A STUDY ON THE EFFICIENCY OF BORAGE OIL AND BETA-CAROTENE IN PREVENTIVE RATS EXPOSED TO GAMMA RADIAYION

Submitted By

Sherin Salah El-Din Abou-Shanb

B.Sc. of (Nutrition & Chemical Nutrition), Faculty of Girls, Ain Shams University, 1990

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A thesis submitted in Partial Fulfillment
Of
The Requirement for the Doctor of Philosophy Degree
In
Environmental Science

Department of Environmental Basic Science
Institute of Environmental Studies and Research
Ain Shams University

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Under The Supervision of:

1- Prof. Dr. Nagwa Ibrahim Yehia Hassanin
Prof. of Nutrition, Department of Biochemistry& Nutrition
Faculty of Girls for Arts, Science & Education
Ain Shams University.

2- Dr. Hala Abd El-Rahman Hassan Khatabe
Assistant Prof. of Nutrition, Department of Nutrition & Food Science
Faculty of Home Economics
Helwan University.

3- Dr. Tamer Mohamed Mahmoud Saad
Assistant Prof. of Biochemistry, Department of Medical
& Radiation Research
Nuclear Materials Authority.

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APPROVAL SHEET

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This thesis Towards a Doctor of Philosophy Degree in Environmental Science has been approved by:

Name	Signature
1- Prof. Dr. Sami Ahmed Abd El-Aziz Prof. of Biochemistry Faculty of Veterinary Medicine Cairo University.	
2- Prof. Dr. Fawzi Amin Shobaki Prof. of Nutrition National Research Centre	
3- Prof. Dr. Nagwa Ibrahim Yehia Hassanin Prof. of Nutrition, Department of Biochemistry& Nutrition Faculty of Girls for Arts, Science & Education Ain Shams University.	

2013

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List of Abbreviations

Abb.	Meaning
BLO	Borage leaves oil
BWG	Body weight gain
e	Negative ion
EDTA	Ethylene diamineteracetic acid
FI	Food intake
GGT	Gamma glutamyl transferase
GSH	Glutathione peroxidase
Gy	Gray = 100 rad = 1 j/kg
$H^{\cdot}$	Hydrogen free radical
H_2O^+	Positive ion
H_2O_2	Hydrogen peroxide
Hb	Hemog lo bine
HDL-c	High density lioprotein- cholesterol
H^+	Positive hydrogen ion
LDL-c	Low density lioprotein- cholesterol
LPO	Lipid peroxidation
MDA	Malondialdehyde
O^{-2}_2	Superoxide anion
O_2H^-	Hydrated peroxy anion
$OH^{\cdot}$	Hydroxyl radical
$R^{\cdot}$	Organic free radical
rad	Radiation absorbed dose = 0.01 J/Kg
RBCs	Red blood cells

Abb.	Meaning
$RO^{\cdot}_2$	Peroxy radical
ROS	Reactive oxygen species
SOD	Superoxide dismutase
TAGs	Triacylglycerols
TC	Total cholesterol
WBCs	White blood cells

Acknowledgment

I would like to express my thanks and gratitude to **Prof. Dr. Nagwa Hassanin,** Prof. of Nutrition, Biochemistry and Nutrition Department, Girls Faculty, Ain shams University, Cairo, Egypt, for suggesting the plan, her supervision, encuragement, valuable advice throughout the stages of the study and revising the manuscript.

My sincere thanks are due to **Dr. Hala Khatabe,** Asst. Prof. of Nutrition, Nutrition and Food Science Department, Faculty of Home Economics, Helwan University, for her supervision, precious comments, helping for the practical stages, sincere encouragement and revising the manuscript.

Special thanks are due to **Dr. Tamer Mohamed Saad,** Asst. Prof. of Biochemistry, Medical and Radiation Research Department, Nuclear Materials Authority, for his supervision, valuable guidance, sincere encouragement and revising the manuscript.

I am grateful to **Dr. Fatma, S. El-sharabasy,** Asst.Prof. of Biochemistry, Department of chemistry of Natural Products, National Research Center, Dokki, Egypt for her Kind help to carry out the extraction of borage leaves oil.

I am grateful to **Dr. Mohamed Farag Hammad,** Head of Medical and Radiation Department and **Dr. Amal Ahmad Abubakr Ammar,** lecturer of Biochemistry, Research Division, Nuclear Materials Authority, Cairo, Egypt, for their valuable assistance during the various step of this work.

I would like to thank all the staff members and my colleagues of the Radiation Biology Department, National Center for Radiation Research and Technology, Atomic Energy Authority Cairo Egypt, for the radiation facility offered, their help and encouragement.

My deepest gratitude goes to my *Mother Amal Faid*, My brother *Karim Abou Shanb*, for their help and encouragement during all my life and the various steps of the work.

