LIÈGE université
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Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur BARKA Abakoura,

Titulaire d'un diplôme de bachelor of sciences in food science and technology,

Titulaire d'un DEA en sciences alimentaires et nutrition,

Titulaire d'un DEA option chimie industrielle et environnement,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 15 octobre 2018, à 14 heures précises (personne ne sera admis après cette heure),

en l'auditorium G (Bioindustries, bât. 9),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Interfacial behavior of colored protein fractions from *Spirulina platensis* ».

Le jury est composé comme suit :

Président : Prof. M.-L. FAUCONNIER, Professeur ordinaire,
Membres : Prof. C. BLECKER (Promoteur), Prof. S. DANTHINE, Prof. A. LEONARD, Prof. F. DELVIGNE, Dr G. KARAMOKO (Université Péléforo Gbon Coulibaly, Côte d'Ivoire), Prof. R. KAROUI (Université d'Artois, France).

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Summary

This study is carried out to evaluate the interfacial activity of different fractions of *Spirulina* soluble proteins. Before the experimental steps, a broad literature review is highlighted to point out the global microalgae potential, with particular emphasis on *Spirulina* sp. The protein content of different microalgae species is presented, together with the nutritional quality of these proteins. Out of this investigation, it clearly appeared that micro algae present a higher productivity per unit area when compared to high plants. They are able to thrive and survive in drastic climatic conditions. *Spirulina* platensis particularly presents high protein content with good nutritional characteristics.

The first experimental assessment is the extraction of the colored *Spirulina* soluble protein fractions from dry *Spirulina* powder and evaluation of their physicochemical properties. Three fractions, including the blue soluble (BSSP), the green soluble (GSSP), and the total soluble (TSSP) *Spirulina* protein fractions are obtained. Investigations on their behavior at air/water interface are carried out, using dynamic methods of drop volume (TVT1), automated drop (tracker), and bubble pressure (BP100) tensiometers. Evaluation of their monolayer films mechanical behavior is done via compression isotherms using Langmuir film balance. The protein contents of the fractions are 82.76%; 82.29%; 74.53% for the blue, the green and the total fractions, respectively. Surface tension decay increases with increasing concentration for all the fractions. The tension decay is less important at pH 3 for all the fractions. The total fraction and the blue fraction appeared to form more elastic films than the green fraction. The blue soluble fraction also presented the highest collapse pressure and initial area.

The second experimental evaluation is focused on the performances of colored *Spirulina* soluble protein fractions as surfactants at water/n-dodecane interface. Evaluation of their interfacial activities is carried out using different methods as for the air/water interface. Different concentrations (0.1%; 0.3% and 0.5% (w/w)) and pH levels (3, 5, and native pH) are tested. Results show that, the interfacial tension decay increased with increased protein concentration. At 0.3% (weight/weight) colored protein concentration in the aqueous phase, the surface tension decay is greater at pH 5 compared to pH 3 and native pH. The interfacial elastic moduli of the fractions suspensions decrease with concentration unlike viscosity moduli.

Investigations on the emulsifying and foaming properties make the third experimental task. Emulsions at pH 3 are very susceptible to destabilization phenomena such as coalescence, and creaming. The emulsifying properties of the three fractions follow the same trends. However, the BSSP fraction shows a better emulsifying effect. Fractions present higher foaming capacities at their native pH, but foams are more stable at pH 3. The foaming behavior at pH 5 is close to that at the native pH.

Despite the undoubted link between *Spirulina* protein surface activity and foaming and emulsifying properties, it should be beard in mind that the best properties are not always only obtained by the conditions of greater ability of the protein to reduce surface or interfacial tension but also to its solubility. Nevertheless the surface activity of the proteins remains the prerequisite to foaming or emulsifying properties.

It should also be emphasized that the fractionation method developped in this work, unlike the methods so far available in the literature, is industrially feasible and could allow for large production of the spirulina protein fractions. One of the obtained fractions (BSSP) presents better emulsifying ptoperties. All the three fractions present interfacial activities, and can provide foaming and emulsifying properties that would allow for their industrial use as emulsifiers in lieu and place of conventional proteins. Their color may be an asset for their use in some specific applications.