Microbial oil and Carotenoid production by Oleaginous Yeast using Vegetable and Urban Waste

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1. Introduction and Objectives

Use of **red yeast** *Rhodosporidium toruloides* to produce **lipids and carotenoids** from culture media derived from **horticultural residues** and **urban pruning residues** or **paper waste** (not recycled) as **low-cost carbon** sources

Low-cost raw material
Obtain culture media from biowaste

Bioreactor process
Fed-batch cultivation yeast *R. toruloides*

Bioproducts production
Lipid and carotenoid quantification and analysis

2. Biotechnological Process

Low-cost raw materials

1. Discarded Pepper

- Crushing
- Centrifugation
- LF collection

2. Urban Pruning

- Pretreatment
- SF collection
- Enzymatic hydrolysis
- LF collection

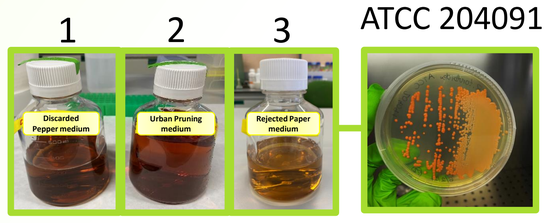
3. Rejected Paper

- Pretreatment
- SF collection
- Enzymatic hydrolysis
- LF collection

LF: Liquid Fraction
SF: Solid Fraction from pretreatment

Low-cost raw materials → Culture media for yeasts

R. toruloides ATCC 204091



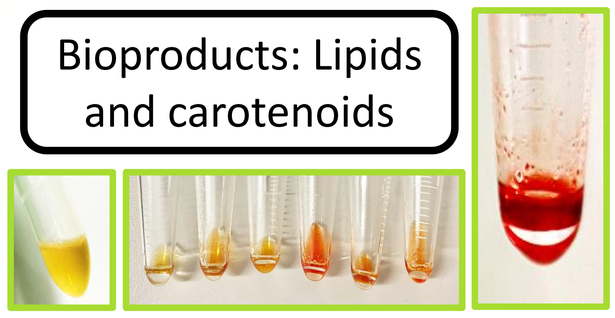
Cultivation strategy

Vegetable and Urban Waste Valorization

Eg: Glycerol (carbon source) Cell extract (proteins)

By-products, wastes as raw material

Bioproducts: Lipids and carotenoids

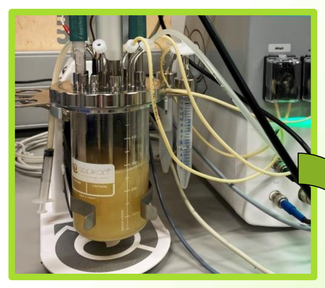


Fed-batch strategy

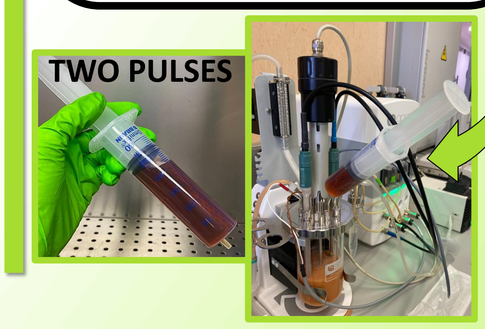
- T: 30 °C / pH: 6
- Aeration 1 vvm
- dO_2 >20% of air saturation

(variable stirring: 500-1500 rpm)

A) Biomass production phase (LF discarded pepper)



B) Accumulation phase (LF of concentrated pruning or paper pulses)



3. Results and Conclusions

Low-cost raw materials

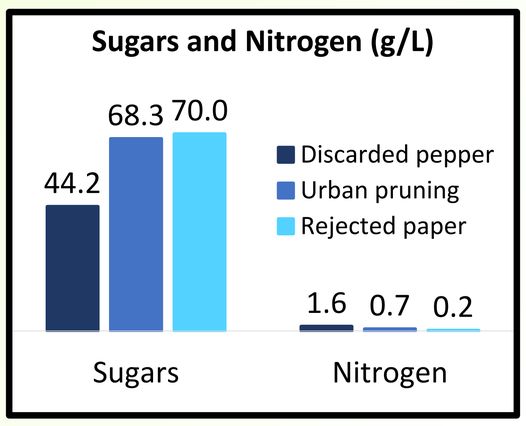


Fig. 1. Carbon and nitrogen sources provided by raw materials

Bioproducts quantification and analysis after Fed-batch strategy

Table 1. Final total lipids and carotenoids content following the fed-batch strategies with different residues as raw material

Fed-Batch strategy	Lipids (%)	FAMEs* (%)	Carotenoids (µg/g DCW*)
A) LF Discarded Pepper and Urban Pruning pulses	52	51	**967**
B) LF Discarded Pepper and Rejected Paper pulses	**56**	52	800

(*FAMEs: Fatty Acid Methyl Esters; DCW: Dry Cell Weight)

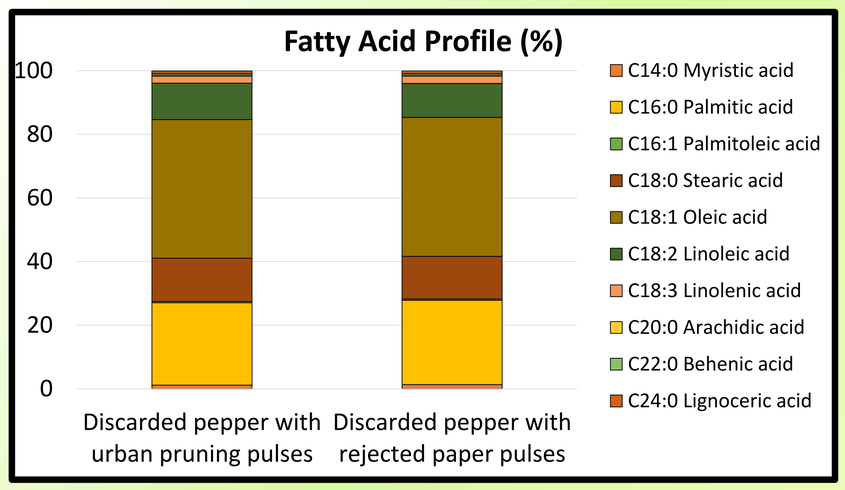


Fig. 2. FAMEs profile at the end of the tests

The **best lipid** accumulation, in ***R. toruloides***, has been achieved in the strategy in which **pulses of concentrated rejected paper** were used. More than **55 %** (w/w) **of microbial oil** accumulation has been obtained, with a predominant profile of **oleic and palmitic acid**, similar to that of vegetable oils destined for **biodiesel**. Nevertheless, the **best carotenoids** content, about **1 mg/g DCW**, has been achieved in the strategy in which **pulses of concentrated urban pruning residues** were used. Depending on the raw material and the carbon and nitrogen content (**C/N ratio**), the accumulation of one compound or another can be favoured. What is interesting is the **co-production** of both bioproducts **exploiting different residues**, with a view to applying the process in a **biorefinery**

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