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Olive Mill Wastewater Transformation from Pollutant to Sun Protection Paste

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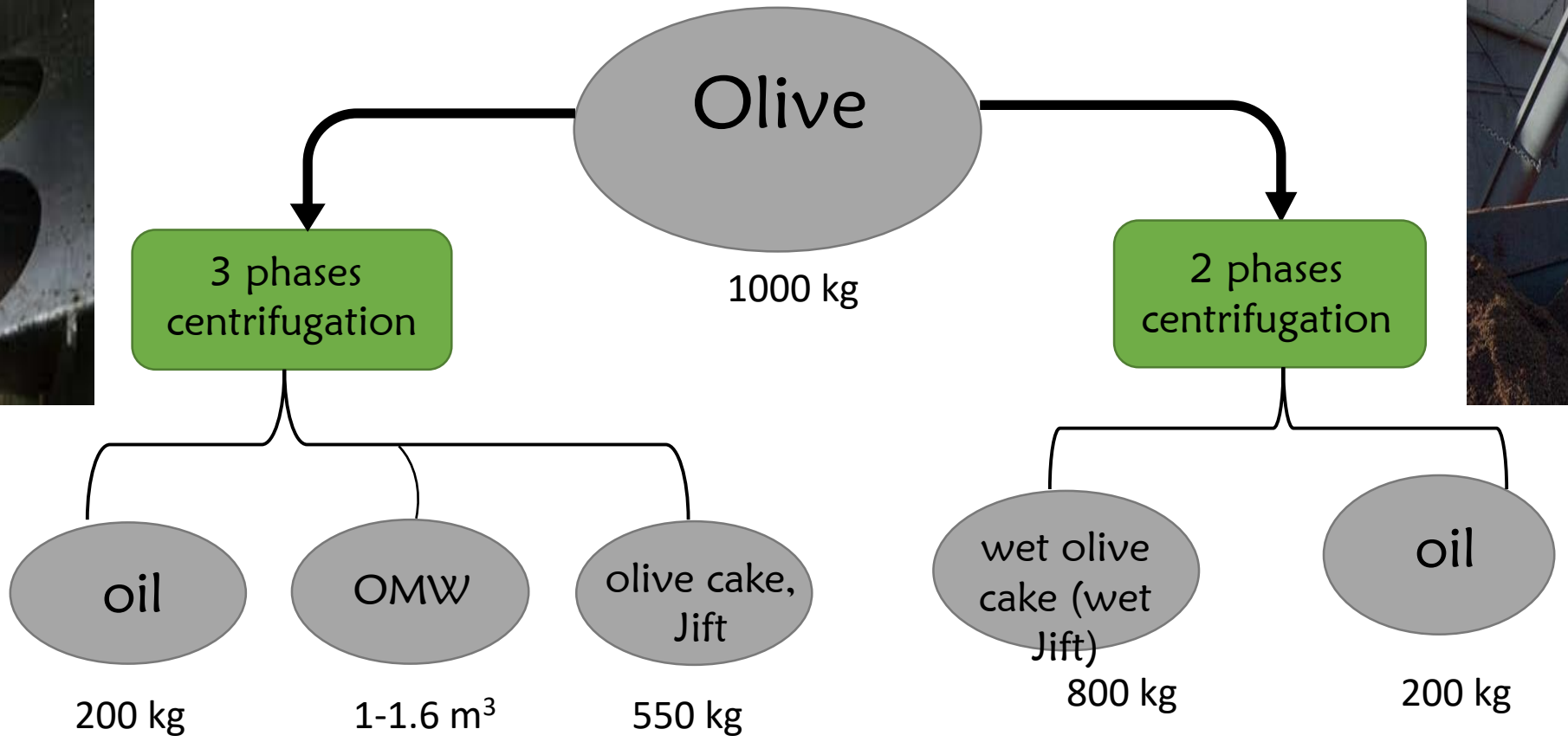
Olive oil extraction syster



OMW: Olive Mill Wastewater

Olive Mill Wastewater (OMW)
Current situation

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In Israel:

- 140 olive mills – 80% three phase system
- 150,000 m^3/year OMW.
- 30,000 tons "Jift" OMSW wet.
- 12,000 "Jift" OMSW dry .

World wide:

- Two phase system - 30 million tons of solids and liquid waste.
- Three phase system - 15 million m^3/year of OMW.

OMW – A Pollutant!

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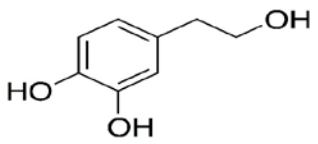
Sample	pH	COD (gr O_2/l)		TP (gr/l) eq to Caffeic acid
		Total	Soluble	
OMW	4.5 – 5.5	90 - 220	50 - 150	3.0-15

It can pollute water bodies and the environment because of its composition:

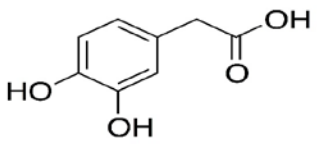
- High BOD (up to 50 g/l) and COD (up to 200 g/l).
- Low pH (≤5).
- High EC (7-11 dS/m) and ion content (mostly K).
- High phenolic content.
- Smell and color.
- Toxic properties for living organisms

Structures of some bioactive phenols and phenolic glycosides in OMW



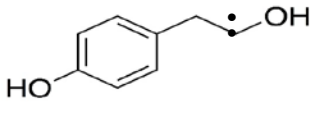
Hydroxytyrosol (HT)

1



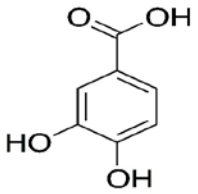
3,4-dihydroxyphenylacetic acid

2



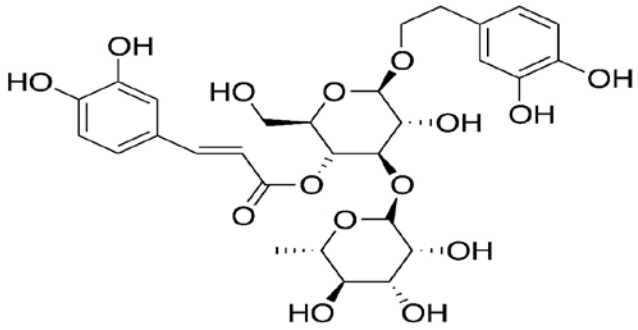
Tyrosol

3



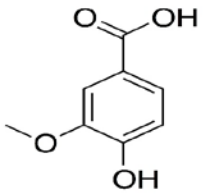
Protocatechuic acid

4



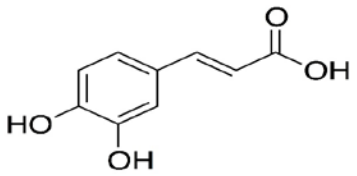
Verbascoside

5



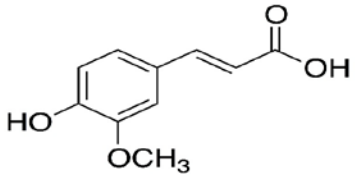
Vanilic acid

6



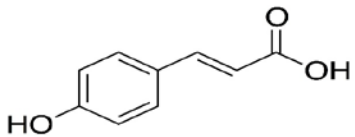
Caffeic acid

7



Ferulic acid

8



p-coumaric acid

9

OMW from a pollutant to a resource

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- For a long time, OMW has been regarded as a hazardous waste with negative impact on the environment.

- However, this view is changing, and the potential of OMW to become a starting material, rich in bioactive compounds, is being recognized.

- In particular, polyphenols, abundant in OMW, are natural antioxidants for the food and pharmaceutical industries. A number of studies have also shown that polyphenols are effective as antibacterial, antiviral, and antifungal compounds.

