

Sugar substitutes during pregnancy

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Abstract

Question I have a pregnant patient who regularly consumes sugar substitutes and she asked me if continuing their use would affect her pregnancy or child. What should I tell her, and are there certain options that are better for use during pregnancy?

Answer Although more research is required to fully determine the effects of in utero exposure to sugar substitutes, the available data do not suggest adverse effects in pregnancy. However, it is recommended that sugar substitutes be consumed in moderate amounts, adhering to the acceptable daily intake standards set by regulatory agencies.



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Sugar substitutes, also referred to as *artificial sweeteners*, are a great alternative for those looking to replace glucose in their diet. With an increased prevalence of diabetes¹ and other diet-related diseases,² sugar replacements are becoming increasingly popular in items such as food, drinks, oral hygiene products, and pharmaceutical products. Canada's *Food and Drug Regulations* specifies how sugar substitutes can be used, as well as the amount allowed, in products, and indicates approval for use of the following nonnutritive artificial sweeteners: acesulfame potassium, aspartame, neotame, polydextrose, Stevia, sucralose, sugar alcohols (known as *polyols*), saccharin, and thaumatin.³⁻⁵

Health Canada states that consumption of sugar substitutes during pregnancy does not pose a health risk but recommends that they be used in moderation so as to not replace nutrients needed for a healthy pregnancy.³ For cases in which pregnant women require sugar substitutes, it is recommended that they consume them according to the acceptable daily intake (ADI). The ADIs have been established by the Food Directorate of Health Canada, and are the same as those set by the Joint Expert Committee of Food Additives of the Food and Agricultural Organization and the World Health Organization.^{6,7} **Table 1**⁶⁻⁹ summarizes the ADIs for commonly used sugar substitutes and the amount found in commonly consumed products.

A meta-analysis reported that low-calorie beverages approved by the US Food and Drug Administration for consumption during pregnancy did not affect preterm delivery when outcomes for women consuming such

beverages were compared with those of women who did not drink sugar-substituted beverages.¹⁰

Sugar substitutes

Acesulfame potassium. Acesulfame potassium is a high-intensity sweetener used in food, beverages, oral hygiene products, and a number of pharmaceutical products.¹¹ There is limited research on the safety of acesulfame potassium during pregnancy, but studies have found that the sweetener does cross the placenta.¹¹ An animal study reported that fetuses exposed to acesulfame potassium through the amniotic fluid had an increased preference for sweet solutions and acesulfame potassium solution in adulthood when compared with those in the control group.¹¹ However, these results were reported for concentrations of acesulfame potassium that were substantially greater than typical human exposure.

Aspartame. Aspartame is one of the most common artificial sweeteners used in food and drink. In the small intestine, aspartame breaks down into aspartic acid, phenylalanine, and methanol at levels that are nontoxic to adults, children, and fetuses.¹² Several animal studies do not suggest concerns with use of aspartame during pregnancy.¹³ Human studies found that the breakdown products of aspartame cross the placenta.¹⁴ However, a dose of 200 mg/kg of aspartame (4 to 5 times the ADI) did not lead to toxicity, such as methanol poisoning or increase in fetal blood phenylalanine levels to the range associated with mental retardation in offspring.¹⁴ Based on available data, consumption

Table 1. The ADIs of common sugar substitutes and the amount found in commonly consumed products

SUGAR SUBSTITUTE	ADI, MG/KG	ADI FOR A PERSON WEIGHING 60 KG, MG	AMOUNT IN SOFT DRINKS, MG/12 FL OZ	AMOUNT IN PACKET, MG
Acesulfame potassium	15	900	50	NA*
Aspartame	40	2400	185	15 per 1 tsp
Neotame	2	120	NA	NA
Polydextrose	Unknown	NA	NA	NA
Saccharin	5	300	7-95	12 per tablet
Stevia	4	240	60	Unknown
Sucralose	9	540	60	12
Sugar alcohols (polyols)	Dependent on specific polyol	NA	NA	NA
Thaumatococin	Unknown	NA	NA	NA

ADI—acceptable daily intake, NA—not available.

*Not available in packet form.

Data from Canadian Diabetes Association,⁶ World Health Organization,⁷ Beverage Institute for Health and Wellness,⁸ and EatRight Ontario.⁹

of aspartame during pregnancy is not expected to be a concern when staying within the acceptable daily limit.¹⁵ It is important to note that women with phenylketonuria should avoid aspartame owing to its breakdown into phenylalanine.³

Neotame. Neotame is a sparsely used chemical derivative of aspartame that is much sweeter.⁷ Thus far, there are limited data on any potential effects of neotame consumption during pregnancy.

