Tuning the properties of biopolymers: from biowaste towards more sustainable advanced materials

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Millions of tonnes of biowaste are generated annually by agricultural and industrial activities, leading to diverse environmental issues. The potential of biowaste to produce value-added products can help boost the circular economy and lead to a significant reduction in the amounts of waste generated and to the efficiency in the use of resources. In this context, alternative sources can be assessed to extract polysaccharides, such as agar or chitin. As for agar, red algae Rodophyta (Gelidium sesquipedale), collected in the Basque Country, can be used to extract agar in boiling water, a simple and sustainable process for agar production. Regarding chitin, this can also be obtained from marine waste, such as crustacean shells, following three processes: deproteinisation in an alkaline medium to separate proteins and polysaccharides, demineralisation to remove inorganic matter using an acid medium, and decolourisation to remove pigments. However, fruit fly pupae (Ceratitis capitata), which causes indirect economic losses in citrus production, or insects (Tenebrio molitor), used for food protein production, can be evaluated as alternative sources for chitin extraction since the demineralisation process can be avoided. Additionally, the use of squid pens as a source of chitin requires neither demineralisation nor decolourisation, thus reducing both production costs and environmental burden. This chitin can be used to improve the functional properties of other biopolymers, such as proteins (e.g. gelatin or soy protein), which can also be extracted from bio-residues, for the development of advanced materials with properties tailored to specific applications, such as tissue regeneration (e.g. wound healing).