Functional extract from microalga *Arthrospira maxima* for cosmetic employment*:* production, characterization and microencapsulation process

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Spirulina (*Arthrospira maxima*) is a microscopic blue-green aquatic alga considered a complete source of nutritional elements. The raw algal biomass directly dried after the collection is used as a whole food or dietary supplement [1]. It contains about 60-70% of proteins, providing all eight essential amino acids (AA) and, furthermore high functional peptides content. More recently, due to the new concept of nutrition and hydration in skin care, spirulina cosmetic application has been proposed based on its protein, AA and, mainly, peptides content. The main interesting peptides in cosmetics are - *signal peptides* stimulating skin fibroblasts to produce more collagen in the matrix of the dermis, - *carrier peptides* delivering trace elements, like copper and magnesium useful in wound healing, and - *enzyme inhibitor peptides* which can reduce the breakdown of collagen and other proteins by interfering with some enzymes (such as MMP or Matrix Metalloprotease). In the present research, the microalgal strain cultures of *Arthrospira maxima* were prepared in Zarrouk's medium [2] and grown in a photobioreactor with exposure to a continuous illumination by cool-white fluorescent lamps and aeration over time. The algal biomass (SP) was liophylized, defatted with *n*-hexane and extracted with distilled water. The total water extract (WSP) contains allophycocyanin alfa and beta, free aminoacids, vitamins and peptides as determined by LC-MS. A series of assays were performed on both Human Epidermal Keratinocyte adults (HEKa) and Dermal Human Fibroblast adults (DHFa) cell lines. WSP did not affect the viability of both HEKa and DHFa cell lines up to 6.0 mg/ml. Moreover, after 24 hours treatment, WSP was able to increase the HEKa proliferation level and DHFa protein content. Low concentrations (1mg/ml) of low molecular weight fractions (< 3 KDa) of WSP (WSP-Co 3 KDa) are able to enhance, in both HEKa and DHFa cell lines, the production of both endogenous extracellular growth factors such as EGF (Epidermal Growth Factor) and FGF (Fibroblast Growth Factor) also enhancing the expression of transmembrane receptors of growth factors (EGFR, VEGFR-1, VEGFR-2) as well as MMP-2 expression. Despite its high functionality, WSP itself showed critical sensory attributes, such as colour intensity and unpleasant odour and taste, which limit its acceptance by consumers; therefore it must be transformed in a stable ingredient with appropriate organoleptic and technological characteristics as well as improved skin performance. Engineered chitosan (C)-based powders containing WSP were produced by spray-drying, a microencapsulation technique commonly used in pharmaceutical and food industry [3]. The selection of the carrier and the careful setting of process parameters resulted in production of a stable and handling powder (WSP/C) made up by small and fully formed microparticles, with high EE (Encapsulation Efficiency). WSP/C produced through a one step process appears a functional ingredient complying with cosmetic use and easy folding into final formulations also ensuring long-lasting stability.

Reference: [1] Plaza, M.; Herrero, M.; Cifuentes, A.; Iba´n˜ ez, E. Innovative Natural Functional Ingredients from Microalgae *J. Agric. Food Chem*., 2009 *57*, 7159–7170 **[2]** Zarrouk C.. Influence de divers facteurs physiques et chimiques sur la croissance et la photosynthe`se de *Spirulina maxima*. Ph. D. Thesis, Paris *Contribution a` l'e´tude d'une cyanophycee* 1966. **[3]** Sansone, F.; Picerno, P.; Mencherini, T.; Porta, A.; Lauro, M.R.; Russo, P.; Aquino, R.P. Technological properties and enhancement of antifungal activity of a Paeonia rockii extract encapsulated in a chitosan-based matrix. *Journal of Food Engineering* **2014** *120*, 260–267