INDUSTRIAL ETHANOL PRODUCTION USING JUICE OF DATES IN A FIXED CELL PROCESS

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ABSTRACT

The ability of two strains of S*accharomyces cerevisiae* and *Candida utilis* to utilize the date Juice has been Studied. The results showed that s. cerevisiae has a high Ability to metabolize date juice for ethanol production. The data on optimization of physiological conditions of fermentation, pH, temperature, and sucrose concentration showed similar effects on immobilized and free cell of *S. cerevisiae* and *C. utilis*, in batch and immobilized fermentation of s. cerevisiae. A maximum yield of 12.8%, 13.4%,w/v, ethanol respectively obtained from 22g/L sucrose when fermentation was carried at pH 4.5 and 30^{o} C using *S. cerevisiae*. These results suggests that date juice can be immobilized *S. cerevisiae* cells.

INTRODUCTION

Juice of date is one of the richest foodstuffs in neutral compounds such as momnosaccharides, disaccharide, mineral salts and vitamins. These substances considered as essential elements for the growth of microorganisms specially yeasts.

That is used for the production of ethanol (1). Finding the best method and optimum conditions for fermentation is required in the process of producing ethanol from date's juice. Several methods were used for fermentation such as immobilized cell method for Saccharomyces cerevisiae by using different carriers like Sodium alginate, Calcium alginate, Polyacrylamide, Collagen, Agar, Dialysis membrane (2,3,4,8). The results showed that the productivity of ethanol by immobilized cells method is higher and economically better than free cells method.

In this study the date's juice that been used was prepared from Zahdi dates syrup. Its concentration was 70% in Brix unit and different concentrations were prepared from that concentration. Also were used to complete the fermentation process, they were Saccharomyces cerevisiae and Candida utilis. Two different methods were used, immobilized cells

and free cells methods after determination the optimum conditions for fermentation (temperature, pH, sugar concentration).

MATERIALS AND METHODS

1- Isolates of yeast strains Saccharomyces cerevisiae and Candida utilis were obtained and kept in:
   2% Sucrose
   1% Yeast extract
   2% Peptone
   2% Agar
And reculturing of these strains was done every 15 days.

2- Date's juice was obtained from local Zahdi date's syrup. The following concentrations were prepared 50, 100, 300g/L. pH was ad justified to 4.5 by using HCL N.

3- Fermentation was done by using 250ml glass flask containing loo ml of the media in anaerobic conditions at 30°C for 48 hours. Cells were collected by centrifuging at 4500 rpm for 15 minutes. Then they were used for immobilization by carriers of sodium alginate according to Marwaha et al (7). That was by putting them in glass tube of 50cm in length and 2cm in radius, the flow rate of the liquid reached 6ml/hr.

4- Analytical methods: total and residual sugars were calculated by Nikerson(II) and Rimengtonet (12) respectively. While the measuring of ethanol was done by GLC according to Marwaha et al (7) or by pyrometer method according to Nanba et al (10).

RESULTS AND DISCUSSION

In studying and determining the optimum condition for fermentation by free cell method. Primitive experiments were designed to find out the optimum time to produce ethanol. Results showed that the production of ethanol by S.cerevisiae reached 8.4% after 36 hrs. Whereas the ethanol by c.utilis reached 6.8% after 48 hrs. This leads us to say that Saccharomyces cerevisiae is better than Candida utilis in the metabolism of momnosaccharides and disaccharides found in date's juice and converting it to ethanol.

Test results found that the optimum temperature for fermentation process by the

two methods free and immobilized cells was 30°C for both Saccharomyces cerevisiae and Candida utilis. The residual sugars percentage reached 0% in this temperature and the metabolism to ethanol reached 100%. As shown in figures (1,2,3,4). We can also conclude that S.cerevisiae was the best in the production of ethanol, thus it gave 10.6% at 30°C by the free cells method with presence of 0.4g/L residual sugar by this yeast. While the immobilized cells gave 11.4% ethanol with complete consumption of all sugar found in the media. Figures (5,7) illustrate the effect of pH on the fermentation conditions and the productivity of ethanol. The productivity increases at pH 4.5 by fixing the temperature at 30°C.

Figures (6,8) shows that S.cerevisiae strain is the best in the production of ethanol and it's metabolism of sugars found in date's juice was 100%.

In this study the effect of concentration of sugar in date' s juice used in fermentation process was studied, and their relationship with percentage of ethanol produced.

It is noticed from the figures (9,10,11,12) that 20% was the best to produce 12.8% of ethanol when using S.cerevisiae in free cells method. And 13.4% ethanol when those cell where immobilized by sodium alginate (optimum conditions for fermentation were used: temperature 30°C, pH 4.5).

