

PROCEEDINGS OF THE FOURTH
INTERNATIONAL CONGRESS OF
ETHNOBOTANY
(ICEB 2005)

21-26 August 2005
Istanbul - Turkey

“Ethnobotany: At the Junction
of the Continents and the Disciplines”

Hosted and sponsored by
Yeditepe University

Edited by
Z. Füsün ERTUĞ

(Offprint)



Y A Y I N L A R I

2006

Proceedings of the IVth International Congress of Ethnobotany
(ICEB 2005)
Yeditepe University
Istanbul, 21-26 August 2005

ISBN: 975-807-153-X
© 2006 Ege Yayınları

Edited by
Z. Füsün Ertuğ

Graphic design
Hülya Tokmak
Zero Prod. Ltd.

Cover design
Ender Yeşildağ

Printed by
Mas Matbaacılık A.Ş.

First Edition
November 2006, Istanbul

Proceedings of the Fourth International Congress of Ethnobotany (ICEB 2005)
Yeditepe University, Istanbul 21-26 August 2005, Z. F. Ertuğ ed.,
Ege Yayınları, Istanbul, 2006.

All rights reserved. No part of this book may be used or reproduced
in any manner without written permission of the publisher and the authors.

Publication and Distribution
Zero Prod. Ltd.
Arslan Yatağı Sok. Sedef Palas, 35/2 Cihangir 34433 Istanbul-Turkey
Tel: +90 (212) 244 75 21 - 249 05 20 Fax: +90 (212) 244 32 09
e-mail: info@zerobooksonline.com
www.zerobooksonline.com

Table of Contents

Table of Contents	iii
Organizers of ICEB 2005	xi
A Brief History of the ICEB	xii
Panel and Workshop Descriptions	xiii
Foreword and Acknowledgements	xvii

PLENARIES

Montserrat GISPERT CRUELLES

A novel approximation to the alimentary culture from an ethnobotanical perspective	1
--	---

Vernon H. HEYWOOD

Biodiversity, global change and human health	9
--	---

Ghilleen T. PRANCE

Some current challenges facing the indigenous peoples of South America	21
--	----

Nancy J. TURNER

Lessons from the grandmothers: Women's roles in traditional botanical knowledge and wisdom in Northwestern North America	27
--	----

PANEL 1: Ethnobotanical Studies of Wild Plant Foods

Achille Ephrem ASSOGBADJO, E. DE CALUWÉ, Brice SINSIN, J.T.C. CODJIA, Patrick VAN DAMME

Indigenous knowledge of rural people and importance of baobab tree (<i>Adansonia digitata</i> L.) in Benin	39
---	----

Manuel PARDO-DE-SANTAYANA, Javier TARDÍO, Ana Maria CARVALHO, Juan José LASTRA, Elia SAN-MIGUEL, Emilio BLANCO, and Ramón MORALES

Diversity and selection of wild food plants in six regions of Northwestern Iberian Peninsula (Spain and Portugal)	49
---	----

Nancy J. TURNER

From the roots: Indigenous root vegetables of British Columbia, their management and conservation	57
---	----

Gisella CRUZ GARCÍA

Children's knowledge and valuation of wild food plants: The influence of an educational program with tribal and non-tribal children in Western Ghats, India	65
---	----

Luís S. DIAS and Alexandra S. DIAS

Herbs and spices in traditional recipes of Alentejo (Portugal)	69
--	----

M. en C. Argelia DÍAZ RICO

Ethnobotany of nourishing plants cultivated and utilized by the ethnic group Mixteco in Tepunte, Guerrero State, Mexico	73
---	----

Judith ESPINOSA-MORENO, Dora CENTURION-HIDALGO, Jaime Gabriel CAZARES-CAMERO

Edible weeds associated to agricultural plots in Tacotalpa, Tabasco, Mexico	77
---	----

Ian C. FITZPATRICK

A study of recognition, transmission, and use of wild-food plants in two Wichí communities of the Argentine Chaco	79
---	----

Peter GIOVANNINI Management, biology and cultural importance of a wild food species in the Tehuacán Cuicatlán Valley, Mexico: The case of <i>Enterolobium cyclocarpum</i>	83
Müberra KOŞAR, Mehmet KOYUNCU, and K.Hüsnü Can BAŞER Folk use of some wild and cultivated <i>Allium</i> species in Turkey	87
Şinasi YILDIRIMLI and Aslı DOĞRU KOCA Uses of some Turkish <i>Asparagus</i> and <i>Tamus</i> species as food	91
Ersin YÜCEL and Gülçin YILMAZ Consumption ways of some <i>Rumex</i> species as food in Turkey	93
PANEL 2: Ethnobotanical Studies on Medicinal and Aromatic Plants	
Paul HERSCH-MARTINEZ Current challenges and scenarios regarding the integration of medicinal plants popular knowledge and formal health systems in Mexico	95
Narayan P. MANANDHAR Native phytotherapy among rural population of Nepal	101
María Rosa MARTINEZ, María Lelia POCHETTINO, Marta CRIVOS, Carolina REMORINI, and Anahí SY Gathering and circulation of medicinal plants in a pluricultural context (Misiones, Argentina)	107
Muhammad Ibrar SHINWARI and Maryum Ibrar SHINWARI Ethnobotany of medicinal and aromatic plants in Pakistan: An Overview	115
Paolo Emilio TOMEI, Rita Elisabetta UNCINI MANGANELLI, Serena TRIMARCHI, and Fabiano CAMANGI Ethnopharmacobotany in Italy: State of knowledge and prospect in the future	123
Duygu F. ALPARSLAN and Ertan TUZLACI The folk medicinal plants of the European part of Turkey	129
Kemal Hüsnü Can BAŞER, Gülendamar TÜMEN, Hulusi MALYER, and Neşe KIRIMER Plants used for common cold in Turkey	133
Rachid BELHATTAB, Georgios KALANTZAKIS, and Dimitrios BOSKOU Antioxidant activity and total phenolic content of two plants belonging to the Lamiaceae family: <i>Origanum glandulosum</i> Desf. and <i>Marrubium vulgare</i> L.	139
Gülşah ÇOBANOĞLU, Cenk SESAL, Yıldız AYDIN, Müşerref ÖZEREN MORGAN, and Zeki SEVEROĞLU The antimicrobial and the antifungal effects of some lichens with a potential medical and economic use in Turkey	143
Burcu ELÇİ-TARIKAHYA, Sadık ERİK, and Ziver BERKMAN Some anticarcinogenic plants and their usage in the Güdül District (Ankara-Turkey)	147
José Salvador FLORES GUIDO, Rita VERMONT-RICALDE, and Jesús KANTÚN Aromatic plants and their application in traditional medicine at the Mayan communities of the Yucatan Peninsula	151
Paolo Maria GUARRERA and Maria Lucia LEPORATTI Analogies and divergences in the use of medicinal plants in different areas of Central and Southern Italy	155
Maria Lucia LEPORATTI and Kamel GHEDIRA Popular phytotherapy in Italy and Tunisia, a preliminary comparison	159
Emi OKUYAMA, Samir Kumar SADHU, Shunsuke YAMAMOTO, Haruhiro FUJIMOTO, Masami ISHIBASHI, and Erdem YEŞİLADA Prostaglandin-inhibitory and antioxidant components of <i>Cistus laurifolius</i> , a Turkish medicinal plant	163