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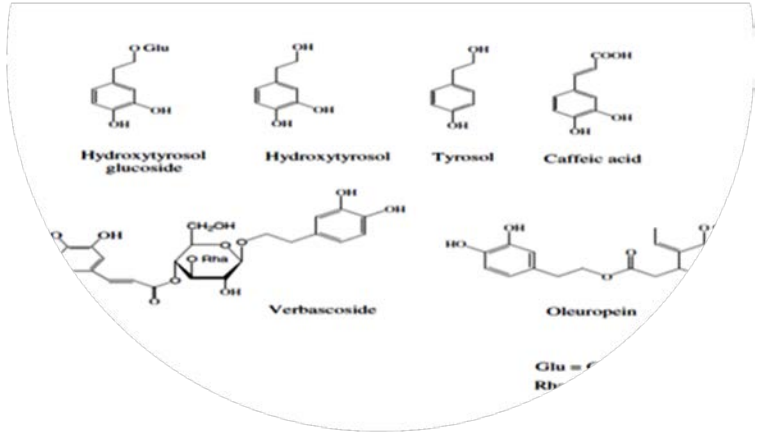
Objective and Aim

The objective and aim of the proposed study is to produce, optimize and characterize an organic extract from OMW in order to obtain a prototype product composed of natural materials with high activity to protect the skin from UV rays.



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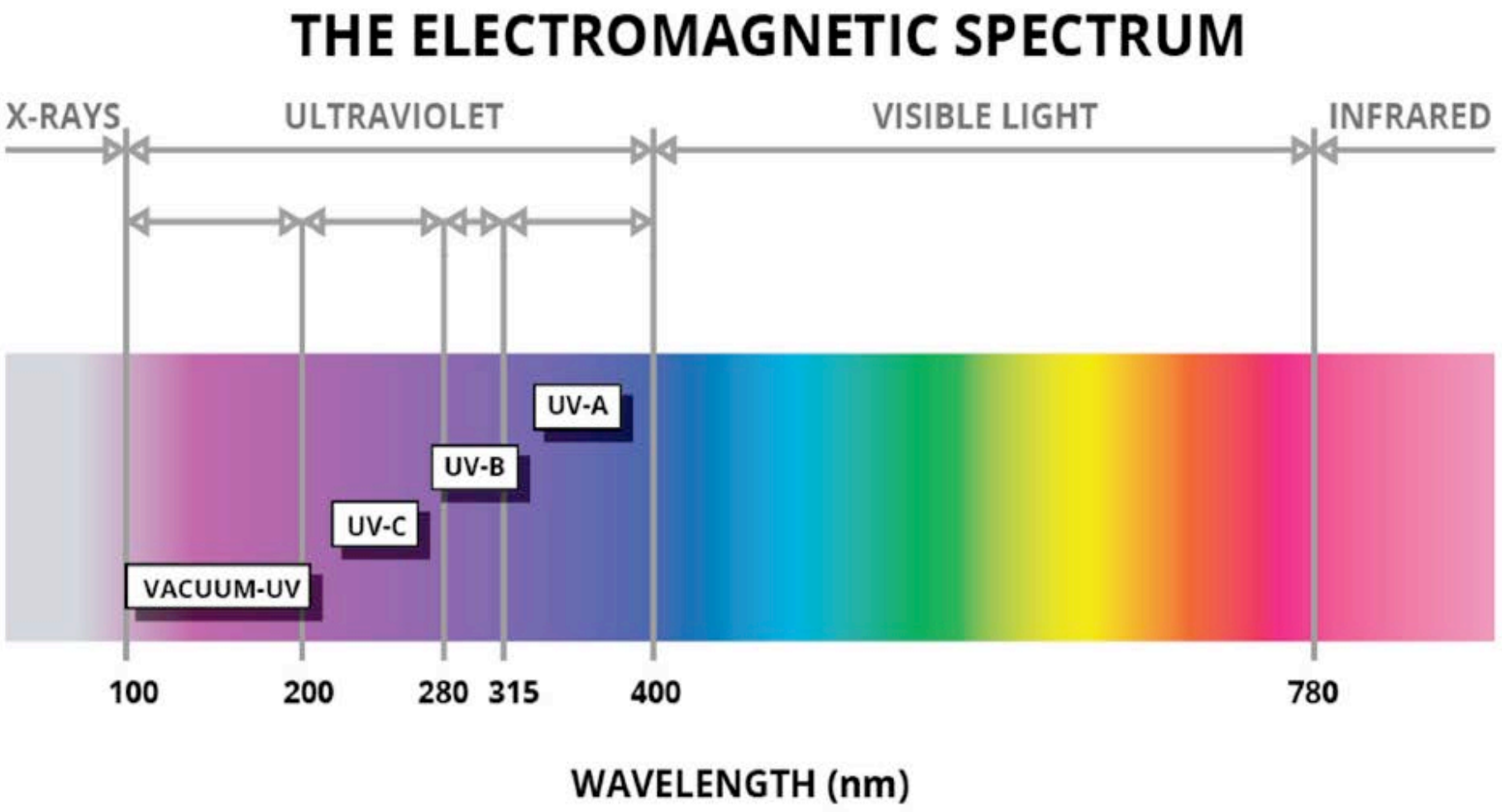

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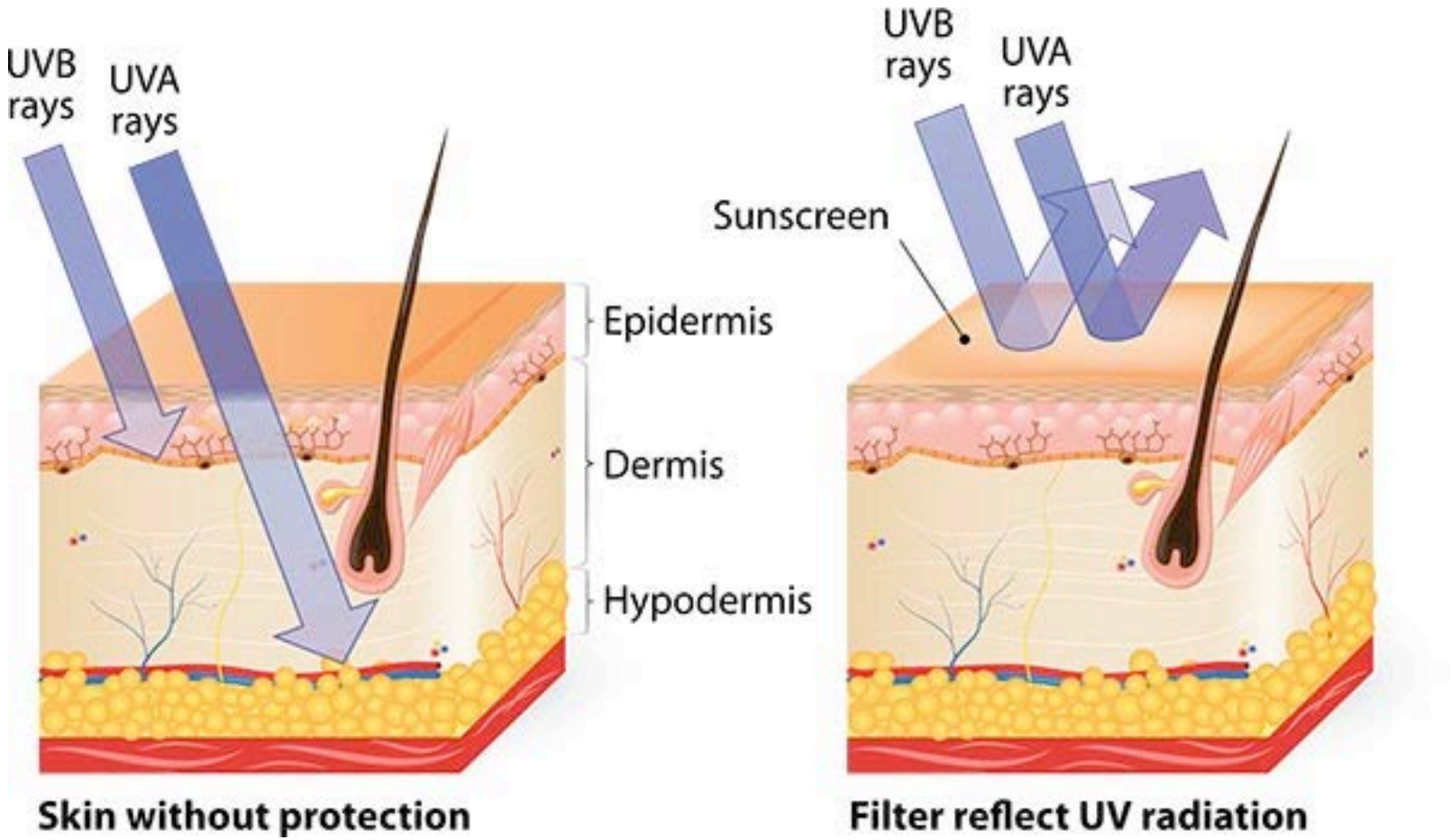
UV penetration into the layers of the skin



