**EVALUATION AND CHARACTERIZATION OF ALGAL BIOMASS APPLIED TO THE DEVELOPMENT OF FINGERMARKS ON GLASS SURFACES**

**Table 1S.** Chemical components (% of area) of the biomass of the studied marine organisms.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Compounds** | *Chlorella* sp. | *D. anceps* | *L. dendroidea* | *L. searlesiana* | *Spirulina* sp. |
| Lactic acid | 1.08 ± 0.04ab | 0.36 ± 0.03ab | ndb | 0.28 ± 0.05ab | 1.15 ± 0.03a |
| Acetic acid | 0.37 ± 0.08a | 0.49 ± 0.08a | 2.80 ± 0.22b | 0.39 ± 0.04a | 0.24 ± 0.05a |
| Hydroxybutyric acid | 0.62 ± 0.02a | nda | nda | nda | 0.54 ± 0.05a |
| Hydroxyvaleric acid | 0.51 ± 0.03a | nda | nda | nda | nda |
| Succinic acid | 1.64 ± 0.25a | 0.19 ± 0.00b | ndb | ndb | ndb |
| Benzenepropanoic acid | 1.85 ± 0.04a | ndb | ndb | ndb | 0.24 ± 0.03b |
| Hydroxyhydrocinnamic acid | 0.41 ± 0.04a | nda | nda | nda | nda |
| Tetradecanoic acid | 0.58 ± 0.10a | nda | 2.34 ± 0.09b | nda | nda |
| Docosahexaenoic acid | 0.50 ± 0.04a | nda | nda | nda | 0.44 ± 0.05a |
| Palmitoleic acid | 8.12 ± 0.19a | ndc | ndc | ndc | 2.32 ± 0.29b |
| Hexadecanoic acid | 9.76 ± 0.34a | 0.46 ± 0.08c | 14.56 ± 0.05b | 0.46 ± 0.10c | 9.40 ± 0.60a |
| Linoleic acid | 25.31 ± 0.34a | ndb | ndb | 0.24 ± 0.08a | ndb |
| Linolenic acid | nda | nda | nda | nda | 5.75 ± 0.56b |
| Oleic acid | nda | nda | 1.42 ± 0.20a | nda | nda |
| Octadecanoic acid | 0.47 ± 0.03a | nda | 0.70 ± 0.18a | 0.17 ± 0.04a | nda |
| Glycerol monopalmitolate | 0.19± 0.05a | nda | nda | 0.18 ± 0.02a | 0.59 ± 0.46a |
| Glycerol monostearate | nda | nda | nda | nda | 0.22 ± 0.27a |
| **Carboxylic acids** | 50.94 ± 0.83a | 1.52 ± 0.20c | 21.82 ± 0.34b | 1.73 ± 0.11c | 20.93 ± 0.77b |
| Alanine | 1.57 ± 0.14a | 1.57 ± 0.23a | ndb | ndb | 0.36 ± 0.15b |
| L-norvaline | 0.68 ± 0.05a | nda | nda | nda | nda |
| Aminocaproic acid | 0.40 ± 0.04a | 0.06 ± 0.01a | nda | nda | nda |
| **Amines** | 2.66 ± 0.16a | 1.63 ± 0.22a | ndb | ndb | 0.36 ± 0.15b |
| Heptadecane | 0.40 ± 0.03a | nda | nda | nda | 1.15 ± 0.11b |
| **Hydrocarbons** | 0.40 ± 0.03a | nda | nda | nda | 1.15 ± 0.11b |
| Glycerol | 10.19 ± 0.14a | ndd | 1.52 ± 0.41c | 1.69 ± 0.02c | 5.82 ± 0.07b |
| 3,7,11,15-Tetramethyl-2-hexadecen-1-ol | 1.86 ± 0.14a | ndb | ndb | ndb | 0.23 ± 0.02b |
| Phytol | 2.89 ± 0.16a | ndb | ndb | ndb | 0.94 ± 0.10b |
| Glycerolgalactopyranoside | 1.76 ± 0.37a | ndb | ndb | ndb | ndb |
| Deoxyglucose | 2.23 ± 0.26a | nda | nda | nda | nda |
| Glycerophosphoric acid | 2.56 ± 0.50a | ndb | ndb | ndb | 0.24 ± 0.08b |
| 3,7,11,15-Tetramethyl-2-hexadecen-1-ol | 4.36 ± 0.30a | 0.54 ± 0.14bc | ndc | 0.27 ± 0.03c | 1.60 ± 0.19b |
| 3,7,11-Trimethyl-1-dodecanol | 0.43 ± 0.09a | nda | nda | nda | 0.19 ± 0.05a |
| D-turanose | 2.08± 0.37a | ndb | ndb | ndb | ndb |
| Erythro-pentofuranose | nda | nda | nda | nda | 0.27 ± 0.12a |
| Deoxy-galactose | nda | nda | nda | nda | 21.64 ± 2.59b |
| Glycerol-galactopyranose | nda | nda | nda | nda | 14.13 ± 2.81b |
| Unknown carbohydrate | nda | 79.19 ± 3.15b | nda | 81.77 ± 2.48b | nda |
| Elatol | nda | nda | 53.35 ± 1.47b | nda | nda |
| **Alcohols** | 28.39 ± 1.47a | 79.73 ± 3.01d | 55.06 ± 1.06c | 83.74 ± 2.42e | 45.08 ± 0.26b |
| Cholesterol | 0.92 ± 0.00a | nda | 5.22 ± 0.22b | nda | 0.38 ±0.03a |
| Ergosterol | 1.45 ± 0.11a | ndb | ndb | ndb | ndb |
| Fucosterol | nda | 2.57 ± 0.56b | nda | 2.77 ± 0.07b | nda |
| **Steroids** | 2.38 ± 0.11a | 2.57 ± 0.56a | 5.22 ± 0.22c | 2.77 ± 0.07a | 0.38 ± 0.03b |
| **Unidentified** | 14.71 ± 1.12 | 14.55 ± 2.03 | 17.88 ± 1.62 | 11.75 ± 2.46 | 32.08 ± 0.55 |
| Results expressed as mean ± standard deviation of triplicates (*n*=3)  Different superscript letters indicate significant differences (*p*<0.05) | | | | | |

