

# **ASSESSMENT OF NANOTECHNOLOGY FOR PREPARATION OF SOME NATURAL PIGMENTS AS FOOD ADDITIVES**

By

**RASHA KAMAL MOHAMED ABD EL-NABI**

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

M.Sc. Agric. Sci. (Food science), Ain Shams University (2010)

**A thesis submitted in partial fulfillment**

**Of**

**The Requirements for the Degree of**

**DOCTOR OF PHILOSOPHY**

**in**

**Agricultural Sciences**

**(Food Science and Technology)**

**Department of Food Science**

**Faculty of Agriculture**

**Ain Shams University**

**2017**

Approval Sheet

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**This thesis for Ph.D. degree has been approved by:**

**Dr. Taiseer Mahmoud Abu-Bakr** .....

Prof. Emeritus of Food Science and Technology, Faculty of  
Agriculture, Alexandria University

**Dr. Yehia Abd El-Razik Hekal** .....

Prof. Emeritus of Food Science and Technology, Faculty of  
Agriculture, Ain Shams University

**Dr. Nagwa Mousa Hassen Rasmy** .....

Prof. Emeritus of Food Science and Technology, Faculty of  
Agriculture, Ain Shams University

**Dr. Ahmed Youssef Gibriel** .....

Prof. Emeritus of Food Science and Technology, Faculty of  
Agriculture, Ain Shams University

**Date of Examination:**    /    /

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M.Sc. Agric. Sci. (Food science), Ain Shams University (2010)

**Under the supervision of**

**Dr. Ahmed Youssef Gibriel**

Prof. Emeritus of Food Science and Technology, Dept. of Food  
Science, Faculty of Agriculture, Ain Shams University  
(Principal Supervisor)

**Dr. Nagwa Mousa Hassen Rasmy**

Prof. Emeritus of Food Science and Technology, Dept. of Food  
Science, Faculty of Agriculture, Ain Shams University

**Dr. Ferial Mohamed Mohamed Abu-Salem**

Researcher Prof. Emeritus of Food Science and Technology, Dept. of  
Food Science & Technology, National Research Center

## 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 Unpublished Ph.D. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2017**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 colorimeter. 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 nanocomposites (A<sub>H</sub>-NC and A<sub>M</sub>-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<sub>H</sub>-NC and A<sub>M</sub>-NC than CS-NP.

Results showed that A<sub>H</sub>-NC had significantly higher antioxidant activity values than that of A<sub>H</sub>. On contrary, A<sub>M</sub>–NC showed less AOA values than that of A<sub>M</sub>. Also, color characterization indicates that both A<sub>H</sub>-NC and A<sub>M</sub>-NC achieved good color parameters than A<sub>H</sub> and A<sub>M</sub>.

Kinetics and thermodynamics of degradation of A<sub>H</sub>, A<sub>M</sub> versus A<sub>H</sub>-NC and A<sub>M</sub>–NC was studied .Results showed the enhancement of the thermal, pH, and light stability of A<sub>H</sub>-NC and A<sub>M</sub>-NC than A<sub>H</sub> and A<sub>M</sub> 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<sub>H</sub> and A<sub>M</sub> extracts were  $\approx 57.55$  and  $21.52$  times less susceptible to degradation than they were at 100° ( $t_{1/2} \text{ } 25^{\circ}\text{C} / t_{1/2} \text{ } 100^{\circ}\text{C}$ ). On other hand at 25°C the half life values of A<sub>H</sub>-NC and A<sub>M</sub>-NC were  $\approx 65.20$  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<sub>H</sub>-NC and A<sub>M</sub>–NC were more stable and acceptable than those of free anthocyanin A<sub>H</sub> and A<sub>M</sub>.

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

## ACKNOWLEDGEMENT

All praises and thanks are due to **ALLAH**, who blessed me with kind professors and colleagues, and gave me the support to complete this thesis.

I am grateful and indebted to **Dr. Ahmed Gabriel**, Professor of Food Science and Technology, Faculty of Agriculture, Ain-Shams University, for his kind supervision, willing cooperation, keen guidance and continuous encouragement throughout this investigation.

I would like to express my sincere appreciation to **Dr. Nagwa Mousa Hassen Rasmy**, Professor of Food Science and Technology, Faculty of Agriculture, Ain-Shams University, for her guidance, encouragement and patience with me throughout my Ph.D. study, editing this thesis and it is my great honor to work under her supervision.

I would like to express my deep gratitude to **Dr. Ferial Mohamed Mohamed Abu-Salem**, Professor of Food Science and Technology, National Research Center for planning of this study, engaging me in new ideas, her valuable criticism, kind direct supervision, encouraging my research and for allowing me to grow as a research scientist.

I am extremely grateful to **Dr. Taher Ahmed Salah E-IDin**, Associate Professor of Nanotechnology, in Agriculture Research Center and Director of Mostafa Elsayed Nanotechnology Research Centre, British University in Egypt for encouraging and giving all the facilities that made this work possible, I appreciate what I have learned from him, not only the broad knowledge, sharp scientific instinct and creative ideas, but also the optimistic and confident personality.

Also, my sincere thanks go to **Dr. Esmat Anwar kottb**, Professor of Food Science and Technology, National Research Center, who gave me the confidence and guidance to explore my research.

Thanks due to all staff members of Food Technology lab, National Research Centre and all staff members of Nanotechnology and Advanced Materials Central Lab., Agricultural Research Center for their assistance and support for using the various laboratory equipments.

In this respect I cannot forget to thank my family for their patience, moral support and giving me chances to complete this work.

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