King Air magazine

Sun Protection Factor (SPF) and Critical Wavelength (CW)

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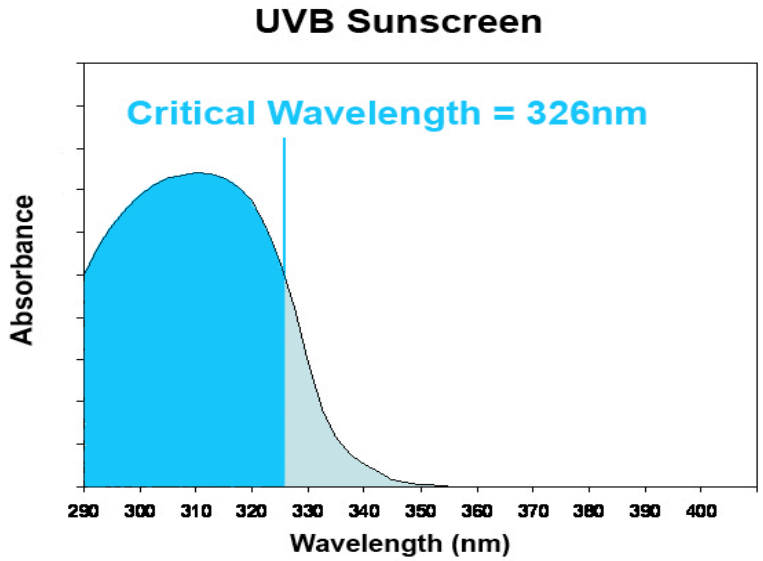
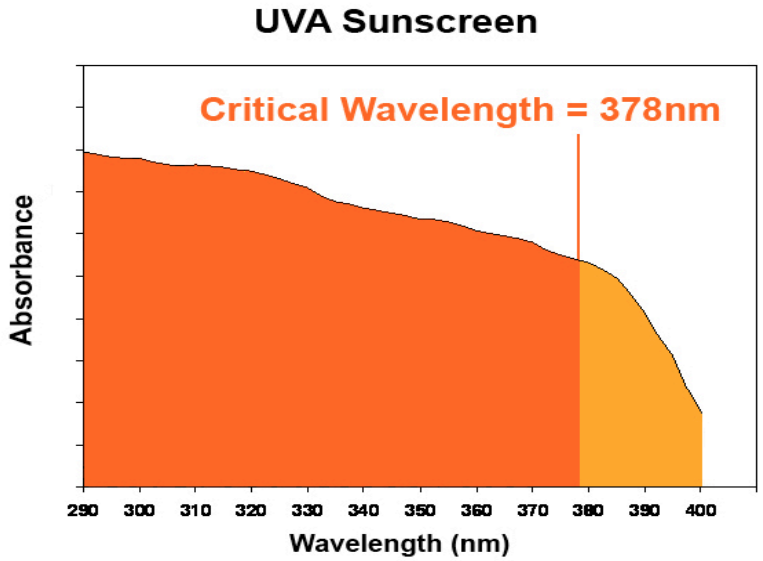
SPF: is a relative value of how long a sunscreen will protect us from UVB rays relatively to a non protected skin (Mansur, J.S; et al 1986).

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

CW: The "Critical Wavelength" (λc) is the wavelength below which 90% of the area under the absorbance curve resides (COLIPA).

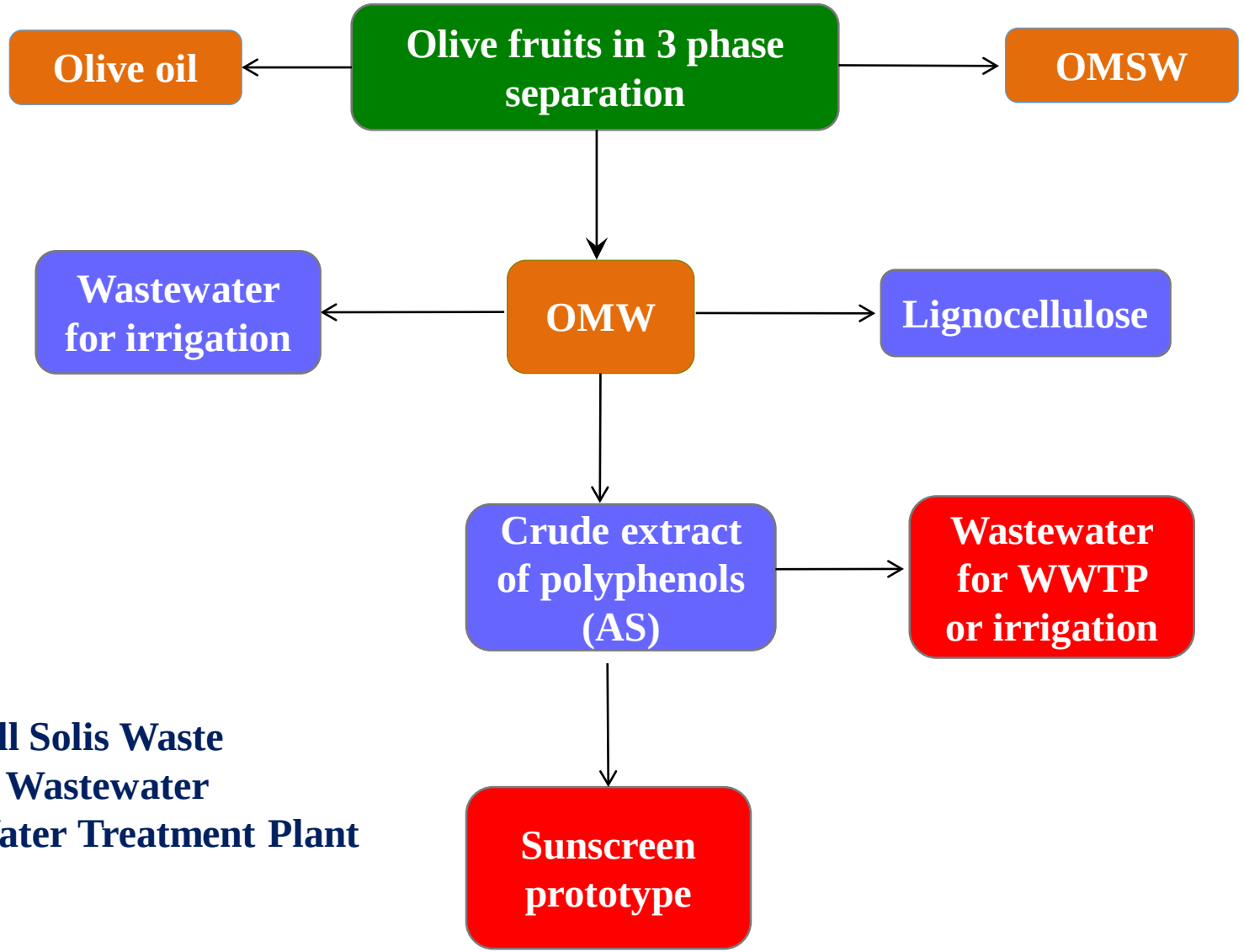
$$\int_{290}^{\lambda_{CW}} Abs(\lambda) \times d(\lambda) = 0.9 \int_{290}^{400} Abs(\lambda) \times d(\lambda)$$





