

COMPARATIVE STUDY OF THE IMPACT OF OVEN BAKING ON MEAT ANALOGUES ENRICHED WITH FRESH OR AIR-DRIED SPIRULINA BIOMASS (*Arthrospira platensis*)

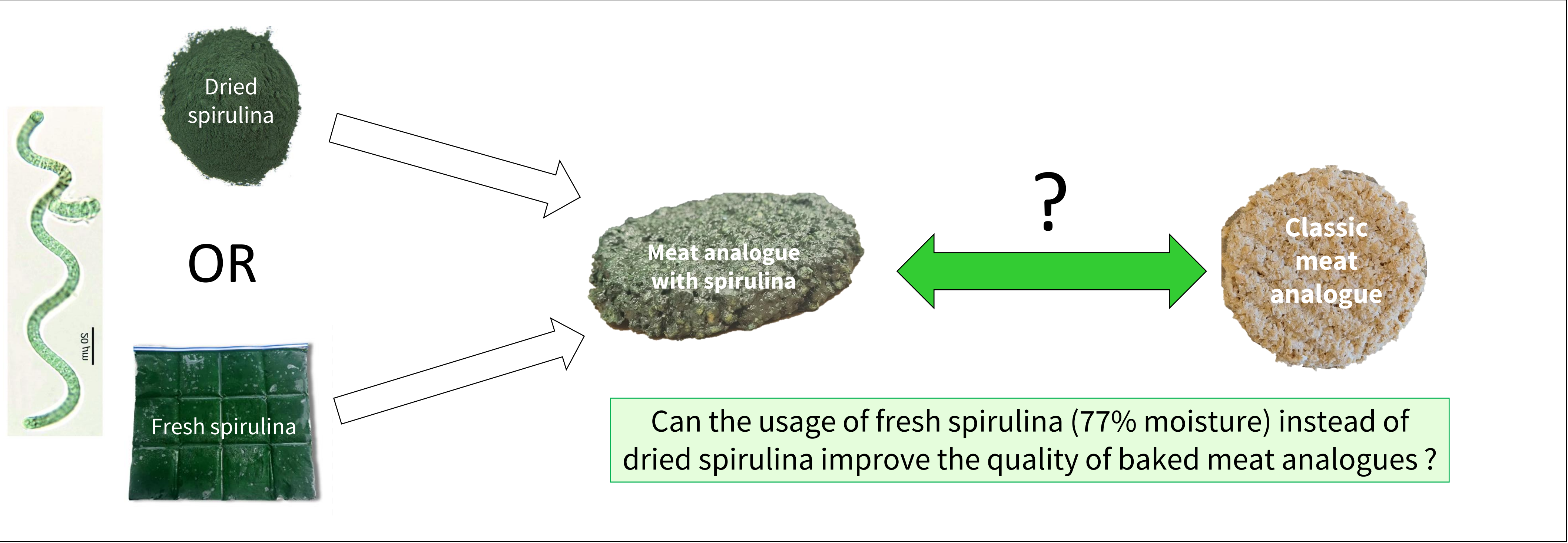
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“At high percentage of incorporation (10% protein), **fresh spirulina** is more suitable than dried spirulina for **meat analogue** development as fewer undesirable notes are perceived when consumed given that fresh spirulina is more neutral in terms of volatiles organic compounds”.

