Original Article

Developing a Composition and Content of Sugar Database for Selected Popular Commercial Snacks

Narisa Rueangsri MSc[1], Chanida Pachotikarn PhD[1], Sunard Taechangam PhD[1], Ratchanee Kongkachuichai PhD[1], Pongtorn Sungpuag PhD[1], Saiko Shikanai PhD[2], Shigeru Yamamoto PhD[2]

[1] Institute of Nutrition, Mahidol University, Nakhon Pathom, Thailand
[2] Asian Nutrition and Food Culture Research Center, Jumonji University, Saitama, Japan

Background: Sugar consumption is one of the major risk factor associated with nutritional problem and can lead to many chronic diseases later in life. Commercial snacks (with high sugar) are some of the most food-items consumed by the school-aged children based on the food and nutrition status survey of Thailand. Nevertheless, there is limited data available in Thailand about the sugar composition of commercial snacks.

Objective: To analyze the types and contents of sugar in selected commercial snacks consumed by school-aged children.

Materials and Methods: Ninety-six commercial snacks consumed by most Thai school-aged children were divided into sixteen categories such as hard candy, soft candy, lollipop, milk tablet, marshmallow, chocolate, wafer, biscuit, cookie, cracker, stuff bread, layer cake, jelly, meat snack, corn snack, and ice cream. All the commercial snacks were analyzed for the types and contents of sugars using the enzymatic method.

Results: Selected popular commercial snacks had different sugar content (g/100 g) and the most sugar content was sucrose. The top three snack items with the highest total sugars (g/100 g) were lollipop fruit flavored (83.4), lollipop cola flavored (81.8), hard candy honey-lemon flavored (75.7). The top three snacks, lollipop (fruit flavored), lollipop (cola flavored), and hard candy (honey-lemon flavored) contained various types and contents of sugar (g/100 g) including glucose 3.8±1.1, 3.3±0.2, 3.7±2.0, fructose 3.9±0.4, 3.7±0.4, 2.1±0.7, sucrose 53.1±6.5, 55.9±7.6, 55.2±2.1, and maltose 22.6±1.2, 18.9±4.0, 14.7±10.8, respectively.

Conclusion: All Thai popular commercial snacks contain high amount of sugar. A sugar composition and content database of selected commercial snacks was developed. It can be used as an educational tool to raise public awareness of high sugar source in diet.

Keywords: Snacks, Sugar, Monosaccharides, Disaccharides, Enzymatic method, School-aged children

J Med Assoc Thai 2018; 101 (5): 569-74
Website: http://www.jmatonline.com

World Health Organization [WHO] in 2008 showed the international trend of overweight and obesity where more than 1.4 billion adults aged 20 years up were overweight, and over 200 million men and nearly 300 million women were obese. In 2011, more than 40 million children were overweight (more than 30 million of overweight children were living in developing countries and 10 million in developed countries). Overweight and obesity are associated with non-communicable diseases such as diabetes mellitus, cardiovascular disease, and hypertension[(1)]. From the national report of children health 2009, the prevalence of overweight and obesity in Thai children aged from 6 to 14 years old had increased from 5.8% in 1985 to 9.7% in 2009. In 2009, the prevalence of overweight and obesity was found higher in Bangkok than central, southern, north-eastern, and northern parts of Thailand[(2)]. Sugar is one of the risk factor that can lead to overweight and obesity[(3)]. Sugars in diet consist of monosaccharide and disaccharide. Sugar in the form of glucose is the metabolically digestible carbohydrate that is an important energy source for human's brain, central nervous system, and red blood cells. It can be stored as glycogen in liver and muscle. All excess calories will be converted into body fat[(4)]. A report from the office of the cane and sugar board showed that sugar consumption among Thai people quickly increased during the past two decades from 12.7 kilograms/person/year in 1983 to 33.8 kilograms/person/year in 2010[(5)]. Food and Agriculture Organization [FAO]/WHO recommendation for free sugar is less than 10% of total energy intake (about 50 grams sugar per day for energy intake of 2,000 kcal daily)[(4)]. Between 2002 and 2006, the Ministry of Public Health also

Correspondence to:

Rueangsri N. Faculty of Allied Health Sciences, Burapha University, 169, Bangsaen, Chonburi 20131, Thailand.
Phone: +66-86-6513098
Email: Narisar@buu.ac.th

