

A Review on Ethanol Production from Water Hyacinth

Dr. Jagadish Patil¹, Ravi Teja K A²

Associate Professor, Department of Chemical Engineering, RV College of Engineering, Bangalore, Karnataka, India¹

U.G. Student, Department of Chemical Engineering, RV College of Engineering, Bangalore, Karnataka, India²

ABSTRACT: With industrial development growing rapidly, there is a desire for sustainable natural resources. Ethanol from biomass, bioethanol, is a gorgeous, stable source of energy for transportation. Supported the premise that bioethanol can contribute to wash environment and therefore the implementation of environmental protection laws in many countries, the requirement for these fuels is increasing. Effective ethanol production is relies on well-designed processes where the employment of most cost-effective structures is most needed. The employment of various concentrations of lignocellulosic material can be attributed to ethanol production. Among the assorted species of lignocellulosic water hyacinth (*Eichhornia crassipes*) may be a source that may be found in many tropical regions of the planet. An irreplaceable aquatic weed that grows fast. An oversized amount of research work is underway for its bioconversion to ethanol using two successive steps of hydrolysis and decomposition. This paper reviews the bioconversion of water hyacinth instead of ethanol.

KEYWORDS: Water Hyacinth, Ethanol, Pretreatment, Fermentation,

I. INTRODUCTION

Fossil fuels are formed by the anaerobic decomposition process. Fossil fuels supply most of the global energy / energy demand. As demand for oil continues to grow, resources reduce the need for alternative energy sources. To overcome these problems, the most widely used lignocellulosic materials are ethanol, another alternative to electricity generation. Commercial ethanol is produced by both synthetic and biological methods [7]. Synthetic ethanol production is usually done by the catalytic hydration of ethylene in the vapor phase. Ethanol produced in this process is widely used as a solvent (60%) and as a chemical agent (40%). More than half (53%) of India's total energy is coal consumption is followed by oil, which accounts for 31% of the total energy consumption. And hydroelectric gas energy accounts 8% and 6% respectively for consumption. According to India the government supplies 30% of India's energy needs to import.

One of the main reasons for the interest in renewable energy sources is the greenhouse effect. Ethanol is attracting global attention due to the potential use of alternatives cars are hit. This is especially important in such countries like India, which bank on severely on crude oil imports, is a huge amount of its annual budget. Ethanol is also valuable as an antioxidant fuel for refrigeration. Ethanol has the highest evaporation temperature (855 MJ / kg) than gasoline (293 MJ / kg). Ethanol contains high octane oil (99) there will be no more than gasoline (80-100) as the resultant pre-ignition will never occur when ethanol is used. Ethanol is completely heated so that hydrocarbon emissions are significantly lower compared to gasoline. Ethanol fuel leaks are less likely to fire and explode. Ethanol works well in clean form or as fuel in cars mixed with gasoline. In addition to ethanol / gasoline blends there are other automotive applications, including markets, ethanol: (a) Use as E85, 85% ethanol and 15% gasoline, (b) E100, 100%

Ethanol with or without petroleum, and (c) use of diesel fuel typically 80% gasoline, 10% ethanol and 10% additives and coordination agents. There are several advantages of mixing ethanol with gasoline that leads to lower carbon mono-oxide (CO), nitrogen oxides (NOx) and after hydrocarbons ethanol combustion compared to gasoline acting as an oxidation factor [4-6]. Since ethyl alcohol synthesis it is non-smoking and odorless and has a total value of 7100 calories / g, in some situations a small oven offers the possibility of being used. It can also be used for lighting purposes. Ethanol alcohol is an important ingredient with the chemical formula C₂H₅OH. It is colorless, transparent, neutral, hydrocarbon with hydrocarbon, strong aroma and strong aroma. The taste of burning. Because of the association of the two waters. And organic compounds, ethanol has a significant industrial concentration applications. The Vital physical aspects of ethanol are calculated In Table 1.

The development of ethanol as a motor fuel can work to achieve this commitment. Greenhouse gas emissions reductions should be measured annually. Where the level per year there is considerable variation, which should be stated on an annual basis. If the Bioethanol from Biomass is used to drive a light-duty vehicle, Net CO₂ emissions by using a single car is less than 7% than better gasoline.

