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A Review On Chemical Constituents From *Eichhornia Crassipes*

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Abstract: *Eichhornia crassipes* (Mart.) Solms, commonly known as water hyacinth, is a prolific aquatic plant recognized for its rapid growth and ecological impact on freshwater ecosystems. Despite its invasive nature, this species has garnered significant scientific interest due to its rich phytochemical profile. The present study investigates the chemical constituents extracted from various parts of *E. crassipes*, solvent extraction and chromatographic techniques. Phytochemical screening revealed the presence of diverse bioactive compounds such as flavonoids, alkaloids, phenolics, terpenoids, and sterols. Advanced spectroscopic analyses (GC-MS, FTIR, and NMR) further identified specific constituents including phenylphenalenes, flavonoids derivatives, steroids and various phenolic acids. These compounds are known for their potential biological activities. This study underscores the value of *E. crassipes* as a sustainable source of bioactive molecules and encourages further exploration into its pharmacological and industrial potential. In this review paper, we want to draw attention to the important developments in the phytochemical investigation and screening of the chemical constituents identified from *E. crassipes* till date.

Keywords: Eichhornia crassipes, chemical constituents, phytochemical screening, mass spectra, GC-MS.

I. INTRODUCTION

Eichhornia crassipes, commonly known as water hyacinth, is a free-floating perennial aquatic plant belonging to the family Pontederiaceae. Native to the Amazon basin, this species has garnered global attention due to its rapid proliferation and profound ecological impact. Characterized by its striking lavender flowers and bulbous, spongy petioles, *E. crassipes* thrives in nutrient-rich, stagnant freshwater bodies, forming dense mats that obstruct sunlight penetration and disrupt aquatic ecosystems [1]. Despite its notoriety as one of the world's most invasive aquatic weeds, *E. crassipes* possesses significant phytochemical and biotechnological potential. Various studies have identified a diverse array of bioactive compounds within its tissues, including flavonoids, alkaloids, phenolics, and terpenoids, which exhibit promising antioxidant, antimicrobial, and bioremediation properties. These attributes have spurred interest in its application across pharmacological, environmental, and industrial domains [2]. The dual nature of *E. crassipes* both as an ecological threat and as a reservoir of valuable phytochemicals underscores the importance of comprehensive scientific investigation. Understanding its biology, chemical composition, and potential utility is essential for developing sustainable management strategies and harnessing its benefits in a controlled manner. There are many reports available on the phytochemical screening of the constituents from *E. crassipes* however no report is available of the thorough phytochemical investigation of this plant. As we have been working on the phytochemical investigations of many medicinal plants [3–6], therefore our review is mainly giving the insight into the chemical constituents identified from *E. crassipes* till date.

2. Chemical Constituents identified from *Eichhornia crassipes*

Worldwide, there are reports available on the phytochemical investigation of Water Hyacinth. In 1988 Issa et al. identified monomer units of D-galactose and D-mannose after the hydrolysis of the polysaccharides of the plant by GC and GC-MS analysis [7]. In India this plant has been very less explored with very less reports are available on the isolation and characterization of active principles from the plant. Anjaneyalu et al. (1983) identified arabinofuranose and xylose from the mucin of the plant after the hydrolysis of the polysaccharides [8]. The identification was based only on GC and GC-MS analysis. Zhou *et al*. (2009) treated shoot and root biomass of the plant with NaOH and CS_2 respectivelyand obtained alkali-treated straw and cellulose xanthogenate [9]. Very extensive research work was done by Greca and co-workers who obtained eleven phenylphenalene metabolite derivatives (**1**-**4**) [10], three and five permethylated derivatives of naphthalenedicarboxylic acids (**5**-**9**) from its ethyl acetate extract (**Figure 1**). Dimeric phenalene metabolites were also identified from the ethyl acetate extract after its separation into a neutral and an acidic fraction (**10**-**18**) (**Figure 2**) [11–13]. The acid part was modified into permethylated derivatives which after chromatography provided these compounds. An antifungal phenyl benzoindenone (19) was also obtained by Greca et al. (1991) [14]. Antialgal compounds, naphthylamine derivative, were isolated by Yang et al. (1992) from the root system of water hyacinth, while Wu et al. (1991) obtained a steroid from this plant [15, 16]. Honda group investigated and found a pigment, acylated anthocyanin (20), disubstituted malonate with delphinidin glycoside and apigenin glycoside from the blue-purple flowers of *E. crassipes* [17].

