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Enhancing and Inhibitory Effects of Fruit Waste Bioactive Compounds on Filamentous Fungi

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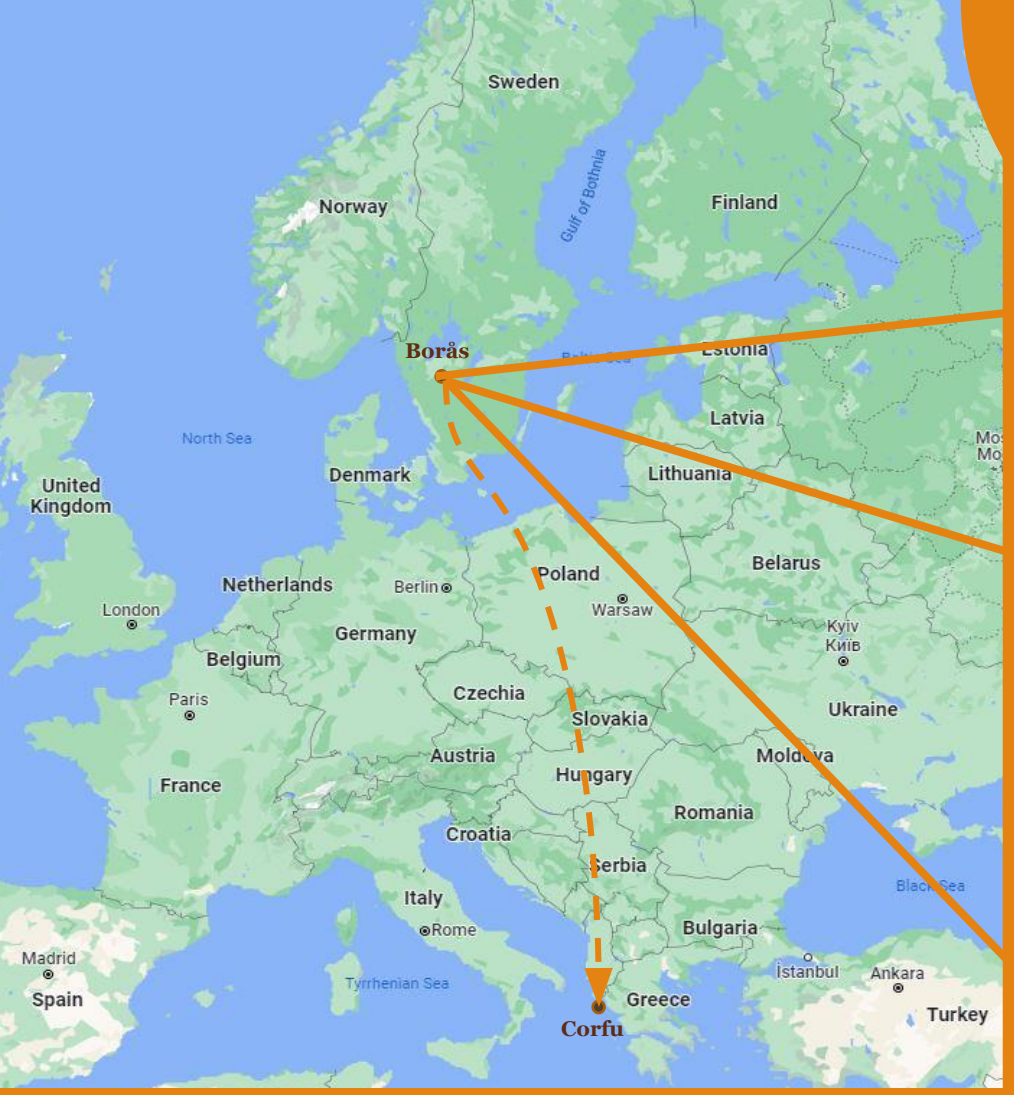

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Swedish Centre for Resource Recovery

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The fruit processing generates more than 0.5 billion tonnes of waste.

Production of fruit juice, canned fruit slices, dried fruit or fermented drinks results in solid waste, **which can be up to half of the whole fruit weight**.

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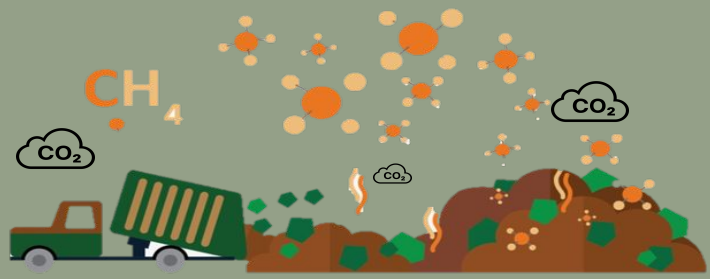
Fruit processing residuals e.g.Peels,seeds,pomace, etc.



- Limited application
  - animal feed and biofertilizer
  - commonly ends up in landfills

Recovery

- Added-value products
  - biodegradable packaging material,
  - bioactive compound extract
  - biogas

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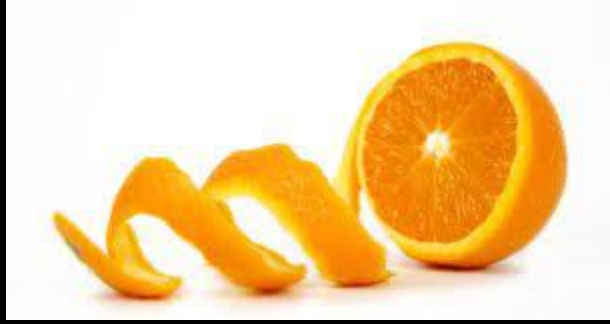

Challenge

- Inhibition of microorganism by fruit bioactive compounds

For example:
D-limonene is an inhibitory compound in biogas production. For an efficient process, the compound should be removed.

Wikandari, R. (2014). *Effect of fruit flavors on anaerobic digestion: inhibitions and solutions* (Doctoral dissertation, University of Borås, School of Engineering).

