THERMAL DEGRADATION OF CANTHAXANTHIN IN A MODEL SYSTEM UNDER TIME AND TEMPERATURE CONDITIONS OF VARIOUS FOOD PROCESSES

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THERMAL DEGRADATION OF CANTHAXANTHIN IN A MODEL SYSTEM UNDER TIME AND TEMPERATURE CONDITIONS OF VARIOUS FOOD PROCESSES

By TARIK HUSSIEN ROSHDY

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بسم الله الرحمن الرحيم

IN THE NAME OF GOD, MOST GRACIOUS, MOST MERCIFUL

ABSTRACT OF THE THESIS

Thermal Degradation of Canthaxanthin in a Model System Under Time and Temperature Conditions of Various Food Processes

By TARIK HUSSIEN ROSHDY, Ph.D.

Dissertation Director: Professor Henryk Daun

Carotenoids are one of the most important groups of natural pigments found in the plant and animal kingdoms. Canthaxanthin is an important oxygenated carotenoid. It occurs in many raw foods such as poultry, eggs, fish and crustaceans. It is also one of the approved food colorants. There is no published information available on thermal degradation products of canthaxanthin.

A model system has been developed to study chemical reactions involved in the heat treatment of canthaxanthin. Time and temperature conditions were selected to simulate deep fat frying, broiling, baking, roasting, drying, and boiling. Canthaxanthin was heated at 210°C, 175°C, and 100°C for 4, 2, 1 and 1/2 hours in glycerol.

Twenty-three compounds from the volatile thermal degradation products (TDP) of canthaxanthin were tentatively identified by gas chromatography and mass spectrometry as follows: Heptane; Methyl-cyclohexane; 2-Methyl-1,3,5-hexatriene; Methylbenzene(Toluene); 4-Methyl-3-penten-2-one; 1,2-Dimethylbenzene (O-xylene); 1,3-Di-methylbenzene(m-xylene); 3,4,4-Tri-methyl-2-cyclohexen-1-one; Methyl(1-Methylethenyl)benzene; 1-Ethenyl-3,5-dimethylbenzene; 1,4-Dimethyl-2-(1-methyl-etnyl)benzene; 5-Methyl-2-(1-methylethyl)-2-cyclohexen-

1-one; 1,2-Di-hydro-6-methylnaphthalene; 1,2-Dihydro-2-methylnaphthalene; 1,3,5-Trimethyl-2-(1,2-propadienyl) benzene; (1-methylethylidene)cyclo-propylbenzene; 1,2-Di-hidro-2,5,8-trimethylnaphthalene; 2,6-di-methyl-naphthal-ene; 1,3,5-Trimethyl-2-(3-methyl-1,3-butadiene)-benzene; 1,2,3-Trihydro-4-keto-1,1,6-trimethylnaphthalene; 1,2-Dimethyl-4-(phenylmethyl)-benzene; 2-(1,1,5-Trimethyl-4-keto-cyclohex-1-enyl-1-toluene-1-ethene; 2,6-Dimethyl-9-(1,1,5-trimethyl-4-keto-1-cyclohexenyl)-1,3,5,7-octatetraene.

Five non-volatile compounds were tentatively identified from thermal decomposition products of canthaxanthin under conditions of our experiments using UV-visible, IR, and mass spectrometry techniques as follows: 3,7-Dimethyl-8-tolunyl(1,2,3-trihydro-4-keto-1,1,6,10-tetramethylnaphthalene; 4-Methyl-1,6-di(1,1,5-trimethyl-4-keto-5-cyclohexenyl)-1,3,5-hexatriene; 3,7-Dimethyl-8-tolunyl-1-(1,1,5-trimethyl-keto-5-cyclohexenyl)-1,3,5,7-octatetraene; 3,6,10-trimethyl-1,12-bis(1,1,5-trimethyl-4-keto-5-cyclohexenyl)-1,3,5,7,9,11-dodecahexaene; 6,10-Dimethyl-1,12-bis(1,1,5-trimethyl-4-keto-5-cyclohexenyl)-1,3,5,7,9,11-dodecahexaene.

This study is the first on canthaxanthin thermal degradation. The presence of all of the above compounds as canthaxanthin thermal decomposition products have not been reported in the literature.

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TO

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DEDICATION

This work is dedicated to my great and lovely mother, who was selected as the Model Mother for my high school in Cairo, Egypt in 1963. With love, support, encouragement and wisdom she lit the way to this achievement.

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