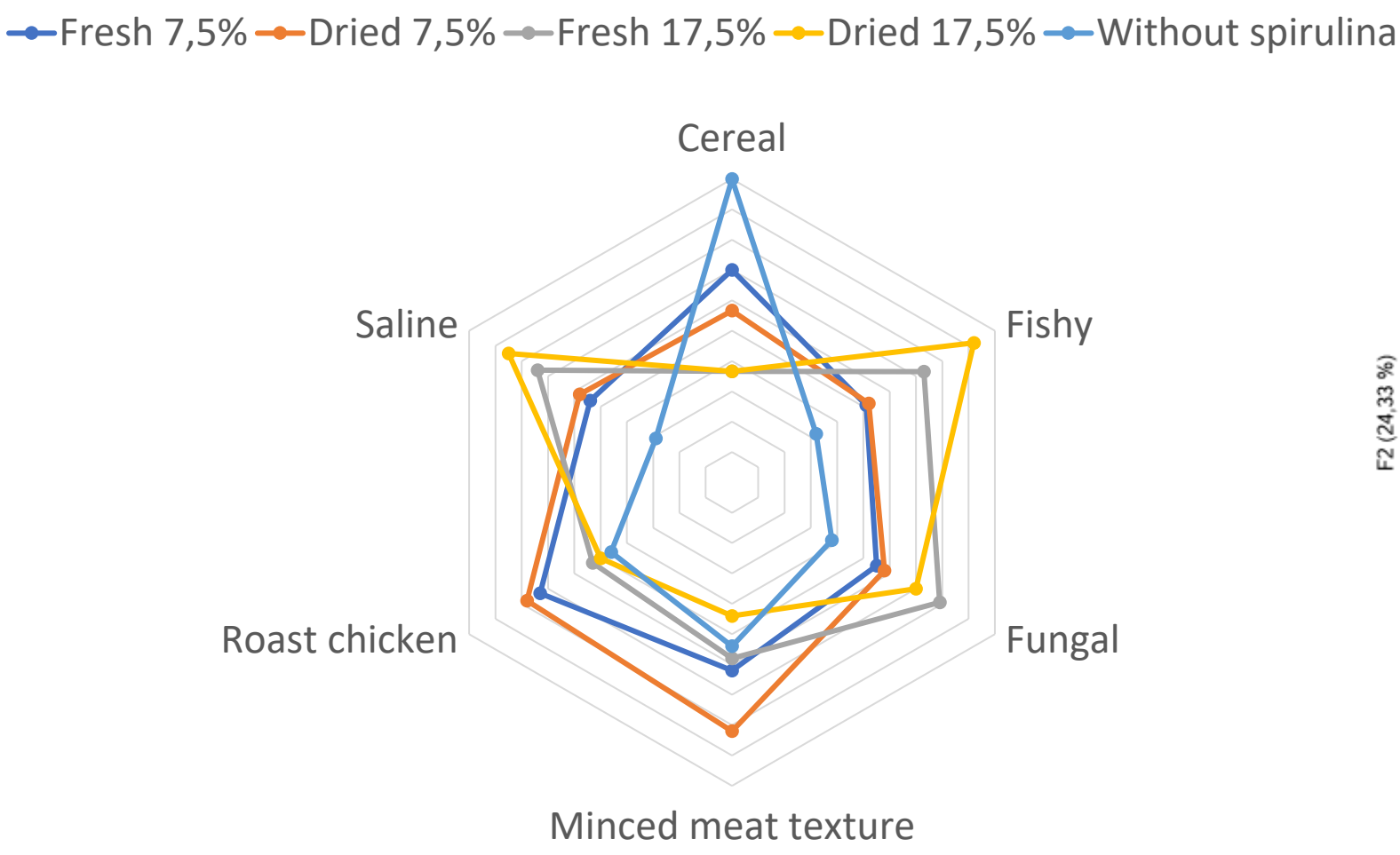
Context

Meat consumption is intended to decrease for ecological reasons. Alternative proteins sources, like plant-based proteins (including meat analogues), exist and need to gain more shares in the human diet. Nevertheless, the digestibility, the organoleptic properties and the amino acid profile remain not ideal. Foodstuffs made from microbial biomass like spirulina (*Arthrospira platensis*) are a promising solution to substitute meat from a nutritional point of view. Foodstuffs enrichment with a low quantity of dried spirulina is nowadays a well-known practice according to the scientific literature. Enrichment with fresh spirulina instead of dried biomass has already shown better results in terms of nutrition, what about the quality and the sensory properties in a meat analogue ?

