

Evaluate the effect of C/N ratio on *Yarrowia lipolytica* grown in fermented food waste



Soodeh SALIMI KHALIGH- PhD
Assoc. Prof. Mahmut ALTINBAŞ

Istanbul Technical University- Turkey
Environmental Engineering Department
Environmental Biotechnology program

■ Outline

1. Background

- Why Food Waste?
- Why Oleaginous yeast?

2. Materials and Methods

- Fermentation of Food Waste
- Growth of yeast on fermented Food Waste under different CN ratios and carbon sources

3. Results

4. Conclusion

▪ Background

- Municipal solid waste: Enhance day by day
- One third of these waste: FOOD WASTE (Han et al. 2016)
- Food waste:
 - preparation food, cooking, uneaten food
 - rich in organic carbon, protein, fatty acids, minerals
- Valuable feedstock for valuable microbial products (Sindhu et al., 2019)



waste



to



fuel

- Increasing energy demands : **find an alternative energy source**
- Different microorganisms: renewable source ---> consume complex organic matters, recovery of valuable products (biofuel).
- **Oleaginous yeast**: sustainable source for lipid production, ability of accumulate lipid more than 20% of dry mass inside the cell (Lee et al., 2019).
- Soluble organic matters ---> more effective Bio-valorization of FW.
- Fermentation: ideal biological pre-treatment to enhance solubilization of organic matter (Strazzera et al., 2018)

▪ **Objective of the study**

- Oleaginous yeast named *Yarrowia Lipolytica* was cultivated on fermented food waste in nitrogen deficiency media.
- To supply nitrogen deficiency media glucose, glycerol, potassium acetate was applied.
- Growth of *Yarrowia Lipolytica* on fermented food waste under nitrogen deficiency media and different carbon sources was evaluated
- Lipid accumulation of *Yarrowia Lipolytica* on fermented food waste under nitrogen deficiency media and different carbon sources was evaluated

▪ Materials and Methods:

- *Food waste collection and preparation*

Cooked and uncooked food: beans, meat, chicken and vegetables, rice, etc.

Grinded, dried at 70°C, filtered to have the parts less than 3 mm, stored at +4°C.



- Strain and inoculum preparation

Yarrowia lipolytica: strain MUCL 28849, BCCM (Belgian Coordinated Collections of Microorganisms).

YPD agar slant, $4\pm 1^\circ\text{C}$

- Anaerobic fermentation of food waste using rumen microorganisms

Batch experiments under thermophilic condition ($55\pm 1^\circ\text{C}$), pH 7, SRT of 5 days.

Fermented Food Waste was applied as growth medium.

■ Materials and Methods:

- *Batch culture to assess optimum C/N ratio and most favorable carbon source*
- *CN ratios of 75, 100 and 125*
- *Carbon sources: glucose, glycerol and potassium acetate*
- *Growth was monitored every day as optical density, biomass concentration and lipid accumulation was measured at early stationary phase*