COSMETIC & PLASTIC SURGERY SPECIALISTS
Dr. Ken Dembny • Dr. Larry Starkin

Work Plan



OMSW: Olive Mill Solis Waste
OMW: Olive Mill Wastewater
WWTP: Waste Water Treatment Plant
AS: Antisolvent

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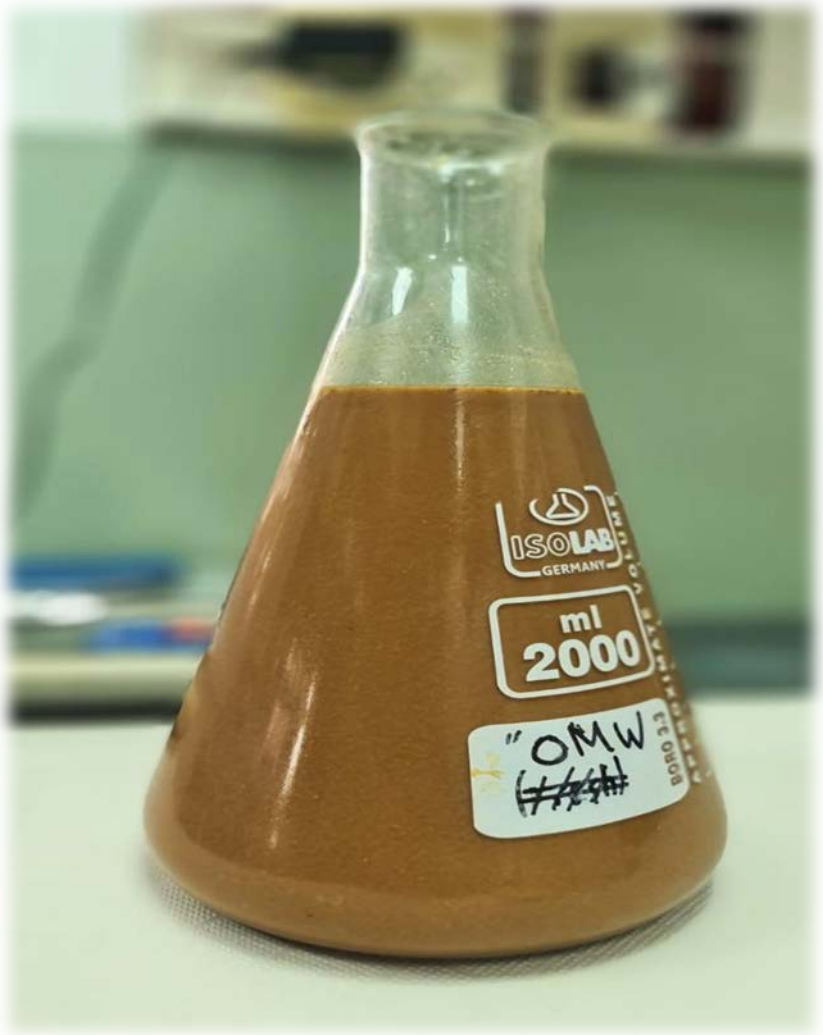

OMW

After Centrifuge

Sieving (106MIC) – solid phase removal

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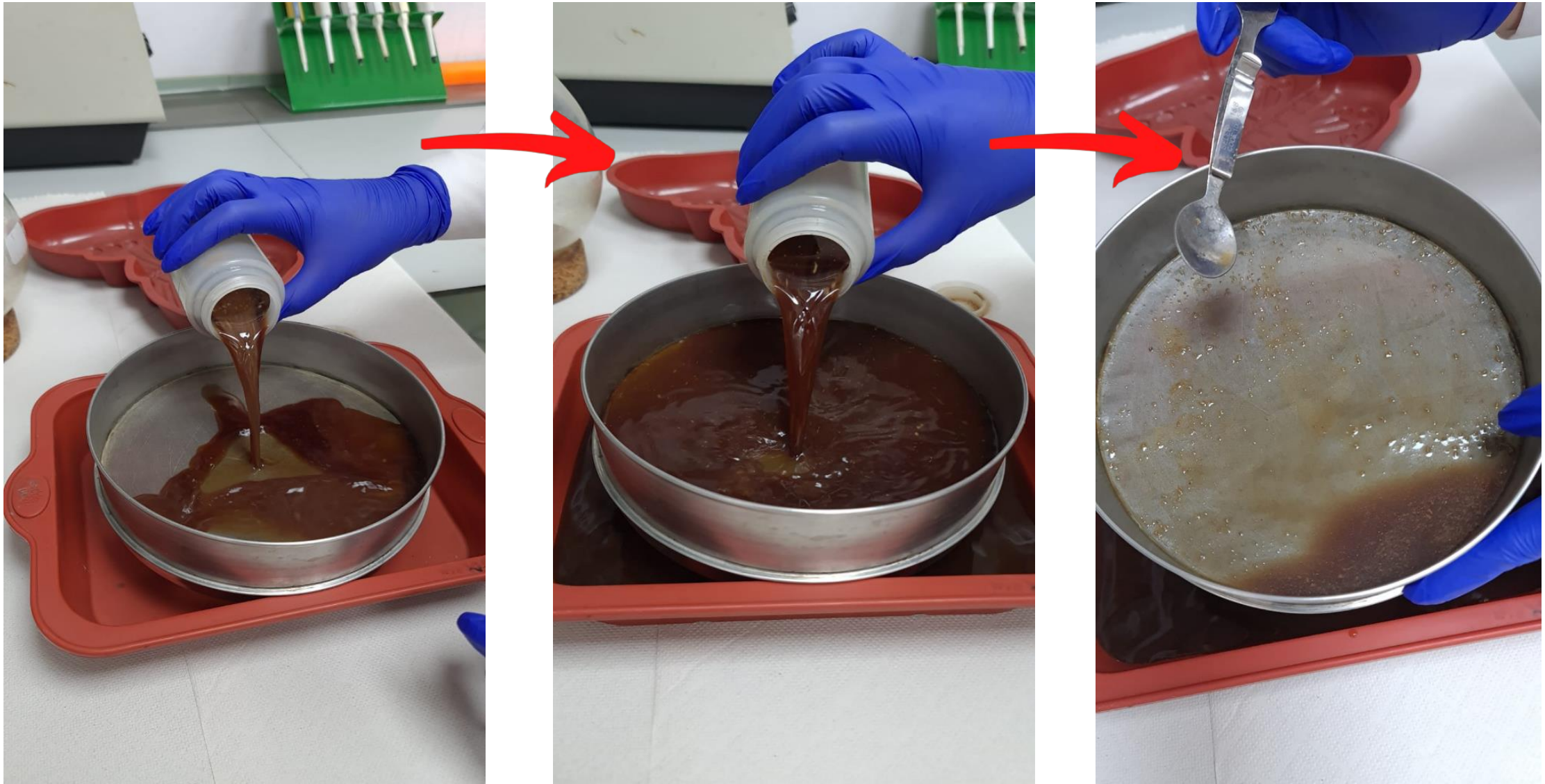
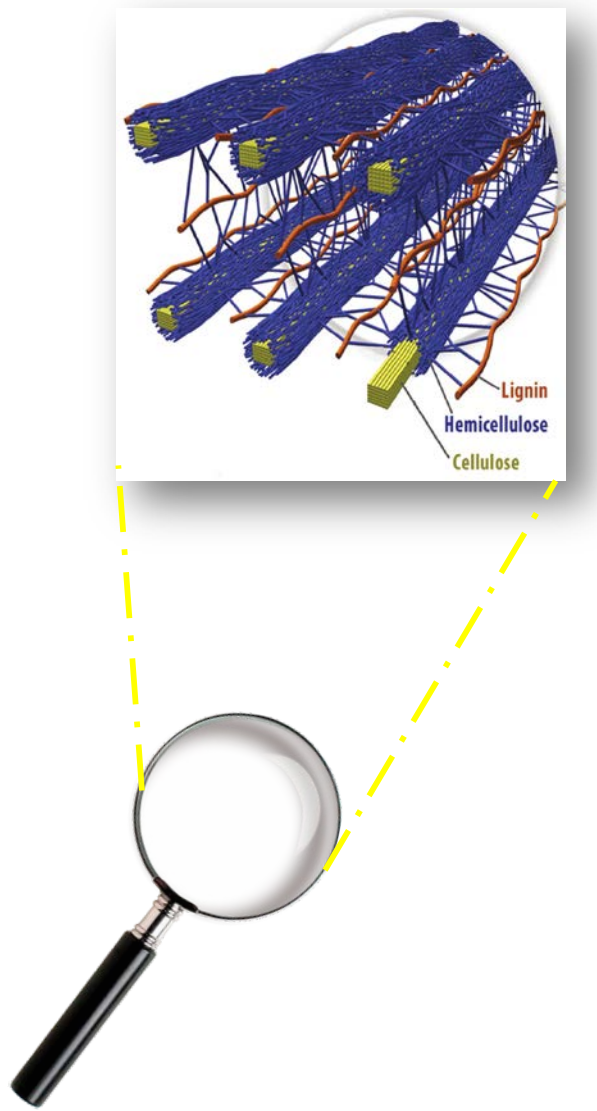


