

# Production of Citric Acid from Different Fruit Peels Using *Aspergillus niger*

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**Abstract:** Citric acid consumption is escalating gradually, witnessing high annual growth rate due to more advanced applications coming to light. Different techniques for the hyper production of citric acid are continuously being studied from the past few decades and still there is a gap, and hence, there is an obvious need to consider new pragmatic ways to achieve industrially feasible and environmentally sustainable bio-production of citric acid. In the present study, fruit peels of mango, banana and orange are used for the production of citric acid. An economical way for the production of citric is carried out by using fruit waste collected from the fruit vendors. Solid-substrate fermentation is carried out by using *Aspergillus niger* as the inoculum. Simple filtration and recovery methods were followed and satisfactory results were obtained. Best utilization of waste, for citric acid production solved the problem of waste management and pollution in the environment.

**Keywords:** Solid state fermentation, Titration, Recovery, *Aspergillus* and Pragmatic

## 1. Introduction

Citric acid is one of the most important organic acids which have an ever ending demand in the world. The production of citric acid has increased rapidly, reaching about 1.7 million tons per annum in 2008 with 5% predicted annual increase in the rate of production in order to meet the growing needs of the global market [1]. Citric acid is used in the food and beverage industry to flavour fruit juices, candy ice cream, and marmalade. In the pharmaceutical industry, citric acid is used as a preservative for stored blood, tablets, ointments, and cosmetic preparations. In the chemical industry, it is used as an antifoam agent and for the treatment of textiles [2]. Recently, major production of citric acid was conducted via microbial fermentation, as it was economical and easy to handle [1].

The two most important microbial sources are bacteria and fungi. But fungus remains the preferred sources for citric acid production. *Aspergillus niger* was the most commonly used fungus for citric acid production due to the high yield and relatively high tolerance to acid accumulation [3]. It has been used by many researchers and in many studies, mainly in solid-state fermentation (SSF), for its ability to live and grow in an environment similar to its natural habitat. In the last 3 decades, SSF has gained great interest from researchers and industries as an alternative technique to the traditional submerged fermentation (SMF). The unique characteristics of SSF, using solid materials, stimulated researchers to use waste such as agro residual and agro industrial wastes, fruit waste as an alternative to raw materials for the production of citric acid. Several advantages of solid-state fermentation over submerged fermentation have encouraged researchers to study and develop it, such as lower energy requirements, less risk of bacterial contamination, and fewer environmental concerns regarding the disposal of solid waste [4].

Today over 99% of the world's output is produced using *Aspergillus niger*, *A.wentii*, *A. clavatus*, *Penicillium luteum*, *P. citrinum*, *Mucor piriformis*, *Candida guilliermondii*, *Saccharomycopsis lipolytica*, *Trichoderma viride*, and

*Arthrobacter paraffineus*[3].

In the present study fruit peels of mango, banana and orange are collected from fruit vendors for citric acid production by using *Aspergillus niger*. This shows an alternative for waste management of fruit waste and extracting best out of waste.

## 2. Materials and Methods

### 2.1 Isolation and preparation of inoculums:

Isolation of *Aspergillus niger* was done by using onion peel.

Dry onion peel were spread with the help of sterile forceps on potato dextrose agar plates and incubated under room temperature.

After 3days of incubation colonies with spores were observed.

Wet mount: By wet mount staining method colonies are identified as *Aspergillus niger*. Inoculum was maintained on Potato Dextrose Agar (PDA) slants, for citric acid production [5].

2.2 Collection of substrates: Different fruit peels like Mango peel, Banana peel and Orange peel were collected from fruit vendors.

2.3 Pretreatment of fruit peels: The collected peels were over dried at 60°C for 2hours for dry fruit peels and used for production of citric acid. Fresh fruit peels were cut in to small pieces and smashed to paste in motor and pestle, used for fermentation to produce citric acid.

### 2.4 Preparation of fermentation media:

Fermentation: Solid-substrate fermentation is carried out to produce citric acid.

Preparation of media:

The basal medium was prepared by introducing different peels both fresh (set 1) and dry (set 2) peels (mango, banana, and orange) (30grms) into separate 100ml Erlenmeyer flask.

The medium was supplemented with nitrogen supplement and by adding ammonium phosphate, potassium hydrogen phosphate and peptone (0.5%) to the basal medium.

The flask was cotton plugged and autoclaved at 15lbs for 15 minutes.

After cooling at room temperature, each medium was inoculated with *Aspergillus niger* dilution suspension and incubated on a rotary shaker at 30°C for 5days (Kareem S.O. et. al) [6].

2.5 Filtration: The medium was diluted with sterile distilled water (1:4w/v) and then filtered through sterile filter paper to get filtrate [7].

2.6 Recovery by CaO<sub>3</sub>: The filtrate obtained after the filtration process from the production medium of the different fruit peels (Mango, Banana and Orange) dry fruit peel with methanol and fresh fruit peel without methanol was recovered by using CaCO<sub>3</sub>.

2.7 Citric acid determination: Citric acid was determined titrimetrically by using 0.1 NaOH and phenolphthalein as indicator and calculated according to the formula [8]

$$N1V1=N2V2$$

N1=Normality of 0.1NaOH

V1=Volume of NaOH

N2=Normality of citric acid,

V2=Volume of citric acid

### 3. Results

**Table 1:** Dry Fruit Peels with Methanol

Sr. No	Fruit Peel	Concentration of Citric acid(g/kg)	Percentage of Citric Acid
1	Mango	1.28	0.128%
2	Banana	11.52	1.152%
3	Orange	5.12	0.512%

**Table 2:** Fresh Fruit Peels without Methanol

Sr. No	Fruit Peel	Concentration of Citric acid(g/kg)	Percentage of Citric Acid
1	Mango	3.2	0.32%
2	Banana	14.08	1.408%
3	Orange	21.76	2.176%

### 4. Conclusion

Citric acid production in solid-substrate fermentation media with different fruit peels. The highest citric acid is produced from fresh peel compared to dry peel. Dry banana peel showed high concentration of citric acid and fresh orange fruit peel produced high concentration of citric acid. In the

present investigation proper utilization of fruit peel waste as substrate for production of citric acid with simple methods proved economical and cost effective.

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### Author Profile



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