

Individual and Total Sugar Contents of 83 Malaysian Foods

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Abstract

As part of the effort in updating and expanding the carbohydrate data in Malaysian Food Composition Databases, 83 foods were selected based on the most commonly consumed foods and food products by Malaysian. The samples include 31 cereal products, 9 starchy roots and tubers products, 4 legume products, 11 nut and seed products, 4 vegetables, 5 fruits, 15 sugar and syrup products, 2 meat products and 2 oil and fat products. Individual sugars (fructose, glucose, sucrose, lactose and maltose) were analysed using High Performance Liquid Chromatography with Refractive Index Detector. Most of the cereal products contained sucrose, glucose, fructose, lactose and maltose. Four starchy root and tuber products contained sucrose, glucose and fructose. Sucrose was detected in all legume, nut and seed products. Most vegetables contained fructose while all fruits contained glucose and fructose. In addition, all syrups contained sucrose except for kiwi and lime cordial. Overall, sugar and syrup products contained the highest total sugar content (15.00-65.52 g/ 100g) while vegetables were the lowest for total sugar content (2.74-4.83 g/ 100g).

Keywords: individual sugars, total sugar, Malaysian, foods

1. Introduction

A comprehensive Malaysian Food Composition Table in Malaysia was published in 1988 and has been revised in 1997 (Siong, Noor, Azudin, & Idris, 1997). However, carbohydrate was determined by difference and reported for all foods. As part of the continuous efforts to update and expand the carbohydrate data in its database, 83 Malaysian foods were selected based on most commonly consumed foods and measured for its individual and total sugar content.

Sugars were defined as the sum of all free mono and disaccharides which would include glucose, fructose, galactose, lactose, sucrose and maltose (Kahn & Sievenpiper, 2014). Glucose and fructose are naturally occurring monosaccharides present in fruit and honey while sucrose is a disaccharide extracted from sugar cane and beet (Tappy & Le, 2010). Maltose is a disaccharide formed by two units of glucose. Combination of galactose and glucose formed lactose, a disaccharide normally found in milk. Data from the 2003 Malaysian Adult Survey (MANS) showed that Malaysian adults consumed 30 grams of sweetened condensed milk (equivalent to 16 grams sugar) and 21 grams of table sugar per day (MOH, 2008). Increased intake of foods high in sugar content and excessive caloric intake is associated with the major factor contributing to the rise of obesity and chronic disease (Bray, 2013; Morenga, Mallard, & Mann, 2013).

With the increase prevalence of diet-related chronic diseases such as diabetes, the information on sugar content in foods are needed to increase the effectiveness of nutritional advices. Recognizing the importance of sugar in the aetiology and prevention of diseases in the country, there is a need to update the Malaysian Food Composition Database with individual and total sugar data which were not included in the 1997 Malaysian Food Composition Database.

2. Materials and Methods

2.1 Selection of Foods

The choice of foods to be analysed was based on the data provided from Malaysian Adult Nutrition Survey carried out between October 2002 and December 2003. The most consumed foods, taken from both the 24-hour diet recall and food frequency questionnaire methods, were selected for analysis. These foods were divided into several food categories. Foods included 31 cereal products, 9 starchy root and tuber products, 4 legume products, 11 nut and seed products, 4 vegetables, 5 fruits, 15 sugar and syrup products, 2 meat products and 2 oil and fat products.

2.2 Sample Collection

A stratified sampling plan based on the Protocol for Sampling and Methods of Analysis for Malaysian Food Composition (2011) was used for sample collection. Foods were sampled from local supermarkets in the Klang Valley. For most of the foods (cereal products, starchy root and tuber products, legume products, nut and seed products, sugar and syrup products and meat products), six top national brands were purchased. In the cases where only one brand dominated, then only that brand was used. The fresh vegetables and fruits were purchased from three major grocery chains (supermarket, wet market and *Pasar Tani*).

2.3 Sample Preparation

Cereal products, starchy root and tuber products, legume products, nut and seed products and meat products were grounded into fine powder using a food grinder, transferred into air tight containers and kept at ambient temperature until further analysis. While for vegetables and fruits, the samples were washed with tap water to remove impurities and non-edible parts such as skin and seed were removed. Then, the edible part of vegetables and fruits were grounded using food processor into homogenous form. Samples were stored in air tight containers and kept at 4°C. Analyses were carried out in duplicate.

