THE STUDY OF THE EFFECT OF SOME ANTINUTRITIONAL SUBSTANCES INVOLVED IN TRADITIONAL FOOD HABITS

THESIS

SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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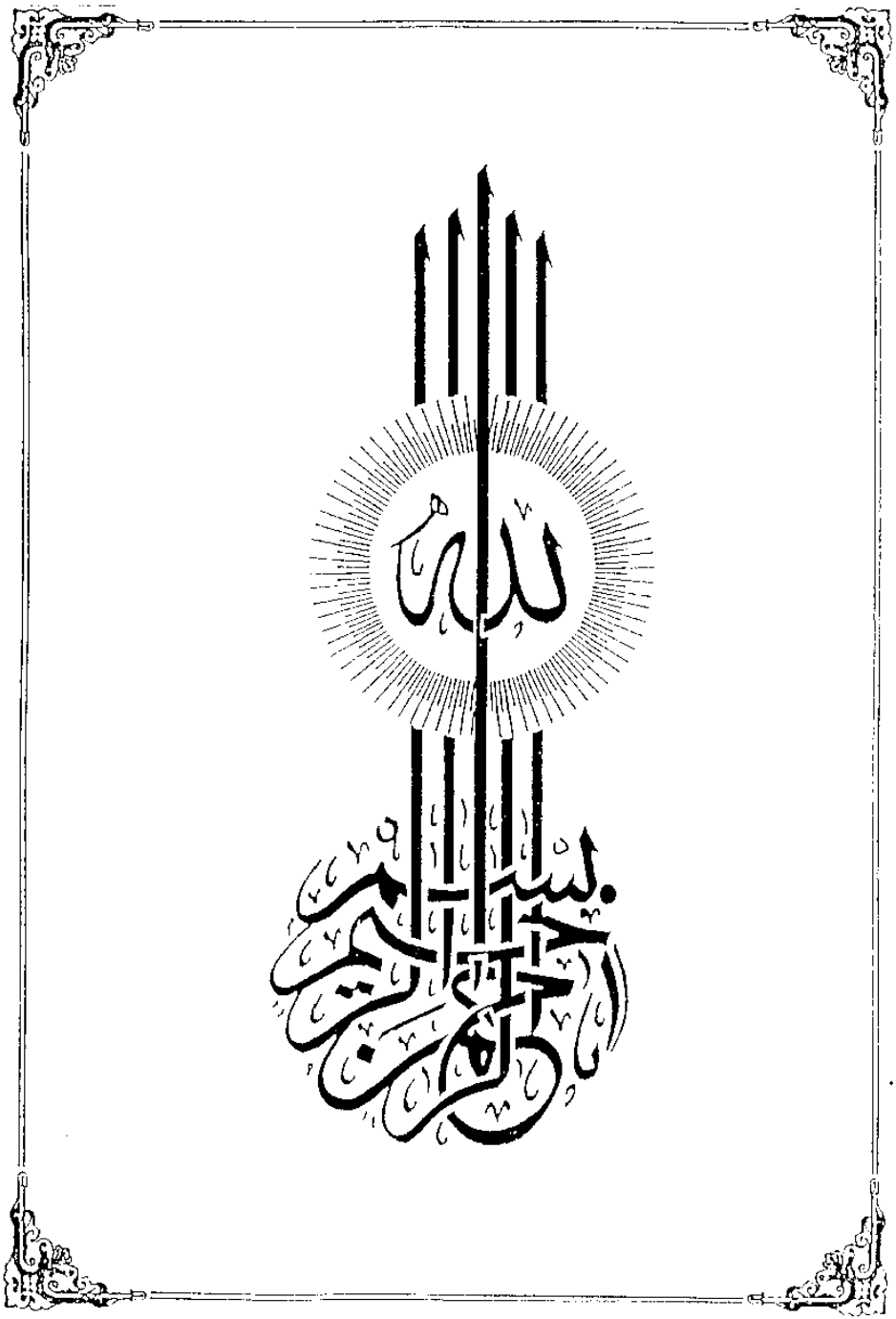
بسم الله الرحمن الرحيم

"سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم"

صدق الله العظيم

"سورة البقرة آية ٣٢"



