١٢ ٧ ١٥٦٠

"EFFECT OF GARLIC, ONION AND OLIVE OILS ON THE METABOLISM OF LIPIDS IN EXPERIMENTAL ANIMALS"

By

MOHAMED HUSSEIN ALY ATTIA

26191

630.27419947
M.H

THESIS

Submitted in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy

In

Agricultural Sciences
(Agricultural Biochemistry)

Soils Department
Faculty of Agriculture
Ain Shams University
Cairo

1988

Central Library - Ain Shams University

c

APPROVAL SHEET

Title: *Effect of garlic, onion and olive oils on the metabolism of lipids in experimental animals.*

Name: *Mohamed Hussein Aly Attia*

Approved by:

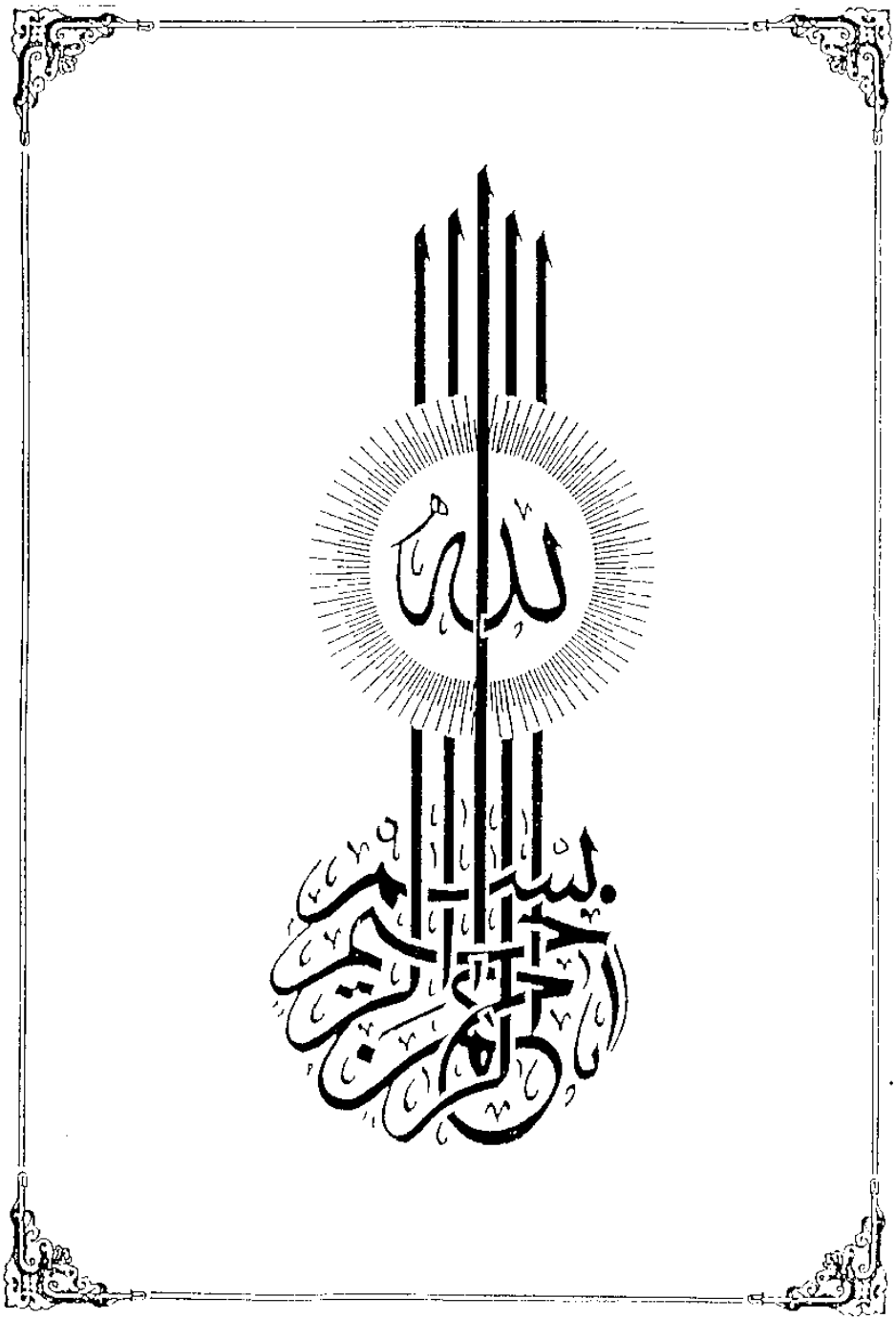
A.R. Nasser

Z.A. El-Hadidy

Committee in Charge

Date: 14 / 4 / 1988.