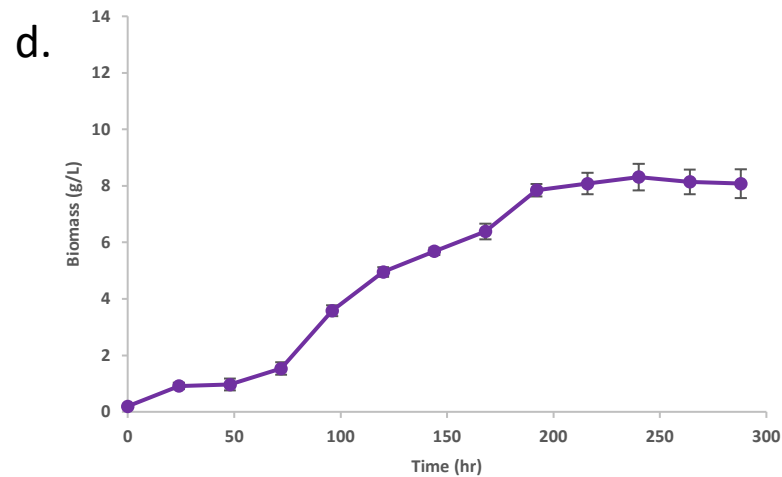
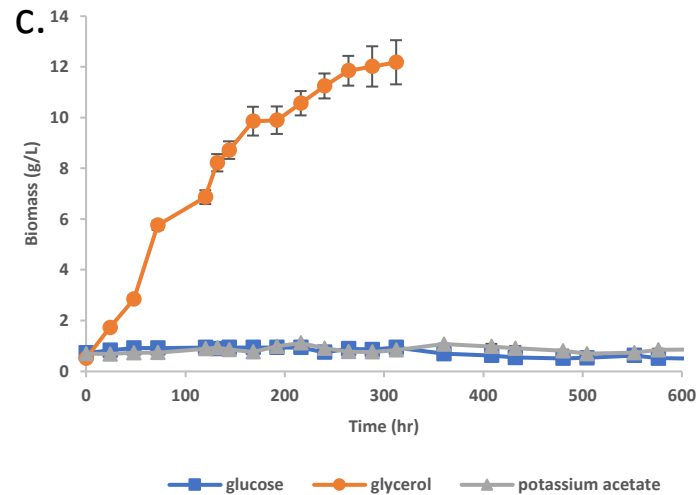
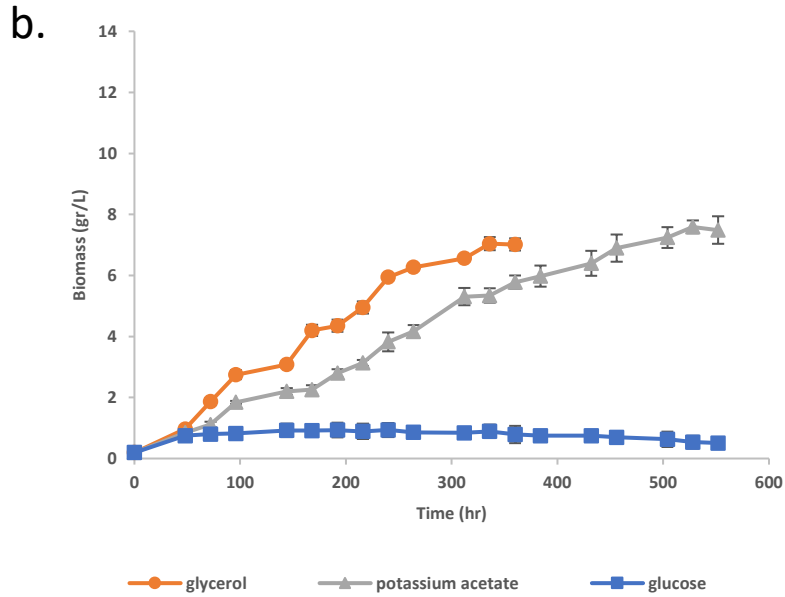
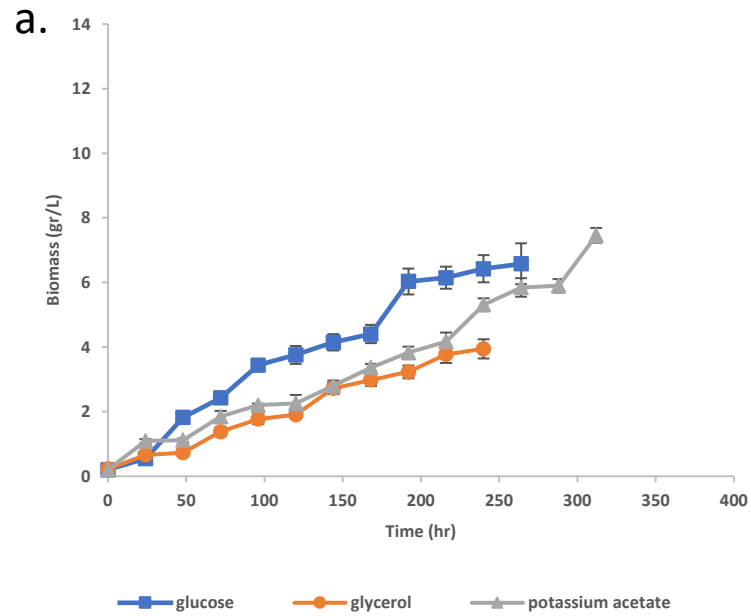