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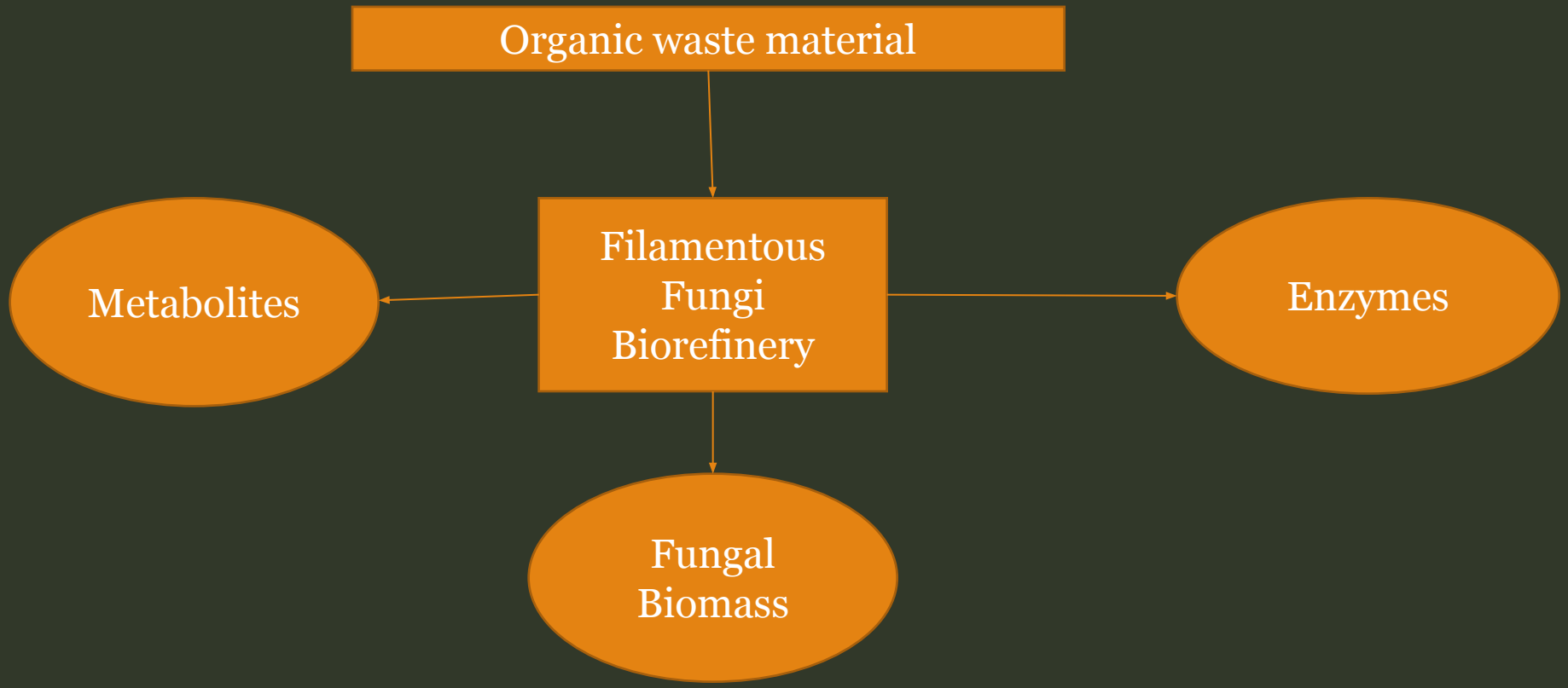
Solution for efficient fermentation processes

- Removal of the inhibitory compound prior to fermentation
- Utilizing microorganisms that are resistant to inhibitory effect of bioactive compounds

Filamentous Fungi



https://doi.org/10.1016/j.biortech.2016.03.018

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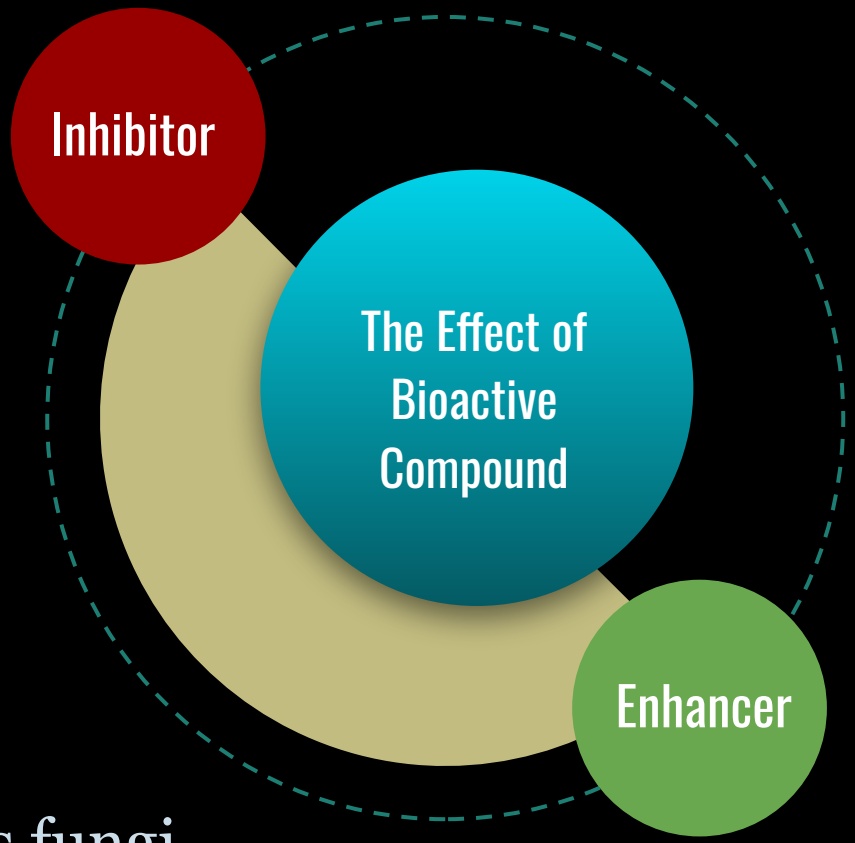

Screening

- 4 filamentous fungi
- 10 bioactive compound
- 3 different concentration of bioactive compounds
  - 2.4 mg/L
  - 24 mg/L
  - 240 mg/L

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Filamentous Fungi

Neurospora intermedia

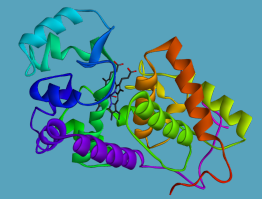
Oncom

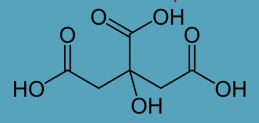
Rhizopus oligosporus

Tempe

Aspergillus niger

Citric acid & enzymes





Aspergillus oryzae

Soy sauce & sake

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10 Fruit/Vegetable Bioactive Compounds Used in This Project