Removal of unwanted solids



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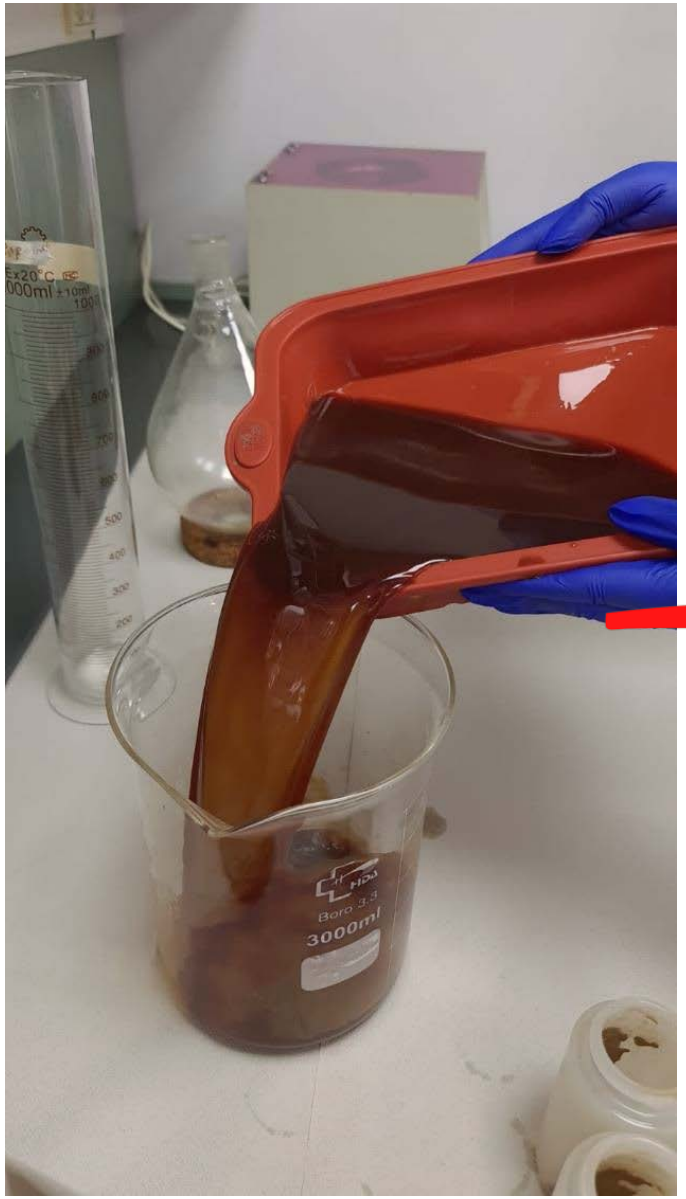
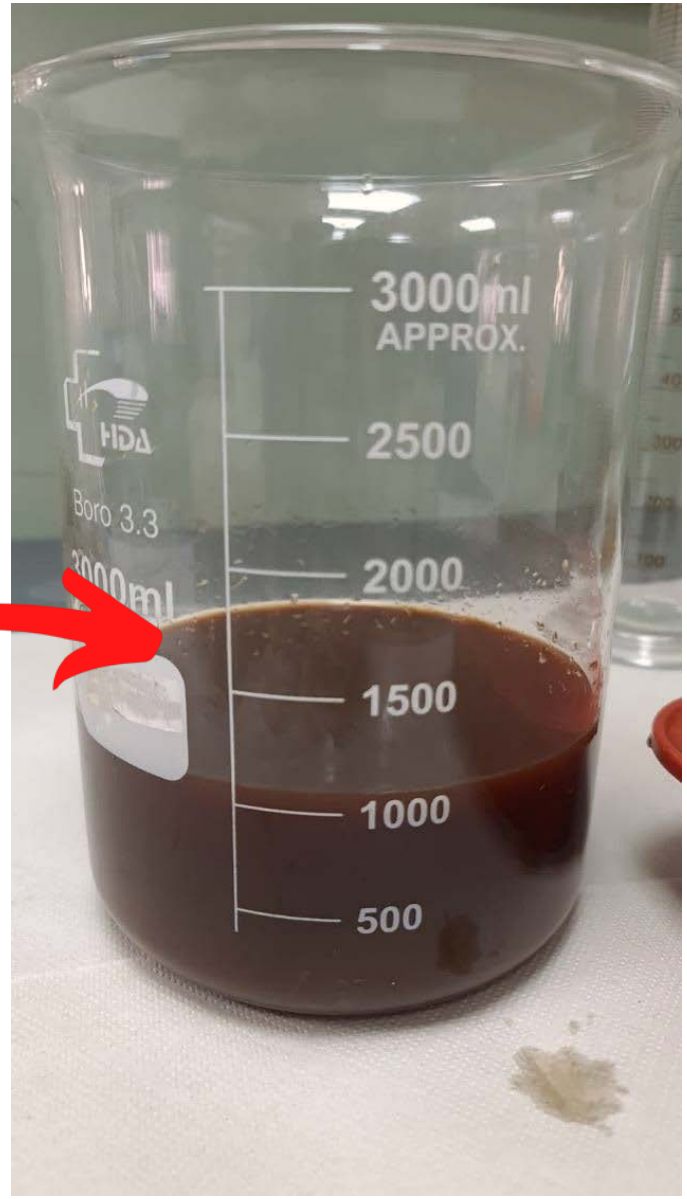




