BIOCHEMICAL STUDIES ON WHEAT GERM

BY

MOHAMED ALI ABOU ZAID

B.Sc. Biochem. (Cairo University)

1967

THESIS

Submitted in Partial Fulfilement

of the Requirments for the

Degree of

MASTER OF SCIENCE

IN

Agricultural Biochemistry

TO

Agric. Biochemistry Department

Faculty of Agriculture

Ain Shams University

Cairo, A.R.E.

1978.

Title: Biochemical Studies on wheat germ.

Name : Mohamed Ali Abo. Zaid.

Approved by :

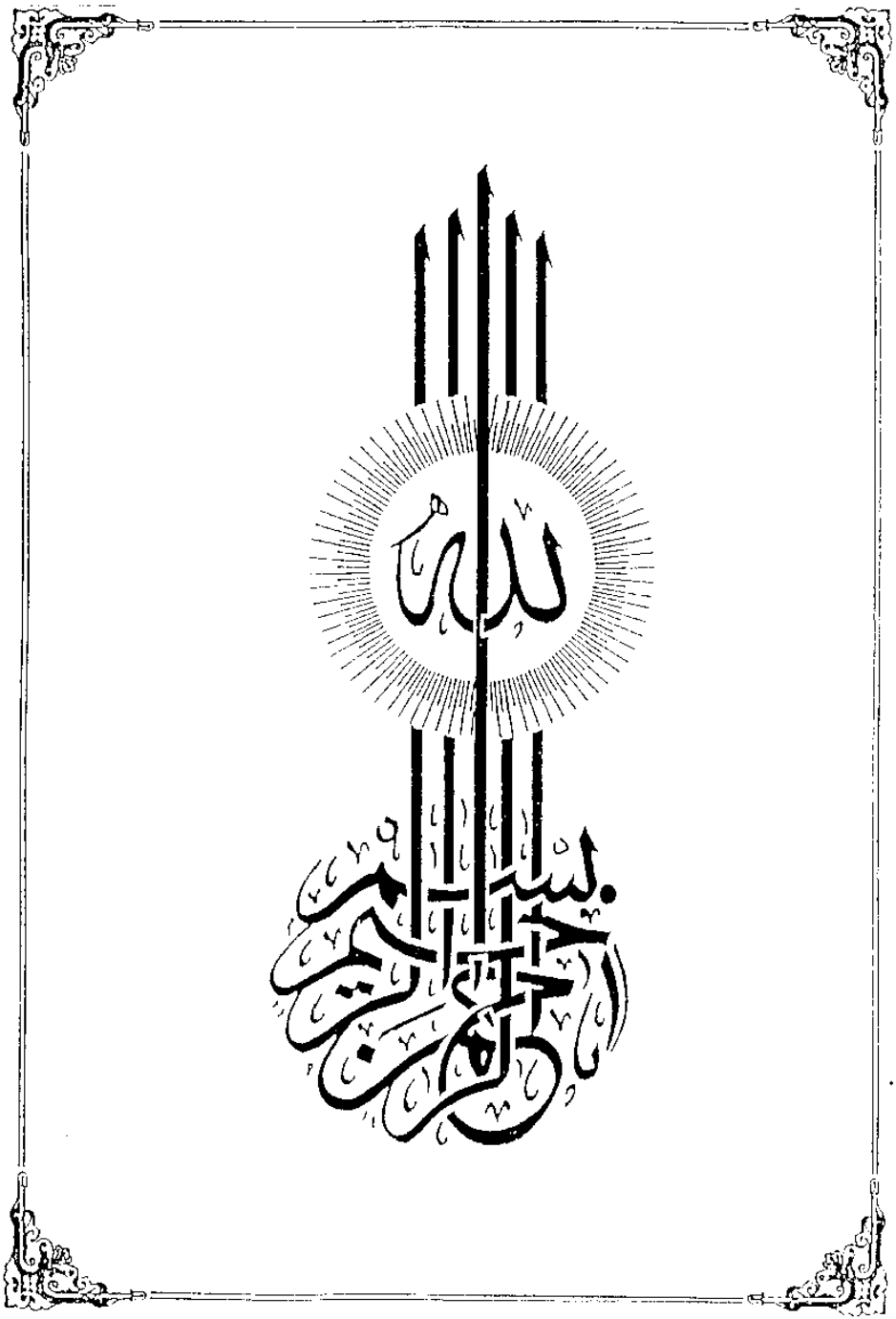
Dr. .....

Dr. .....

Dr. .....

Committee in charge

Date 10 / 10/ 1978.