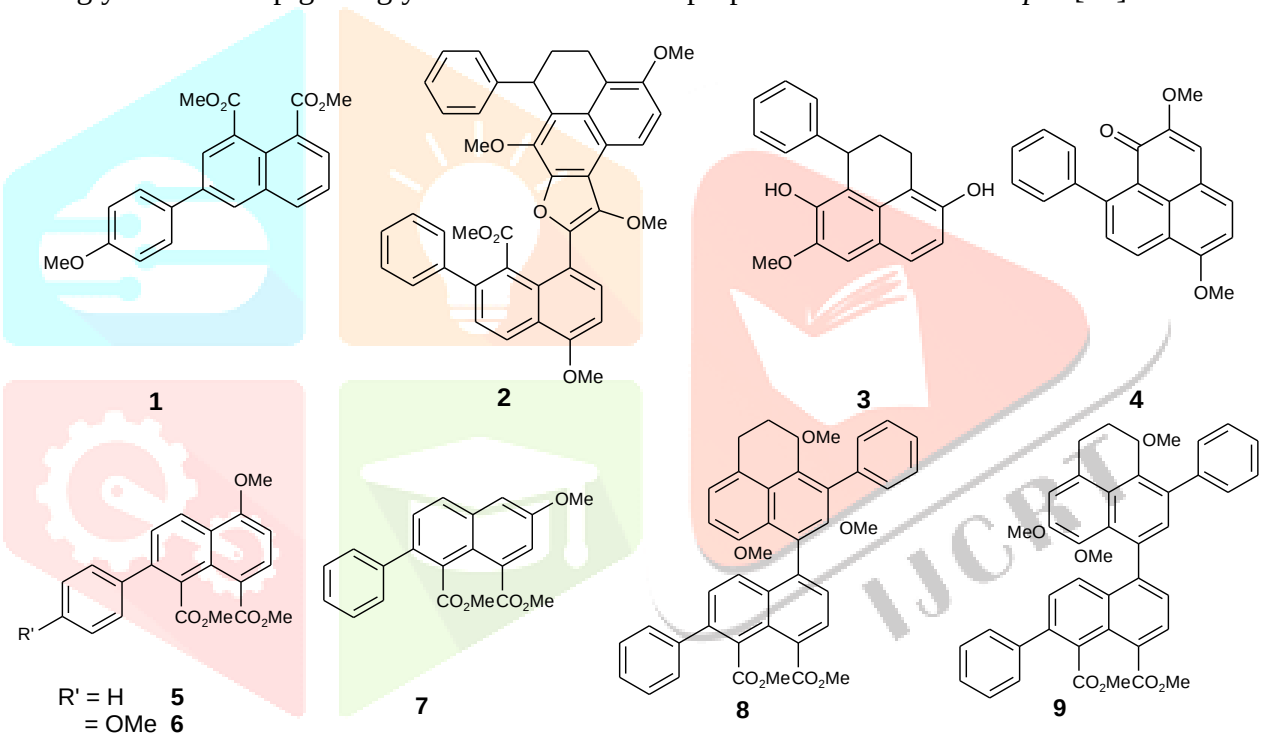

Figure 1. Chemical Constituents of *Eichhornia crassipes*

In last 15 years a few reports have been published on further phytochemical investigation. Only preliminary phytochemical screening was done by few researchers in last decade [18, 19]. Wang et al. (2011) isolated and characterized six phenylphenalenesfrom methanolic extract of the plant along with four known compounds (**21**-**30**) (**Figure 2**) [20]. In 2014, Cardoso et al. reported the presence of shikimic acid in the plant after hydrolysis of ethanolic extract with HCl [21]. Aboul-Enein et al (2014) isolated and nine compounds (**31**-**39**) (**Figure 3**) from the plant and identified them on the basis of FT-IR, ^{1}H-NMR and mass spectral data [22]. Elvira *et al*. (2018) obtained the flavonoids with the identification of basic structure only, as quercetin-7-methyl ether compounds [23]. Further work on the identification or characterization of chemical entities from the plant has not been reported. However, only preliminary phytochemical screening was done by few researchers in last fifteen years showing the presence of carbohydrates, anthraquinones, phenols, sterols, tannins, flavonoids, alkaloids etc performed by general chemical tests [2, 24-29].

