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Sugar content analysis in selected commercially available complementary foods in Malaysia

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Abstract

A concern worth exploring in commercially available complementary foods (CACFs) is whether too much sugar is present. The studies regarding the sugar content in CACFs in Malaysia are limited. Thus, this study was undertaken to determine the total sugar content in selected CACFs in Malaysia. The sugar content was determined using the enzymatic method. Samples were categorized into breakfast (cereal-based), meal (rice, pasta and noodles) and snack (biscuits and rusks) groups. The results showed that the average total sugar content in breakfast, meal and snack groups were 14.5%, 9.2% and 14.1%, respectively. Most of the total sugar content in the CACFs was contributed by glucose. About 29% of the CACFs had a total sugar content of more than 20%. A total of 59.6% of CACFs had more than 10% of the total calories per serving derived from sugar. CACFs serve as the first food in the life of a human and will shape the future dietary habits of a child. Thus, a policy that restricts the amount of sugar in CACFs would be recommended in order to establish a healthy diet foundation for children.

1. Introduction

Complementary foods refer to foods other than breast milk that are given to breastfed infants to fulfil their nutritional needs as breast milk alone may not be sufficient for infants. The World Health Organization (WHO) suggests that nutritionally safe and adequate solid foods should be introduced to infants at the age of 6 months (Maslin and Venter, 2017).

Traditionally, complementary, or infant foods were made at home by pureeing or mashing easily available items such as fresh fruits and vegetables. However, after World War II, the production of commercially available complementary foods (CACFs) increased. Nowadays, there are various types of CACFs available, leading to concerns about nutritional values such as having a high level of added sugar, being lacking in micronutrients (Zehner *et al*., 2019; Hutchinson *et al*., 2021) and concealing vegetables with fruit and puree, which may have a negative impact on how well children learn about food taste and texture (WHO, 2019).

The sugar content in CACFs is one of the nutritional factors that has raised concerns. Some CACFs have been found to contain a significant amount of sugar (Elliot and Conlon, 2014; Azaïs-Braesco *et al*., 2017). The WHO guidelines suggest that the consumption of free sugars should be limited throughout the life course, with the intake of free sugars in both adults and children recommended to be less than 10% and preferably less than 5% of the total energy intake (WHO, 2015).

The taste of sugar contributes to overall pleasure and satisfaction. Sweetness can induce rewards and cravings similar to drugs (Ahmed *et al*., 2013). Thus, the concept of addiction could apply to the sugar intake. The preference for this sweetness has been taken advantage of by the food industry to promote their products. Children become an easy target as food preferences and eating behaviour start early in life and persist into later years. According to Baker and Baker (2015), toddlers have been exposed to foods with unnecessary high amounts of sugar. These may lead them to yearn for this taste in later life. Due to this, these children are at risk of childhood obesity and other noncommunicable disease in the long run.

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Locally, several studies have examined the sugar or added sugar content in Malaysian foods and beverages (Amarra *et al*., 2016; Hamid *et al*., 2018; Khalid *et al*., 2018; Dora *et al*., 2018; Chong *et al*., 2019). However, little research has been done on the sugar content of CACFs. Roslan and Shukri (2021) studied CACFs by analysing their sugar and sodium contents. The results indicated that finger foods contained mostly excessive sugar. However, the sugar amount was solely based on the food labelling. Thus, the results may not indicate the exact quantity of sugar in the products. Khor and Lee (2021) studied the intake of complementary foods by infants and toddlers in an urban setting. However, the study did not cover sugar content and was not specific to complementary commercial foods. The results show that an imbalance in the subjects' food intake can adversely affect the health and nutritional status of infants and young children.

As there are significant public and governmental concerns about the sugar content of CACFs in the global market (Walker and Goran, 2015; Cogswell *et al*., 2015; Hutchinson *et al*., 2021), it is crucial to determine the exact amount of sugar present in these products in Malaysia. It is also important to identify which complementary meals contribute the most sugar intake to infants and toddlers in order to ensure that their diets align with the Malaysian Recommended Nutrient Intake (RNI) and WHO regulations. Therefore, this study aimed to measure the total and individual sugar content of CACFs available in the Malaysian market.

