STUDIES ON THE EFFECT OF SOME EDIBLE ADDITIVES ON SOME PROPERTIES OF ICE MILKS

BY

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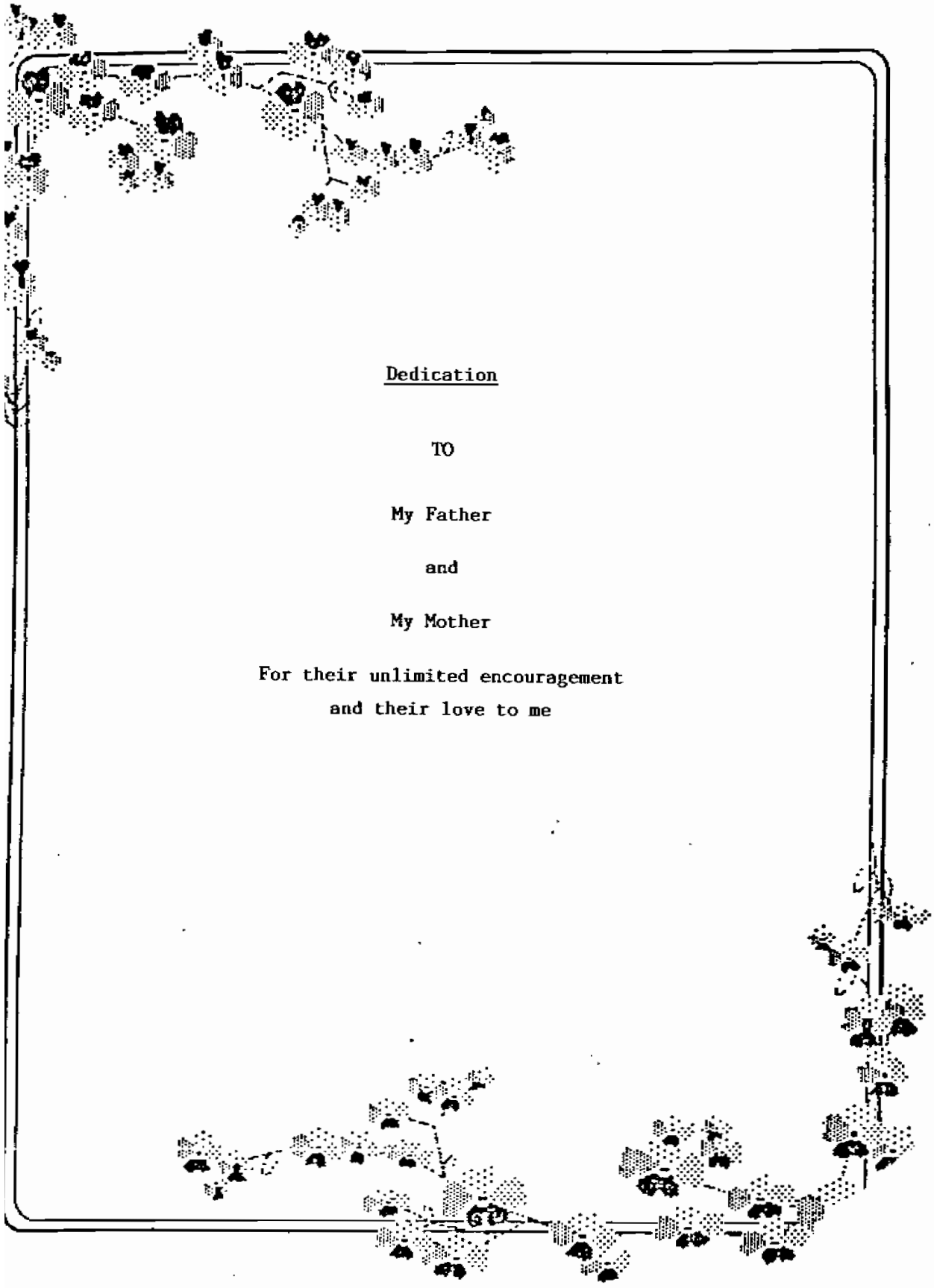


