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Eco Physiological Investigation of Genus Prosopis

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ABSTRACT: The genus Prosopis is widely distributed in various agroforestry ecosystems, primarily in semiarid and arid climates of the Americas, Asia and Africa. These species serve as the food source for a large number of animal communities, such as goats and sheep, which consume their seeds and flowers. The seeds are also used to produce various products including flour and pulp. In northern Chile some species of Prosopis are threatened, which supports the inclusion of these species in reforestation plans. One critical source of information in the formulation of such reforestation strategies is the physiological analysis of these populations and the effects of abiotic factors on parameters such as reproduction and growth in the Prosopis forests of the Atacama Desert. In this note, we analyze the importance of ecophysiological studies of Prosopis populations and the main strategies adopted by these plants in response to water scarcity, which are critical to the survival of these desert communities. Future research must investigate these variables to provide an improved understanding of the endogenous behavior of species of Prosopis, which will be instrumental for creating forestation plans that will regenerate and preserve these woodlands.

KEYWORDS: Prosopis, ecosystem, population, desert, investigation

I. INTRODUCTION

Prosopis is a genus with almost 45 species distributed in America, Africa, and Asia. Argentina is one of the countries with the greatest diversity (nearly 27 species) all over the world (Burkart, 1976), it has approximately 23,000,000 ha of native forests in the Chaco and Monte regions with several Prosopis species. Prosopis alba (common name White Algarrobo) was sacred for the Chaco ancient populations being one of the main food sources. However, this legume tree is a class of underutilized, neglected, or orphan crops, as it is in the minor crops group with regional importance. In Argentina, the National Program of Algarrobo (NPA) promotes the crop of this species to decrease the pressure on the native forests, thus contributing to regional development under a social, environmental, and economic sustainability approach. P. alba has a high pods production (. 19.1) compared to other species that grow in similar environmental conditions. The fresh pods were consumed directly and the dry pods were used for many ancestral food preparations such as "patay," unfermented and fermented beverages (añapa and aloja),[1,2,3] syrup or flour (Cardozo et al., 2010; Felker, Takeoka, & Dao, 2013; Meyer et al., 1986; Pérez et al., 2014; Pérez, Zampini, Alberto, & Isla, 2017; Rodríguez et al., 2017, 2017; Saunders et al., 1986; Schmeda-Hirschmann et al., 2015; Schmeda-Hirschmann, Theoduloz, Jiménez-Aspee, & Echeverría, 2017; Sciammaro, Ferrero, & Puppo, 2015; Sciammaro, Ribotta, & Puppo, 2016). Prosopis genus belongs to the leguminous (Fabaceae) family. There are 44 species known, three of them natives from Asia, one from Africa, and the rest are native from America (Sciammaro, Ribotta, & Puppo, 2016). Different names are given to the Prosopis. In India, Prosopis cineraria is called "Khejri" or "Kalpavriksha" (Kumar, Govindasamy, & Nyola, 2017), "Jand" in Pakistan and "Ghaf" in Arabic (Malik, Mann, Gupta, & Gupta, 2013). African species, Prosopis africana, located mainly in Nigeria, is known as "Kiriya" or "Okpehe" (Zubair et al., 2017), and in Kenya, Prosopis juliflora is known as "Mathege" (Khobondo, Kingori, & Manhique, 2017). In Northern Argentina, Prosopis ruscifolia is named as "Vinal" (Bernardi, Sánchez, Freyre, & Osella, 2010). In general, in South America, Prosopis tree is called "Algarrobo" (Pérez et al., 2014) and in North America, it is known as "Mesquite" (Gallegos-Infante, Rocha-Guzman, Gonzalez-Laredo, & Garcia-Casas, 2013).

This plant has an essential place in the history of the first settlers. Since ancient times people from the USA, Mexico, Peru, Bolivia, Chile, Paraguay, and Argentina have taken advantage of this tree for their survival (Capparelli & Prates, 2015). Also, the tree has significant economic value as a source of fuel and fodder (Anand, Thakur, Gargi, Choudhary, & Bhardwaj, 2017), in charcoal production and as construction material (Bekele, Haji, Legesse, & Scha, 2017). Prosopis rind, flowers, leaves, and pods are used in traditional medicine (Garg & Mittal, 2013). In the case of the pods, beyond their properties as sedative and anti-inflammatory, they have been a source of food to humans and animals (Pérez et al., 2014).

