ORIGINAL ARTICLE

A STUDY OF THE DIGESTIVE EFFECT OF DATES ON SUCROSE AND STARCH

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ABSTRACT
A study of the digestive effect of dates on sucrose and starch has been carried out. Digestion of sucrose and dates and starch and dates at pH 7.4 results in the breakdown of both sucrose and starch to glucose and fructose. On the contrary, digestion of sucrose and starch alone at pH 7.4 does not cause any breakdown suggesting that dates do affect the breakdown of sucrose and starch in the intestine. The variations in the analytical results are of the order of 1-2 % in terms of RSD.

Keywords: Dates, sucrose, starch, digestion.

INTRODUCTION

Dates have been used as a diet in the Arab world from time immemorial. It has been mentioned in Qur'an (Surah Ash Shua'ra 26: 148) and Hadith that dates have a digestive effect on normal food. Dates in meal can affect starch digestion (Clarke, 1995). It has been observed that the weight gain, growth rate and protein efficiency ratio are improved in fish with diets containing dates as compared with a starch diet alone (Belal and Al-Jasser, 1997). The use of date paste in bakery products may improve the digestion of their sucrose and starch content (Mustafa *et al.*, 1989). The object of the present study is to provide scientific validation to this effect.

MATERIALS AND METHODS

Fresh dates were obtained from the personal garden of Haji Saeed Ahmed Lootah, in Dubai. Sucrose and maize starch were obtained from BDH. All other chemicals and reagents were of the purest form available form BDH/ Merck.

Preparation of date pulp

Seeds were removed from dates and the dates were thoroughly crushed in a warring blender to obtain the pulp.

Digestion Procedure

5 g samples of the date pulp were placed in 250 ml conical flasks designated as A, B, C. To each flask 100 ml distilled water at pH 2.0 (0.05 M KCl-HCl buffer) was added. To flasks B and C 5 g sucrose and starch were added, respectively. In two other 250 conical flasks designated as D and E, 100 ml distilled water at pH 2.0 was added followed by the addition of 5 g of sucrose in flask D and 5 g starch in flasks E as control.

All the flasks (A-E) were placed in a water bath maintained at 37±1°C and the contents of the mixture were continuously shaken for two hours. At the end of this period 5 ml aliquots were pipetted from each flask, filtered and stored in a refrigerator for HPLC analysis. The experiment was repeated using distilled water at pH 7.4 (0.05 M phosphate buffer) to observe the effect of pH on digestion.

High-performance liquid chromatographic assay

The assay of sugars in various samples was carried out by high-performance liquid chromatography (HPLC) according to the method of AOAC (Cunniff, 1996). The essential details are given below.

Instrumentation

The HPLC system (Shimadzu) consisted of a LC 10 solvent pump, a loop sample injector, RID-10A detector and electronic integrator. Samples were chromatographed at room temperature on a 250x4.6 mm i.d. column packed with 5µm bondasil-NH_2. The mobile phase consisted of water-acetonitrile (75:25, v/v). It was degassed ultrasonically and used at a flow rate of 1.0 ml /min.

Preparation of calibration graphs

A quantity amounting to 0.1999-0.2250 g of each standard sugar (glucose, fructose, sucrose, maltose, lactose) was dissolved in distilled water in a 100 ml volumetric flask and made up to volume with distilled water. A 10 µl aliquot of different concentrations of the sugars was injected into the column and the peak areas of the respective concentrations of each sugar were determined. These values were used to construct the calibration curves for each sugar.

Procedure

A 5 ml aliquot of the content of each flask (A-E) was

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Table 1: HPLC analysis of the contents of flasks A-E maintained at pH 2.0*

Sample	5 g dates in 100 ml water		5 g dates + 5 g sucrose in 100 ml water		5 g dates + 5 g starch in 100 ml water		5 g sucrose in 100 ml water	
Sugar content	g	%	g	%	g	%	g	%
Total sugar	3.43	68.7 (1.5)	7.31	73.1 (1.9)	3.38	33.8 (1.8)	5.02	100.4 (0.8)
Sucrose	1.05	21.1 (2.0)	3.79	37.9 (1.7)	0.60	6.0 (1.1)	3.90	78.0 (1.2)
Fructose	1.21	24.2 (1.1)	1.73	17.3 (2.1)	1.32	13.2 (1.6)	0.52	10.4 (2.5)
Glucose	1.17	23.4 (1.3)	1.79	17.9 (2.0)	1.31	13.1 (2.0)	0.60	12.0 (1.1)
Maltose	-	-	-	-	0.15	1.5 (0.5)	-	-

