

Fruit juice and fructose

Key points

- Fructose is a dietary simple sugar found naturally in fruits and 100% fruit juices (FJ) and added to sweet foods and drinks.
- FJ contributes a relatively modest amount of fructose to the diet.
- Research has found no harmful effect of moderate fructose intakes on glycaemic control in those with type 2 diabetes, nor on risk factors for cardiovascular disease.
- Furthermore, when energy balance is maintained, current evidence shows no significant effects of fructose on body composition.

Fructose is a dietary monosaccharide (simple sugar) that is commonly found bonded to glucose to make the disaccharide sucrose, otherwise known as table sugar. Fructose stands out amongst other dietary sugars due to claims that it may have detrimental effects on health.

Sources of fructose in the diet

All fruits naturally contain sugars, including fructose. The total amount of fructose in a portion of fruit varies from 1 to 6 g for citrus fruits, around 7 g for pineapple, and 3 to 10 g for apples and pears, depending on the variety. The fructose content of FJs reflects the composition of whole fruit. For example, 100 mL of orange juice contains 2.4 g fructose, while 100 g of whole orange contains 2.2 g of fructose¹.

Dietary surveys from the UK and New Zealand estimate that daily fructose intakes are around 20 to 40 g, compared with 50 to 70 g in the USA^{2,3,4}. A significant source of fructose in the UK and France is whole fruit, followed by soft drinks containing sucrose. In general, FJ at current consumption patterns contributes very little fructose to the diet. A 200 mL glass of 100% orange juice would provide 5 g of fructose, however the average FJ intake in Europe (including consumers + non-consumers) is less than 100mL per day.

Does fructose consumption affect disease risk?

Looking first at type 2 diabetes, a systematic review and meta-analysis of short-term, controlled trials examined the effect of fructose on glycaemic control in individuals with diabetes⁵. This revealed that isocaloric (equal calorie) exchange of fructose for other carbohydrates improves long-term glycaemic control, without affecting insulin production. This fits with the authorised health claim for fructose as assessed by EU legislators, which states: “Consumption of foods containing fructose leads to a lower blood glucose rise compared to foods containing sucrose or glucose.”⁶.

Turning to risk factors for cardiovascular disease, a meta-analysis of prospective cohort studies, involving more than 200,000 adults, found no difference in risk of developing high blood pressure between the lowest and highest consumers of fructose⁷. Indeed, the authors speculated that intakes of fructose up to around 50 g per day were associated with a lower risk of hypertension. A further meta-analysis of 13 trials reported that a calorie-matched exchange of fructose for other carbohydrates significantly lowered diastolic blood pressure but had no impact on systolic blood pressure⁸. In line with these findings a meta-analysis of observational studies involving 624,128 individuals found no association of fructose intake with cardiovascular disease incidence⁹. Harmful associations with cardiovascular disease mortality were only found at intakes well above the average daily intake.

Is there an association between fructose intake and body weight?

Studies considering the impact of fructose on body composition have not found any consistent evidence of harm when participants remain in energy balance (calories in = calories out). For example, a systematic review considered 41 intervention studies where fructose intakes ranged from 17% to 38% of energy¹⁰. Even at these high intakes, fructose had no significant overall effect on body weight in normal weight participants, nor in people with type 2 diabetes when calories remained in balance. Interestingly, small but significant weight reductions were seen in the five trials that recruited overweight/obese participants. However, in the hypercaloric trials (excess calories), body weight increased by a similarly small amount, leading the authors to conclude that this effect may be due to the extra calories provided, rather than the fructose per se.

Conclusion

Although fruit and FJ are sources of fructose in the diet, they contribute a relatively small amount to the overall diet compared with other sources. Studies suggest that modest amounts of fructose (< 50 g per day) can help to reduce risk factors for type 2 diabetes and cardiovascular disease^{8,11}. In addition, studies considering the impact of fructose on body composition have found no consistent evidence of harm when participants remain in energy balance and when fructose comes from natural sources, e.g. fruit and FJ. Evidence shows that moderate intakes of fructose consumed as part of an energy balanced diet are not harmful to health and may even provide health benefits.

October 2024.

References

1. UK Department of Health (2013). Nutrient analysis of fruit and vegetables. Available at: <https://www.gov.uk/government/publications/nutrient-analysis-of-fruits-and-vegetables>
2. Schneider E et al. (2021). FODMAP consumption by adults from the French population-based NutriNet-Santé Cohort. *J Nutr* 151: 3180-3186.
3. Gibson S (2008). Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions. *Nutr Res Rev* 21: 134-47.
4. Marriott BP et al. (2009). National estimates of dietary fructose intake increased from 1977 to 2004 in the United States. *J Nutr* 139: 1228S-1235S.
5. Cozma AI et al. (2012). Effect of Fructose on Glycemic Control in Diabetes: A systematic review and meta-analysis of controlled feeding trials. *Diabetes Care* 35: 1611-1620.
6. European Commission. Food and Feed Information Portal Database. Available at: <https://ec.europa.eu/food/food-feed-portal/screen/health-claims/eu-register>
7. Jayalath VH et al. (2014). Total fructose intake and risk of hypertension: a systematic review and meta-analysis of prospective cohorts. *J Am Coll Nutr* 33: 328-339.
8. Ha V et al. (2012). Effect of fructose on blood pressure: a systematic review and meta-analysis of controlled feeding trials. *Hypertension*. 59: 787-95.
9. Khan TA et al. (2019). Relation of total sugars, sucrose, fructose, and added sugars with the risk of cardiovascular disease: A systematic review and dose-response meta-analysis of prospective cohort studies. *Mayo Clin Proc* 94: 2399-2414.
10. Sievenpiper JL et al. (2012). Effect of fructose on body weight in controlled feeding trials. *Ann Intern Med* 156: 291-304.
11. Wiebe N et al. (2011) A systematic review on the effect of sweeteners on glycemic response and clinically relevant outcomes. *BMC Med* 9: 123.