For the environment, Prosopis tree (Pt) presents several benefits. It can grow in arid and semi-arid regions (where other crops hardly prosper), it does not require of annual plantings and can accompany other crop species (in India is planted near the millet crop), and it tolerates extreme temperatures (Anand et al., 2017; Rodriguez et al., 2017) as well the alkalinity and salinity. It improves and stabilizes the soil because it promotes the nitrogen fixation (Cardozo et al.,

2010), and is fast-growing and drought-resistant (Estévez, uerola, Bernuy, & Sáenz, 2014). However, this legume tree is a class of orphan crop, as it is in the minor crops group with regional importance that have been neglected by researchers and industry due to its limited economic importance in the global market (Díaz-Batalla et al., 2017a,b; Mamone et al., 2017). Virtually, the industrial use of Prosopis is non-existent. In order to obtain an integral use of this tree is still necessary more information about germination, planting, cultivation, protection, blooming, ripening and harvesting (Barba De La Rosa, Frias-Hernández, Olalde-Portugal, & Castañeda, 2006), as well as information about the functional properties and possible applications.
•Prosopis spp. is an underutilized legume.
•Leaves, rind, exudate gum, flowers, and pods of Prosopis tree have bioactive properties.
•The Prosopis pod is used worldwide as an ingredient for food and feed.
•The pod flour has potential as a partial wheat replacement in bakery products.[4,5,6]

Prosopis is a genus of leguminous trees in the family of Mimosaceae native to Chaco and distributed in the northern Argentine, western Paraguay, southern Bolivia and southwestern Regions of Brazil (Morales et al., 2017). Within the genre Prosopis, there are species that have a high tolerance to salinity, which, in addition to the different uses of this tree, either as fodder (Atanasio et al., 2017), medicinal use (Henciya et al., 2017) or even as wood for the manufacture of furniture (Michela et al., 2015), make it a crop of interest for government breeding programs that promote propagation in soils with moderate salinity (Meloni et al., 2004; Felker et al., 2008).

The growth of P. alba it was reported with a 50% decay, when seedlings were exposed to a salt concentration between 10 and 25 dS m^{-1} during the early stage of seedling development (Velarde et al., 2003). Some authors have proposed that the inoculation of P. alba with an AMF reduces the level of damage caused by salinity in plants (Feng et al., 2002). Mechanisms involved in improving AMF-mediated growth include efficient use of available water (Ruiz-Lozano et al., 1996), K+/Na + ratio (Sannazzaro et al., 2006) and photosynthesis.

As published in (Scambato et al., 2009), P. alba inoculated with the arbuscular mycorrhizal fungus Glomus intraradices and assessed against a saline condition of 200 mM NaCl, had a positive phytostimulation compared to control (without inoculating with G. intraradices), given that net photosynthesis maintenance and greater control over the rate of perspiration were observed, a process that may be mediated by the fungus synthesis of ABA (Charpentier et al., 2014), which acts as an inhibitor of stomatic opening (Yu and Assmann, 2016). Instead, an increase in the synthesis of osmoprotective metabolites was obtained in mycorrhized plants grown in salinity; this metabolite is proline, which could reduce the water content at the root by favoring the influx of water to the rest of the plant. This response, together with the reduction in stomatic conductance and perspiration rate observed in salinized plants, could explain the increase in stem water observed in plants inoculated with AMF (Scambato et al., 2009).

II. DISCUSSION

The genus Prosopis (Fabaceae) has been widely studied around the world for its ethnobiological and ecological value. In drylands, there are several reasons why Prosopis spp. can be considered as a valid option to contribute to regional sustainable development due to their resistance to water, thermal and saline stress conditions, and the nutritional properties of its pods (Cattaneo et al., 2016; Moreno, Torres, & Campos, 2017; Villagra & Cavagnaro, 2006). Prosopis species have been used since ancient times as native food crops that can be grown in areas considered unsuitable for agriculture because of different environmental stress situations (Castro Navarro, 2017). In addition, these species improve soil properties, facilitate the growth and development of other plant species (Felker, 1979) and increase the biodiversity of ecosystems. For this reason, they are considered multipurpose species and have been proposed as an alternative to ecological restoration or rehabilitation, particularly in arid environments, such as the Monte phytogeographic province, Argentina, which is affected by moderate to severe desertification (Mazzonia & Vazquez, 2009).