2.4 Sugar Analysis

The analysis for mono and disaccharides (fructose, glucose, sucrose, lactose and maltose) was carried out using High Performance Liquid Chromatography (HPLC) with Refractive Index Detector (Waters, USA). One gram of sample was weighed into a 10 ml centrifuge tube and then dissolved in 25 ml acetonitrile:deionized water (50:50 v:v). This solution was then centrifuged for 30 minutes at 3200 rpm. The supernatant was filtered using 0.45 nylon filter into an HPLC vial. Separation were carried out on an amino-bonded column with a mobile phase of acetonitrile:deionized water:triethylamine (75:25:0.2) and sugar content were determined by Refractive Index Detector against the standard solution. Standard solutions of 0.1, 0.2, 0.5, 0.8 and 1.0 ppm were prepared and analysed prior to samples analysis. As an effort to ensure the reliability of the data, quality control samples were used and analysed simultaneously after calibration of the standards. This was done prior to samples analysis.

Biscuits and cordial were used as quality control for solid and liquid samples. The result for control was acceptable if its fall within the two standard deviation of the mean previously set as acceptable limit for the control.

2.5 Statistical Analysis

All data were calculated using Excel 2010 and results were reported as mean and standard deviation.

3. Results and Discussion

Table 1 shows the individual and total sugar content of some Malaysian foods. Results for cereal products showed various levels of sucrose, glucose, fructose, lactose and maltose. Total sugar content varied from 0.00 g /100 g for rice and 24.56±6.48 g /100 g for raisin biscuit. Sucrose is the major contributing sugar to the total sugar content in selected commercial biscuits in Malaysia (Norhayati et al., 2015). For starchy root and tuber products, only four foods contained sucrose, glucose and fructose and total sugar content varied between 0.00 g /100 g for sago flour up to 12.54±8.39 for spicy tapioca chips. For legume products, all four foods contained sucrose. Total sugar content varied between 2.15±0.50 g/ 100g for carob flour up to 42.23±15.85 g/ 100g for sweet soy sauce. All eleven nuts and seeds products contained sucrose and only three contained fructose and glucose. None of the nuts and seeds products contained lactose and total sugar content varied between 1.10±0.05 g/ 100g for pumpkin seed and 40.97±8.41 g/ 100g for crush peanut. All vegetables were found to contain fructose except yellow capsicum which found to contain glucose. Total sugar content for vegetables varied between 2.74±0.64 g/ 100g for yellow capsicum and 4.83±1.30 g/ 100g for red capsicum. All five fruits contained glucose and fructose and total sugar content varied between 2.92±0.59 g/ 100g for honeydew and 10.70 g/ 100g for pomegranate. All fifteen sugar and syrup products contained sucrose except for kiwi and lime cordial and all cordial contained glucose and fructose. Total sugar content for sugar and syrup products varied

between 15.00 ± 5.52 g/ 100 g for root beer cordial and 65.52 ± 13.53 g/ 100 g for pineapple cordial. For meat products, beef sausage contained maltose meanwhile chicken sausage contained fructose, glucose and maltose. Total sugar content for meat products varied from 0.255 g/ 100 g to 0.543 g/ 100 g. Oils and fats products contained sucrose, glucose and fructose and total sugar content varied between 8.59 ± 1.20 g/ 100 g for mayonnaise and 15.47 ± 2.40 g/ 100 g for thousand island sauce. The total sugar values include free monosaccharide and disaccharide intrinsic to the plant and any added sugar during food preparation and manufacture (Sanchez-Castillo et al., 2000). Sugars and syrups products content the highest total sugar compared to other food categories because the main ingredient for these products is sugar as stated at the ingredient list. Added sugar refers to sugars and syrups added to foods during processing or preparation and sugar and syrups added at the table (Van Horn, Johnson, Flickinger, Vafiadis, & Yin-Piazza, 2010). The types of added sugars frequently used in food supply are fructose and non-fructose rich corn syrups, cane and beet sugar, honey and other edible syrups. Usually, these sugars are added as ingredients in processed foods, cereal and bakery products, beverages, dairy products, candy and other confectionary items (Sigman-Grant & Morita 2003).

