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Review Article

Bio-prospecting Potential of *Tacca leontopetaloides* (L.) O. Kuntze for Access and Benefit Sharing

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Abstract

Phytochemical studies on the plants of this species have led to the isolation of ca. 122 compounds including steroidals, diarylheptanoids and terpenoids. Some chemical constituents displayed cytotoxic activity, microtubule-stabilizing activity and so on. Therefore, *Tacca* are important plants not only in the medicinal sense but also as a food source or as an energy material. Thus, we encourage any bio-prospecting company or an individual interested to work on the genetic resource, *Tacca leontopetaloides* (L.) O. Kuntze, for ethno-medical/pharmacological/uses and industrial activities in the production of medicinal extracts, food and beverages.

Keywords: Bioprospecting; Phytochemical; Tacca leontopetaloides; Steroidals; Diarylheptanoids; Terpenoids; Cytotoxic

Introduction

Ethiopia is endowed with rich plant biodiversity and associated traditional knowledge which creates an environment for successful bioprospecting. However, like other developing countries, Ethiopia lacks financial resources to exploit the plant genetic resources significantly. The only options for Ethiopia is to collaborate with the developed nations or domestic investors and interested one in pharmaceutical, food, cosmetics and other companies alike and jointly explore them strategically and wisely. The National Competent Authority, the Ethiopian Biodiversity Institute (EBI), through the Access Benefit Sharing Directorate and its respective acting centers, plays a practical role in the implementation of the Nagoya Protocol on Access and Benefit Sharing of Genetic Resources and Associated Community Knowledge. Based on Proclamation No 482/2006 and Regulation 169/2009 (Access to Genetic Resources and Community Knowledge and Community Rights), Ethiopia has been implementing the access and benefit sharing objective of the CBD. Both the Proclamation and Regulation include a range of issues such as ownership, user rights, conditions for access, benefit sharing, types of benefits, powers and responsibilities among others. Therefore, the objective of this information is to encourage any bioprospecting company or an individual interested to work on the genetic resource, *Tacca leontopetaloides* (L.) Kuntze, for ethno-medical/pharmacological/uses and industrial activities in the production of medicinal extracts, food and beverages.

Description of the plant

Tacca leontopetaloides (L.) Kuntze is a wild perennial herb belonging to the family Taccaceae. The genus has 10 species of which Tacca J.R. and G. Forst is the only genus in Africa, a relatively newly-developed plant family carved out of the Dioscoreaceae, but both families are still closely connected taxonomically [1]. The plant is native to Malaysia and the Pacific Islands [2,3] and it is naturally distributed from Tropical Africa, through Southern Asia to northern Australia and Pacific islands [4]. Because of its wide distribution, the plant has numerous common and synonymous scientific names, but Polynesian arrowroot appears to be the most widely used. The plant is more widespread in the middle belt to North West and South West of Ethiopia.

It is more abundant in solitary forms, in open fields or under the shade of trees or hill tops. The plant is found mainly in rainy season (April to October), while dormant through the dry season (from November to February). It is interesting to note that this plant which produces tubers also produces fleshy sweet tasting fruits which are dispersed by birds and mammals [5].

The plant still remains in the wild and is underutilized in Ethiopia. The seeds have shown poor germination while vegetative propagation by tubers appears to be the most prevalent method most region of Ethiopia. In remote rural areas of Benishangul Gumuz Regional State, the plant is considered an economic food crop which is already in domestication [6].

Figure 1: Photographs showing *T. leontopetaloides* plant; A: Whole plant; B: Upper leaf surface; C: Root tubers; D: Flowers; E: Fruits; F: Seeds (All photos taken by author, except F).

The leaves are erect, with long sheathing cataphylls enclosing the bases of the petioles and flowering stems. The petioles are ridged longitudinally, with a sheathing base; leaf blade is trisected at the apex of the petiole; the lobes are ovate-acuminate with smaller, orbicular lobes between them (Carter, 1962). There is just one flowering stem, also ridged longitudinally. The flowers are of the perianth type, 20 - 40, with erect perianth segments and usually green tingled with purple. However, only a few of the flowers produce fruits. The flowers are actinomorphic and hermaphroditic, umbellate, and the bracts form an involucre, which is greenish. The stamens are usually 6, the anthers are 2-celled, ovary is inferior and one-celled with three parietal placentas but the ovules are numerous (Hutchinson and Dalziel, 1968). The fruit is a berry, sub globose and 6-ridged. The seeds are numerous with copious endosperm and a minute embryo. The seeds are ovate, longitudinally ridged, and red-brown but surrounded by a thin fleshy aril (Carter, 1962).

In addition, the inflorescence is borne on a leafless unbranched scape arising directly from the rhizome. The flowers are made up of two whorls of three tepals, basically fused, green to dark brown or purple in colour. The fruits are indehiscent, while the seeds are prismatic with thin-walled endosperm and a distinct raphe [1]. The leaves are broad-blade, deeply lobed and divided into three sections (Ounruen and Sangyojarn, 2001). The leaf in upper surface has depressed veins and the under surface is shiny with bold yellow veins. Figure 1 illustrates the different plant parts.

