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Utilization of Fruit Peel Waste in Producing Single Cell Protein

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ABSTRACT

Single cell protein (SCP) is one of the most important alternatives& an innovative way to successfully solve the global food problem. India is the second major producer of fruits & vegetables in the world. It contributes 10% of world fruit production.Thus, fruit processing wastes are useful substrate for production of microbial proteins. The utilization of fruit wastes in production of SCP will help in controlling pollution & also in solving waste disposable problem to some extent in addition to satisfy the world shortage of protein rich food. In present work SCP production was carried out by using different fruits waste peels as a substrates and Saccharomyces cerevisiae yeast.
Key words: *SCP, fruit waste peels, Yeast*

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INTRODUCTION

The population of world is increasing day by day and by 2050, the world population could increase to 9.3 billion. Because of this increasing population the demand of animal derived protein will also increase [1]. Most of the developing countries of the world are facing a major problem of malnutrition [1]. The diet in many developing countries with nutritional problems is based on foods rich in carbohydrates due to traditional protein sources being relatively more expensive. An option to satisfy the demand for proteins is alternative sources such as moringa, chia, zein, wheat, peas, beans, whey proteins, insects and microorganisms [2]. Single cell protein production technologies arose as a promising way to solve the problem of worldwide protein shortage. Single cell protein refers to dead and dried cells of microorganisms such as yeast, bacteria, fungus and algae [3].

MATERIAL AND METHODS

Collection of Fruit Peel Waste

The banana, pineapple and orange fruit wastes were collected from the local fruit juice centers of Karad, Maharashtra, India and were brought to the laboratory in polythene bags and stored at 4° C until further study.

Isolation of Microorganisms [4]

The microorganism used to ferment fruit waste was *Saccharomyces cerevisiae* obtained from department of Microbiology, KIAS, Karad. The yeast was grown on Yeast Extract Potato Dextrose Agar (YPDA) and sub -cultured every 3 weeks and incubated at 28 - 32° C.

Production of SCP [5]

Inoculum Preparation

Saccharomyces cerevisiae culture was obtained from 4 days incubation on three plates of YPDA incubated at 28° C and was used as inoculum. It was prepared by washing the growing culture with 25mL sterile distilled water. The suspension was prepared with concentration of 10^7CFU/mL and used as an inoculum.

Preparation of Fruit Peel Extract

The fruit peels were used as substrate for production of SCP (200 g each of pineapple, banana and oranges with 1-L D/W). Peels were degraded to convert cellulose content into more available sugars by chemical treatments with little modification to the procedure of Lenihan *et. al*., 50 mL of 10% (w/v) HCL was added to each waste in conical. The mixture was placed in water bath at 100°C for 1 hour. After being allowed to cool, it was filtered through Whatman filter paper. The filtrates were neutralized and diluted with sterile distilled water at varying concentrations and autoclaved at 121°C for 15 min.

Fermentation and Harvesting of Single Cell Protein

Submerged fermentations were carried out in 250 mL (with 2mL of inoculum) flask with three trial media (100mL each) as bellow:

a) Supplemented fruit hydrolysate (SFH) had the following composition: $(NH_4)_2SO_4$ (2g), KH_2PO_4(1g), $MgSO_4.7H_2O$ (0.5g), NaCl (0.1g), $CaCl_2$ (0.1g) (pH 5.5) made up to 1-L with fruit peel waste hydrolysate.
b) The second medium designated Glucose supplemented Fruit Hydrolysate (GFH) had all the compositions of SFH plus glucose (2g/L).
c) The third has the fruit Hydrolysate medium (FHM) only.
   Fruit hydrolysate was prepared by taking 200 g each of banana, pineapple and orange fruit peel waste in 1-L D/W pulverized in mixer and filtered through muslin cloth, sterilized and used. In all the media, initial pH was adjusted to 5.5 using 1N H2SO4 and/or 1NNaOH. Each medium was transferred into 250mL Erlenmeyer flask and sterilized at 121° C for 15 mins. Inoculums of 2mL from suspension of *Saccharomyces cerevisiae* was aseptically transferred into each medium. Fermentation was carried out at 28°c under static condition followed by determination of SCP and other parameters after 6day intervals.

