Beneficial Environmentally Usage of Water Hyacinth: A Mini Review

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Abstract

Invasive species are a global threat to biological diversity and ecosystem functioning. Management of most aquatic plant species depends on properly identifying the desirable or nuisance plant. For instance, if eradication of this notorious weed is not possible, then the feasibility of using this plant as an alternative energy resource e.g. bioethanol and briquette can be considered. As aquatic plants do not compete with land resources used in amble food crop cultivation and thus are an incentive factor when it comes to biofuels production. Therefore, this review presents the major application of water hyacinth such as phyto remediation and bio energy production.

Keywords: Aquatic plants; Application; Phyto remediation; Bio energy production

Introduction

Aquatic plants growing in ponds and lakes are beneficial for fish and wildlife. Although invasive aquatic plants have long been regarded as an intriguing potential feedstock because of their high growth rate in natural water bodies, most contemporary management is based on plant control rather than utilization [1]. For instance, large scale utilization of the water hyacinth species can serve as a positive approach to control, especially in the developing countries. The controlling mechanisms have had an important impact in controlling the spread of water hyacinth [2]. Malik [3], showed a remarkable approach towards the controlling and eradication of water hyacinth growth along with the combination of herbicidal control, integrated bio logical control and watershed management controlling nutrient supply. Overall, when considering the social and environmental benefits, the frameworks can possibly provide better socio-economic returns [2].

There are few recommendations to utilize harvested invasive aquatic plants for fertilizer, compost, paper-making, fuel production and other, as reported in many publications a decade ago. The possibility that any demonstration of value for invasive aquatic plants could have the perverse effect of speeding their spread [4]. Then, aquatic plants and manures are intrinsically high-moisture materials and as such, are more suited to `wet' processing techniques [5]. In addition to the desire for controlling overgrowth, a primary rationale for attempting to utilize such plants is that they often show primary productivity rates significantly higher than terrestrial bio energy feedstock candidates [6]. For example, water hyacinths have been shown to produce annual crop yields of 100 dry tons per hectare in natural lakes [7]. By way of comparison, the highest trial yields obtained for switchgrass in the USA are in the order of 25 dry tons per hectare [8]. The rapid emergence of the bioenergy economy would seem to provide a clear opportunity for implementation of programs that can direct the productivity of aquatic plants into beneficial uses.

Phyto Remediation

Water hyacinth (E. crassipes), a rooted saprophyte, is a member of the pickerel weed family: Pontederiaceae, and Genus: Eichhornia [9]. It can accumulate high rate of metals due to quickly adaptation to different aquatic physicochemical conditions [10]. Recently, Rezania et al. [11], reviewed that the water hyacinth (WH) is capable of assimilating large quantities of pollutants (heavy metals) and nutrients, which makes it effective in wastewater treatment. Hence, the removal
uptake of nutrients by water hyacinth is highly related to its optimum growth rate [12,13]. As indicated by Zheng et al. [14], *Eichhorniacrassipes* was effective in removal of heavy metals and can tolerate high concentrations of heavy metal and can survive in extreme conditions too. As documented by Kay et al. [15], the metal accumulations within plant tissues of water hyacinth was in the order leaves < stems < roots.

**Energy production**

As aquatic plants do not compete with land resources used in arable food crop cultivation and thus are an incentive factor when it comes to bio fuel production. Rezania et al. [16] found that some of the aquatic plants like water hyacinth can also be used for the production of biofuels. There are several advantages in the production of ethanol in comparison with gasoline, namely the utilization of an abundant and cheap source of renewable resources, reduction in greenhouse gas emission and benefits for rural community and social aspect of sustainability [17]. The possibility of water hyacinth conversion to the briquettes evaluated since two decades, which reviewed recently by Rezania et al. [16]. In another study, Rezania et al. [18] have reported that dried water hyacinth can use for manufacturing briquette, which is used for co-firing in coal power plant.

Water hyacinth is lignocellulosic and in its structure has monosaccharide and polysaccharide which contain different types of sugars and starch [16]. On the other hand, high contents of cellulose and hemicellulose with low lignin, impressive growth rate and no competition on land use made this plant as suitable lignocellulosic material for bio energy generation [19]. The high efficiency conversion of lignocellulosic such as WH to fuel ethanol usually comprises three major steps: pretreatment for breaking down the lignocellulosic structure, enzymatic hydrolysis to produce fermentable sugars, and microbial fermentation for ethanol yield [20].

In terms of combustion characteristic, water hyacinth briquette showed higher calorific value in comparison to the mangrove and firewood [21]. However, the value is still lower than the calorific value of charcoal. The mixing of fuel briquettes clearly demonstrated that water hyacinth based briquettes promised a potential of alternative to firewood and charcoal. Besides, Rodrigues et al. [22] proved that the water hyacinth briquette has greater amount of moisture content, similar amount of volatile matter and much greater ash content compared to the local wood fuel. In a study by Rezania et al. [18], the results showed that by increasing in WH percentage in bio-briquette, O₂ and CO level decreased, whereas, that of CO₂ and NO, NOₓ and SOₓ were increased. Therefore, the results conclude that the WH: EFB biomass bio-briquette could be a great potential as an alternative source to conventional coal.

**Conclusion**

Water hyacinth is known as multifunctional plant since 50 years ago. This paper showed the potential application of this plant. Although, several researches should be carried out for the conversion of WH – waste to wealth that leading to a sustainable management of this plant [23]. In the other point of view, the feasibility of using hyacinth for various applications have been done as an academic interest, and there is no based products or technologies which are currently available on the market [24]. Therefore, for future studies, the implication of large scale utilization of water hyacinth for mentioned products in potential market is recommended.

**References**


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