Dedication

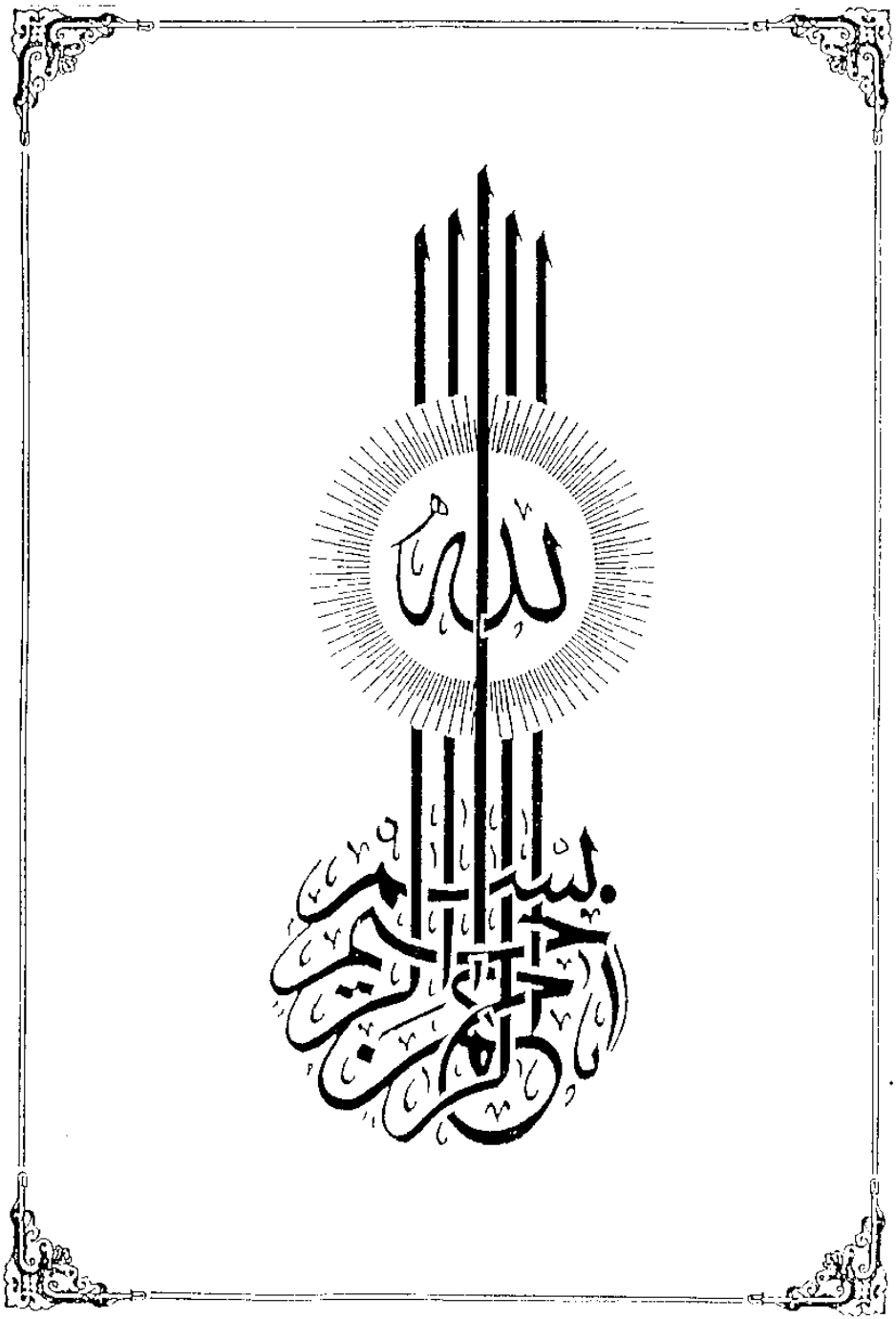
TO

My Father

and

My Mother

For their unlimited encouragement
and their love to me



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C O N T E N T S

INTRODUCTION

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Diabetes is a condition resulting from the failure of the pancreas to provide an adequate supply of insulin. In this condition a person can has high levels of sugar in the blood stream after a meal but the cells can not take the sugar to produce energy (Labuza, 1974).

Foods, when chemically analysed are found to consist mainly of three groups of biochemical components: carbohydrate, protein and fat. The normal pancreas produces amount of insulin which vary naturally with the quantity of carbohydrates content. In case of diabetics, where insulin production is deficient, an artificial balance of diet components and insulin must be imposed to maintain a normal state of metabolism and prevent disease. In diabetes where insulin synthesis in the pancreas is reduced, patients require a diet which is poor in carbohydrates in general.

