

Palmyrah Distillery Spent Wash for Ethanol Production by a Thermotolerant *Saccharomyces cerevisiae* S₁ at 40°C

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ABSTRACT

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Palmyrah distillery spent wash was used as an alternative to the predefined PYN medium (peptone, yeast extract, magnesium sulphate, potassium hydrogen phosphate and ammonium sulphate). In this study, the focus was on the utilization of spent wash from Sri Lankan palmyrah based distilleries to reduce the biological oxygen demand (BOD). To utilise the spent wash, it was supplemented with glucose and different nitrogen sources. Replacing PYN medium with spent wash and the increase in the glucose concentration led to a decrease in ethanol production. Hydrolysis of spent wash with a commercial protease (Neutrase) and supplementation with 200 gL⁻¹ glucose produced 73.4 gL⁻¹ ethanol. Among the different nitrogen sources supplemented 4.6 gL⁻¹ (NH₄)₂SO₄ increased ethanol production to 92.5 gL⁻¹ indicating that the spent wash could be economically used to produce ethanol, while decreasing the BOD from 25,000 to 4,000 mgL⁻¹.

Key words: biological oxygen demand, ethanol, distillery, spent wash, supplementation.

INTRODUCTION

Ethanol is one of the important fuels from renewable sources and is produced by the fermentation of sugars of sugar cane or corn starch (after hydrolysis). One of the main problems faced by distillers is the disposal of the distillery spent wash¹⁶. This material is the unwanted residual liquid waste generated during alcohol distillation and is highly polluting for watercourses. Distillery effluents may be treated or re-utilized to alleviate environmental problems²³. A number of approaches may be adopted to clean up spent wash. For example, filtering the spent wash and reusing the permeate in the cooking process of the raw materials¹², bioremediation and decolourization^{14,17}, using the distillers dried grains with solubles (DDGS) in poultry feeding²², production of biomass and volatile oils¹³, subjecting to liquid hot water pre-treatment and ammonia fibre expansion in addition to enzyme treatments¹¹. Research has concentrated on the development of

value-added products from spent wash such as fertilizer, SCP (single cell protein) and biogas by anaerobic digestion⁵.

In the northern part of Sri Lanka, especially in the Jaffna peninsula, the distilleries use naturally fermented palmyrah and coconut sap called 'palmyrah toddy' and 'coconut toddy', respectively (*personal communication*, Palmyrah distilleries, Jaffna). The inflorescence of palmyrah and coconut palm is seasoned and the sap is collected in clay pots, where it is fermented by air borne microorganisms. The 'toddy' is distilled and the effluent (spent wash) from the distillation column is not reused or treated. This spent wash possesses a high pollution potential with the BOD ranging from 20,000 to 25,000 mgL⁻¹. Spent wash re-utilization in fermentations can lower alcohol production costs by decreasing the expenditure involved in disposing of spent wash. However, it is necessary to optimize the sugar and nitrogen content²⁵. Supplementation of spent washes from whiskey distilleries with different carbon sources has been reported^{5,9}. To date, no studies have been conducted in Sri Lanka to bioremediate spent wash from the distilleries in the Jaffna Peninsula.

Ethanol production at elevated temperatures using thermophilic microorganisms^{4,6,7} is advantageous due to the energy savings achieved through a reduction in cooling costs. This may avoid frequent production cessations due to overheating problems², bacterial contamination and the volume of cooling wastewater effluent. To conduct the fermentation process at 40°C, a thermotolerant strain of *Saccharomyces cerevisiae* S₁, isolated locally, was employed³.

In this study, the focus was on the utilization of spent wash from Sri Lankan distilleries and the supplementation of the spent wash with glucose and different nitrogen sources for ethanol fermentation.

MATERIALS AND METHODS

Materials

Spent wash (collected from the distillation column effluent) was obtained from Palm Products Distilleries (Thikkam, Jaffna). In the palm products distilleries, palmyrah (*Borassus flabelliformis* L.) toddy is distilled. The palmyrah toddy is a naturally fermented palmyrah sap. The palmyrah sap is secreted by the inflorescence and has a sugar content of 12–15%. The toddy is distilled in a column distillation plant and the effluent from the plant is

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