Central Library - Ain Shams University



Central Library - Ain Shams University

ACKNOWLEDGEMENTS

The author is deeply grateful to **Dr. Aly Rizk Nassar,** *Professor of Agricultural Biochemistry, Soils Department, Faculty of Agriculture, Ain Shams University, for his supervision, kind help, fruitful discussion and encouragement during the course of the present investigation.*

The author is also indebted to **Dr. Ragy Riad Francis,** *Professor of Agricultural Biochemistry, Soils Department, Faculty of Agric. Ain Shams University, for his kind help, reading the manuscript and his sincere guidance through this work.*

Many thanks to **Dr. Nagah El-Shahat Geabah,** *Professor of Agricultural Biochemistry, Soils Department, Faculty of Agriculture; Ain Shams University, for his kind help, continuous encouragement and suggestions during this work.*

The author wishes to express his deepest gratitude to **Dr. Moustafa Mohamed Saied,** *Associate Prof. of Biochemistry, Drug Research & Control Centre, for his kind help, valuable directions and suggestions during this investigation.*

Central Library - Ain Shams University

CONTENTS

Central Library - Ain Shams University

Central Library - Ain Shams University

INTRODUCTION

Interests in the nature of the active principal of garlic, Allium sativum L., and onion, Allium cepa L., has long occupied the attention of biochemists, chemists and other scientists as well, all over the world.

A striking property of garlic and onion bulbs in their ability to exhibit an intensive odor as soon as they either cut or crushed. Such odor is mainly due to the presence of sulphur volatile compounds.

The importance of garlic and onion goes back for thousands of years, not only as food and spices but also as remedy for many diseases. Apparently, ancient Egyptians and Indians are the pioneers who enlightened the road for many investigators in the field.

Garlic and onion bulbs together with their products such as allicin (diallyl disulphide oxide) are reported to have not only antibacterial, antiprotozoal and antifungicidal properties, but also they do have pesticidal action against a variety of species. The reason behind such favorable effects are usually the principal constituent, namely, diallyl disulphide, and to some extent diallyl trisulphide. To verify the remarkable effects of garlic and onion, important clinical studies on human volunteers had been carried

Central Library - Ain Shams University

out and confirmed that both could prevent alimentary hyperlipaemia in addition to their hypocholesterolaemic effect. Moreover it had been reported that both garlic and onion inhibited the development of atherosclerosis.

Although olive oil is used extensively in the middle east area, mainly, as vegetable oil yet little information is available concerning its effect on blood constituents.

Based on these facts animal rations had been experimentaly supplemented by either garlic oil, onion oil or their major constituents. However information on the effect of these compounds and also olive oil to rats as experimental animals, is still in its infancy.

Accordingly, the present work was carried out to shed some light on the fat metabolism in laboratory animals, with the following points in mind:

1. Action of garlic oil, onion oil, dipropyl disulphide, allyl. Sulphide and olive oil on the different lipid fractions in serum either in hyperlipaemic rats or normal rats.
2. The relationships between the different lipid fractions in serum through the metabolism using the different treatments mentioned before at various intervals of time.
3. The efficiency of the different treatments when compared with atromid-s (experimented drug for lipid lowering).

Central Library - Ain Shams University

REVIEW OF LITERATURE

I. Chemical constituents of garlic oil:

The essential oil of garlic was first prepared since about one and half century ago by **Wertheim (1845)**, who reported that, it consists largely of allyl sulphide. However, fourty seven years later, **Semmler (1892)** found that the oil contained no allyl sulphide at all, but a number of disulphides and trisulphides, among them was chiefly diallyl disulphide 60%.

Stoll and Seebeck (1947) found that allicin could be also given by enzymic degradation of pure alliin, the specific parent substance of allicin of garlic oil.