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CONTENTS

ABBREVIATIONS

A.A.P.	Alkylaryl polyether.
B.C.F.	Bromocresol sulfonphthalein.
B.S.A.	Bovine serum albumin.
P.T.	Interaction of protein and level of tea.
B.V.	Biological value.
D.F.	Degree of freedom.
E.D.T.A.	Ethylene diamine tetra acetate.
I.P.	Inositol phosphate.
L.S.D.	Least significant difference.
M.S.	Mean squares.
N.P.U.	Net protein utilization.
O.D.	Optical density.
P.B.T.S.	Pyridyl bisphenyl triazine sulfonate.
P.E.R.	Protein efficiency ratio.
P.V.P.P.	Poylvinyl polypyrolidence.
R.P.M.	Rounds per minute.
S.B.	Serum blank.
S.V.	Source of variance.
T.D.	True digestibility.
T.V.P.	Textured vegetable protein.

INTRODUCTION AND AIM OF THE WORK

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Millions of people in the world suffer from some degree of malnutrition as a result of ignorance and/or poverty and faulty food habits. In Egypt, food habits and costs play an important role in the way and kind of food consumed.

Egyptian diets consist of a high percentage of cereals and legumes. Most of the Egyptian families eat faba beans in breakfast everyday; others may eat it twice a day or it may be the only food taken throughout the whole day. Also, tea beverage is common between the Egyptians, whether taken before, between or after meals.

Both beans and tea contain many antinutritional factors, the most important of which are phytates and tannins, which posses serious nutritional effects.

Tannins are a class of plant polyphenols which are almost universally present in animal and human diets derived from plant *(Singleton and Kratzer, 1969)*. They are water-soluble and heat stable compounds *(Bronner et al., 1956)*. Tannins are considered one of the antinutritional factors, because they precipitate soluble, or sparingly soluble proteins rendering them less available *(Hurrell et al., 1982)*.

Eggum and Christensen (1975), showed that tannic acid singificantly reduced the digestibility of soybean protein. Moreover, iron absorption was reported to be inhibited by tea ***(Stagg and Millin, 1975; El-Bahay, 1978; Rossander et al., 1979 and El-Shabaki and Saleh 1986).***

It was reported that polyphenols react with proteins reducing their available lysine and tryptophan content. This is due to the formation of nonabsorbable complexes which are not absorbed and thus excreted in faeces ***(Hurrell et al., 1982).***

Phytates as naturally occurring compounds, may significantly influence the functional and nutritional properties of foods ***(De-Boland et al., 1975).*** They are present in cereals and legumes up to 5% by weight. Numerous studies have led to the conclusion that phytic acid and its derivatives combine with certain essential dietary minerals, rendering them unavailable or less available or less available for absorption ***(O'Dell and Savage, 1960; Likuski and Forbes, 1964; Reinhold et al., 1973; Forbes and Parker, 1977; Evans and Pierce, 1982 and Wise, 1983).***

Hence, the aim of this work is to reveal the different adverse biological effects of both tannins and phytates when ingested to albino rats as pure compounds or as major antinutritional factors in some traditional foods or beverages.

Also, this work was designed to study the Egyptian meal types and habits. Also, the present study is concerned not only with the study of the inhibitory effects of these two major antinutritional factors on mineral absorption, but also on protein digestion, biological value and net protein utilization. On this respect, the effect of the two antinutritional factors on the absorption of Ca, Zn and Fe were traced, compared and related to the relevant effects on haemoglobin and the anaemic state of the animal.

Also, serum protein fractions and serum lipid fractions, serum haemoglobin as well as Ca, Fe and Zn contents in the serum were determined during certain periods to identify the general biological state of the animal under the effect of the two antinutritional factors.

The distribution of lipid fractions in serum and in liver, specially cholesterol was followed in the different animal organs. Also, the antinutritional effects of the two factors were compared when taken at similar concentrations, berfore or with meals. Also, when the antinutritional factor is in the free state (authentic samples) or combined with other food components. This study tries also to determine the mode of action of these antinutritional factors; aiming to correct some of faulty food habits and choice of meals.

