

Valorization of milk thistle oilcakes in the culture of *Yarrowia lipolytica* yeast

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INTRODUCTION & AIM

Milk thistle (*Silybum marianum*) is a plant belonging to the *Asteraceae* family, originally native to the Mediterranean region. Today, however, it is widely distributed in other parts of the world, including Europe, North America, and Australia. It is characterized by large, spiny leaves with distinctive white spots and striking purple flowers, which also give it ornamental value. Milk thistle is highly valued for its content of silymarin - a complex of flavonolignans known for their strong hepatoprotective properties. Silymarin supports liver cell regeneration and protects the organ from the harmful effects of toxins. The seeds of milk thistle are a rich source of protein, dietary fiber, healthy fats, and numerous micronutrients, making them a valuable ingredient in functional foods and dietary supplements.

Oicakes - the residues remaining after pressing oil from the seeds - also have significant economic importance. They contain high amounts of protein and fiber and can be successfully used as nutritious animal feed or as an additive to food products, enriching them with valuable nutrients.

The process of valorization of such by-products, like oilseed cakes, involves reusing them in ways that enhance their value - for example, in the production of dietary supplements, feed, or innovative food products. This approach not only reduces waste but also ensures more efficient and sustainable use of all plant materials, contributing to environmental protection and sustainable development.



Figure 1. Seeds and oilcake from Milk thistle

METHOD

Characteristics of milk thistle cakes

- dry matter determination by the moisture analyzer method
- determination of fat content in the oilcake using cold extraction and a Soxhlet extraction method. Extraction was performed using two different solvents: hexane and dichloromethane. Tests were performed in triplicate.
- fatty acid profile analysis using gas chromatography (GC)

Cultivation of the yeast *Yarrowia lipolytica* on medium with the addition of oilcakes

Yarrowia lipolytica yeast was cultivated in parallel on three different media: a standard YPG medium (20 g/L peptone, 10g/L yeast extract, 20g/L glucose), a medium with peptone only (20 g/L), and a medium with peptone (20 g/L) and oil cake (200 g/L). Cultures were maintained for 96 hours in a shaking incubator at 28°C. After this time, the pH, cell viability, and fatty acid profile of the oil fraction in the medium with oilcake were analyzed.