Fenerolli (1924) stated that oil of garlic, obtained by steam distillation, is yellow and has a density of 1.0525. It had a strong odor. It is slightly soluble in water and soluble in alcohol and ether. It contained 6% of allyl propyl disulphide, 60% of diallyl disulphide, small quantities of diallyl trisulphide, diallyl tetrasulphide and sesquiterpene. The oil freed from allyl sulphide. Sixteen Kg. of garlic give 10.2 g of pure oil i.e. 0.06% oil in garlic cloves.

Cavallito and Bailey (1944) found that the oil of garlic is soluble in water to the extent of approximately 2.5% at 10°C, it is miscible with alcohol, benzene and ether.

Khoshoo et al. (1961) stated that garlic contained 0.13-0.21% volatile oil (organic sulphides).

Central Library - Ain Shams University

Gusev and Grishina (1965) stated that the essential oil of garlic was up to 0.03%. **While Wertheim (1845)** and **Semmler (1892)** indicated the presence of 0.1-0.2% oil in the fresh garlic cloves.

Coley-Smith and King (1969) identified the following volatile sulphur compounds in garlic distillate by means of G.L.C.: methyl-mercaptan, dimethyl sulphide, dimethyl disulphide, di-n-propyl sulphide, diallyl sulphide, methyl allyl disulphide (tentative), diallyl trisulphide (tentative), beside other compounds were present in trace amount were unidentified.

Gianfranco and Giannone (1971) stated that gas chromatographic analysis of the essential oil of garlic showed the presence of the following fractions:

Propanol, dimethyl sulphide, methyl propyl sulphide, pentanol, dipropyl sulphide, dimethyl disulphide, (trace), diallyl disulphide, dimethyl trisulphide and methyl allyl trisulphide. Methyl allyl sulphide is probably present. They confirmed the presence of propanol and pentanol by T.L.C. They also stated that the gas chromatographic analysis of two oils showed that the method of distillation influences the quantitative ratio between single components.

2. Chemical constituents of onion oil:

Wertheim (1845), found no allyl sulphide in onion oil, but by distilling the oil under reduced pressure and collecting various fractions he concluded from the boiling point and other physical

Central Library - Ain Shams University

properties that the main constituent is a disulphide, $C_6 H_{12} S_2$, probably propyl allyl disulphide. The oil amounted to only 0.005% of the whole weight of the onions.

Semmler (1892) isolated, disulphide ($C_6 H_{12} S_2$) from onion oil as a chief constituent and a higher sulphide which, on reduction with zinc dust, yields $C_6 H_{12} S$. He added that the oil did not contain any terpenes or allyl sulphide.

Haensel (1903) obtained 0.015% of a brown oil which remained turbid even after warming. He also, stated the following properties: d_{35} was 0.996 and optical rotation was -3° 40'.

The chief constituent of the essential oils of garlic and onion is usually stated to be allyl sulphide (**Bernthsen and Sudborough, 1931; Whitmore, 1937; Vass, 1939**).

Arasimovich and Ivanova (1939) noted that the yields of the oil were between 0.018 and 0.04% in the different Russian onion varieties.

Challenger and Greenwood (1949) found that n-propylthiol had been detected in the onion, A. cepa. The thiol was removed from the freshly chopped bulbs in a stream of sterile air and absorbed in mercuric cyanide.

Carson (1968) stated that the most important volatile flavor compounds from the onion contained H_2S, thiols, disulphides,

Central Library - Ain Shams University

trisulphides, thiosulphinate and the elusive lachrymatory factor by using gas chromatographic procedures.

Saghir et al. (1967) reported that n-propyl disulphide is the major volatile constituent of common onion (Allium cepa).

Cowan, et al. (1967) stated that onion oil contains the following major components methyl disulphide, allyl disulphide, allyl alcohol, allyl monosulphide, beside n-propyl disulphide.

Coley-Smith and King (1969) identified the following volatile sulphur compounds in onion distillate by means of G.L.C.: methyl mercaptan, dimethyl sulphide, n-propyl mercaptan, dimethyl disulphide, di-n-propyl sulphide, di-n-propyl disulphide, beside other unidentified compounds which were present in minor amounts.

Aazza and Maguer (1980) found that the main constituents of onion oil are dipropyl disulphide, n-propyl thiol and n-propanol according to the data which obtained by G.L.C. and mass spectrometry.

Aazza et al. (1980) used gas chromatographical analysis, to separate from onion oil 28 volatiles with major constituents being propanethiol, methyl pent-2-enol, methyl propyl disulphide, propanal and dipropyl disulphide.

