BIOCHEMICAL STUDIES ON SEEDS OF SOME OIL CROPS AS A SOURCE OF ESSENTIAL FATTY ACIDS (*OMEGA* 3 AND 6)

By

MOHAMED AHMAD AHMAD YOUSSEF

B. Sc. Agric. Sci. (Biochemistry), Fac. Agric., Ain Shams Univ., 1993
M.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Ain Shams Univ., 2002

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Approval Committee

Dr. Mohamed Mohamed Shams El-Din……..
Professor of Biochemistry, Fac. Agric., Ain Shams University

Dr. Ahmed Mahmoud Mustafa Aboul-Enein……..……
Professor of Biochemistry, Fac. Agric., Cairo University

Dr. Abd El-Moneim Mohamed Naguib El-Nakkadi……..……..
Professor of Biochemistry, Fac. Agric., Cairo University

Date: 22 / 6 / 2010 .

SUPERVISION SHEET

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SUPERVISION COMMITTEE

Dr. Abd El-Moneim Mohamed Naguib El-Nakkadi
Professor of Biochemistry, Fac. Agric., Cairo University

Dr. Hanna Fawzai Mohamed Ali
Assistant Professor of Biochemistry, Fac. Agric., Cairo University

Dr. Zeinab Hanem Abd El–Rahman Salama
Researcher Professor of Plant Nutrition, National Research Centre

Name of Candidate: Mohamed Ahmed Ahmed Youssef **Degree:** Ph.D.
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Supervisors: Dr. Abd El-Moneim Mohamed Naguib El-Nakkadi
Dr. Hanna Fawzai Mohamed Ali
Dr. Zeinab Hanem Abd El – Rahman Salama
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ABSTRACT

A filed experiment was carried out in Monfya governorate 2007/2008 to study the foliar application effect of bio-fertilizers (effective microorganisms with fermented plant extract EM-FPE) and micronutrients (MN) solution on the oil content, physicochemical properties as well as fatty acids composition of black sesame seed oil (BSO) and golden flax seed oil (GFO) compared with control treatment. Foliar application increased the oil content in black sesame seed and golden flax seed compared with control treatment from 31% to 39% and 33.0 % to 39.06 % respectively. The major content of BSO was linoleic acid (18:2, *omega* 6) increased from 27.54 % to 36.595 % by bio-fertilizer application also GFO α-linolenic acid (18:3, *omega* 3) strongly increased by bio-fertilizers application from 43.6 to 54.6% of total fatty acids. Moreover, the EM-FPE as foliar application showed the lowest values for total saturated fatty acids content (myristic, palmitic and stearic acids) in both oils compared with control treatment. Eventuality, the foliar application of MN adverts impalpable effect just at board of significance. However, dealing with EM-FPE in oil seed crops was dressing boosted significantly in unsaturated fatty acids mainly essential fatty acids content.

In addition, the administration of enhanced BSO (rich in linoleic acid *omega* 6) and GFO (rich in α-linolenic acid *omega* 3) with two concentrations were compared with olive oil (rich in oleic acid *omega* 9) and evening primrose oil (rich in linoleic acid and γ-linolenic acids *omega* 6) in hyperlipidemic rats (as prophylactic, curative and protective diet).

Substitution of basal diet with 5 % GFO and 5 % lard fat exhibited a prophylactic agent whereas substitution of 10 % GFO in basal diet exhibited the curative effect. Lipid profile (total lipids, triglycerides, total cholesterol, lipoproteins fractions and risk ratio) and liver function (ALT, AST and ALP) were improved compared to controls groups and other oils administration. In addition, the substitution of 5% GFO for long period exhibited the defense (protective) for hyperlipidemia in animals.

Biological experiments explored clear changes in fatty acids composition in rat's liver by GFO substitution when compared with other oils and control groups. The GFO in diet produced a significant increase of α-linolenic acid 18:3, *omega* 3 and decrease in arachidonic acid, oleic acid, and saturated fatty acids of the total fatty acids in rat's liver.

