Contents Digest

Milk proteins as encapsulation devices and delivery vehicles

Increasing the shelf life of sensitive substances and targeting the release of nutritional/bioactive molecules are among the great challenges for the food industry. The development of food products with embedded encapsulation devices used to reach these objectives constitutes a growing market. Milk proteins are biopolymers that are chemically and structurally versatile and are well adapted to several encapsulation purposes. On page 5, Saïd Bouhallab and coworkers review the strategies, techniques, advantages and trends associated with the use of milk proteins as encapsulating device are reviewed. Special attention is given to the novel potential of reversibly co-assembled protein structures as encapsulating devices. Encapsulation technologies that have been used for a long time in the pharmaceutical industry for drug delivery applications offer a real opportunity for the food industry. Encapsulation represents a means to develop innovative products to satisfy the growing demand of the consumer for foods with health and well-being benefits and is now widely used to stabilize food ingredients, increase flavor retention or to mask undesirable flavors. Hydrophobic vitamins, polyphenols, flavorings, fatty acids, cells, and minerals are among encapsulated bioactives. At the laboratory scale, milk proteins are effective in protecting bioactives against oxidation and photodegradation, increasing their solubility, and in maintaining the viability of probiotic cells. Traditional encapsulations technologies have been applied to milk proteins, including spray drying, freeze drying, extrusion and coacervation. However, despite the success on a laboratory scale, these technologies applied to proteins as encapsulation devices still present limitations and difficulties for the large-scale production of food-grade microencapsulated substances. Hence, the up scaling of laboratory results remains a research challenge. For food applications, a further challenge is to ensure that sensitive molecules can be entrapped in a form that is physically and chemically compatible with the food matrix without adverse effects. Also, the use of milk proteins for the targeted delivery of food bioactives or for increasing nutrient bioavailability remains an emerging research area. Encapsulation via novel technologies constitutes another issue for future research. The trend is toward a reduction in particle size with a special interest in developing techniques such as electrospraying and electrospinning of proteins for the production of nanosized particles. Another field to explore is the encapsulating potentialities of spontaneously co- or self-assembled supra-molecular structures: native casein micelles, α-lactalbumin nanotubes, β-lactoglobulin fibers, and nanospheres from oppositely charged proteins. The fact that these nanoparticles are tailored from natural and edible polymers, without the use of exogenous additives, makes them promising as building blocks for encapsulation, offering several associated innovations and advantages. Before suggested applications are implemented, fundamental research to better control milk protein co-assembly into nano-microspheres is needed in particular concerning: (i) assembly and disassembly mechanisms in the presence of bioactives and (ii) the stability of formed supra-molecular structures toward processing and storage conditions either on their own or incorporated within food matrices. For some application purposes, it would be necessary to tailor and stabilize these structures using, for instance, food-grade cross-linkers. Due to their edibility, milk proteins and their multiple assemblies constitute ideal drug carriers for an oral-delivery system and several pharmaceutical projects are already ongoing.

Melatonin from different fruit sources, functional roles, and analytical methods

Recently melatonin has been reported in different fruits and its exact amount is influenced by many factors, including fruit type, variety and ripening stage, growth location and condition, and analytical method employed. Validated analytical methods with adequate sample treatment are required to obtain accurate measurement of melatonin in fruits. Importantly, diet high in melatonin from fruits could enhance human health. Also, melatonin could be used to improve the phytoremediation efficiency of plants against different pollutants such as heavy metals. On page 21, Xiaoyuan Feng and coworkers review the recent contributing factors on the production and amount of melatonin in fruits, current analytical approaches, its functional roles, as well as the future research needs to clarify the mechanisms of fruit melatonin for improving human health and environment contaminations. Melatonin is a compound naturally present in foods. It has been shown that melatonin is widespread in different varieties of fruit and its exact amount is influenced by many factors, including fruit varieties and ripeness stage, genetic traits, growth conditions, environmental stresses, and analytical method. Recently more studies have focused on understanding the relationships between melatonin content and fruit ripening stage, but the regulated mechanisms of melatonin based on the fruit ripening have not been fully understood. Noticeably, the influence of postharvest manipulations to prolong the shelf life of fruits on melatonin concentrations has not been investigated yet. Such information may help the understanding of the physiological roles of melatonin during ripening. To accurately determine the amount of melatonin in fruits, validated analytical

