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ULTRASONICALLY-EXTRACTED MARINE POLYSACCHARIDES AS POTENTIAL GREEN ANTIOXIDANT ALTERNATIVES

By

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under supervision

of

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Chaired by PROF. DR. TAKAYOSHI KOBAYASHI

applied sciences

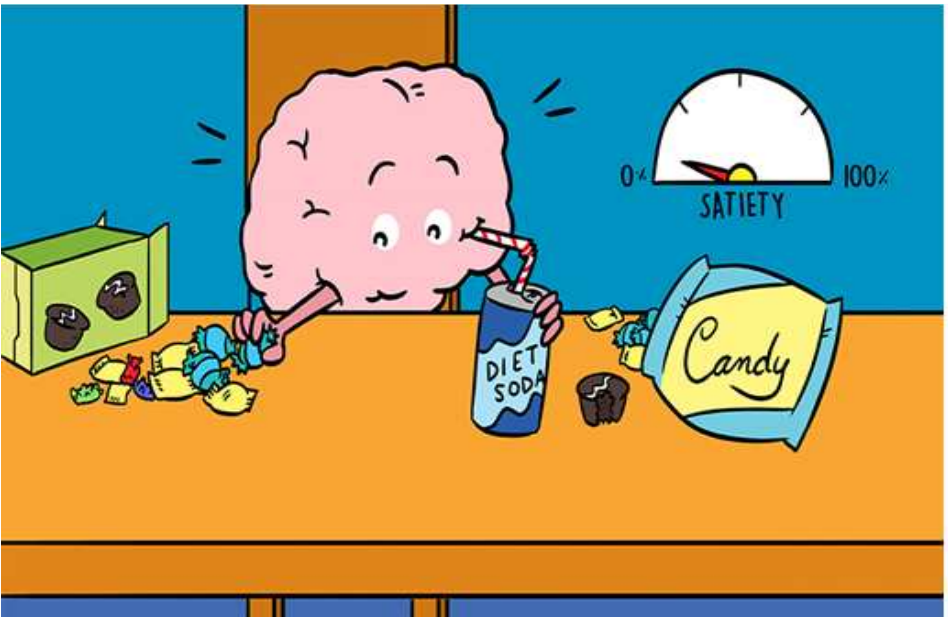
MDPI

Outline

- **Background**
- **Aim of work**
- **Methods**
- **Results and Discussion**
- **Conclusion**
- **Future Work**

Background

WHY NATURAL ANTIOXIDANT ALTERNATIVES ?