Water hyacinth, *Eichhornia crassipes*, is a freshwater aquatic plant belonging to the Pontardiaceae family, which belongs to the Lily family and is native to the Brazilian and Ecuadorian regions. It is a popular ornamental plant found in water gardens and waterfalls, with beautiful blue-green flowers turning them into pink flowers and scattered leaves and coated petioles. It can grow from a few centimeters to one meter. The stems and leaves contain sacks full of air that help them to sink. In developing countries, they are used in traditional medicine and to remove toxins from contaminated water. They reproduce through solons and seeds, which are efficient for up to 20 years, so they are difficult to control. Therefore, it is considered as weed-free weed in many parts of the world because it develops rapidly and releases nutrients and oxygen into the aquatic environment, which has a negative impact on flowers and animals. In addition, due to excessive evaporation, it increases the problem of water wherever it grows. The potential to convert water hyacinth into biogas or ethanol is currently being developed in many developing countries, especially in India. So-called "waste" products make food production, fats and chemicals an important source of livelihood, something that we can think about in the future and maturity is one way to achieve this goal.

Research work on this aspect of detoxification is ongoing to achieve maximum productivity, and more research is needed for developing more economical and less time consuming methods. The general process description is shown in Fig. 1.

II. METHODOLOGY

2.1. Chemicals, reagents and microorganisms

Whole ethanol, potassium dichromate and fluoroglucinol solution may be used. *Candida shehatae* can be selected as microorganisms. The organism needs to be maintained Sabouraud dextrose agar (10 g / L neo-peptone, 20 g / L dextrose, pH) 6.5; SDA) at 4 .C.

2.2. Preparation of water hyacinth

Chronic Freshwater Hyacinth (WH) stems were collected from an inland natural Lake Kulamalai Community, Nakarnapatham Province, Thailand, and May 2006. Water Hyacinth is washed in many ways to remove dirt from tap water often, Make small pieces (~ 1-2 cm), Small cells (- 3-5 mm), finally Preheat the oven to 105 ° C for 6 hours. The dry goods were stored in the room temperature until used. Preparation of water hyacinth as a green cloth for ethanolconversion is described in Fig. 2. [7]

2.3. Pretreatment

The following procedures can be used for pretreatment of water hyacinth.

2.3.2. Acid hydrolysis

Concentrated acids such as H₂SO₄ and HCl have been used to treat lumocellulosic substances. Although these are powerful agents for cellulose hydration, concentrated acids are toxic, corrosive, and dangerous, and require reactors for corrosion. Additionally, concentrated acid must be recovered after hydration to make this process economically feasible.

Acid hydrolysis has been successfully developed to remove lignocellulosic substances. Sulfuric acid splash dilution can achieve a higher reaction rate and greatly improve cellulose hydration. At medium temperature, direct treated with reduced yields due to sugar decomposition. High temperature cellulose hydrolysis dilutes the acid treatment.

Recently developed dilute acid hydrolysis processes use less severe conditions and high silan for geothermal transfer yields. To achieve optimal overall process economics it is necessary to obtain a high silogen conversion yield because many lignocellulosic substances constitute up to one-third of total carbohydrate.

There are basically two types of dilute acid pre-treatment: high temperature (above T 160 C), continuous flow the batch process for loading of solids (10-40%) (5-10% [surface weight / weight of the reaction mixture]), and low temperature (T less than 160 C). Dilute acid absorber can significantly improve cellulose hydration, but its cost is usually higher than some physico-chemical splash processes, such as steam blasting or AFEX. Neutralization of pH is required for low enzyme hydrolysis or fermentation processes.

2.3.3. Alkali pretreatment

Some sites can also be used to remove lignocellulosic materials, and the effect of alkaline precipitation depends on the lignin content of the products. The mechanism of alkaline hydrolysis is believed to be responsible for the saponification of intermolecular ester bonds that crosslink the oxylone hemicellulose and other components, for example, lignin and other hemicellulose. The porosity of lignocellulosic substances is increased by the removal of crosslinks. Reducing NaOH treatment of lignocellulosic materials increased swelling, increased internal surface area, reduced polymerization, reduced crystallization, isolated structural relationships between lignin and carbohydrate, and dissolved

lignin formation. The digestion of NaOH-treated hardwoods increased from 14% to 55%, while the lignin content decreased from 2455% to 20%. However, softwoods with lignin content of more than 26% had no effect on the thin NaOH sham. Diluted NOH splash is useful for the hydration of straws with a low lignin content of 10-18%. A mixture of irradiation and 2% NaOH was applied to the gradient of corn stalks, cassava bark and peanuts. The glucose yield of maize stems was 20% compared to 43% after treatment with electron beam irradiation at 500 kg and 2% NaOH levels, respectively. Ammonia was also used as an excuse to remove lignin. Scientists describe the ammonia recycling percolation process (temperature, 170 ° C; ammonia concentration, 2.5–20%; reaction time, 1 hour) for the conversion of corn guards / stover blends and weeds. Calibration efficiency is 60-80% for Corncap and 65-85% for Switch grass.

