

THE EDIBLE *FUCUS SPIRALIS* LIFE-CYCLE: GC-MS PROFILE ANALYSIS



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INTRODUCTION:

- Fucus spiralis* Linnaeus, known in Azores as “fava-do-mar” is an edible brown macroalgae (Ochrophyta (Phaeophyceae)) since its receptacles are eaten as a local delicacy [1]. It is very rich in fiber (crude content 63.9% dw) [2], contains important minerals (Na⁺, K⁺, Mg²⁺, Ca²⁺) and its content in lipids is small (5.2%) [3], aspects that confirm its nutritional value. It is also rich in secondary metabolites, such as phlorotannins, sterols and fatty acids, which are associated with several biological activities [4].
- It is known that the chemical composition of seaweeds are dependent on environmental factors and geographical location [5]. However, as far as we know the metabolomic profile changes throughout life cycle of *Fucus spiralis* has not been explored.
- Being GC-MS an extremely useful tool for assessing the differences (quantitative and qualitative) in profile of volatile constituents, here we report the GC-MS profile, of hexane fractions obtained from the methanolic extracts of fresh *F. spiralis* collected in two phases of its life cycle (juvenile and mature phases).

RESULTS AND DISCUSSION:

- The GC-MS analysis (Fig. 1 and Table 1) allowed the identification, in juvenile and mature phases, of alkanes, fatty acids, aldoses, alditols, sterols, monoacylglycerols, tocopherol and free glycerol, being the hydroxylated compounds identified as TMS derivatives.
- In juvenile phase the most abundant constituents are mannitol (25.4%), palmitic acid (16.1%), fucosterol (11.7%) and myristic acid (9.4%) (Table 1).

Table 1. – Identified compounds on hexane fraction from *Fucus spiralis* juvenile and mature phase (mg/100 mg of hexane fraction)

Identified Compounds (peak number)	<i>Fucus spiralis</i> life-cycle phase juvenile Phase (Mean ± SD)	Mature Phase (Mean ± SD)
Alkanes		
Tridecano (3)	0.301 ± 0.006	nd
Farnesane (5)	0.048 ± 0.008	nd
Tetradecane (6)	0.294 ± 0.014	0.154 ± 0.001
Pentadecane (7)	0.144 ± 0.006	0.320 ± 0.001
Hexadecane (8)	nd	0.138 ± 0.003
Fatty acids		
Butanodioic acid (4)	nd	0.067 ± 0.004
Citric acid (11)	nd	0.261 ± 0.004
Myristic acid (12)	1.716 ± 0.089	2.741 ± 0.006
Pentadecanoic acid (14)	nd	0.121 ± 0.004
Hexadecenoic (17)	nd	0.092 ± 0.001
Palmitic acid C16:0 (18)	2.928 ± 0.177	3.037 ± 0.049
Linoelaidic acid C18:2 (19)	0.193 ± 0.002	0.193 ± 0.003
Oleic acid C18:1 (20)	1.943 ± 0.126	2.019 ± 0.031
Stearic acid (21)	nd	0.206 ± 0.017
Araquidonic acid C:20:4 (23)	0.417 ± 0.005	0.570 ± 0.012
Eicosapentenoic acid (24)	0.228 ± 0.001	0.368 ± 0.010
Sugars		
Galactofuranose (15)	0.129 ± 0.012	0.073 ± 0.028
Disaccharide (29)	nd	0.084 ± 0.006
D-Lactitol (27)	0.081 ± 0.005	0.274 ± 0.001
Mannitol (13)	4.625 ± 0.109	6.095 ± 0.240
Pentaldol (16)	0.422 ± 0.013	0.088 ± 0.003
Sterols		
Fucosterol (32)	2.132 ± 0.110	1.432 ± 0.060
Desmosterol (31)	tr	0.546 ± 0.009
Ursane triterpenoid (30)	0.329 ± 0.048	nd
Monoacylglycerols		
1-Monopalmitylglycerol (25)	0.048 ± 0.007	0.078 ± 0.004
1-Mono-oleoylglycerol (26)	0.060 ± 0.004	0.149 ± 0.016
Others classes		
Delta tocopherol (28)	0.565 ± 0.017	0.814 ± 0.028
2-methyl-4-cetopentan-2-ol (1)	0.320 ± 0.006	nd
Glycerol (2)	0.045 ± 0.011	0.089 ± 0.002
Glyceryl glucosyl (22)	0.063 ± 0.013	nd
Phloroglucinol and lauric acid (9)	0.072 ± 0.009	0.183 ± 0.001
Not identified (10)	0.115 ± 0.003	0.311 ± 0.020

- Although in the mature stage the main constituents are the same, mannitol content and myristic acid increased about 5 percentage points, while the content of the fucosterol decreases nearly 5 percentage points (Table 1).