Serap ÖZ AYDIN, Tuncay DİRMENCİ, Gülendam TÜMEN, and Kemal Hüsnü Can BAŞER Plants used as analgesic in the folk medicine of Turkey	167
Johanna PUTSCHER and Christian R. VOGL An ethnobotanical survey on herbal medicine in Quito markets	173
Erika RIVERA-ARCE, X. LOZOYA, R. ALVARADO, E. ZÁRATE, J. AGÜERO, M. CHÁVEZ, and M. GATTUSO Ethnobotany and pharmacognosy of the Mexican Plant Drug: <i>Mimosae tenuiflorae</i>	177
G. Maria SALUD PÉREZ, Miguel A.S. ZAVALA, Daniel M. ZAVALA, and Cuauhtemoc G. PÉREZ Anti-diarrhoeal activity of <i>Chysactinia mexicana</i>	181
G. Maria SALUD PÉREZ, Miguel A.S. ZAVALA, Cuauhtemoc G. PÉREZ, and Daniel M. ZAVALA Anti-diarrhoeal effect of different extracts of <i>Bidens odorata</i>	185
Chandrakant B. SALUNKHE and N.K. DRAVID Little known medicinal uses of some flowering plants of Maharashtra, India	189
Cristina P. SÁNCHEZ ROJAS, M. Reyes GONZÁLEZ-TEJERO, José M. RAMIRO GUTIÉRREZ, M. CASARES PORCEL, and J. MOLERO MESA Ethnobotany in Sierra de Huelva (South Spain): Medicinal plants	193
Sara SANTOS, Ana I.D. CORREIA, A. Cristina FIGUEIREDO, Luís S. DIAS, and Alexandra S. DIAS The use of herbal remedies in urban and rural areas of the Setúbal Peninsula (Portugal): A study among elders	197
Fatih SATIL, Tuncay DİRMENCİ, and Gülendam TÜMEN The trade of wild plants that are named as <i>Thyme (kekik)</i> collected from Kazdağ	201
Muhammad Ibrar SHINWARI and Maryum Ibrar SHINWARI Ethnobotanical study of medicinal and aromatic plants of moist temperate Himalayas in Pakistan	205
Mitra TAGHIZADEH, Mohamad Reza SALEHI ALEA, and Mahshid TAGHIZADEH The efficacy of a herbal mouthwash on the control of gingivitis	209
Zeynep TUNALIER, Neşe KIRIMER, and K. Hüsnü Can BAŞER Demise of a 60-year old Turkish herbal medicine: Lityazol Cemil	213
Gülendam TÜMEN, Hulusi MALYER, K. Hüsnü Can BAŞER, and Serap ÖZ AYDIN Plants used in Anatolia for wound healing	217
PANEL 3: Plant Use of Farmers and Pastoralists	
Patricia C. ANDERSON Non-mechanised processing and storage of cereals, grasses and pulses used for fodder, fuel, food and crafts: Examples from N. Tunisia, Atlas Region, Northwestern Tell	223
Christian Christian BERTSCH, R. VOGL, and Carolina Joana DA SILVA Ethnoveterinary medicine for cattle and horses in the Northern Pantanal Matogrossense, Brazil	233
Jeanne T. GRADE and Patrick VAN DAMME Goat's self-medication against internal parasites in Karamoja, Uganda	241
Natesan PUNNIAMURTHY Ethno Veterinary Medicine (EVM): Use of fresh herbal extracts under field conditions for primary veterinary health care in India	249
Tedje VAN ASSELDONK and Helen BEIJER Herbal folk remedies for animal health in the Netherlands	257
Manuela MANCA and Tania MANCA Uses of plants by shepherds in working process of milk in the village of Bitti (Sardinia, Italy)	265
Jose MARTÍNEZ GONZÁLEZ and Juan Jose LASTRA MENÉNDEZ Ethnobotanical study of the cattle farmers profile in the Aller Valley (Asturias, Spain)	269

Antonio C. PERDOMO-MOLINA The use of local fig tree varieties (<i>Ficus carica</i> L.) for animal feed purposes in the Canary Islands (Spain)	273
Ila SHRESTHA and Keshab SHRESTHA Medicinal plants in ethnoveterinary practices in Langtang National Park, Nepal	277
Lucia VIEGI, Simonetta BULLITTA, and Giovanna PILUZZA Traditional veterinary practices in some rural areas of Sardinia (Italy)	281
Lucia VIEGI, Ignazio CAMARDA, and Giovanni PIRAS Some aspects of ethnoveterinary medicine in Sardinia (Italy)	285
PANEL 4: Reproduction and Transmission of Botanical Knowledge and Technology in Basketry and Plaited Artifact	
Belle ASANTE Reviving sustainable plant-based crafts when recent trends favor synthetic fiber usage: Stylistic vicissitudes of Harari baskets in Ethiopia	289
Z. Füsün ERTUĞ An overview of the plaited crafts of Turkey (Anatolia and Thrace)	297
Dario NOVELLINO Weaving traditions from Island Southeast Asia: Historical context and ethnobotanical knowledge	307
Dario NOVELLINO An account of basket weaving and the use of fibre plants in the Mount Aurunci Regional Park (Central Italy)	317
Sonia A. VOUGIOUKALOU Weaving knowledge and weaving plants: What will survive the 21st century?	327
Ana Maria CARVALHO, Manuel PARDO-DE-SANTAYANA, and Ramón MORALES Traditional knowledge of basketry practices in a Northeastern Region of Portugal	335
Giovanni PIRAS Plant-derived utensils employed in traditional agro-pastoral activities in Northwest Sardinia, Italy	339
José M. RAMIRO GUTIÉRREZ, M. Ramirez GONZÁLEZ-TEJERO, and Cristina P. SÁNCHEZ-ROJAS Ethnobotany in Huelva province (Spain): Basketry and woodcarving	343
Javier TARDÍO, Laura ACEITUNO, and Ramón MORALES The use of plant-based brooms in the province of Madrid (Spain)	347
PANEL 5: Biodiversity and Genetic Resources	
Francisco BASURTO, Virginia EVANGELISTA, Myrna MENDOZA, and Miguel Angel MARTINEZ ALFARO Food fruits of home gardens and coffee plantations in the Sierra Norte de Puebla, Mexico	351
Nina L. ETKIN Wild plant management in rural Hausaland: Local ecological knowledge contributes to the conservation of biodiversity	359
Vernon H. HEYWOOD Human use of plant resources - the knowledge base and conservation needs	365
Amin U. KHAN Demonstrating the forgotten values of a threatened thorn forest community at an archaeological site: The case for popularizing values in an illustrative manner	373
Miguel Ángel SERRATO CRUZ and Juan Saúl BARAJAS PÉREZ <i>Tagetes filifolia</i> Lag.: A Mexican genetic resource	377