2.3.4. Biological pretreatment

In biological sham processes, microbes such as brown-, white-, and soft-rot. In fungal wastes, lignin and hemicellulose are used for decomposition. Brown basically rotates Cellulose attacks, white and soft breads attack both cellulose and lignin. White rot Fungi are the most effective basidiomycetes for lignocellulosic biological splash. Material. Researchers examined wheat straw actresses with 19 white rot fungi. It was found that 35% grass was converted by Pleurotusastratus to reduce sugars. Five weeks. Pinochet achieved a similar change in sham. Sorbita 37 and Pycnophorussynaprinus 115 in four weeks to prevent damage. As for cellulose, the cellulase-less mutation of Sporotrichiumpalurelendum is generated. It has been reported that the erosion of lignin (Bermuda formation) in wood chips. Grass with white rot fungi. Bermuda grass stems are enhanced by bio-degradation 29–32% using Cerebariopsissubvermispora and 63–77% after using Cytus stercorus 6 weeks.

White fungal fungus b. Chryso sporium produces lignin-degrading enzyme, lignin. Peroxidase and manganese-based peroxidase during secondary metabolism. Reaction in the carbon or nitrogen range. Two enzymes were found. The outer fibers of many white-rot fungi are responsible for the decay of wood cell walls. Other enzymes, including polyphenol oxidase, lysis, and H2O2 production enzymes. Reducing quinone enzymes also weakens lignin. Organic benefits. The scenarios are low energy demand and mild environmental conditions. However, most biological pretreatment methods have a very low rate of dehydration

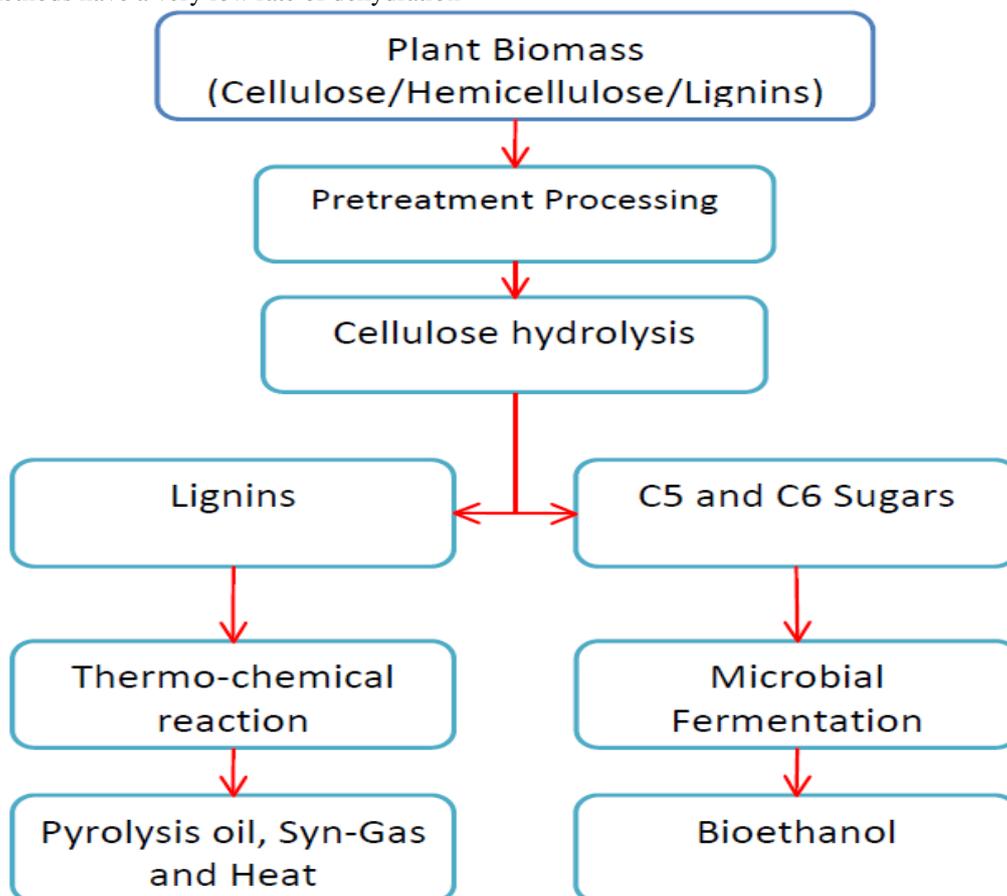


Fig. 1. Description of the process.