Distribution of the plant in Ethiopia

The plant is native to Malaysia and the Pacific Islands [2,3] and it is naturally distributed from Tropical Africa, through Southern Asia to northern Australia and Pacific islands. Because of its wide distribution, the plant has numerous common and synonymous scientific names, but Polynesian arrowroot appears to be the most widely used. The plant is more widespread in the middle belt to North West and South West of Ethiopian regions, especially in thorny bush, open savanna and desert of Dry and Moist Kolla agro climatic zones of Tigray, Gondar, Gojam, Wollega, Keffa, Showa, Gamo Gofa and Sidamo, areas, 500 - 1,900 m a.s.l. [4].

Figure 2: Photographs showing the distribution of *T. leontopetaloides* plant in Ethiopia.

Propagation

The seeds are easy and light and are probably dispersed by birds. The seeds have shown poor germination while vegetative propagation by tubers appears to be the most prevalent method of propagating the species in these regions [3].

Phytochemical constituents

The chemical constituents of *Tacca* include steroidals, diarylheptanoids and their glucosides, terpenoids, flavonoids, and some other compounds [7,8]. Of all the compounds, one hundred steroidals are the predominant constituents have been isolated from the Genus *Tacca* [7,9].

Steroidals Taccalonolides

Taccalonolides are a new class of plant-derived natural steroids with a microtubule-stabilizing activity. In 1987, two new steroidal bitter principles, Taccalonolides A (1) and B (2), were isolated from a Chinese medicinal plant *T. plantaginea* [10]. Then Chen and his group first elucidated their complete structures with modern chemical techniques [11]. Extensive studies of the Genus *Tacca* have led to the identification of Taccalonolides C-Z (3-26), AA-AJ (27-33) and H2 (34) [7,12,13]. All of them were new constituents and have antitumor activities. Taccalonolide AJ (33), an epoxidation product of Taccalonolide B, was generated in semisynthesis. Each Taccalonolide molecule contains a C (2)-C (3) epoxide.

Pregnane glycosides

Steroidals, namely Taccagenin (97), nuatigenin (98), stigmasterol (99) and daucosterin (100) were isolated from *T. leontopetaloides* and *T. chantriers* [14,15].

Starch

Starch is a natural biodegradable biopolymer which is in high demand recently for use in many industrial products. Search for

more new sources of starch from plants, however, has also greatly increased. *Tacca* starch from *T. leontopetaloides* is found to have higher amylose content than maize starch but a lower content than potato starch. Its features in the formation of compacts (tablets) were comparable to those of maize starch with *Tacca* starch being more resistant to deformation [16]. Maneka., *et al.* [17] found lower gelatinization temperature and the narrow gelatinization range demonstrated an energy efficient cooking process. It has an implication for the food industry. The weak associative forces stabilizing *Tacca* starch granules could be explored for its potential use as a disintegrant in the pharmaceutical sector [17]. The physicochemical properties of *Tacca* starch showed potential usefulness of the starch in aqueous and hydrophobic food and drug systems [18].

Ethno-medicinal uses

In Western Ethiopia, the tubers are eaten especially when other staple foods are scarce [4]. Although the tubers are poisonous, the poison is removed by soaking or washing the starchy tubers in water and rinsing repeatedly. Thereafter they can be boiled or roasted. The tuber contains starch, ceryl alcohol, steroidal saponins and a bitter principle, Taccalin [1]. The bitter raw tubers are used to treat stomach ailments, mainly diarrhea and dysentery in many Gumuz and Shinasha ethnic groups of Benishangul Gumuz Regional state of Ethiopia [4,19]. The root starch is used to stiffen fabrics in some of the Islands [18]. Ethnobotanical uses of the plant especially in Ethiopia is immense.

Conclusion

Tacca leontopetaloides is a wild perennial herb belonging to the family Taccaceae. The plant is naturally distributed from North Western Ethiopia, through Central to Southern and South western Ethiopia. The plant is most widely used by local peoples in the remote areas of the country both as food and medicine. Different phytochemical studies on the plants of this species have led to the isolation of ca. 122 compounds including steroidals, diarylheptanoids, and terpenoids. Therefore, *Tacca* are important plants not only in the medicinal sense but also as a food source or as an energy material. Thus, we encourage any bio-prospecting company or an individual interested to work on the genetic resource, *Tacca leontopetaloides* (L.) O. Kuntze, for ethno-medical/pharmacological/uses and industrial activities in the production of medicinal extracts, food and beverages.

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- Suneetha G., *et al.* specifies the method for analysis of azelnidipine in human plasma by ultra-performance liquid chro-

Discussion

The presented review highlights on various analytical methods reported for estimation of Azelnidipine in alone or in combination with Olmesartan medoxomil in marketed formulation and biological matrix like human plasma. RP-HPLC and UV methods were found to be most widely used methods. These methods are found to be rapid, accurate, sensitive, economical and reproducible for determination of Azelnidipine in various marketed formulations and biological matrix.

Conclusion

So, from all above information it should be concluded that various spectroscopic methods, chromatographic methods and other methods were used for determination of Azelnidipine alone or in combination which has been successfully used on a routine basis and allows the quantification of the drug in various pharmaceutical dosage form and in biological matrix in short analytical time.

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