Sugary drinks

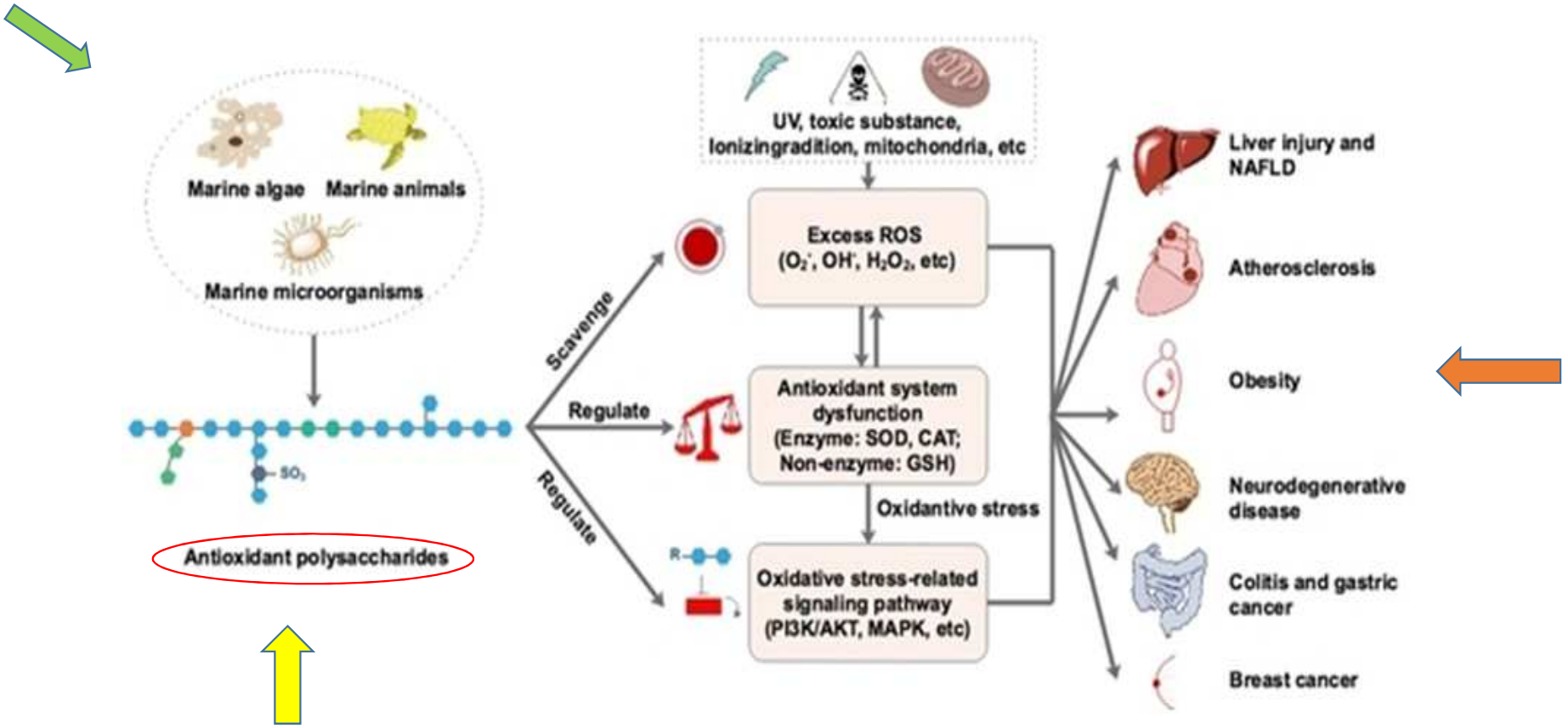
Diabetes

Obesity

Tooth decay

- **https://kids.frontiersin.org/article/10.3389/frym.2019.00051.**
- **https://www.123rf.com/photo_58669218_stock-vector-soda-and-lollipop-bully-tooth-sweets-provoke-dental-caries-concept-vector-illustration.html.**

NATURAL ANTIOXIDANTS



- **Zhong, Q.; Wei, B.; Wang, S.; Ke, S.; Chen, J.; Zhang, H.; Wang, H. The Antioxidant Activity of Polysaccharides Derived from Marine Organisms: An Overview. *Mar. Drugs* 2019, *17*, 674.**

Aim of work

- Investigation of ultrasonic assisted extraction of sulfated polysaccharides (SPs) from the different marine species.
- Chemical characterizations of these extracts.
- Structure elucidation for these extracts based on FTIR spectroscopy.
- Testing these extracts as alternative natural antioxidants using DPPH scavenging free radical test.

Methods

Marine Species

Green algae
U. lactuca

Red algae
J. rubens

Mangroves
A. marina

Extraction (T, t)

