Jacq.) R. Br. ex G. Don Fabaceae-Mimosoideae	Roaga	Fruit	Snake bites Stomach aches	Leaf Trunk bark	Ca, Fe, Vita A Vita B1, Vita B2 Vita C	Cardiac glycosids Steroids, Tannins Alkaloids Saponins	[28, 54]
<i>Piliostigma reticulatum</i> (DC.) Hochst. Fabaceae- Caesalpinioideae	Baguende	Leaf	Varicella Stomach aches	Leaf Tunk bark	K Vita C Vita P	Saponins Tannins Phlobatinins Glycosids	[55, 56]
<i>Saba senegalensis</i> (A. DC) Pichon Apocynaceae	Weeda	Fruit	Itching Children's mycosis	Leaf	Ca, Vita A Vita C	Citric acid, Malic acid, Terpenoids Steroids Carotenoids	[30, 57]
<i>Sclerocarya birrea</i> (A.Rich.) Hochst. Anacardiaceae	Noabga	Fruit	Malaria Stomach aches Eye pain Diabetes Bad spirit	Leaf Trunk bark	Ca, Mg, K, P Vita C	Citric acid Malic acid Catechins Tannins	[58, 59]
<i>Strychnos innocua</i> Del. Loganiaceae	Pootr poiga	Fruit Leaf	Malaria	Leaf Trunk bark	Ca Vita C	Terpenes Sterols Flavonoids	[60, 61]
<i>Tamarindus indica</i> L. Fabaceae- Caesalpinioideae	Pusga	Fruit Leaf	Malaria General tiredness Stomach aches Children's mycosis	Trunk bark	K Vita C Vita K3 Vita P	Citric acid Malic acid Pectins Tannins Flavonoids Anthocyanins Sterols Triterpenes	[28, 62]
<i>Vitellaria paradoxa</i> C.F. Gaertn. Sapotaceae	Taanga	Fruit	Malaria Stomach aches Diarrhea Children's mycosis	Trunk bark	Vita E Vita F	Para-coumaric acid, Catechins Gallic acid Epigallocatechins Cinnamic acid	[28, 63]
<i>Ziziphus mauritiana</i> Lam. Rhamnaceae	Mugunuga	Fruit	Stomach aches	Root	Vita A, Vita B3 Vita C, Vita K1 Vita E	Mucilage, Pectins Catechins Flavonoids	[28, 30]

Results showed that diseases most treated by these food species were mainly digestive disorders (stomach aches, diarrhea), malaria and its associated symptoms, children's mycosis. Other important diseases such as hypertension and diabetes are also treated by some of these food species. Leaves were the most consumed parts in food (48%) and also the most used in medicinal recipes (54%). Fruit consumption

was also very important (48%). The trunk bark and fruits were recommended for healthcare at 28% and 7% respectively. 19% of the plants listed were herbaceous against 81% of woody species. Some of them were distinguished from others by their high use value (UVs  $\geq 0.60$ ). These plants are used in the treatment of the most common diseases (Figure 2 and 3).





**Fig 2:** Food species most used in the treatment of digestive disorders in the study villages



**Fig 3:** Food species most used in the treatment of malaria and its associated symptoms



## Discussion

The intimate relationship that Man has developed with the environment around him has taught him to discern plant resources for food and healing. Twenty five (25) plants with both nutritional and therapeutic values have been identified. The use values greater or equal to 0.5 (UVs  $\geq 0.50$ ) for all species indicate that these plants are well known and used by populations. The presence of numerous mineral elements such as Ca, Mg, P, Na, Al, Fe, K, V, vitamins A, B1, B2, B3, C, F, K1, P, E, proteins, lipids and carbohydrates as shown by previous work justify the food use of these different local plants. Results showed that the diseases most frequently encountered by the populations were digestive disorders (Stomach aches, diarrhea), malaria and its associated symptoms. Our results support previous work which had showed that infectious and digestive diseases are the most common in Burkina Faso [64, 65]. The presence of compounds such as tannins, citric acid, p-coumaric acid, mucilage, xanthenes, catechins known for their astringent, antidiarrheal, antispasmodic, spasmolytic, laxative, antibacterial, antiparasitic effects and their efficiency against difficult digestion, would justify the use of certain plants containing them such as *Acacia macrostachya*, *Adansonia digitata*, *Balanites aegyptiaca*, *Bombax costatum*, *Capparis sepiaria*, *Cassia tora*, *Corchorus olitorius*, *Diospyros mespiliformis*, *Lansea microcarpa*, *Maerua angolensis*, *Parkia biglobosa*, *Piliostigma reticulatum*, *Tamarindus indica*, *Vitellaria paradoxa*, *Ziziphys mauritiana* in the treatment of digestive disorders. Flavonoids in plants are recognized for their antiparasitic, anti-inflammatory, antipyretic, antioxidant and antiradical properties [10, 11]. This could explain the use of certain plants such as *Azvelia Africana*, *Annona senegalensis*, *Balanites aegyptiaca*, *Crataeva adansonii*, *Hibiscus sabdariffa*, *Leptadenia hastata*, *Moringa oleifera*, *Sclerocarya birrea*, *Strychnos innocua*, *Vitellaria paradoxa* containing them in the treatment of malaria and its associated symptoms. Other important diseases such as diabetes and hypertension, skin-dermatological disorders are treated by some food plants. Results also showed that leaves and fruits were the most consumed in food (48%). Leaves were also the most used in medicinal recipes (54%). The trunk bark and fruits were recommended for healthcare at 28% and 7% respectively. There is a need to raise awareness in order to avoid misuse of parts (trunk bark). The use of leaves is therefore to be encouraged because it has a double advantage, firstly because being the site of synthesis of secondary metabolites, leaves contain many chemical groups, but also because the use of leaves prevents the destruction of the plant and preserve its longevity [66, 67]. Increasing awareness of better nutrition has established a direct link between healthy nutrition and good health or conversely between malnutrition and the appearance of certain diseases. Thus, to cope with the new health problems related to an unbalanced diet (diabetes, cholesterol, obesity, etc.), some developed countries have rediscovered with the help of dietary advice, the positive or even curative action of certain foods or plants [68]. The current trend is thus converging towards health food. Indeed, many studies have proved the efficiency of nutraceuticals which are defined as foods whose specific properties go beyond the simple nutritive effect associated with the nutrients they contain [69, 70]. Traditional foods can be an important track in finding solutions to chronic disease and malnutrition as well as ensuring food and health security in low-income countries.

## Conclusion

The objective of this study was to make known plants with both nutritional and therapeutic virtues of Oubritenga province in Central Burkina Faso. Results obtained showed the presence of many plants containing important phytonutrients. These results constitute an essential scientific documentation for the development of new natural nutraceuticals in order to reinforce food and health security in Sahel countries.

## Thanks

We thank Total Foundation for financing the project

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