The reason for the descent of ethanol production rate at high concentrations 30% to the inhibition that occurred when the atom of carbon hydrolyze As result of losing off activity enzymes specially invertase enzyme due to raising ethanol percentage in the media.

From the experiments mentioned above that immobilized can be used in the production of ethanol and from inexpensive sources, presented by date' s juice, thus the productivity reached almost 13.4% when using Immobilized cell method by yeast of S.cerevisiae. In addition to that this method has large economical advantages. Thus yeast cells keep their activity and fermentation affectivity for
more than 3 months (9).

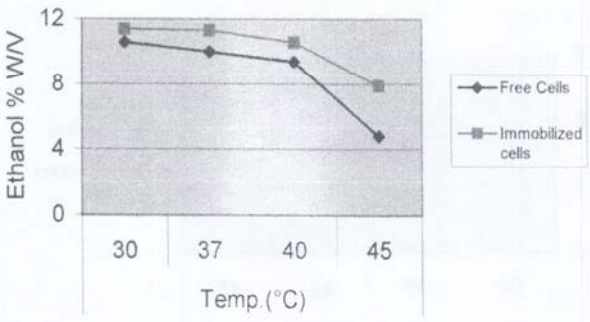

Fig.1 Effect of Temperture on Ethanol Production by *S.cerevisiae*

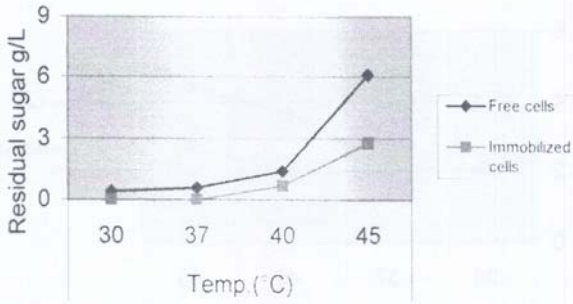

Fig.2 Effect of Temperture on Residual Sugar by *S.cerevisiae*

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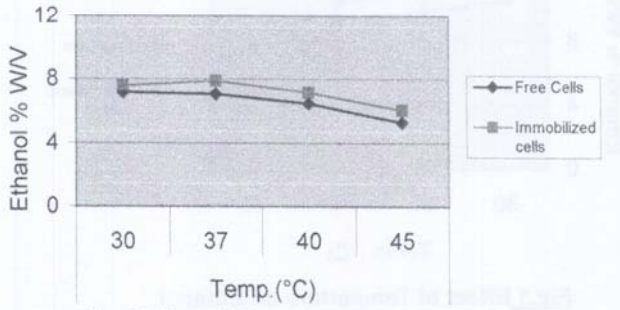

