BIOPROCESS DEVELOPMENT FOR PRODUCTION OF CITRIC ACID

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ABSTRACT

- Citric acid is a commodity chemical produced and consumed throughout The World.
- It is used mainly in the food and beverage industry, primarily as an acidulate.
- Although it is one of the oldest industrial fermentations, its World production is still in rapid increasing.
- Global production of citric acid in 2007 was over 1.6 million tones. Biochemistry of citric acid fermentation, various microbial strains, as well as various substrates, technological processes and product recovery are presented. World production and economics aspects of this strategically product of bulk biotechnology are discussed.

INTRODUCTION

- Citric acid is the main organic acid produced today by fermentation.
- The history of citric acid actually started in 1784 with W. Scheele, who first isolated it from the lemon
- juice as calcium citrate, which treated with sulphuric acid gave citric acid in the liquid phase.
- Citric acid is a standard ingredient in cosmetic formulations for pH adjustment, and in antioxidant systems as a metallic-ion chelator.

SUMMARY

- Citric acid is the most important organic acid produced in tonnage and is extensively used in food and pharmaceutical industries.
- It is produced mainly by submerged fermentation using Aspergillus niger or Candida sp. from different sources of carbohydrates, such as molasses and starch based media.
- Citric acid is a weak organic acid found in citrus fruits. It is a natural preservative and is also used to add an acidic (sour) taste to foods and soft drinks. In biochemistry, it is important as an intermediate in the citric acid cycle and therefore occurs in the metabolism of almost all living things.

PRODUCT OF CITRIC ACID

- Food flavoring and preservative.
- Cosmetics and personal care.
- products.
- Antioxidant.
- Cleaning products.
- Medical uses.

TABLE OF CONTENT

➢MICRO-ORGANISMS USED FOR CITRIC ACIC PRODUCTION

A large number of micro-organisms have been employed to produce citric acid. These include bacteria, fungi, and yeasts.

1) **Yeasts**

- *Candida tropicalis*
- *C.oleophila*

2) **Bacteria:**

- *Bacillus licheniformis*
- *Arthrobacter paraffinens*

3) **Fungi:**

- *Aspergillus nagger*
- *A.aculeatus*

➢RAW MATERIALS

Raw materials that are used for citric acid production are divided into two groups:

- **Group 1:**

  Substances with low ash content

  e.g. cane or beet sugar, dextrose syrups, and crystallized dextrose

- **Group 2:**

  Materials which have high ash content.

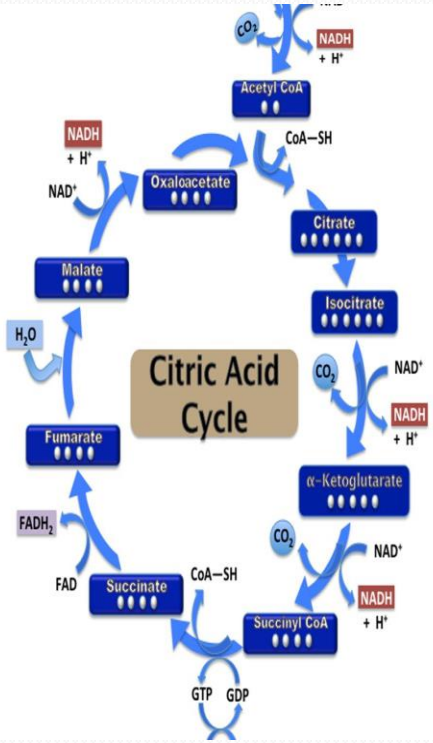
  e.g. cane and beet molasses, crude unfiltered starch hydro-lysates.

➢CITRIC ACID CYCLE

The citric acid cycle is also called the tricarboxylic acid cycle (TCA).

- <u>The steps include in the citric acid cycle are:</u>

1) Formation of Citrate
2) Formation of Isocitrate via cis-Aconitate
3) Oxidation of Isocitrate to a-Ketoglutarate and CO_2
4) Oxidation of a-Ketoglutarate to Succinyl-CoA and CO_2
5) Oxidation of Succinate to Fumarate
6) Hydration of Fumarate to Malate
7) Oxidation of Malate to Oxaloacetate



➢CITRIC ACID PRODUCTION TECHNIQUES

The industrial citric acid production can be carried in three different ways:

- **Surface fermentation:**

  Surface fermentation, also known as liquid surface culture, was the original citric acid industrial production technique.

- **Submerged fermentation:**

  This is the most widely used fermentation technique in the world today. Eighty per cent of the world's production is estimated to be from the submerged method.

- **Solid-state fermentation:**

  The solid-state process, or 'Koji' fermentation, originates from Japan, which has an abundance of agro-industrial residues/wastes.

➢PURIFICATION

Purification is a simple way of getting pure citric acid followed by two simple techniques.

1.Precipitation

2.Filtration

- Precipitation is the most commonly used technique.It is performed by the addition of calcium oxide hydrate (milk of lime) to form the slightly soluble tri-calcium citrate tetrahydrate. The precipitated tri-calcium citrate is removed by filtration and washed several times with water. It is then treated with sulphuric acid forming calcium sulfate, which is filtered off.

➢FACTORS AFFECTING CITRIC ACID PRODUCTION

- Carbon source
- Nitrogen Source
- Phosphorus Source
- Trace Element
- the pH of fermentation medium
- Aeration

➢USES OF CITRIC ACID

- It is used in the detergent industry as a phosphate substitute.
- Used as a preservative and flavoring agent.
- Emulsifying agent in ice cream.
- Also used as an antioxidant.

CONCLUSION

- This review focuses on the details of citric acid production.
- Currently, citric acid is the most produced organic acid in the world.
- Global production is expected to increase further with increasing demand.
- Although citric acid production using *A. niger* provides satisfactory performance at the moment, there is still room for greater improvements in increasing yield and minimizing waste by developing novel fermentation techniques and the optimization of *A. niger* using genetic manipulation.

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REFFERENCE

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THANK YOU