

## Nutrition Discussion Forum

### *Low carbohydrate does not mean low glycaemic index!\**

Dumesnil *et al.* (2001) reported the results of a study from Laval University, Québec, in which overweight men were fed under metabolic ward conditions for 6 d on each of three different test diets. They concluded that: ‘... a low-glycaemic index–low-fat–high-protein diet can produce a marked decrease in *ad libitum* energy intake without increasing hunger or decreasing satiety while having rapid and marked effects on metabolic risk variables’. However, the authors have provided no evidence that the effects they observed were in any way due to the use of low-glycaemic-index (GI) foods.

The conclusions related to GI are unjustified because the paper fails to demonstrate that the GI of their low-GI–low-fat–high-protein diet is less than that of the control (American Heart Association; Krauss *et al.* 1996) diet. The GI of neither experimental diet is given. An appendix is provided giving sample menus from each dietary regimen and showing the GI values of the foods in each diet. However, the information is imprecise: there are no weights of foods given, in some cases the specific food is not indicated. Three foods, wholewheat bread, unsweetened jam and fresh fruits, provide most of the carbohydrate in the low-GI diet. The GI values of bread and jam are indicated as being: ‘Undetermined, but probably <51’. The GI of ‘fresh fruits’ is listed as being 36–53.

We have tested commercial varieties of wholewheat bread available in Canada, and wholewheat bread baked in our laboratory, on several occasions. The lowest value ever obtained was 65 (Wolever *et al.* 1994a), although the value obtained was usually closer to 71 (Jenkins *et al.* 1983a,b, 1986, 1988; Wolever *et al.* 1986, 1994a). Thus wholewheat bread is not a low-GI food. The published GI values of certain popular tropical fruits, readily available in Canada, are higher than the maximum value of 53 given by the authors; e.g. ripe banana (all yellow skin, GI 54), over-ripe banana (few brown spots on skin, GI 64) (Wolever *et al.* 1988), pineapple (GI 66) and watermelon (GI 72) (Foster-Powell & Brand Miller, 1995). Since the fruits used are not indicated, it is not possible to verify that the GI values cited are correct.

To the best of my knowledge, there is no published GI value for jam, although Jenkins (DJA Jenkins and C Kendal, personal communication) found the GI of strawberry jam to be 84. The carbohydrates in regular jam consist of the sugars in the fruit, plus the sucrose or other carbohydrate added to sweeten and thicken the jam. Fruits contain varying proportions of sucrose, fructose and glucose with some, such as pear, peach and apricot,

containing 100–160 g sorbitol/kg (Wolever *et al.* 1993). Dumesnil *et al.* (2001) do not indicate what kind of fruit was in ‘Unsweetened jam’. Presumably the jam contained no added sucrose, but could have contained extra fruit or fruit juice. It may or may not be correct to assume that it contained no other sweetener such as sorbitol or aspartame. These different kinds of jam would contain different amounts of carbohydrate, but the GI may not change. Removing sugar from jam, or replacing it with extra fruit or fruit juice would not be expected to change the GI appreciably, if the sugars in the fruit approximate the composition of sucrose. Sweetening jam with aspartame would not alter its GI since aspartame is not a carbohydrate. The effect on the GI of sweetening the jam with sorbitol is a contentious issue depending on whether sorbitol is included as a ‘glycaemic carbohydrate’.

Dumesnil *et al.* (2001) indicate that cheese, salad and yellow waxed beans have a ‘Low GI’ and, in a footnote, further add: ‘...no data are available but GI probably <30’. This represents a fundamental error about the definition of the GI. Foods which do not raise blood glucose do not necessarily have a low GI. The GI is an index of the blood glucose raising potential of the glycaemic carbohydrate in foods (Food and Agriculture Organization/United Nations University/World Health Organization, 1998). Thus, the term ‘low-GI food’ is normally used to describe high-carbohydrate foods. Foods containing no carbohydrate do not have a GI. Foods containing only a small amount of carbohydrate theoretically could have a GI, but because they do not contain enough carbohydrate to raise blood glucose, it is difficult in practice to determine the GI. Since cheese, salad and yellow waxed beans contain very little carbohydrate, it is not meaningful to describe them as low GI. The available carbohydrate in cheese, lactose, has a low GI (Wolever *et al.* 1985), and so there is at least some justification in calling it a low-GI food. However, I do not know what glycaemic carbohydrates are contained in salad and yellow beans, though I would guess that it was glucose (high GI). Nevertheless, diet GI is not affected appreciably whether these foods are considered to have high or low GI, because they contain little glycaemic carbohydrate.

I estimated the GI of the sample diets using previously described methods (Wolever *et al.* 1994b). For fresh fruits, I used apple. I took the GI value of unsweetened jam to be 61. The weights of foods was based on common portion sizes, adjusted so as to result in total food weight and intakes of energy, fat, protein, carbo-

\*All glycaemic index values quoted in this article are given on the glucose standard, i.e. the glycaemic index of glucose = 100.

**Table 1.** Weight of food, and energy and macronutrient content of diets based on sample menus provided by Dumesnil *et al.* (2001) and used to calculate diet glycaemic index

	AHA diet*	Low-GI–low-fat–high-protein diet†
Weight of food (g)	2244	2078
Energy (kJ)	11695	8815
Protein (% energy)	15	31
Fat (% energy)	30	32
Carbohydrate (% energy)	55	37
Dietary fibre (g)	26	29
Glycaemic index (%)	62.9	61.4

AHA, American Heart Association GI, glycaemic index.