Measuring volume

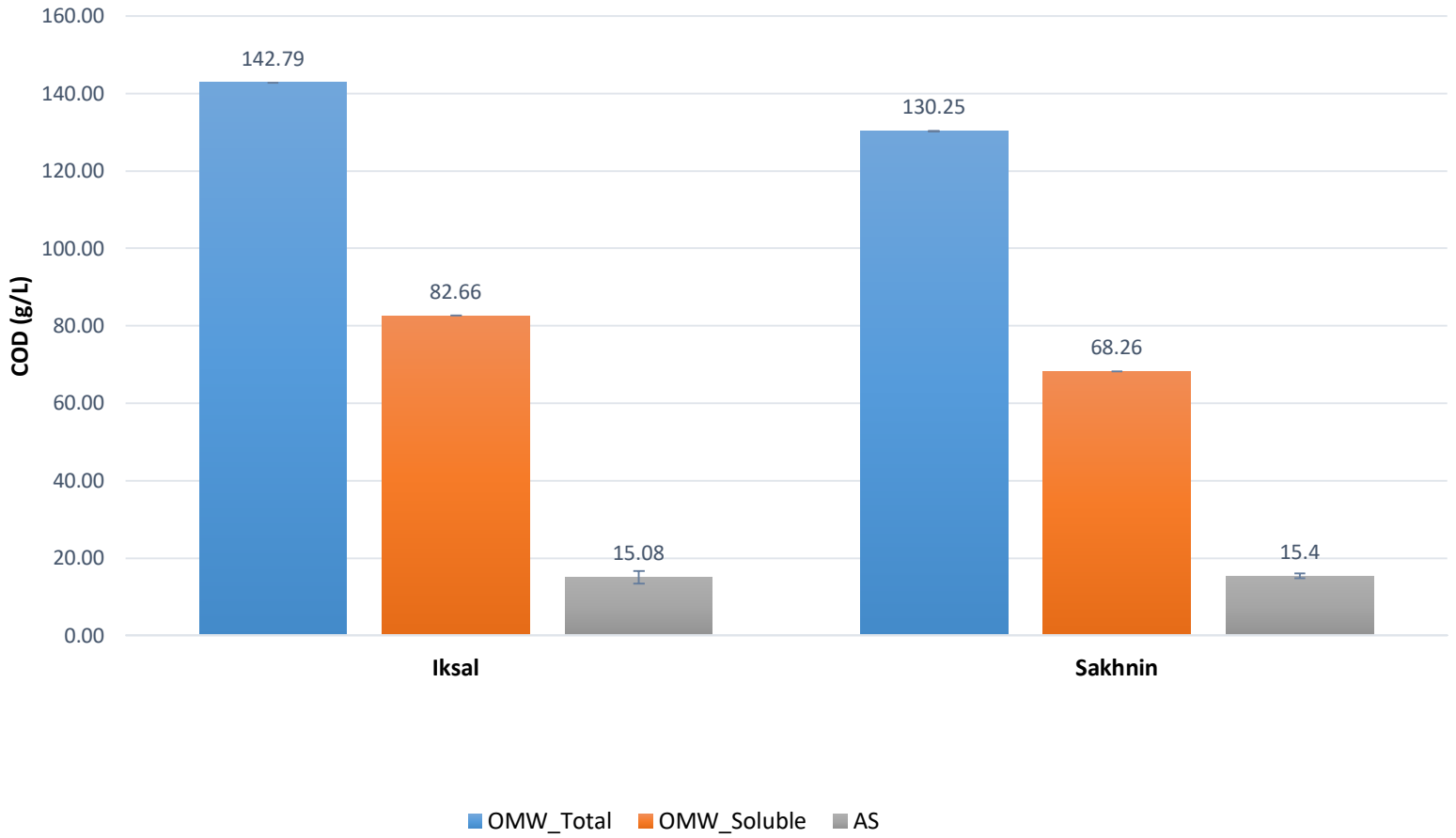
1200ml OMW

↓

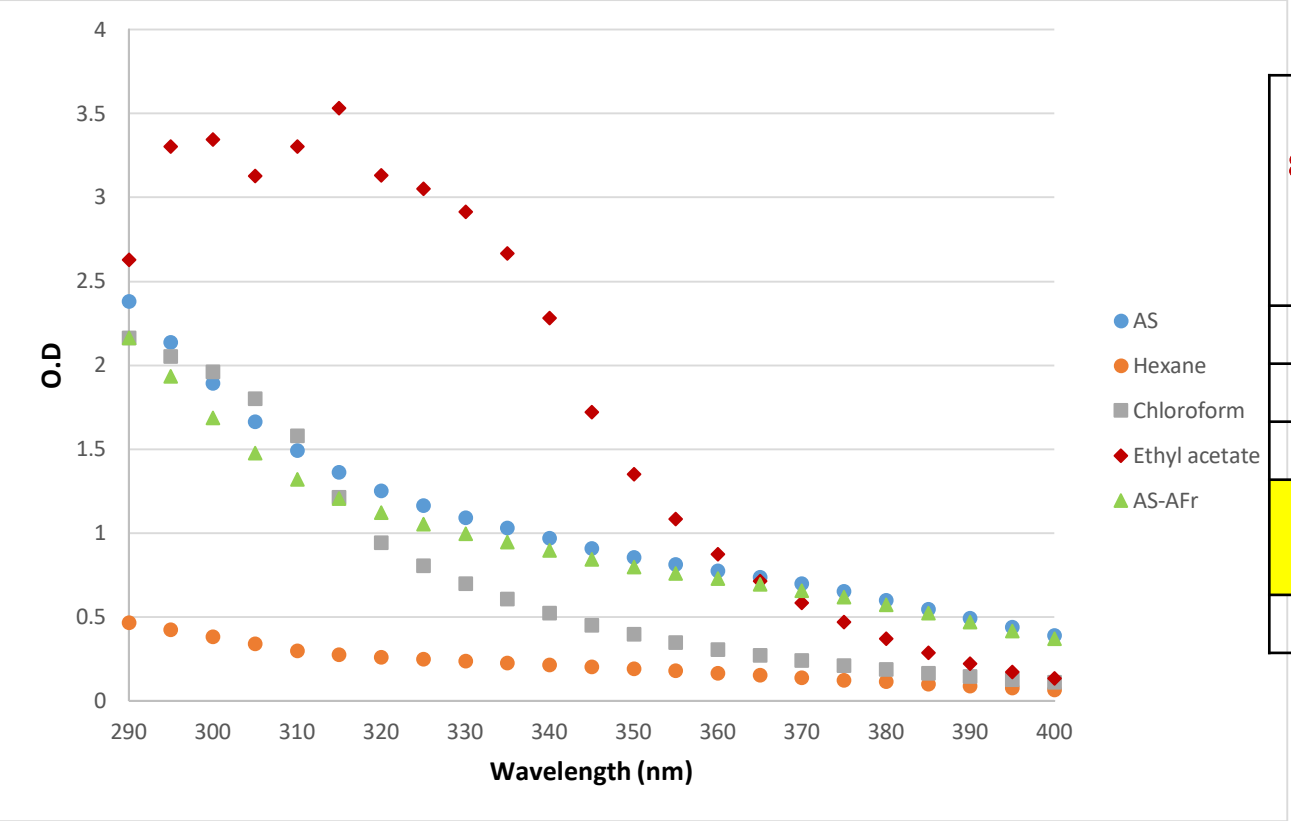
VOAC= 1050ml

Results

COD reduction through OMW treatment

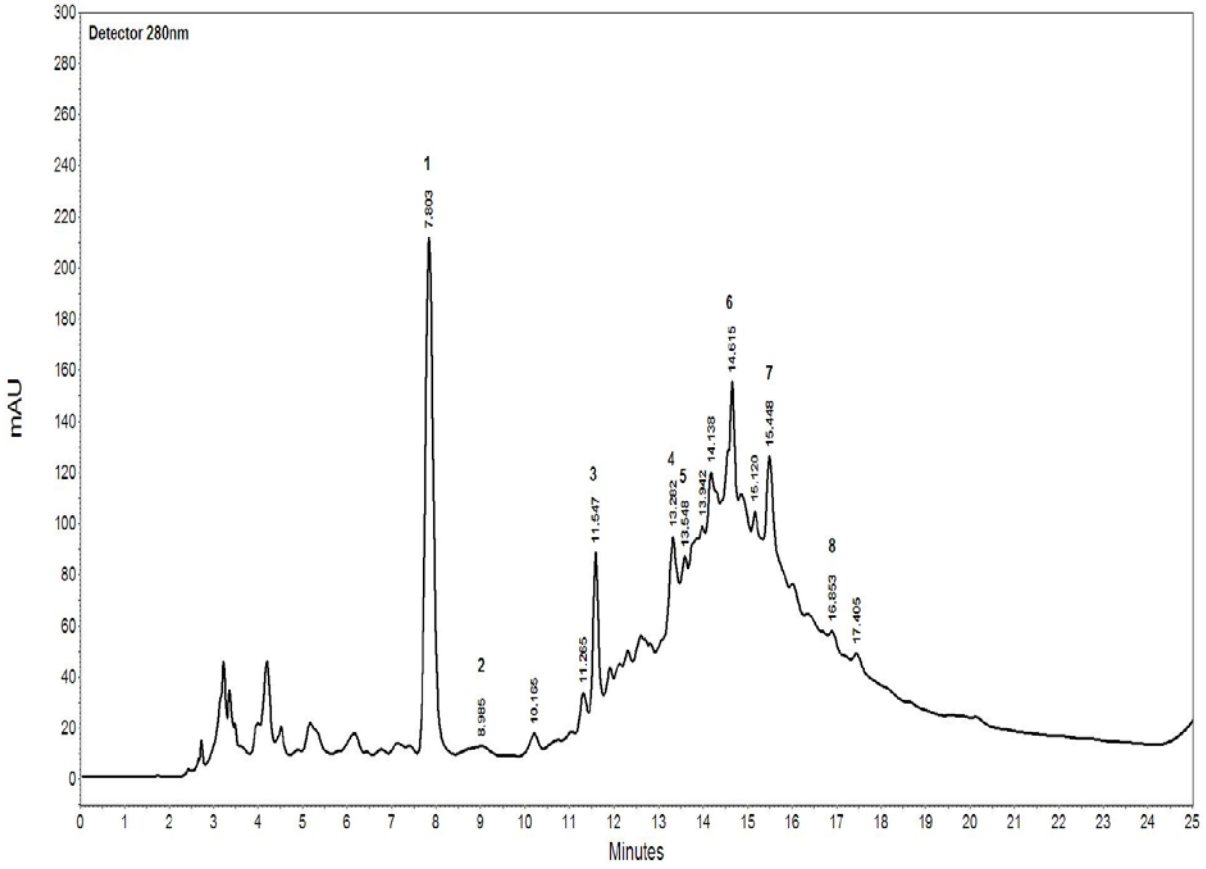


UV activity of the fractions obtained by Fractionation Guided Assay (FGA)

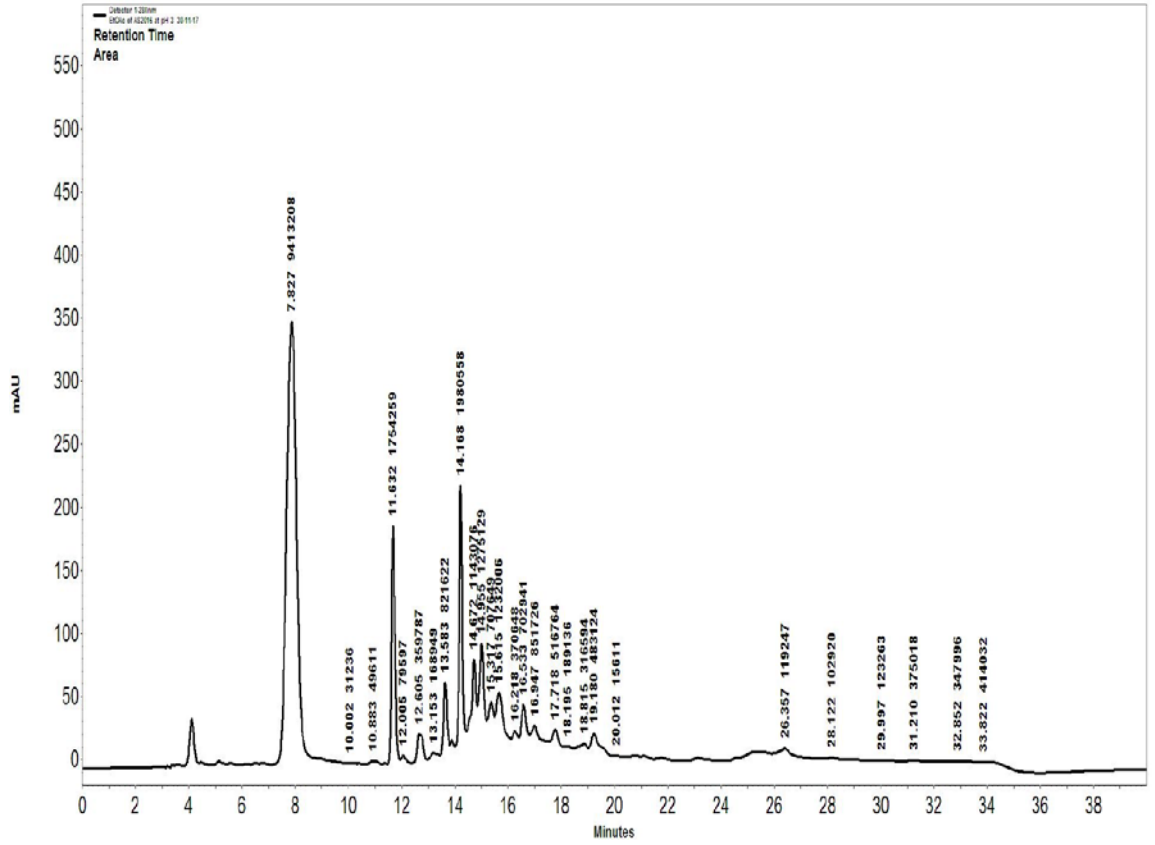


Fraction 800 ppm	SPF ± 3std	CW±3std	TP±3*std* [mg/l] eq to Caffeic acid	Sugars ±3std [mg/l] eq to D-(+)-Glucose
AS	11.27 ± 0.70	375 ± 0.00	68.82 ± 0.95	152.762 ± 0.040
Hex Ext	3.48 ± 0	320 ± 3.54	10.74 ± 1.90	ND
CLF Ext	12.23 ± 0.23	355 ± 3.54	80.98 ± 0.22	ND
EtOAc Ext	35.72 ± 0.79	360 ± 7.07	350.46 ± 1.68	86.452 ± 0.019
AS_AFr	10.53 ± 0.29	380 ± 0.00	57.68 ± 0.22	139.682 ± 0.032