Table 1. Individual and Total Sugars content of 83 Malaysian Foods (g/100g as eaten)

English name	Malaysian name	n	Sucrose	Glucose	Fructose	Lactose	Maltose	Total Sugar
<i>Cereal products</i>								
Rice, boil in beg rice	Ketupat	6	-	-	-	-	-	-
Rice, siam	Beras siam	6	-	-	-	-	-	-
Rice, basmathi	Beras basmathi	6	-	-	-	-	-	-
Rice, fragrant	Beras wangi	6	-	-	-	-	-	-
Biscuit, chocolate chip	Biskut coklat cip	6	24.17 ± 4.67	-	-	-	-	24.17 ± 4.67
Wafer, chocolate, full coated	Wafer salut coklat	6	32.45 ± 3.95	0.83 ± 2.04	-	5.85 ± 3.73	-	39.13 ± 4.14
Biscuit, corn	Biskut jagung	6	8.80 ± 6.19	2.15 ± 3.33	2.18 ± 3.38	0.48 ± 1.18	0.40 ± 0.98	14.02 ± 3.21
Biscuit, cracker with sugar	Biskut kraker bergula	6	12.28 ± 2.85	-	-	-	2.63 ± 0.38	14.92 ± 2.95
Biscuit, crackers, vegetable flavor	Biskut kraker perisa sayuran	6	7.45 ± 5.91	-	-	0.85 ± 1.36	1.42 ± 1.63	9.72 ± 5.69
Biscuit, cream filled	Biskut berkrim	6	23.25 ± 5.87	-	-	1.60 ± 1.75	0.80 ± 1.25	25.65 ± 4.91
Biscuit, oatmeal	Biskut oat	6	15.67 ± 2.12	-	-	0.38 ± 0.94	0.38 ± 0.94	16.43 ± 3.06
Biscuit, shortbread	Biskut shortbread	6	16.38 ± 8.79	1.05 ± 2.57	-	-	0.37 ± 0.90	17.80 ± 5.78
Biscuit, whole meal crackers	Biskut kraker mil penuh	5	3.56 ± 5.02	-	-	-	1.40 ± 1.31	4.96 ± 5.74
Corn flakes	Emping jagung	6	5.10 ± 0.90	1.92 ± 0.47	1.52 ± 0.43	-	0.05 ± 0.05	8.58 ± 1.09
Muesli	Muesli	6	0.43 ± 0.43	7.70 ± 1.77	8.68 ± 1.76	0.83 ± 0.83	1.12 ± 1.12	18.75 ± 2.05
Biscuit, milk	Biskut susu	6	17.52 ± 3.37	0.31 ± 0.77	0.34 ± 0.83	0.19 ± 0.46	1.04 ± 1.77	19.06 ± 2.78
Biscuit, raisin	Biskut kismis	4	11.63 ± 8.58	4.26 ± 3.45	5.05 ± 4.26	3.34 ± 6.05	0.31 ± 0.61	24.56 ± 6.48
Cookies, butter	Biskut mentega	6	20.63 ± 2.56	0.22 ± 0.35	0.21 ± 0.33	0.66 ± 1.62	-	21.62 ± 2.30
Oatmeal cereal, dry	Bijirin oat, kering	6	1.20 ± 0.28	-	-	-	-	1.20 ± 0.28
Barley flour	Tepung barli	1	3.83	-	-	-	-	3.83
Egg noodles	Mee telur	6	-	-	-	-	0.21 ± 0.51	0.21 ± 0.51
Flour, rye	Tepung rye	4	0.71 ± 0.13	-	-	-	-	0.71 ± 0.13
Nestum cereal, dry	Bijirin nestum, kering	1	7.20	0.80	-	-	3.18	11.15
Premix flour	Tepung pracampuran	6	1.44 ± 3.84	-	-	-	-	1.44 ± 3.84
Spaghetti, dry	Spageti, kering	6	0.27 ± 0.30	-	-	-	2.10 ± 0.38	2.33 ± 0.38
Flour, wheat, self-raising	Tepung naik sendiri	6	0.19 ± 0.29	-	-	-	-	0.19 ± 0.29
Bun, chocolate	Ban coklat	4	6.82 ± 3.34	4.30 ± 1.32	4.93 ± 1.33	0.31 ± 0.40	1.45 ± 0.39	17.81
Bun, coconut	Ban kelapa	6	13.59 ± 2.71	3.96 ± 0.93	4.54 ± 1.31	-	1.30 ± 0.53	23.18
Bun, kaya	Ban kaya	3	15.19 ± 2.18	3.33 ± 1.54	3.58 ± 0.97	-	0.70 ± 0.42	22.82
Bun, potato	Ban kentang	6	3.12 ± 1.93	3.50 ± 0.90	5.03 ± 1.74	0.35 ± 0.32	1.33 ± 0.68	13.55
Bun, red beans	Ban kacang merah	3	12.70 ± 3.48	2.60 ± 0.71	3.12 ± 0.62	-	0.69 ± 0.46	19.12