- In both mature and juvenile phases the most abundant classes are fatty acids and alditols (Fig. 2).
- This is the 1st time that such high content in alditols is detected in non hydrolysed samples.

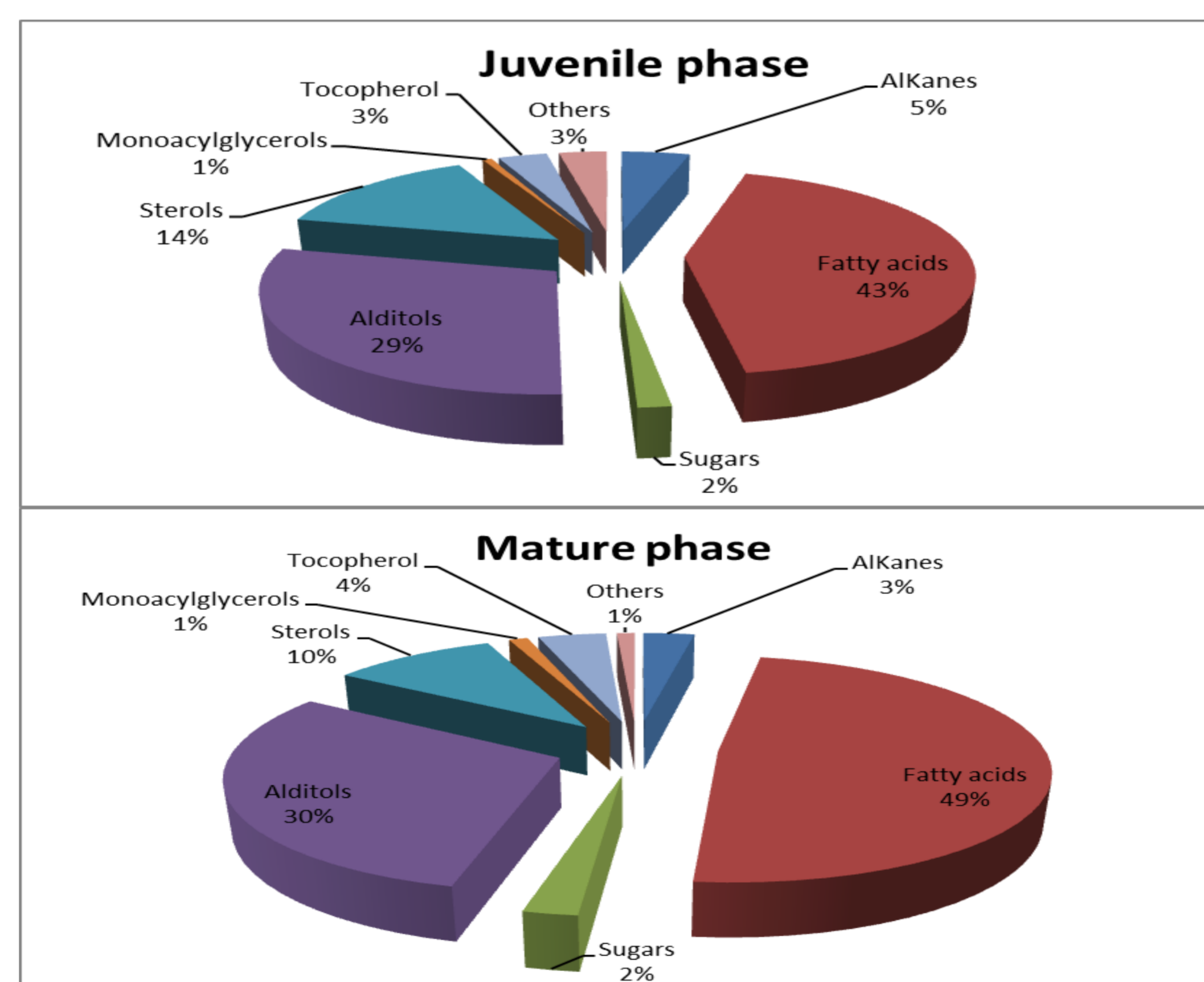


Fig. 2. Total amount of each class of compounds in each analysed sample.

- It is noteworthy that in mature phase the sterols content decreases while the fatty acids content increases (Fig. 2).
- Another interesting fact is that compounds such as citric and stearic acids and desmosterol were only found in mature phase (Table 1).
- Several of the identified compounds are used in food and pharmaceutical industries what is a great foundation for this algae potential.