Dedicated

To

My mother ..... The first teacher

My father ..... who devoted his life to offer me the best in life, education.

My wife My sons

and every one thus making this work possible

and also to my Home-Country

ACKNOWLEDGEMENT

The author wishes to express his sincere gratitude, deep appreciation and infinite thanks to Prof. D.S.I. El-Hinnawy, Professor of Biochemistry, Ain Shams University, for his paternal guidance, supervision and constructive criticism. Without his help this work could not be performed.

The author wishes also to express his immeuse gratitude and his sincere appreciation to Dr. Salwa A.Eid and Dr. Z. A. El-Hadidy. Assistants Professor of Biochemistry, Ain Shams University for his valuable guidance, supervision and advantageous criticism which brought this thesis into being.

I gratefully acknowledge Dr. M.H. El-Sadany, Researcher of the Horticultural Research Institute, Agricultural Research Centre for the facilities he kindly offered.

The author is also grateful to the staff of Food Technology branch of the Horticulture Research Institute.

CONTENTS

Introduction

Wheat (Triticum Vulgae), the principal raw material for bread has allways been the principal crope, because of its great importance as human food. Wheat germ are relatively high in protein, fat, Carbohydrate and minerals. Moreover they are good source of vitamins A, B and E (Blumenthal, 1947).

The wheat grains may conveniently be regarded as consisting of three parts; the germ or embryo (2-3 % of the grain), the starchy endosperm (85 precent of the grain), and the various outer parts which represents mainly the brain (14 % of the grain) (Kent - Jones and Amas, 1950).

It is noticeable that the germ is very rich in protein and have no toxic compounds, but this advantage is rather offset by its high fat content, which may cause rancidity of the flour. Germ also contains certain enzymes and colouring matters which injure the colour and baking value of the flour (Lockwood, 1945). For these reasons, it is essential to remove the germ from the all-important endosperm as early as possible in the milling process. Cylinder mills are operated to separate wheat germ whithin the milling process.

In A.R.E. about 920, 100 tons of wheat are milled by cylinder mills which represents 34.35% of the whole milled wheat per year 1976 (The General Authorities of Supply Commodities). The contents of wheat germ which could be separated from the latter amount are about 18,402 tons. This amount of germ, generally contains a considerable content of oil (about 10% as reported by Mallri, et al 1964) which could be calculated as 1840 tons for the whole amount. Although this amount of wheat oil appears to be comparatively so small in comparison with the total production of oils and fats in A.R.E. (159722 tons as reported by the Egyption Industries Union, Annual Book, 1975) yet this amount could fulfil some of the lack in the local oil production. Furthermore, wheat germ oil is nowdays of essential use in nutritional and medical purposes. It could be also added to other oils for increasing their stability.

The wheat germ itself could be considered as a very useful by - product for many important purposes such as a good protein source when mixed with some baby foods or cakes. It could be used also for animal feeding. Thus, it is worthy to evaluate the main constituents of the wheat germ and likwise the whole wheat grain.

In the present study, two local varieties of wheat; i.e. Giza 155 and Chnab 70, and an imported French variety were chemically evaluated. The main topics of this evalution could be summerized as follows:

1- The efficiency of some organic solvents for the wheat germ oil extraction. Determination of Fatty acids content, stability, vitamin E (Tocopherols) content and lipase activaty in the different wheat germs.

2- Determination of protein and protein fractions of wheat germs.

3- Determination of the free and total amino acids in the proteins of wheat germs.

4- Determination of starch and sugars of wheat grains and their germs.

5- Determination of ash, crude fibers and moisture content in the wheat germs.

Review of Literature

A- Oil contents of wheat germs

The main constituent of the wheat grains are carbohydrates fractions. At the sametime, oil in wheat germs represented small part of wheat grain constituents, but, it considered to be one of the chief component of the wheat germ.

Rutkowski, et al (1960); Mallri, et al (1964); Peterson, (1965); Meyer, (1968) and Bolling, et al (1973) found that the oil content of wheat grain was approximatly about 2 %. On the other hand, El-Hinnawy et al (1977) found that, the oil contents ranged from 1.35 to 1.55% of the wheat Kernels. It was found that wheat germs contained from 9.00 to 11.9 % oil as indicated by Rutkowski, at al (1960); Peterson, (1965); Meyer, (1968); Maruzzi, et al (1969) and Bolling, et al (1973).

The amount of oil, which could be produced from wheat grains is largely affected by the method employed in extraction. The solvent extraction method is considered now the best procedure for oil extraction as stated by Cofield, (1952).

