Exploring nutritional enhancement of a ready-to-eat spinach-mash with algae

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Dare 2 Change

Food Development & Production

Introduction

Consumers are increasingly open to **incorporating new foods** in their diet, especially if they are considered **healthy** and **sustainable**. The global demand for **algae-based foods** has been rising, and algae are being **increasingly consumed** for both their nutritional and health benefits as well as their technological advantages.

In recent years, substantial evidence has been gathered to support the health benefits of algae-derived food products [1]. This promising **alternative** and **sustainable protein** source offers several advantages over other raw materials currently in use, particularly from an environmental perspective. Moreover, a key characteristic of algae is their **production of micronutrients** and **bioactive compounds** with potential benefits for promoting better human health [1].

Objective:

This project aims to reformulate the original conventional recipe for *esparregado* (a traditional Portuguese mash) made from spinach, which served as a base for incorporating algae and/or microalgae.

Methods

1. **Proximal composition** using standard determination methods (in accredited laboratory):
   - Total fat (g/100g product)
   - Saturated fatty acids (g/100g product)
   - Polyunsaturated fatty acids (g/100g product)
   - Carbohydrates (g/100g product)
   - Sugars (g/100g product)
   - Proteins (g/100g product)
   - Salt (g/100g product)
   - Fibers (g/100g product)
   - Ash (g/100g product)
   - Energy (kcal/100g product)
2. Standard **quantification** of:
   - **Vitamins**
   - **Minerals**
3. **Sensorial analysis**: preliminary analysis by a trained panel with 10 panelists

   Nutritional Claims proposed based on composition

Prototype Production:

Prototypes were produced in a **semi-industrial scale**, within the facilities of the industrial partner *Faster-Produtos Alimentares Lda*.

Recipes were **formulated** using a conventional recipe for *esparregado*, developed by the company, as base-recipe.

The ~~**optimized**~~ **formulations** were optimized using a matrix design for this purpose, allowing the theoretical calculation of each nutrient, to ensure that the claims could be met.

The amount of **algae and/or microalgae** in each formulation was adjusted to add-up within the amount of spinach.

Three formulations were proposed:

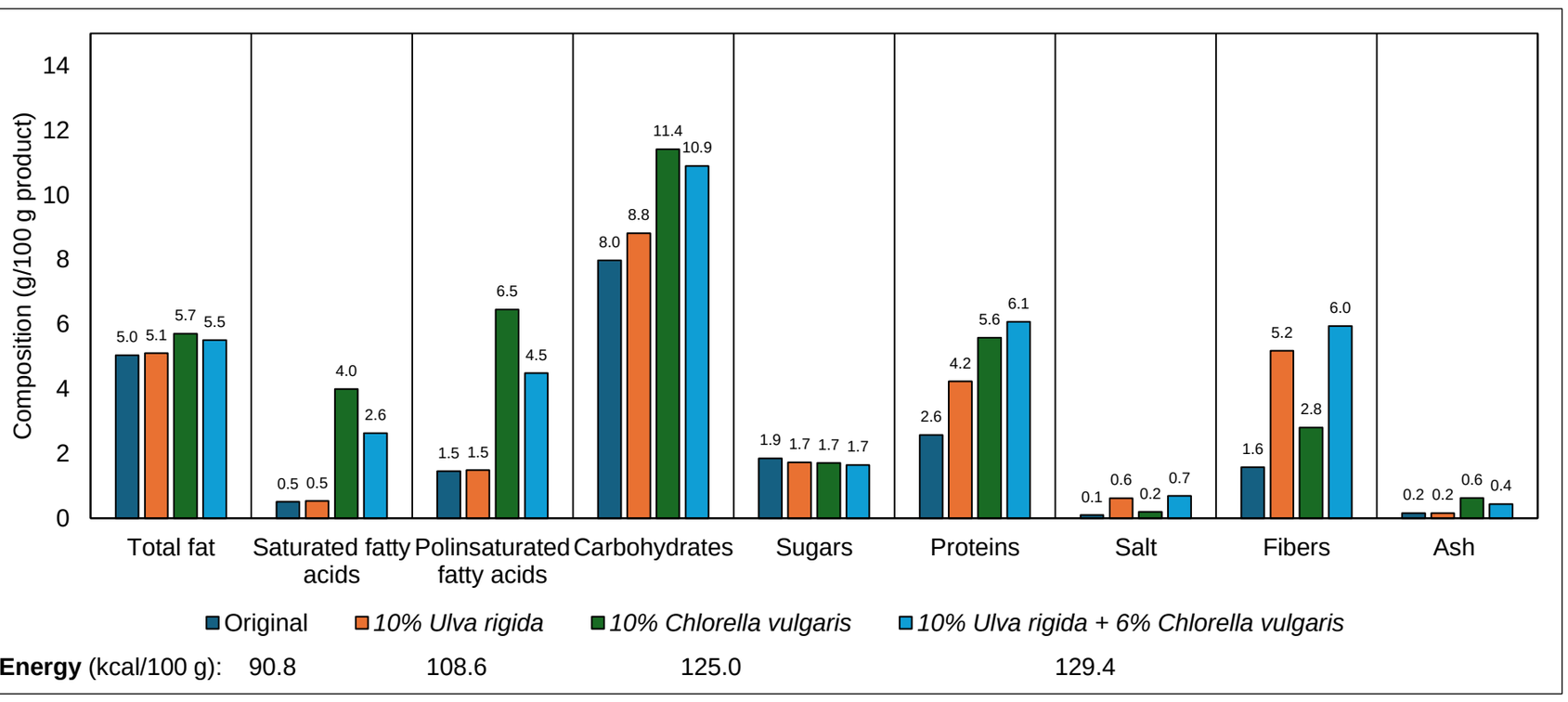
(1) containing 10% (w/w) *Ulva rigida*;