2. Materials and methods

2.1 Sample collection

The study collected 51 CACF samples from hypermarkets in Kota Bharu, Kelantan (AEON and Lotus) and an online platform such as Shopee. The samples were randomly selected from the list of well-known brands of CACFs in Malaysia, obtained from the Ministry of Health Nutrition Division. For ease of reporting, the CACFs were divided into three categories: breakfast, meal, and snack. The breakfast category included cereal-based products, while the meal category included rice, pasta, or noodle products. Biscuits and rusks were classified as snacks. Under the breakfast category, 8 brands of CACFs were chosen, which consisted of various flavours and totalled up to 19 samples. Under the meal category, 7 samples were chosen, which consisted of 3 brands. The snack category consisted of 25 samples from 10 different brands of CACFs.

2.2 Sample preparation

Sugar content was determined using the method by Hamid *et al*. (2018). An amount ranging from 5 to 10 g of samples were taken and transferred to sterile, sealed containers before analysis. The protein of the sample was clarified with Carrez reagents after the extraction of fat with hot water. For Carrez clarification, 1 g of solid sample was transferred into a volumetric flask which contained 60 mL of distilled water and incubated for 15 mins in a water bath at a temperature of 70°C (Megazyme, 2022). Afterwards, 5 mL of Carrez-I solution and 5 mL of Carrez-II solution were added. The pH of the solution was adjusted to 7.5-8.5 with 0.1 M sodium hydroxide and was allowed to precipitate at room temperature for one hour before being filled up to 100 mL with distilled water. Approximately 1.5 mL of solution was centrifuged at 3000 rpm for 5 mins. The solution was then used for the analysis of sugar profiles.

2.3 Determination of sugar content

Enzymatic test Roche and Enzytec UV method (Boehringer Mannheim/R-BIOPHARM, Enzymatic BioAnalysis/Food Analysis) was performed using UV-Vis Spectrophotometer, Cary 100 Bio for determination of glucose, fructose, sucrose, maltose, lactose and galactose in CACFs. Enzymatic tests were measured at 340 nm.

2.4 Statistical analysis

The results from the analysis of CACFs were used to calculate total sugar in grams per 100 g by summing up the total of glucose, fructose, sucrose, maltose, galactose and lactose. All data were calculated using Excel (2021) and results were reported as mean and standard deviation. The percentage of difference in the total sugar was calculated by taking a difference between total sugar in labelling and laboratory-determined data and multiplying by 100. The percentage of total calories derived from sugar per serving was calculated as follows:

[(Actual total sugar per serving × 4) / (Total calories per serving)] × 100

3. Results

The study examined 19, 7, and 25 samples for the breakfast, meal, and snack groups, respectively. Table 1 displays the total and individual sugar content of CACFs in the breakfast group. Glucose was the most abundant individual sugar in the breakfast group, with Brand B (banana and strawberry) containing the highest amount of glucose (14.9%). Only Brands B, G and H contained lactose sugar, while other types of sugars were present in insignificant quantities in some of the brands. On average, Brand B had the highest total sugar content (21.5 g/100 g), while Brand C had the lowest (2.6 g/100

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Table 1. Individual and total sugar content of CACFs for breakfast group.