▪ Results

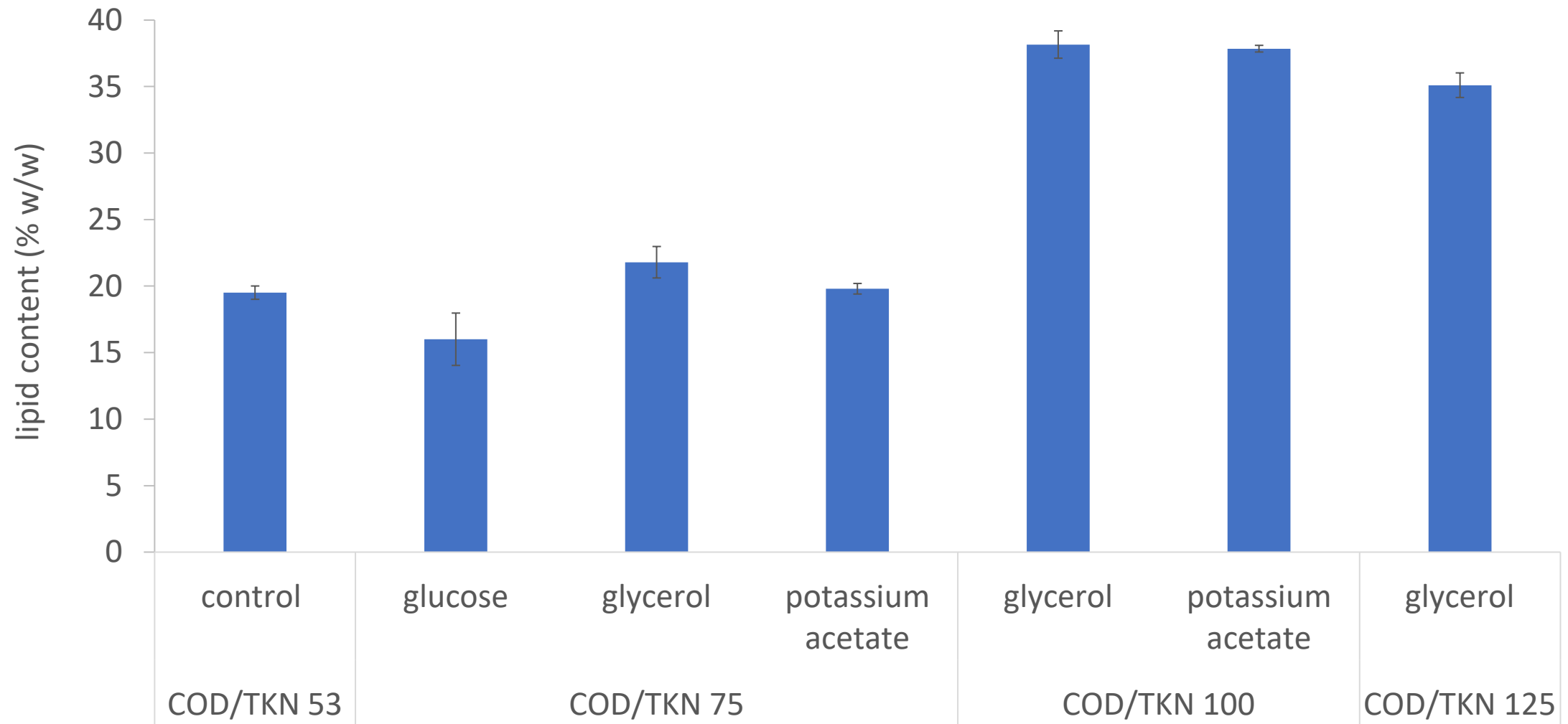
Fermented food waste characterization

<i>Parameters</i>	<i>Values</i>
Total COD	51,255±500 mg/L
Soluble COD	48,400±492 mg/l
TKN	907±14 mg /L N
Ammonia	28.5±3.5 mg/L N
Total phosphorus	242±8 mg/L PO ₄ ³⁻
Ortho phosphate	143±23 mg/L PO ₄ ³⁻
pH	5.44±0.05