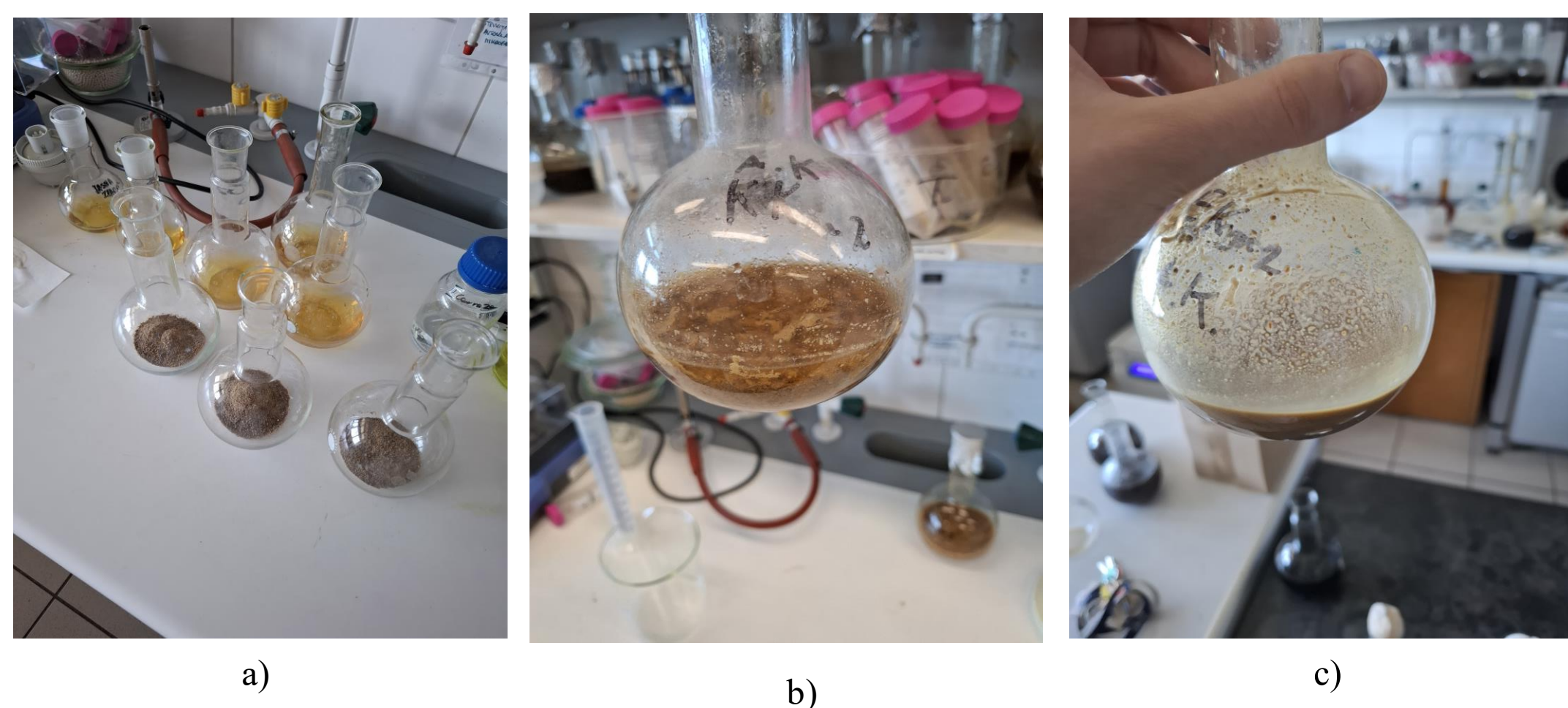


Figure 2. Preparation of medium: a) prepared flasks with mediums, b) medium with oilcake before (b) and after (c) cultivation.

RESULTS & DISCUSSION

Table 1. Physicochemical characteristics characteristics of milk thistle seed cake

Dry matter [%]			95,08 ± 0,28
Water [%]			4,93 ± 0,29
Oil content [g]	Soxhlet	Hexane	27,5 ± 0,35
		Dichloromethane	25,0 ± 0,14
	Cold Extraction	Hexane	13,5 ± 0,07
		Dichloromethane	11,0 ± 0,14

Table 2. The number of living cells depending on the medium

Medium	10° [CFU /ml]	
YPG		Average
test 1	0,55	0,925
test 2	1,3	
Pepton		
test 1	0,35	0,275
test 2	0,2	
Milk Thistle oilcake + pepton		
test 1	2	2,5
test 2	3	

Table 3. Fatty acid composition of the lipid fraction of the oilcake before and after cultivation of *Yarrowia lipolytica*

Fatty Acid	[%] before cultivaton	[%] after cultivation
14:0		1,64
16:0	13,3 ±1,1	9,26 ±1,95
18:0	5,74 ±0,28	3,18 ±0,89
18:1	26,55 ±0,2	52,78 ±2,20
18:2	49,38 ±0,5	29,23 ±3,34
18:3	0,18 ±0,01	3,23
20:0	2,12 ±0,55	0,76
20:1	0,64 ±0,14	1,05
24:0	0,21 ±0,2	0,68
Other	1,02	1,35

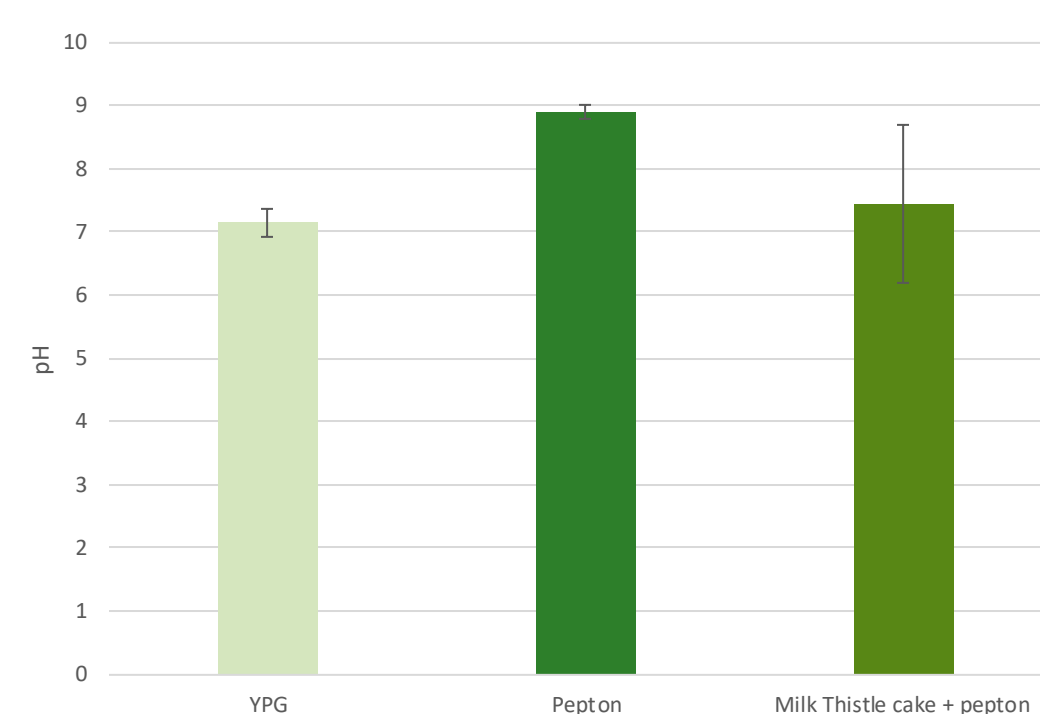


Fig 1. Average pH of medium after 4 days cultivation of *Yarrowia lipolytica* yeast