How to cite this article: Rueangsri N, Pachotikarn C, Taechangam S, Kongkachuichai R, Sungpuag P, Shikanai S, et al. Developing a composition and content of sugar database for selected popular commercial snacks. J Med Assoc Thai 2018;101:569-74.

reported that average of sugar consumption among Thai people was 30 kilograms/person/year, which is three times higher than the recommendation of FAO/WHO. In addition the present study reported that the average sugar consumption among Thai children under five years were 30.4 grams per day and 25% of children consumed sugar more than 40 grams per day[6]. The present study conducted in 2004, showed that commercial snack has three main components including sugar, carbohydrate, and fat[7]. From the survey of food and nutrition status of Thailand in 2003, snacks were one of the most food items consumed by school-aged children[8]. Furthermore, National Statistic Office in 2005 and 2010 reported that Thai people older than six years increasingly consumed snacks per week from 48.9% to 51%[9] and the survey of sugar consumption among Thai children in 2006 showed the average money that they spent to purchase snacks was about 26 baht/person/day, which was equal to 40% of their obtained money in a day[10]. In 2006, children of grade sixth from Hat Yai district were consuming commercial snacks producing about 495 kcal/day in average, which was equal to 30% of total energy requirement per day and exceeded the recommendation of the Royal College of Pediatricians of less than 20% of total energy requirement per day[11].

In Thailand, it is obvious that high sugar consumption by children is one of the major risk factor associated with nutrition problem and can lead to many chronic diseases[3]. In addition, the survey of 2003 reported that commercial snacks (containing high sugar) are one of the most food items consumed by school-aged children[8]. Nevertheless, there is limited data available in Thailand about the sugar composition of commercial snacks and the types and amount of sugar consumption per day. Therefore, the purpose of the present study was to analyze the types and contents of sugar in selected commercial snacks.

Material and Method

Sample selection of commercial snacks for sugar analysis

Snacks were selected from the literature review based on the snack consumption survey from six previous studies[2,12-16]. Three similar food categories out of six were included in the present study. After that, food items in each food category were selected from Ministry of Public Health's study[13]. Finally, the three best-selling brands were chosen in each food item from Marketeer, Positioning, AC Nielsen, Brand Age, National Food Institute websites (www.nfi.or.th), and other related business website. Brand of selected commercial snacks were not identified in the present study. Selected food categories from six previous studies were classified into 17 food categories including hard candy, soft candy, lollipop, milk tablet, marshmallow, stuff bread, layer cake, meat snack, chocolate, wafer, biscuit, cracker, cookie, jelly, corn snack, ice cream, and chips. However, current study analyzed only 16 food categories since chips had less than 1 gram of sugar and were excluded.

Sugar analysis by enzymatic method

Sample was taken from the package and homogenized for a few minutes by mixer. Then, about 1 gram of sample was taken in flask and subsequently mixed with 100 ml of distilled water. After that, the mixture was centrifuged for five minutes at 2,500 rpm, and then filtered and supernatant was pipetted out for testing. The fat in the sample was removed whilst proteins were deproteinize with Carrez reagents. Sample was analyzed by enzymatic F-kit from R-Biopham company. F-kit reagent used for sugar analysis is of three types including Sucrose/D-Glucose/D-Fructose F-kit, Lactose/D-Galactose F-kit, Maltose/Sucrose/D-Glucose F-kit to find out sucrose, glucose, fructose, lactose, galactose, and maltose. Finally, after analyzing sample with enzymatic F-kit, sample was put in cuvette to read absorbance by UV-Vis spectrophotometer (Model: IIelios Beta, AnalTech Co., Ltd.) at 340 nm.

Data analysis of sugar contents was calculated by mean and standard deviation.