Abstract

Ionizing radiation is known to generate reactive oxygen species. Borage leaves oil (*Borage officinal L.*) contain a high percentage of gamma-linolenic acid, which is reported to be used as a preventive treatment of a wide range of disorders. This study was conducted to investigate the efficacy of borage leaves oil (BLO) as compared with B-carotene against gamma -irradiation induced oxidative stress in rats.

One hundred thirty two adult male albino rats of Sprague-Dawley strain were divided into ten groups, negative control(G1);animals exposed to single sublethal dose (6.5KGy) of gamma-radiation(G2);animals received 200µg/Kg b.w/day BLO,(G3); (G4) legend as in (G3) for 7days then irradiated and six of them was sacrificed after the first day post irradiation and the remainder divided into two sub-group named (G5) and (G6);animals received 30mg/kg b.w /day β-carotene,(G7) legend as in (G8) and following the same method of (G4) and divided into sub-group named (G9) and (G10). Six rats from each group were sacrificed after1, 7 and 15 days post irradiation.

The results showed that, irradiation induced high significant decrease at 7th and 15th day in body weight gain (BWG) and feed intake(FI) as compared with corresponding non-irradiation group.

Activities of SOD, GSH and GSH-Px were highly significantly decreased, while marked highly significant increase in MDA and lipid profiles parameters, except HDL-C which recorded very highly significant decrease due to irradiation, there was a great damage on liver tissues as shown by histopathological examination.

Supplementation with either BLO or B-carotene before or during treatment after irradiation exerted marked amelioration of irradiation induced disturbances in all the investigated parameters and histopathological changes treated.

Therefore, BLO could have a beneficial role in modulating oxidative stress by improving the natural antioxidant mechanism.

Key words: BLO, SOD, GSH, GSH-PX, MDA, Lipid profile, BWG, FI.

Introduction

Damaging effects of ionizing radiation are brought by direct and indirect mechanisms, the direct action produces disruption of sensitive molecules in the cells, while the indirect effect results from its interaction with water molecules, which results in the production of highly reactive free radicals and their subsequent action on subcellular substrates that destroy the structure of cells **(Manuchair Ebadi, 2003** and **Devasagayam et al., 2004)**.

Reactive oxygen species (ROS) in excess can damage cellular components and cause lesions in an organism. Activated oxygen, however, readily reacts with biomembrane polyunsaturated fatty acids to cause lipid peroxidation, which disturbs physiological functions of living cells **(Sardesai, 1995)**. Cells possess an elaborate defense system to destroy these reactive species, which are the antioxidant defenses, the imbalance between reactive oxygen species and the antioxidant defense mechanism of the cell leading to an excessive production of oxygen metabolites, creates a condition frequently termed (oxidative stress) **(Ho et al., 1998)**.

Many radical scavengers, interestingly naturally occurring antioxidants carotenoids, have been found to be effective in inhibiting the oxidative damage. Carotenoids occur naturally in many foods and vegetables. They reported to be excellent antioxidants and inhibit some types of cancer **(Nishino, 1998)**. Furthermore **Funegrad et al. (1995)** found that, supplementation with antioxidant vitamins can reduce the adverse effects of irradiation in rats. Moreover, **Ammar, (2000)** found that, administration of ß-carotene before irradiation exerted marked amelioration of the radiation hazards.

Flavonoids are a group of naturally occurring compounds with interesting medical properties, such as antiviral, anti-inflammatory, antiallergic, antibacterial and antitumor activities **(Krol et al., 2002)**. Plant phenolics can delay the onset of oxidation and decomposition of hydroperoxides in living tissues **(Yanishlieva and Marinova, 1995).** Borage (*Borage Officinalis Linn*) belongs to the family *Boraginaceae*, it has many active constitutes **(Chevallier, 1996)**. Borage has been used from ancient times for culinary and medicinal purposes. Borage oil has been used for the treatment of a wide range of nutritional and clinical disorders, because it contain two to three times more γ-linolenic acids than evening primrose oil **(Foster et al., 2010)**, it lowers blood pressure in spontaneously hypertensive rats **(Engler and Engler, 1998)** and exhibit anticarcinogenic activity **(Munoz et al., 1998)**.

Borage oil is one of great interest among medical and nutritional research groups due to its high content of γ-linolenic acid (GLA) **(Wolff and Sebedio, 1994).** Moreover, **Pradeep et al. (2008)** found that, dietary supplementation with borage (starflower) oil could be substituted for non-steroidal anti-inflammatory drugs and has a beneficial effect on controlling pain.

Aim of the Work

The objective of the present study was to evaluate the possible radio-protective effect of each of Borage leaves oil as antioxitant as compare to β-carotene against gamma-irradiation hazards in male albino rats.