Limonene
Terpenoid

Myrcene
Terpenoid

Quercetin
Phenol

Octanol
Alcohol

Ascorbic acid
Organic acid

10 Fruit/Vegetable Flavor Compounds Used in This Project

Betanin
Glucoside

Hexanal
Aldehyde

Ellagic acid
Phenol

(-)-Epicatechin
Phenol

Car-3-ene
Terpenoids

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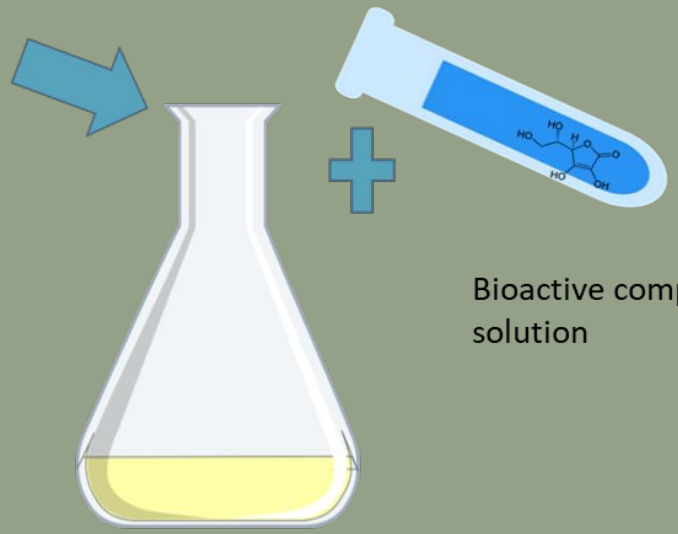
Filamentous fungi



Bioactive compound solution

Synthetic medium

35 °C
72 h

Results : Biomass yields

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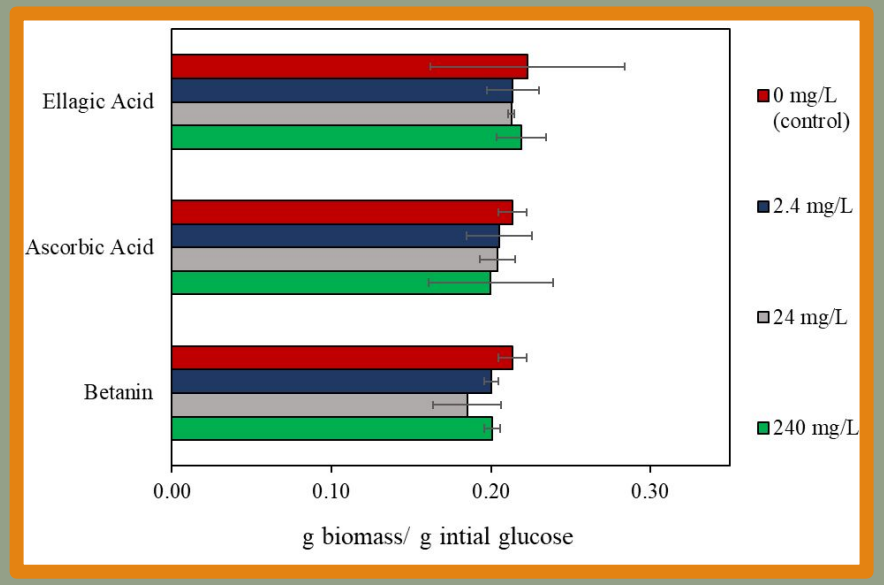
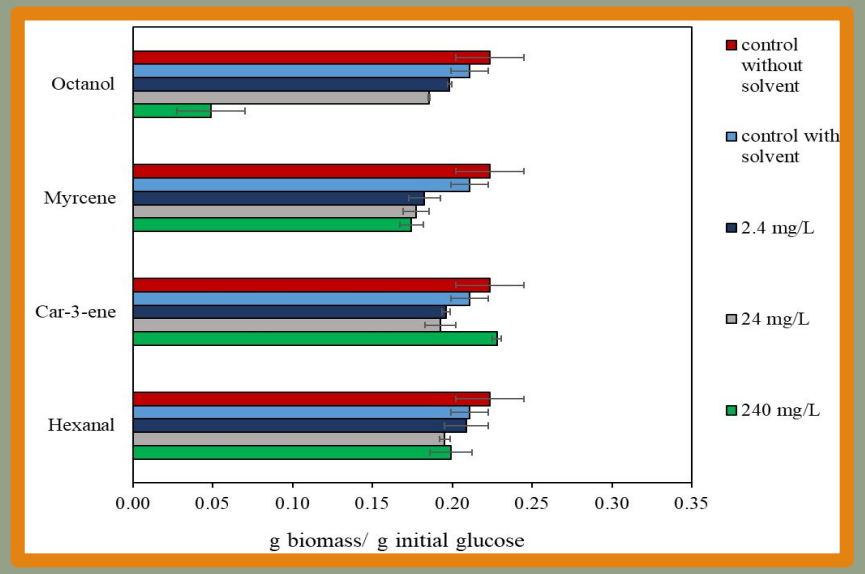
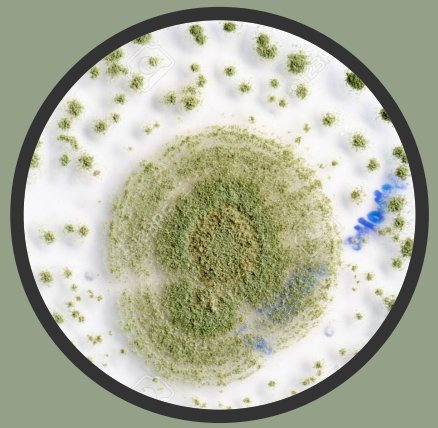
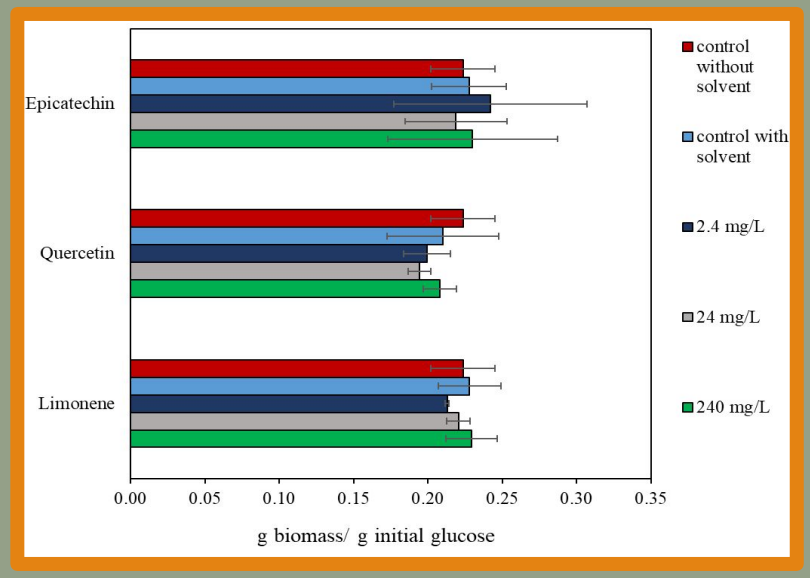