Saccharin. Until recently, saccharin was banned as a sweetener in Canada.^{4,5} The compound crosses the human placenta at term.¹⁶ In a study conducted in rhesus monkeys, fetal elimination of saccharin was much slower than on the maternal side, suggesting that repeated ingestion of saccharin by the mother could lead to a considerable accumulation of the substance in the fetus.¹⁷ However, animal data that report exposure with doses 100 to 400 times the human ADI do not suggest a risk of malformations.¹⁸ A case-control study reported no increased risk of spontaneous abortions in women who consumed saccharin.¹⁹

Stevia. Stevia was approved by Health Canada as a food additive in 2012.⁴ It is becoming increasingly popular as a natural alternative to artificial sweeteners. The compound originates from the leaves of the *Stevia rebaudiana* plant, and is used as a noncaloric sweetener.⁴ In animal studies, Stevia did not increase toxicity in rat embryos, nor did it affect fertility or pregnancy outcomes.²⁰ However, there are no data on the outcomes of use of Stevia during human pregnancies.

Sucralose. Sucralose is another common artificial sweetener. Animal studies report no increased risk of


malformations or other adverse fetal effects with exposure to high-dose levels of sucralose during pregnancy.²¹

Polyols and polydextrose. Polyols are compounds that occur naturally but they are manufactured for use commercially.²² Canada's *Food and Drug Regulations* indicate approval for the use of the following sugar alcohols: "hydrogenated starch hydrolysates, isomalt, lactitol, maltitol, maltitol syrup, mannitol, sorbitol, sorbitol syrup, xylitol and erythritol."²² Limited evidence exists on the effects of polyols during pregnancy. However, owing to the presence of polyols in both maternal and fetal samples from normal pregnancy,²³ it is likely that these compounds are safe when consumed in moderation.

Polydextrose is another compound that is approved as a food additive. Unlike polyols, polydextrose supplements texture without adding sweetness to foods.²² It is a synthetic indigestible glucose polymer and is classified as a dietary fibre; therefore, it is not expected to be a concern.²⁴

Thaumatococin. Thaumatococin is a sweet protein derived from the *Thaumatococcus daniellii* plant.⁷ Although little evidence exists on the effects of thaumatococin during pregnancy, the protein is processed in the body similarly to other dietary proteins⁷ and therefore is not expected to have adverse effects during pregnancy.

Conclusion

While data concerning the use of sugar substitutes during pregnancy are limited, they do not suggest an increased risk of toxicity, adverse pregnancy outcomes, or neonatal issues. It is recommended that they be consumed in moderation and that pregnant women adhere to the ADI levels outlined by regulatory directives. 

