

**STUDIES ON SUGAR ALCOHOLS
AND FREE SUGARS ON GLUCOSE AND
LIPID METABOLISM IN RATS**

By

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A Thesis Submitted In Partial Fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

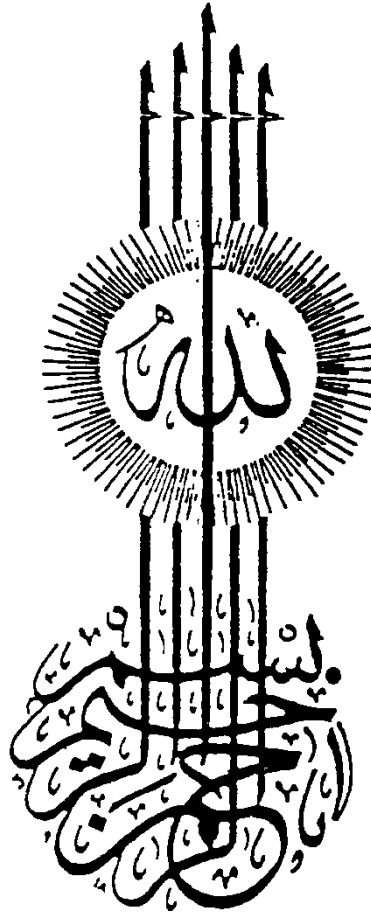
In

Agriculture (Agric. Biochemistry)



**SOIL DEPARTMENT
FACULTY OF AGRICULTURE
AIN-SHAMS UNIVERSITY**

1988



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صدق الله العظيم



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ACKNOWLEDGMENT

I wish to express my deepest gratitude to Prof. Dr. Mohamed A.E. Shatla Professor of Biochemistry, Faculty of Agriculture, Ain Shams University. I am deeply indebted to him for supervising this work, sincere help, profound guidance and encouragement throughout the course of this study.

I am grateful to Dr. Zinab A. Abdou Assistant Professor of Biochemistry, Faculty of Agriculture, Ain Shams University. My sincere thanks and gratitude to her for inestimable help, profound guidance and encouragement.

Sincere thanks and gratitude to Prof. Dr. El-Said M. Hegazi Professor of Nutritional Biochemistry, Food Science and Nutrition Department, National Research Centre for suggesting the work, kind help, profound guidance and encouragement.

Deepest gratitude for the staff members of Food Science and Nutrition Department of the National Research Centre for their sincere help, guidance and encouragement.

Thanks for the National Research Centre for supporting and funding this work.

Deepest sincerity and gratitude to my family. I am indebted for sincere encouragements.

CONTENTS

	<u>Page</u>
* INTRODUCTION.....	1
* REVIEW OF LITERATURE.....	4
-Fructose as a sweetener.....	4
-Sorbitol and mannitol as sweeteners.....	5
-Effect of type of carbohydrate on plasma glucose	7
-Effect of type of carbohydrate on plasma lipid ...	10
-Effect of sweetener on glucose metabolism	13
-Effect of sweetener on lipid metabolism.....	18
-Lipid metabolism in diabetes	22
-Effect of alloxan on glucose metabolism.....	23
-Effect of alloxan on alkaline phosphatase activity	25
* MATERIALS AND METHODS	
Experiment I	26
Experiment II	26
Diet	26
1. Estimating of blood sugar	27
2. Determination of serum glucose.....	31
3. Determination of total lipids	35
4. Determination of triglycerides.....	36
5. Determination of cholesterol	37
6. Determination of phospholipids.....	39
7. Determination of liver glycogen	40
8. Assay of serum alkaline phosphatase activity	43
9. Statistical analysis	47
* RESULTS AND DISCUSSION	51
* SUMMARY	53
* REFERENCES	90
* ARABIC SUMMARY.....	96

INTRODUCTION

INTRODUCTION

In the treatment of diabetes, a disease of considerable public health importance, there is enormous controversy and diversity of opinion over the permissible intake of carbohydrate foods particularly the moiety of sucrose.

The use of simple sugars or "concentrated carbohydrates" has been discouraged in the diets of most diabetic patients (Bierman et al., 1970). This restriction of glucose and sucrose has been recommended in an attempt to prevent rapid changes in blood glucose levels.

Saccharin the non-nutritive artificial sweetener had been widely used by diabetic persons. With discontinuation of clyamates and possible removal from the market place of saccharin as a non-nutritive sweeteners, questions have arising concerning the appropriate use of non-glucose containing sweeteners to replace glucose and sucrose in diets of patients with diabetes mellitus. Nutritive sweeteners that are available include fructose and sugar alcohols, such as sorbitol, mannitol and xylitol, since other sweeteners are not sweet enough. These sugar alcohols can be used as a substitutes for sucrose and glucose for diabetic patients.

Arguments in favor of the utility of fructose and sugar alcohols are based primarily on the differences in the absorption and metabolic pathways of these substances in comparison to monosaccharide, glucose or glucose moiety of the disaccharide sucrose. Due to the existence of an active transport mechanism for glucose but not for fructose and the sugar alcohols, fructose and the sugar alcohols are absorbed into the blood stream at a slower rate than glucose. Once absorbed, most of the initial metabolism of fructose and sugar alcohols occurs in the liver independently of insulin. Because of the combined effects of the lower rate of absorption and stepwise metabolism, fructose and sugar alcohols do not produce a sharp elevation in the blood glucose level as compared with glucose and sucrose.