Rosa María FLORES-SERRANO, J. Salvador FLORES, Rosario ITURBE, and Guillermina PÉREZ Plant diversity and soil contamination (hydrocarbons and metals): A case study in Ciudad Madero, Tamaulipas, Mexico	383
PANEL 6: Continuity and Change in Food and Medicine: Archaeobotany and the Written Record	
Sabine BECKMANN Root, resin, red and ritual purification - The role of terebinth in Eastern Mediterranean Bronze Age cult	387
Aylen CAPPARELLI, M. Lelia POCHETTINO, Andreoni DIEGO, and Rubén D. ITURRIZA Differences between written and archaeological record: The case of plant micro remains recovered at a Northwestern Argentinean Pipe	397
Patricia A. CLARK Iatrosophia and oral traditions: A case study in Crete's Amari valley	407
Tracey LU The exploitation of Taro in South China	413
Peter J. MATTHEWS Written records of Taro in the Eastern Mediterranean	419
Fragkiska MEGALOUDI Kollyva and funeral bread offerings in Greece: The example of Thasos Island	427
Rolando M.D. NERI-VELA The Badianus Codex and Ophthalmology	431
Alexandra LIVARDA and Georgia KOTZAMANI Plant lore in 'Dark Age' Greece: Archaeobotanical evidence from Lefkandi, Euboea, literal sources and traditional knowledge combined	435
Emel OYBAK DÖNMEZ Plant use at Early Bronze Age Gre Virike (Şanlıurfa, Turkey)	439
PANEL 7: Capturing Local Perceptions and Priorities of Ethnobotanical Resources	
Lilian GONZALEZ-CHEVEZ and Paul HERSCH-MARTINEZ Medicinal ethnobotany and meaning construction. A semiotic analysis of plants through representations and practices of some illnesses from the Nahua culture of Guerrero, Mexico	443
Ramón MORALES, Manuel PARDO-DE-SANTAYANA, and Javier TARDÍO The perception of plants in the complete works of Cervantes, particularly "Don Quijote"	451
Manuel PARDO-DE-SANTAYANA and Elia SAN-MIGUEL The gender of plants according to popular nomenclature in the North of Spain	461
Miguel Ángel SERRATO-CRUZ <i>Cempoalxochitl</i> : A Mexican flower symbolizing the human	467
Barbara FRUTH and Musuyu MUGANZA Traditional use of wild rainforest plants by the Nkundo, Democratic Republic of Congo (DRC)	471
PANEL 8: Gender Issues in the Ethnobotanical Research	
Erika FRIEDL Old plants and new woman in the Zagros Mountains, Iran	475
Martina Aruna PADMANABHAN Governing the use and conservation of agricultural biodiversity: Institutional and gender analysis of rice cultivation in South India	483
Begum SHAHEEN and Mohammad Adnan SAHIBZADA Role of women in collection, processing and marketing of medicinal plants in Roringar Valley, Swat, Pakistan	491

Nancy J. TURNER “Those Women of Yesteryear”: Woman and production of edible seaweed (<i>Porphyra abbotiae</i>) in Coastal British Columbia, Canada	499
PANEL 9: Conservation and Development: Ethnobotanical Discipline at Ethical and Professional Crossroads	
Anil K. GUPTA Ethical issues in accessing people’s knowledge and innovations for developing low cost health technologies	507
Sarah-Lan MATHEZ STIEFEL and Madyo D.N. COUTO Linking applied ethnobotany to social learning: A participatory tool for the promotion of indigenous plants use in Matutuíne, Southern Mozambique	517
PANEL 10: Theory and Methodology in the Study of Ethnobotany	
Montse RIGAT, M. Àngels BONET, Sònia GARCIA, Teresa GARNATJE, Joan VALLÈS Ethnobotanical studies in the High River Ter Valley (Pyrenees, Catalonia, Iberian Peninsula)	523
Ignazio CAMARDA Ethno-systematic of Sardinian flora as a scientific system	527
Dora CENTURION-HIDALGO, Jaime Gabriel CAZARES-CAMERO, Judith ESPINOSA-MORENO, and Alberto MAYO-MOSQUEDA Ethnobotanical study of Arecaceae of Tabasco’s Sierra of Mexico	531
Melissa CEUTERICK and Patrick VAN DAMME Indigenous use, nomenclature and classification of plants in a Nahuatl-speaking village in the Balsas-Basin, Guerrero, Mexico	533
César del C. LUNA-MORALES Science, traditional knowledge and ethnobotany	537
Maryum Ibrar SHINWARI and Muhammad Ibrar SHINWARI Nomenclatural ambiguity found about herbal crude drug material used in <i>Unani</i> Medicines of Pakistan ...	541
PANEL 11: Transmission, Contact and Exchange of Plant Resources and Knowledge Between Regions: Historical and Contemporary Approaches	
Amélia FRAZAO-MOREIRA Arabic Gum: From its historical importance in the global markets to its contemporary significance in the local context of Mauritania	545
Stefanie KLAPPA Sago and the settling of Sahul: how present patterns of plant use may illuminate subsistence prehistory ...	551
Carlos R. RAMIREZ SOSA Quantitative ethnobotany in El Salvador, Central America: A model to study ethnobotanical knowledge dynamics	557
Özge SAMANCI Vegetable Patrimony of the Ottoman Culinary Culture	565
BROAD SPECTRUM STUDIES	
Hugo J. DE BOER and Anneleen KOOL Ethnobotany at Uppsala University	571
Ali A. DÖNMEZ and S. Olga BAYRAKTAROĞLU Plants of the <i>İnce Memed</i> : A novel written by Yaşar Kemal	573
Ali A. DÖNMEZ, Emel OYBAK DÖNMEZ, and Serap IŞIK Cultivation of the saffron (<i>Crocus sativus</i> L.) in Türkiye and saffron stories	577