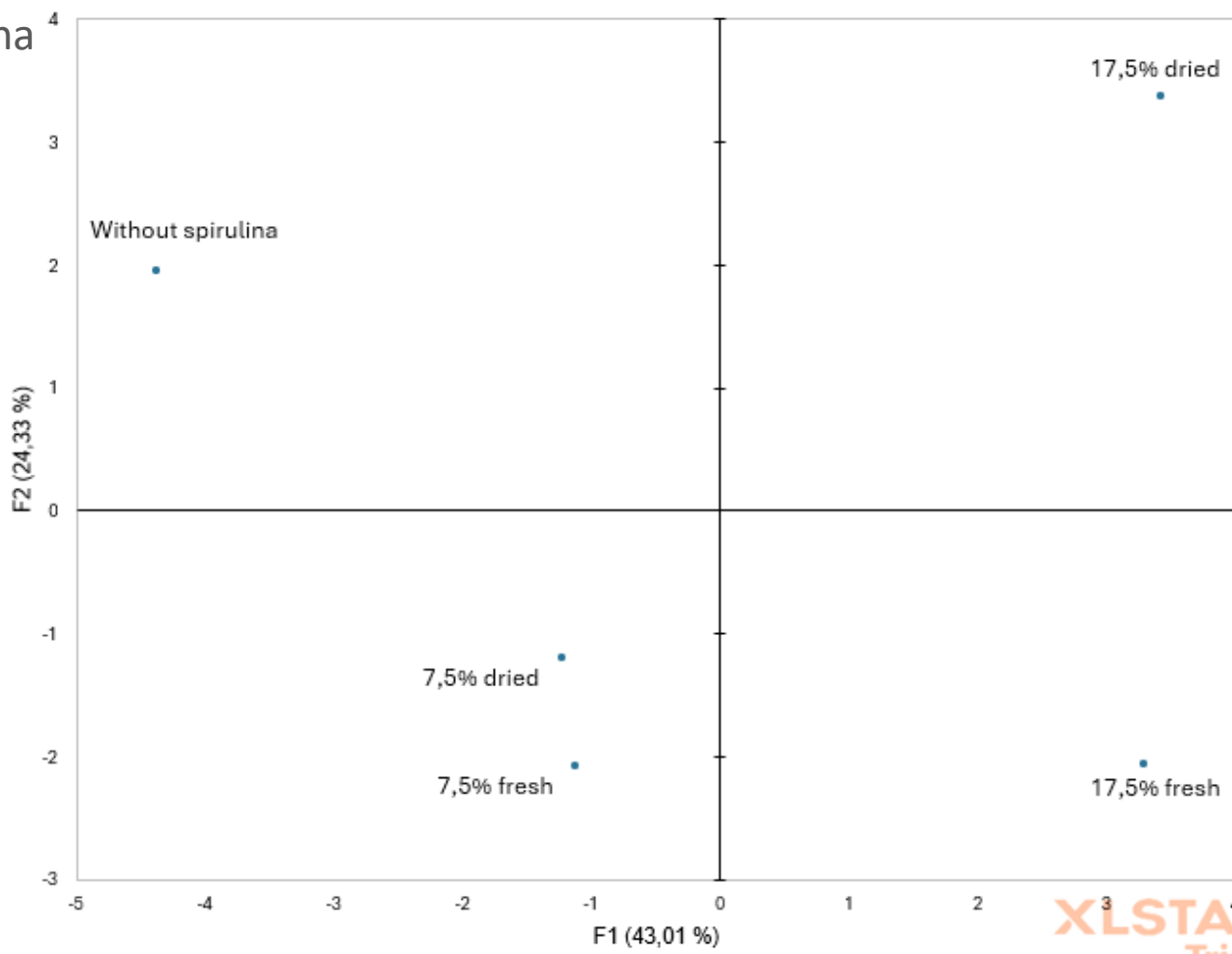


Ingredients proportion of the 7 formulations tested

Ingredients (%)	Without spirulina	Spirulina 7.5%		Spirulina 12.5%		Spirulina 17.5%	
		Dried	Fresh	Dried	Fresh	Dried	Fresh
Fresh spirulina	0	0	30	0	50	0	70
Dried spirulina	0	7.5	0	12.5	0	17.5	0
Texture wheat protein	23.5	20	20	17.5	17.5	14.5	14.5
Oat flakes (ground)	11.75	10	10	8.75	8.75	7.25	7.25
Wheat flour	11.75	10	10	8.75	8.75	7.25	7.25
Salt	1	1	1	1	1	1	1
Water	52	51.5	29	51.5	14	52.5	0



Radar chart of the intensity of the main sensory attributes perceived per formulation.



Formulations positioning according to two variables generated by PCA on sensory test results.

Strategy

7 formulations have been considered (3 incorporation percentages, 2 forms of spirulina biomass and one spirulina-free version).