There are 40 species of Prosopis in the Americas, 30 of which are found in Argentina, being this the country with the largest number of species, where 13 of them are endemic (Burkart, 1976; Steibel & Troiani, 2017). In the Patagonian arid environments, there are eight species, which can be considered the southernmost Prosopis species in the world. There is consensus among scholar academics that the main center of diversity and polymorphism of this genus is the Argentine–Paraguayan–Chilean region (Mcrostie et al., 2017) and that it may have subsequently expanded into xeric territories, as could have been the case of Prosopis alpataco. This species is distributed from the central to the southern part of the Monte phytogeographic province and it is considered a key species of this region as a result of their morphological and physiological adaptations. It reaches its ecological optimum in heavy clayish, saline, and sporadically flooded soils of arid areas with a dry and hot climate, summer rainfall, and average temperatures of 15–17 °C (Villagra, 1998; Villagra & Cavagnaro, 2005).

P. alpataco developed morphological and physiological adaptations that allowed it to colonize xeric environments, including the appearance of shrub forms, seed dormancy, reduction of leaf area, changes in root architecture and wood types (Villagra & Roig-Juñent, 1997). For example, its seeds have a physical dormancy that allows the temporal and spatial regulation of germination in unpredictable environments, which gives them an adaptive advantage in xeric conditions (Villagra, 1995; Villagra & Cavagnaro, 2006). In this context, germination will not take place when environmental conditions are not favorable for seedling development.
Currently, P. alpataco is propagated by seeds, so there is great interest in developing techniques that can provide a more efficient alternative to traditional propagation methods. Thus, sexual reproduction is complemented by other strategies, like micropropagation, to produce seedlings of forest species from arid areas in order to restore degraded ecosystems. In recent years, some attempts have been made to micro propagate this species, and an efficient plant tissue culture protocol has been reported for alpatacos distributed further south (Boeri & Sharry, 2017). On the other hand, the expansion and adaptation to xeric environments are likely to include modifications in the metabolic pathways of the plant with the production of secondary metabolites. These phytocomposites do not play a direct role in the vital processes of the plant but are related to its survival mechanisms in response to different environmental conditions. In this context, under abiotic stress conditions, the biosynthesis of secondary metabolites generally increases in plants (Sharma et al., 2017).[7,8,9] Bioprospecting techniques allow evaluating and quantifying the compounds present in species adapted to xeric environments, such as Prosopis alpataco. Hence, the study of native genus species could provide the knowledge needed to find new bioproducts and characterize potential sources of food and medicine. Consequently, these characterizations give an additional value to the native flora, which has a positive impact on people's lives (Boeri et al., 2017).

In this review, we present a detailed description of the different sexual and vegetative propagation strategies of Prosopis alpataco. Furthermore, we update information about differents bioprospecting aspects of this species, based on previous research.

The species of the genus Prosopis are extremely resistant to adverse environments (heat, drought, alkalinity, and salinity) and they contribute to soil stabilization and improvement, allowing sustainable agriculture (Carbas et al., 2017; Cardozo et al., 2010). Since their development provides numerous ecologically desirable characteristics, many projects are based on carob trees for the recovery of soils since due to its highly branched root system, it constitutes a protector against erosion (Cruz Alcedo, 1999; ueiredo, 1983; Marti & Battle Caravaca, 1990). The sustainable use of this sub-valuated resource also represents an opportunity source of income for the native populations of arid and semiarid areas of South America and other regions of the world and an opportunity for innovation for the food industry (Ríos, Cejas, & Maldonado, 2008).

Several works have been published on the collection of pods of different species of the genus and on their use in the manufacture of flour, bread, syrup, lodge, and its use as medicine, substitute for chocolate or coffee, confirm its importance (Escobar, Estévez, Fuentes, & Venegas, 2009; Meyer, 1984; Roig, 1993; Schmeda-Hirschmann et al., 2015; Sciammaro, Ferrero, & Puppo, 2015).

The nontimber use of these resources promotes the conservation of the native flora and of the native forest. In addition, the possibility of entering the production chain is given to owners of underexploited lands, causing a productive boost with economic and social improvements to the involved regional economies.

Tree species of the genus Prosopis are the main invasive woody weeds throughout dryland Africa. Of these Prosopis juliflora is by far the most dominant species in tropical regions, and is with very few exceptions, the only species found in the Horn and East Africa. P. pallida are however the common Prosopis species in Cape Verde and Senegal (Pasiecznik, Harris, & Smith, 2004), and in the Horn, it is also present in parts of Djibouti (Pasiecznik & Choge, 2013). All Prosopis tree species are native to the Americas, with the exception of P. africana in more humid regions south of the Sahel, P. farcta in the Middle East (Caparelli in Review 8 shows it there some 12,000 years ago), and P. cineraria in Asia (Pasiecznik et al., 2004). These differ significantly in morphology, also having palatable foliage and pods that are highly valued as a human food. This paper reports only on Prosopis juliflora, hereafter referred to as Prosopis.