Gizem EMRE BULUT and Ertan TUZLACI An ethnobotanical study in Bozcaada (Çanakkale-Turkey)	581
Fatma GÜNEŞ The ethnobotanical importance of some <i>Lathyrus</i> (Fabaceae) species	585
İbrahim İlker ÖZYİĞİT, Nermin GÖZÜKIRMIZI, and Belma D. SEMİZ <i>Agrobacterium</i> -mediated transformation of cotton: <i>Gossypium hirsutum</i> L. “Çukurova 1518” from Turkey	589
Veerambakkam S. RAMACHANDRAN and Jaya VIJAYAN Contribution to the knowledge of non-timber products from tropical forests: A case study from Walayar Range, Palakkad district, Kerala, India	593
Parviz REZVANI MOGHADDAM and Motlagh AHMADZADEH Agronomical studies of black cumin (<i>Nigella sativa</i>) as a new crop in dry and semi dry agricultural system of Iran	597
Daiva SESKAUSKAITE Plants in Lithuanian Folk Songs	601
Serdar Gökhan ŞENOL, Özcan SEÇMEN, and Emin UĞURLU Some ethnobotanical uses in the rural areas of Ödemiş, Tire, Kiraz (İzmir-Turkey)	605
Tedje VAN ASSELDONK and Arend De HAAS Spontaneous foraging behavior of primates in outdoor enclosures	609
Şinasi YILDIRIMLI, Aslı DOĞRU KOCA, and Muhittin DİNÇ The Turkish folk plant names and some uses	613
CATALOGUE OF THE BASKETRY EXHIBITION	617
Dario NOVELLINO and Z. Füsün ERTUĞ General Introduction “Baskets of the World” the Social Significance of Plaited Crafts	619
Dario NOVELLINO An introduction to basketry in Island Southeast Asia	621
The Philippines (Oriental Mindoro)	626
The Philippines (Southern Palawan)	628
The Philippines (Northern-Central Palawan)	631
Borneo-Indonesia (West/Central Kalimantan)	634
Rajinda K. PURI Indonesia (East Kalimantan)	636
Rachel CHUA Eastern Malaysia (Sabah)	638
Roy F. ELLEN Indonesia, the Moluccas (South Central Seram)	640
Sonia VOUGIOUKALOU An introduction to basketry in Polynesia	643
Polynesia, South Pacific (The Cook Islands)	645
Mary BUTCHER An introduction to basketry in Japan	646
Japan (Kyushu Island)	648

Belle ASANTE	
An introduction to basketry in Africa	649
Africa (Ethiopia)	653
M. El HAOUZI and Gary J. MARTIN	
Africa (Morocco)	655
Maurice BICHARD	
An introduction to basketry in the Mediterranean	658
Dario NOVELLINO	
Central Italy (Maranola)	664
Francesco MINONNE, Concetta MELE, Antonella ALBANO, and Silvano MARCHIORI	
Salento (Apulia), Southern Italy	668
Ana Maria CARVALHO	
Northeastern Portugal (Trás-os-Montes)	669
José M. RAMIRO GUTIÉRREZ, M. Reyes GONZÁLEZ-TEJERO, and Cristina P. SÁNCHEZ ROJAS	
Spain (Huelva Province)	671
Z. Füsün ERTUĞ	
Turkey	673
Turkey (Aksaray)	677
Turkey (Buldan-Denizli)	678
Turkey (Bodrum-Muğla)	679
Mesut KIRMACI, Zahide ŞAHİN, and Serhat MANAV	
Turkey (Aydın)	680
Hasan AKAN	
Turkey (Mardin)	682
Josephine POWELL	
Turkey (Anatolia)	683
Mary BUTCHER	
An introduction to basketry in Eastern and Central Europe	684
Daiva ŠEŠKAUSKAITĖ	
Lithuania (Sargeliai)	688
Index of the Authors and Organizers	691

Indigenous knowledge of rural people and importance of Baobab tree (*Adansonia digitata* L.) in Benin

ASSOGBADJO, Achille Ephrem¹, E. DE CALUWÉ², Brice SINSIN¹, J.T.C. CODJIA¹ and Patrick VAN DAMME²

¹ Faculty of Agronomic Sciences, University of Abomey-Calavi, 05 BP 1752, Cotonou (Akpakpa-Centre), Benin assogbadjo@yahoo.fr

² Faculty of Biosciences Engineering, University of Gent, Coupure Links 653, B-9000, Gent, Belgium patrick.vandamme@ugent.be

This study is related to the ethnobotany and nutritional importance of the baobab tree in Benin. Laboratory analyses were performed on baobab seeds, leaves and pulp in order to obtain their chemical composition. Ethnobotanical investigations with fourteen ethnic groups provided information about the food and medicinal uses, processing and preservation of baobab's products by local people. Each part of the tree is used as food or for medicinal purposes. Local populations have traditional ways of processing baobab products for subsequent auto-consumption, marketing and preservation. In some ethnic groups, baobab tree has important cultural value and is used in worship. Laboratory analyses show that fruit pulp and leaves are poor in lipids (from 0.41% to 1.69%) and protein (3.28%). On the other hand, the seed is very rich in protein (33.88% DM) and lipid (28.28% DM). The different organs from the baobab tree contain high values of micronutrients (Ca, Mg, Fe, K, Zn) ranging from 0.176‰ to 0.332‰, and can thus be used in formal food preparations.

Key words: *Adansonia digitata*, baobab tree, ethnobotany, micro-nutrients, processing, Benin

The majority of small-scale farmers in Africa live in fragile and marginal environments characterised by low soil fertility and limited water, high pest and disease pressure and poor access to markets. As a result, farm productivity is often low leading to low farmer household incomes and food insecurity. These problems could be solved through agricultural diversification by means of valorizing all resources and developing new production systems. This needs a better knowledge of the potential of natural resources available and already integrated to the cultural norms of rural populations. Among these resources, the baobab, a multipurpose species, is involved in the life of populations in Africa (Sidibé and Williams 2002). The species contributes to populations' income (Addy et al. 1995; Igboeli, Addy, and Salami 1997; Obizoba and Amaechi 1993) and has various medicinal and food uses (Barminas, Carles, and Emmanuel 1998; Delisle et al. 1997; Sena et al. 1998; Sidibé et al. 1996; Sidibé and Williams 2002; Yazzie et al. 1994). In Benin, studies on baobab are recent with the work of Codjia et al. (2001) and Assogbadjo et al. (2005a; 2005b). The

present study aims to show the importance of baobab in the cultural background of different ethnic groups in Benin and to point out its role in human food and nutrition.

Material and methods

Ethnobotanical survey

The study was done with different ethnic groups distributed in Benin. The following ethnic groups were considered:

- In Southern-Benin: Adja, Fon, Mina, Goun and Yoruba;
- In Central-Benin: Datcha, Mahi and Nago;
- In Northern-Benin: Dendi, Otamari, Djerma, Haoussa, Peulhs and Lokpa.

Both individual and group interviews were done using a structured questionnaire. The interviews allowed capitalizing indigenous knowledge on the species. We investigated the different uses of the species' organs, their processing technologies, the cultural role of the species in rural area, its uses as medicines for the treatment of some diseases. Moreover, the different criteria used by local

population to characterize different types of the species and the cultural role of the tree were also investigated.

Laboratory analyses

Physico-chemical analyses were performed in the laboratory of biochemistry and food microbiology, and the laboratory of soil sciences, at the University of Abomey-Calavi, Benin. These analyses were performed on the leaves, the seeds and the pulp. Moisture content, minerals, vitamins, and macronutrients were determined using AOAC (1984). The analyses were performed on triplicate basis on randomly selected samples, and mean values were calculated.

