NUTRITIVE VALUE OF SOME EDIBLE SEEDS

A THESIS

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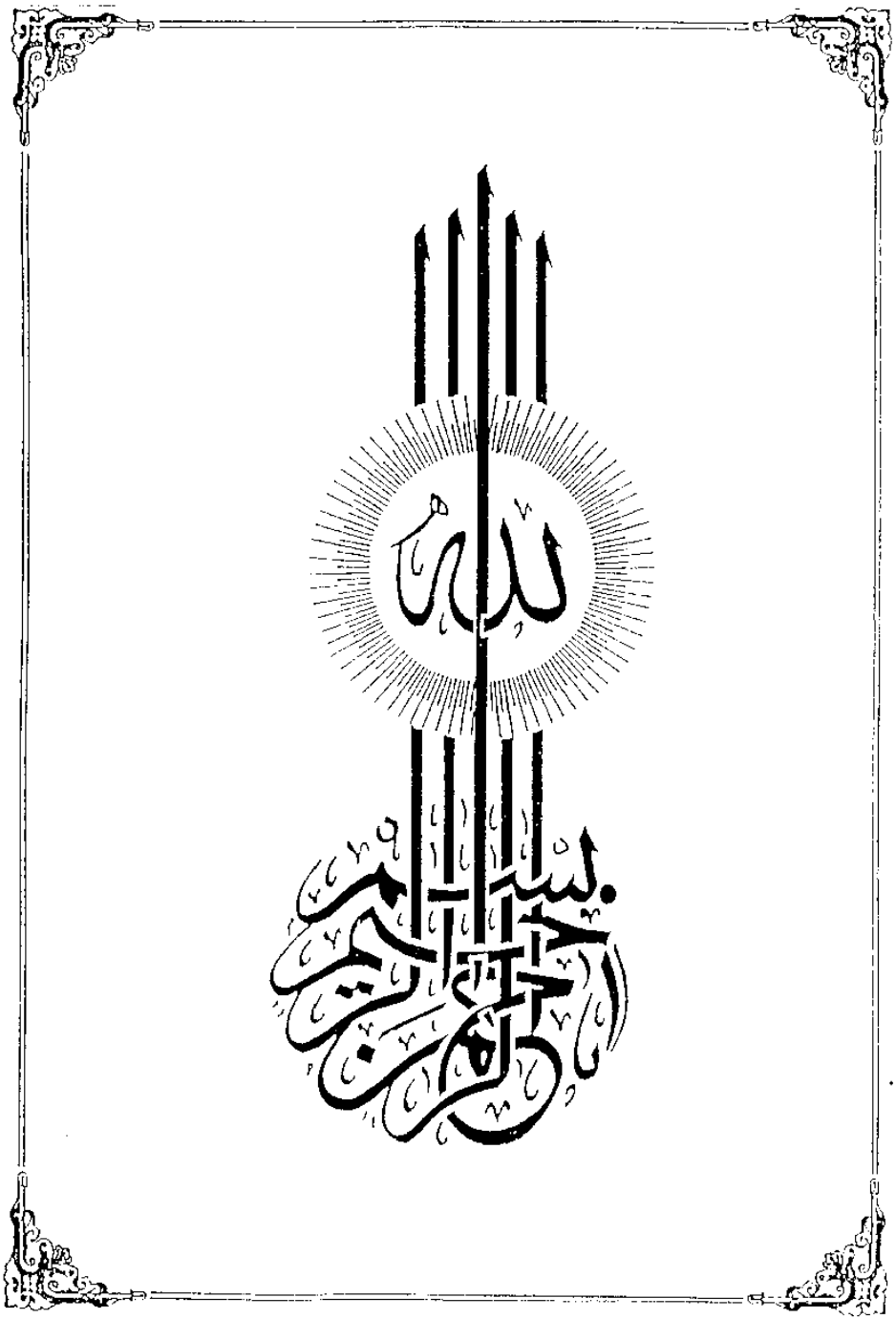

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I -AIM OF THE THESIS

One of the challenging problems of our time is the problem of the insurance of the production and distribution of food to keep pace with the increasing number of human race. One of the most serious widespread dietary defficiency is that of protein. This problem has been tackeled extensively by nutritionists. Not only the amount of protein which is of paramount concern but the quality which is most important.

The most serious problem, in our time, which is not yet solved is how to meet the protein requirements of man. The problem of protein requirement is in fact receiving a great deal of attention in a great number of countries including Egypt.

