ASSESSMENT OF NANOTECHNOLOGY FOR PREPARATION OF SOME NATURAL PIGMENTS AS FOOD ADDAITIVES

By

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B.Sc. Agric. Sci. (Food Technology), Cairo University (2003)

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ABSTRACT

Rasha Kamal Mohamed Abd El-Nabi: Assessment of Nanotechnology for Preparation of some Natural Pigments as Food Additives. Unpublished Ph.D. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2017

Anthocyanins attracted attention as a potential source of natural colorants and as antioxidants. The extraction procedure is of great importance for the quality of natural colorant. In the present study, different extraction media such as, ethanol (0 - 80 %), acidified water (1% HCl) with ethanol (0 - 80 %), acetic acid solution (1 - 2 %) and acidified (0.5 - 2 % lactic acid) 80 % ethanol were used to extract anthocyanins from Hibiscus (A_H) and black mulberry (A_M). The antioxidant capacity of different extracts were also evaluated using DPPH, ABTS and FRAP assays. Among different tested media, acidified (2 % lactic) 80 % ethanol, acidified (1%HCl) 50 % ethanol and 2 % acetic acid solution significantly exhibited higher anthocyanin content from hibiscus (being 725.91, 685.78 and 634.90 mg/100g, respectively). On other side, the maximum content of anthocyanins extracted from mulberry was obtained by using 1 % HCl acidified water (1282.18 mg / 100 g). With regard to antioxidant activity, both the acidified (2 % lactic acid) 80 % ethanol and acidified (1%HCl) 50 % ethanol of hibiscus extracts and 1% HCl acidified water of mulberry showed strong antioxidant activity.

Color characteristics (L*, a*, b*, Hue and Chroma) of hibiscus and black mulberry extracts, which exhibited the highest anthocyanin content, were measured using a Hunter coloimeter. Overall, the color of hibiscus extracts was dark (low L* value) but with low intensity (less vivid).On the other hand, the color of mulberry extracts was light (high L* value) but with high intensity (high vivid).

A strong correlation was observed between the anthocyanin levels and antioxidant capacity values of different hibiscus and mulberry extracts (R^2=0.98, 0.984 and 0.90) measured by DPPH, ABTS and FRAP assays, respectively

Synthesis and characterization of chitosan nanoparticles (CS-NP)

and evaluation of their loading capacity with natural anthocyanins from hibiscus and black mulberry to produce anthocyanin nanocomposities (A_H-NC and A_M-NC) was carried out. Characterization with TEM showed that CS-NP were successfully synthesized with diameters ranged from 40 to 52 nm and UV–Vis spectrophotometry confirmed the successful loading of anthocyanins into chitosan nanoparticles (CS-NP). Zeta potential results reflect the greater stability of A_H-NC and A_M-NC than CS-NP.

Results showed that A_H-NC had significantly higher antioxidant activity values than that of A_H. On contrary, A_M –NC showed less AOA values than that of A_M. Also, color characterization indicates that both A_H-NC and A_M-NC achieved good color parameters than A_H and A_M.

Kinetics and thermodynamics of degradation of A_H, A_M versus A_H-NC and A_M –NC was studied .Results showed the enhancement of the thermal, pH, and light stability of A_H-NC and A_M-NC than A_H and A_M as a result of loading the pigment on CS-NP. By comparing the half-life values of different anthocyanins samples, it could be concluded that, at 25°C, A_H and A_M extracts were ≈ 57.55 and 21.52 times less susceptible to degradation than they were at 100° ($t_{1/2}$ 25°C / $t_{1/2}$ 100°C). On other hand at 25°C the half life values of A_H-NC and A_M-NC were ≈ 65.20 and 21.27 times less susceptible to degradation as at 100°C, respectively.

The potential application of anthocyanins as natural colorants in gelatin gum and ice cream was also studied. Results showed that the color parameters and sensory evaluation of gelatin gum and ice cream samples colored with anthocyanin nanocomposites A_H-NC and A_M –NC were more stable and acceptable than those of free anthocyanin A_H and A_M.

Key words: Anthocyanins, *Hibiscus sabdarriffa L.* , *Morus nigra L.***,** extraction, antioxidant activity, color parameters, chitosan nanoparticles, nanofood , food nanotechnology, nanocomposite, temperature, light, pH stability, kinetic degradation.

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