Production of Citric Acid from Fruit Waste of Banana Using *Aspergillus niger*

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Abstract

In this study citric acid production was carried by using banana waste from Aspergillus niger. Effect of different carbon and nitrogen sources like glucose, sucrose, yeast extract and peptone were studied on production. Citric acid production was recorded from 3rd day of incubation upto 5th day. The percentage of citric acid ranged from 0.028% to 0.480% maximum production was obtained from glucose as carbon source i.e; 0.480% on 5th day and maximum production was obtained from yeast extract as nitrogen source i.e; 0.168% on 5th day.

Keywords: Citric acid, Aspergillus niger

Introduction

Citric Acid is a major organic acid.It is a natural constituent of citrus fruits like lemon and orange. It is responsible for sour taste of the fruit (Apelblat 2004).Citric acid is an industrially important organic acid (Jialong 2005).It is mainly required in food and pharmaceutical industries (Pandey, A 2001). Out of the total citric acid produced, 70% is consumed by food industry, 12% is consumed by pharmaceutical industries and the remaining 18% are consumed by other industries (Haq, I 2004)

Earlier, citric acid was produced by chemical synthesis, however it is costly process. Many microbes including bacteria, yeast and fungi are known to produce citric acid(Kapoor1982).The fungus A.niger is an organism of choice for citric acid production because of its capability to ferment cheap substrate and produce high yield. Recently there is an increasing trend of utilization of agrowaste for citric acid production (Soccol 2003). Use of cheap agricultural waste like apple, orange can reduce the cost of fermentation process (Schuster 2002).

Banana is a popular fruit consumed worldwide. Banana peel is also used as feedstock for animals like goat, cattles.In maharshtra, particularly in marathwada, banana is widely cultivated. Nutritionally, banana peels contain carbohydrates, proteins, tannin, lipids, fibres .However peels of this fruit are discarded as waste material. Such fruit waste discarded in an

in-appropriate ways can create environmental issues. Therefore studies were carried out to test potential of fruit waste like banana peel as a substrate for citric acid production.

Materials and methods

Isolation of *Aspergillus niger*

Potato Dextrose Agar medium was prepared. Dilutions of soil sample were prepared.This suspension was spread on petri plates containing PDA medium. Plates were incubated at 30˚C for 3-4 days.

Identification of *Aspergillus niger*

Identification of *A.niger* was done by microscopic observation.Black/Green colonies growing on agar pates were taken on slide with the help of wire loop and stained with Lacto phenol cotton blue. The identified colonies were sub cultured on PDA medium and preserved for further use.

Fermentation media preparation

Fermentation media was prepared by grinding banana peels and mixed with water to make suspension. This suspension was filtered through muslin cloth and sterilized.

Effect of carbon and nitrogen source

Effect of different carbon sources (glucose and sucrose) and nitrogen sources (peptone and yeast extract) was studied on production of citric acid.

Determination of percentage of citric acid

Citric acid was determined titrimetrically by using 0.1 N NaOH and phenolphthalein as indicator[AOAC 1995] by using following formula

$$\% \text{ Citric acid} = \frac{\text{Normality X Volume of NaOH X Equiv. Wt. of CA}}{\text{Weight of sample (g) X 10}}$$

Results and Discussion

Citric acid is one of the most widely used organic acid and has many applications in food, industries. Citric acid is naturally found in many fruits. It is an intermediate organic acid of tricarboxylic acid cycle. Today most of the citric acid is commercially produced by microbial fermentation process.

In the present study production of citric acid was carried out by using banana peel as a fermentation medium.Effect of carbon and nitrogen source was also studied on citric acid production. Citric acid production was recorded from 3rd to 5th day of incubation. When glucose (5%) was used as a carbon source, percentage of citric acid was found to be maximum on 5th day of incubation (0.48%).When sucrose (5%) was used as a carbon source, percentage of citric acid was found to be maximum on 5th day of incubation (2.31%)

(Table 1). So, in this study, sucrose was found to be suitable carbon source for citric acid production.

When peptone (1%) was used as a nitrogen source, percentage of citric acid was found to be maximum on 5th day of incubation (0.12%). When yeast extract (1%) was used as a nitrogen source, percentage of citric acid was found to be maximum on 5th day of incubation (3.10%) (Table 2). So, in this study yeast extractwas found to be suitable nitrogen source for citric acid production. A similar study was undertaken by Satheeshkumar et.al (2019) and found that recycling the waste generated from fruit processing industries.

Damari Priscilla (2020) carried out the production of citric acid using banana waste as a substrate. They also optimised the fermentation medium and found that addition of supplements significantly enhanced the yield of citric acid.

It can be concluded that production of commercially important products like citric acid can be carried out by cheap and easily available substrate which will reduce cost of fermentation.

Table 1. Effect of carbon source on citric acid production.

Sr no.	Substrates	Percentage of citric acid (%)		
		3rd day	4th day	5th day
1.	Banana peel	0.028	0.129	-
2.	Banana peel and 5 % glucose	0.024	0.033	0.480
3.	Banana peel and 5% sucrose	0.028	0.014	2.310

Table:2. Effect of nitrogen source on citric acid production.

Sr no.	Substrates	Percentage of citric acid (%)		
		3rd day	4th day	5th day
1	Banana peel	0.028	0.129	-
2.	Banana peel and 1%peptone	0.096	0.072	0.120
3.	Banana peel and 1%yeast extract	0.052	0.072	3.102

References

1.Apelblat A, (2014). Citric Acid (Springer International Publishing, Switzerland)

2.Damari J. priscilla, M.Gnaneel (2020). Production of citric acid from Banana peel using aspergillus niger International Journal of creative research thoughts. Volume 8, Issue 2 February

3.Dhandayuthapani, K., Thiyageswaran, G. Pradeep, K.S.(2008).Production of citric acid from banana waste by Aspergillus niger. Intl J. Appl. Bioeng.. 2: 35-38

4.Haq, I., Ali, S., Qadeer, M. A. and Iqbal, J. (2004). Citric acid production by mutants of Aspergillus niger from cane molasses. Bioresource Technology. 93, 125-130.

5.Jianlong, W. (2000). Production of citric acid by immobilized Aspergillus niger using a rotating biological contactor. Bioresource Technology,.75: 245-247

6.Kapoor, K.K., Chaudhary, K. Tauro, P. Prescott and Dunn's Industrial Microbiology, 4th edn. G. Reed (Ed), AVI Publishing Co, Wesrport, CT. 1982

7.Pandey, A., Soccol, C.R., Rodriguez- Leon, J.A. Nigam, P (2001). Production of organic acids by solid state fermentation. In: Solid state fermentation in biotechnology-fundamental and applications. Asiatech Publishers. New Delhi, 113-126.

8.Satheeshkumar Subramaniyan1, Sivagurunathan Paramasivam, Muthulakshmi Kannaiyan, Uma Chinnaiyan (2019). Utilization of Fruit Waste for the Production of Citric Acid by using Aspergillus Niger Journal of Drug Delivery and Therapeutics 9(4-A):9-14

9.Schuster, E., Dunn-Coleman, N., Frisvad, J. C. and Van Dijek, P. W. (2002). On the safety of Aspergillus niger– A review. Applied Microbiology Biotechnology 59, 426-435

10.Soccol, C. R. Vandenberghe, L. P. S. (2003) Overview of applied solid-state fermentation in Brazil. Biochem. Eng. Journal., 13: 205-218.