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Production of Single Cell Protein from Yeast using Papaya Extract Medium

C. Maragatham and A. Panneerselvam*

PG & Research Dept. of Microbiology, PRIST University, Thanjavur, Tamil Nadu, India
** PG Dept. of Botany and Microbiology, A.V.V.M Sri Pushpam College, Thanjavur, Tamil Nadu, India*

ABSTRACT

Extracts of papaya fruit were used as substrate for single cell protein production using Saccharomyces cerevisiae. A 500 g of papaya fruit was extracted with different volumes of sterile distilled water. Extraction with 200ml of sterile distilled water sustained highest cell growth. Biochemical analysis of dry biomass revealed the following composition: 34.0% protein, 40.0%, sacchride, 0.003% lipids, 9.54% moisture and 0.14% total ash. Nutrition found in papaya fruit extract were 9.6% saccharide, 0.2% crude protein and 7.0% total soluble sugars.

Key words: Papaya, *Saccharomyces cerevisiae*, single cell protein.

INTRODUCTION

papaya is a sugar crop with soluble saccharide in the form of glucose, fructose and sucrose [18] and it is widely cultivated in several countries [17]. Its display rapid growth and high yield of 100kg plant per year or 154,000kg per hectare per year, even during from fourth year of growth. The average yield per hectare is about 22000 fruits weighing 34tons [2]. Sugars represent that part of the fruits which is used by Microorganisms for single cell protein and alcohol [14]. The potential of papaya as an energy crop was estimated by Ayanaru *et al* [4] who showed that it has a capacity of generating of ethanol by microbial conversion of sugar in the papaya fruit. Sugar crops like papaya fruit have the advantage over starch and cellulose waste in single cell protein programmes, as the latter require extensive supply of sugars and digestion prior to their utilization for cell growth and biomass production.

According to various investigations on the fermentations of fruit juices, it has been reported that they could be used as feed-stocks for the production of single cell protein (SCP) based on their level of sugar and ability to support the growth of yeasts [1], [12], [13]. Single cell proteins thus, are the dried cells of microorganisms such as yeast that could be grown in large-scale culture

systems for use as protein for human or animal consumption [10]**,** [19]. Extract of papaya fruits were used as substrate for single cell protein production using *Saccharomyces cerevisiae*. A 500 g of papaya fruit was extracted with different volumes of sterile distilled water. Extraction with 200 ml of sterile distilled water sustained highest cell growth [11]. The aim of this study was to investigate the growth of *Saccharomyces cerevisiae* in papaya medium and the effects of different dilutions of the extract and inoculation size on the single cell protein production.

MATERIALS AND METHODS

Procurement of papaya fruit and isolation of Yeast strain

The papaya fruits (Variety Co2) used for the preparation of papaya wine was procured from Tamil Nadu Agricultural University, Coimbatore. The yeast *Saccharomyces cerevisiae* culture isolated from rotten papaya fruits. The culture was maintained on malt agar medium and stored at refrigerator.

Preparation of papaya fruit extract

A 500 g ripe papaya fruits were taken. The fruits were washed with several changes of sterile water and peeled. Seeds and placenta were removed from the sliced pulp, cleaned initially with 2.0% solution of H_2So_4, sliced into cubes, rinsed in sterile water, and the pulp was mascerated in mixie/blender. The fruit extract was obtained from filtered with the use of cheese cloth. The extract was placed into sterile container and the saccharide, crude protein and total soluble sugar were determined. From the extract, 100 ml was measured into sterilized 250 ml conical flask. To each was added glucose (2% w/v) and $(NH_4)_2HPO_4$ (0.25% w/v) which served as a nitrogen source supplement. The conical flasks were plugged loosely with sterile cotton wool and aluminium foil. This was sterilized using autoclave. On cooling the medium in the flask was inoculated with 1.0 ml of inoculums (3.4×10^3 cells / ml). This sample was incubated on mechanical shaker at 200 rpm for 45 h at 25ºC. The concentration of cells in the inoculums and inoculated extract was determined by inoculum size (4.2×10^3, 5.6×10^3 and 5.6×10^4 cells/ml) on the biomass production were investigated. Inoculated flasks were incubated at 25ºC for 5 days. The effect of different dilution samples such as extraction of papaya fruit with 200, 400 and 600 ml distilled water and varying.