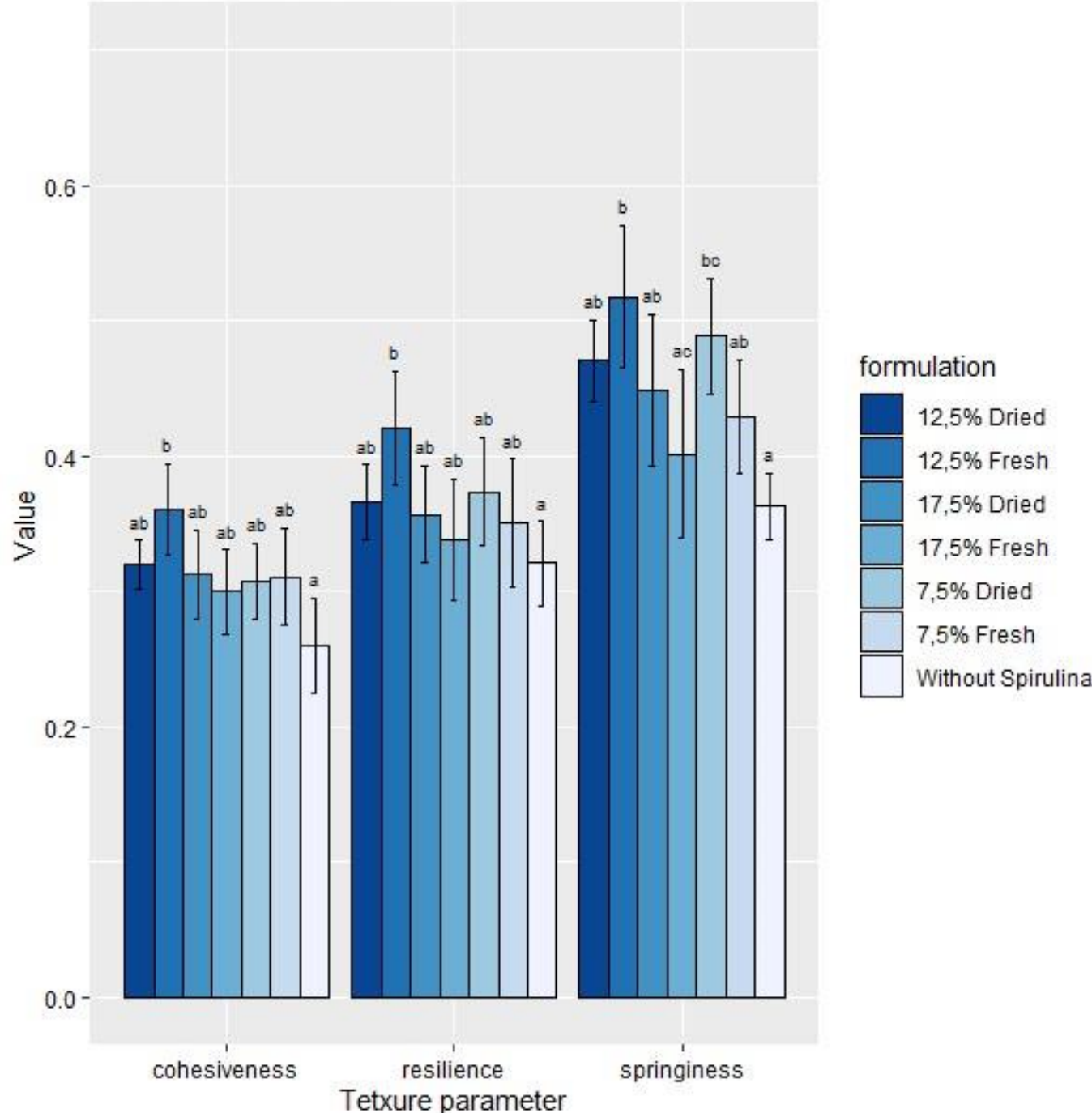
How are meat analogues made ?

- (1) Mixing of the ingredients with a robot.
- (2) Shaping of the burgers (manually).
- (3) Baking : 12 minutes at 180°C.

Which parameters have been determined ?

- (1) Moisture preservation (gravimetric)
- (2) Colour ($L^* a^* b^*$)
- (3) Texture (Texture Profile Analyse)
- (4) Sensorial profile (Flash Profile)
- (5) Volatiles organic compounds (SPME/GC-MS)

Texture parameters according to formulation
Mean with standard deviation



Texture parameter linked to product integrity according to formulations (TPA test, 40% compression and 2,5mm/s).

Main results :

- The moisture preservation, the baking yield and the texture are not impacted by the formulation. **Fresh spirulina is as interesting as dried spirulina.**
- At 17.5% of spirulina (10% protein), in comparison of 7.5%, meat analogues are perceived more “fungal”, and the texture is further away from minced meat. Nevertheless, there is a difference between fresh and dried, **products made with dried spirulina are perceived more “fishy” and “salty”.**
- At 7.5% of enrichment products are similar in terms of taste**, no matters the form used. On top, the texture is closer to meat in comparison with an enrichment of 17.5%.
- 7 volatiles organic compounds were found in the pure fresh spirulina and 29 in the pure dried spirulina. **Fresh spirulina is more neutral in terms of odour.**