**Table 2S.** Results of the IR Spectroscopy analysis of the samples.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bonding (cm-1)** | *Chlorella* sp. | *D. anceps* | *L. dendroidea* | *L. searlesiana* | *Spirulina* sp. |
| **-O-H** | 3280 | 3240 | 3303 | 3253 | 3280 |
| **=C-H** | - | 3022 | 3022 | 3022 | - |
| **-C-H** | 2918 | 2968 | 2973 | 2973 | 2954  2923 |
| **-C=O**  **(ester)** | 1737 | 1737 | 1737 | 1737 | - |
| **-O-H**  **(bending)** | - | - | 1418 | - | - |
| **-C=O**  **(amide)** | 1643 | - | - | - | 1650 |
| **-N-H**  **(amide)** | 1536 | - | - | - | 1540 |
| **-C-H**  **(bending)** | 1454 | 1366 | 1368 | 1366 | 1450 |
| **-C-N** | 1230 | 1228 | 1228 | 1228 | 1233 |
| **-C-O** | 1217  1027 | 1215  1208  1079  1020 | 1217  1206  1138  1124  1095  1025 | 1217  106 | 1020 |
| **-C-Cl** | - |  | 875 |  | - |
| **-C-Br** | - |  | 656 |  | - |

**Table 3S.** Particle size distribution of the studied marine biomasses.

|  |  |  |  |
| --- | --- | --- | --- |
| **Samples** | **10% (μm)** | **50% (μm)** | **90% (μm)** |
| *Chlorella* sp. | 23.56 | 84.73 | 192.80 |
| *D. anceps* | 14.58 | 86.49 | 243.98 |
| *L. dendroidea* | 15.67 | 84.86 | 195.18 |
| *L. searleasiana* | 21.69 | 140.00 | 350.92 |
| *Spirulina* sp. | 8.66 | 42.18 | 148.00 |
| Commercial developer | 2.73 | 28.43 | 42.87 |