A. oryzae



- Octanol inhibition
- Car-3-ene
  - 9% decrease with 24 mg/L
  - 8% increase with 240 mg/L
- Myrcene 16% and 17% decrease (24 mg/L and 240 mg/L)
- Betanin 13% decrease at 24 mg/L

Results : Biomass yields

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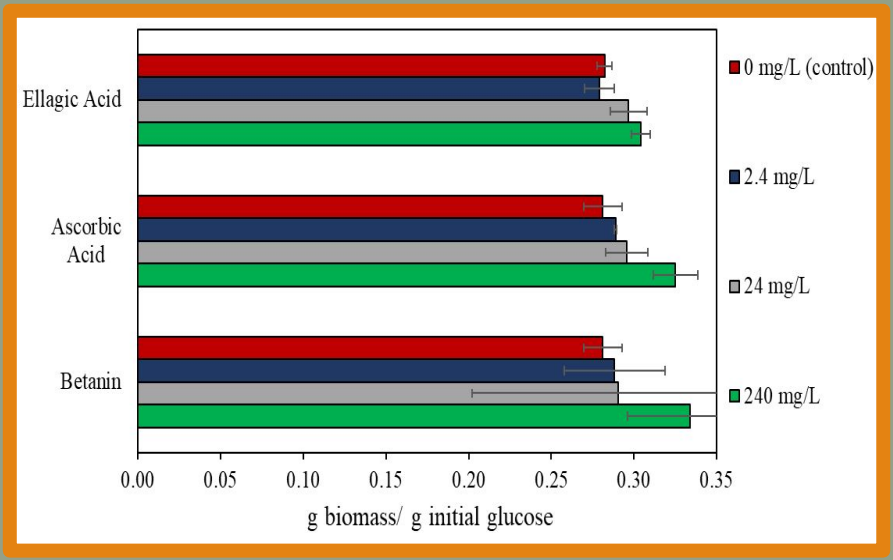
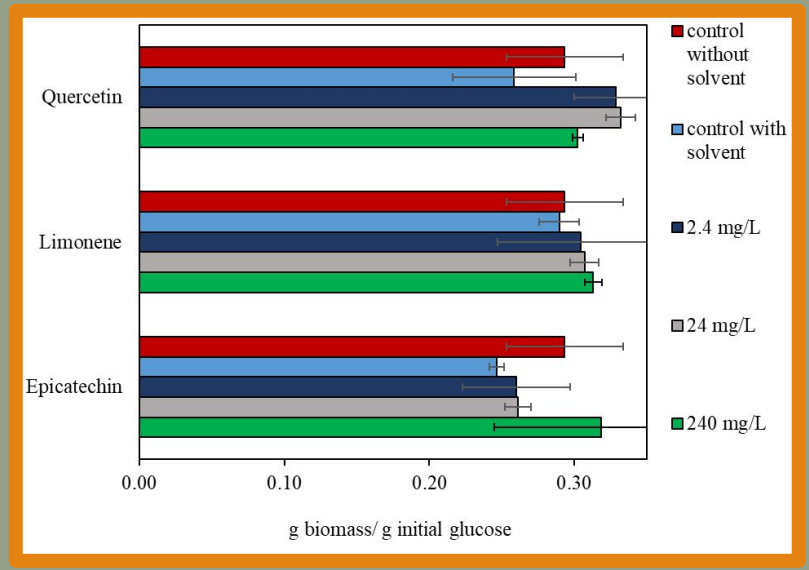
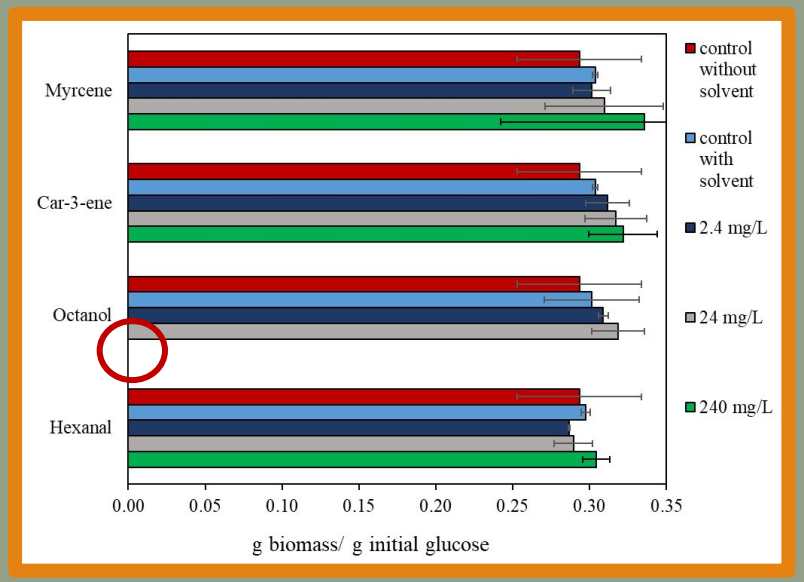




A. niger



- Octanol inhibition
- Ascorbic acid, 16% increase (240 mg/L)
- Elagic acid, 7.8% increase (240 mg/L)
- Quercetin, 27-28% increase (2.4 and 24 mg/L)
- Hexanal, 6% increase (240 mg/L)

