Effect of mastication on lipid bioaccessibility of almonds in a randomized human study and its implications for digestion kinetics, metabolizable energy, and postprandial lipemia.

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Abstract:

Background: The particle size and structure of masticated almonds have a significant impact on nutrient release (bioaccessibility) and digestion kinetics. Objectives: The goals of this study were to quantify the effects of mastication on the bioaccessibility of intracellular lipid of almond tissue and examine microstructural characteristics of masticated almond. Design: In a randomized, subject-blind, crossover trial, 17 healthy subjects chewed natural almonds (NAs) or roasted almonds (RAs) in 4 separate mastication sessions. Particle size distributions (PSDs) of the expectorated boluses were measured by using mechanical sieving and laser diffraction (primary outcome). The microstructure of masticated almonds, including the structural integrity of the cell walls (i.e., dietary fiber), was examined with microscopy. Lipid bioaccessibility was predicted by using a theoretical model, based on almond particle size and cell dimensions, and then compared with empirically derived release data. Results: Intersubject variations (n = 15; 2 subjects withdrew) in PSDs of both NA and RA samples were small (e.g., laser diffraction; CV: 12% and 9%, respectively). Significant differences in PSDs were found between these 2 almond forms (P, 0.05). A small proportion of lipid was released from ruptured cells on fractured surfaces of masticated particles, as predicted by using the mathematical model (8.5% and 11.3% for NAs and RAs, respectively). This low percentage of lipid bioaccessibility is attributable to the high proportion (35–40%) of large particles (.500 mm) in masticated almonds. Microstructural examination of the almonds indicated that most intracellular lipid remained undisturbed in intact cells after mastication. No adverse events were recorded. Conclusions: Following mastication, most of the almond cells remained intact with lipid encapsulated by cell walls. Thus, most of the lipid in masticated almonds is not immediately bioaccessible and remains unavailable for early stages of digestion. The lipid encapsulation mechanism provides a convincing explanation for why almonds have a low metabolizable energy content and an attenuated impact on postprandial lipemia.