H_2O-EtOH

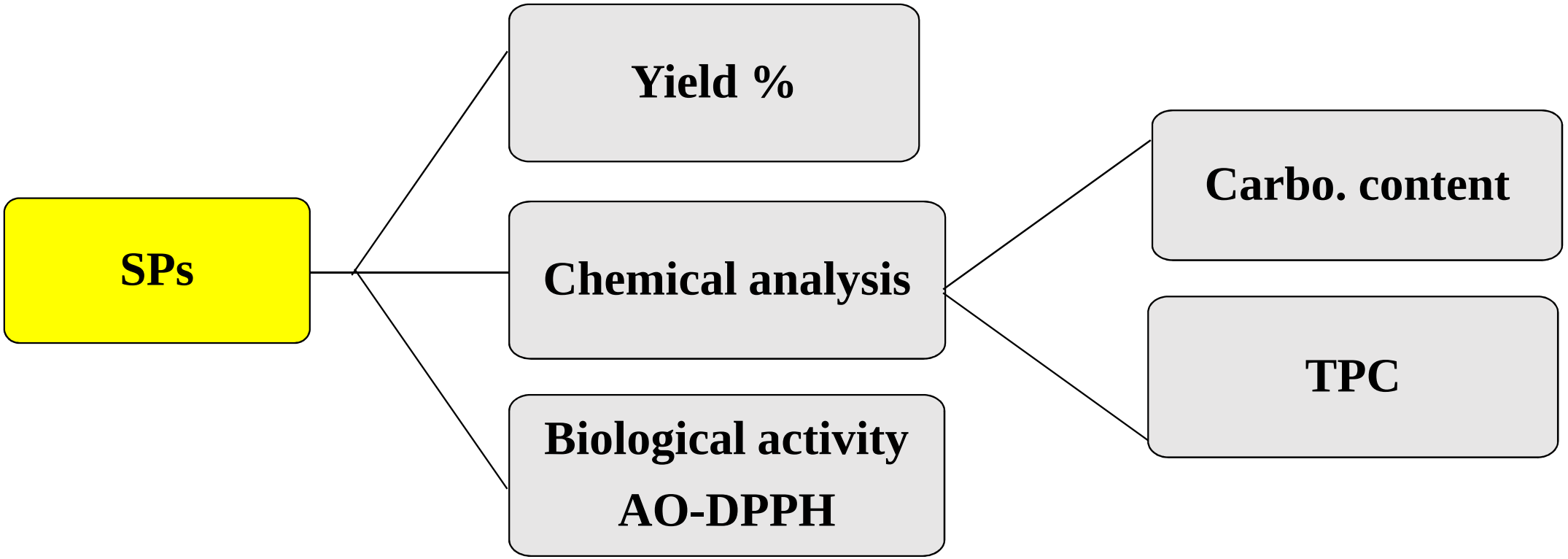
SPs

<u>Conditions</u>

Ulva.US (60°C, 4h)

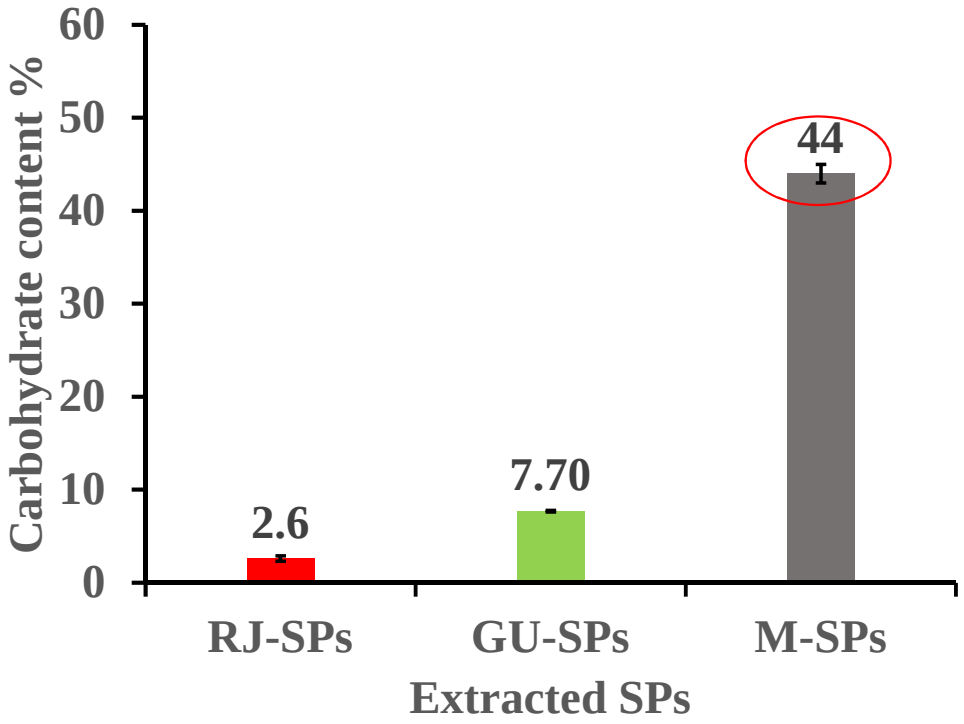
Jania.US (RT, 4h)