Results : Biomass yields

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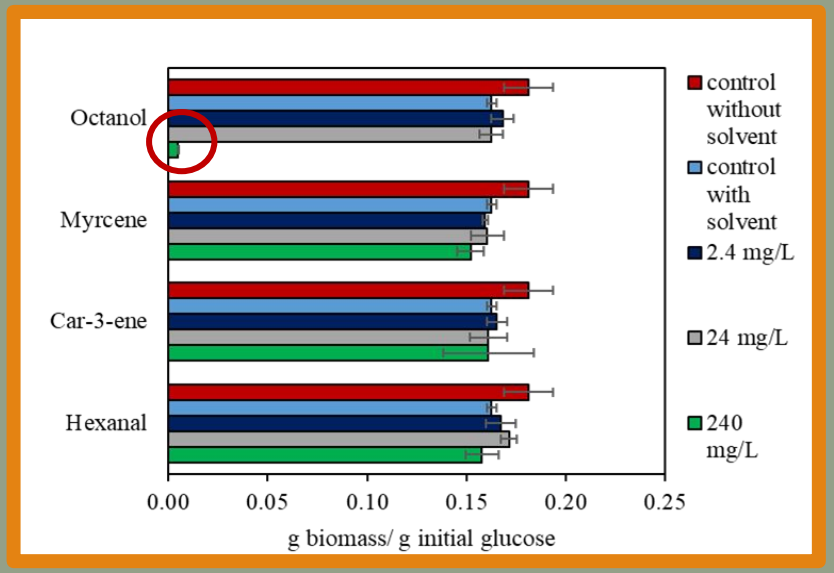
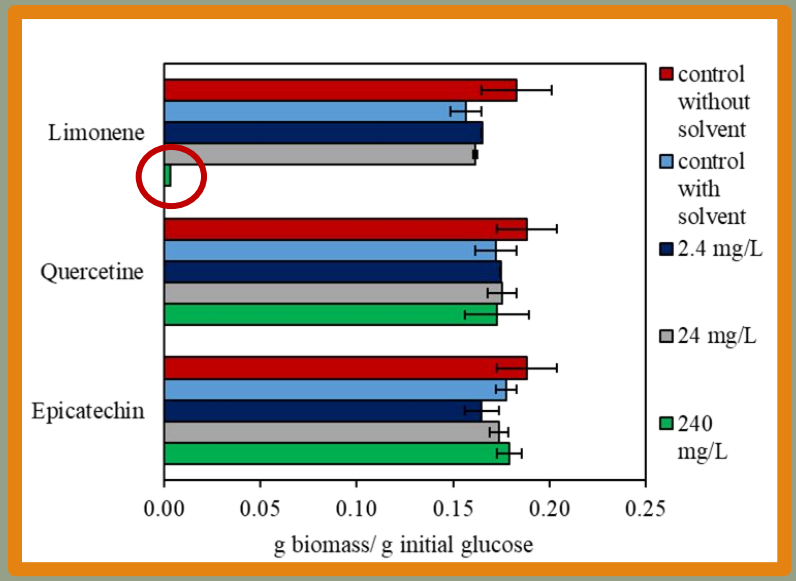
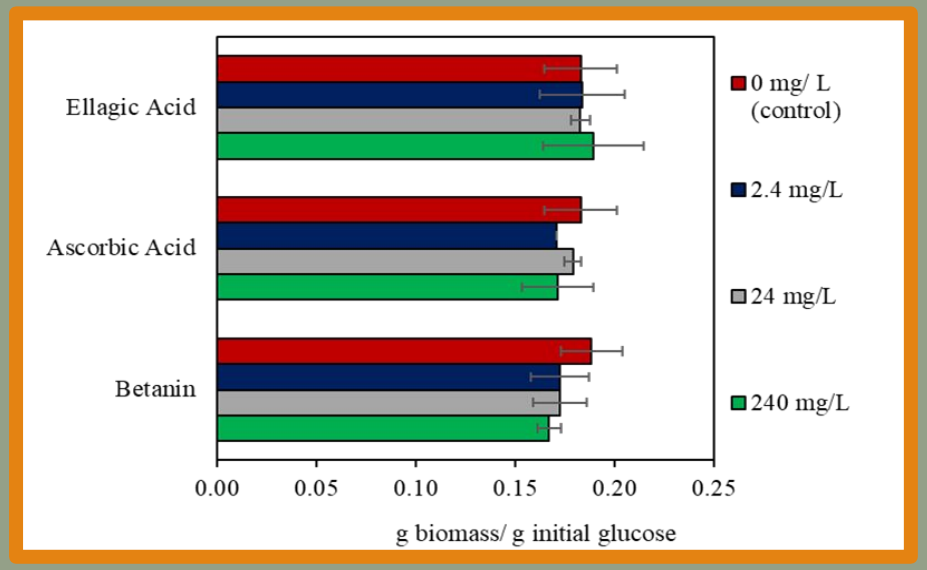