The earliest record of Prosopis in the region was its introduction to Sudan in 1917 by R.E. Massey, from the Egyptian Department of Agriculture at Giza and from South Africa (Broun & Massey, 1929). Given the genetic similarity of Sahelian P. juliflora and Prosopis in Haiti, Puerto Rico, and Bonaire in the Caribbean, most of today's invasions in the Horn of Africa and the Sahel probably arose from introductions of thorny, shrubby, and invasive Prosopis juliflora provenances from the Caribbean (Nick Pasiecznik unpublished observation, Peter Felker, pers. comm.). Since the 1970s, P. julifora has been introduced into the Horn of Africa from other parts of Africa by well-intended international and aid organizations to combat desertification and to address the "fuelwood crisis" (Choge, Ngujiri, Kuria, Busaka, & Muthondeki, 2002).

Prosopis then spread rapidly from these plantations and trial plots, spread mainly by livestock and other animals, with seeds passing undigested through the gut, but also along watercourses after rains (Shiferaw et al., 2017). Overgrazing increases seedling recruitment as they cannot compete with good grass cover, and by depleting soil nitrogen, with increased frequency of droughts, this gives Prosopis trees a competitive advantage. In Ethiopia, it was estimated that Prosopis was expanding at a rate of 50,000 ha per year (Yemane, 2014). In 2015, there were an estimated 5 million hectares of Prosopis in the Greater Horn of Africa (including Kenya) and 10 million hectares throughout the continent (Pasiecznik et al., 2015). But extrapolations from recently published papers reporting remote sensing data in specific sub-national jurisdictions, expansion rates, and personal communications, lead the authors to estimate that there are possibly 10 million hectares of Prosopis in the Horn of Africa alone (Shackleton, Le Maitre, Pasiecznik, & Richardson, 2014; Meroni et al., 2017).

A regional conference in Addis Ababa (Tsegay, Livingstone, & Fre, 2014) described "control by utilization" initiatives tested in Djibouti, Eritrea, Ethiopia, Kenya, Somaliland, and Sudan. This confirmed the multiple uses of Prosopis and highlighted other successes. However, many of these efforts were not sustained. The overriding reason appeared to be the absence of ongoing support for training in technical and business skills and the lack of markets and appropriate processing machinery (GIZ, 2017).[10,11,12]

III. RESULTS

A thorough analysis of the spread and impacts of Prosopis (Bokrezion, 2008) notes that Prosopis is valued for firewood, pods especially as dry season fodder, and also for fence posts and poles for construction. However, pastoralists and farmers have expressed great concern about the damaging impact Prosopis is having on rangeland species, and reduced accessibility to grazing areas and water points. With almost no access for NGOs in the country, there are no known projects where Prosopis management and utilization have been promoted. The natural distribution of the genus Prosopis extends along tropical and subtropical areas of America, Africa, and Asia (Burkart, 1976; Pasiecznik et al., 2001, among others) (. 8.1A), occupying mainly arid and semi-arid parallel ecosystems (see Morello, 2002). Together with the genus Acacia, Prosopis dominate and structure these ecosystems (Beresford-Jones, Arce, Whaley, & Chepstow-Lusty, 2009). In America, its distribution can be divided into three main regions, which are presented here over the biogeographical schemes of Morrone (2001, 2014, 2017) (. 8.1B): (1) Southwestern of North America and Northern of Mexico; (2) Central America and Northern South America; and (3) Southern South America. The first one extends over the Nearctic region, while the other two over the Neotropical region. Only P. denudans reach the highest latitudes of the genus—48ºS—in a small area belonging to the Andean region around the Golfo San Jorge, Provincia Santa Cruz (Burkart, 1976) (. 8.1B). The Caribbean was apparently not an original Prosopis natural distribution area; instead, it has been proposed that the genus was introduced there by humans from continental South America (i.e., North Venezuela) around ~ 1000 years BP (Burkart, 1976; Johnston, Little, and Washworth in Pasiecznik et al., 2001). Prosopis distribution in humid areas (those with mean annual precipitations higher than 700/800 mm) is restricted to the oriental half of the Great American Chaco to the East (Verga & Lauenstein, 2017)