Analytical procedure

The total saccharide was determined according to Pearson [15] using anthrone method. Total soluble solid was determined by the method of AOAC [3]. Moisture content was determined as described by AOAC [3], based on the principle of drying to constant weight. Protein was determined by a modified biuret method described by Herbert *et al* [7]. The procedure of Kates [8] was used for the lipid content. The E.D.T.A. titrimetric method was used for the estimation of calcium [2]. Ash content was obtained by igniting the samples in a muffle furnace at 55ºC as previously described by Pearson [15].

RESULT AND DISCUSSION

The viable cell counts of the yeast isolate in the fruits pulp extract is presented in Table 1. The medium extracted with 200ml sterile distilled water produced highest cell growth (Table 2). Growth in the undiluted samples extracted with 400ml and 600ml sterile distilled water peaked

after 1 or 2 days. Data on the dry biomass harvested from the papaya medium are shown in table 3. The results of the chemical analysis of the papaya fruit extract are presented in table 4. The results of chemical analysis of the dry yeast cells produced from *Saccharomyces cerevisiae* are presented in table 5.

The mean viable cell counts of *S.cerevisiae* in papaya medium were found to decrease after one or 2 days (Table 1). The production of single cell protein from *Saccharomyces cerevisiae* using papaya extract as a substrates. It has been given good result for single cell protein production. So this biomass is used for cattle feed and poultry feed. The results were revealed by other authors. The decrease in growth can be attributed to limiting nutrients and oxygen, arising from their exhaustion of nutrients and oxygen [9]. The investigation revealed that increase an initial inoculum size up to 5.6 x 10^3 cells/ml yield cell growth. Concentration above this value, however, produced disproportionate increase in growth of *S.cerevisiae* [16] reported that autolysis is likely to be increased with high initial inoculum. This is because there is the existence of disproportionate amount of nutrients, as well as lower conversion of efficiency. According to Chikwendu [5], at lower inoculum level cells are larger and further indicated that this type of growth arises when competition for available nutrients is not great among the cells present. The yield of dry mass of cells from the papaya medium ranged from 0.38-0.57 g. (table 3). The results of the chemical analysis of papaya fruit extract established that it is a good energy and nutrient source for cell mass formation with high saccharide content of 9.6% (Table 4). The result of chemical analysis of the dry yeast cells show that the yeast protein was of high nutritional value (Table 5). The level of crude protein of 35.5% obtained from the dry biomass recommends the product as a potential food and feed supplement when compared to the lower limits of 8% for cattle and poultry feed [6].

Table: 1 The viable cell count of *Saccharomyces cerevisiae* in papaya medium during 5 days of incubation

Days of incubation	CFU
1	6.09 x 10^7
2	7.00 x 10^7
3	6.44 x 10^6
4	8.24 x 10^5
5	6.26 x 10^4

Table: 2 Cell counts of *S.cerevisiae* in undiluted and diluted papaya medium extracted with different volumes of sterile distilled water

Days of incubation	Undiluted sample	Diluted Samples		
		200 ml	400ml	600ml
1	9.20x10^7	1.22x10^8	7.23x10^5	7.73x10^4
2	8.60x10^7	1.28x10^8	4.36x10^5	3.27x10^4
3	7.51x10^6	9.31x10^7	5.28x10^4	4.30x10^3
4	4.63x10^5	8.25x10^7	3.55x10^3	8.48x10^2
5	4.14x10^5	8.27x10^6	4.16x10^3	5.22x10^2

Table: 3 Dry mass of *Saccharomyces cerevisiae* harvested from papaya medium per 100 ml

Number of harvest	Dry mass of cells(g)
1	0.55
2	0.44
3	0.57
4	0.38

Table: 4 Percentage chemical composition of papaya fruit extract.

Constituents	Percent
Moisture content	80.0
Protein	0.2
Saccharide	9.6
Total soluble sugars	7.0
Total ash	0.2
Lipid	0.3
Calcium	0.01

Table: 5 Percentage chemical compositions of dry yeast cells produced from *S.cerevisiae.*

Constituents	Percent
Moisture content	9.54
Protein	34.0
Saccharide	40.0
Total soluble sugars	7.65
Total ash	0.14
Lipid	0.003
Calcium	4.41

CONCLUSION

The production of single cell protein from *Saccharomyces cerevisiae* using papaya extract as a substrate. The results of the chemical analysis of papaya fruit extract established that it is a good energy and nutrient source for cell mass formation with high saccharide content of 9.8%. The result of chemical analysis of the dry yeast cells show that the yeast protein was of high nutritional value. It has been given good result for single cell protein production. So this biomass is used for cattle feed and poultry feed.

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