

BIOCHEMICAL STUDIES ON SOME NUTRITIONAL PROTEINS

A THESIS

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PART IISTUDIES ON THE PROTEIN EFFICIENCY RATIO AND
BIOLOGICAL VALUE OF THE EXAMINED SEEDS

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This thesis contains two parts :

PART I :

A GENERAL SURVEY ON THE BIOCHEMICAL
CONSTITUTION OF SOME PLANT SEEDS OF
THE FAMILY GRAMINEAE (CEREALS).

It includes the chemical estimations of the seed constituents. Moisture, fat, total nitrogen (proteins), ash, fibres, carbohydrates and minerals percentages were estimated.

The nitrogenous content (total nitrogen) was further examined to determine cold and boiling water soluble nitrogenous compounds.

Mineral estimations were further studied. The minerals chosen were, phosphorus, calcium, sodium, potassium, magnesium and iron. The estimations were carried in such a manner as to show the water and acid soluble fractions.

PART II :

STUDIES ON THE PROTEIN EFFICIENCY
RATIO AND BIOLOGICAL VALUE OF THE
EXAMINED SEEDS

This part includes two methods for protein evaluation :

Method I. The protein efficiency ratio (P.E.R.), with relation to studies on the factor $\left(\frac{I^2}{TP}\right)$, and effect of sex on P.E.R.

Method II. Biological value (B.V.) of the examined seeds was also determined as well as the digestibility coefficient (D.C.).

All studies were carried out on two protein levels, of 5 and 7 percentages.

P A R T I

A GENERAL SURVEY ON THE BIOCHEMICAL CONSTITUTION
OF SOME PLANT SEEDS OF THE FAMILY GRAMINEAE (CEREALS).

INTRODUCTION

World population estimated in 1961 as 3000 million (Leonard and Martin, 1963); present rate of world population growth is 1.7 per cent per year. At such a rate, there is a prospect of a world population of 6280 million people by 2000 A.D. (Leonard and Martin, 1963). Such population would necessitate a tremendous increase in food production.

Cereals will assume a more and more important role in attempts to meet future world food requirements as population continues to increase. Cereals are the most important components of the Egyptian diet, contributing more than 70% of the total caloric intake, 68% of the proteins and 33% of the fats (Hassan, 1958).

The cereals contained carbohydrates, protein, fats, minerals and vitamins. Whole grain cereals come closer to being in themselves an adequate human diet than any other plant product (Mangelsdorf, P.C., 1953).

The minerals are important as tissue builders, but they cannot supply heat or energy as they enter the body in the oxidised form.

They vary in this condition from proteins, fats and carbohydrates. In spite of this fact, there are reasons to believe that they are also important in regulating the production of energy during the general metabolism. The body requirements of these minerals are obtained from various sources, of which vegetable and plant seeds are of major importance.

The minerals chosen for investigation were : phosphorus, calcium, magnesium, iron, sodium, and potassium. The first three elements make up the major part of the minerals of the bone where 99% of body weight calcium is found in the skeletal structure, bones and teeth. On the other hand, magnesium and phosphorus are important constituents of soft tissue and many organic essential compounds. Iron is the nucleus of the haemoglobin structure and plays an active role in the transport of oxygen from the lungs, to the tissue and carbon dioxide from the tissue to the lungs.

Sodium and potassium are concerned in the osmotic regulation between the intra and extra-cellular body fluids as well as the maintenance of acid-base equilibrium.

Sodium and potassium were usually determined by gravimetric (Piper, 1942) or turbidimetric methods (Lindner, 1944 & Wolf 1944, Hunter & Hall 1953). The former ones were time consuming and need a large amount of plant material and the chemicals needed are not available while turbidimetric methods are not accurate and their results depend upon change in temperature, pH and the way by which the reagents are added. These difficulties were minimized by the use of flame photometer.

Flame photometer theory is based upon the fact that, if a metallic salt, such as NaCl is introduced into a non-luminous flame, it burns with a characteristic colour representing the metal in question. The flame photometer is an instrument utilizing this phenomenon to measure the relative concentration of the alkali metals in solutions, the solutions under test are atomized and introduced into a non-luminous flame burning under carefully controlled conditions. This flame becomes coloured, and the intensity of the light emitted is measured by means of a photo-cell. The various regions of the spectrum appropriate to the

different elements are isolated by passing the light through an optical filter or a monochromator of either the prism or diffraction grating type. The intensity of the light emitted with the sample is then compared with that emitted with a prepared solution of known concentration of the alkali salt in question.

