

---

 COMMENTS AND  
 RESPONSES
 

---

**Response to  
 Comment on:  
 Aeberli et al.  
 Moderate Amounts  
 of Fructose  
 Consumption Impair  
 Insulin Sensitivity in  
 Healthy Young Men:  
 A Randomized  
 Controlled Trial.  
 Diabetes Care  
 2013;36:150-156**

We appreciate the interest in our recent article on the effects of fructose consumption on insulin sensitivity in young men (1), even though we do not agree with White's (2) view that our data do not support our conclusion. However, considering his affiliations in the sugar-sweetened beverages (SSBs) industry, his critique is neither new nor surprising.

Let us first clarify the study design. Subjects received 40 g (medium fructose [MF]) and 80 g (high fructose [HF]) of fructose per day. Assuming an energy intake of a sedentary study population around 2,400–2,500 kcal/day, this represents 6–7% and 13–14% of total energy intake. Dietary intake was assessed to exclude significant differences in total energy intake. Considering the large day-to-day variations of dietary protocols, however, we suggest to calculate the amount of energy provided by the different SSBs based on an overall mean energy

intake, rather than the energy intake during each intervention. Doing so, MF provided 7.5% of total energy and HF 15%. Therefore, we do not agree with White's statement that the amounts of fructose provided in the HF and MF interventions were nearly equivalent.

We agree that the sample size was relatively small, but a strength of the study was its randomized crossover design. The effect of the HF diet on hepatic insulin sensitivity could clearly be demonstrated even with nine subjects, which we consider a strength rather than a limitation of the study. Also, contrary to White's statement, we did see a dose effect: only the HF intervention affected insulin sensitivity.

As pointed out, we have found a significant decrease in hepatic insulin sensitivity after the HF intervention, but no change of whole body (essentially muscle) insulin sensitivity. This point is discussed at length in the article, and we do not repeat our reasoning here, but our study design allows us to measure these differential effects of short-term HF diets on glucose metabolism. It is of course possible that a prolonged administration of high amounts of fructose may also alter muscle insulin sensitivity, possibly through a progressive deposition of ectopic fat in skeletal muscle as shown previously by Lê et al. (3).

Even though plasma lipids and fasting glucose were still within a normal range even after the SSB interventions, small but significant effects were visible. We would never have expected that 3 weeks of consumption of moderate amounts of fructose as administered in this study would lead to acute dyslipidemia. However, the fact that already after this short study duration and with those relatively low amounts a significant change could be seen is an important finding that should be further evaluated in longer-term studies.

In summary, with this randomized crossover study we could demonstrate that even in a small sample of nine subjects, consuming moderate amounts of fructose over a limited time period (3 weeks) has harmful effects on glucose and lipid metabolism, i.e., a significant decrease in hepatic insulin sensitivity as well as alterations in the lipid profile compared with a glucose intervention.

ISABELLE AEERLI, PHD  
 MICHEL HOCHULI, MD, PHD  
 KASPAR BERNEIS, MD

From the Division of Endocrinology, Diabetes and Clinical Nutrition, University Hospital Zurich, Zurich, Switzerland.

Corresponding author: Kaspar Berneis, [kaspar.berneis@usz.ch](mailto:kaspar.berneis@usz.ch).

DOI: 10.2337/dc13-0299

© 2013 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See <http://creativecommons.org/licenses/by-nc-nd/3.0/> for details.

---

**Acknowledgments**—No potential conflicts of interest relevant to this article were reported.

.....

**References**

1. Aeberli I, Hochuli M, Gerber PA, et al. Moderate amounts of fructose consumption impair insulin sensitivity in healthy young men: a randomized controlled trial. *Diabetes Care* 2013;36:150–156
2. White JS. Comment on: Aeberli et al. Moderate amounts of fructose consumption impair insulin sensitivity in healthy young men: a randomized controlled trial. *Diabetes Care* 2013;36:150–156 (Letter). *Diabetes Care* 2013;36:e104. DOI: 10.2337/dc12-2587
3. Lê KA, Ith M, Kreis R, et al. Fructose overconsumption causes dyslipidemia and ectopic lipid deposition in healthy subjects with and without a family history of type 2 diabetes. *Am J Clin Nutr* 2009;89:1760–1765