References

- [1] A. I. Neto, I. Tittley, P. Raposeiro, Flora Marinha do Litoral dos Açores. Secretaria Regional do Ambiente e do Mar, Horta, Açores, 2005.
- [2] Patarra, R. F.; Paiva, L.; Neto, A. I.; Lima, E.; Baptista, J. J. Appl. Phycol. 2011, 23, 205-208.
- [3] Paiva, L.; Lima, E.; Patarra, R. F.; Neto, A. I.; Baptista, J. Food Chem. 2014, 164, 128-135.
- [4] Andrade, P. B.; Barbosa, M.; Matos, R. P.; Lopes, G.; Vinholes, J.; Mouga, T.; Valentão, P. Food Chem. 2013, 138, 1819-1828.
- [5] a) Villares, R.; Fernández-Lema, E.; López-Mosquera, E. Botanica Marina, 2013, 56, 49-61. b) Gubelit, Y. I.; Makhutova, O. N.; Sushchik, N. N.; Kolmakova, A. A.; Kalachova, G. S.; Gladyshev, M. I. J. Appl. Phycol. 2014, 27, 375-386.

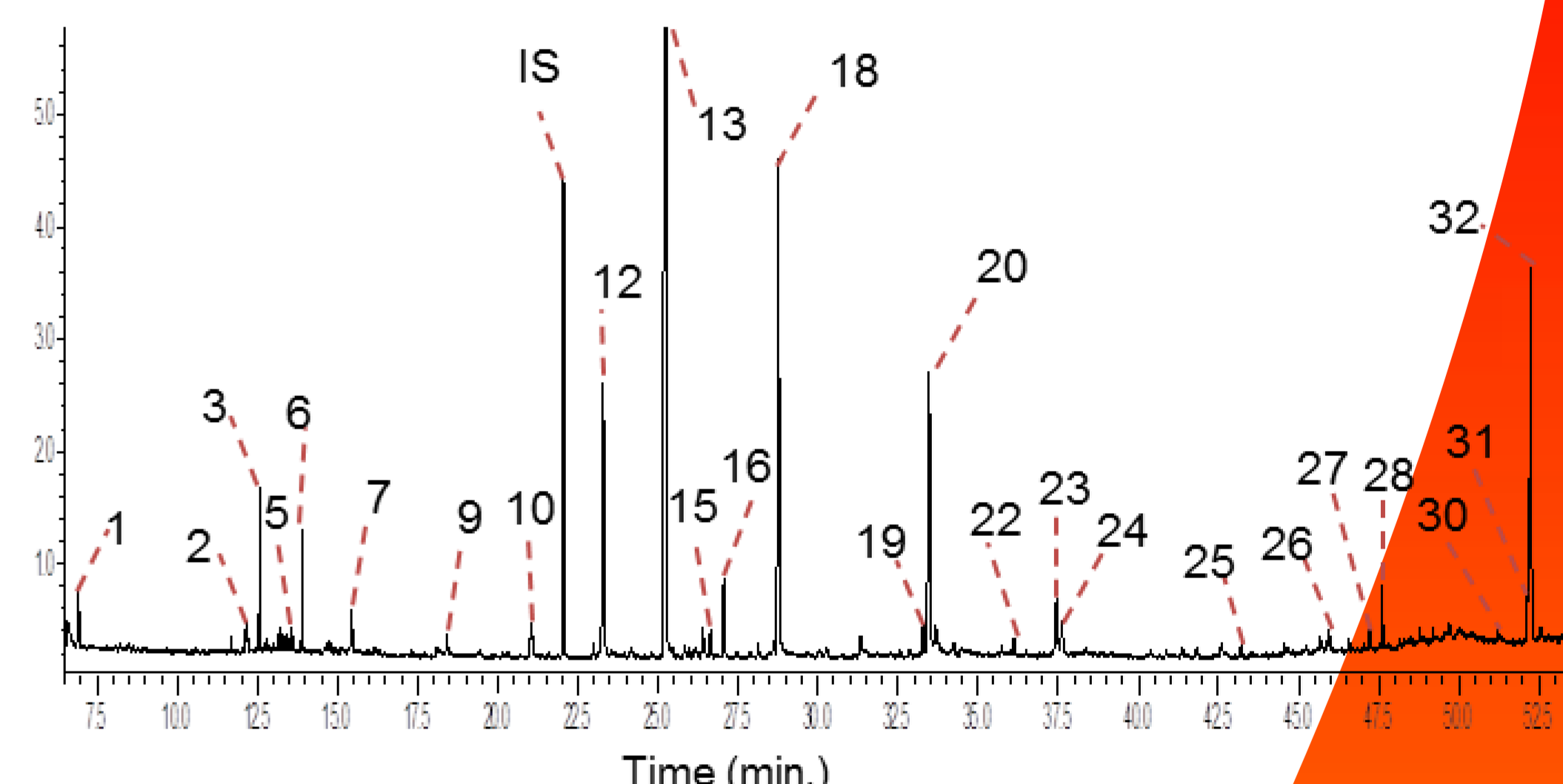
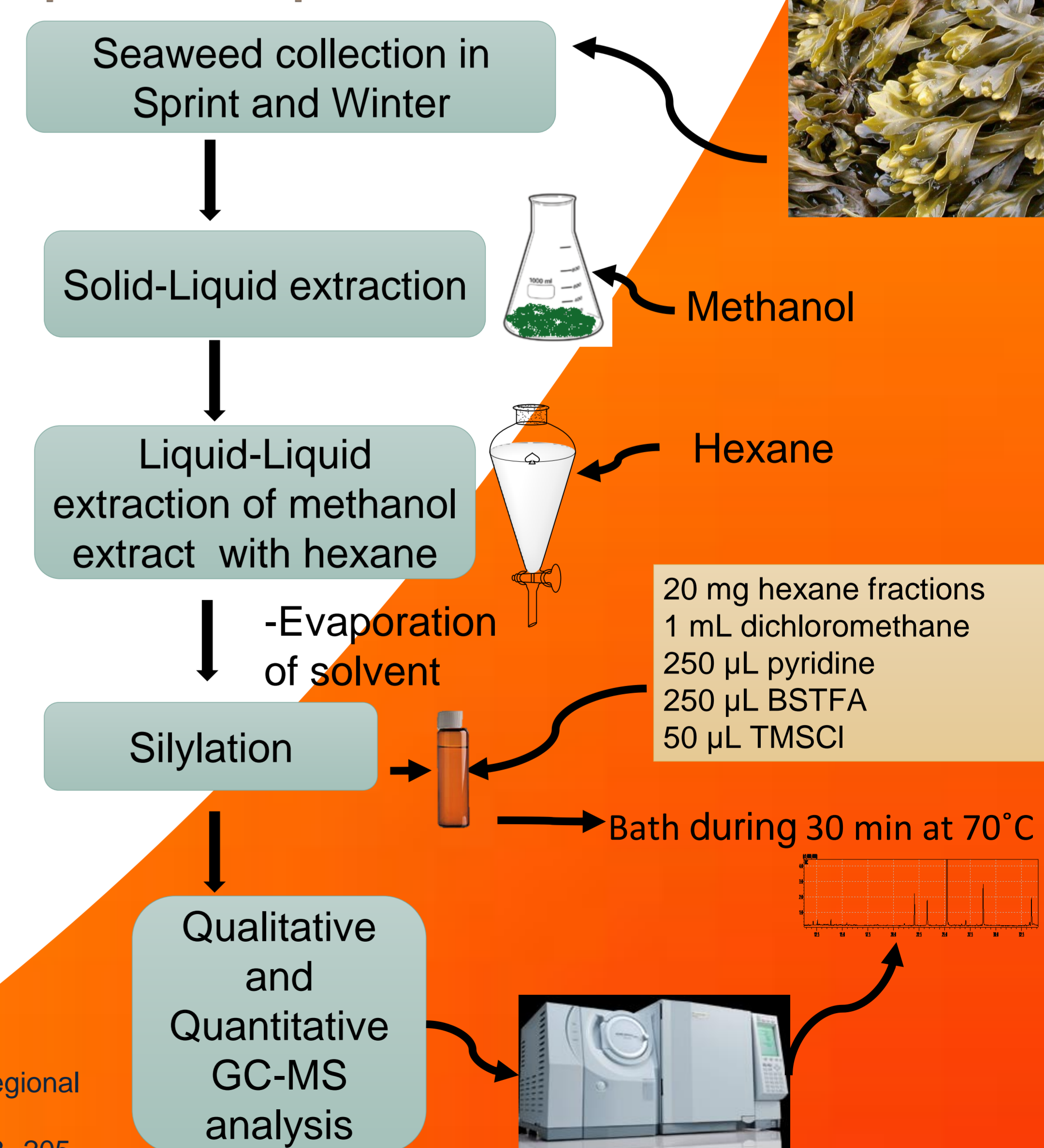


Fig. 1. GC-MS profile of hexane fraction of *Fucus spiralis* juvenile phase. Peak identification as in Table 1.

Experimental procedures



Acknowledgements:

We would like to thank University of Aveiro and FCT/MEC for the financial support to the QOPNA research Unit (FCT UID/QUI/00062/2013), through national funds and where applicable co-financed by the FEDER, within the PT2020 Partnership Agreement, and the University of Azores. We would like to thank also to A.I.Neto by harvesting seaweed.

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