0924-2244/$ - see front matter © 2014 Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.tifs.2014.04.002

methods with adequate sample treatment are required, which remains the most challenging in the study of melatonin in fruits. There is a need for more accurate analytical methods to obtain reliable result in fruits in order to compile data to understand the impact of the dietary melatonin. The biosynthetic pathway of melatonin in fruits should also be further studied as well, although the recent research verified the presence of SNAT in plants for the first time and ASMT is the rate-limiting enzyme for melatonin biosynthesis. It is unclear whether the postulated biosynthetic pathway in plants is ubiquitous or not. The homologue or a paralogue of 5-OH Trp synthase has not been identified in plants, implying that the enzyme, that converts tryptophan to serotonin, may have a different evolutionary origin. Moreover, studies indicated that the primary function of melatonin in fruits is to serve as the first line of defense against oxidative stresses, which are a result of internal and environmental insults. However, it is still unknown whether the antioxidant capacity of melatonin in fruits is exclusively dependent on its direct interaction with ROS or it is mediated by melatonin receptors. Melatonin receptors have not been reported in fruits. Besides functioning as an antioxidant, melatonin could be used to improve the phytoremediation efficiency of plants against different pollutants such as heavy metals. Finally, fruit intake may influence endogenous melatonin level and consequently promote human health by virtue of its biological activities. Hence, the use of melatonin in nutraceutical and environment phytoremediation is a new frontier to be explored.

Role of processing on bioaccessibility of minerals

Phytate, phenolic compounds and fiber are known anti-nutritional factors (ANFs) that contribute to the low bioaccessibility and bioavailability of iron and zinc in plant foods. Better insight into the localization of minerals and anti-nutritional factors in plant tissues, as well as on the mechanisms of interaction between minerals and ANFs, may lead to better targeted processing for improvement of the bioaccessibility of minerals in plant foods. On page 32, John Van Camp and coworkers review the subcellular distribution of iron and zinc and their ANFs in plant organs, as well as the mechanisms of interaction between these metals and their ANFs. These insights are then used to better clarify the role of various processing technologies, like mechanical treatments, soaking, germination, fermentation and heating, on improving the bioaccessibility of iron and zinc in plant foods. It is clear that an increase in mineral bioaccessibility cannot be obtained by focusing on the complexation and/or degradation of just one ANF. Therefore, more knowledge is needed on how different ANFs act together in determining the mineral bioaccessibility in plant products. Besides, it is important to take into account the cellular location of both minerals and ANFs when investigating the impact of different processing techniques on the increase of mineral bioaccessibility. New techniques including high resolution secondary ion mass spectrometry (NanoSIMS), synchrotron radiation soft X-ray full-field imaging mode (FFIM) and low-energy X-ray fluorescence (LEXRF) spectromicroscopy are now available to study the mineral and antinutrient location and interaction in the plant before and after processing, and thus more insight can be gained. Based on the various interaction mechanisms, relevant processing techniques can be selected, i.e. destroying the plant matrix, and thus affecting the location in the plant cell of both minerals and ANFs, influencing the pH, which in turn affects the interaction, and degradation or conversion of ANFs (phytate, phenolic compounds and fibers), all of them affecting the bioaccessibility. However, one needs to take into account that interaction of minerals with other compounds (e.g. proteins, fermentation metabolites) can also occur, which in turn, can affect the mineral bioaccessibility.

Protein nanostructures in food − should we be worried?

Nanotechnology promises to affect many aspects of our lives with its development being greeted with both excitement and fear. The debate concerning nanotechnology has echoed that of genetically engineered organisms and their introduction into the environment and the food chain. Nanotechnology offers many potential advantages in the processing and manufacture of foods: enhanced bioavailability, color and flavor; novel food textures; new delivery mechanisms; and access to biosensors to enhance food safety. In fact, many of the foods we have been consuming for centuries already contain nanostructures, leading many to assume that they are safe. The extent to which novel nanostructures may afford new risks has not been adequately resolved, however, leading to concern within some consumer groups. In this article, we use proteins as a case study to explore our current understanding of nanostructures in foods and the extent to which novel nanostructures may introduce new properties. It is well recognized that some protein nanostructures are toxic and are associated with disease, so there is legitimate concern as to whether such species should be deliberately introduced into our foods. On page 42, Juliet A. Gerrard and coworkers review current literature on protein nanostructures in food and possible risks associated with their use, and aim to provide a balanced assessment to inform future decision-making regarding the utilization of