The first problem of concern of the FAO at present time is that of the production of protein foods of good quality. Food balance sheets and dietary surveys have proved a definite defficiency in proteins, especially those of animal origin.

Diseases of protein deficiency, together with protein-calorie malnutrition are very common in developing countries. It has been estimated that about 17% of the people in the whole world were receiving an average of 30 gms of animal protein, a further 25% receiving between 15 and 30 g/day while 28% receiving less than 15 g/day.[1]

Animal proteins are, in fact, scarce and expensive. So, the main problem of concern to fight against protein malnutrition should be based on the use of cheap protein sources. Plant proteins are very much cheaper than animal proteins, although they are of a low biological value.

In Egypt, one of the major nutritional problems is the available proteins. Legumes, in general contain a high percentage of proteins. They are in fact the most important sources of proteins in Egypt and Arab countries. These legumes include the broad beans, the lentils, lupinus seeds, peas, fenugreek ... etc. The broad beans and lentils are the most widely consumed legumes in Egypt. The lentils come next in consumption to the broad beans.[2]

Besides the lentils the lupinus seeds are also very much consumed by the Egyptians especially by the poor class inhabitants.

Because of the importance of the latter legumes namely lentils and lupinus in local nutrition, the present investigation was carried out to asses the nutritive value of the latter seeds and the biological value of their proteins.

minimum requirement of protein. For example, Rose[11] found that a higher caloric intake was necessary to maintain nitrogen balance in subjects ingesting a fixed quantity of protein hydrolysate or amino acid mixture than when they ate unhydrolysed protein (casein). Nitrogen retention (and, therefore, "minimal protein requirement" as determined by the nitrogen balance method) is the result of interaction of many influences. Swanson[12] has enumerated some of these as caloric value of the diet, source of non-protein calories, physiologic state, body stores, quantity of dietary proteins, time factor and distribution of the protein over the day's meals. Obviously, therefore, a practical diet should be designed to supply a reasonable margin of safety above the minimal protein intake which can suffice under ideal conditions. There is much evidence that nitrogen balance can be maintained in adults on intakes of about 40 gm of protein daily. Accordingly, intake levels of 70 gm per day for adults are reasonable.

There is much evidence for the ill-effects of mild protein under-nutrition. Benedict and his co-workers stated that a restricted diet definitely depressed sex instinct, even when it produced no other observable effect.

Does a liberal intake of protein confer definite advantages. Much evidence could be cited in favor of an

affirmative answer to this question. Witness the relationship between phagocytic activity and the protein intake of young mice[13] and the importance of proteins in the formation of antibodies[14] also the more rapid healing of experimental wounds reported in rats fed a high protein ration[15], and the striking remission of human peptic ulcers, when a high-protein high-caloric diet is given.[16] Cannon[14] has discussed the effect of protein in promoting resistance to disease. Lund[17] has written of the benefits which accrue to surgical patients and of the dangers which can be avoided when the plasma proteins are maintained at a high level.

A critical appraisal of these results leads to the conclusion that the reported beneficial effect result from the provision of adequate protein, not from the addition of super-abundant supply. Present evidence supports the reasonableness of the recommended allowances of the Food and Nutrition Board of the National Research Council:[18] Men 70 gm. daily, women 60 gm. daily (i.e. 1 gm/kgm of body weight). With an increased allowance to 85 and 100 during pregnancy and lactation respectively. This allowance for children varies with age and growth from some 1.5 to 3.5 gm. per kilogram of body weight. The requirement for infants fed cow's milk is higher than that for breast fed infants.[19]

III THE NUTRITIVE VALUE OF PROTEINS

Earlier concepts of nutrition divided proteins into those of first and those of second class, the former being of animal and the latter of vegetable origin. The value of a food as a source of protein is determined by the concentration of protein in it, the digestibility of the protein, the availability of its amino acids for the synthesis of tissue protein and its amino acid pattern, particularly the content and proportions of the essential amino-acids. Digestibility and amino-acid pattern in turn determine the value of the food protein to the animal. There exist now many biological methods of scoring a protein on this basis, most of which confound these variables into one numerical expression. Bender[20] deals with these methods in detail. All are designed for and capable of assigning to a protein a relative order of nutritional merit and thus all can be considered as measuring its biological value, Mitchell (1926) defines the biological value of a protein as the percentage of absorbed (digestible) nitrogen retained by the body, the endogenous nitrogen losses being allowed for in the calculations.