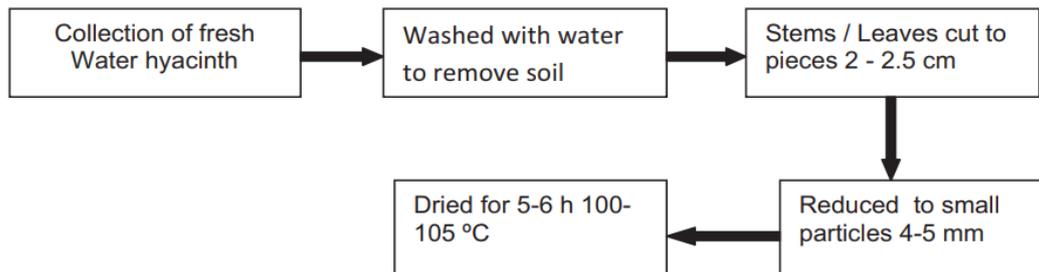


Fig. 2. Water hyacinth preparation.

2.4. Preparation of hemicellulose acid hydrolysate

One hundred grams of dried hyacinth is usually mixed with a final volume of 1000 mL containing 1% or 10% sulfuric acid. At 121, C, the mixture was autoclaved and cooled at 103 kPa for 15 min. below room temperature. The hydrolysate is then filtered to remove unhealthy materials using Whitman Paper No. 1. The filtrate will eventually be collected and the xylose content Analysis [10].

2.4.1. Detoxification of hemicellulose hydrolysate

The hemicellulose acid hydrolysate is then heated to 60C and alkalized with NaOH until the pH reaches 9.0-9.5. Ca (OH) 2 solution was added to the solution to detoxify the harmful substances in the hydrolysate. After the removal of insoluble residues by purification, the clear liquid that lies above a sediment should be collected for further use as fermented sugar [10].

2.5. Lignin separation

2.5.1. Preparation of the lignocellulosic hydrolysate

After washing with water, the excretory material is properly filtered, and then the sugar can be collected to filter analysis.

2.5.2. Detoxification procedure

Methods of enzymatic toxicity include laccase (1 m), lignin peroxidase (1 m), lactase and lignin peroxidase combined (1 m each), and control (water). Added instead of enzyme. Fermentation samples should be analyzed. This model of fermentation requires GC-MS analysis; the size of their phenolic compounds can be determined by gel-trafficking chromatography. With NaOH, hydrolysate pH 5.3, lignin peroxidase pH 3.2, and lignase and lignin perinase can be adjusted to pH 4.5 for the treatment and treatment of laccase. Add lacquer, lignin peroxidase or water as needed. All samples were incubated at 30 ° C for 12 h. Rotary Shaker (90 rpm). Hydrogen peroxide 0.2 M should be added to peroxidase samples every hour and at the end of the experiment; the catalyst (0.04 mg / mL) can be added as shown in Figure 3. [24]