Neurospora intermedia



- Octanol inhibition
- D-limonene inhibition

Results : Biomass yields

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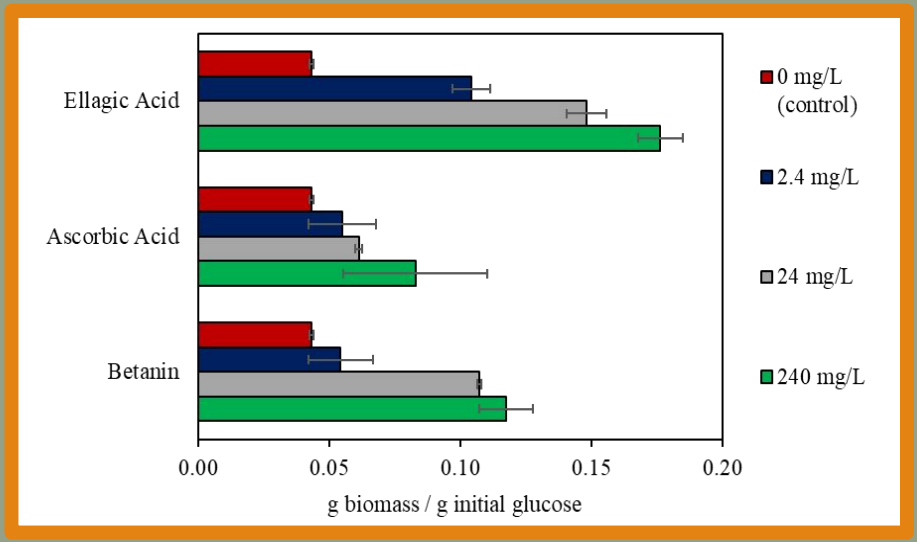
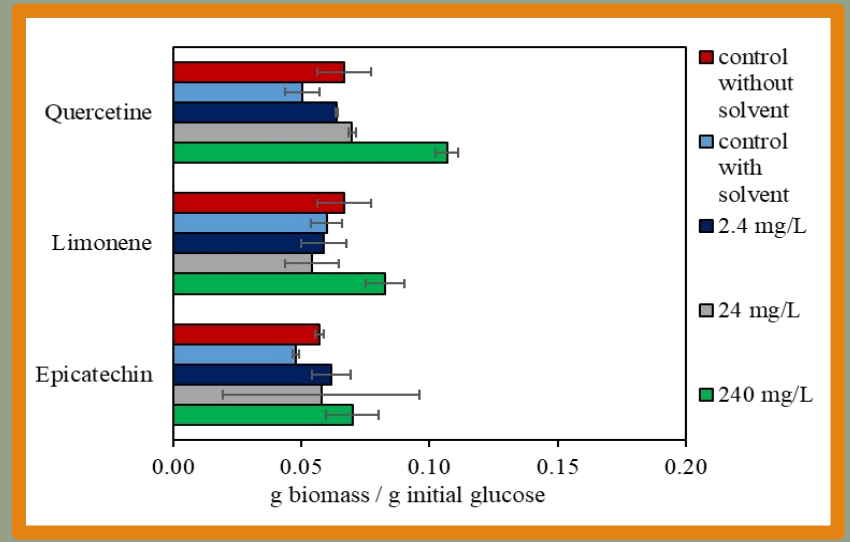
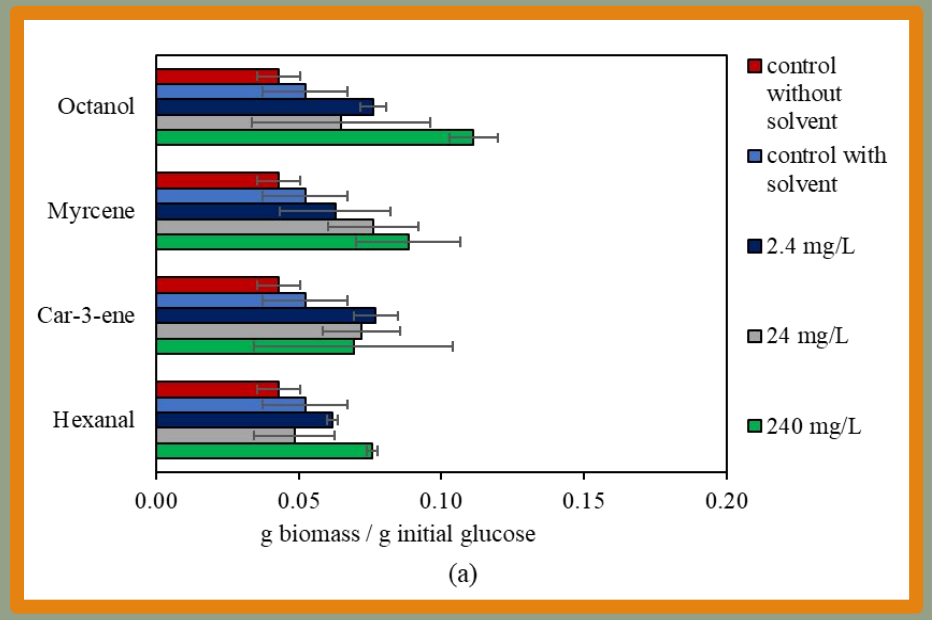