\*Krauss *et al.* (1996).

†Dumesnil *et al.* (2001).

hydrate and fibre which were the same as the average values for the diets given in Table 1 of Dumesnil *et al.* (2001). The estimated GI values of the two diets are very similar (Table 1). The resulting values may be imprecise because of missing information about the type and amounts of foods in the sample menus, and the need to estimate GI values for several foods. Nevertheless, there is no evidence from this calculation that the low-GI diet actually had a low GI.

Thus, it is not possible to ascribe any of the effects Dumesnil *et al.* (2001) observed to differences in GI. I would not be so concerned if the authors had referred to their experimental diet as a Montignac diet in the title and conclusions of their paper. However, for such a reputable research group to attribute their results, even in part, to the GI does damage by contributing to the wealth of erroneous information and unsubstantiated claims about the GI which already exist, promulgated by those who are not experts in the field.

Thomas M. S. Wolever

Department of Nutritional Sciences  
University of Toronto  
Toronto  
Ontario M5S 3E2  
Canada

## References

- Dumesnil JG, Turgeon J, Tremblay A, Poirier P, Gilbert M, Gagnon L, St-Pierre S, Garneau C, Lemieux I, Pascot A, Bergeron J & Després J-P (2001) Effect of a low-glycaemic index–low-fat–high protein diet on the atherogenic metabolic risk profile of abdominally obese men. *British Journal of Nutrition* **86**, 557–568.
- Food and Agriculture Organization/United Nations University World Health Organization (1998) *Carbohydrates in Human Nutrition*. Rome: FRAO.
- Foster-Powell K & Brand Miller J (1995) International tables of glycemic index. *American Journal of Clinical Nutrition* **62**, 871S–893S.
- Jenkins DJA, Wesson V, Wolever TMS, Kalmusky J, Giudici S, Csima A, Josse RG & Wong GS (1988) Wholemeal versus wholegrain breads: proportion of whole or cracked grain and the glycaemic response. *British Medical Journal* **297**, 958–960.
- Jenkins DJA, Wolever TMS, Jenkins AL, Giordano C, Giudici S, Thompson LU, Kalmusky J, Josse RG & Wong GS (1986) Low glycemic response to traditionally processed wheat and rye products: bulgur and pumpnickel bread. *American Journal of Clinical Nutrition* **43**, 516–520.
- Jenkins DJA, Wolever TMS, Jenkins AL, Thorne MJ, Lee R, Kalmusky J, Reichert R & Wong GS (1983a) The glycaemic index of foods tested in diabetic patients: a new basis for carbohydrate exchange favouring the use of legumes. *Diabetologia* **24**, 257–264.
- Jenkins DJA, Wolever TMS, Jenkins AL, Lee R, Wong GS & Josse RG (1983b) Glycemic response to wheat products: reduced response to pasta but no effect of fiber. *Diabetes Care* **6**, 155–159.
- Krauss RM, Deckelbaum RJ, Ernst N, Fisher E, Howard BV, Knopp RH, Kotchen T, Lichtenstein AH, McGill HC, Pearson TA, Prewitt TE, Stone NJ, Horn LU & Weinberg R (1996) Dietary guidelines for healthy American adults. A statement for health professionals from the Nutrition Committee. *American Heart Association Circulation* **94**, 1795–1800.
- Wolever TMS, Cohen Z, Thompson LU, Thorne MJ, Jenkins MJA, Prokipchuk EJ & Jenkins DJA (1986) Ileal loss of available carbohydrate in man: comparison of a breath hydrogen method with direct measurement using a human ileostomy model. *American Journal of Gastroenterology* **81**, 115–122.
- Wolever TMS, Wong GS, Kenshole A, Josse RG, Thompson LU, Lam KY & Jenkins DJA (1985) Lactose in the diabetic diet: a comparison with other carbohydrates. *Nutrition Research* **5**, 1335–1345.
- Wolever TMS, Jenkins DJA, Jenkins AL, Vuksan V, Wong GS & Josse RG (1988) Effect of ripeness on the glycaemic response to banana. *Journal of Clinical Nutrition and Gastroenterology* **3**, 85–88.
- Wolever TMS, Katzman-Relle L, Jenkins AL, Vuksan V, Josse RG & Jenkins DJA (1994a) Glycaemic index of 102 complex carbohydrate foods in patients with diabetes. *Nutrition Research* **14**, 651–669.
- Wolever TMS, Nguyen PM, Chiasson J-L, Hunt JA, Josse RG, Palmason C, Rodger NW, Ross SA, Ryan EA & Tan MH (1994b) Determinants of diet glycemic index calculated retrospectively from diet records of 342 individuals with non-insulin-dependent diabetes mellitus. *American Journal of Clinical Nutrition* **59**, 1265–1269.
- Wolever TMS, Vuksan V, Katzman-Relle L, Jenkins AL, Josse RG, Wong GS & Jenkins DJA (1993) Glycaemic index of some fruits and fruit products in patients with diabetes. *International Journal of Food Sciences and Nutrition* **43**, 205–212.

DOI: 10.1079/BJN2002603