(2) containing 10% (w/w) *Chlorella vulgaris*;

(3) combining 10% *Ulva rigida* with 6% *Chlorella vulgaris*.

Results

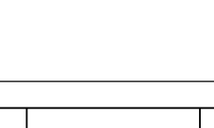
1



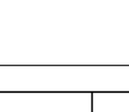
Proximal composition comparison between the original recipe and the prototypes incorporating micro and microalgae; labels on top of bars show the final mean value. Below the colored legend are shown the respective values for energy, in kcal.

2

	Vitamins				
	A	B2	B12	C	E
Original	37.1	-	-	23.4	21.7
10% *Ulva rigida*	33.1	16.8	-	20.8	22.6
10% *Chlorella vulgaris*	33.1	-	97.5	20.8	22.6
10% *Ulva rigida* + 6% *Chlorella vulgaris*	30.2	15.9	59.7	19.0	23.3



Ulva rigida (from Alga+)



Chlorella vulgaris (from Allmicroalgae)

	Minerals									
	Calcium	Potassium	Magnesium	Iron	Chromium	Molybdenum	Iodine	Phosphorus	Zinc	Copper
Original	98,7	-	-	-	-	-	-	-	-	-
10% *Ulva rigida*	172,8	23.1	89.2	84.9	135.0	43.1	326.1	-	-	-
10% *Chlorella vulgaris*	158,5	17.3	-	16.7	-	-	-	29.0	56.3	55.5
10% *Ulva rigida* + 6% *Chlorella vulgaris*	202,5	22.2	59.3	61.7	81.0	25.9	195.6	30.6	57.5	64.3

% RDD - High content % RDD - Source of

Vitamins and minerals present in the original and prototype recipes. The values represent the percentage of the recommended daily dosage for each component, and are colored in orange for values within the claim “Source of”, or green for values falling within the claim “High content”, accounting for the significant amount (15% of the RDD) and twice the significant amount (30% of the RDD), respectively, as defined by the European Legislation (annex XIII, Regulation 1169/2011).

3

Evaluation	Prototype			Scale
	10% *Ulva rigida*	10% *Chlorella vulgaris*	10% *Ulva rigida* + 6% *Chlorella*	
Like/dislike	5.1±0.9	4.7±1.7	4.5±1.6	1= extremely unpleasant; 7= extremely pleasant
Purchase intention	3.4±0.8	3.1±1.1	3.0±1.0	1= certainly not buying; 5= certainly buying
Color	3.2±0.6	3.2±0.9	3.1±0.5	1= too clear; 3= ideal; 5= too dark
Taste	3.0±0.8	3.0±1.0	2.5±0.7	1= too mild; 3= ideal; 5= too intense
Texture	3.8±0.6	3.6±1.2	3.3±1.1	1= extremely unpleasant; 3= indifferent; 5= extremely pleasant

Preliminary sensorial analysis of the prototypes, with respect to general appreciation, purchase intension and organoleptic parameters such as color, taste and texture. Values are represented as mean value ± standard deviation.

Discussion

In terms of macronutrients, all prototypes present a **high protein content**, **low fat** and **low sugar** profiles, and energy values within the same range of the original recipe; prototype (1) and (3) containing *Ulva*, present a **high fiber content**.

Regarding vitamins and minerals: protypes containing *Ulva* ((1) and (3)), are proposed to be **source of vitamin B2** and **high in iron**, **magnesium**, **chromium**, and **iodine**. Prototypes with *Chlorella* are, in particular, **high in vitamin B12**, **zinc** and **copper**.

The addition of algae and/or microalgae is mostly not affecting organoleptic characteristics negatively, although the panel considers there is still the need for slight improvement. The tasting panel (n=10) was limited, so it will be necessary to conduct a sensory evaluation with a larger panel to obtain representative data.

Conclusions

(Micro)Algae proved to be a valuable addition to increase the nutritional value of a traditional food, sustainably, and without severely impacting the traditional organoleptic properties, that consumers will certainly value, with the prototype combining micro- and macroalgae (3) presenting itself as the most attractive solution, by gathering the positive characteristics of both.

References

[1] P. Nova, A. Martins, C. Teixeira, H. Abreu, J. Silva, A. Silva, A. Freitas, A. Gomes, Journal of Applied Phycology, 32(3) (2020) 1789-1802

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