CACFs	g/100 g							% Difference of Total Sugar from Label[a]	% of Calorie from Sugar (kcal)
	Glucose	Fructose	Sucrose	Maltose	Galactose	Lactose	Total Sugar		
1 A (*sweet potato and pumpkin)*	1.48±0.64	11.00±3.63	ND	ND	ND	ND	12.48±2.61	-69.3	13.53
2 A (*multigrain)*	0.56±0.03	ND	ND	ND	ND	ND	0.56±0.03	-97.8	0.6
3 A (*banana and beetroot)*	6.11±0.08	ND	ND	ND	ND	ND	6.11±0.08	-85.1	6.5
4 B (*chicken and corn soup)*	10.38±0.34	ND	ND	1.10±0.04	ND	ND	11.48±0.24	-4.3	11.48
5 B (*brown rice)*	4.18±0.11	1.04±0.05	9.59±0.19	0.82±0.02	ND	10.49±0.16	26.12±0.12	42.6	24.58
6 B (*banana and strawberry)*	14.86±0.67	ND	ND	1.05±0.00	0.37±0.01	10.95±0.44	26.86±0.40	3.2	25.28
7 C (*oatmeal)*	4.21±1.60	ND	ND	ND	ND	ND	4.21±1.60	-37.2	4.21
8 C (*multigrain)*	1.04±0.01	ND	ND	ND	ND	ND	1.04±0.01	-84.5	0.97
9 D (*original)*	4.59±0.06	ND	ND	ND	ND	ND	4.59±0.06	UC	4.71
10 E (*plain)*	3.35±0.95	ND	ND	ND	ND	ND	3.35±0.95	-82.6	3.35
11 F (*rice, quinoa and fruits)*	8.56±1.12	ND	ND	ND	ND	ND	8.56±1.12	UC	8.8
12 F (*rice and quinoa)*	1.00±0.01	ND	ND	ND	ND	ND	1.00±0.01	UC	1.05
13 G (*rice)*	12.48±0.60	ND	ND	ND	ND	ND	12.48±0.60	84	4.94
14 G (*rice and soy)*	12.12±0.62	ND	ND	2.45±0.01	ND	ND	14.57±0.62	UC	13.94
15 G (*multigrains and garden vegetables)*	8.46±0.01	2.40±0.07	ND	2.62±0.02	ND	15.61±0.16	29.09±0.10	UC	28.52
16 G (*oat, wheat and prunes)*	12.00±0.43	ND	ND	1.99±0.04	ND	14.09±0.33	28.08±0.31	-14.9	27
17 G (*wheat, honey and dates)*	12.48±0.47	ND	ND	2.49±0.01	ND	15.65±0.01	30.62±0.33	-4.3	29.58
18 H (*oat and peach)*	4.42±0.06	0.88±0.01	ND	ND	ND	21.95±1.59	27.25±0.92	66.2	26.8
19 H (*fruits cereal)*	4.97±0.58	ND	ND	ND	ND	22.45±0.04	27.42±012	-18.1	27.19

[a]The negative values indicate that the nutritional labelling data is lower than the laboratory-determined data.
ND: Non detected, UC: Unable to calculate due to incomplete information on the label.

Table 2. Individual and total sugar content of CACFs for meal group.

CACFs	g/100 g							% Difference of Total Sugar from Label	% of Calorie from Sugar (kcal)
	Glucose	Fructose	Sucrose	Maltose	Galactose	Lactose	Total Sugar		
1 D (*carrot, sweet potato and spinach*)	2.10±0.04	ND	ND	ND	ND	ND	2.10±0.04	UC	UC
2 D (*beetroot, pumpkin and wheat*)	3.94±0.47	ND	ND	ND	ND	ND	3.94±0.47	UC	UC
3 D (*quino*a)	1.27±0.04	ND	ND	ND	ND	ND	1.27±0.04	UC	1.46
4 D (*buckwhea*t)	39.67±1.01	ND	ND	ND	ND	ND	39.67±1.01	UC	45.99
5 I (*carrot*)	4.16±0.09	ND	ND	ND	ND	ND	4.16±0.09	UC	UC
6 I (*sweet potato*)	0.63±0.01	ND	ND	ND	ND	ND	0.63±0.01	UC	UC
7 H (*pasta*)	12.76±0.34	ND	ND	ND	ND	ND	12.76±0.34	76.5	14.50

ND: Non detected, UC: Unable to calculate due to incomplete information on the label.

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g). The highest total sugar content in the breakfast group was found in Brand G (wheat, honey, and dates), with a sugar content of 30.6 g/100 g, while Brand A (multigrain) had the lowest total sugar (0.6 g/100 g). On average, the total sugar content in this group was 14.5%. About 52.6% (n = 10) of the 19 samples analysed had more than 10% of total calories per serving derived from sugar, with Brand G (wheat, honey, and dates) having the most calories per serving from sugar (29.6%). The lowest calories per serving from sugar (0.6%) was found in Brand A (multigrain). Regarding the difference in total sugar between labelling and analysed data, this study found that 10 of the 19 samples analysed under this group had a lower sugar content than the analysed data.

Table 2 displays the total and individual sugar content of CACFs in the meal group. Glucose was the only sugar present in all brands. Brand D (buckwheat) had the highest total sugar content (39.7 g/100 g), while Brand I (sweet potato) had the lowest (0.6 g/100 g). On average, the total sugar content in the meal group was 9.2%. More than half of the meal group samples did not list the total sugar content or total calories per serving on the nutrition labels. Consequently, it was not possible to compare the sugar content or calculate the calories contributed by sugar in these samples. Of the samples with sugar labels provided, Brand D with buckwheat flavour contained the most calories per serving from sugar, which was 46%.