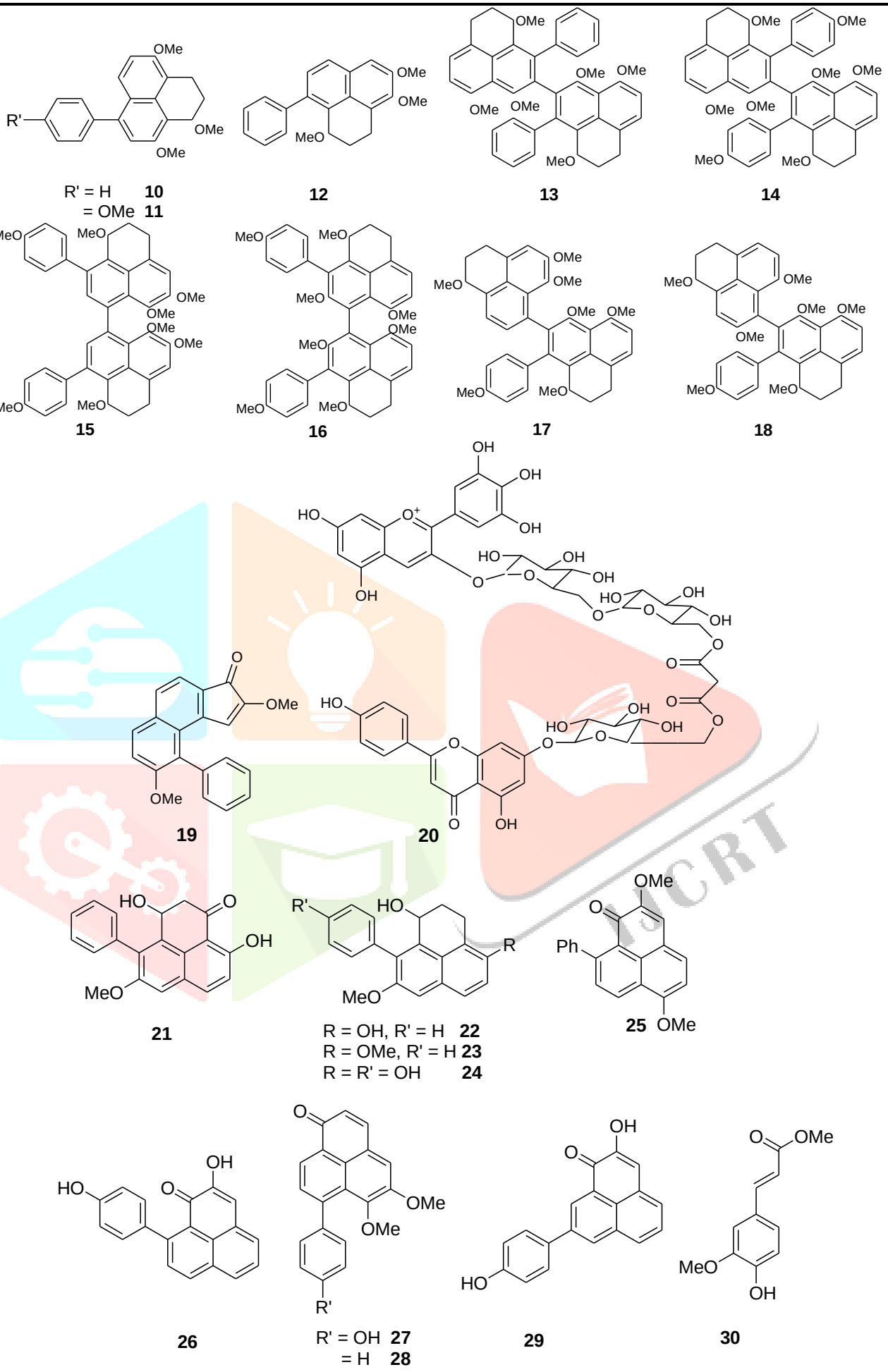

Figure 2. Chemical Constituents of *Eichhornia crassipes*

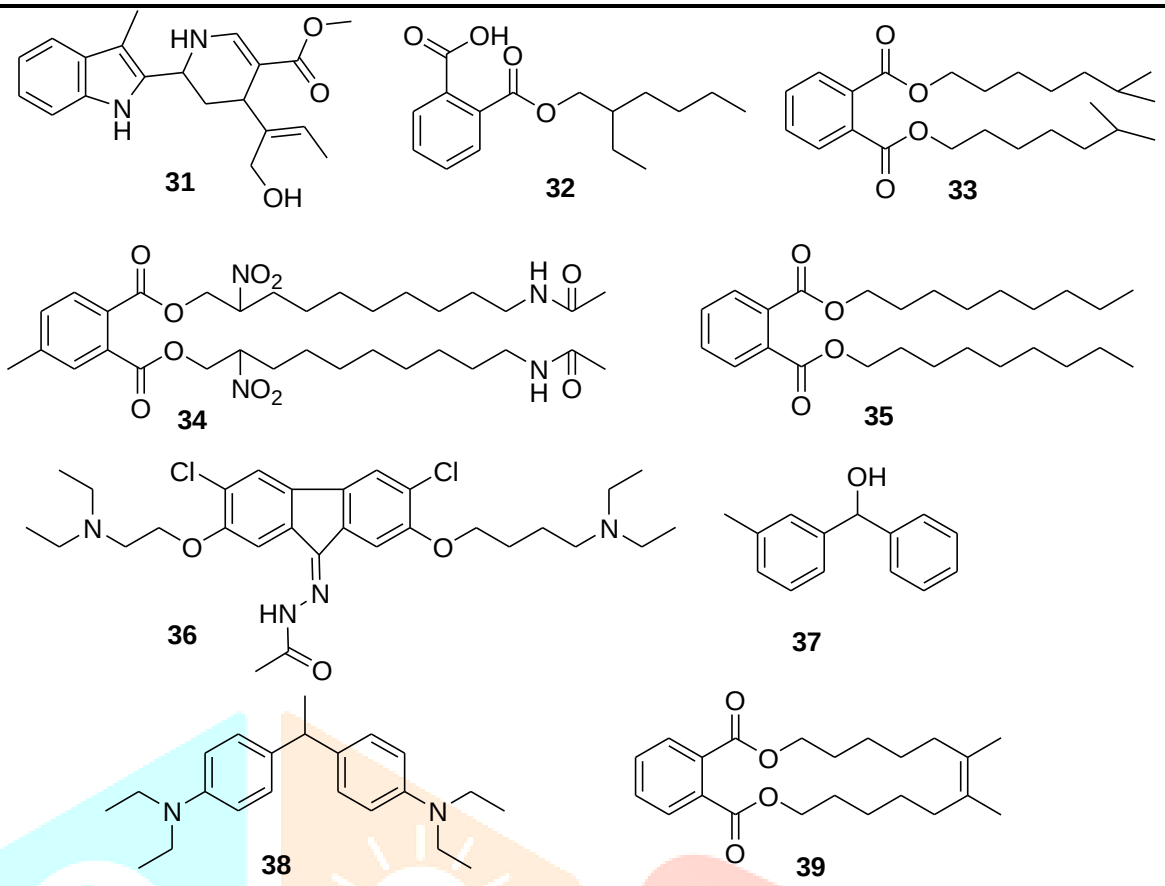

Figure 3. Chemical Constituents of *Eichhornia crassipes*

Conclusion

In conclusion, the review on chemical constituents from *Eichhornia crassipes* underscores the plant's rich phytochemical profile, including flavonoids, alkaloids, phenolics, and terpenoids, which contribute to its diverse pharmacological properties such as antioxidant, antimicrobial, and anti-inflammatory activities. Despite its notoriety as an invasive aquatic weed, *E. crassipes* emerges as a promising candidate for pharmaceutical, environmental, and industrial applications. The article advocates for further research to isolate and characterize its bioactive compounds, optimize extraction methods, and explore its therapeutic potential through clinical validation, thereby transforming a problematic species into a valuable natural resource.

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