Enzymatic hydrolysis of spent *Saccharomyces cerevisiae* derived from sago bioethanol fermentation

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Abstract

Spent Saccharomyces cerevisiae is a by-product of bioethanol fermentation. The spent yeast is abundant in valuable components which can be used for many applications. One of the ways to prepare yeast extract is through enzymatic hydrolysis which is by rupturing the yeast cell walls using exogenous enzymes under certain conditions that promote the leakage of intracellular compounds. To date, enzymatic hydrolysis of spent S. cerevisiae derived from the production of sago bioethanol is yet to be thoroughly explored. In the present study, we examine the feasibility of enzymatic hydrolysis of spent S. cerevisiae generated from sago bioethanol fermentation. The effect of two enzymes namely alcalase and cellulase and their concentrations (0.1-0.5% (v/v) on the release of protein and carbohydrate in the hydrolysate was also investigated.

Additionally, the surface morphology of the hydrolysed yeast cells was observed using a Scanning electron microscope (SEM). Our results showed that the optimal concentration of alcalase and cellulase for enzymatic hydrolysis of spent S. cerevisiae was 0.4% (v/v) and 0.5% (v/v) respectively. In addition, cellulase was found to be more superior than alcalase with respect to the protein content in the hydrolysate. The enzymatic hydrolysis of spent yeast by alcalase and cellulase yielded improvements of 1.1 to 1.8-fold and 3.5 to 5.6-fold of protein and total carbohydrate concentration respectively in comparison to that achieved via autolysis. It was evident from the SEM analysis that there was a notable change in the surface morphology of the lysed yeast cells indicating the lysis of the yeast cells throughout the enzymatic hydrolysis. In summary, the current work provides useful insights into the strategies of valorising spent S. cerevisiae generated from sago bioethanol production. This will further help the development of value-added products from the waste, hence promoting a sustainable economy besides reducing the environmental impacts associated with the disposal of spent S. cerevisiae.

Keywords: Enzymatic hydrolysis, Bioethanol fermentation, *Saccharomyces cerevisiae*, Spent Baker's yeast, Yeast extract.

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Introduction

Spent *Saccharomyces cerevisiae* is a major by-product of the brewing industry. The spent yeast is rich in protein, essential amino acids, RNA, vitamin B and minerals, making it as a promising source for the production of yeast extract[14,32]. Yeast extract refers to the soluble portion of yeast cells after the separation of the insoluble components[33]. It has been reported to possess biological properties such as antioxidant properties. Besides that, the yeast extract is also used as a source of peptides for value-added functional foods and as a component for microbiological growth media[21]. In addition, yeast extract has also been widely used as a flavouring agent and flavour enhancer in food industry[6]. To date, spent *S. cerevisiae* is typically used either as a low-cost protein source in animal feed formulations or is discarded to the environment causing severe ecological impacts[15,26].

There is a growing interest in valorising the spent *S. cerevisiae* for various applications. One of the ways to derive the yeast components is by enzymatic hydrolysis. Enzymatic hydrolysis is an efficient method in yeast extract production since it offers higher process specificity compared to conventional processes[9]. Enzymatic hydrolysis is performed by adding exogenous enzymes that accelerate the rupture of yeast cell wall[22]. Furthermore, these enzymes also increase the activity of endogenous enzymes in releasing intracellular compounds, resulting in hydrolysates of superior sensorial quality and improved functional and biological functions with minimal salt content[30,31].

An alternative to increase the bioactivity of ingredients at a reduced cost would be through the use of commercial enzyme pools for enzymatic production of bioactive peptides from complex feedstock mixtures[25]. Several studies have reported the use of commercial lytic enzymes such as pancreatin, flavourzyme, brauzyn, papain, lyticase and alcalase for lysing yeast cells[4,21,33]. These enzymes have one or more of the following activities: proteolytic activity (proteases or peptidases), RNA degrading activity (nucleases), or deaminase activity (deaminases)[8,9,33].

Most of previous reports on enzymatic hydrolysis in the literature focused on the use of either fresh yeast or spent yeast from brewing fermentation. In general, there is still scarce information on the valorisation of spent *S. cerevisiae* derived from bioethanol fermentation using agricultural