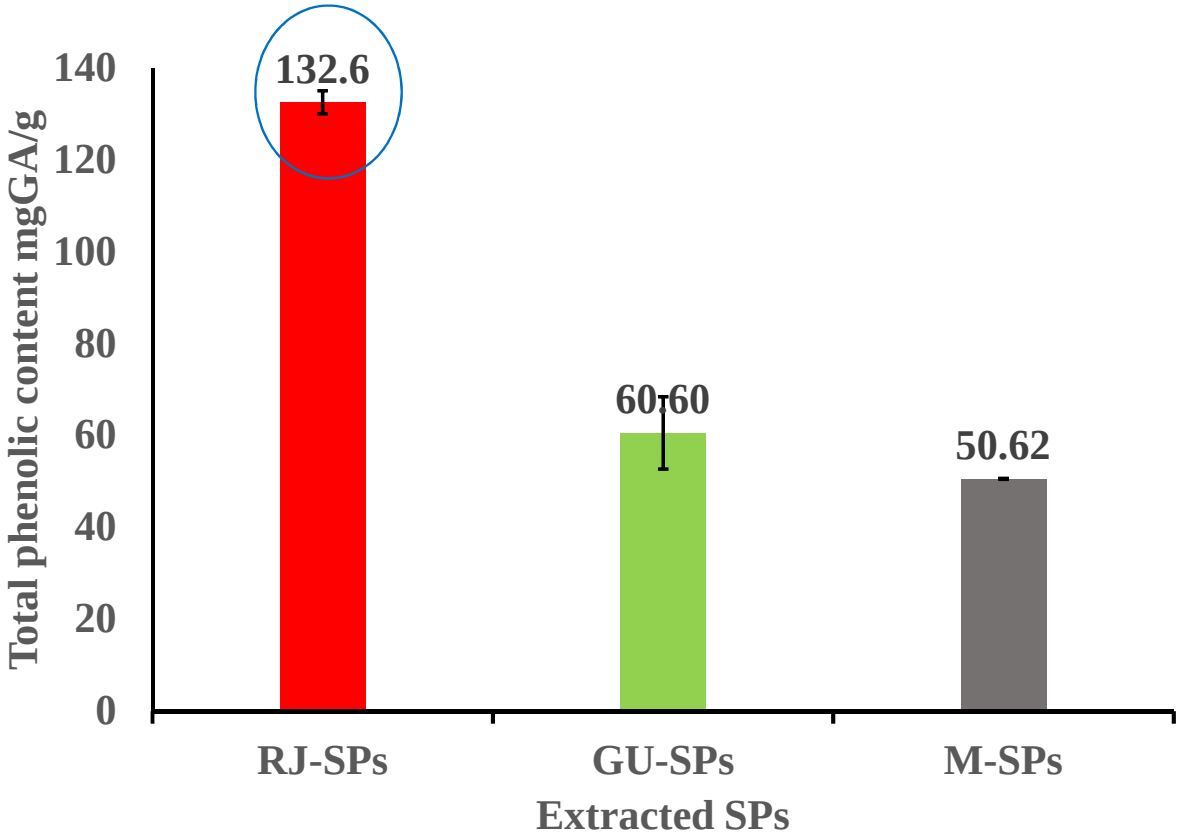
***Avicennia*.US (RT, 0.25h)**


SPs
Yield %
Chemical analysis
Biological activity
AO-DPPH
Carbo. content
