

A collage of various fruits, vegetables, and nuts on a white surface. The items include sliced onions, raspberries, granola, sliced carrots, almonds, chia seeds, avocado, blackberries, blueberries, and various powders. A large, central circle with a pink-to-orange gradient contains the word "VITAMINS" in a dark purple, serif font. Two smaller circles of the same gradient are positioned to the right and bottom-left of the main circle.

VITAMINS

M.Sc Botany Part 1
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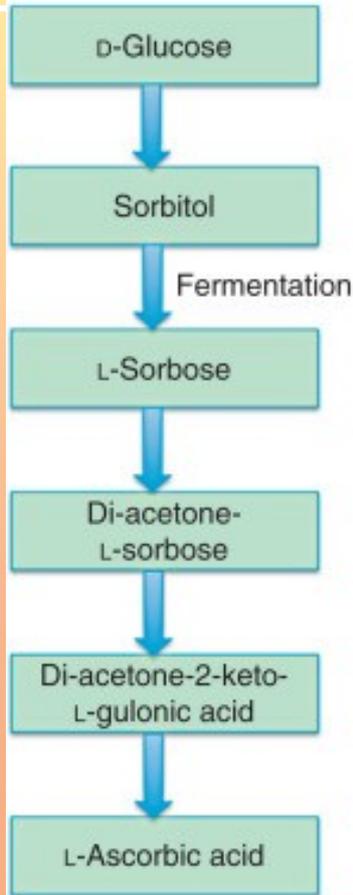
Vitamins are essential organic compounds required in small amounts for metabolic processes, growth, and disease prevention. They play critical roles in vision, immunity, energy production, with industrial applications in food fortification, pharmaceuticals, and nutraceuticals & preventing deficiency diseases.

Vitamin Production Process

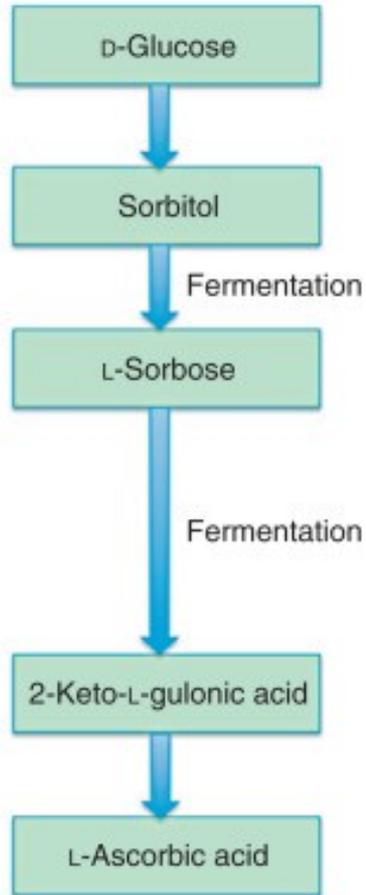


Formation of L – Ascorbic acid

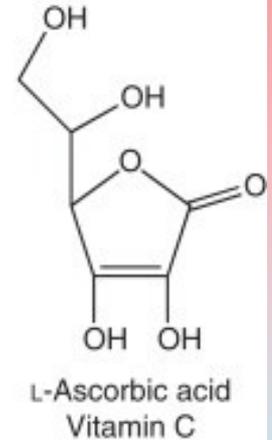
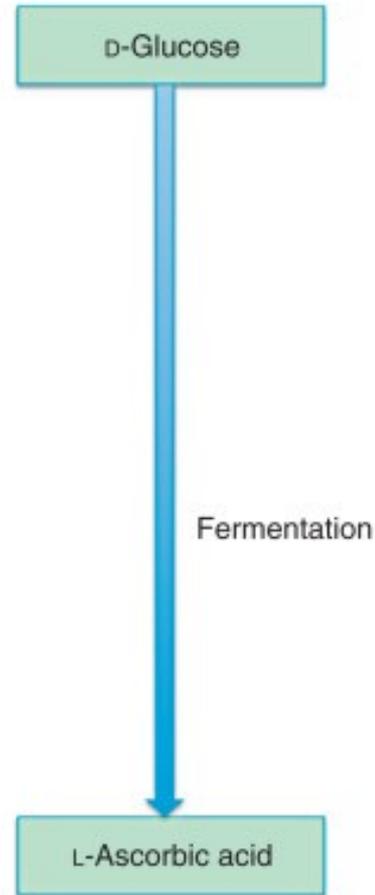
Reichstein process