Results

Food uses and traditional processing of baobab's organs

Almost all baobab's organs are used for food purposes (Table 1). The freshly harvested leaves are sun dried, milled, sieved and a green powder is obtained. This powder is used as flavoring agent in sauce preparation (99%). Leaves are also directly used as leafy vegetable (91%). In northern Benin, leaves are used by some ethnic groups to prepare a sauce named *tutonakankounti* in Otamari area and *Kô Foy Tayo* in Dendi and Djerma areas. These linguistic denominations mean sauce of baobab fresh leaves. This sauce is eaten with millet, corn or sorghum dough. In Northern Benin, a survey among households revealed that the leaves are daily consumed, the whole year, by local

populations. In contrary, in the ethnic groups from southern Benin (Fon, Mina, Adja) and the ones from central Benin (Datcha and Mahi), rural populations rarely use or almost don't use baobab leaves for sauce preparation. In these areas, indigenous knowledge are not very developed on the species, that is most of the time, considered as a refuge for witches.

The pulp is used in the preparation of drinks (64%), sour dough (64%), gruel (54%) and as dessert (16%) (Table 1). An appreciable quantity of pulp is mixed with water and the mixture is further sieved and give a nice drink named *Kô ba you* by Djerma and Dendi ethnic groups. This drink is often consumed by farmers (Fig. 1) during harvest of agricultural products. The *mutchoyan* in Otamari, is sour dough made with baobab pulp and cereals flour. Figure 2 shows the technological procedure. The pulp is also used as a substitute of milk, and is hence added to gruel in Dendi, Haoussa and Djerma ethnic groups. In Dendi area, this type of gruel is especially given to people during burial ceremonials of old persons (70 to 80 years). It aims to decrease thirst of people from the cemetery. The pulp is also mixed with millet or sorghum flour and the mixture is used to prepare a gruel named *Kö koumandi* which is mostly consumed during shortage periods.

From baobab seeds, the kernels are extracted. Kernels are used to prepare many traditional protein extracts that are consumed as flavouring agents in sauce. A sauce named *mantofaman* in Otamari area is recommended for people suffering from hypertension.

Table 1. Percentage of persons using baobab's organs for food purposes

Organs Food uses	Leaves	Fruit/Capsule			Flower	Root of young plants	Bark	Branches	Trunk
		Pulp	Seeds	Pericarp					
Potash	0	0	0	48	41	0	3	9	0
Gruel	0	54	0	0	0	0	0	0	2
Drink	0	64	0	0	0	0	0	0	0
Vegetable	91	0	0	0	0	0	0	0	0
Mustard	0	0	5	0	0	0	0	0	0
Dough	0	64	0	0	0	0	0	0	0
Sauce	99	0	95	0	0	0	0	0	0
Spices	0	0	0	0	0	0	2	0	0
Dessert	0	16	0	0	1	7	0	0	0



Fig. 1 Otamari farmer producing a cold drink from baobab pulp.

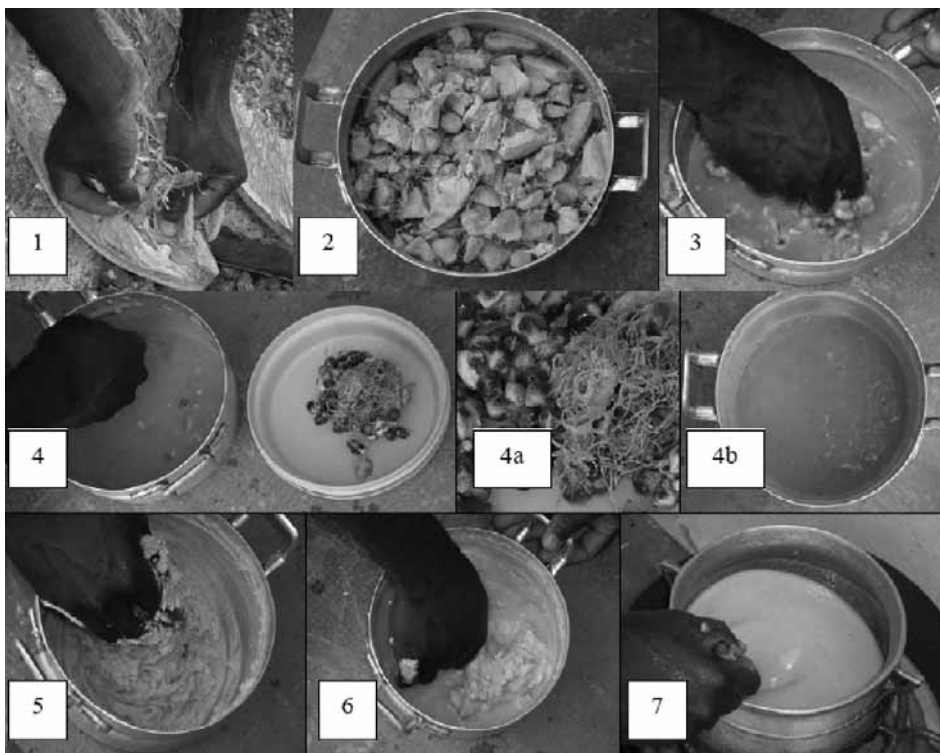


Fig. 2 Process diagram of sour dough using baobab pulp.

Legend:

1-2-3: Gruel preparation, pulp is separated from the pulp and water is added.

4-4a-4b: Fibres and seeds are removed and the pulp is dissolved in water.

5-6-7: Pulp is mixed with cereal flour and the mixture is subjected to heating hence swelling and solidification; the sour dough is then obtained.

Figures 3 and 4 show respectively the different processing methods of the seeds in the rural areas.

Capsule of the fruit, bark of the trunk, branches and flowers are mainly used in potash. The later is used either for food purposes or in soap preparation especially in Datcha area (central Benin). In

order to produce soap, capsules are grinded and boiled in water. As boiling proceeds, palm oil or palm seeds oil is added and saponification occurs; soap is then produced and is further shaped for commercialization on local markets.

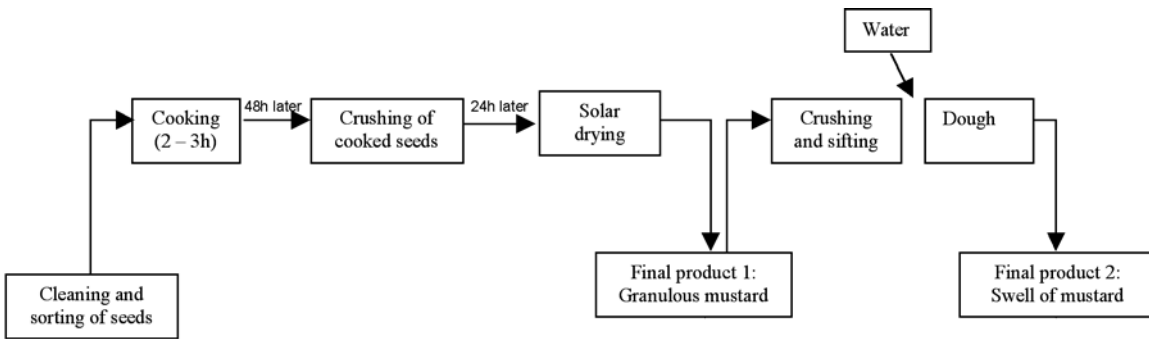


Fig. 3 Process diagram of mustard from baobab seeds.

