Impact of drying processes on the fatty acid composition of *Chlorella vulgaris*

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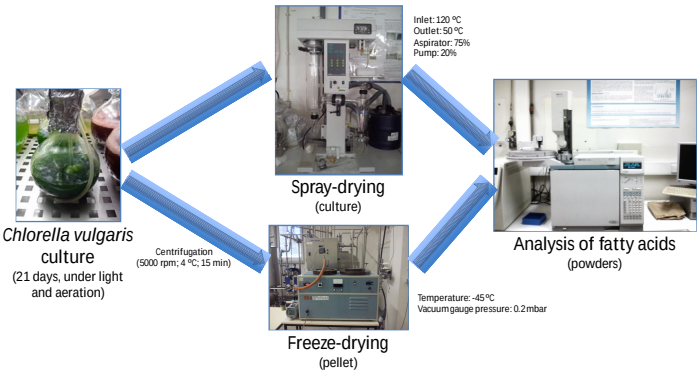
Introduction

Healthy fatty acids (FA) composition, namely, polyunsaturated fatty acids (PUFA), is one of the most interesting characteristics of microalgae in the development of new functional food products. In order to be more easily incorporated into different formulations, drying of the microalgae biomass can be performed. Freeze-drying is the most widely utilized methodology for drying microorganisms, while spray-drying can be a faster and less expensive solution.

Objectives

The aim of this research work was to evaluate the effects of these two drying techniques on the yield and FA quantitative and qualitative profiles of harvested *Chlorella vulgaris* biomass.

Methods



ANALYSIS OF FATTY ACIDS:
For the analysis of the total fatty acid (FA) composition, samples (500 mg) were prepared according to Castro-Gómez et al. [1]. For quantification purposes, samples were added with 50 µL of tritridecanoin (1.34 mg/mL in hexane) and heptadecanoic acid (1.4 mg/mL in hexane) prior to derivatization and extracts were added with 100 µL of methyl undecanoate (1.4 mg/mL in hexane). FAME were analysed in a gas chromatograph HP6890A (Hewlett-Packard, Avondale, PA, USA), equipped with a flame-ionization detector (GLC-FID) and a BPX70 capillary column (50m x 0.32 mm x 0.25 µm; SGE Europe Ltd, Courtaboeuf, France). Analysis conditions were as follows: injector (split 10:1; injection volume 1 µL) and detector temperatures were 250ºC and 270ºC, respectively; carrier gas was hydrogen (11 psi) and the oven temperature program started at 60ºC (hold 2 min), raised 10ºC/min to 135ºC (hold 2 min), then 10ºC/min to 165ºC (hold 2 min) and finally 10ºC/min to 230ºC (hold 7 min). Supelco 37 and CRM-164 were used for identification of fatty acids. GLC-Nestlé36 was assayed for calculation of response factors and detection and quantification limits (LOD: 0.079 µg FA/mL; LOQ: 0.264 µg FA/ mL).

Results

Table 1 – Fatty acid profiles (µg/100mg)

Fatty acid	Spray-drying	Freeze-drying
C12	0.99 ± 0.01	1.10 ± 0.16
C13ai	0.97 ± 0.06	1.53 ± 0.05
C12:1	4.82 ± 0.60	107 ± 4
C14	29 ± 1	38 ± 1
C14:1	1.22 ± 0.16	1.08 ± 0.12
C15ai	0.52 ± 0.04	0.73 ± 0.03
C15	20 ± 0	37 ± 2
C16	985 ± 4	1417 ± 32
C16:1 c7	28 ± 0	46 ± 1
C16:1 c9	40 ± 0	49 ± 1
C16:2 c9c12	585 ± 11	762 ± 18
C17	10 ± 0	15 ± 1
C17:1	11 ± 0	14 ± 0
C18:5	51 ± 1	62 ± 1
C18	40 ± 0	79 ± 2
C18:1 c9	164 ± 1	269 ± 6
C18:1 c11	14 ± 0	18 ± 1
C18:2 t9t12	1.10 ± 0.10	0.84 ± 0.08
C18:2 c9t12	5.69 ± 0.05	7.19 ± 0.26
C18:2 c9c12	3504 ± 41	4960 ± 107
C18:3 c6c9c12	4.85 ± 0.03	7.19 ± 0.34
C18:3 t9t12t15	8.13 ± 0.19	7.83 ± 0.82
C18:3 c9c12c15	1370 ± 26	1490 ± 27
C20:1 c9	3.58 ± 0.06	5.08 ± 0.15
C20:4 AA	3.09 ± 1.50	1.00 ± 1.73
C23	2.43 ± 0.14	2.96 ± 0.08
C24	12 ± 0	20 ± 0
C22:5 n3 (DPA)	6.43 ± 0.08	11 ± 0
Total	**6908**	**9430**

*Note: Averages ± standard deviations

Table 2 – Drying yields

Drying Method	Yield (%)
Freeze-drying	99
Spray-drying	37

- Results showed that yield of *C. vulgaris* biomass powder was of almost 100% when obtained by freeze-drying, and only 40% when spray-drying was employed.
- Although the highest total FA concentration was found in the freeze-dried *C. vulgaris* powders (9430 µg FA/100mg vs. 6908 µg FA/100mg), some FA were present in higher amounts in the equivalent spray-dried powders (e.g. C14:1; 1.22 µg/100 mg vs. 1.08 µg/100 mg and C18:2 t9t12; 1.10 µg/100 mg vs. 0.84 µg/100 mg).
- The most important FA compounds for human nutrition such as C18:2 c9c12 (linoleic acid; 3504 µg/100 mg in spray-dried samples ; 4960 µg/100 mg in freeze-dried samples), C18:3 c9c12c15 (α-linolenic acid; 1370 µg/100 mg in spray-dried samples ; 1490 µg/100 mg in freeze-dried samples) and C22:5 n3 (docosapentaenoic acid; DPA) were higher in the freeze-dried biomass powders: e.g. DPA concentration was two-fold higher in the freeze-dried powder (11 µg/100mg) than in the spray-dried counterpart (6 µg/100mg).

Conclusions

According to the results from this research, when PUFA content is concerned, freeze-drying is the best method to obtain algae powders from *C. vulgaris*.

References

1 Castro-Gómez P, Fontecha J & Rodríguez-Alcalá LM (2014) A high-performance direct transmethylation method for total fatty acids assessment in biological and foodstuff samples. Talanta **128**, 518–523.

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