Results

Thai sugar composition table from selected commercial snacks consisted of 16 categories including hard candy, soft candy, lollipop, milk tablet, marshmallow, chocolate, wafer, biscuit, cookie, cracker, stuff bread, layer cake, jelly, meat snack, corn snack, and ice cream. The results showed that, total sugar content of hard candy were 67.49 to 75.69 grams per 100 grams. The highest total sugar was found in honey-lemon flavored. The major source of sugar in hard candy was sucrose, which were 38.19±19.97 to 55.23±2.14 grams per 100 grams. The total sugar content of soft candy were 60.90 to 69.33 grams per 100 grams. The highest total sugar was found in fruit flavored. The major source of sugar in soft candy was sucrose, which were 37.73±0.96 to 47.54±9.15 grams per 100 grams. The total sugar content of lollipop were 81.80 to 83.37 grams per 100 grams. The highest total sugar was found in fruit flavored. The major

source of sugar in lollipop was sucrose, which were 53.07±6.48 to 55.89±7.61 grams per 100 grams. The total sugar content of milk tablet were 53.86 to 57.39 grams per 100 grams. The highest total sugar was found in sweentend flavored milk tablet. The major source of sugar in milk tablet was sucrose, which were 26.91±7.14 to 35.01±9.10 grams per 100 grams. The total sugar content of marshmallow were 59.96 to 65.03 grams per 100 grams. The highest total sugar was found in marshmallow with chocolate assorted filling. The major source of sugar in marshmallow was sucrose, which were 29.64±0.28 to 35.08±1.36 grams per 100 grams. The total sugar content of chocolate was 50.90 grams per 100 grams. The major source of sugar in chocolate was sucrose, which were 44.01±7.36 grams per 100 grams. The total sugar content of wafer were 32.69 to 42.97 grams per 100 grams. The highest total sugar was found in chocolate wafer stick. The major source of sugar in wafer was sucrose, which were 14.12±15.79 to 37.60±5.70 grams per 100 grams. The total sugar content of biscuit were 32.57 to 34.01 grams per 100 grams. The highest total sugar was found in chocolate coated biscuit. The major source of sugar in biscuit was sucrose, which were 26.61±0.16 to 29.73±3.86 grams per 100 grams. The total sugar content of cookie were 30.41 to 36.77 grams per 100 grams. The highest total sugar was found in cookie filled with vanilla cream. The major source of sugar in cookie was sucrose, which were 29.66±0.79 to 34.08±3.98 grams per 100 grams. The total sugar content of cracker (coconut butter cracker) was 24.31 grams per 100 grams. The major source of sugar in cracker was sucrose, which were 23.46±7.77 grams per 100 grams. The total sugar content of stuff bread (red bean bread) was 19.32 grams per 100 grams. The major source of sugar in stuff bread was sucrose, which were 15.12±4.51 grams per 100 grams. The total sugar content of layer cake (custard cake) was 23.60 grams per 100 grams. The major source of sugar in layer cake was sucrose, which were 19.38±1.82 grams per 100 grams. The total sugar content of jelly were 21.35 to 63.94 grams per 100 grams. The highest total sugar was found in sugar coated juicy gummy. The major source of sugar in jelly was sucrose, which were 11.50±6.24 to 40.93±5.63 grams per 100 grams. The total sugar content of corn snack was 36.08 grams per 100 grams. The major source of sugar in corn snack was sucrose, which were 20.62±1.93 grams per 100 grams. The total sugar content of meat snack (squid seafood snack sweet and spicy) was 28.37 grams per 100 grams. The major source of sugar in meat snack was sucrose, which were 26.38±3.61 grams per 100 grams. The total sugar content of ice cream were 19.72 to 22.44 grams per 100 grams. The highest total sugar was found in chocolate chip flavored ice cream. The major source of sugar in ice cream was sucrose, which were 11.66±0.86 to 14.85±1.69 grams per 100 grams.

The top five snack items with the highest total sugar (grams per 100 grams) were lollipop (fruit flavored) 83.37, lollipop (cola flavored) 81.80, hard candy (honey-lemon flavored) 75.69, hard candy (berry flavored) 72.88, and soft candy (fruit flavored) 69.33. The major source of sugar in each item was sucrose, which were 45.50±11.77 to 55.89±7.61 grams per 100 grams. Lactose presented in most snacks but in varied amount whereas galactose presented in minute amount in few snacks (Table 1).

Discussion

Most snacks had about 30 grams per serving except candy groups, which had about 3 grams per serving in hard and soft candy, and 10 grams per serving in lollipop. If people ate snacks one to two times per day, sugar exceeded the standard recommendation. The highest total sugar content (grams per serving) was found in marshmallow with chocolate assorted filling, which were 19.51 grams per serving (30 grams).