Fig.3 Effect of Temperture on the Ethanol Production by C.utilis

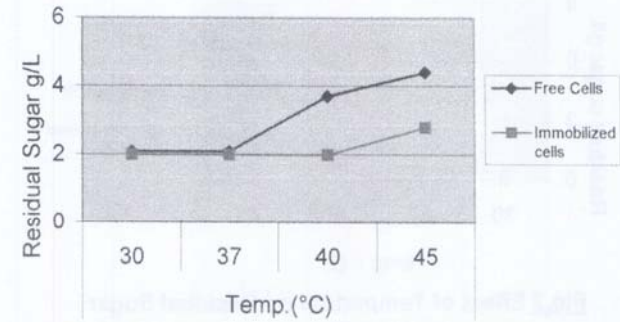

Fig.4 Effect of Temperture on the Residual Sugar by C.utilis

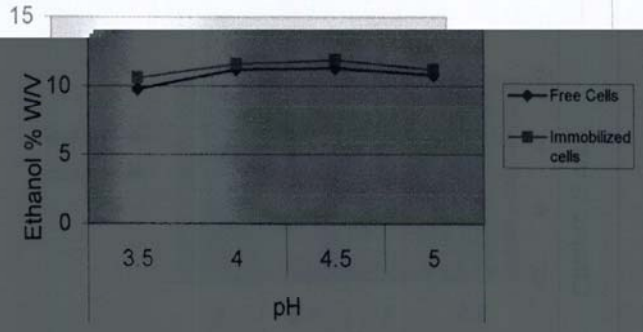

Fig.5 Effect of pH on the Ethanol Production by *S.cerevisiae*

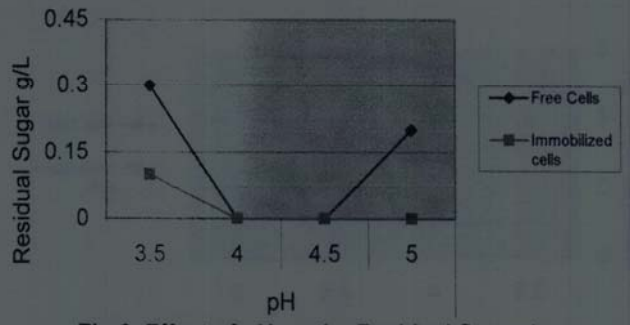

Fig.6 Effect of pH on the Residual Sugar by *S.cerevisiae*

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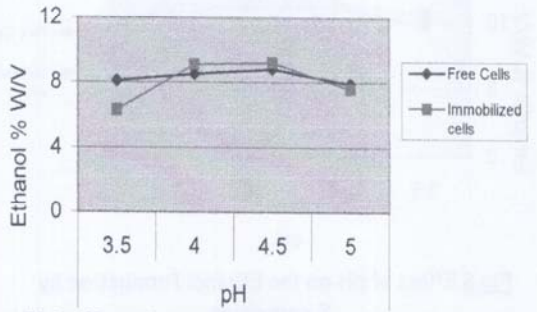

Fig.7 Effect of pH on the Production of Ethanol by *C.utilis*

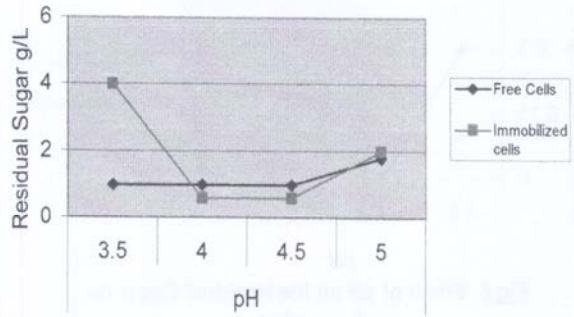

Fig. 8 Effect of pH on the Residual Sugar by *C.utilis*

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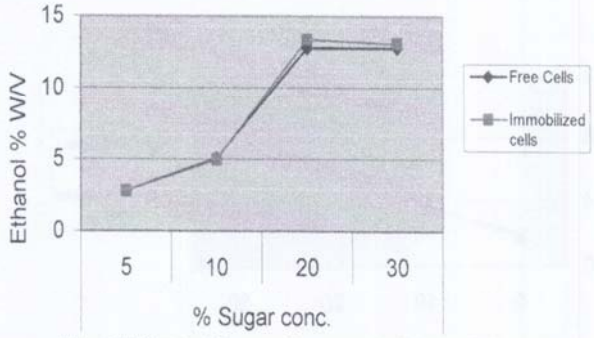

Fig. 9 Effect of Sugar Concentration on Ethanol Production by S.cerevisiae

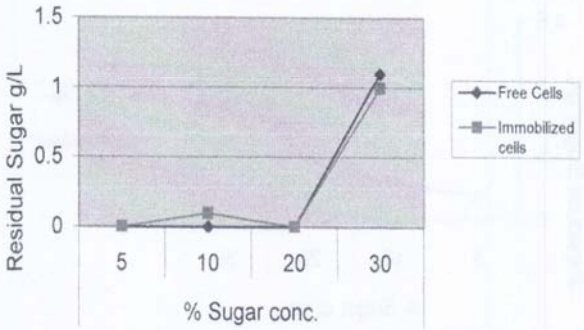

Fig.10 Effect of Sugar Concentration on the Residual sugar by *S. cerevisiae*

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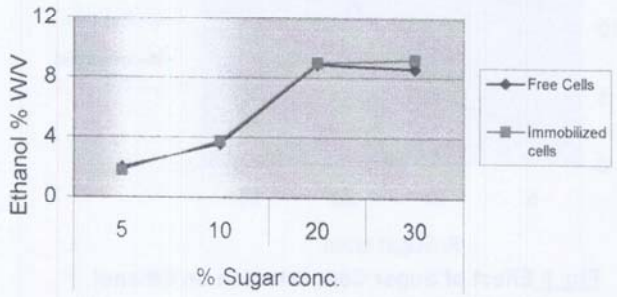

Fig.11 Effect of Sugar Concentration on the Ethanol Production by *C.utilis*

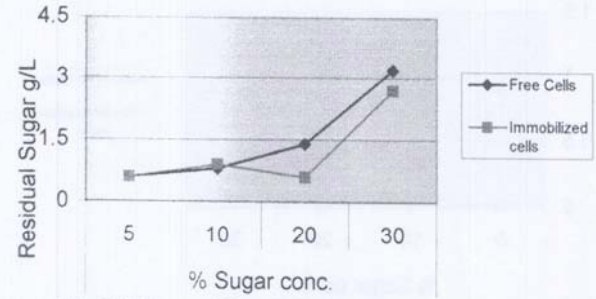

Fig.12 Effect of Sugar Concentration on the Residual Sugar by *C.utilis*

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