(continue on next page)

Table 1. (Continued)

English name	Malaysian name	n	Sucrose	Glucose	Fructose	Lactose	Maltose	Total Sugar
<i>Starchy root and tuber products</i>								
Breadfruits chips	Kerepek sukun	4	1.94±0.51	-	-	-	-	1.94±0.51
Potato chips, spicy	Keropok ubi kentang berperisa rempah pedas	5	2.51±0.83	0.16±0.37	0.10±0.21	-	-	2.75±0.50
Tapioca chips, spicy	Kerepek ubi kayu pedas	6	7.69±3.88	2.19±2.86	2.19±2.86	-	0.65±1.01	12.54±8.39
Sweet potato, red, chips	Kerepek ubi keledek	4	4.99±0.40	-	-	-	-	5.09±0.56
Tapioca chips, barbeque	Kerepek ubi kayu perisa barbeque	5	10.61±11.31	-	0.35±0.33	-	-	10.95±11.36
Tapioca chips, black pepper	Kerepek ubi kayu perisa lada hitam	3	4.35±0.79	0.21±0.36	0.37±0.34	-	-	4.92±1.29
Tapioca chips, plain, salted	Kerepek ubi kayu bergaram	3	2.67±0.55	-	0.19±0.33	-	-	2.85±0.89
Tapioca chips, plain, unsalted	Kerepek ubi kayu tanpa garam	6	5.33±3.55	0.48±1.17	0.36±0.38	-	-	7.61±5.87
Flour, sago	Tepung sagu	6	-	-	-	-	-	-
<i>Legume products</i>								
Black eye bean	Kacang mata hitam	6	2.38±0.43	-	-	-	-	2.38±0.44
Carob flour	Tepung kacang kuda	6	2.05±0.53	-	0.10±0.25	-	-	2.15±0.50
Soya flour	Tepung kacang soya	6	5.57±2.73	-	0.77±0.40	-	-	6.33±3.12
Soya sauces, sweet	Kicap manis	6	28.67±15.41	7.25±2.66	5.00±1.89	-	1.39±0.96	42.23±15.85
<i>Nut and seed products</i>								
Broad bean	Kacang parang	6	1.37 ±0.43	-	-	-	-	1.37±0.43
Coconut, shredded	Kelapa parut	3	3.64±0.29	0.62±0.06	0.16±0.28	-	-	4.33±0.55
Flaxseed	Biji flaks	6	1.67±0.17	-	-	-	-	1.69±0.15
Ginkgo Nuts	Kacang ginkgo	6	0.85±0.64	0.51±0.56	0.32±0.37	-	-	1.68±0.70
Hazelnuts	Kacang hazel	2	1.71 ±0.64	-	-	-	-	1.72±0.64
Macadamia nuts	Kacang makadamia	4	4.28±1.02	-	-	-	-	4.28±1.02
Peanut, crush	Kacang tumbuk	6	25.92±13.69	8.11±10.51	0.77±0.65	-	5.76±4.50	40.97±8.41
Peanut/Groundnut, f lour coated	Kacang tanah bersalut tepung	3	7.79±2.61	-	0.27±0.24	-	-	8.06±2.41
Pistachio nut	Kacang pistasio	6	5.40±0.31	-	1.01±0.78	-	-	6.41±0.82
Pumpkin seed	Biji labu	6	1.10±0.07	-	-	-	-	1.10±0.05
Sunflower seed	Biji bunga matahari	6	2.38±0.84	0.21±0.33	-	-	-	2.38±0.84
<i>Vegetables</i>								
Baby corn	Pucuk jagung	6	-	2.75±0.17	0.43±0.28	-	-	3.15±0.37
Capsicum, green	Lada bengala hijau	6	-	-	2.76±0.41	-	-	2.76±0.41
Capsicum, red	Lada bengala merah	6	-	3.23±0.40	2.04±1.03	-	-	4.83±1.30
Capsicum, yellow	Lada bengala kuning	6	-	2.74±0.64	-	-	-	2.74±0.64
<i>Fruits</i>								
Dragon fruit, red	Buah naga isi merah	3	-	5.21	1.53	-	1.64	8.40
Dragon fruit, white	Buah naga isi putih	3	-	5.48	2.08	-	0.94	8.50
Honeydew	Tembikai susu	4	-	1.31±0.23	1.61±0.36	-	-	2.92±0.59
Pomegranate	Delima	3	-	5.42	5.28	-	-	10.70
Watermelon, yellow	Tembikai kuning	2	-	1.82	2.50	-	-	4.30
<i>Sugar and syrup products</i>								
Cordial root beer	Kordial rut bir	2	3.64±5.14	5.79±5.35	5.59±5.31	-	-	15.00±5.52
Cordial, grape	Kordial anggur	6	0.59±0.97	16.46±12.15	17.13±13.71	-	-	34.9±26.22
Cordial, guava	Kordial jambu batu	4	16.47±19.18	24.30±12.12	23.86±11.70	-	-	64.63±7.03
Cordial, kiwi	Kordial kiwi	4	-	10.40±13.80	9.96±13.05	-	-	20.40±26.88
Cordial, lime	Kordial limau nipis	4	-	15.97±8.94	15.20±8.47	-	-	31.22±17.41
Cordial, mango	Kordial mangga	6	2.50±3.37	20.78±10.87	20.18±10.58	-	-	43.46±22.08

