

Kudzu: An Invasive Plant or a Sustainable Resource

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Kudzu (*Pueraria lobata* (Willd.) Ohwi) is a fast growing leguminous vine plant that has strong reproductive ability and low requirements on its growing conditions. It has been considered an invasive plant in some places because of its aggressive growth, which can destroy the habitat for native plants and animals. However, its strong environmental adaptability makes it easily cultivated as a sustainable resource. Kudzu can also keep soil from washing away and play an important role in ecological protection. Kudzu has had numerous practical uses in our daily lives since ancient times. For example, its root, stem, flower and pod are used in traditional Chinese medicine. Its root is a healthy food. And its leaf is used as fodder and forage for livestock. Moreover, some recent studies on kudzu have found that it is rich of bioactive ingredients, especially isoflavones, which further broadens its uses in medicine, healthy food, and cosmetics industries. Its high starch and cellulose content makes it a promising feedstock for biofuel production and paper preparation. This editorial will give a brief discussion on kudzu and its comprehensive utilization.

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Kudzu: A Fast Growing and Easily Cultivated Leguminous Plant

Kudzu (*Pueraria lobata* (Willd.) Ohwi) is a perennial leguminous plant native to East Asia. Because of its strong reproductive ability and low requirements on its growing conditions, it is now widely distributed in East Asia, Southeast Asia, South Asia, Australia, United States, and some European countries. Kudzu has multiple ways of reproducing. It can propagate through its roots, stem, and seeds. Although it generally grows in warm and wet mountainous areas, including slopes, valleys, amid sunny shrubs, and in sparse or dense forests, kudzu can also grow under cold, and drought climatic conditions based on its strong environmental adaptability. Kudzu is a fast-growing vine having tuberous starchy roots and hairy trifoliolate leaves and racemes of purple flowers followed by long hairy pods containing many seeds. Under suitable conditions, it can form dense stands of vines that produce a leaf area index of 4 to 8. Its growth rates can exceed 2 m per week, and its vine length can reach 8 m. As a result of its aggressive growth, kudzu often overtops other vegetation and forms a dense monoculture, which destroys the habitat for native plants and animals. This will harm local biological diversity and ecology. Therefore, it is considered an invasive plant in places like the southern United States. On the other hand, kudzu plays an important role in soil and water conservation. It can improve soil quality through its nitrogen and organic matter fixation. It is also effective for inhibiting erosion, compaction

and leaching of nutrients, as well as the suppression of weeds. This will help to keep a healthy ecology. From an ecological view, kudzu plays a two-sided role. Thus, there needs to be a balance in the process of its development and utilization. Moreover, due to its strong reproductive ability and environmental adaptability, kudzu naturally is an easily cultivated crop with a relatively high production (10 to 25 ton dry kudzu root per hectare), which provides an opportunity to have it as a sustainable resource.

Use of Kudzu as a Sustainable Resource

Utilization of kudzu has a long history in such Asian countries as China, Japan, Korea, and India. Since ancient times, kudzu roots have been used as food and its leaves have been used as fodder and forage for livestock. Its roots, stems, flowers, and pods are traditional Chinese medicine, mainly used as antidipsotropic and antialcoholic agents. Its vine can be used as a rope, and its stem bark can be used to weave cloth. This is the primary utilization stage of kudzu. At this stage, the plant matter of kudzu is used as a whole, and little information is known about its chemical composition.

With the development of modern phytochemistry, many studies on kudzu have been carried out in the last 50 years. A great variety of active compounds are found in kudzu. Among these active compounds, the isoflavones such as pueraria, daidzein, and daidzin are extremely rich in kudzu. It is reported that the mass content of total isoflavones and pueraria in dry kudzu roots can exceed 10% and 5%, respectively. Besides its roots, its vines, flowers and pods are all in rich of isoflavones. The isoflavones from kudzu have multiple pharmacological and biological activities, such as immunomodulatory, anticancer, anti-inflammatory, antioxidant, antidiabetic, antihypertension, hypolipidemic, cardioprotective, hepatoprotective, nephroprotective, neuroprotective, antiglycation, skin regeneration, melanogenesis inhibitory, and wound healing. These studies provide not only theoretical support for its traditional uses but also further broaden its application in medicine, healthy food, and cosmetics industries. Apart from isoflavones, kudzu has a high starch content in its roots (20 to 40% dry mass basis) and high cellulose content in its vines (25 to 35% dry mass basis). This indicates kudzu can be a promising feedstock for biofuel production and paper preparation.

As discussed above, kudzu has a promising prospect as a sustainable resource. However, the planting and processing of kudzu are all currently carried out on a small scale. There is still a lot work to do in its development and utilization. Firstly, more studies are needed to further increase the production of kudzu and its bioactive compounds content, especially for isoflavones through conventional breeding and genetic modification technology. Such efforts can lay a solid foundation for its large-scale planting and provide enough high quality raw material for its industrial processing. Secondly, industrial-scale technology for the extraction, separation, and purification of its bioactive ingredients, especially for isoflavones, needs to be further improved. At present, most practically-used technology is not a good fit for large-scale production based on economic and environmental considerations. The most outstanding issue is a lack of suitable method to realize the effective separation of its bioactive compounds. There is also a large amount of waste formed during the separation process, which can lead to environmental pollution. Kudzu refinery technology has recently been put forward and can effectively solve this problem. For example, the starch in kudzu roots is first separated, and the formed waste

waters and residues are used to extract isoflavones and dietary fiber. The obtained starch is isolated for usage as a healthy food or fermented to bioethanol. The isoflavones are used for medicine or cosmetic production. The other problem is that the utilization of kudzu is currently concentrated on its roots, and its vines have been neglected. Some studies have shown that its vines are rich in isoflavones and cellulose. Extraction of isoflavones, combined with the usage of the remaining cellulosic fibers for paper preparation can be an effective utilization way for its vines. Anyway, large-scale processing of kudzu needs to make full use of its composition and realize its comprehensive utilization. Finally, more studies should be carried out to further broaden its application and extend its production chain, which increase its additional value and make its planting and processing a profitable industry.

Kudzu, as a fast growing and easily cultivated crop with a relatively high production, has great potential for its large-scale planting, and provides enough high-quality raw material for its large-scale industrial processing. With more and more new technology adopted and high value downstream products developed, the planting and processing of kudzu will definitely form an economical viable industrial cluster. Kudzu, as a sustainable resource, has the potential to play an important role in improving rural economy, protecting local ecology, and realizing rural revitalization.

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