Traditional taxonomy of the genus considers 44 species (Burkart, 1976), and, although still under revision (Beresford-Jones, 2011; Pasiecznik et al., 2001), it is the most widely used and so followed in this review. While three species are native from the Old World and one from Africa, all the rest are from the American continent (Burkart, 1976); near seven species are from the Nearctic region and the rest from the Neotropical region. According to Burkart (1976), the main diversification center of the genus is in the semi-arid lands of the conjunction of Argentinean-Paraguayan and Chilean boundaries; while a second one is in the Mexican-Texan deserts. On the other hand, Felker (in Lee, Russell, Bingham, & Felker, 1992) proposed Peru as the third center of diversification, in this case of tropical Prosopis. Recent studies on molecular phylogeny and diversification history of the genus strongly support: (1) an ancient association of Prosopis with arid conditions; (2) an almost complete divergence process of Algarobia section—the last one to diversify—by the end of the Pliocene-beginning of the Pleistocene; and (3) a close relation between species of Chilenses, Pallidae and Ruscifoliae series; which, together with other features, are more in agreement with Burkart traditional taxonomy (Catalano, Vilardi, Tosto, & Saidman, 2008) than with other proposals.
The Prosopis genus, family Leguminosae or Fabaceae, Mimosaceae subfamily is customarily in arid and semiarid zones of Africa, America, and Asia. It comprises 44 species either tree or shrubby being taxonomically divided into five sections. Three species are native to Asia, 1 to Africa, and the remaining 40 are native to America, mainly to South America (Burkart, 1976). Some of the common vernacular are algarrobo, mezquite, Mesquite, Screwbean (Galera, 2000).

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The demand for mesquite wood increased in Century XVI (1500 AD) at the time Argentina and Paraguay were being colonized. As such Prosopis trees were greatly overexploited to meet the needs of mining (gold and silver), railroads, and other manufacturing industries (Choge & Chikamai, 2004; Rojas, 2013).[13,14,15]

The wood from the Prosopis spp. trees, usually referred to as "algarrobos" in South America, has been used in Argentina since colonizers arrived. Local aboriginal peoples utilized these trees as sources for foods and drinks either for themselves or their animals (pods, tender parts of the foliage, and seeds) and the wood for different purposes (houses, furniture, weapons). Because of this characteristic multiplicity of uses they were called as "Tacko" standing for "THE TREE" in Quechua, the language spoken by most of the aborigines living throughout the dispersal zone (Roig, 1993).

At the time of the Spaniard conquest, the use of this wood expanded considerably and it was used as material to build religious facilities (churches, convents, etc.), to manufacture the cobblestones with which the first colonial cities were paved, and for firewood and charcoal. The demand for these fuels increased markedly by the time railway came, while the development of agriculture and livestock caused young stems of Prosopis algarrobilla a.k.a. "Ñandubay" and Prosopis kuntzei a.k.a. "Itin" to be used as fence posts and poles (Roig, 1993).
Among all the native tree species existing in the country today, it is likely that the most widely used one is Prosopis alba "Algarrobo blanco" or "White mesquite" due to its larger relative size, its good health status, and resistance to salinity (Velarde, Felker, & Degano, 2003).

Since the last decades of the last century (1980), the production of solid furniture, some of the very high quality, out of the wood of "Algarrobo," especially from that of Prosopis alba, developed in Argentina. Today in the Argentine provinces where Prosopis is abundant, the majority of the chairs in restaurants, shutters on windows, and bedroom sets are made of P. alba. There are universities in these provinces where forestry faculties support Prosopis utilization (Ruiz, unpub. obs.).

In spite of the lack of tall, spineless straight Prosopis as grows in Argentina, since about 1980 a very high-quality artisanal lumber, furniture, and flooring industry has developed in Texas and Arizona where minimal lumber prices are \$5/bd ft. or \$2100 per cubic meter or \$3000 per ton. This industry has been partially supported by the Texas Forest Products lab and formerly Texas A&M University Kingsville (Felker, pers. comm.).

In Haiti where charcoal and firewood from Prosopis juliflora is the major source of the country's energy, there is no university backstopping technology of utilization of Prosopis for anything other than fenceposts, charcoal, or firewood (see Review 6 in this volume). Given the value of \$3000 per ton for lumber in Texas and the price of \$200–300 per ton of charcoal in Haiti (Tarter et al., 2017), the lack of value-added income to Prosopis is a travesty. [16,17,18]

IV. CONCLUSION

There are 15-m-tall, 1-m diameter Prosopis in Haiti and thus the genetic potential for lumber is possible. The coppice growth from Prosopis stumps is very rapid and if a single stem per stump is left, the new shoot will grow very straight erect and approximately 2.5 m in height per year (Felker, pers. comm.). As the root system is already established, with proper spacing of the coppice growth, economically viable lumber plantations should be possible in 10–15 years.