HPLC of AS and EtOAc fractions



HPLC chromatogram of AS extract at a concentration of 1000 ppm



HPLC chromatogram of EtOAc fraction of AS at a concentration of 1000 ppm

How to increase CW values? Adsorbent Resins

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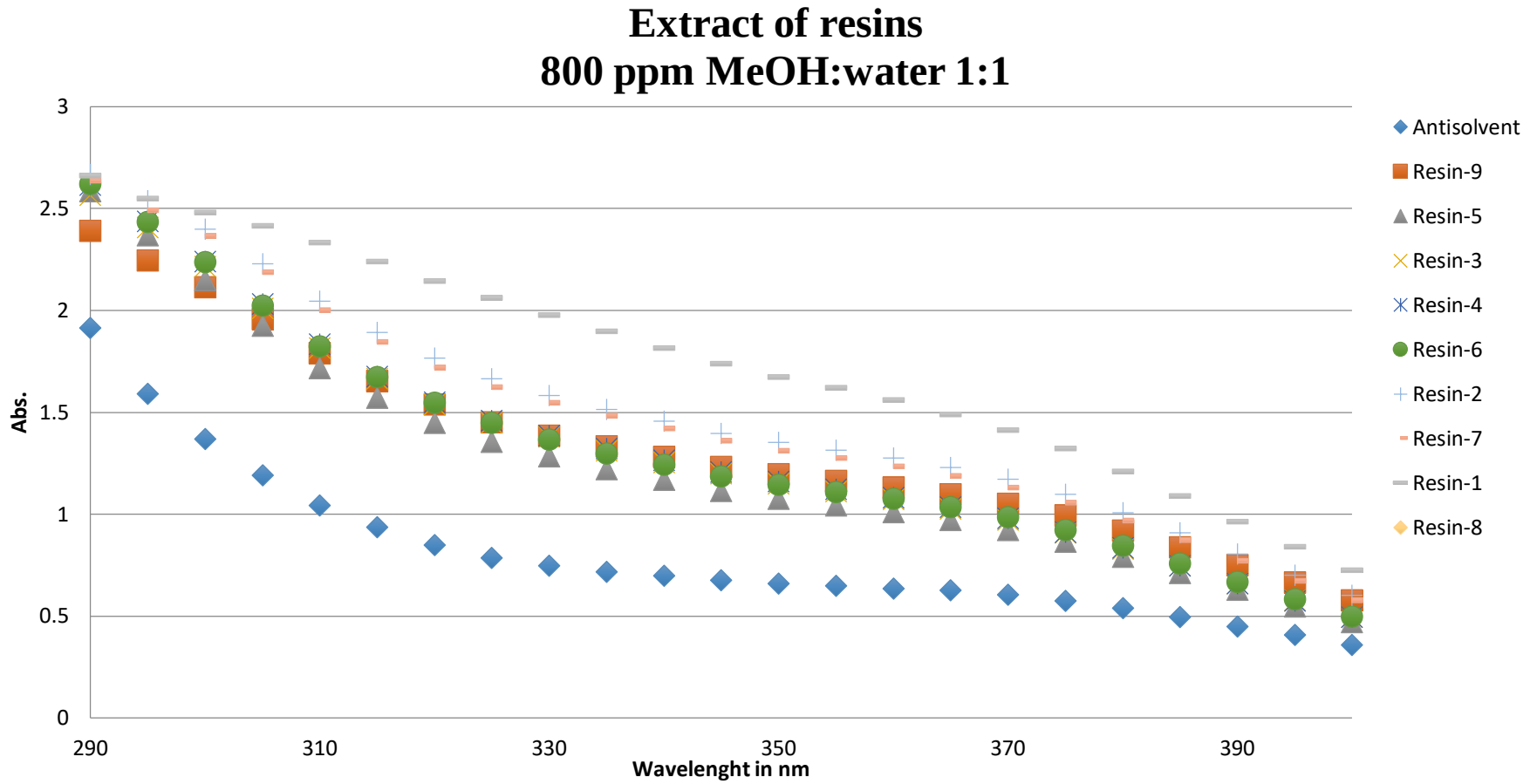
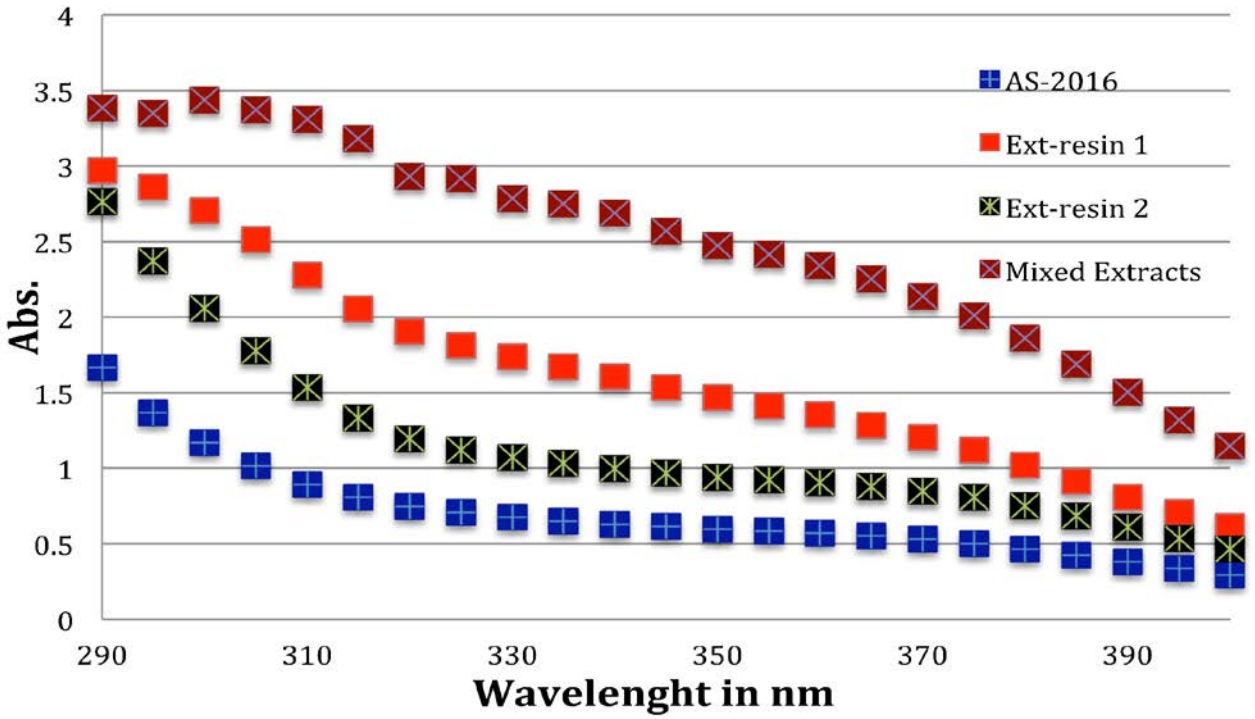
UV absorption curves of the Antisolvent extracts adsorbed to various resins



UV activity of the resins' extracts in comparison to Antisolvent



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AS	11.27 ± 0.70	378 ± 1.15	68.82 ± 0.95	146.27 ± 20
Ext-resin 1	26.83 ± 2.30	377 ± 0.57	105.39 ± 23.55	146.30 ± 11.78
Ext - resin 2	18.78 ± 0.51	377 ± 1.10	75.28 ± 17.95	122.05 ± 36.16
Mixed Ext 1+2	31.21 ± 2.32	382 ± 1.50	189.27 ± 45.71	293.3 ± 47.84

Sample	Amount
OMW	1 L
AS	35 gr
Ext-resin 1	4.88 gr
Ext-resin 2	4.22 gr
Mixed Ext 1+2	9 gr

SPF and CW of FGA extracts versos resins

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AS	11.27 ± 0.70	375 ± 0.00	68.82 ± 0.95	152.762 ± 0.040
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AS_AFr	10.53 ± 0.29	380 ± 0.00	57.68 ± 0.22	139.682 ± 0.032

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Conclusions:

- ❖ Polyphenols in OMWW are responsible for the SPF values and active against UVB radiation, while phenolic glycosides in OMWW are active against UVA radiation and responsible for the CW values.

- ❖ The fractions obtained from FGA process are active against UVB rays only and they could no longer be considered as broad spectrum.

- ❖ Adsorbent resins were a breakthrough in this research because they could adsorb phenols and phenolic glycosides from Antisolvent fraction, with impressive values (SPF > 30 and CW > 380).

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Thank you for your attention

Properties of resins

Resin	Resin 1	Resin 2
Matrix type	acrylate-divinylbenzene	styrene-divinylbenzene
Particle size	20-60 mesh	20-60 mesh
Pore size	0.5 ml/g pore volume 300-400 Å mean pore size	0.55 ml/g pore volume 200 Å mean pore size
Surface area	380 m^2/g	800 m^2/g

The interaction between the resins and the extract:

Hydrogen bonds*

Hydrophobic interactions*

$\pi - \pi$ bonding*