*Starch did not yield any sugars.
Values given in parenthesis represent %RSD

Table 2: HPLC analysis of the contents of flasks A-E maintained at pH 7.4

Sample	5 g dates in 100 ml water		5 g dates + 5 g sucrose in 100 ml water		5 g dates + 5 g starch in 100 ml water		5 g sucrose in 100 ml water		5 g starch in 100 ml water	
Sugar content	g	%	g	%	g	%	g	%	g	%
Total sugar	3.07	61.4 (1.7)	7.53	75.3 (1.8)	4.44	44.4 (1.9)	5.04	100.8 (1.2)	0.0	0.0
Sucrose	0.16	3.2 (1.0)	-	-	0.14	1.4 (0.5)	4.18	83.6 (1.6)	-	-
Fructose	1.47	29.4 (1.4)	3.59	35.9 (1.2)	2.09	20.9 (1.3)	0.42	8.4 (1.2)	-	-
Glucose	1.44	28.8 (1.2)	3.70	37.0 (1.1)	2.05	20.5 (1.2)	0.44	8.8 (0.8)	-	-
Maltose	-	-	0.24	2.4 (0.5)	0.16	1.6 (0.6)	-	-	-	-

Values given in parenthesis represent %RSD

pipetted after two hours and the homogenized sample was centrifuged at 4000 rpm for 15 minutes (centrifuge model Sigma 302). The solution was then filtered through a 0.45µ filter (Millipore, Mass., USA). A 10 ul aliquot of the filtered sugar solution was injected into the column and the peak area of each sugar was determined. The concentration of each sugar in the samples was calculated with reference to the calibration curves.

RESULTS AND DISCUSSION

The results of the HPLC analysis of the contents of each flask maintained at pH 2.0 and 7.4 are given in tables 1 and 2, respectively. The data obtained for the analysis of dates, sucrose and starch alone along with those in the presence of dates for digestion at pH 7.4 are given in table 3. The variations in analytical results, judged by the values of RSD, are of the order of 2%.

Digestion of dates of pH 2.0 yielded a total sugar content of 3.43 g (68.7%) including sucrose, glucose and fructose. The addition of dates to sucrose resulted in an excess of 4.4 % sugars compared to that of dates alone. At the same time the amount of glucose and fructose was found to be somewhat decreased compared to that of the dates alone. It may be concluded that the dates do not facilitate the hydrolysis of sucrose at pH 2.0.

The addition of dates to starch on digestion at pH 2.0 did not result in the breakdown of starch suggesting that dates have no effect on starch. The fact that 35 % less sugars were obtained from dates in the presence of starch

Table 3: Data obtained for the analysis of dates, starch and sucrose alone along with those in presence of dates for digestion at pH 7.4

Sample	5 g dates in 100 ml water %	5 g dates + 5 g sucrose in 100 ml water %	5 g sucrose in 100 ml water %	5 g dates + 5 g starch in 100 ml water %	5 g starch in 100 ml water %
Total sugar	61.4 (1.9)	75.3 (2.5)	100.8 (3.0)	43.8 (1.9)	0.0
Sucrose	3.2 (0.3)	0.0	83.6 (2.7)	1.3 (1.2)	0.0
Fructose	29.4 (1.5)	35.9 (1.7)	8.4 (1.8)	20.9 (1.0)	0.0
Glucose	28.8 (1.9)	37.0 (0.8)	8.8 (1.2)	20.0 (0.7)	0.0
Maltose	0.0	2.4 (0.7)	0.0	1.6 (0.5)	0.0

Values given in parenthesis represent %RSD

may be due to some interaction or binding effect between the date components and starch to inhibit the release of sugars.

The digestion of dates with sucrose and starch at pH 7.4 gave some interesting results. The analysis of dates alone showed the presence of glucose (28.8%), fructose (29.4%) and sucrose (3.2%). The addition of sucrose to dates increased glucose content to 37.0% and fructose content to 35.9% indicating the complete hydrolysis of sucrose by dates. This is significant in view of the fact that the digestion of sucrose alone gave 8.8% glucose and 8.4% fructose only. Similarly, the addition of dates to starch, on digestion, resulted mainly in the formation of glucose (20.0%) and fructose (20.9%), whereas, under the same conditions, starch alone did not yield any sugar. Thus, dates appear to have a significant effect on the breakdown of starch at pH 7.4.

It may be concluded from the present study that dates do influence the breakdown of sucrose and starch on digestion in the intestine (pH 7.4). It also provides a scientific proof to the Quranic statement that dates have a digestive effect on normal food. Further work is required to supplement the results of the present study.

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Received: 31-05-2006 – Accepted: 14-01-2007