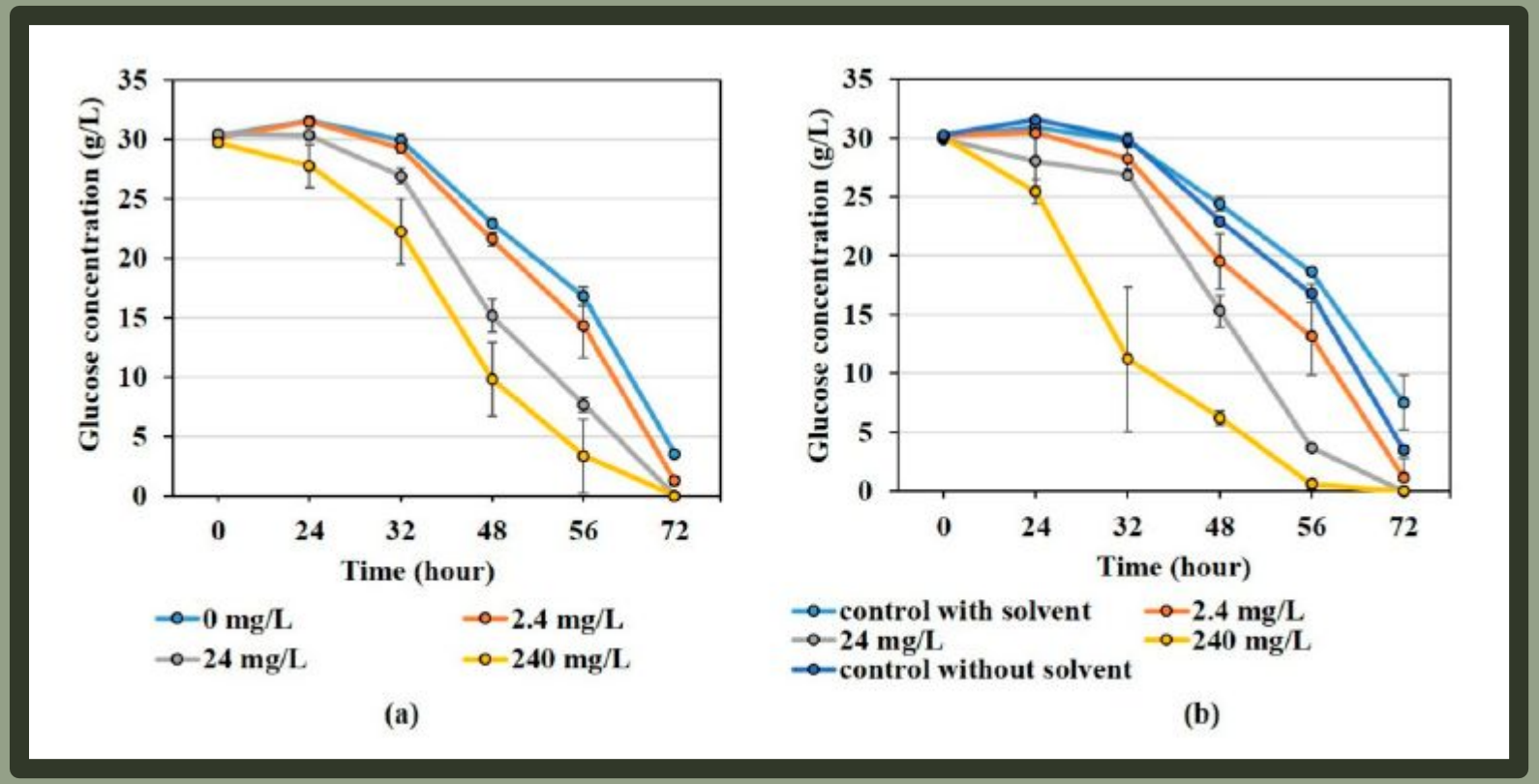


Rhizopus oligosporus



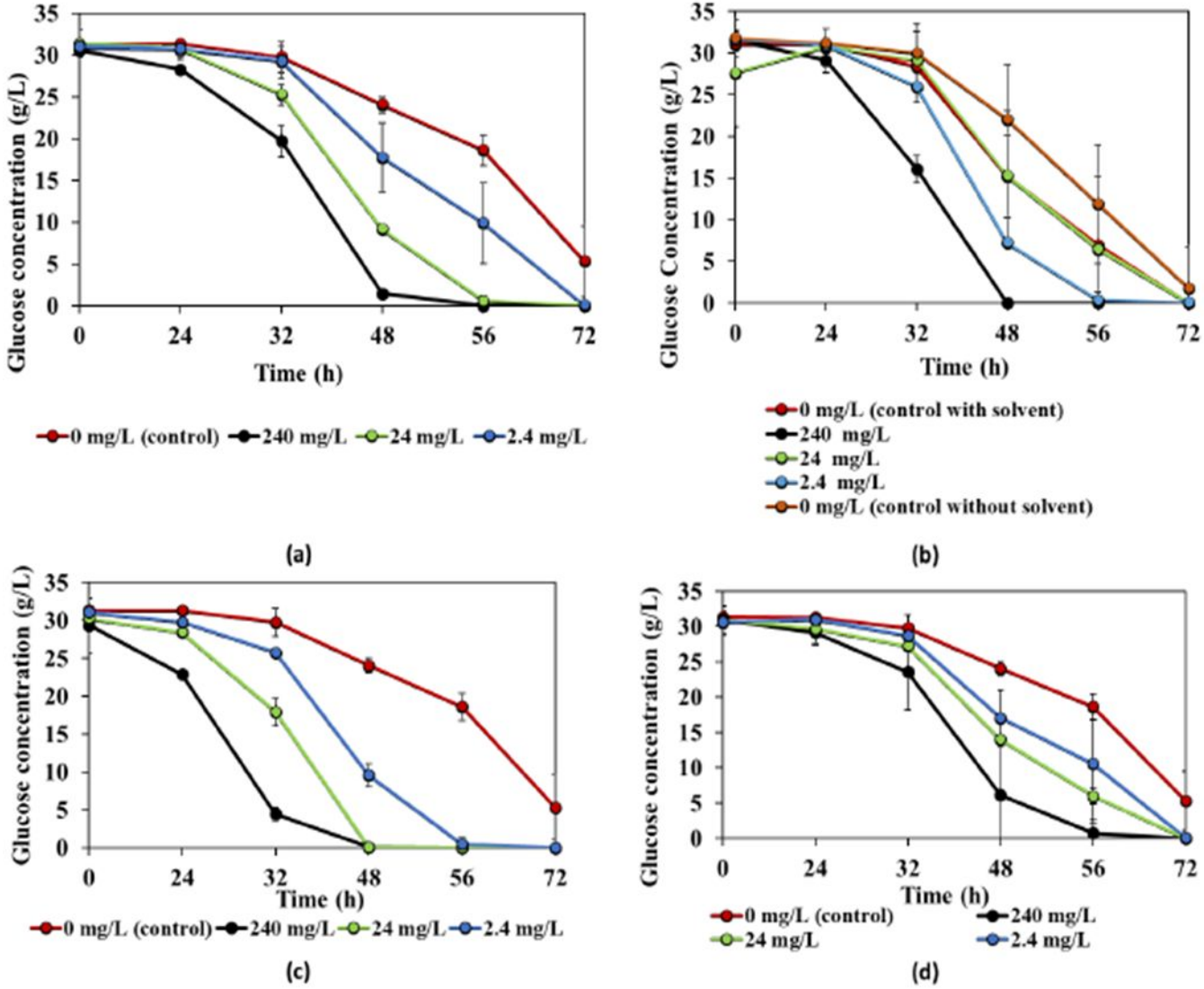
- Ellagic acid, up to 4-fold increase (240 mg/L)
- Betanin, up to 2.7-fold increase (240 mg/L)
- Quercetin, up to 2-fold, (240 mg/L)
- Octanol, up to 2-fold, (240 mg/L)
- Ascorbic acid; Limonene, Hexanal; Myrcene 38-92% increase

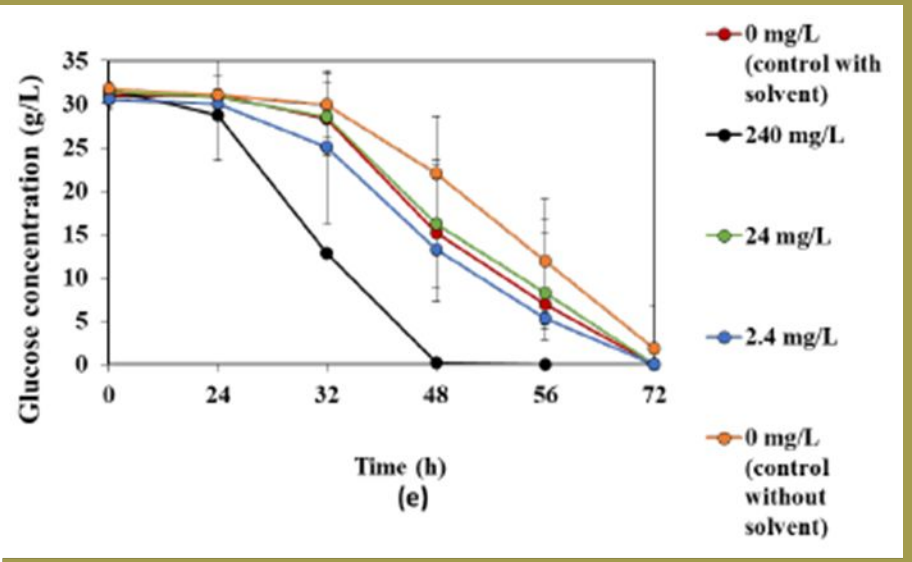
Results:
Glucose consumption trends



Glucose consumption of A. niger in bioactive compound added mediums. a) Ellagic acid; b) quercetin

Results: Glucose consumption trends





Changes in the glucose consumption trend of *R. oligosporus* during cultivation in the presence of bioactive compounds: (**a**) betanin, (**b**) octanol, (**c**) ellagic acid, (**d**) ascorbic acid, and (**e**) hexanal.