Central Library - Ain Shams University

3. Chemical constituents of olive oil:

(a) Saponifiable matters of olive oil:

Craig and Murty (1959) found by using the G.L.C. analysis that olive oil consists of palmitic (13.4 - 13.6%), palmitoleic (1.2-1.3%), Stearic (3.1-3.3%), oleic (73.5-76.2%), linoleic (5.5-7.4%) and linolenic (0.6-1.0%).

Herb et al. (1960) stated that olive oil contains palmitate (10.8 - 11.7), stearate (2.2 - 2.9), total saturated (13.4-14.6), palmitoleate (0.9-1.4), oleate (77.1-78.4), total monoenoate (78.5-79.3), linoleate (5.3-7.5) and linolinate (0.9) percent.

Table (1): shows the different percentages of fatty acids forming glycerides of olive oil obtained from four different countries as it was stated by Rotini (1961), (Tunisian and Italian olive oils) and El-Qadi (1976), (the Palestinian and Jordanian olive oils):

Table(1): Percentages of fatty acids forming four different olive oils.

Fatty acid	Tunisian oil	Italian oil	Palestinian oil	Jordanian oil
Palmitic	13.9-a2l.l	7-25	10.5	13.65
Palmitoleic	0.98-2.2	0-2.0	-	-
Stearic	1.3-2.52	2.0-3.0	3.3	1.50
Linoleic	9.5-16.7	4.0-12.0	8.6	6.77
Linolenic	0.21-1.22	Traces	-	0.11
Oleic	59.6-70.6	65-84.0	77.5	74.93

Central Library - Ain Shams University

Privett and Blank (1963) stated that fatty acid composition of triglycerides of olive oil is: C_{16} saturated 9.4%, C_{16} monoene 0.95%, C_{18} saturated 2.2%, C_{18} monoene 77.5% and diene 9.9%, these results were obtained by means of G.L.C.

Vioque et al. (1964) stated that the percentage of saturated triglycerides, monoene triglycerides and diene were 17.5, 65.9 and 16.5 respectively. The iodine number of this lipid fraction (triglycerides) is about 84.4.

Gracian (1967) used the spectrophotometric analysis in order to determine components of the Spanish olive oil, he found that oleic acid (65-79%), linoleic acid (5.1-19.8%) and total saturated acids (10-16.5%).

Astrit (1972) concluded that the olive oil produced in Elbasan, Albania (1969-1970) was composed of 95.0-95.2% fatty acids and 4.8-5.0% glycerol. The fatty acid portion had 85.14% liquid and 13.81% solid fatty acids. Using gas chromatography, the fatty acids contained were palmitic (11.43%), palmetoleic (0.17%), stearic (2.51%), oleic (73.02%), linoleic (11.76%) and linolenic (0.46%) acids.

Gracian and Martel (1974) stated that olive oil contains less amounts of linoleic than sunflower oil through the fractionation of olive oil triglycerides by T.L.C. on silica gel containing silver nitrate.

Central Library - Ain Shams University

Nader (1977) analysed the Palestinian olive oil by G.L.C. He stated that fatty acid constituents of olive oil are myristic (0.48%), palmitic (13.99%), stearic (2.78%), oleic (77.03%) and linoleic (5.72%).

(b) Unsaponifiable matters of olive oil:

The contents of the unsaponifiable matters of olive oil were subjected to a plenty of investigations. Unsaponifiable matters compose mainly of the following components:

(i) Squalene:

Squalene is the predominate content of the unsaponifiable matters of olive oil, it was detected first in olive oil in (1935), by Thorbjarnarson and Drummond. This was confirmed by Fabris and Vitaghano in (1956). In (1954) Fuhrmann reported that the squalene content was 200 mg. per 100 g of olive oil.

Tous (1961) reported that squalene of olive oil contains a more methylene group in the chain than that found in shark squalene. This difference may be reflected in the structure of cholesterol which can be biologically synthesized from the two squalenes.

Gracian et al. (1964) reported that the squalene content of 268 samples of Spanish olive oil was 90-989 mg/100g oil, with most lots between 150-550 mg/100 g oil. The ratio of squalene to unsaponifiable material varied between: 0.30-0.49 for petroleum

Central Library - Ain Shams University