Table 3 illustrates the total and individual sugar content of CACFs in the snack group. Glucose was the primary sugar present in all samples followed by fructose and sucrose. Neither galactose nor lactose were detected in any of the snack group samples. On average, Brand B had the highest sugar content (27.6 g/100 g), and Brand M had the lowest (1.9 g/100 g). Brand A (red quinoa) had the highest total sugar content (28.2 g/100 g), while Brand M (black and brown rice puff quinoa) had the lowest (0.7 g/100 g). On average, the total sugar content in the snack group was 14%. Of the 25 snack samples examined, 64% (n = 16) had more than 10% of their total calories per serving from sugar. Brand A (red quinoa) had the highest contribution of calories from sugar, with 29.8% of calories per serving coming from sugar. Brand M (black and brown rice puff quinoa) had the lowest calories per serving from sugar (0.7%). Regarding the difference in total sugar between labelling and analysed data, this study found that 7 out of 25 samples had a higher sugar content than the analysed data, with Brand N (banana) having the largest disparity (90.1%).

4. Discussion

The study discovered that the total sugar level in the CACFs varied, ranging from 0.6 to 39.7 g/100 g, with 15 samples containing more than 20 g/100 g of total sugar. This is particularly concerning as these products are meant for infants and babies. According to the Malaysian Dietary Guideline, sugary foods and drinks should be avoided by children below the age of one year (National Coordinating Committee on Food and Nutrition, 2013). Of the 51 samples analysed, only 47 could be assessed for the percentage of calories from sugar, and 28 products (59.6%) had more than 10% of their calories per serving derived from sugar. This finding concurred with Koo *et al*. (2018) results, which defined "high sugar" as products with more than 10% of calories derived from sugar and found that more than 50% of Taiwanese CACFs had high sugar content. WHO recommends that both adults and children consume less than 10% of their daily calories from free sugars, which include sugars that are naturally present in honey, syrups, and fruit juices, as well as those added during processing or preparation (WHO, 2015).

A recent investigation carried out in several European countries found that one-third of the total energy in commercial baby foods came from sugar, which exceeded the recommended intake by WHO (Hutchinson *et al*., 2021). The same trend of high sugar content was found in the United States, where 44% of infant and toddler foods were identified as high in sugar, according to a study by Cogswell *et al*. (2015). However, in that study, "high sugar" was defined as products with more than 35% of their total calories derived from sugar. If this same criterion were applied to the current study, only one product (2%) would be classified as having high sugar content.

There are some baby food products that use sweeteners other than sucrose, like fruit juice concentrate. This may appeal to parents who believe that natural ingredients are being used. However, processed fruit sugars that are often added to these foods still contribute to free sugars, which have the same effect as other added sugars. Evidence from prospective cohort studies shows that consuming sugar increases the risk of dental caries (Fidler Mis *et al*., 2017). Furthermore, there is evidence that children who frequently consume sweet foods may develop long-term changes in their food preferences, leading to a greater preference for sweet foods later in life (Koletzko *et al*., 2019). Therefore, consuming high-sugar foods during childhood can have lasting effects on eating patterns later in life.

Nutritional labels offer useful information to consumers. It is the only informational resource that customers can rely on to learn more about the products they purchase. Therefore, it is critical that the labelling be accurate. To assess the difference between declared and actual sugar content in CACFs, the study compared

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Table 3. Individual and total sugar content of CACFs for snack group.