The present work was designed to determine the effect of fructose, sorbitol and mannitol on glucose and lipid metabolism when compared with starch, glucose and sucrose. In the short-term study, the effects of sugars and sugar alcohols on glucose tolerance curve were determined in normal rats. In the long-term study, the effect of sugars and sugar alcohols on glucose level; alkaline phosphatase activity, total lipids; cholesterol; triglycerides and phospholipids were determined in the plasma of

alloxan-diabetic rats kept on experimental diets with different sugars and sugar alcohols supplements. The study was extended to determine liver weight and liver glycogen content in rats after feeding experiment. The body weight gain, food consumption and food efficiency were also noticed through the time of this investigation.

***REVIEW
OF
LITERATURE***

REVIEW OF LITERATURE

Fructose as a sweetener

Fructose has a well accepted flavor, the possible application of fructose as a sweetener in the low calorie foods or diabetic foods and in improving the flavor and crust colour of bread or the texture of ice cream and icings was reviewed by Kimura and Carr (1976) and Brunzell (1978).

Berghe et al., (1978) reported that although warnings have been issued against the infusion of fructose, this sugar is still widely used in parenteral nutrition. They cited the degradation of the adenine nucleotides in the fructose metabolizing tissues, manifested by hyperuricaemia and in a rise in the concentration of blood lactate; both effects are caused by the rapid metabolism of the sugar. They added that for these reasons, fructose is unsatisfactory substitute for glucose in parenteral nutrition. The same conclusions apply to sorbitol which is converted into fructose by the liver.

Sestoft (1979) discussed the use of fructose in the dietary treatment of diabetes mellitus. He concluded that there are many questions on the quantitative aspects of fructose metabolism in relation to the state of regulation in diabetics and on its role in the pathogenesis of diabetes can not be answered. He added it is wise not to promote the large-scale use of fructose as a sweetener for diabetics.

Frattali (1980) reviewed the regulatory and nutritional aspects of fructose and sugar alcohols in foods. He reported that arguments in favor of the utility of fructose and sugar alcohols are based primarily on the differences in the absorption and metabolism of these substances in comparison to glucose. He added that fructose and sugar alcohols are absorbed in blood stream at a lower rate than glucose. Such lower rate of absorption and stepwise metabolism fructose does not produce sharp elevation in the blood glucose when compared with glucose or sucrose.

Aoyama et al., (1980) studied the effect of glucose and fructose in a diet or a drinking water on body weight gain, liver lipid content and serum triglyceride level in 4 strains of rats. The results showed that body weight gain was similar in each strain for rats given glucose or fructose. Liver lipid content of rats given fructose was greater than glucose. They also found that fructose in the diet, but not in the drinking water, increased serum triglyceride.

Sorbitol and mannitol as sweeteners:

Sorbitol is widely used in dietetic candies and milk jans. It is suggested to be used in foods for diabetic patients or to be used in cake mixture pastry,

Biscuits, chocolate and sugar less gums. On the other hand, mannitol is rarely considered as a nutritive sweetener for substantial dietary use because it is comparatively less sweet than sucrose and causes laxation when consumed in single doses (Allison, 1979 b).

Schell and Siebert, (1980) reported that rats given 50 mg. sulphonilamide intraperitoneally 2 hours after sorbitol or fructose, acetyl sulphonilamide in urine had a higher specific radioactivity after sorbitol than after fructose. The same authors found that men and women who took 30 g. fructose or sorbitol by mouth exhaled more hydrogen from their lungs after sorbitol than after fructose.

Siebert (1982) pointed out that all available data assured the fact that sorbitol metabolism proceeds only partially via fructose; and the other major pathway involves attacked by intestinal microorganisms, with formation of volatile fatty acids.

Lorenz and Grossklaus. (1984) reported that sorbitol had the strongest osmotic effect in gastrointestinal tract of rats as compared with glucose or sucrose and the effects were dose-dependent. Recent intestinal absorption study, of sorbitol and the effect of its acute administration on glucose homeostasis in normal rats conducted by Lauwers et al., (1985), who resulted that in rat ,

the intestinal absorption of sorbitol is about six times slower than that of 3-O-methyl glucose; a non-metabolized sugar, known to be absorbed like glucose. They found that sorbitol absorption increased with time but the increase was very small at high lumen concentrations. The findings also demonstrated that sorbitol absorption is not restricted to the duodeno-jejunum but also takes place, although at a slower rate (66 %), in the terminal ileum.

Mackenzie and Hauck (1986) introduced a brief review of the toxicological status of sorbitol. They reported that groups of rats were fed a sucrose-containing ground cereal-based diet in which 0, 2.5, 5.0 and 10 % (w/w) sorbitol was included at the expense of sucrose. The study was extended for 3 generation reproduction. It was concluded that sorbitol administered in the diet to three successive generations of rats at levels up to 10% had no adverse effect on growth or reproductive performance in either sex.

Effect of type of carbohydrate on plasma glucose:

Simpson et al., (1979) found that diet, in which carbohydrates make up 60 % of the total energy when given to patients of maturity-onset-diabetes decreased blood glucose more than did a standard carbohydrate-poor diet (40 % of the total energy) .