

Nutrition Discussion Forum

Minor importance of de novo lipogenesis on energy expenditure in human

We read the letter of Chwalibog and Thorbek concerning energy expenditure by *de novo* lipogenesis, with interest (Chwalibog & Thorbek, 2001), but note that they seem to have misunderstood the conclusions of our article published in the *American Journal of Physiology* (Acheson *et al.* 1984). The subjects in our study were not overfed carbohydrate, but received a breakfast containing 8.37 MJ (2000 kcal) in the form of carbohydrate (approximately equal to their daily resting energy requirements). The results obtained by indirect calorimetry measurements during the following 9 h demonstrated that very little *de novo* lipogenesis took place. We therefore concluded that only negligible amounts of *de novo* lipogenesis would occur under normal dietary conditions, when a mixed diet is consumed. These conclusions have since been supported by a series of studies by Hellerstein's group, who measured fractional turnover rates by labelling the hepatic fatty acid precursor pool (Hellerstein *et al.* 1991; Hellerstein, 1999).

When human subjects were overfed large amounts of carbohydrate during several consecutive days, however, substantial *de novo* lipogenesis was induced, leading to the transformation of some 475 g carbohydrate into 150 g lipid by the 7th day (Acheson *et al.* 1988). Indirect calorimetry measurements were performed over 24 h in a respiratory chamber and daily energy expenditures and C and N balances could be determined in this study. In discussing its results, we addressed the question of the thermic effect of *de novo* lipogenesis. We observed a 35% increase in energy expenditure, which was considerably higher than the prediction based on the theoretical value of 25% for the cost of *de novo* lipogenesis % (Flatt, 1978; Acheson *et al.* 1988). However, this assessment could have been confounded to some extent by the experimental conditions, as the subjects were consuming such large quantities of carbohydrate that their energy expenditure rarely, if ever, returned to basal levels.

The energy cost of synthesizing fat from glucose and depositing it in adipose tissue is considerable, but ATP expenditures are substantially lower during fat than during glucose oxidation (Flatt & Tremblay, 1997). If synthesis of fat from glucose and the oxidation of an equivalent amount of fat are considered together, the substrate handling costs are in effect hardly greater than those incurred during the direct oxidation of glucose (Flatt & Tremblay, 1997). Thus one can expect that energy expenditure is raised appreciably by *de novo* lipogenesis only when lipid is being synthesized from carbohydrate and retained. In subjects eating *ad libitum*, however, the synthesis of fat, which may be initiated by the occasional consumption of even uncommonly large amounts of carbohydrate, is not sufficient to offset the amounts of fat oxidized during the rest of the day (Acheson *et al.* 1982). Under conditions of approximate energy balance, *de novo*

lipogenesis is thus very unlikely to have a demonstrable effect in raising 24 h energy expenditure.

As Chwalibog and Thorbek point out, *de novo* lipogenesis may be an important consideration for animal husbandry, where feed efficiency is an important consideration. However, feed efficiency is hardly an important issue in man and *de novo* lipogenesis a rather limited process. Thus, one might indeed wonder how important it may be to know the exact impact of *de novo* lipogenesis on energy expenditure in man.

References

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