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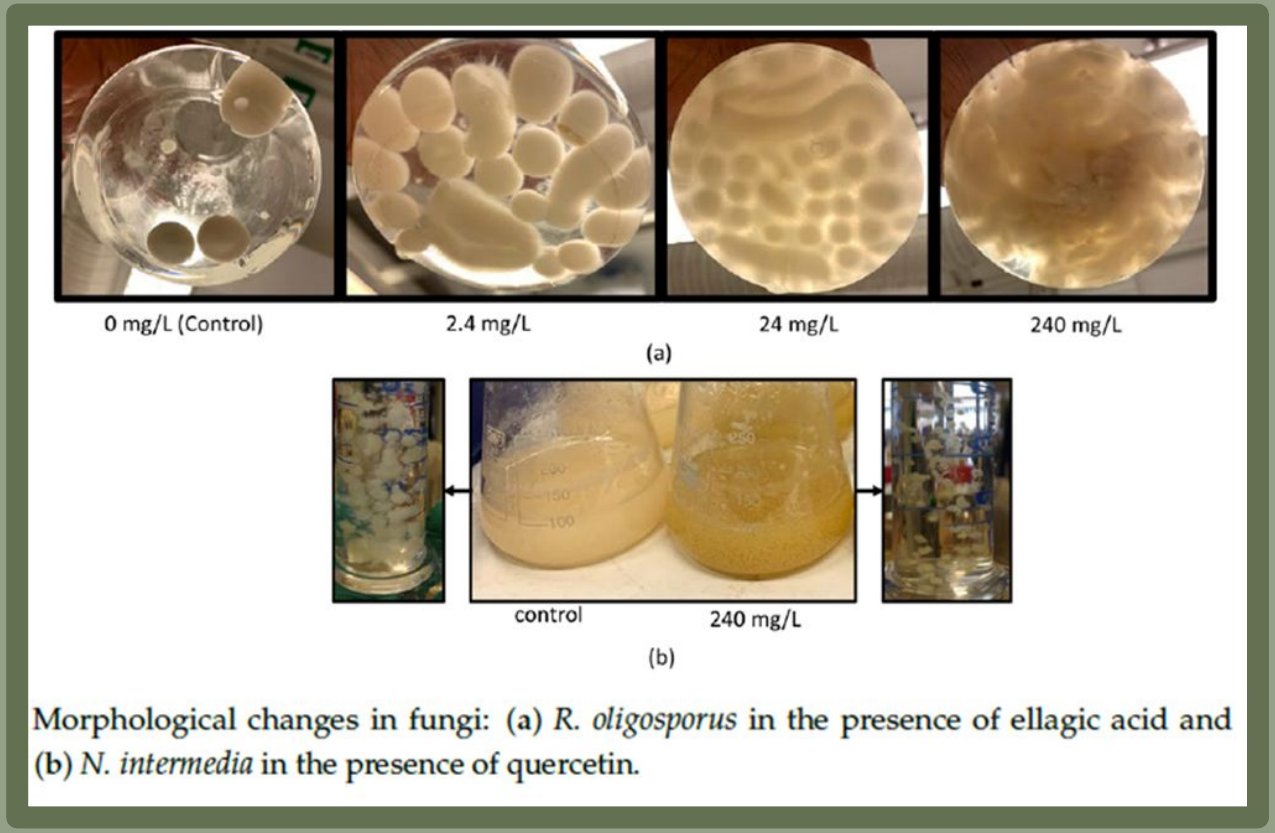
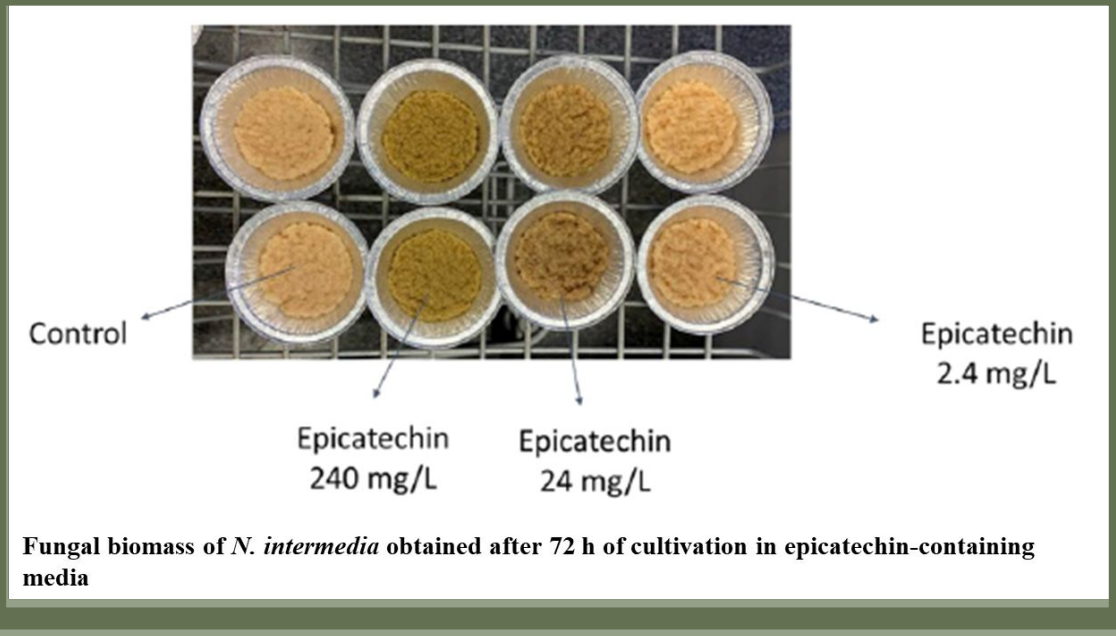


Morphological changes in fungi: (a) *R. oligosporus* in the presence of ellagic acid and (b) *N. intermedia* in the presence of quercetin.

Morphology change



Fungal biomass of *N. intermedia* obtained after 72 h of cultivation in epicatechin-containing media

Adsorption on biomass

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Potential utilization in food industry:

- Bioactive compounds (limonene and octanol) can be applied as a natural antifungal agent.
  - Considering *A. niger* as contaminant in processes such as in food industry, octanol can prevent contamination while food-fermenting fungus *R. oligosporus* can grow.
- Potential candidates in Fruit processing residual valorization
- Developing a fermentation strategy to boost biomass yield
- Helpful for current and novel fermented food production

Benefit:

Natural Antifungal agent

Process improvement

Waste treatment

Color removal

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Thank you!