REVIEW OF LITERATURE

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Tannins

Distribution, Structure and Properties

Tannins are widely distributed in higher plants and they occur at high levels in various plants utilized by humans. Tannins are usually associated with proteins, carbohydrates, amino acids, vitamins and minerals (*Deshpande and Cheryan , 1985 and Makker et al., 1987).* Tea contains polyphenols, methylxanthines, aluminium and other minerals, *(Eden, 1976).* The polyphenols in various types of tea differ greatly. Green tea contains mainly low molecular weight polyphenols, while black tea contains condensed polyphenols of high molecular weight; *(Sanderson et al., 1976 and Pintauro, 1977).*

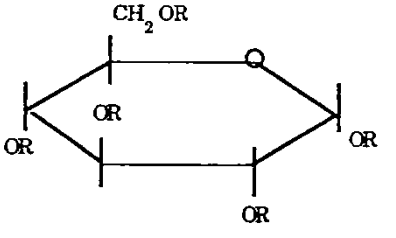
Reddy et al. (1985), showed that tannins represent one of several antinutritional factors present in beans. They are located mainly in the seed coat or testa. The tannins content of dry beans ranges from 0.0-2.0% depending on the type of beans and the colour of the seed coat. Many high tannin beans are lower in their nutritional value as compared with those of low tannin content.

Swain (1965), describes tannins as any natural occurring compound with a high enough molecular weight (500-3000) containing

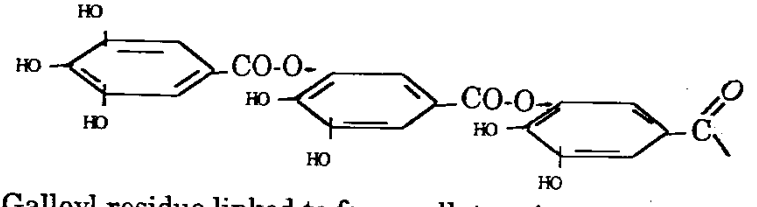
a sufficiently large number of phenolic - OH or other suitable groups to enable it to form effective crosslinks between porteins and other macromolecules; the formation of effective crosslinks may be judged by the precipitation of soluble proteins, or inhibition of enzymes.

Pierpoint (1983), stated that there are two main classes of tannins; hydrolyzable and condensed tannins. The hydrolyzable tannins are based on a core of polyhydric alcohol usually glucose, whose OH groups are estrified either partialy wholly with gallic acid.

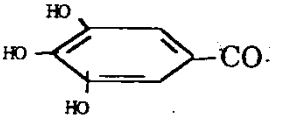
The general structure of hydrolyzable tannins may be as follows:



Where R may be a galloyl or number of galloyl residues linked to gives gallotannins.

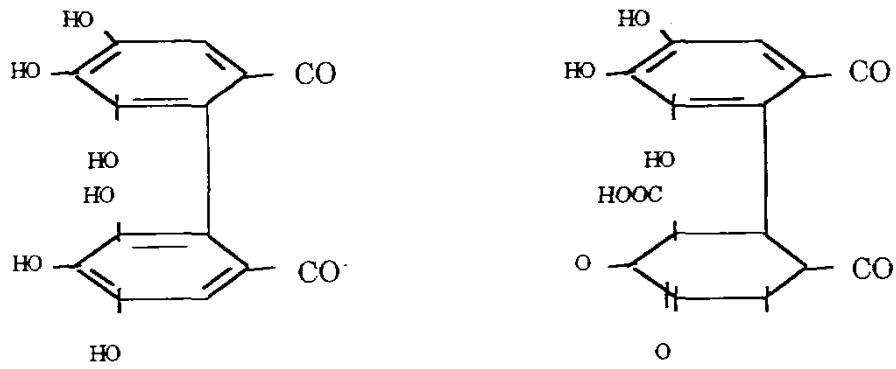


Galloyl residue linked to form gallotannins



Galloyl residue

The residue R may also be galloyl residues which have bean oxidatively linked as in ellagitannins as follows:



As their name indicates, they are hydrolyzed by acids, alkalies, and tannases drived from fungi such as Asperigillus and Penicillium species. They are hydrolyzed intestinally in nonruminants, even though tannases have not been detected in animal tissues or intestinal bacteria, ***(Glick and Joslyn, 1970).*** The products are absorbed and the sugar moiety metabolized, presumably usefully whereas the phenols are hydroxylated, methylated, or conjugated before being excreted, ***(Milic and Stojanovic, 1972 and Me- leod, 1974).***

Another form of tannins is known as condensed tannins. The most common members of this group are described as procyanidins because of the red anthocyanidins that they give when heated in acid medium ***(Haslam 1977, 1978).***

Condensed tannins are often considered to be less effective protein precipitants than the hydrolyzable tannins. The ability of some