The majority of food items classed as "dietetic" are really "calorie-reduced" or dietetic food for diabetics. Non-nutritive sweeteners (artificial sweeteners) are now used widely for the production of some foods. Non-nutritive sweeteners are sweetening substances that are not utilized in energy metabolism as sucrose.A lot of consumers select calorie-reduced foods to prevent, retard or reverse obesity. Such products are also suitable for diabetics, because of their low sugar content. Dietetic food suitable for diabetics may also contain the same

calorie value but using a sugar substitute, such as sorbitol, which does not require insulin for its metabolism. In the few years ago cyclamate was withdrawn from the market in many countries because doubt arose concerning its safety. Today, saccharin is the only approved non-nutritive sweetener in many countries.

In Egypt, unofficial surveys show that there are more than 3 million diabetics and more than 5 millions suffering from obesity. Therefore, it is necessary to formulate some low-calorie dietetic ice milk, suitable for diabetics. Ice milk is a milk product which contain low amount of fat but high amount of sucrose, thus it is not suitable for diabetics or dietetic. The aim of this study was mainly to formulate some ice milk recipes which contain artificial sweeteners such as aspartame, saccharin and new commercial sweetening agent "Sucrol" in combination with polydextrose and sorbitol as bulking agents. The study was carried out under two parts, each of two sections:

Part I:- Aspartame and saccharin as sweeteners for ice milk.
- Section (A): Suitable sweetners level.
- Section (B): Effect of used sweetners on some properties of ice milk.

Part II:- Sucrol as sweetner for ice milk.
- Section (A): Suitable sweetners levels.
- Section (B): Effect of sucrol on some properties of ice milk.

REVIEW OF LITERATURE

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1. Aspartame:

Properties:

Aspartame commonly known by the trade name Nutra Sweet. Aspartame was discovered in 1965 by a Scientist at G.D. Searle and Company (Rosetta, 1986).

Cloninger and Baldwin, (1970) reported that aspartame is the generic name of a new intense sweetener which is derived from the full chemical name of NL-aspartly-phenylalanine 1 methyl ester. Its principal elements are the amino acids aspartic acid and phenylalanine. They also reported that aspartame is 180 times sweeter than a 2% sucrose solution but only 43 times sweeter than 30% sucrose solution. It is a nutritive substance and is metabolized by the body. It contains calories like all proteins and provides 4 calories per gram. However, because only small amounts are required to provide the equivalent sweetness of sugar aspartame-sweetned foods are significantly reduced in calories when compared to sugar sweetened food. The same authors showed that its stability is a function of time, temperature, pH and available moisture. Decomposition appears to follow simple first order kinetics. Aspartame has maximum stability at 25^{o}C with approximately pH 4.3.

Beck, (1974) showed that aspartame is a white crystalline powder, has a clean sweet taste and no oder . It is water soluble and its isoelectric point is pH 5.2. At 25^{o}C and at its isoelectric point, aspartame will gave

only 1% solution in water. On the other hand, at pH 2.2 where maximum solubility is achieved a 10% solution can be obtained. He also reported that aspartame has been used successfully in applications where heat processing is of short duration such as in High Temperature Short Time systems (HTST), where cooling can be accomplished quickly.

Cloninger and Baldwin, (1974) showed that in product formulation, variance from the equivalents may result from combination of the aspartame with certain ingredients. For example enhancement of the aspartame may be achieved by certain ingredients such as the gums, gelatin and a non carbonated orange-flavored beverage used in this study.The complexity of the better product makes it difficult to attribute the enhancement to any specific ingredient. Also, use of more than one sweetener in food permits lowering of the total amount of sweetener ingredients required to achieve a specified level of sweetness.

Frey, (1976) studied the effects and differences, if any, resulting from the ingestion of aspartame (sweetener) vs.sucrose. A 13 wk, double-blind study was conducted using 126 apparently healthy children and adolescents as panelists. Clinically significant differences in laboratory parameters measured could not be demonstrated; all mean values were within normal limits. No unusual findings were observed in phenylalanine or tyrosine levels. All phenylpyruvic acid and methanol determination were negative. No important physical changes were occurred, and no product-related side effects were reported.

