

• Organic Acids

1) Citric Acid.

* Organic acid Definition and brief introduction.
→ organic compound with acidic properties.
→ Applications

i) organic acids are used in food preservation.
ii)

① * Citric acid Production

→ 1st discovered as constituent of lemon.
→ also it is intermediate of kreb cycle and therefore it is present in every living organism.
→ about 7-9% citric acid obtain from lemon and 99% by microbial fermentation.

Applications

→ Used as Flavouring agent in Foods and beverages.
→ Used in chemical industry as an antimicrobial agent.
→ Citric acid used as an agent for stabilization.
→ Used as detergent.

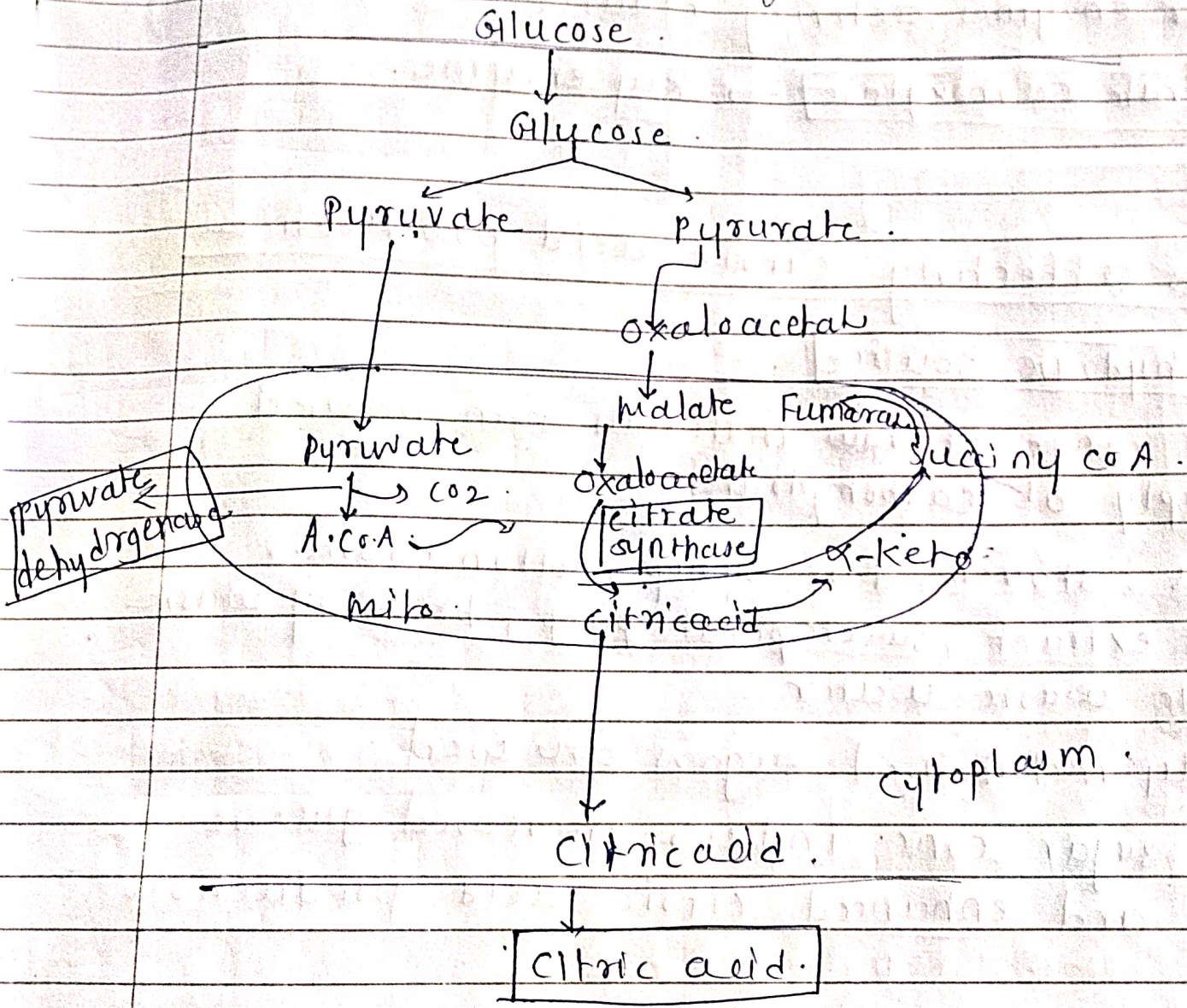
Microbial strains for citric acid production

- Aspergillus niger is most commonly used for industrial production of citric acid.
- A. clavatus, A. wentii, penicillium luteum, C. guilliermondii, cornybaeterium sp.

Microbial biosynthesis of citric acid production

- Citric acid → 1^o metabolic product
Formed in TCA cycle.
- Glucose → carbon source for production of citric acid.
- Glucose → 2 Pyruvate → acetyl-co-A and oxaloacetate → condenses to give citrate.

• Biosynthetic pathway for Citric acid production
- Non-medium



production of ... / or actually ...