Another method with which we are concerned is the rat-growth method of Osborne, Mendel & Ferry[28]. In its original

form the protein sources were given in the diet at several levels to determine the maximum ratio between gain in weight and protein intake (protein efficiency ratio). Nowadays it is customary but not necessarily justified, to select a single suboptiomal protein level, usually 8-10% for the assessment of proteins by this method.

Normally proteins are considered in relation to their ability to promote growth or to repair body tissues or both. A protein that may be adequate for repair and maintenance in an adult animal may be less satisfactory for the combined functions of growth and repair in the young. Further, the value of a protein for certain functions such as replacement and building of specific plasma proteins, haemoglobin and enzymes may be quite different from that for the repair of body tissues as a whole. Thus lactelbumin is superior to casein in promoting the growth of young rats[22, 23] but casein has proved better for the regeneration of plasma proteins and the formation of haemoglobin in protein depleted anemic dogs.[24]

1-Significance of the amino-acid composition of proteins :

Proteins are composed of some twenty amino-acids. Eight to twelve of them, depending on the species of animal, are essential amino-acids, which means that unlike the other acids

they either cannot be synthesized by the animal or are synthesized too slowly. The following acids are deemed essential for man: valine, leucine, isoleucine, threonine, methionine lysine, phenyl alanine and tryptophan.(25) The rat(26) and chick(27) require also arginine and histidine and the chick needs the further addition of glutamic acid and glycine.(28) The rat synthesizes enough arginine for maintenance but not enough for growth.(26) Certain non-essential acids spare the essential ones; thus cystine can partially replace methionine, and tyrosine and serine respectively spare phenyl alanine and glycine.

Naturally any consideration of protein value presupposes that the energy requirements of the animal are fully covered by carbohydrates and fats, otherwise the amino-acids are bur for fuel.

For the rat the biological value of egg proteins is close on 100(28,29,30) which shows that they are almost completely utilized. Thus the growth rate of rats on a diet containing 9% of egg proteins could not be improved by the addition of any individual amino-acid, same lysine that had a very slight effect, but increase in the proportion of egg proteins in the diet promoted further growth.(31)

2-Supplementary effects and the time factor in protein utilization :

Maximum utilization of proteins can only take place when the energy needs are satisfied by fats and carbohydrates and all the essential amino-acids are available simultaneously in the correct proportions, together with adequate quantities of non-essential amino-acids, or of non-protein nitrogen. When one or more of the essential amino-acids are short they are termed limiting acids as they limit the extent to which the particular protein can be used for tissue synthesis.

In a mixed diet with its different proteins supplementary relationships become apparent whereby amino-acids deficiencies in one food are made good by a relative surplus in another. A protein of highest biological value is not necessarily the most economic in improving less complete proteins. It is the dovetailing of relative amino-acids surpluses and shortages that leads to efficient supplementary relationships between proteins. It is possible to predict supplementary effects from amino-acids analysis of individual proteins[32,33,34] but confirmation by animal experiments is necessary (Ramachandran & Phansalkar 1956; Harper, Winje, Benton 1955)[33,35] as some amino-acids may be present in foods in a form that resist enzymic hydrolysis.

High biological values of 80-90 have been reported for the proteins of mixed, non-vegetarian human diets[36,37] and 73-84 for cereal and pulse mixtures[38,39,40,41]. Few individual proteins have such low biological values so that it is evident that marked supplementary effects must take place.

IV -BIOLOGICAL METHODS OF EVALUATING PROTEIN QUALITY

Proteins are unique among the food-stuffs in that the same name is given to a large number of heterogenous substances. With proteins, however, vast numbers of substances of differing composition and differing nutritive value are all covered by the one name.

That the different nutritional values of proteins are not generally taken into account is indicated by the wide acceptance of "N X 6.25" as an adequate description of protein foods despite the fact that proteins can vary between 0 and 100% availability for physiological purposes. The question to be answered is "What is the value of the protein under investigation to man or domestic animal?" The animal can use protein to replace metabolic losses, for the construction of new tissue as in growth, for reproduction, for lactation, or, looked at from another point of view for meat, wool, egg, or milk production. It is possible to measure these effects directly on the particular animal or man, but the technical difficulties are very great.

Consequently a number of experimental methods have been developped to determine an index of the "value" of a protein. Apart from the microbiological tests, the rat is the most commonly used animal.