Koch et al., (1976) reported that aspartame, a new artificial sweetener, was administered to 45 obligate phenylketonuric adults for 28 wk. This new sweetening agent was well tolerated, and no untoward medical or biochemical changes were noted.

Mazur, (1976) reported that the dipeptide ester L-aspartyl-L-phenylalanine methyl ester (APM) has been found to have a remarkably clean, sucrose-like taste with no off flavour and a potency 150-200 x sucrose. Subsequent work has shown that many α-amides of L-aspartic acid are sweet.

Stern et al., (1976) studied the effect of the consumption of the nutritive sweetener aspartame on non-insulin dependent diabetics. 43 adult diabetics between the age of 21 and 70 completed a 90-day study; participants were instructed to continue their usual diet and to take 2 capsules of an assigned preparation 3 x daily with meals, either the aspartame (1.8 g) or the placebo. Throughout the study subjects were examined for symptoms of intolerance, fasting plasma phenylalanine levels $>$ 4 mg/100 ml, and deterioration of diabetic control. At the conclusion of the study, subjects exhibited no symptoms that could be traced to the administration of aspartame or the placebo, and diabetic control was unaffected by the chronic administration of these substances.

Powers and Pangborn, (1978) found by paired comparison methods concentrations of 0.75% and 0.86% calcium cyclamate and of 0.17% and 0.19% aspartame were equivalent

in sweetness to 10% sucrose in distilled water at 3^{o} and $22^{o}C$, respectively.

Tesarik, (1980) defined USAL as a synthetic of α-L-aspartyl-L-phenylalanine methyl ester with a sweetening capacity 150-200 x that of sugar. A limitation is its low stability in solution at temp. around $100^{o}C$, or in strongly acid or alkaline media. It is most stable in weakly acid environments with pH between 3 and 4. USAL can partly substitute sugar in some products.

G.D.Searle and Company (1982) mentioned that like a protein, Nutra Sweet is metabolized to its component amino acids via normal metabolic processes as is the methyl ester. Nutra Sweet has the clean, sweet taste of sugar without the bitter, chemical or metallic aftertaste often associated with artificial sweeteners. Nutra Sweet Contains an ester linkage that, under certain moistures, temperature and pH conditions may hydrolyze to the dipeptide, aspartylphenylalanine (AP) or be converted to its diketopiperazine (DKP). Aspartylphenylalanine and diketopiperazine are not sweet. Nutra Sweet exhibits minimum solubility in water at its isoelectric point (pH 5.2) and solubility increases with increasing temperature. NutraSweet has been used successfully in applications where heat processing is of short duration such as in High Temperature Short Time (HTST) systems, where cooling can be accomplished quickly. There is also some evidence that NutraSweet can be used in applications where Ultra-High Temperature (UHT) is used such as in aseptic packaging where exposure to high heat is very short and the product is rapidly cooled before packaging.

Anon, (1984,b) reported that the toxicological studies were extended up to 24 months in mice, rats, and dogs, and 12 months in monkey, with doses reaching as such as 4 g/kg/day (equal to 280 g/day for a man weighing 70 kg).The author(s)concluded that aspartame is virtually non toxic,even for smoll children and during pregnancy. He also shows that the acceptable daily intake (ADI) of aspartame for humans is 0-40 mg/kg body weight. It is sixteen times safer than saccharin (0-2.5 mg/kg body weight).Reports are mentioning that in certain concentrations saccharose, xylitol, and gelatine act positively on the stability of aspartame appear to call for further experiment. An important point to observe is that cyclization product of aspartame, diketopiperazine, is non-toxic and tastless.

Vetsch, (1985) reported that the solubility of aspartame in water is pH-and temperature-dependent. Maximum sobluiblity is attained at a pH of 2.2; minimum solubility is noted at its isoelectric point, pH 5.2.

Anon, (1986) reported that safety aspects of aspartame, including World Health Organization (WHO) suggested maximum daily intakes of 40 mg aspartame/kg body wt., and health risks associated with aspartame intake.

Davoli et al., (1986) mentioned that rats given the FDA's (Food and Drug Administration) projected 99th percentile daily intake for humans, assuming aspartame were to replace all sucrose sweeteners in the diet (34 mg/kg). Four male adult volunteers each received 500 mg, equivalent to 6-8.7 mg/kg, which is approx. the FDA's estimate of mean