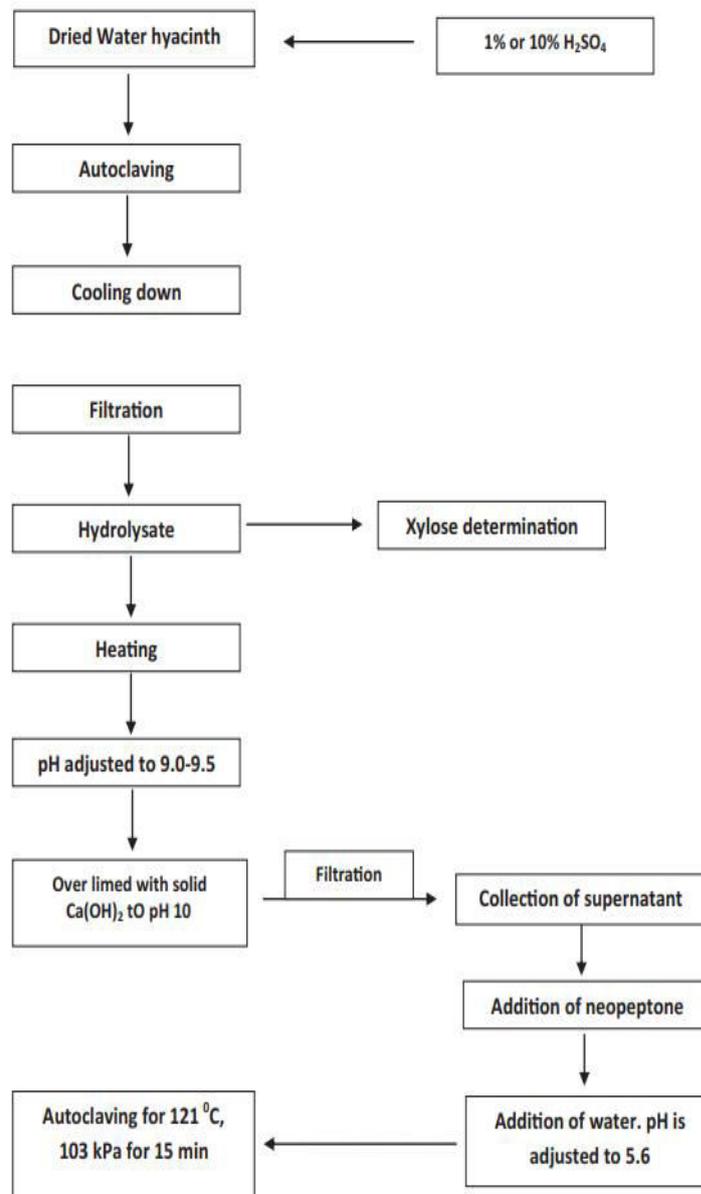


Fig. 3 Detoxification, Media preparation and Hydrolysis.

2.6. Fermentation

2.6.1. Use of *Pichia stipitis* and *C. shehatae*

All fermented organisms must ferment monosaccharides and, in addition, face potential hydrolysis. *S. cerevisiae* is the most commonly used ethanol producer. *S. cerevisiae* cannot be fermented, containing 40% of the raw materials. Xylose fermented yeast *P. stipitis*. This multidisciplinary approach involves a large amount of research, which requires less time to devise a standard biomass-refueling process.

III. CONCLUSION

In conclusion, we investigated the possibility of applying the right technologies (acidic hydrolysis and yeast incorporation) in bioconversion from water hyacinth to ethanol. As mentioned earlier, water hyacinth is one of the most severe weeds that can cause serious problems in freshwater or groundwater, especially in tropical areas. Although control management is widely used to keep the plant in good condition with herbicides and mechanical removal, in many cases, it remains.

It does not work because of the dangerous development of marine health. The process here helps bring down the plant providing a simple and cost effective process that is compatible with developing countries.