**Table 4S.** Superficial elementary composition of the studied marine biomasses.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Elements (%)** | **Samples** | | | | | | |
| *Chlorella* sp. | *D. anceps* | *L. dendroidea* | *L. searlesiana* | | *Spirulina* sp. | |
| **Si** | - | - | 0.6 | | - | | - |
| **P** | 14.54 | 0.51 | - | | 0.29 | | 11.57 |
| **S** | 7.37 | 2.08 | 4.45 | | 1.5 | | 10.91 |
| **Cl** | - | 46.54 | 45.84 | | 37.94 | | - |
| **K** | 23.3 | 41.3 | 9.63 | | 51.83 | | 45.59 |
| **Ca** | 40.62 | 8.3 | 36.19 | | 5.98 | | 22.44 |
| **Ti** | 0.56 | - | 0.13 | | - | | - |
| **Mn** | 0.3 | - | - | | - | | 0.2 |
| **Fe** | 12.85 | 0.24 | 0.81 | | 0.06 | | 7.08 |
| **Cu** | 0.16 | 0.05 | 0.04 | | 0.03 | | 0.19 |
| **Zn** | 0.12 | 0.07 | - | | - | | - |
| **As** | - | 0.03 | - | | 0.04 | | - |
| **Br** | - | 0.33 | 2.05 | | 1.42 | | - |
| **Rb** | - | - | - | | 0.06 | | - |
| **Sr** | 0.19 | 0.47 | 0.18 | | 0.3 | | 0.13 |
| **Zr** | - | - | 0.04 | | - | | - |
| **Ag** | - | 0.04 | - | | 0.06 | | - |
| **I** | - | - | 0.05 | | 0.48 | | - |
| **Ba** | - | - | - | | - | | 1.89 |
| **Pa** | - | 0.03 | - | | - | | - |



**Figure 1S.** FT-IR spectrum of all the algae biomasses.



**Figure 2S.** GC-MS chromatogram of the extract from the biomass of *Chlorella* sp.



**Figure 3S.** GC-MS chromatogram of the extract from the biomass of *Spirulina* sp.



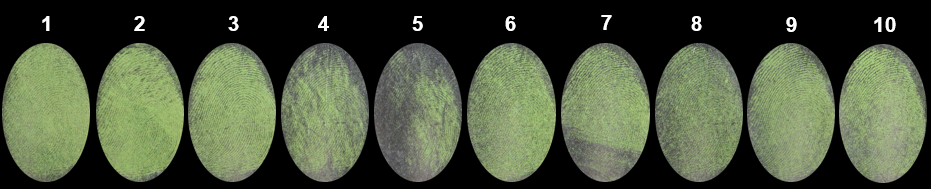
**Figure 4S.** GC-MS chromatogram of the extract from the biomass of *L*. *dendroidea*.



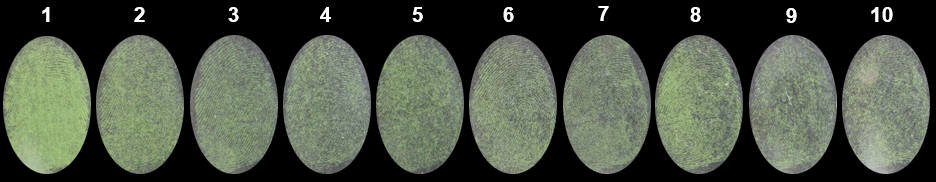
**Figure 5S.** GC-MS chromatogram of the extract from the biomass of *D. anceps*.



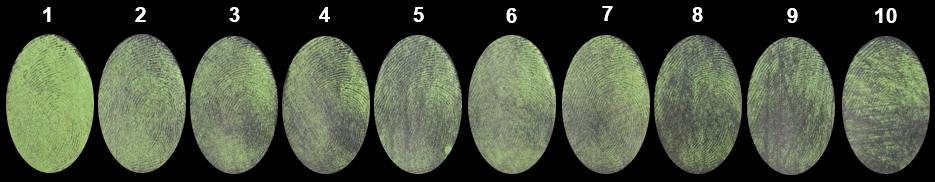
**Figure 6S.** GC-MS chromatogram of the extract from the biomass of *L*. *searlesiana*.



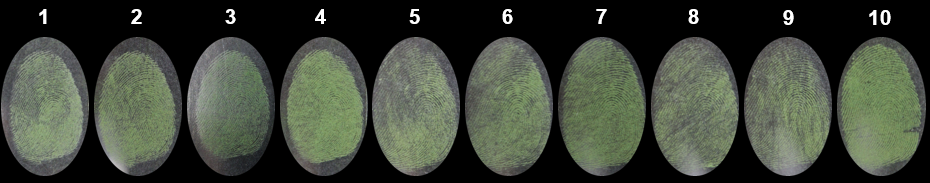
**Figure 7S**. Depletion study using Spirulina sp. biomass under 24 hours for natural latent fingerprint



**Figure 8S**. Depletion study using Spirulina sp. biomass under 72 hours for natural latent fingerprint



**Figure 9S**. Depletion study using Spirulina sp. biomass under 24 hours for sebaceous latent fingerprint.



**Figure 10S**. Depletion study using Spirulina sp. biomass under 72 hours for sebaceous latent fingerprint