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Commentary

Unexpected Outcomes for a High-foliage Diet

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DESCRIPTION

A 2022 review of lipid nutrition had an unexpected prediction that plant-based diets of non-captive primates may give a tissue balance of n-3 and n-6 Highly Unsaturated Fatty Acids (HUFA) like that seen in blood lipids of people eating traditional Inuit and Japanese foods [1]. This is significant because lower proportions of n-6 in HUFA (i.e., higher proportions of n-3) in blood lipids of such people associate with a lower risk for cardiovascular disease and death [1]. As a result, supplemental n-3 HUFA is widely used to modify the high-risk "Western" diet and lower the Health Risk Assessment (HRA) biomarker, %n-6 in blood HUFA. The review explores the concept that "healthy normal diets" balance intake and expenditure of food energy and balance proportions of n-3 and n-6 HUFA in tissues.

An empirical equation was developed to fit observed hyperbolic, competitive patterns of HUFA accumulation by rats, mice and human volunteers in Chicago and Japan [2]. Overall, it successfully predicted the diet-induced HUFA balance for nearly 4,000 people in 92 subject groups in 34 published studies from 11 different countries [3]. The enzyme dynamics for forming HUFA by the elongation-desaturation pathway appear to be highly conserved since primates and rodents diverged from mammalian precursors 50 million years ago. This retention allows controlled diet-tissue studies with small rodents or primates to serve as surrogates for the likely HRA biomarker produced in an unlikely process of asking human volunteers to eat a single daily diet for prolonged periods.

Importantly, high-foliage diets of primates have nearly equal intakes of 18:2n-6 and 18:3n-3 with negligible amounts of n-3 or n-6 HUFA which animal tissues form from ingested 18:2n-6 and 18:3n-3 Polyunsaturated Fatty Acids (PUFA; 2). The essential n-3 and n-6 PUFA nutrients compete more efficiently than endogenous n-9 acids for the desaturation and elongation enzymes that produce and accumulate tissue HUFA [1]. Growth of rat pups increased as dietary PUFA increased from 0% to 1% of food energy (1 en%) and it related to the proportion of n-3 and/or n-6 in HUFA accumulated in tissues. Eating 0.1 en% PUFA gave about half of the maximum response and more than 1 en% PUFA did not further increase the growth or the proportion of its derived HUFA in tissues.

The 2022 review describes how embedding the equation in a relational database, https://omegameals.com, facilitates predicting tissue HRA values likely to result from eating selected combinations of food items [1]. The balance among eleven n-3 and n-6 nutrients in each food item summarize as a single Omega 3-6 Balance Food Score needed to predict the likely HRA score for the overall daily diet [4]. Scores for over 5,000 food items listed at https://omega3scores.com guide alternate food choices for "repair" of diets and recipes. The OmegaMeals.com software allows *in silico* studies to guide food choices which produce a HRA marker that can be confirmed by direct lipid analysis. Values are familiar examples of food intakes and HUFA balances seen with USA volunteers; 42 en% fat, 10 en% 18:2n-6, 2 en% 18:3n-3 and a HRA value of 79%. The low HRA value of 27% for a prototypic hominid primate was unexpected.

Fatty acids were 14 en% in the diet of non-captive mountain gorillas; mostly 18:2n-6 (30%), 18:3n-3 (21%) and 16:0 (24%) [5]. Herbaceous leaves had more n-3 than n-6 and fruits had much more n-6 than n-3. The prototypic diet suggests that evolving hominid primates may have eaten foods dramatically different from current Daily Nutritional Goals in 2020–2025 Dietary Guidelines for Americans [6]. The advice for Americans to eat 10-fold more 18:2n-6 than 18:3n-3 has no accompanying supportive rationale or interventional evidence of benefit. It contrasts with the fact that higher %n-6 in human tissue HUFA associates with higher risk for chronic cardiovascular and immune-inflammatory disorders.

There may be merit in developing experiments with small primates or closely related rodents (e.g., guinea pigs) eating high-foliage diets. The recommended guinea pig food, timothy hay,

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probably gives a low HRA value like that seen for humans eating "anti-inflammatory" diets. We need to learn more about new combinations of food items that humans may find more rational, desirable and healthier than current diets labelled as "vegetarian", "Mediterranean", or "paleolithic".

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COMPETING INTEREST

The authors declare that they have no competing interests.

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