Table 1. (Continued)

English name	Malaysian name	n	Sucrose	Glucose	Fructose	Lactose	Maltose	Total Sugar
<i>Sugar and syrup products</i>								
Cordial, orange	Kordial oren	6	1.27±2.85	20.41±9.72	19.72±9.25	-	-	41.41±18.89
Cordial, pineapple	Kordial nenas	4	2.90±3.65	32.64±5.13	29.97±5.45	-	-	65.52±13.53
Cordial, roselle	Kordial roselle	6	3.63±8.89	24.10±9.88	23.30±9.50	-	-	51.03±18.50
Cordial, sarsi	Kordial sarsi	6	6.25±5.40	13.43±10.21	13.23±10.09	-	-	32.91±22.12
Cordial, soursop	Kordial durian belanda	6	1.99±4.09	21.87±13.79	21.52±13.63	-	-	45.39±29.61
Jam, apricot	Jem aprikot	6	8.47±4.60	23.33±1.78	19.85±1.94	-	2.00±1.34	53.65±1.96
Jam, blueberry	Jem blueberi	6	5.08±4.32	23.73±1.70	21.72±1.65	-	4.27±2.34	54.78±2.83
Jam, grape	Jem anggur	6	1.02±1.02	26.20±4.49	26.00±4.69	-	-	52.43±9.48
Jam, strawberry	Jem strawberi	6	9.78±4.72	17.42±3.11	15.77±2.80	-	9.68±5.53	52.67±1.94
<i>Meat products</i>								
Sausage, beef	Sosej daging ayam	6	-	-	-	-	0.255	0.255
Sausage, chicken	Sosej daging ayam	6	0.32±0.07	0.68±0.71	0.20	-	-	0.543±0.60
<i>Oils and fats</i>								
Mayonnaise	Mayonis	6	5.48±1.23	1.71±0.31	1.40±0.2	-	0.18±0.18	8.59±1.20
Sauce, thousand island	Sos thousand island	6	5.35±1.55	4.28±1.03	5.83±2.31	-	-	15.47±2.40

4. Conclusions

This data showed that most cereal products contained sucrose, glucose, fructose, lactose and maltose; most starchy roots and tubers products contained sucrose, glucose and fructose; all legume products, nuts and seed products contained sucrose; all five fruits contained glucose and fructose and syrups contained the highest sucrose compared to all other food groups. Overall, sugars and syrups products contained the most total sugar and vegetables the least. These data provide information on the sugar content of various food products in Malaysia that will help to assist the public in making healthy food choices.

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