CACFs	g/100 g							% Difference of Total Sugar from Label[a]	% of Calorie from Sugar (kcal)
	Glucose	Fructose	Sucrose	Maltose	Galactose	Lactose	Total Sugar		
1 A (*mango*)	2.15±0.02	4.21±0.12	6.99±0.62	0.33±0.01	ND	ND	13.68±0.32	11.5	13.68
2 A (*orange peach*)	0.94±0.01	1.67±0.06	5.42±0.04	0.41±0.04	ND	ND	8.44±0.04	UC	8.62
3 A (*original*)	21.35±1.85	ND	ND	ND	ND	ND	21.35±1.85	26.9	22.59
4 A (*red quinoa*)	6.92±0.03	10.79±0.01	10.50±1.17	ND	ND	ND	28.21±0.68	7.1	29.75
5 B (*mixed fruits*)	27.33±0.58	ND	ND	ND	ND	ND	27.33±0.58	-8.9	26.72
6 B (*original*)	27.86±0.53	ND	ND	ND	ND	ND	27.86±0.53	-12.9	26.99
7 B (*banana*)	26.24±0.33	ND	ND	1.31±0.01	ND	ND	27.55±0.23	-13.9	26.69
8 D (*banana*)	7.66±0.32	ND	ND	ND	ND	ND	7.66±0.32	-4.3	7.30
9 D (*beetroot and sweet potato*)	9.42±0.20	ND	ND	ND	ND	ND	9.42±0.20	15.8	8.76
10 E (*banana*)	9.37±0.98	ND	ND	ND	ND	ND	9.37±0.98	UC	9.61
11 G (*banana and strawberry*)	8.04±1.01	ND	ND	ND	ND	ND	8.04±1.01	UC	7.26
12 G (*banana and orange*)	8.00±0.78	ND	ND	ND	ND	ND	8.00±0.78	UC	7.23
13 H (*original*)	27.63±1.27	ND	ND	ND	ND	ND	27.63±1.27	UC	27.63
14 H (*banana*)	26.28±1.22	ND	ND	ND	ND	ND	26.28±1.22	UC	26.28
15 K (*original*)	4.38±0.72	3.93±0.02	2.61±0.52	ND	ND	ND	10.92±0.51	-14.7	12.23
16 K (*carrot*)	11.52±0.27	ND	ND	ND	ND	ND	11.52±0.27	-0.7	11.38
17 L (*original*)	6.11±0.62	5.08±0.01	1.10±0.24	ND	ND	ND	12.29±0.38	-2.5	12.29
18 L (*vegetables*)	5.37±0.14	3.74±0.04	2.22±0.30	ND	ND	ND	11.33±0.19	-10.1	11.20
19 L (*apple*)	11.21±0.31	ND	ND	ND	ND	ND	11.21±0.31	-3.4	11.08
20 L (*blueberry and goji*)	13.61±0.03	ND	ND	0.26±0.03	ND	ND	13.87±0.03	4.1	14.56
21 L (*sweet potato and carrot*)	13.75±0.03	ND	ND	ND	ND	ND	13.75±0.03	6.2	14.44
22 M (*banana and pumpkin*)	0.85±0.01	1.01±0.01	ND	ND	ND	ND	1.86±0.01	UC	1.93
23 M (*black and brown rice quinoa*)	0.70±0.04	ND	ND	ND	ND	ND	0.70±0.04	UC	0.73
24 M (*black rice*)	3.21±0.05	ND	ND	ND	ND	ND	3.21±0.05	UC	3.33
25 N (*banana*)	10.11±3.83	ND	ND	ND	ND	ND	10.11±3.83	90.1	11.32

[a]The negative values indicate that the nutritional labelling data is lower than the laboratory-determined data.
ND: Non detected, UC: Unable to calculate due to incomplete information on the label.

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the nutrition labels of total sugar content to the analysed sugar content. Out of the 32 CACFs that declared their total sugar level, 7 had a higher sugar content (over declaration) by more than 20% than the analysed data, while 6 samples had lower sugar content (under declaration) by 20%. This supports the findings of a previous study that reported nutrient label data often underestimated or overestimated sugar content, which varied from 88% less to 82% higher total sugar than listed (Walker and Goran, 2015). In general, previous studies mostly relied on nutritional labelling for assessment of sugar content, making it difficult to compare their results with the present study, which used laboratory analysis.

The study has some limitations. Firstly, the samples collected do not represent all CACFs in Malaysia. It should also be noted that nutritional information on product labels of CACFs may differ by up to 20% from the actual value (Cogswell *et al*., 2015). Hence, comparing the sugar content between the analysed data and the nutritional labelling of CACFs could result in some deviation. Moreover, some products only listed the carbohydrate content and not the sugar content, making it impossible to make a direct comparison between nutritional labelling and laboratory analysis data from the study.

5. Conclusion

The present study suggests that the sugar content in CACFs is notably high, with more than half of the CACFs analysed not adhering to the WHO's recommendation to limit sugar content to less than 10% of the total energy intake. However, it is challenging to classify CACFs as "high sugar" because there is no universal definition for what constitutes of "high sugar" products in Malaysia. While there are guidelines available for consumers to make informed choices, they typically focus on the healthy aspects of a product, such as the "Healthy Choice Logo (HCL)." While it is positive that consumers have the option to choose healthier products, there should also be a way to avoid choosing the worst products available. It would be beneficial to establish a limit or maximum threshold for key nutrients such as sugar content to guide consumers in choosing the healthiest products and encourage food producers to prioritize healthier options.

Conflict of interest

The authors declare no conflict of interest.

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