Sucrose is a disaccharide combination of the monosaccharides glucose and fructose. However, all snacks had only a little bit of fructose.

The total sugar and sucrose contents in chocolate in Thailand, Taiwan[17], and Japan[18,19] were 50.9 and 48.7, 47.5 and 44.0±7.4, and 36.2±0.1 and 36.8±0.9 grams per 100 grams, respectively. Total sugars content of chocolate in Thailand was higher than Japan by 7.2%. Total sugar content in jelly of Thailand, Taiwan[17], and Japan[18,19] was 47.0, 24.1, and 42.6, while that of sucrose was 27.4±14.9, 17.8±2.1, and 37.7±1.0 grams per 100 grams, respectively. Total sugars content of jelly in Thailand was higher than Taiwan by 95%. The country that had the highest total sugars in chocolate and jelly was Thailand. In addition, the comparison of total sugars between Thailand and Taiwan[17] in candy was 72.0 and 43.8, and in cookie was 34.5 and 31.2 grams per 100 grams, respectively. The country that had the highest total sugars in candy and cookie was also Thailand. Furthermore, the comparison of total sugars between Thailand and Japan[18,19] for marshmallow was 62.5 and 3.7, and for wafer was 37.1 and 22.8 grams per 100 grams, respectively. The country that had the highest total sugars in marshmallow and wafer was also Thailand. The highest type of sugar in all snack

Table 1. The composition and content of sugar in selected Thai commercial snacks (n = 3)

