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Research Article

MOLASSES BASED MEDIA FOR BIOMASS PRODUCTION OF BAKER'S YEAST

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Abstract- This study reported that optimum and economic conditions for baker's yeast production using sugarcane molasses were 10% molasses culture medium containing 0.15% urea at pH=5.0 and the initial count of yeast inoculum as 103 cell/ ml. At optimized conditions, FJ1 showed biomass yield of 5.63g/L which further increases to 6.54g/L on supplementation with CSL. Therefore, CSL was found to increase the biomass yield by 16.16%.

Keywords- *Baker's yeast, molasses*

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Introduction

India is the second largest producer of sugarcane after Brazil. In Punjab, there are 16 sugar mills, including 7 private and 9 cooperative that are reported to crush around 828 lakh quintals of cane till April 30, 2018. Around 42 to 43 lakh quintals molasses has been produced this year as average production of molasses is around 5 kg per quintal of sugar cane. Molasses is a waste product of the sugar industry consisting of different fermentable sugars. Sugarcane molasses has a water content of 17-25%, containing 45-55% (w/w) fermentable sugars in the form of sucrose, glucose and fructose and polysaccharides (dextrin, pentosans, polyuronic acids) content about 2-5%. Molasses are being used in distilleries and also in the production of animal feed. While a few of the private mills have their own running distilleries where they use molasses, others sell it in the open market to cattle feed makers and distilleries. But surplus production has led to drastic decrease in the rates and also stock build up of the product, as the processing capacity of distillers is limited. While sugar prices have fallen by 30% in past few months owing to bumper sugarcane production across India, including Punjab, rates for molasses, a by-product of sugarcane, has also now crashed by 85 per cent. According to Punjab State Federation of Cooperative Sugar Mill (*Sugarfed*), the quoted rate for molasses received in July, 2018 was Rs 85 per quintal, against the last year's Rs 550 per quintal. Due to poor market of molasses this year, Sugarfed expected a rate of Rs 150 per quintal. Recently, an accidental release of about 10,000 kilo litres of molasses in the Beas River, Punjab was reported to reach bottom of river lowering the oxygen level. As a result, thousands of fishes were killed. Therefore, a strategy for alternate use of molasses was highly desirable. Yeast grows best at 6.0 pH and also requires some enrichment in terms of additional nutrients like (N, P, Mg, Ca, trace elements of Fe, Zn, Cu, Mn and vitamins, usually biotin) [1]. Minimizing the cost of baker's yeast production is the ultimate purpose of many new era types of research. Therefore, many studies were conducted using different substrates to reduce the cost of production of baker's yeast. Research by Ali *et al* [2] was conducted where *Saccharomyces* strain was used to estimate the efficient conditions for baker's yeast production. Cane and beet molasses were considered as the fundamental substrate to be utilized as a part of yeast production plants, the main waste product of the sugar industry [3]. These were chosen for two basic reasons: to start with, yeast utilizes the sugars present in molasses exceptionally well and secondly, they are economically attractive since they are waste item originating from sugar refineries with no other application and are free from toxic substances and fermentation inhibitors [4]. Cost of the end product depends majorly on the fermentation raw material used. A technology producing commodity products should aim to utilize sustainable resources and improve environmental quality. As raw materials are often dominant factors in determining the price of commodity products, renewable materials available at large scale is required as feedstock, so that the products will be domestic and provide security of supply [3]. The principal raw material used in developing baker's yeast is the pure yeast and molasses, where molasses acts as the major carbon source and provides growth and energy source along with a part of the needed nitrogen. Baker's yeast has served the mankind since golden age. *Saccharomyces cerevisiae* is important yeast having wide applications in food and pharmaceutical industry. It is used in fermentation and production of baked goods, having medicinal importance and having major role as health supplement and as probiotics.

Baker's yeast in bread making

Baker's yeast is an important component of baked goods and is an internationally recognized GRAS (Generally Regarded as Safe) product. When this yeast is added to the dough it produces CO_2 that makes bread rise. It plays an important role in giving the overall texture, aroma and flavor to the baked goods. Baker's yeast is available in the market in the form of cream yeast and dry baker's yeast. Dry yeast is further of two types: Active Dry Yeast and Instant Yeast. Active dry yeast particles are spherical, very small (0.2-0.3 mm) in diameter and this yeast has to be reconstituted in lukewarm water to reactivate yeast cells. Instant yeast particles are cylindrical somewhat larger (few millimetre) and need no reactivation. Deactivated yeast is also available as a health supplement and is available in the market in the form of powder, flakes and tablets. Some of the preparations are available in the form of syrups. Another important product of yeast is yeast extract which is obtained by autolysis of yeast proteins with the help of salts.