Competing interests
None declared

References

1. Public Health Agency of Canada [website]. *Diabetes in Canada: facts and figures from a public health perspective*. Ottawa, ON: Public Health Agency of Canada; 2011. Available from: www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/facts-figures-faits-chiffres-2011/chap1-eng.php#DIA. Accessed 2013 Aug 4.
2. Public Health Agency of Canada [website]. *Obesity in Canada—snapshot*. Ottawa, ON: Public Health Agency of Canada; 2012. Available from: www.phac-aspc.gc.ca/publicat/2009/oc/index-eng.php#mfi. Accessed 2013 Aug 13.
3. Health Canada [website]. *The safety of sugar substitutes*. Ottawa, ON: Health Canada; 2008. Available from: www.hc-sc.gc.ca/hl-vs/iyh-vsv/food-aliment/sugar_sub_sucre-eng.php. Accessed 2013 July 25.
4. Health Canada [website]. *Sugar substitutes*. Ottawa, ON: Health Canada; 2010. Available from: www.hc-sc.gc.ca/fn-an/secureit/addit/sweeten-edulcor/index-eng.php. Accessed 2013 Jul 25.
5. Health Canada [website]. *List of permitted sweeteners (list of permitted food additives)*. Ottawa, ON: Health Canada; 2014. Available from: www.hc-sc.gc.ca/fn-an/secureit/addit/list/9-sweetener-edulcorant-eng.php. Accessed 2014 Oct 1.
6. Canadian Diabetes Association [website]. *Sugars & sweeteners*. Toronto, ON: Canadian Diabetes Association; 2014. Available from: www.diabetes.ca/diabetes-and-you/healthy-living-resources/diet-nutrition/sugar-sweeteners. Accessed 2014 Oct 1.
7. World Health Organization [website]. *Evaluations of the Joint FAO/WHO Expert Committee on Food Additives (JECFA) list of chemicals in functional class sweetener*. Geneva, Switz: World Health Organization; 2010. Available from: <http://apps.who.int/food-additives-contaminants-jecfa-database/search.aspx?fc=66#>. Accessed 2013 Oct 12.
8. Beverage Institute for Health and Wellness [website]. *Low- and no-calorie sweeteners*. Atlanta, GA: The Coca-Cola Company; 2013. Available from: <http://beverageinstitute.org/us/article/understanding-low-and-no-calorie-sweeteners-safety-guidelines-adi-and-estimated-intakes/>. Accessed 2013 Aug 13.
9. EatRight Ontario [website]. *Sweet foods and diabetes—can people with diabetes still eat sugar?* Toronto, ON: Dietitians of Canada; 2014. Available from: www.eatrightontario.ca/en/Articles/Diabetes-Prevention/Sweet-foods-and-diabetes—can-people-with-diabete.aspx. Accessed 2013 Aug 13.
10. La Vecchia C. Low-calorie sweeteners and the risk of preterm delivery: results from two studies and a meta-analysis. *J Fam Plann Reprod Health Care* 2013;39(1):12-3.
11. Zhang GH, Chen ML, Liu SS, Zhan YH, Quan Y, Qin YM, et al. Effects of mother's dietary exposure to acesulfame-K in pregnancy or lactation on the adult offspring's sweet preference. *Chem Senses* 2011;36(9):763-70. Epub 2011 Jun 7.
12. Franz M. Is it safe to consume aspartame during pregnancy? A review. *Nutrition update. Diabetes Educ* 1986;12(2):145-7.
13. Ranney RE, Mares SE, Schroeder RE, Hutsell TC, Raczalowski FM. The phenylalanine and tyrosine content of maternal and fetal body fluids from rabbits fed aspartame. *Toxicol Appl Pharmacol* 1975;32(2):339-46.
14. Sturtevant FM. Use of aspartame in pregnancy. *Int J Fertil* 1985;30(1):85-7.
15. Health Canada [website]. *Health Canada comments on the recent study relating to the safety of aspartame*. Ottawa, ON: Health Canada; 2006. Available from: www.hc-sc.gc.ca/fn-an/secureit/addit/sweeten-edulcor/aspartame_statement-eng.php. Accessed 2013 Jul 25.
16. Cohen-Addad N, Chatterjee M, Bekersky I, Blumenthal HP. In utero-exposure to saccharin: a threat? *Cancer Lett* 1986;32(2):151-4.
17. Pitkin RM, Reynolds WA, Filer LJ Jr, Kling TG. Placental transmission and fetal distribution of saccharin. *Am J Obstet Gynecol* 1971;111(2):280-6.
18. Dropkin RH, Salo DF, Tucci SM, Kaye GI. Effects on mouse embryos of in utero exposure to saccharin: teratogenic and chromosomal effects. *Arch Toxicol* 1985;56(4):283-7.
19. Kline J, Stein ZA, Susser M, Warburton D. Spontaneous abortion and the use of sugar substitutes (saccharin). *Am J Obstet Gynecol* 1978;130(6):708-11.
20. Geuns JM. Stevioside. *Phytochemistry* 2003;64(5):913-21.
21. Kille JW, Tesh JM, McAnulty PA, Ross FW, Willoughby CR, Bailey GP, et al. Sucralose: assessment of teratogenic potential in the rat and the rabbit. *Food Chem Toxicol* 2000;38(Suppl 2):S43-52.
22. Health Canada [website]. *Sugar alcohols (polyols) & polydextrose used as sweeteners in foods*. Ottawa, ON: Health Canada; 2005. Available from: www.hc-sc.gc.ca/fn-an/secureit/addit/sweeten-edulcor/polyols_polydextose_factsheet-polyols_polydextose_fiche-eng.php. Accessed 2013 Jul 30.
23. Brusati V, Jozwik M, Jozwik M, Teng C, Paoletti C, Marconi A, et al. Fetal and maternal non-glucose carbohydrates and polyols concentrations in normal human pregnancies at term. *Pediatr Res* 2005;58(4):700-4.
24. Raninen K, Lappi J, Mykkänen H, Poutanen K. Dietary fiber type reflects physiological functionality: comparison of grain fiber, inulin, and polydextrose. *Nutr Rev* 2011;69(1):9-21.

MOTHERISK

Motherisk questions are prepared by the Motherisk Team at the Hospital for Sick Children in Toronto, Ont. Ms Pope, currently a student at McMaster University in Hamilton, Ont, was a member of Motherisk at the time of preparing this update. Dr Koren is Director and Ms Bozzo is Assistant Director of the Motherisk Program. Dr Koren is supported by the Research Leadership for Better Pharmacotherapy during Pregnancy and Lactation.

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