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Improving and optimizing protein concentration yield from homogenized baker's yeast at different ratios of buffer solution

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ABSTRACT

Baker's yeast (*Saccharomyces cerevisiae*) and other lignocellulosic materials use as energy producing biomass have improved over time. These to date have continued to play a massive and quality role in the developmental needs of energy for sustainable future. Baker's yeast dominance in this energy trends has shown to be very productive as part realization of the set goal ahead. This through current research has shown to be positively supportive in the tackling of the rising greenhouse gas emissions (GHG) and global warming.

In this study, the mechanical pre-treatment of yeast substrate was conducted through its homogenization in the high-pressure homogenizer (HPH). With the operating conditions of temperature, pressure and number of passes (cycles) ranging from (30–50 °C), (30–90 MPa) and (1–5) respectively, this was ensured that the HPH machine maximum pressure of 100 MPa was not exceeded. The homogenized yeast was diluted in three levels of dilutions with buffer solutions; denoted as solution C in the ratio of; 10:90, 20:80; and 30:70 respectively. The resultant protein concentration yield so obtained was analyzed and optimized through using the *Design Expert V.8* in the comparison of the three samples in the ratios given with the 3 input factors of pressure, temperature and number of cycles estimated within the considered limits.

Introduction

Comparatively, baker's yeast have now been seen as a great source of energy production just as in other microbial products whose cell produces high protein contents required for bioenergy production. As energy has become the prime mover of economic growth in this 21st Century due to the growing demand for the rising population worldwide, it is, therefore, necessary to develop an alternative energy source whose production are affordable and will not in any way interferes with society negatively. This when developed, will compensate present energy need through the reduction of

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environmental concerns owed to pollution and global warming [1]. All biomass are produced by green plants converting sunlight into plant material through photosynthesis [2] and baker's yeast as a biomass is an organic material that has stored sunlight in the form of chemical energy. This as well known, biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing during its releases when consumed as fuel. As part contribution of biomass to energy development worldwide, via renewable energy source (RES) this [3], pointed out that only in the last 10 years, the energy demands have doubled, as the current energy resources as known would not meet the market request. Energy from biomass conversion will, therefore, be considered as the most important fuel worldwide after coal, oil, and natural gas and is expected to become one of the key energy resources for global sustainable development [4].

Baker's yeast as a biomass substrate and its consideration in this work was based on its inexpensiveness and easily availability along with the protein contents stored in the substrate high enough to be compared to in the 3 levels of dilutions. Literature survey has also shown this substrate to be in the top group with higher protein content. Energy development overall has shown to be of greater improvement and this has included the use of baker's yeast for energy efficiency and improvement through mechanical disruption technique of high-pressure homogenizer (HPH). Ref. [5] have concluded in his editorial paper on, “The 3rd international conference on sustainable energy and environmental protection (SEEP) 2009” that more research and developments will be needed to tackle the energy problem so as to continually reduce the emission, for a reasonable standard of living for our world. Fernandez et al. [6] have explained and highlighted yeast and yeast derivatives being widely used in the formulation of food systems. This also has now been extended widely to the production of energy in addition to producing food. Accordingly, Vasallo et al. [7] stemmed this interest in yeast and polysaccharides increasing as a result of the continuously growing fermentation industry which produces yeast biomass as a by-product. While Nielsen et al. [8] discussed extensively on the metabolic engineering of yeast for production of fuels and chemicals, they considered it offering many advantages as a platform cell factory for such production. Ref. [9] evaluated yeast and considered it as the workhouse in the current biofuel industry due to its use in the production of ethanol. *Saccharomyces cerevisiae* has been metabolically engineered to produce several advanced biofuels: 1-butanol [10] and isobutanol [11]. Baker's yeast usefulness for energy production can never be ascertained without the disruption of the cell wall for the release of the innermost contents. Protein concentration which is stored in the cell wall of the baker's yeast will need to be fully disrupted for its release. This is a key step towards the isolation and purification of many biotechnological products that are present in the interior of cells of the cell walls of micro-organisms [12]. These are liberated using the high-pressure homogenizer (HPH). White and Marcus [13] and Keshavarz et al. [14] have suggested factors such as the type of microorganisms, growth and storage conditions of the cells as the important choices in considering disruption method required. This, however, when chosen must consider coupling of a high disintegration efficiency with a short disruption time [15]. Cell wall breakage of baker's yeast (*S. cerevisiae)* for the release of intracellular contents of protein as analyzed using the high-pressure homogenizer (HPH) shown in Fig. 1 satisfies the condition for the disruption process. Authors [16–20] and many others have exhibited in their research works through using high-pressure homogenizer (HPH) for biomass substrates disruptions for energy yield improvements.

This paper, therefore, considered the improvement of protein concentration yield at the different rate of buffer solution when added to the baker's yeast after homogenization and through optimization, the yield was eventually determined. In essence, the objective basically was to determine the highest yield of protein in the considered ratio of buffer against the homogenized yeast. The considered ratio of homogenized yeast against buffer solution were 10:90, 20:80, and 30:70.

Background

The use of baker's yeast in our everyday lives cannot be underestimated. This has remarkably been considered very useful in all human endeavors. Reed and Nagodawithana [21] found yeast to be important as a raw material for food, pharmaceutical and cosmetic industries, in addition, to being an excellent source of nutrients, mainly protein, vitamins of the B complex and essential minerals. As a source of protein, it has been regarded as a class of nitrogenous organic compounds which have large molecules composed of one or more long chains of amino acids and as an essential part of all living organisms, especially as structural components of body tissues. Of great importance in this study, is the ability of the protein to be fully liberated when homogenized under high pressure. Most widely used amongst microorganisms for ethanol fermentation is S. *cerevisiae* a form of baker's yeast;

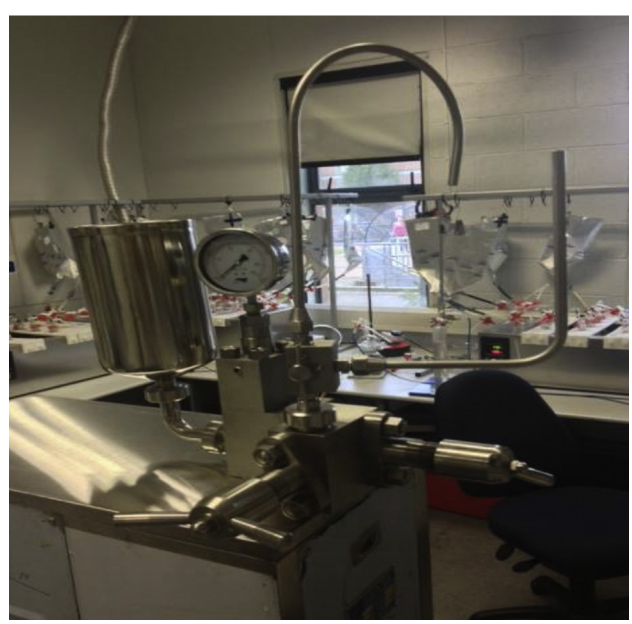

Fig. 1 – GYB40-10S 2 stage homogenizing valves.