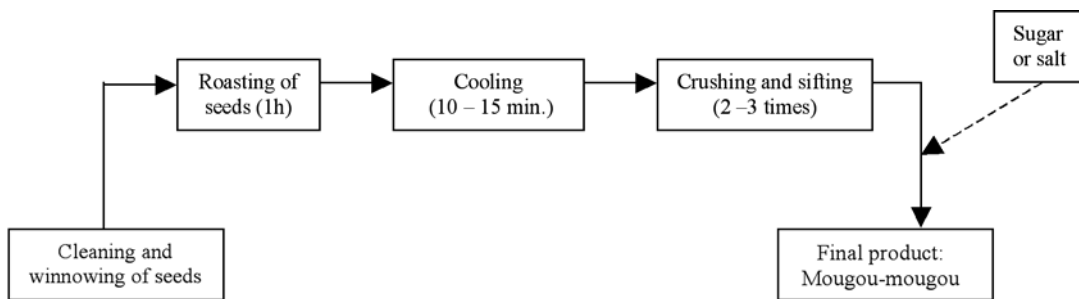


Fig. 4 Process diagram of mougou-mougou.

Therapeutic utilization of baobab’s organs

Baobab is a therapeutic multipurpose tree. Each part of the tree (roots, pulp, bark, leaves, flowers, seeds, etc.), alone or in association with other vegetal species, is certainly beneficial for populations in several areas. In pharmacopoeia, the different parts and organs of baobab are used to treat 19 different diseases and sicknesses (Table 2). The pulp is the part of baobab, the most used for medicinal purposes (Fig. 5). Leaves, bark and seeds are used in the treatment of 7, 5 and 3 diseases, respectively while the root and the flower are used in the treatment of 1 and 2 diseases (Fig. 5). Indigenous knowledge on therapeutic utilization of baobab varies greatly from one region to another. It is noticed that only populations from northern Benin detain such knowledge while populations from central and southern Benin have very limited or no knowledge on the therapeutic utilization of baobab (Table 2). However, in whole Benin, the efficacy of baobab leaves and pulp in the treatment of tiredness, malaria and anemia is recognized.

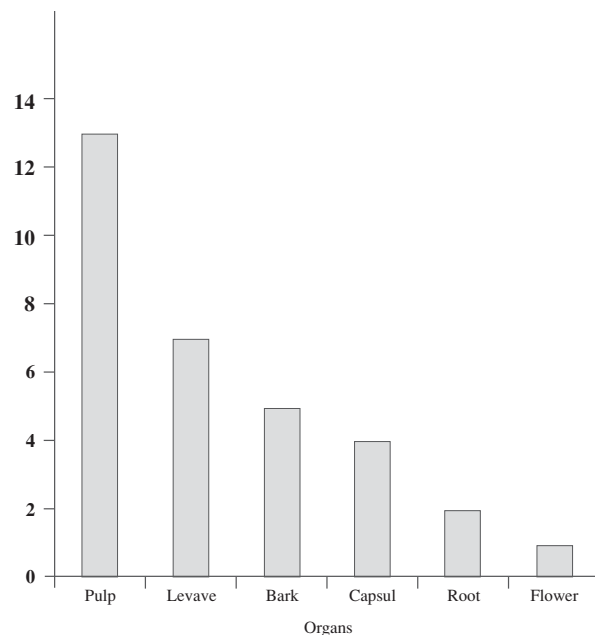


Fig. 5 Contribution of different baobab’s organs in diseases treatment.

Table 2. Therapeutical utilizations of baobab's organs mentioned by populations without posology

Baobab's organs	Diseases treated or virtues	Percentage (%) of positive response per zone		
		Northern Benin	Central Benin	Southern Benin
Pulp	Stomachache	90	0	0
	Ulcer	90	0	0
	Loss of virility	50	0	0
	Invigorating	100	100	100
	Convalescence	100	50	25
	Malaria	100	25	15
	Anorexia	80	0	0
	Diarrhea	100	0	0
	Cold or cough	100	0	0
	Flu	100	0	0
	Purge	60	0	0
	Aphrodisiac	55	0	0
	Hemorrhoids	65	0	0
	Seeds	Cough	85	0
Stomachache		85	0	0
Arterial hypertension		80	0	0
Leaves	Anemia	100	75	15
	Invigorating	100	55	0
	Loss of virility	45	0	0
	Hemorrhoids	55	0	0
	Aphrodisiac	45	0	0
	Asthma	100	0	0
	Teeth of nursing	85	0	0
Bark	Diarrhea	80	0	0
	Incurable wounds	100	75	0
	Teeth diseases	80	0	0
	Burn	100	50	0
	Baby's vigor	90	0	0
Root	Epilepsy	35	0	0
	Normal growth and baby protection	80	0	0
	Baby stomachache	45	0	0
Capsule	Indigestion	50	0	0
	Nausea	45	0	0
	Wound	100	75	0
Flowers	Ease expulsion of fetus during delivery	15	0	0

Folk classification of baobab individuals by local people

In Benin, rural populations use several criteria to differentiate baobab individuals in traditional agroforestry systems. They are related to the characteristics of the fruits (color and seed size, precocity

in maturity, trees' productivity, capsule shape, taste of the pulp); of the bark (color, structure) and of leaves (color, taste and shape). Table 3 shows the percentage of persons using the different criteria to identify baobab individuals. The most used criteria are: the shape of capsules (53%), the taste

Table 3. Folk classification of baobab individuals in traditional agroforestry systems

	Criteria	% persons using the criteria to distinguish ecotypes
Fruits	Precocity of maturity	63
	Productivity of trees	13
	Shape	53
	Taste of pulp	54
	Color and size of seeds	4
Leaves	Color	3
	Taste	20
	Shape	4
Bark	Color	14
	Structure	3

of the pulp (54%), the taste of leaves (20%), the bark color (14%) and the precocity in fruit maturity (63%). The local perception related to baobab differentiation varies from one person to another. Using the color and the structure of the bark as criteria, 3 types of baobab can be distinguished in the natural environment: baobab with pink and smooth bark, baobab with rough and gray bark and baobab with smooth and gray bark. Using the shape of the fruits, 4 types of baobab can be distinguished: baobab with small size capsules, baobab with middle size and long shape, baobab with middle size and round shape, baobab with big size capsules. Using the taste of the leaves, two types of baobab can be distinguished: baobab with bitter leaves and baobab with delicious leaves. Using the taste of the pulp, local populations distinguish the baobab with sweet pulp and the baobab with acidic taste.