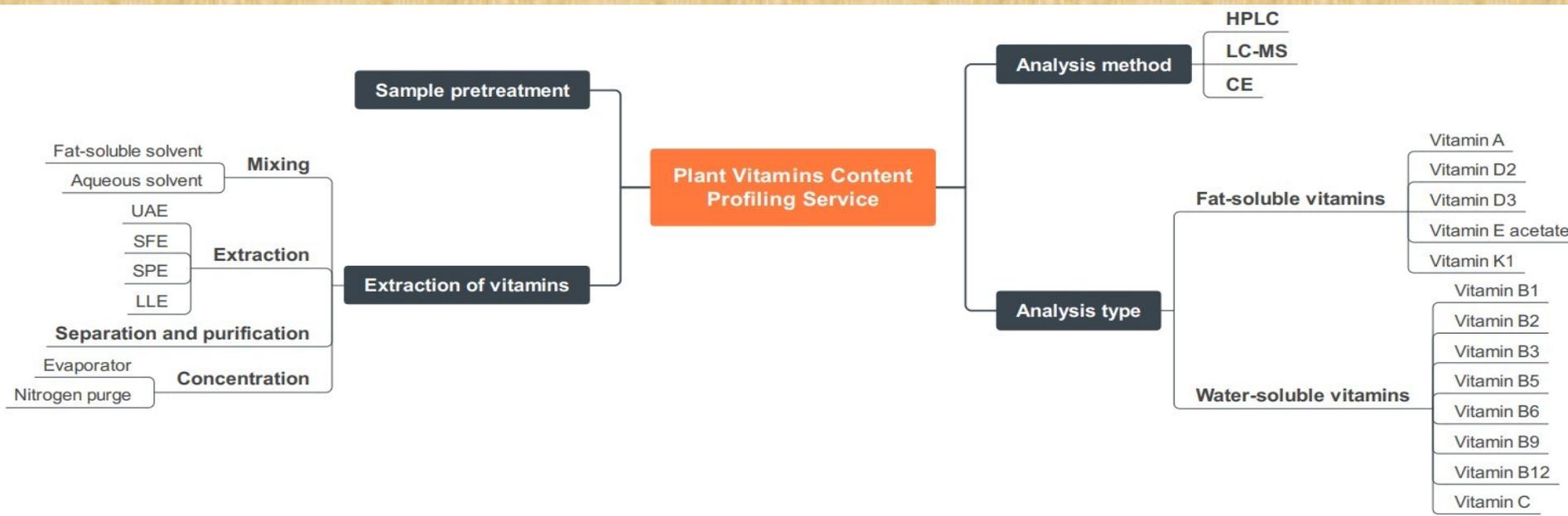
2 Fermentation steps



Single fermentation step



Vitamin profiling



Applications

- **Nutraceuticals & supplements**
- **Food Fortification**
- **Animal feed industry**
- **Healthcare & pharmaceuticals**
- **Cosmetics & personal care**

FUTURE ASPECTS

- Metabolic engineering and CRISPR enhance microbial strains for 10-50x higher yields, as in vitamin B12 production .
- Future technologies include synthetic biology for cell factories, biofilm reactors, and sustainable bio-refineries reducing chemical waste. Precision fermentation scales green production, potentially replacing 70% of synthetic methods.
- Nanotechnology in purification - Enhanced selectivity and faster processing.

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