Items	Average sugars of items (grams/100 grams), mean ± SD						
	Glucose	Fructose	Sucrose	Lactose	Galactose	Maltose	Total
Hard candy							
Berry flavored	6.95±3.62	3.24±1.14	45.50±11.77	0.00±0.00	0.00±0.00	17.19±2.87	72.88±5.54
Honey-lemon flavored	3.69±2.01	2.08±0.74	55.23±2.14	0.00±0.00	0.00±0.00	14.68±10.82	75.69±5.93
Plum flavored	9.06±8.79	3.95±3.61	38.19±19.97	0.00±0.00	0.00±0.00	16.29±3.11	67.49±10.69
Soft candy							
Fruit flavored	4.23±2.46	1.50±0.61	47.54±9.15	0.00±0.00	0.00±0.00	16.07±7.07	69.33±4.73
Milk flavored	1.57±1.01	0.44±0.55	37.73±0.96	7.26±4.15	0.00±0.00	13.89±2.71	60.90±6.99
Mint flavored	3.32±3.14	0.08±0.03	47.26±11.62	0.00±0.00	0.00±0.00	13.00±5.54	63.66±11.50
Soft candy chocolate filling	0.93±0.10	0.11±0.07	47.02±3.84	0.00±0.00	0.00±0.00	16.98±2.78	65.04±6.72
Lollipop							
Cola flavored	3.29±0.19	3.69±0.39	55.89±7.61	0.00±0.00	0.00±0.00	18.94±4.03	81.80±11.84
Fruit flavored	3.75±1.14	3.94±0.43	53.07±6.48	0.00±0.00	0.00±0.00	22.61±1.16	83.37±4.25
Milk tablet							
Chocolate flavored milk tablet	0.40±0.58	0.00±0.00	35.01±9.10	18.35±8.50	0.11±0.02	0.00±0.00	53.86±2.52
Sweetened flavored milk tablet	0.17±0.14	0.06±0.04	26.91±7.14	30.18±8.26	0.10±0.02	0.00±0.00	57.39±2.36
Marshmallow							
Marshmallow with chocolate assorted filling	18.37±0.51	0.00±0.00	29.64±0.28	4.25±0.04	0.00±0.00	12.77±0.08	65.03±0.27
Marshmallow chocolate flavored	6.61±3.98	0.17±0.09	35.08±1.36	0.00±0.00	0.00±0.00	18.10±1.88	59.96±0.65
Chocolate							
Chocolate	0.05±0.03	0.01±0.01	44.01±7.36	6.83±2.07	0.00±0.00	0.00±0.00	50.90±8.30
Wafer							
Chocolate coated wafer filled with chocolate cream	2.00±3.25	0.07±0.11	31.44±2.94	6.56±0.83	0.00±0.00	0.00±0.00	40.06±5.15
Chocolate wafer stick	0.10±0.07	0.09±0.05	37.60±5.70	5.16±3.48	0.03±0.01	0.00±0.00	42.97±5.39
Wafer filled with chocolate/cocoa cream	4.18±3.58	0.02±0.02	17.34±13.53	4.87±2.90	0.02±0.00	6.26±5.82	32.69±7.41
Wafer filled with vanilla cream	4.74±4.08	0.01±0.01	14.12±15.79	7.90±2.46	0.00±0.00	5.94±5.14	32.70±7.95
Biscuit							
Biscuit filled with chocolate	0.14±0.13	0.11±0.13	26.61±0.16	5.72±3.40	0.00±0.00	0.00±0.00	32.57±3.45
Chocolate coated biscuit	0.04±0.01	0.03±0.01	29.73±3.86	4.21±1.59	0.00±0.00	0.00±0.00	34.01±2.28
Cookie							
Cookie chocolate chip	0.37±0.46	0.10±0.14	29.66±0.79	0.28±0.26	0.00±0.00	0.00±0.00	30.41±1.00
Cookie filled with chocolate cream	1.27±0.86	0.13±0.18	33.38±4.26	1.61±1.42	0.00±0.00	0.00±0.00	36.39±2.27
Cookie filled with vanilla cream	1.44±1.41	0.36±0.28	34.08±3.98	0.88±1.13	0.00±0.00	0.00±0.00	36.77±1.81
Cracker							
Coconut butter cracker	0.46±0.60	0.17±0.16	23.46±7.77	0.23±0.39	0.00±0.00	0.00±0.00	24.31±7.08
Stuff bread							
Red bean bread	1.92±0.14	1.85±0.18	15.12±4.51	0.43±0.17	0.00±0.00	0.00±0.00	19.32±4.37
Layer cake							
Custard cake	2.80±2.36	0.96±0.84	19.38±1.82	0.46±0.55	0.00±0.00	0.00±0.00	23.60±2.25
Jelly							
Carrageenan jelly	5.15±2.37	4.70±2.10	11.50±6.24	0.00±0.00	0.00±0.00	0.00±0.00	21.35±2.85
Gummy jelly with mixed fruit flavored	12.05±9.61	0.00±0.00	29.87±7.76	0.00±0.00	0.00±0.00	13.73±4.51	55.65±8.24
Sugar coated juicy gummy	3.27±1.73	0.00±0.00	40.93±5.63	0.00±0.00	0.00±0.00	19.74±0.83	63.94±6.25
Corn snack							
Popcorn	11.29±4.64	3.67±1.60	20.62±1.93	0.50±0.43	0.00±0.00	0.00±0.00	36.08±3.49
Meat snack							
Squid seafood snack sweet and spicy	0.85±0.18	1.14±0.96	26.38±3.61	0.00±0.00	0.00±0.00	0.00±0.00	28.37±4.18
Ice cream							
Ice cream chocolate chip flavored	0.20±0.05	0.03±0.02	14.85±1.69	4.73±0.74	0.02±0.01	2.61±0.49	22.44±2.17
Ice cream chocolate flavored	0.43±0.43	0.25±0.42	13.16±0.86	4.39±1.08	0.00±0.00	1.75±1.29	19.72±1.28
Ice cream strawberry flavored	1.10±1.34	0.95±1.34	11.66±0.86	4.44±0.32	0.03±0.00	1.94±0.22	20.11±1.88

categories was sucrose, while maltose was found in food categories that have glucose syrup in their ingredient such as hard candy, soft candy, lollipop, marshmallow, wafer, jelly, and ice cream.

Conclusion

When comparing the types and contents of sugar among other Asian countries products, we found that Thailand had the highest total sugars.

All Thai popular commercial snacks contain high amount of sugar. A sugar composition and content database of selected commercial snacks was developed. It can be used as an educational tool to raise public awareness of high sugar source in diet.

What is already known on this topic?

Health care professionals, dietitians, snacks companies, and consumers are aware of the large amount of sugars (monosaccharides and disaccharides) contained in Thai commercial snacks.

What this study adds?

A sugar composition and content database of selected popular commercial snacks was created. This will be useful and beneficial for Thai people to estimate the daily sugar intake. Consumption of snack should be limited to keep sugar intake within the recommendation for benefit of health. The snack companies and government should cooperate to reduce the sugar added in Thai snacks.