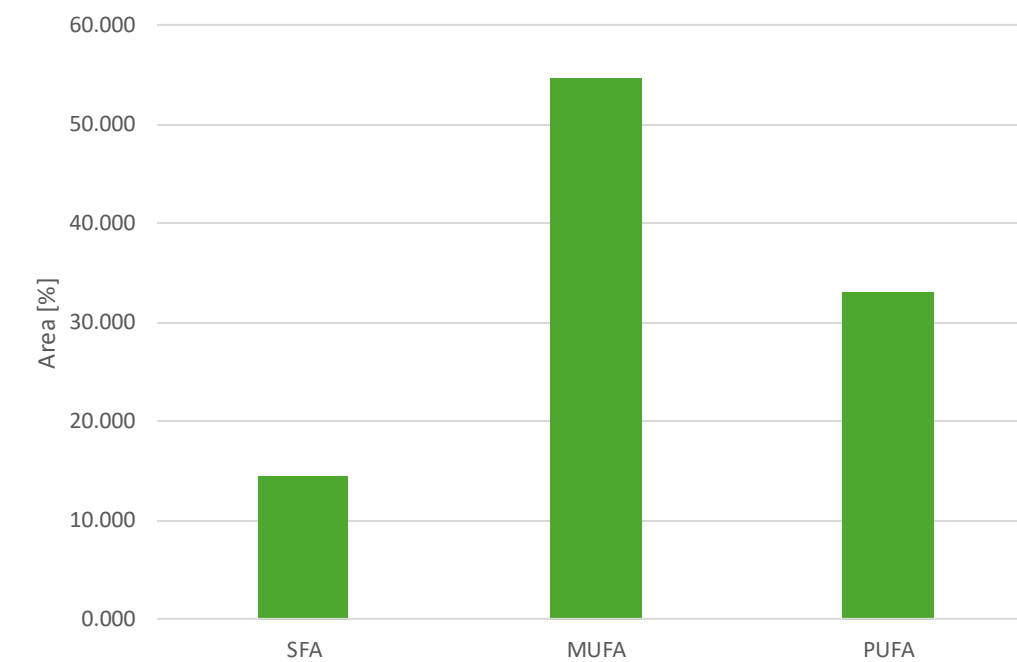


Fig 2. Average of fatty acid content after cultivation in oilcakes with peptone

Milk thistle oilcakes show promising utility potential. Their valorization may involve their use as a component of microbiological media. The relatively high (for plant waste) fat content in cakes can be used as a carbon source in media for the growth of microorganisms. Research on the physicochemical properties of milk thistle oilcake has shown that this oil is a valuable source of essential fatty acids, mainly linoleic and oleic.

Yeast culturing *Yarrowia lipolytica* in media supplemented with cake showed a significantly higher concentration of microbial cells in the medium (nearly three times higher) compared to standard YPG medium. After four days of cell growth, the pH of the medium was close to neutral, while the pH of the medium with peptone was strongly alkaline, indicating progressive cell proteolysis. Analysis of the fatty acid composition before and after yeast multiplication showed that microbial cells metabolize linoleic acid most effectively in their growth process.

CONCLUSION

The conducted research demonstrated that milk thistle oilcakes can serve as a valuable substrate for the cultivation of *Yarrowia lipolytica* yeast. The medium enriched with milk thistle cake supported effective yeast growth, indicating its potential as a cost-efficient and sustainable nutrient source. Moreover, the analysis of fatty acid profiles after cultivation revealed the presence of beneficial lipids, suggesting possible applications in biotechnology and food industries. The valorization of oilcakes not only contributes to waste reduction but also promotes circular bioeconomy and sustainable use of agricultural by-products.

FUTURE WORK / REFERENCES

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2. Meddeb W., Rezig L., Abderrabba M., Lizard G., Mejri M. 2017. Tunisian milk thistle: An investigation of the chemical composition and the characterization of its cold-pressed seed oils. International Journal of Molecular Sciences 18(12), 2582: 1–13.