STUDIES ON PROMOTORS AND INHIBITORS OF IRON ABSORPTION IN BEVERAGES

THESIS

SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENT
FOR THE DEGREE OF MASTER IN
Nutritionand Food Chemistry

To The
University College for Women
AIN SHAMS UNIVERSITY

BY

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1988

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ACKNOWLEDGMENT

I am indebted and extremely grateful to ***Professor Dr. SAAD KHALIL SHEHAB****, Professor of Biochemistry, Ain Shams University College for Women, for his supervision, his great interest in the work, unfailing advice and valuable discussion.*

Particular thanks and gratitude are due to ***Professor Dr. FAWZI AMIN EL-SHOBAKI****, Professor of Nutritional Biochemistry, National Research Centre, for suggesting the work, valuable supervision, kind help, careful guidance, and continuous encouragement throughout this work. To him I owe a great deal for teaching me the art of being a scientific research worker.*

Thanks and gratitude are extended to ***Dr. SORAYA T. EL-DAMHOUGI*** *and* ***Dr. NADIA SALEH****, for their sincere help.*

I would sincerely like to express my deepest thanks to the staff members of the Food Science and Nutrition Department (N.R.C.), for thier encouragement.

Thanks to the authorities of the National Research Centre, Cairo, Egypt, for providing facilities.

CONTENTS

Page

INTRODUCTION

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Iron deficiency anaemia has been attributed to many etiological factors such as:

a) Deficiency of dietary iron

b) Low bioavailability of ingested iron.

c) Intestinal malabsorption of iron.

In order to combat anaemia, these conditions have to be corrected, to realise a state of balance between supply and requirements.

Most of the naturally occurring forms of iron, particularly those from plant origin have poor or low bioavailability, which limit their proper use for haemoglobin synthesis.

Iron deficiency anaemia is a nutritional problem in developing countries **(Dallman and Siimes, 1979).** In Egypt the incidence of iron deficiency anaemia among school children is about 40% **(Nutrition Institute, 1978).** Those who suffer from iron deficiency, have to be supplied with certain foods or drinks that promote iron absorption. This necessitates, the search for such items of foods or drinks that have the property of promoting the absorption and utilization of iron.

Several beverages are consumed in our homes and sometimes many of them are offered to children and adults as a remedy from diseases such as diarrhea or common cold.

The aim of the present investigation is to study the effect of extracts of some beverages commonly used in our country on the absorption and utilizaiton of iron.

REVIEW OF LITERATURE

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Mechanism of Iron Absorption:

Site of absorption: Although small amounts of iron salts can be absorbed from the stomach **(Rhodes *et al*.,1968)**, The ileum **(Jacobs *et al*., 1966)** and the colon **(Chernelch *et al*.,1970)**, the most active site of absorption is the duodenum and the upper jejunum **(Wheby, 1970)**. **Ansari *et al*. (1977)** observed that about 90% of the dose ferric chloride ($^{59}FeCl_3$) being absorbed in the first 20% of the small intestine of rat. There is a progressive decrease in the absorption rate from the duodenum to the terminal ileum **(Van Campen and Mitchell, 1965)**, and studies with everted gut pouches suggest that this is a property of the mucosa, and not ascribable only to luminal factors such as pH **(Manis and Schachter, 1962; Howard and Jacobs, 1972)**. It is of interest that the absorption rate in the ileum is high in neonatel rats, the decline to the adult level occurring when the epithelium changes at weaning **(Gallagher *et al*., 1973)**. It has been pointed out that the lower absorption rates of the distal small intestine may be compensated by a longer transit time through this part of the bowel **(Booth, 1967)**, and prolonging the transit time with pharmacological agents does increase iron absorption in rats **(Schade *et al*.,1969[a])**. Under normal circumstances, however, there is little doubt that iron is absorbed from the proximal small intestine than from the distal regions **(Wheby and Crosby, 1963).** This is true for haem iron as well **(Wheby *et al.*,1970).**

Stages of Absorption:

Absorption can be subdivided into at least two distinct steps, namely the entry of iron into the mucosal cell from the lumen of the gut "uptake" and its transfer from the nucosal cell into the body "transfer".

In experiments with rats, **Wheby and co-workers (1964)** noted that transfer was slower than uptake, more restricted to the duodenum, and affected to a greater degree by such factors as the size of the body iron stores and the quantity of iron in the diet. Moreover, not all the iron taken up from the lumen into the cells is necessarily transferred , in accordance with the body's need for iron, a variable proportion may be sequestered within the mucosal cell, and eventually discarded when the cell exfoliates **(Conrad and Crosby, 1963; Charlton *et al.*,1965).**

Mucosal Uptake of Iron:

The uptake of iron by the mucous membrane of the small intestine is a function of the concentration of iron within the lumen. When iron solutions are perfused through isolated duodenal loops of anaesthetised rats, the relationship between the concentration within the lumen and the quantity entering the mucose is linear over a 0.1-5.0 mM range **(Thomson and Valberg,1971).** While the relationship is linear, the slope of the line varies in accordance with the body's iron requirement, and it is clear that the latter influences the amount of iron which enters the mucosa from the lumen as well as the proportion which is subsequently transferred into the plasma.

In animal studies uptake is diminished if they have previously been given parentral iron preparations, and enhanced if they are iron deficient, pregnant or have been venesected. This has been demonstrated *in vivo* **(Thomson and Valberg, 1971)**, with everted intestinal pouches *in vitro* **(Howard and Jacobs, 1972)** and with preparations of isolated mucosal cell brush borders **(Kimber *et al.*,1973).** Similar observations have also been made using human duodenal mucosa obtained by biopsy **(Cox and Peter, 1978).**

The greater uptake by the more proximal regions of the small intestine both *in vivo* and *in vitro* appears to be at least partly due to differences at the level of the initial contact of the iron with the mucous membrane **(Bothwell *et al.*,1979).** Electron microscopic studies suggest that the iron becomes attached to the surface glycoproteins (the 'glycocalyx') of the bruch border of the mucosal cells **(Kimber et al., 1973)**. Brush borders from the cells of the proximal small intestine bind iron in preference to other metals such as cobalt or manganese, and the iron cannot be removed even by repeated washing; neither of these features is seen with brush borders from the more distal intestinal mucosa **(Huebers et al., 1971[b])**. These observations suggest that the more efficient uptake of iron in the proximal regions is associated with the presence of specific receptors for iron on the mucosal cell membranes. Moreover, it seems possible that variation in the number and distribution of these receptors may be part of the mechanism by which the absorption of food iron is adjusted to meet changing body iron needs, since preparations of isolated brush borders from the distal intestine of iron deficient animals bind more iron than those from animals with normal iron stores, while proximal iron binding is inhibited in iron loaded animals **(Greenberger et al.,1969)**.

The binding of iron by isolated brush borders is temperature dependent, but not affected by removing glucose or oxygen from the incubation medium **(Kimber et al.,1973)**. The uptake of iron by everted gut pouches is, however, inhibited by anoxia as well as by a number