The cereals are crop plants belonging to the grass family (Gramineae). The Gramineae family is divided into two subfamilies :

1. Festucoideae.
2. Panicoideae.

This work is interesting in some representatives of both subfamilies, i.e. Triticum Vulgare (Wheat), Oryza sativa (Rice) and Hordeum Vulgare (Barley) represents the subfamily Festucoideae, while Zea Maize (corn), and Sorghum Vulgare both belong to the subfamily Panicoideae.

1. Triticum Vulgare - Wheat (Qamh)

Wheat is an annual cereal with two seasonal crops.

- (a) Winter wheat.
- (b) Spring wheat.

Wheat usually grows to a height of 2-4 feet.

Wheat is the most widely cultivated of all cereals (Leonard and Martin, 1963).

Wheat as human food is used principally in the form of flour for baked products such as bread, biscuits, pastories and crackers. Industrial uses of wheat include the manufacture of starch, gluten, distilled spirits, malts and paste (Leonard and Martin, 1963). Wheat starch is utilized chiefly in the laundry and textile industries, and can be converted into syrup, sugar or industrial alcohol (Langford, C.T. 1947). Gluten is used in gluten breads for diabetics and for the production of mono-sodium glutamate (Leonard and Martin, 1963). Some low grade flours are used in the manufacture of pastes for wall papering, plywood adhesives and in iron foundries as a core binder (U.S.D.A. Northern Reg. Res. Lab. Paper ACE, 1942).

2. Oryza Sativa - Rice (Ruz).

Thinking of rice, leads naturally to thinking of the orient, where nearly 95% of the world's rice crop is produced. Rice is a popular food especially in urban areas, but not as important in the diet as maize or wheat (Fouad, 1943). In years of poor corn harvest consumption of rice increases. The Nile delta is the main rice growing area containing about 96% of the total area planted to this crop.

Rice plant is an annual grass that grows to a height of about 4 feet. It is mostly grown in hot moist tropics.

Rice is a carbohydrate rich food, its protein content is low and it is better to be supplemented or added to richer proteinic sources to elevate its dietetic value.

Milled rice is consumed largely in the boiled state. It is also used in the manufacture of breakfast foods such as puffed rice, flaked rice and rice krispies (Leonard and Martin, 1963). Broken rice is used as human food as well as for the making of alcoholic beverages. Rice starch, generally made from broken rice, is used in face powders, (Leonard & Martin, 1963).

Rice bran contains a considerable quantity of oil which consists mainly of oleic acid. Rice bran is rich with thiamine (anti-beriberi) vitamin.

Rice hulls are used for fuel and for making rayon and linoleum (Leonard & Martin, 1963).

Rice straw is widely used for thatching roofs of buildings in China, Japan and other Asiatic countries. It is also used to make paper, hats and some other

products. Other uses include mulches, fertilizers and fuel (Leonard, W.H., 1948).

3. Hordeum Vulgare - Barley (Shair)

Barley is an annual summer crop, the stems rarely exceed 3 feet in height. Barley is the least important of Egypt's food grains and is grown chiefly for use in brewing and as fodder in areas too poor to yield good wheat crops (U.A.R. Agriculture 1959). Barley probably was the first cereal used by the ancients for making beverages (Leonard & Martin, 1963).

About 30% of the barley crop in the United States is used for malting. Approximately 80% of the malt is used in beer, 14% in distilled alcoholic products and 6% in malt syrups, malted milk concentrates, breakfast food and coffee substitute (Shands, H.L. and A.D. Dickson, 1953).

Barley flour is used in baby foods and breakfast cereals. It also may be mixed with wheat flour for making bread when wheat is scarce. A mixture of up to 20% of barley flour produces a satisfactory bread.

In Japan the straw is used for straw ropes, roof thatching and mulches for vegetables (Leonard Warren H., 1947).

4. Zea Maize - Corn (Durah Shamiyah)

Maize is an annual long grass, cultivated in tropical areas where it reaches a height that varies from 3-15 feet.

Corn locally called durah shamiyah, is the most important grain, occupying about one fifth of the total crop area and 44% of the land devoted to cereals (Money-Kytl, A.F. 1957). Maize grains are essentially nutritional as they contain a high percentage of easily digestible carbohydrates, fats and proteins. Maize yields more industrial products than any other grain. While every part of the plant has commercial values, the kernels are by far the most important because of their high carbohydrate content. Wet milling, dry milling, and the distillery operations are the most important corn industries (corn facts and figures; 5th Ed. 1949, Corn in Industry, 5th Ed. 1960; Majors K.R., 1950-1951; Sprague, G.F. 1955).

The wet millers produce starch, starch derivatives oil and feed from corn. Ordinary corn starch is composed of about 78% amylopectine and 22% amylose. Waxy corn is 100% amylopectin (Jenkins M.T., 1948). Corn starch is obtained from the fully softened, degermed, and finally