Comparing the features of astaxanthin at different microencapsulated form

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Outline

Introduction

- Astaxanthin
- Microencapsulation

Microencapsulation in different ingredients

- Calcium alginate
- Maltodextrin and gum Arabic
- Soluble corn fiber mix with whey protein isolate or sodium caseinate

Conclusion

Abstract

Astaxanthin is a type of carotenoids found in marine animals to give them a characteristic red pigmentation. Astaxanthin has been shown to exhibit a stronger antioxidant activity than vitamin E and β-carotene. However, astaxanthin has poor water solubility and the presence of double bonds has made astaxanthin susceptible to oxidants, light and heat; those limit its application in the food industry. Microencapsulation can protect astaxanthin against deterioration and to improve the solubility and stability. The utilization of calcium alginate to encapsulate astaxanthin was able to significantly improve the thermal stability of astaxanthin. Using maltodextrin and gum arabic, separately or mixed, mixed with phosphatidylcholine, to microencapsulate astaxanthin. The resulting powders present interesting properties for use as food ingredients, as they have an intense red color, high water solubility and stability. Furthermore, the higher bioaccessibility of the astaxanthin contained in the extract and the higher antioxidant activity of the bioaccessible fractions, as compared to those of the non-encapsulated sample. Blends of milk protein (either whey protein isolate, WPI or sodium caseinate, SC) and carbohydrate (soluble corn fiber, SCF 70) as the wall materials can provide reasonably good properties of water activity, surface morphology, microencapsulation efficiency and oxidative stability.

References

Anal, A. K., Stevens, W. F., & Remunan-Lopez, C. (2006). Ionotropic cross-linked chitosan microspheres for controlled release of ampicillin. *Int J Pharm, 312*(1-2), 166-173. doi: 10.1016/j.ijpharm.2006.01.043

Bernhard, K. (1989). Synthetic astaxanthin. The route of a carotenoid from research to commercialisation *Carotenoids* (pp. 337-363): Springer.

Chen, Q., McGillivray, D., Wen, J., Zhong, F., & Quek, S. Y. (2013). Co-encapsulation of fish oil with phytosterol esters and limonene by milk proteins. *Journal of Food Engineering, 117*(4), 505-512. doi: 10.1016/j.jfoodeng.2013.01.011

Dickinson, E. (2003). Hydrocolloids at interfaces and the influence on the properties of dispersed systems. *Food hydrocolloids, 17*(1), 25-39.

Frankel, E. N., Neff, W. E., & Selke, E. (1981). Analysis of autoxidized fats by gas chromatography-mass spectrometry: VII. Volatile thermal decomposition products of pure hydroperoxides from autoxidized and photosensitized oxidized methyl oleate, linoleate and linolenate. *Lipids, 16*(5), 279-285.

Gharsallaoui, A., Roudaut, G., Chambin, O., Voilley, A., & Saurel, R. (2007). Applications of spray-drying in microencapsulation of food ingredients: An overview. *Food Research International, 40*(9), 1107-1121. doi: 10.1016/j.foodres.2007.07.004

Higuera-Ciapara, I., Felix-Valenzuela, L., Goycoolea, F. M., & Argüelles-Monal, W. (2004). Microencapsulation of astaxanthin in a chitosan matrix. *Carbohydrate Polymers, 56*(1), 41-45. doi: 10.1016/j.carbpol.2003.11.012

Kanakdande, D., Bhosale, R., & Singhal, R. S. (2007). Stability of cumin oleoresin microencapsulated in different combination of gum arabic, maltodextrin and modified starch. *Carbohydrate Polymers, 67*(4), 536-541. doi: 10.1016/j.carbpol.2006.06.023

Keri Marshall, N. D. (2004). Therapeutic applications of whey protein. *Alternative Medicine Review, 9*(2), 136-156.

Kittikaiwan, P., Powthongsook, S., Pavasant, P., & Shotipruk, A. (2007). Encapsulation of Haematococcus pluvialis using chitosan for astaxanthin stability enhancement. *Carbohydrate Polymers, 70*(4), 378-385. doi: 10.1016/j.carbpol.2007.04.021

Lin, S. F., Chen, Y. C., Chen, R. N., Chen, L. C., Ho, H. O., Tsung, Y. H., . . . Liu, D. Z. (2016). Improving the Stability of Astaxanthin by Microencapsulation in Calcium Alginate Beads. *Public Library of Science One, 11*(4), e0153685. doi: 10.1371/journal.pone.0153685

Miao, F., Geng, Y., Lu, D., Zuo, J., & Li, Y. (2013). Stability and changes in

astaxanthin ester composition from Haematococcus pluvialis during storage. *Chinese Journal of Oceanology and Limnology, 31*(6), 1181-1189. doi: 10.1007/s00343-013-2105-3

Montero, P., Calvo, M. M., Gómez-Guillén, M. C., & Gómez-Estaca, J. (2016). Microcapsules containing astaxanthin from shrimp waste as potential food coloring and functional ingredient: Characterization, stability, and bioaccessibility. *LWT - Food Science and Technology, 70*, 229-236. doi: 10.1016/j.lwt.2016.02.040

Rahman, M. S., & Labuza, T. P. (2007). Water activity and food preservation. *Handbook of food preservation, 20*, 448-471.

Shen, Q., & Quek, S. Y. (2014). Microencapsulation of astaxanthin with blends of milk protein and fiber by spray drying. *Journal of Food Engineering, 123*, 165-171. doi: 10.1016/j.jfoodeng.2013.09.002

Sheu, T. Y., & Rosenberg, M. (1998). Microstructure of microcapsules consisting of whey proteins and carbohydrates. *Journal of Food Science, 63*(3), 491-494.

Shilpa, A., Agrawal, S. S., & Ray, A. R. (2003). Controlled delivery of drugs from alginate matrix. *Journal of Macromolecular Science, Part C: Polymer Reviews, 43*(2), 187-221.

Tantra, R., Schulze, P., & Quincey, P. (2010). Effect of nanoparticle concentration on zeta-potential measurement results and reproducibility. *Particuology, 8*(3), 279-285.

Vilstrup, P. (2001). *Microencapsulation of food ingredients*: Leatherhead Publ.

Wilson, N., & Shah, N. P. (2007). Microencapsulation of vitamins. *ASEAN Food Journal, 14*(1), 1.