TPC

Results and Discussion

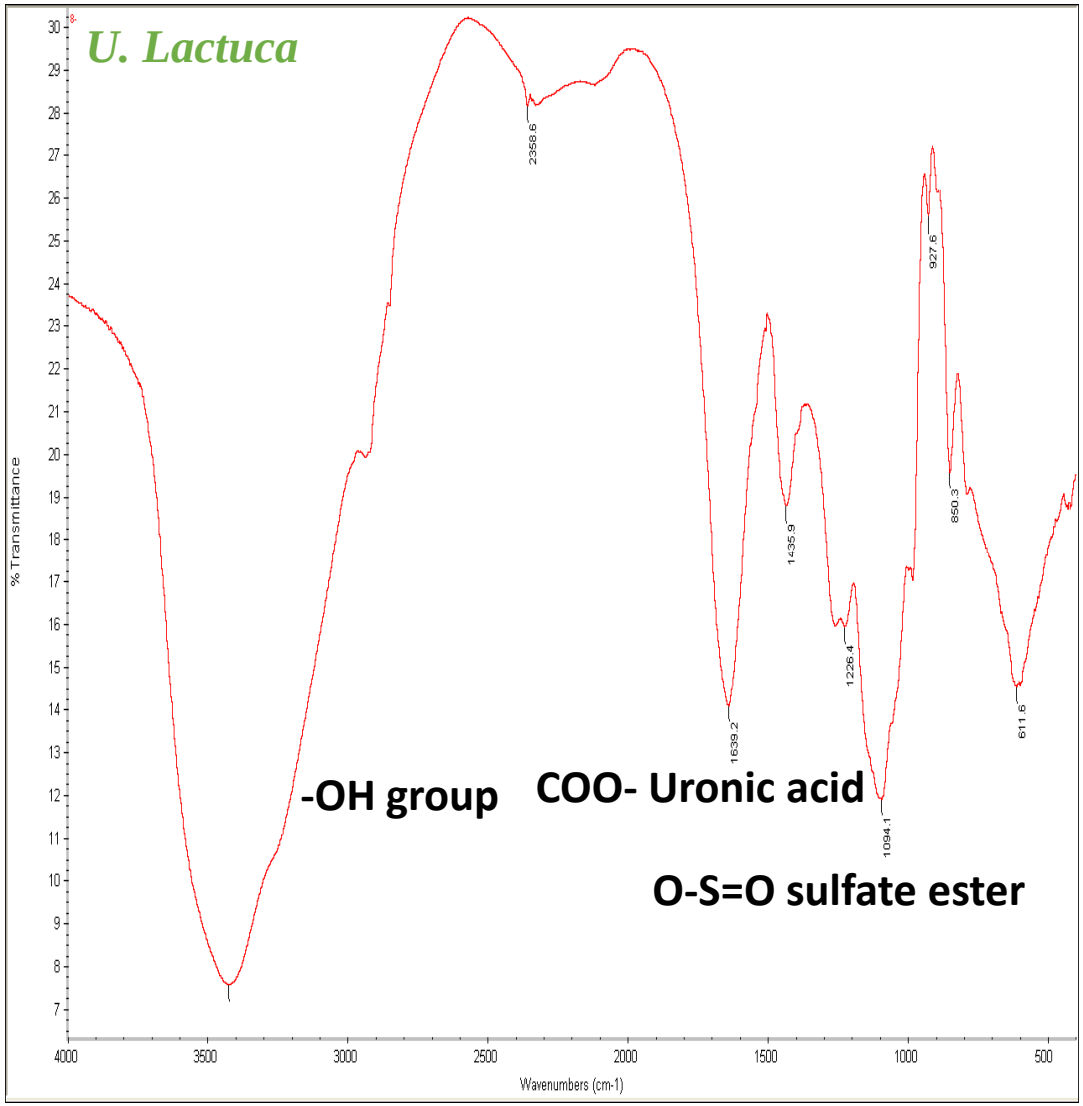
Type of UAE-SPs	Yield %
GU-SPs	5.50 ± 0.25
RJ-SPs	0.36 ± 0.04
M-SPs	3.52 ± 0.94