Production of SCP

Inoculate of 2mL from suspension of *Saccharomyces cerevisiae* were aseptically transferred into each medium flask. SCP production was carried out at 28°C under static condition followed by determination of biomass and other parameters after 6day incubation.

Determination of Total Protein Content By Biuret Method [6]

The biuret method was used for determining the total protein content of SCP and using bovine serum albumin as standard protein. Biomass was centrifuged at 7000 rpm for 10 min., then pellet was subjected to ultrasonication for cell bursting and then taken for determination of total protein content.

RESULTS AND DISCUSSION

Table 2 represents the protein content of media before fermentation of media and it was found that it ranged from minimum of 2.19 mg/mL in case of GFH medium to maximum of 2.5 mg/mL in case of SFH medium. SFH No much variation was observed in the protein contents of three media, whatever variations were there may be attributed to added peels.

Table 3 represents the protein content of single cell protein after fermentation and it was found that medium SFH shows maximum yield of SCP i.e.,9,09 mg/mL than GHF (5.45 mg/mL) and FHM (4,70) as it contains fruit peel hydrolysate with salts and hence more suitable for SCP production using *Saccharomyces cerevisiae.*

Table 1. Standard Curve for Protein Estimation.

Concentration of BSA(mg/mL)	O.D. at 530 nm
1	0.07
2	0.11
3	0.12
4	0.13
5	0.15
6	0.22
7	0.24
8	0.23
9	0.27
10	0.31

Table 2. Extent of Protein Content of Media before Fermentation

Medium used	O.D. at 530 nm	Protein content (mg/mL) of media
SFH media	0.115	2.5
GFH media	0.112	2.19
FHM media	0.114	2.23

Table 3. Protein Content of Single Cell Protein Biomass in the Different Media after Fermentation

Medium used	O.D. at 530 nm	Protein content (mg/mL) of SCP
SFH media	0.29	9.09
GHF media	0.11	5.45
FHM media	0.15	4.70

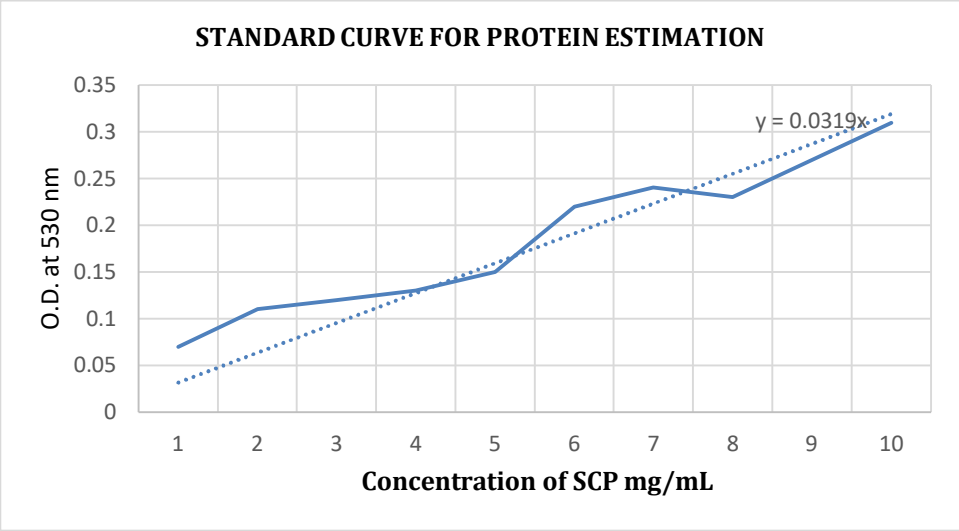

Figure 1: Standard curve for protein estimation

CONCLUSION

Saccharomyces cerevisiae was obtained from department of Microbiology, KIAS, Karad. The yeast was grown on Yeast Extract Potato Dextrose Agar (YPDA) and sub cultured every three weeks and incubated at 28°C.

The banana, pineapple and orange fruit waste were collected from the local fruit juice center of Karad and was brought to the laboratory and stored at 4°C until further study.

SCP production was carried out using different types of media such as SFH, GHF, FHM.

The protein content of SCP produced by using SFH, GHF, FHM media was found to be 9.09 mg/mL, 5.45 mg/mL and 4.70mg/mL.

It was found that the protein content was improved after fermentation of fruit peel waste.

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