This same urgency for immediate cash flow and lack of understanding of management or potential markets for Prosopis lumber is the norm for extensive P. juliflora naturalized semi-arid stands that stretch from Dakar to Delhi.[19]

This review will address both the Prosopis wood technology needs of well-developed Prosopis solid wood applications such as in Argentina and the United States and those of Haiti and sub-Saharan Africa and the Middle East.[20]

REFERENCES

1. "Prosopis L." Germplasm Resources Information Network. United States Department of Agriculture. 1999-03-05. Retrieved 2009-12-31.
2. ^ "Prosopis L." TROPICOS. Missouri Botanical Garden. Retrieved 2009-12-31.
3. ^ Prosopis L. Plants of the World Online. Retrieved 9 August 2016.
4. ^ Quattrocchi, Umberto (2000). CRC World Dictionary of Plant Names. Vol. 4 M-Q. CRC Press. p. 2171. ISBN 978-0-8493-2677-6.

5. ^ Hughes, Colin E.; Ringelberg, Jens; Lewis, G. P.; Catalano, Santiago (August 2016). "Disintegration of the genus Prosopis L. (Leguminosae, Caesalpinioideae, mimosoid clade)". PhytoKeys (205). Pensoft Publishers: 147–189. doi:10.3897/phytokeys.205.75379. PMC 9849005. PMID 36762004.
6. ^ [a] [b] Medicinal Plants of the Southwest Archived 2007-04-20 at the Wayback Machine
7. ^ Graziano MN, Ferraro GE, Coussio JD (December 1971). "Alkaloids of Argentine medicinal plants. II. Isolation of tyramine, beta-phenethylamine and tryptamine from Prosopis alba". Lloydia. 34 (4): 453–4. PMID 5173440.
8. ^ [a] [b] [c] [d] [e] Tapia A, Egly Feresin G, Bustos D, Astudillo L, Theoduloz C, Schmeda-Hirschmann G (July 2000). "Biologically active alkaloids and a free radical scavenger from Prosopis species". J Ethnopharmacol. 71 (1–2): 241–6. doi:10.1016/S0378-8741(00)00171-9. PMID 10904169.
9. ^ [a] [b] Luis Astudillo; Guillermo Schmeda-Hirschmann; Juan P Herrera; Manuel Cortés (April 2000). "Proximate composition and biological activity of Chilean Prosopis species". J Sci Food Agric. 80 (5): 567–573. doi:10.1002/(SICI)1097-0010(200004)80:5<567::AID-JSFA563>3.0.CO;2-Y. Archived from the original on 2012-12-16.
10. ^ "Prosopis glandulosa". www.hort.purdue.edu. Retrieved 2008-05-01.
11. ^ Dr. Duke's Phytochemical and Ethnobotanical Databases
12. ^ Constantino Manuel Torres; David B. Repke (15 March 2006). Anadenanthera: visionary plant of ancient South America. Psychology Press. pp. 134–. ISBN 978-0-7890-2642-2.
13. ^ P. juliflora as a source of food and medicine for rural inhabitants in Rio Grande do Norte. ROCHA, R. G. A. In: The Current State of Knowledge on Prosopis juliflora. (Eds.) M. A. Habit and J. C. Saavedra. FAO,, 1990 Rome, Italy, pages 397-403
14. ^ Pasiecznik, N.M.; Felker, P.; Harris, P.J.C.; Harsh, L.N.; Cruz, G.; Tewari, J.C.; Cadoret, K.; Maldonado, L.J. (2001). The Prosopis juliflora—Prosopis pallida Complex: A Monograph (PDF). ISBN 978-0-905343-30-3.
15. ^ Adikwu, MU; Ezeabasili, SI; Esimone, CO (2001). "Evaluation of the physico-chemical properties of a new polysaccharide gum from Prosopis africana". Bollettino Chimico Farmaceutico. 140 (1): 40–5. PMID 11338777.
16. ^ Prosopis pallida species info
17. ^ [a] [b] ""Mesquite (Prosopis species)" Department of Sustainability, Environment, Water, Population and Communities, Canberra" (PDF).
18. ^ [a] [b] Mesquite Info
19. ^ The Mesquite