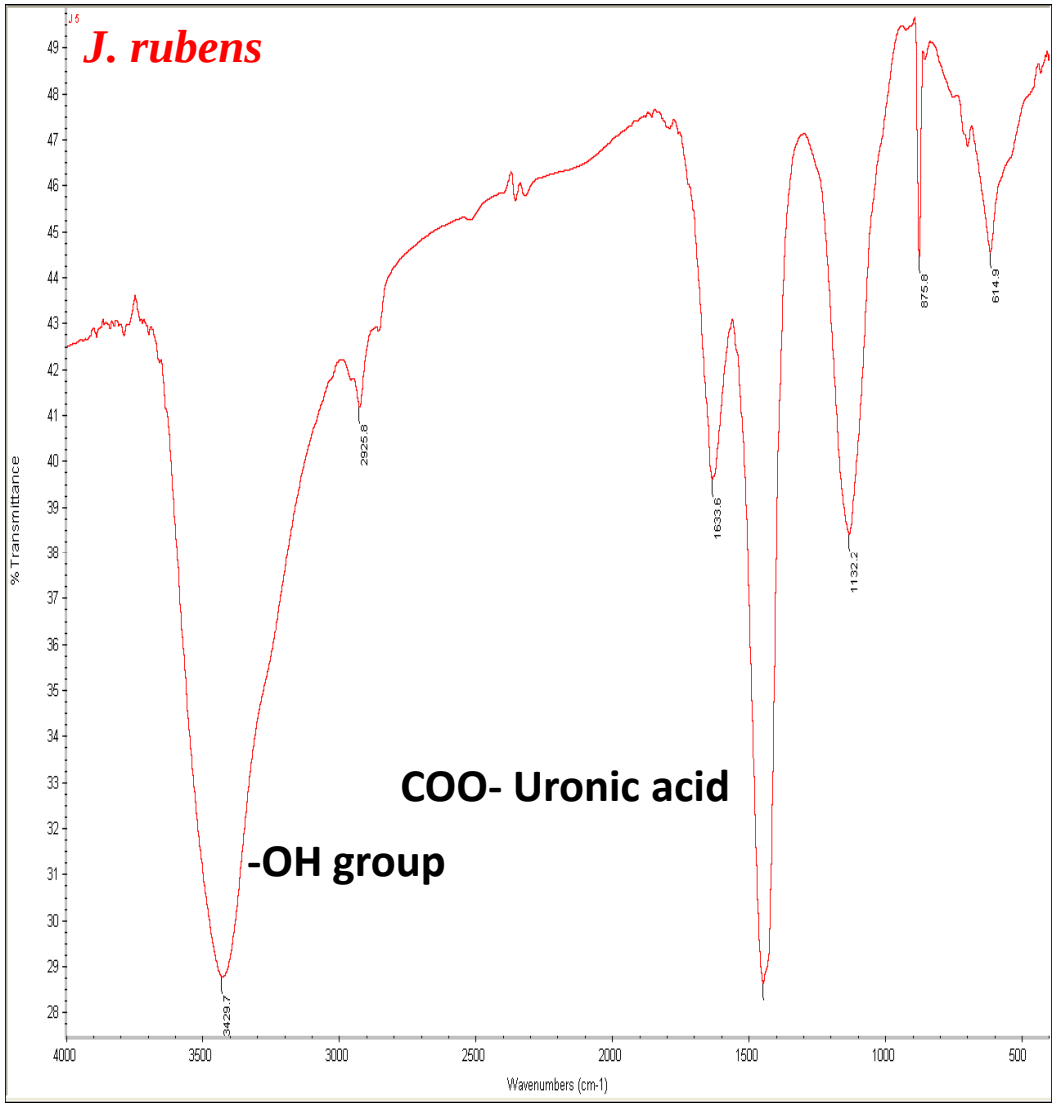


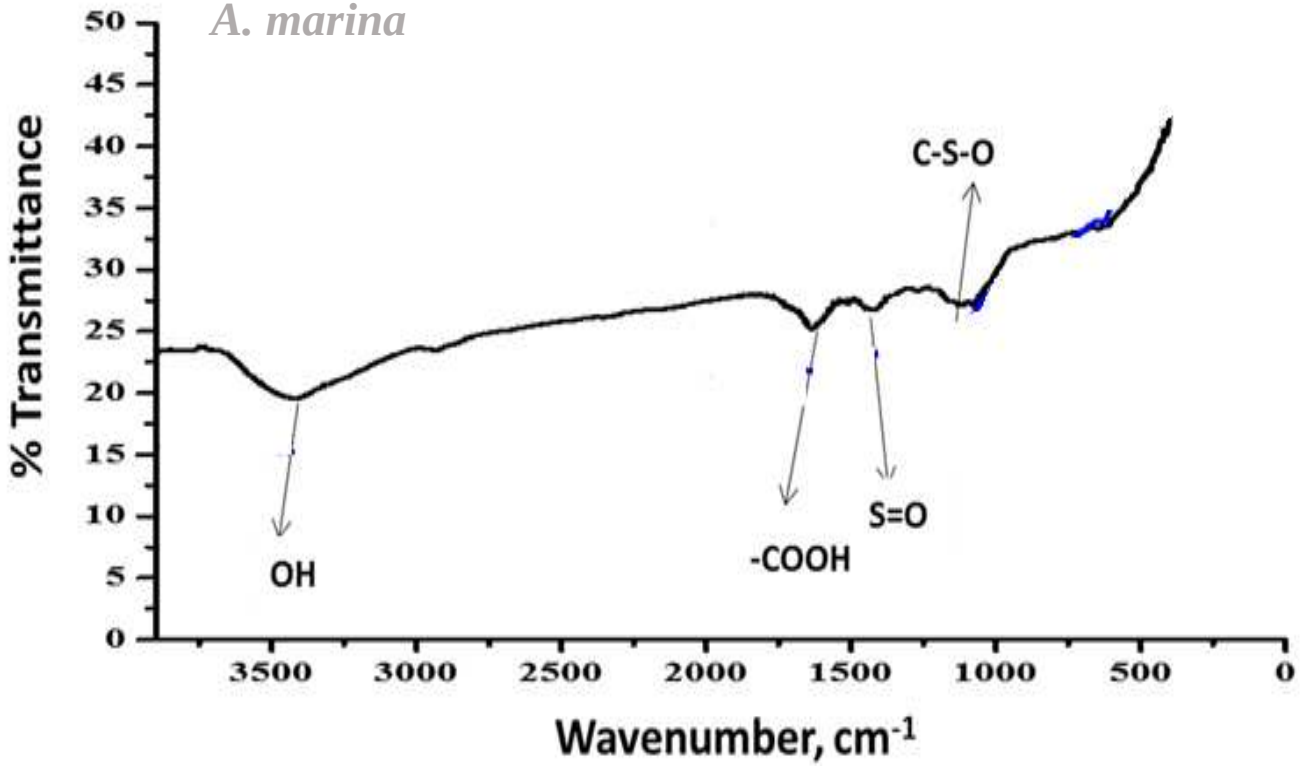

Total phenolic content mgGA/g
140
120
100
80
60
40
20
0
132.6
60.60
50.62
RJ-SPs
GU-SPs
M-SPs
Extracted SPs

Function groups based on FTIR spectra

Wavelength, cm^{-1}	Function groups	RJ-SPs	GU-SPs	M-SPs
3500-3400	OH group	√	√	√
1600-1420	Uronic acid and phenolic groups	√	√	√
1260-1258	Ester Sulfate group	**X**	√	√
1088-1012	Acidic polysaccharide	√	√	√
963-927	Glycosidic linkage	√	√	√
850-845	Galactose sulfate group	√	√	**X**