Authors' contributions

Rueangsri N contributed to sample selection, analysis, and calculation. All authors read and approved manuscript and supported the enzymatic analysis.

A special thanks to Yamamoto S for his support of enzymatic F-kits as well as the kind support by US-Japan Medical Science Program.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. World Health Organization. Overweight and obesity [Internet]. 2016 [cited 2016 Jan 14]. Available from: http://www.who.int/gho/ncd/risk_factors/overweight_text/en/.
2. Satiennoppakao W. Report of food consumption survey of Thai people. In: Eakplakorn W, editor. Thailand national health and examination survey 2008-2009. Nonthaburi: National Health Examination Survey Office, Thailand; 2011:31-48.
3. Sirikunchayanon C, Ungchusak C. Sugar, health, and management of consumption. Bangkok: Thaiveterans Printing; 2012.
4. World Health Organization. Diet, nutrition, and the prevention of chronic diseases. Joint WHO/FAO Technical Report Series, No. 916, Geneva: WHO; 2003.
5. The Office of the Cane and Sugar Board, Ministry of Industry. Proportion of sugar consumption in Thailand (kg/person/year) [Internet]. 1983-2010 [cite 2016 Mar 28]. Available from: http://www.oie.go.th/index.
6. Ungchusak C, Triroj B, Promma S. Report of low sweet family day [Internet]. 2016 [cite 2016 Mar 28]. Available from: http://www.sweetenough.in.th/.
7. Sirikulchayanonta C, Pavadhgul P, Chongsuwat Srisorrachata S. A preliminary study of hyperlipidemia in Bangkok school children. Asia-Pacific J Public Health 2006;18:15-9.
8. Bureau of Nutrition, Health Department. The 5th Report of food and nutrition status survey of Thailand 2003. Bangkok: Veterinarian Patronage Printing; 2006.
9. National Statistic Office, Ministry of Information Technology and Communication. The household survey of economic and social status 2010. Bangkok: Srimuang Printing; 2011.
10. Thai Health Organization [Internet]. 2016 [cite 2016 Apr 12]. Available from: www.thaihealth.or.th.
11. Tangvitoon A. Behavior of snacks consumption from grade 6 children in Had Yai district: relationship with nutritional status. Research project. Songkla: Department of Pediatrics, Faculty of Medicine, Prince of Songkla University, 2006.
12. Bureau of Nutrition. The 5th report of food and nutrition status survey of Thailand 2003. Bangkok: Veterinarian Patronage Printing; 2006.
13. Prasertsom P, Chanbang P, Rithyu U. Survey of snack and beverage consumption in Thai children 3-12 years old. In: Prasertsom P, editor. Sugar in snack, beverage, milk, and milk powder for children. Bangkok: Namo Printing and Publishing; 2007:11-24.
14. Chitchang U, Sirichakkaval P, Soranacharoenpong K, Prasertsom P, Chanbang P. The study of snack and light meal consumption behavior in children 3-15 years old: The study report of Thai sweet enough network. Institute of Nutrition, Mahidol University and Bureau of Dental Health, Ministry

of Public health; 2004.
15. National Bureau of Agricultural Commodity and Food Standards. Food consumption data of Thailand. Bangkok: National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives; 2006.
16. Aueadkarun S, Prasertsom P, Ungchusak C. The study report of food marketing in schools. Nonthaburi: Bureau of Dental Health, Ministry of Public Health; 2011.
17. Tseng AT, Tsao HC, Sarukura N, Huang KC, Wang MF, Huang PC, et al. Development of a food composition database of refined monosaccharides and disaccharides in snacks, desserts, and beverages. Nutr Sci J 2010:35;127-37.
18. Yamamoto S, Taniguchi H, Sarukura N, Tseng AT, Takeichi H. Development of a food composition database of monosaccharide and disaccharides in sweet snacks and beverages. J Jpn Diet Assoc 2009:52;22-5.
19. Takeichi H, Wakikawa N, Taniguchi H, Sarukura N, Tsao H, Tseng AT, et al. Concentrations of monosaccharide and disaccharides in commercial sweet snacks. J Jpn Diet Assoc 2010:53;23-6.