Symbolic and cultural value of baobab in Benin

Apart from its therapeutic and food uses, baobab is considered as a fetish tree, sacred, deified and full of mysteriousness. In fact, all ethnic groups in Benin recognize baobab as a fetish tree and provide to it a special place in their different culture. For the Fons ethnic group from Southern Benin, baobab individuals are inhabited by bad spirits and one should be suspicious about them. In Otamari ethnic group, the divinity of the tree is revealed

by *fa* oracle. The later precise the necessary sacrifice for the veneration of the revealed sacred tree. The divine trees are marked with wood pieces from *Diospyros mespiliformis* or *Gardenia erubescens* and/or stones. In Dendi and Djerma area (northern Benin), a ritual is organized every year around the sacred baobab, to implore rain divinities, at the beginning of the crop year. In Otamari area, farm works start by presenting the seeds to sacred baobab that is invoked for a good crop season. The same scene is done in the village during very difficult situations: epidemics, dryness or any other adversity that overpass human understanding. At such kind of ceremonial, a white sheep, a black dog or a black cow is immolated around the tree. In Djerma area, each traditional healer has its own fetish baobab tree, to which he regularly refers. During wedding and baptism ceremonials, baobab pulp and leaves are usually used to prepare the different meals to be served to guests. In Tchanga (Haoussa), after funerals of old persons, all members of the family bath for one week with baobab bark decoction drive out evil spirits. Otamari culture also use baobab in its tradition. During funeral ceremonial named *dikou* in Otamarin area, the defunct is represented by a piece of baobab branch, packed in straw. All honor are given to this funeral symbol before the burial. Initiation ceremonial of the young Otamari *difôni* (for boys) and *dikountri* (for girls) occurred around a baobab. These ceremonials are very important festivities in Otamari tradition.

Physico-chemical composition of baobab's leaves, pulp and seeds

Table 4 shows the physico-chemical composition of different baobab organs. Lipid contents of pulp and leaves are low and are respectively 0.41% and 1.69%. Similarly, protein content of pulp and leaves are respectively 3.28% and 14.12%. The seeds have a protein content of 33.88% and a lipid content of 28.28%. Carbohydrate content is relatively high in the pulp and the leaves and is respectively 88.66% and 75.06% against 29.59% for the seeds. Energy values are also high, ranging from 372 kcal/100g for the pulp and the leaves and 508 kcal/100g for the seeds. All analyzed organs contain minerals such as calcium (Ca), magnesium (Mg), potassium (K), sodium (Na),

Table 4. Physico-chemical composition of baobab's leaves, pulp and seeds

Element	Organs		
	Leaves	Pulp	Seeds
Dry matter (%)	84,32 ± 0,04	91,95 ± 0,02	91,28 ± 0,02
Ash (%)	9,13 ± 0,04	7,65 ± 0,09	7,65 ± 0,05
Proteins (%)	14,12 ± 0,04	3,28 ± 0,06	33,88 ± 0,07
Lipids (%)	1,69 ± 0,01	0,41 ± 0,01	28,28 ± 0,04
Fibres (%)	13,23 ± 0,07	11,07 ± 0,01	8,72 ± 0,04
Carbohydrates (%)	75,06	88,66	29,59
Energy (kcal/100g)	371,93	371,45	508,4
Ca (‰)	1,81	0,332	0,332
Mg (‰)	1,098	1,002	1,121
K (‰)	7,504	8,241	7,856
Na (‰)	0,176	0,268	0,274
P (ppm)	244,13	1456,56	2330
Mn (ppm)	52	13	10
Zn (ppm)	54	21	59
Fe (ppm)	293	928	293
Vit A (ng/g)	55,8	29	30,8
Vit C (mg/g)	4,95	2,22	3,46
Vit D (ng/g)	118,2	40	78,8
Vit E (µg/g)	2	0,67	1,64
Vit K (mg/kg)	2,38	0,83	2,14

phosphorus (P), manganese (Mn), zinc (Zn) and iron (Fe) in variable proportions. The pulp and the seeds have the same content in calcium (0,332‰). The pulp is richer in potassium than the other organs. It is followed by the seeds and the leaves, which are all richer in phosphorus. Moreover, iron is largely more abundant in the pulp which contains three times more than the other organs. The vitamin content (A, C, D, E and K) of the pulp, leaves and seeds are also presented in Table 4. The table point out that the leaves are the richest in vitamins, followed by the seeds and the pulp, whatever the type of vitamin.

Discussion

The utility of baobab's organs for rural populations in Benin has not to be proved. Apart from the different uses described in Benin, other baobab uses are reported in the literature. In Malawi,

they are boiled with potash and are afterwards used in sauce preparation (Williamson 1975). In Zimbabwe, they are used as vegetable and substitute frequently lettuce on the market (Sidibé and Williams 2002). In contrary, the leaves are not used as food in India and Madagascar (Sidibé and Williams 2002). The pulp is used in other African countries. In Tanzania, it is used in the fermentation of sugarcane for bier production (Fleuret 1980). Fulani and Hausa people from Northern Nigeria mix it with cow milk to obtain a cold drink as it is also the case in Northern Benin. The use of the seeds as protein extract and oil source was also reported by Pele and Berre (1967). Moreover, the different uses of baobab's organs have been recapitulated by Dweck (1997), who mentioned the use of baobab leaves powder, pulp and seeds in the treatments of asthma, tiredness, otitis, incurable wounds and in blood pressure regulation. It had been noticed in India, as it is the case in northern Benin, the use of baobab bark as anti-pyretic, the pulp against diarrhea and dysentery (Sidibé and Williams 2002). In addition to the use of the bark in traditional medicine in India and Benin: Adesanya, Idowu, and Elugoba (1988) mentioned its use in the treatment of anemia in Nigeria. In West Africa, Wickens (1982) demonstrated the presence in the bark, the pulp and the seeds, of antidotes against poison from *Strophantus* sp. At the other hand, Andrianaivo-Rafehivola, Siess, and Gaydou (1995) demonstrated that the seed oil is efficient against liver diseases while Baumer (1995) reported the exportation of Sudanian pulp to British pharmaceutical industries, which use it in the production of anti-inflammatory products. Up to now, to our knowledge, there is no scientific data on the quality and the nutritional stability of the nutrients present in the leaves. It makes it difficult to adjudge the bioavailability and the stability of the nutrients present in baobab's leaves. However, the numerous uses of the species could be due to the relatively high content of nutrients in its organs. Actually, the different organs contain alkaloids, tannins, flavonoids, sterols, coumarins and saponoids (Codjia and Assogbadjo 2001; Ramadan et al. 1993; Sidibé and Williams 2002). They are nitric and basic substances with several physiological properties keeping up the nervous system and the spinal cord (alkaloids).