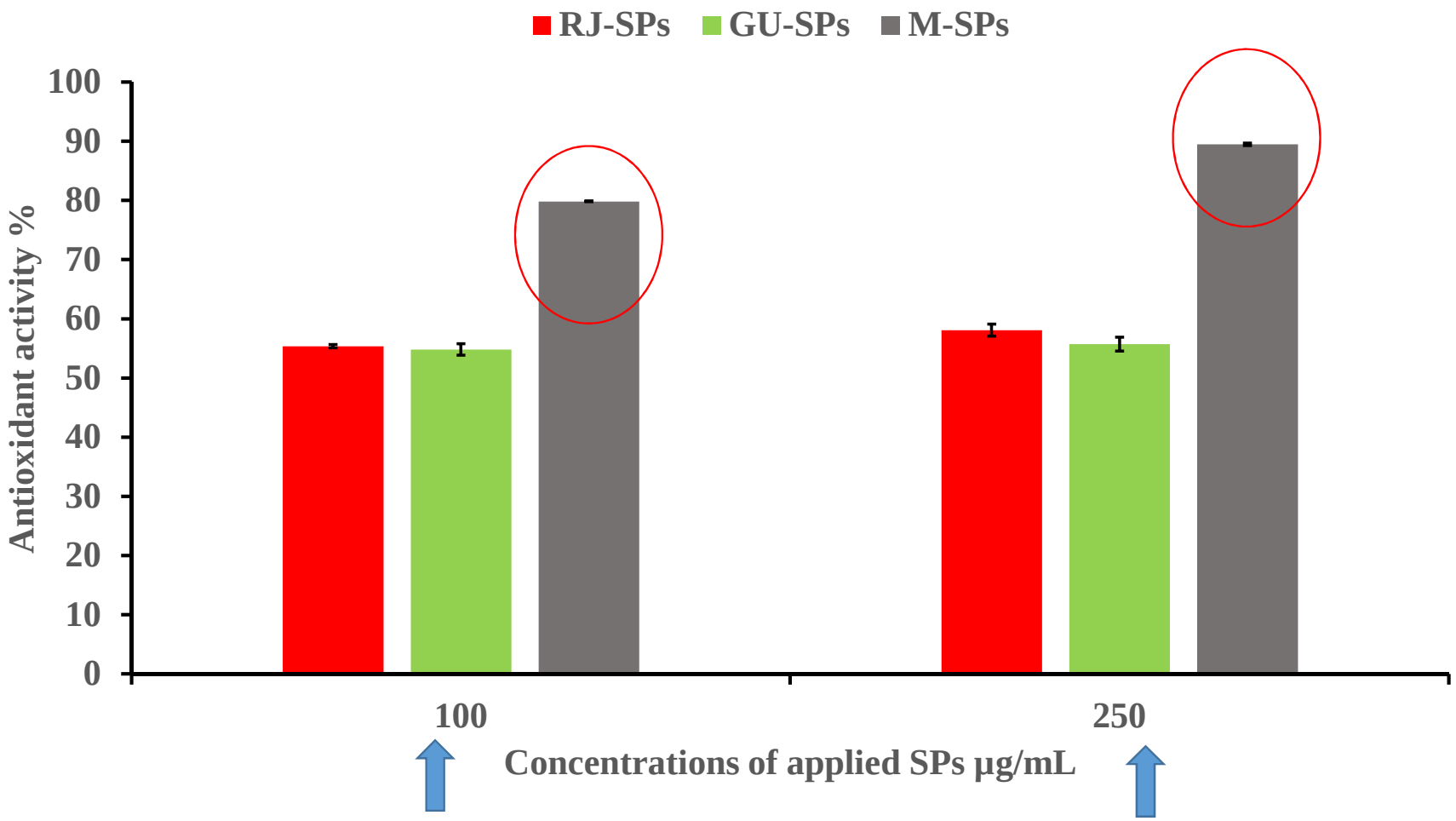

U. Lactuca
% Transmittance
Wavenumbers (cm-1)
2358.6
1639.2
1435.9
1226.4
1094.1
927.6
850.3
611.6
-OH group
COO- Uronic acid
O-S=O sulfate ester


J. rubens
% Transmittance
Wavenumbers (cm-1)
2925.8
1633.6
1132.2
875.8
614.9
3429.7
COO- Uronic acid
-OH group


A. marina
% Transmittance
50
45
40
35
30
25
20
15
10
5
0
3500
3000
2500
2000
1500
1000
500
0
Wavenumber, cm-1
OH
-COOH
S=O
C-S-O

Constituents of sugars by mole%, for RJ-SPs, GU-SPs and M-SPs. Based on HPLC analysis

Types of Monosaccharides	RJ-SPs	GU-SPs	M-SPs
Glucose	94.04	6.55	24.51
Galactose	0.10	3.53	17.46
Glucuronic acid	0.16	89.92	7.65
Xylose	2.14	NA	1.29
Mannose	3.51	NA	0.16


RJ-SPs
GU-SPs
M-SPs
Antioxidant activity %
100
90
80
70
60
50
40
30
20
10
0
100
250
Concentrations of applied SPs µg/mL

Conclusion

- SPs of the marine organisms ***U. lactuca***, ***J. rubens*** and ***A. marina***, were extracted using ultra sonication.
- SPs of ***A. marina*** exhibited the highest carbohydrate content 44 ± 1 %.
- SPs of ***J. rubens*** were characterized by the highest phenolic content; 132.6 ± 2.5 mg GA/g.
- HPLC analysis showed that the SPs of ***J. rubens*** and ***A. marina*** have glucose as their major sugar constituent comprising 94.04% and 24.51.
- SPs of ***A. marina*** showed the highest antioxidant activity at the two applied concentrations which indicates that its SPs could be utilized as antioxidant alternatives.

Future work

- Synthesizing nanoparticles using these SPs extracts.

- Testing effect of NP-extracts on plant growth.

Acknowledgements

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THANK YOU

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