Different Medias for biomass production

In recent years, there has been an increasing trend towards more efficient utilization of agro-industrial residues such as cassava bagasse, sugar cane bagasse, sugar beet pulp, coffee pulp/husk, apple pomace, *etc.*

From 1910 to 1940, much effort was put in to find the best and cheapest growth media available. Several processes have been developed that utilize these as raw materials for the production of bulk chemicals and value-added fine products such as ethanol, single cell protein (SCP), mushrooms, enzymes, organic acids, amino acids, biologically active secondary metabolites etc. [5] Because fermentation raw materials are major contributors to the cost of production of low-value products such as Baker's yeast, exploration of inexpensive and locally available fermentable sources was essential. Therefore, Damtew *et al* [6] investigated the efficiency of cane molasses in supporting the industrial production of baker's as well wine and brewery yeast and evaluated the growth kinetics and biomass yield of the strains at different substrate concentration and different nitrogen sources and results revealed that yeast grows best at 10% (w/v) and 15% (w/v) molasses sugar concentration and had higher growth kinetics at this sugar concentration. Among the nitrogen sources, ammonium nitrate was the best for all the yeast types. Commercial yeast, as well as our laboratory isolate (FJ1) grown on molasses based medium, showed extensive growth at the optimized conditions depicting the usefulness of molasses as a rich carbon source. In our laboratory, unclarified molasses with supplementation of Corn Steep Liquor (CSL) @ 50g/l has been found to be a suitable medium for optimum biomass production of baker's yeast.

Medicinal importance of yeast

There are different strains of yeasts being used in the market *e.g., Saccharomyces cerevisiae*, *S. exiguous* and *S. boulardii*. Baker's yeast, being rich in Vitamin B (B_1, B_2, B_3, B_5, B_6, B_7, B_9), minerals (Zn, Se, Cr) and proteins, has been used as a health supplement and has remarkably low levels of fats and sodium. The beta-glucan fiber obtained from cell wall of yeast increases antimicrobial activity and decreases *Staphylococcal* abscess formation in guinea pig model. It has been reported that beta-glucan fiber is far better than oats. Several studies have been carried out on compositional analysis of baker's yeast and have reported 7.5±1.5% Nitrogen, 6±2% Ash, 6±2% Fat, 20±9% carbohydrate, 28±5% Fibre, 46±10% Proteins on percent dry weight basis. It is containing different minerals like sodium, potassium, calcium, magnesium and iron. Purified beta-glucan fibers given to healthy volunteers enhances the secretion of salivary immunoglobulin A (IgA) and killing of pathogens by neutrophils and monocytes have been observed after yeast-derived beta-glucan (Betafectin) administration and in surgical patients. Clinical trials have revealed the decrease in serum triacylglycerol in hypercholesterolimic patients and an improvement in glucose tolerance test in diabetics. Some of the yeasts are also known for their probiotic and immune-modulatory functions. As a probiotic, yeast can improve gut flora and can be used for prevention and treatment of intestinal diseases. There are some reports regarding their role in folate biofortification, mycotoxin detoxification and in increasing the bioavailability of nutrients. It has been reported to play an important role in lowering of serum cholesterol and have antimutagenic, antioxidative, anti-tumour potential. Keeping in mind the nutritive and medicinal importance of baker's yeast and market demand of this industrially important organism, its cultivation on cheap agro-industrial waste like molasses is a promising technology to exploit the surplus stock of molasses.

Application of review: The present review is likely to have following positive impacts:

1. Utilization of molasses as a substrate for biomass production of yeast will provide a strategy for conversion of a low value industrial waste into protein enriched biomass and in turn can decrease the illegal release of this waste into water bodies that can have alarming effect on flora and fauna.
2. The cost of cream yeast available in the market is approx. Rs. 200 for 200 gm. The development of yeast using molasses is a simple method for cost-effective production of yeast.

Review Category: Biomass Production

Abbreviations: FJ1- Laboratory isolate of *Saccharomyces cerevisiae* obtained from fruit juice
CSL- Corn Steep Liquor
SCP- Single Cell Protein

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