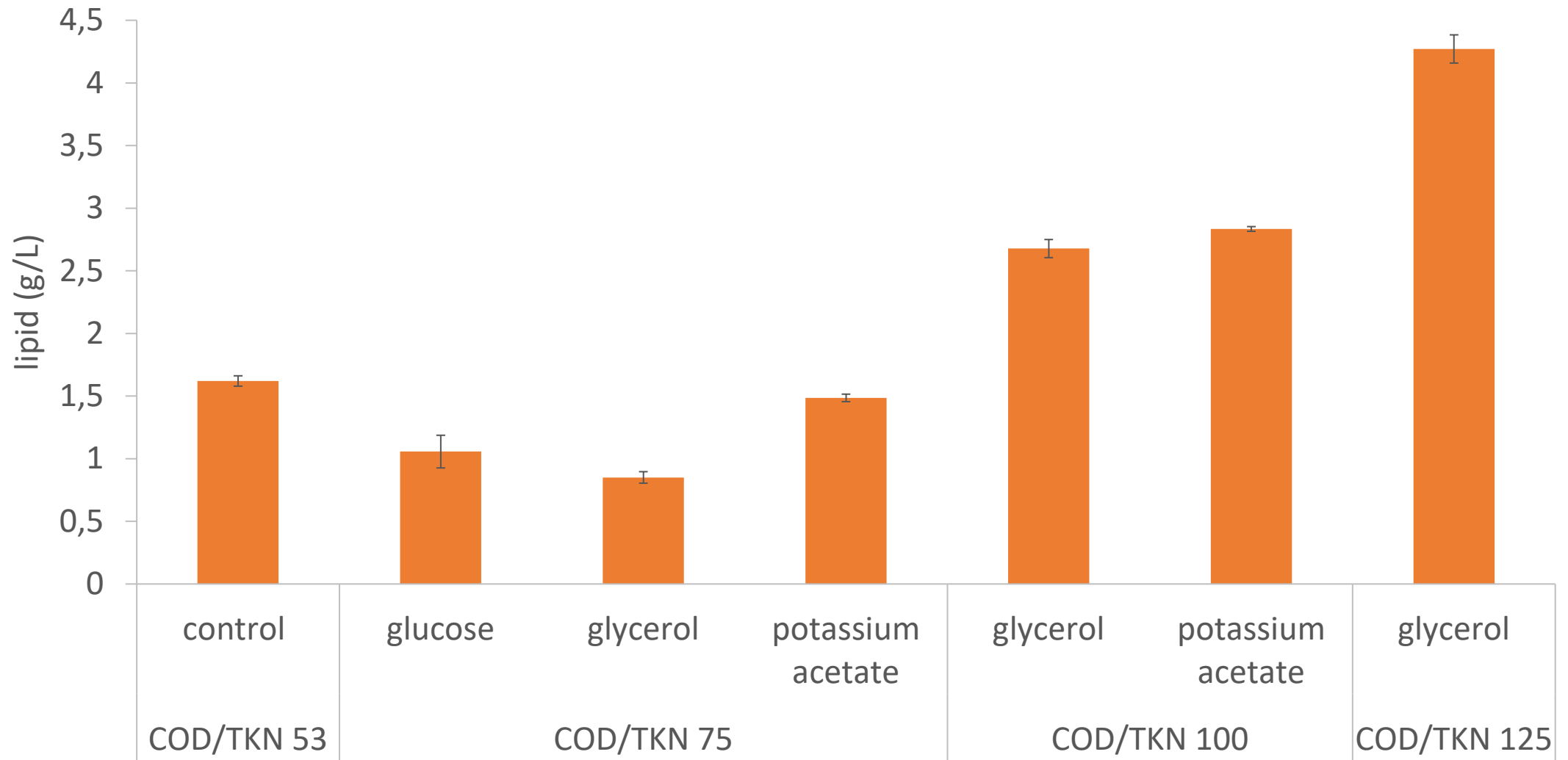
• Results



Biomass concentration in (a) Different carbon sources at COD/TKN 75. (b) Different carbon sources at COD/TKN 100. (c) Different carbon sources at COD/TKN 125. (d) Control (Fermented food waste with unchanged COD/TKN).



Lipid amount (%) in different initial COD/TKN ratios.



Lipid concentration obtained in different initial COD/TKN ratios.

- Conclusions

- According to this study, FW can be applied as favorable carbon source to produce intracellular lipid.
- Nitrogen deficiency together with high amount of organic carbon: important parameters to enhance the amount of accumulated lipid by *Y.lipolytica*.
- In this study, among applied organic carbon sources to increase biomass concentration, lipid content and lipid concentration, **glycerol** is selected as the most favorable one.
- By increasing COD/TKN over 75, lipid content of the cell enhanced directly.
- More investigations are required to optimize the condition of COD enhancement, such as adding carbon sources at the end of growth phase of microorganism.



THANK
YOU