They are vein invigorating with antispasmodic, anti-ulcer, anti-inflammatory properties (flavonoids). As polyphenolic compounds, in association with skin proteins, they render the skin impure (tannins). The presence of adansonin (C₄₈H₃₆O₃₃) in the bark justifies its use against malaria and other fevers (Sidibé and Williams 2002). The high iron content of the leaves and the seeds, 29.3% dw (Codjia Assogbadjo 2001), may justify its use against anemia, since iron has the property of fixing hemoglobin. The seeds are not only rich in proteins (33,88%) and lipids (28,28%) but also contain essential amino-acids, with levels compatible with the recommended norms for humans by FAO (Yazzie et al. 1994). The high content in proteins and essential amino-acids could justify the use of the seeds for child growth and could explain why they are used in rural area for the production protein extracts, for instance the *mougou-mougou* in Dendi area in Benin.

Rural populations from Africa, especially women have cumulated folk knowledge on this resource since mille ages. In Mali, local populations use the bark color to differentiate baobab individuals (Sidibé et al. 1996). They manage to determine the taste of the pulp using the bark color as criteria and then orientate it for a specific use. Baobab's with black bark are supposed to produce

moderately sweet pulp, the ones with red bark produce fruits with very sweet pulp, finally, the ones with gray bark are supposed to produce little good quality fruits and are systematically used for fibres and cord production.

The indigenous knowledge of local populations is also cultural. Historically, the Otammari or Betammaribè, in addition to the Besorubè constituted a big socio-cultural group, known as *somba*. Mercier (1968) reported numerous etymologies related to this ethnic group and one of this make the *somba* the "baobab people" because they consume the pulp. Baumer (1995) indicated that baobab is very important in the sahelian culture in such a way that some villages are totally built in dense baobab stands, as it is also the case in northern Benin. Moreover, the cultural value and the mythology of baobab are also reported in Sénégal, Mali, Burkina Faso, and Niger (Sidibé and Williams 2002). In Bandiagara in Dognon area, it is a burial type for lepers. The dead body is fixed to a stretcher, pushed into the hollow baobab, closed with clay and straw. In fact, the use of such a burial is the consequence of the fact that people are afraid from contamination from the death body. A leper dead body buried under the soil may cause a low rainfall and may contaminate the soil over years and hence cereals, fruits and water holes.

Literature Cited

- A.O.A.C. 1984. Official Methods of Analysis of the Association of Official Analytical Chemists (A.O.A.C.), 40th Ed.
- Addy, E.O.H., L.I. Salami, L.C. Igboeli, and H.S. Remawa. 1995. Effect of processing on nutrient composition and anti-nutritive substances of African locust bean (*Parkia filicoidea*) and baobab seed (*Adansonia digitata*). *Plant Foods for Human Nutrition* 48: 113-117.
- Adesanya, S.A., T.B. Idowu and A.A. Elujoba. 1988. Antisickling activity of *Adansonia digitata*. *Planta Medica* 54: 374.
- Andrianaivo-Rafehivola, A.A., M.H. Siess, and E.M. Gaydou. 1995. Modifications of hepatic drug metabolizing enzyme activities in rats fed baobab seed oil containing cyclopropanoid fatty acids. *Food and Chemical Toxicology* 33: 377-382.
- Assogbadjo, A.E., B. Sinsin, and P. van Damme. 2005a. Caractères morphologiques et production des capsules de baobab (*Adansonia digitata* L.) au Bénin. *FRUITS* 60: 327-340.
- , Sinsin B., J.T.C. Codjia, and P. van Damme. 2005b. Ecological diversity and pulp, seed and kernel production of the baobab (*Adansonia digitata*) in Benin. *Belgium Journal of Botany* 138: 47-56.
- Barminas, J.T., M., Carles, and D. Emmanuel. 1998. Mineral composition of non-conventional leafy vegetables. *Plant Foods for Human Nutrition* 53: 29-36.
- Baumer, M. 1995. Arbres, arbustes et arbrisseaux nourriciers en Afrique Occidentale. ENDA (Environment and National Development in Africa), Tiers Monde, Dakar.
- Codjia, J.T.C., and A.E. Assogbadjo. 2001. Diversité des ressources forestières alimentaires du Bénin, rôle pour les populations et possibilité de valorisation

- pour un développement humain durable. Communication présentée durant séminaire sur l'aménagement intégré des forêts naturels des zones tropicales sèches en Afrique de l'Ouest. 25-29 Juin 2001 Parakou-Bénin.
- Codjia, J.T.C., K.B. Fonton, A.E. Assogbadjo, M.R.M. Ékué.** 2001. Le baobab (*Adansonia digitata*), une espèce à usage multiple au Bénin. Ed. Cocomultimedia, Cotonou, Bénin.
- Delisle, H., S. Bakari, G. Gevry, C. Picard, and G. Ferland.** 1997. Teneur en provitamine A de feuilles vertes traditionnelles du Niger. Cahiers Agricultures 6:553-560.
- Dweck, A.C.** 1997. Ethnobotanical use of plants. Part 2, Africa. Cosmetics and Toiletries 112:4.
- Fleuret, A.** 1980. Non food uses of plants in Usambara. Economic Botany 34:320-333.
- Igboeli, L.C., E.O.H. Addy, and L.I. Salami.** 1997. Effects of some processing techniques on the antinutrient contents of baobab seeds (*Adansonia digitata*). Bioresource Technology 59:29-31.
- Mercier,** ed. 1968. Tradition, changement, histoire. Les "Somba" du Dahomey Septentrional. Anthropos, Paris.
- Obizoba, I.C., and N.A. Amaechi.** 1993. The effect of processing methods on the chemical composition of baobab (*Adansonia digitata* L.) pulp and seed. Ecology of Food and Nutrition 29:199-205.
- Pele, J., and S. Berre.** 1967. Les aliments d'origine végétale au Cameroun. Cameroun Agricole Pastorale et Forestier 108:16-33.
- Ramadan, A., F.M. Harraz, and S.A. El Mougy.** 1993. Anti-inflammatory, analgesic and antipyretic effects of the fruit pulp of *Adansonia digitata*. Fitoterapia 65:418-422.
- Sena L.P., D.J. Vanderjagt, C. Rivera, A.T.C. Tsin, I. Muhamadu, O. Mahamadou, M. Millson, A. Pastuszyn, and R.H. Glew.** 1998. Analysis of nutritional components of eight famine foods of the Republic of Niger. Plant Foods for Human Nutrition 52:17-30.
- Sidibé, M., J.F. Scheuring, D. Tembely, M.M. Sidibé, P. Hofman, and M. Frigg.** 1996. Baobab - home-grown vitamin C for Africa. Agroforestry Today 8: 13-15.
- , and **J.T. Williams.** eds. 2002. Baobab. *Adansonia digitata*. International Centre for Underutilised Crops, Southampton, UK.
- Wickens, G.E.** 1982. The baobab - Africa's upside-down tree. Kew Bulletin 37:173-209.
- Williamson, J.** 1975. Useful Plants of Malawi. University of Malawi, Limbe.
- Yazzie D., D.J. Vander, A. Jagt Pastuszyn, A. Okolo, and R.H. Glew.** 1994. The amino acid and mineral content of baobab (*Adansonia digitata* L.) leaves. Journal of Food Composition and Analysis 7:189-193.