Many solvents could be used for extraction of vegetable oils. The degree of extraction depends completely on the chemical structure of the solvent and the temperature employed during the process as stated by Kamal and Izzatt, (1958).

Bailey, (1955) and Duel, (1951) noticed that the different oil seeds vary markedly in the rate of oil extraction by organic solvents. This was proved by closely controlled laboratory experiments and was also confirmed in commercial practice. It is well known that the oily seeds subjected to repeated extractions with a solvent yielded much output of oil than a single extraction.

Lavenant, (1954) studied the extracting power of acetone and di-ethyl ether at different temperature. The results seemed to indicate remarkable variations in the residual oil content. The maximum amounts of extraction depended upon the micella, concentration and shell thickness and the increase in residual oil content. The extraction of corn germ oil with acetone was in good correlation with that of hexane. However, cyclohexane, Ethanol, trichloroethan, dichloroethan and ether represented several variations, in the physical properties of the oil extracted.

El-Hinnawy, (1957) tested the extractability of different solvents and proved the superiority of isopropanol for extracting oil from rice bran, sesame and peanut seeds respectively.

By Comparing the use of two peteroleum ether solvents which differed in their boiling point (one of b.p.35-202°C and the other of b.p. 48-83°C) in extracting the wheat germ oil. Avanzo, (1951) found that the required extraction time for the lower - boiling solvent was 2-3 times as that of the higher boiling solvent. The time for solvent recovery and the vitamin loss were lower with the low boiling solvents, but the stability of the oil was higher. Eaves, et al (1952), in another compartive study using five fat solvents (hexane, benzene, ether, acetone and butanone) for the extraction of cotton - seed oil; found that n-hexane gave comparatively the lowest yield of oil, while acetone and butanone extracted the highest amount of oil. Kamal and Ezzatt, (1958) noticed that the amounts of lipids extracted by different solvent were not quite similar in the different oleagineous seed.

Rzhekhin and Pogonkiva, (1959) noticed that diethyl ether extracted higher amounts of oil from sunflowrs seed than petroleum ether with increase about 80 %.

Ramadan, (1964) found that carbon tetrachloride showed its superiority over the acetone, di-ethyl ether, peteroleum ether (b.p. 50 - 70°C) ethyl alcohol 95% as solvents for the extraction of prickly lettuce oil from the seeds.

Nadia, (1966) found that di-ethyl ether, hexane and ethyl acetate were more efficient than methanol, iso-propanol, petroleum ether (40-70°C) and acetone; were quite efficient solvents for the extraction of sunflower seed oil.

Baikov, et al;(1968) found that the free lipids of the oligenous seeds could be directly extracted by ether, while bound lipids could be extracted by ether after treating with hot alcohol.

Finney, et al,(1976) extracted wheat flour lipids by petrolium ether, n-hexane, n-heptane, benzene, chloroform, acetone, butanol, methanol, and 95% ethanol. He concluded that polar solvents extracted substantially less lipids than the highly polar solvents simultaneously, lipids extracted with the former solvents had less polarity than those extracted with latter ones.

Physical & Chemical Properties of wheat germ oil:

It was found that specific gravity of wheat germ oil determined at 25°C by Matz, (1955); and Mallat; et al (1954) was in the range of 0.9248 - 0.9380. The refractive index ranged between 1.4762 and 1.4851 at 20°C as reported by Kent - Jones and Amos, (1950). The saponification value ranged

from 179 to 192 as reported by Rutkovski, et al (1960) and Mallri; et al (1964). The unsaponifiable matter was found to be 1.6 to 6 % as reported by Mallri, et al (1959) and Tykheeva, et al (1971).

The iodine value of this oil ranged from 115 to 129 as reported by Eckey, (1954); Matz, (1955), Rutkovski, et al (1960). But its acid value ranged from 6 to 20 as reported by Kent - Jones and Amos, 1950; and Eckey, 1954. Jamieson (1943) found that its acetyl value was [illegible] in the germ oil of wheat.

The fatty acids of cereals consist largely of glycerides of oleic and linoleic acids as the commonly found components (Jacobs, 1951).
At the same time, the crude wheat germ oil is usually somwhat high in free fatty acids (Mallri, et al (1964). [illegible] and Balcuasci, (1964) classified the oils to 4 groups according to their fatty acid composition and put the wheat germ oil in the group of oils which are rich in linoleic acid.
Baikov, et al (1968) found that the free and bound lipids of wheat flour contained chiefly palmitic, oleic, linoleic and linolenic [illegible].