LETTER

Reply to Wollstonecroft et al.: Cooking increases the bioavailability of starch from diverse plant sources

We thank Wollstonecroft et al. for supporting the evidence that not all calories are equal (1). We found that the bioavailability of calories from lean beef (*Bos taurus*) and sweet potato (*Ipomoea batatas*) increased with food processing (2). For both foods, cooking had a larger impact on bioavailability than pounding, and when these processing methods were applied in combination, cooking improved a pounded diet whereas pounding did not improve a cooked diet. Our findings emphasize that the biochemical assays used in the production of modern nutrition labels do not fully account for the energetic significance of food processing. Such assays ignore important costs of the digestive process that are typically lowered by processing, including diet-induced thermogenesis and nutrients metabolized by gut bacteria instead of the human host.

Wollstonecroft et al. observe that compared with sweet potato tubers, other starch-rich plant foods might respond in different ways to cooking and/or nonthermal processing (1). We agree. However, we also note much evidence in favor of a uniquely important effect of cooking in improving the bioavailability of starch from diverse plant sources (e.g., tubers and other root vegetables, cereals, pulses, legumes, and fruits such as plantain) (3, 4). Wollstonecroft et al. drew particular attention to species variation in the propensities of cell walls to rupture and separate during processing. Unusually, for example, heating inhibits cell separation in cassava (*Manihot esculenta* Crantz). Although we acknowledge variation among plants in such responses, even in the case of cassava the bioavailability of starch has been found to rise with cooking (5). We look forward to studies of the effects of food processing in many plant and animal foods other than the tubers and ungulate meat that we selected on the basis of the high importance of such items in human evolution.

Wollstonecroft et al. stress that thermal and nonthermal processing methods can complement one another to promote bioaccessibility (1), much as we reported previously (2, 6). For example, they suggest that cooked legumes often require secondary nonthermal processing to disrupt cell walls (although we hypothesize that mastication could also fulfill this purpose in vivo). Certainly thermal and nonthermal processing do interact in complex ways requiring empirical assessment, which is why the four treatments in our experimental design (raw/whole, raw/pounded, cooked/whole, and cooked/pounded) were chosen to allow explicitly for the evaluation of complementarity and interaction between effects of cooking and pounding. Our finding that body mass outcomes, controlling for intake and activity, were significantly higher on cooked/pounded treatments compared with raw/pounded treatments demonstrates that cooking and pounding led to greater bioavailability in combination. Importantly, however, body mass outcomes did not differ across cooked/pounded and cooked/whole treatments. This strengthens our conclusion that cooking played a uniquely important role in promoting energy gain in our model food items.

We thank Wollstonecroft et al. for their valuable work on the physiochemical effects of food processing, and we hope that our combined publications stimulate broader interest in the contributions of food processing to human energy budgets in the past and present.

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The authors declare no conflict of interest.

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