REFERENCES

- [1] Bentley RW. Global oil and gas depletion: an overview. *Energy Policy* 2002;30:189–205.
- [2] Cavallo AJ. Predicting the peak in world oil production. *Nat Resour Res* 2002;11:187–95.
- [3] Demirbas A. Products from lignocellulosic materials via degradation processes. *Energy Sources A: RecovUtil Environ Effects* 2008;30(1):27–37.
- [4] Takahashi CM, LimaKGC, Takahashi DF, AlterthumF. *WorldJMicrobiolBiotechnol* 2000;16:829, doi:10.1023/A:1008987103701.
- [5] Badger PC. In: Ja-nick J, Whipkey A, editors. *Trends in New Crops and New Uses*. Alexandria, VA: ASHS Press; 2002.
- [6] Mielenz JR. *Curr Opin Microbiol* 2001;4(3):324, doi:10.1016/S1369-5274(00)00211-3.
- [7] Isarankura-Na-Ayudhya C, Tantimongcolwat T, Kongpanpee T, Prabhate P, Prachayasittikul V. Appropriate technology for the bio-conversion of water hyacinth (*Eichhornia crassipes*) to liquid ethanol: future prospects for community strengthening and sustainable development. *EXCLI J* 2007;6:167–76. ISSN 1611-2156.
- [8] Sun Y, Cheng J. Hydrolysis of lignocellulosic materials for ethanol production: a review. *Bioresour Technol* 2002;83(1):1–11, doi:10.1016/S0960-8524(01)00212-7.
- [9] Lavarack BP, Griffin GJ, Rodman D. *Biomass Bioenergy* 2002;23(5):367, doi:10.1016/S0961-9534(02)00066-1.
- [10] Frederick Jr WJ, Lien SJ, Courchene CE, DeMartini NA, Ragauskas AJ. *Bioresour Technol* 2008;99(11):5051, doi:10.1016/j.biortech.2007.08.086.
- [11] Kim KH, Tucker MP, Nguyen QA. *Biotechnol Prog* 2002;18(3):489, doi:10.1021/bp025503i.
- [12] Emtiazi G, Naghavi N, Bordbar A. Biodegradation of lignocellulosic waste by *Aspergillus terreus*. *Biodegradation* 2001;12(4):257–61, doi:10.1023/A:1013155621336.
- [13] Keller FA, Hamilton JE, Nguyen QA. Microbial pretreatment of biomass: potential for reducing severity of thermochemical biomass pretreatment. *J Appl Biochem Biotechnol* 2003;105(1-3):27–41, doi:10.1385/ABAB:105:1-3:27.
- [14] Shide EG, Wuyep PA, Nok A. Studies on the degradation of wood sawdust by *Lentinus squarrosulus* (Mont.) Singer. *Afr J Biotechnol* 2004;3(8):395–8. 972 A. Ganguly et al. / *Renewable and Sustainable Energy Reviews* 16 (2012) 966–972
- [15] Taseli BK. Fungal treatment of hemp-based pulp and paper mill wastes. *Afr J Biotechnol* 2008;7(3):286–9.
- [16] Han SK, Shin HS. Enhanced acidogenic fermentation of food waste in a continuous-flow reactor. *Waste Manage Res* 2002;20(2): 110–8.
- [17] Yue ZB, Yu HQ, Hu ZH, Harada H, Li YY. Surfactant-enhanced anaerobic acidogenesis of *Canna indica* L. by rumen cultures. *Bioresour Technol* 2008;99(9):3418–23, doi:10.1016/j.biortech.2007.08.010.
- [18] Jarboe LR, Grabar TB, Yomano LP, Shanmugan KT, Ingram LO. Development of ethanologenic bacteria. *Adv Biochem Eng Biotechnol* 2007;108:237–61, doi:10.1007/10 2007 068.
- [19] Peterson JD, Ingram LO. Anaerobic respiration in engineered *Escherichia coli* with an internal electron acceptor to produce fuel ethanol. *Ann NY Acad Sci* 2008;1125:363–72.
- [20] Nikolov T, Bakalova N, Petrova S, Benadova R, Spasov S, Kolev D. An effective method for bioconversion of delignified waste-cellulose fibers from the paper industry with a cellulase complex. *Bioresour Technol* 2000;71(1):1–4, doi:10.1016/S0960-8524(99)00059-0.
- [21] Georgieva TI, Hou X, Hilstrom T, Ahring BK. Enzymatic hydrolysis and ethanol fermentation of high dry matter wet-exploded wheat straw at low enzyme loading. *J Appl Biochem Biotechnol* 2008;148(1-3):35–44, doi:10.1007/s12010-007-8085-z.
- [22] Hao JJ, Tian XJ, Song FQ, He XB, Zhang ZJ, Zhang P. Involvement of lignocellulolytic enzymes in the decomposition of leaf litter in a subtropical forest. *J Eukaryot Microbiol* 2006;53(3):193–8.
- [23] Mtui G, Masalu R. Extracellular enzymes from Brown-rot fungus *Laetiporus sulphureus* isolated from mangrove forests of Coastal Tanzania. *Sci Res Essay* 2008;3:154–61.
- [24] Jönsson LJ, Palmqvist E, Nilvebrant N-O, Hahn-Hägerdal B. Detoxification of wood hydrolysates with laccase and peroxidase from the white-rot fungus *Trametes versicolor*. *Appl Microbiol Biotechnol* 1998;49:691–7.
- [25] Nigam JN. Bioconversion of water hyacinth (*Eichhornia crassipes*) hemicellulose acid hydrolysate to motor fuel ethanol by xylose-fermenting yeast. *J Biotechnol* 2002;97:107–11.