Key words: Black sesame seeds, golden flax seeds, micronutrients, effective microorganisms in fermented plant extract, essential fatty acids, hyperlipidemia

DEDICATION

I dedicate this work to whom my heart felt thanks; to my mother for their patience and for all the support they lovely offered along the period from childhood until now.

Also, I dedicated this work for my honor mother in my work Dr. Zeinab Hanem Abd El–Rahman Salama

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INTRODUCTION

Oil crops are the major source of raw materials such as oil, protein carbohydrate with potential application as nutraceuticals and functional foods. They also might provide low-cost renewable resource of high value-added compounds such as tocopherol and phytochemicals.

Recent studies have highlighted the numerous health benefits of oil crops as a source of poly unsaturated fatty acids PUFAs for the formation of healthy cell membranes, the proper development, and functioning of the brain and nervous system. In addition, they are used for the production of hormone-like substances called eicosanoids (thromboxanes, leukotrienes, prostaglandins). These compounds regulate numerous body functions including lipidemia, heart disease, osteoporosis, depression, stroke, blood pressure, blood viscosity, vasoconstriction, immune, inflammatory responses rheumatoid arthritis, psoriasis, and ulcerative colitis (Medeiros *et al.*, 2007).

Sesame recognized as one of the oldest and ancient oil crops in the world (Beatrice *et al.*, 2006). A wide range of oil content, from 37% to 63% has reported for sesame. Black sesame oil is classified as a polyunsaturated oil; it contains about 80 % unsaturated fatty acids. Oleic acid (18: 1, *omega* 9) and linoleic acid (18:2, *omega* 6) are the major fatty acids and are present in approximately equal amounts. The black sesame varieties contained higher amounts of total sterols, tocopherols and sesamolin which possessed excellent antioxidant activity. Therefore, it has a long shelf life and stability.

Flax is economically important oil seed crop containing about 40% oil in the seed (Oomah and Stitter, 2009). Flax seed (also known as linseed) is regaining its popularity from its traditional usage as a raw material in oil production and of the reported health benefits of *omega* 3 fatty acid and its exceptionally high content of the α-linolenic acid (ALA) 18:3 *omega* 3. According to Overeem *et al.* (1999) flaxseed oil usually contains greater than 50% of ALA; which two times higher than of fish oil and considered the world's richest source of *omega* 3. Flaxseed oil also contains *omega* 6 fatty acids (linoleic acid 18:2 *omega* 6 LA). Flax seeds color correlated with the type of α-linolenic acid (*omega* 3) contents in the oil hence brown seed is rich in *omega* 3 fatty acid while, yellow seed flax has two types. United State developed variety named *omega* which has oil rich in α-linolenic acid as brown flax but not contains anti nutrients, such as the cyanogenic glycoside and linamarin so called golden flax or medicinal flax and was available commercially as early as 2008. The second type is an entirely different flax called solin or linola, which has oil rich in linoleic acid *omega* 6 (Duane and Zollinger, 2008).

New approach to increase the productivity of oil crops to meet the greet demand is formulating the application of biofertilizers, which is rich in organic acids, chelated micronutrients, phosphorus, potassium, and secondary metabolites (polyphenols and flavonoids).

Therefore, the aim of the present investigation is to:

1. Increase oil productivity of both black sesame (BS) and golden flax (GF) plants in response to micronutrients and biofertilizers application.

2. Enhance the essential fatty acids content *omega* 3 and *omega* 6 in oils of both plants.
3. Improve oil seed properties of both black sesame and golden flax plants.
4. Evaluate the hypolipidemic effects (prophylactic, curative and Protective) of black sesame oil (BSO) rich in linoleic acid (*omega* 6) & oleic acid (*omega* 9) and golden flax oil (GFO) rich in α-linolenic acid (*omega* 3) and linoleic acid (*omega* 6) in comparing with evening primrose oil rich in linoleic and γ-linolenic (*omega* 6) and virgin olive oil rich in oleic and linoleic (*omega* 9 and 6) as a standard oils.