Enzymatic regulation of citric acid production

- During synthesis → there is tenfold increase in activity of citrate synthase.
- other enzymes activity reduces.
- Pyruvate carboxylase → key enzyme.
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Factors affecting citric acid production.

1) Carbohydrate source

- wide range of raw materials can be used for supply of carbohydrates.
- molasses, starch, date syrup, cotton waste, banana extract, sweet potato pulp, brewery waste, pineapple waste water.
- Rapidly metabolised sugars are used.
- High sugar conc. induces increased glucose uptake and enhanced citric acid production.
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② Trace Metals

→ manganese, zinc, iron concentration should be optimum.

③ PH

→ maximum production when pH is 2.5
→ transport of citric acid is much higher

④ Dissolved O_2

→ When dissolved O_2 tension is higher —
citric acid production increases.

⑤ Nitrogen Source

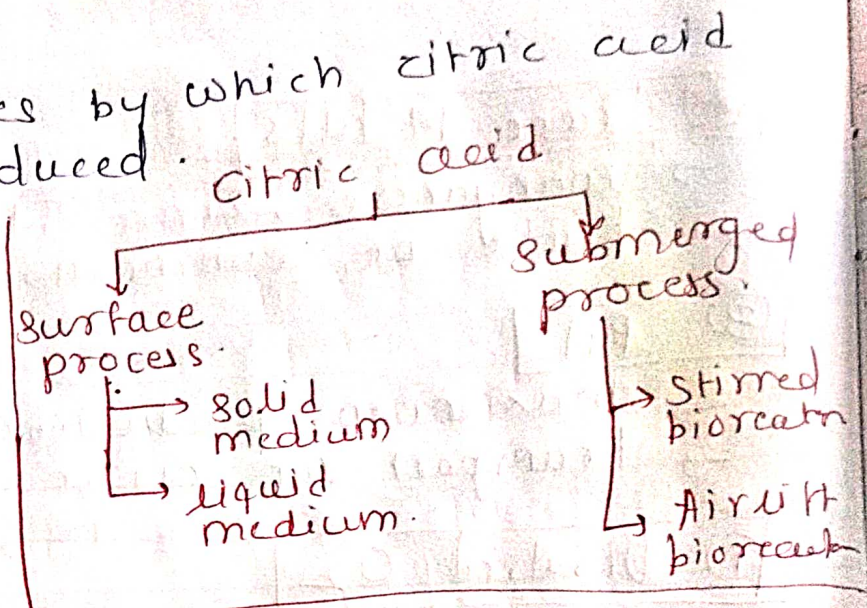
→ Ammonium salts, nitrates and urea are the nitrogen sources.
→ Exogenous addition of ammonium salts stimulates citric acid production.

ethanol to acetic acid is an aerobic

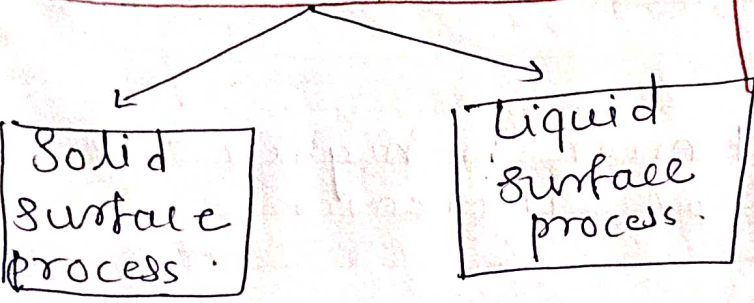
Fermentation process

There are two processes by which citric acid can be industrially produced.

- ① Surface process
- ② submerged process



Surface process



① Solid surface Fermentation

→ surface process using solid substrates such as wheat bran or pulp from sweet potato starch are used as culture media.

→ pH is 4-5, Temp - 28°C.

→ SSF → 80 to 100 hours For maximal production of citric acid.

→ citric acid can be extracted into hot water and isolated.

② Liquid Surface Fermentation

- Surface Fermentation using liquid medium is oldest method of production.
- Nutrient supply by → Beet molasses
- Fermentation usually carried out in aluminium trays filled with HM.
- Inoculum in form of spores spread over medium.
- Sterile air is passed → for O_2 and cooling.
- Temp - $30^\circ C$
- Fermentation stops 7-15 days.
- Medium and Mycelium and nutrient solⁿ is separated

● Submerged process

→ Two types of bioreactors are in use

Stirred
Tank

Aerated towers

- Yield of citric acid production depends on structure of mycelium.
- Adequate supply of O_2 is required.
- Foam formation avoided by anti foam agents.
- Nutrient con. is very imp. in industrial production of citric acid.

Recovery of citric acid

- Recovery starts with filtration of culture broth and washing of mycelium
- Culture broth is subjected to pH 7.2 and temp. $70-90^{\circ}\text{C}$ for precipitating citric acid for further purification.
- Final step is treatment with activated charcoal, cation and anion exchangers and crystallization.
- Citric acid monohydrate formed below 36°C is main commercial product.
- above 40°C C.A. crystallises in anhydrous form.
- purity -