Critique on equations of net endogenous acid production (NEAP) and indirect proof of constant organic acid excretion

Dear Sir:

In their recent article, Ströhle et al (1) address acid-base balance of diets in the light of historical hunter-gatherer lifestyles using formulas as developed by Kleinman and Lehmann (2) and as used by Sebastian et al (3), which have been under recent criticism, especially in regard to the organic acid component (4). Without referring to this criticism, the authors have made an effort to justify the formulas exactly on points criticized, but not in clear elucidation of the shortcomings of the formulas but a continued justification.

The authors state that the organic component is predictable from the unmeasured anion content (mEq/d) of the diet. In other words, diet is the determinant in estimating “organic acid production” (2, 3), a historical term also under indirect criticism (4), with which the authors make an apparently minor semantic correction and replace it with “organic acid excretion,” with the explanation that organic anions are metabolized to bicarbonate when not excreted. That is to say that the formula, even if developed for endogenous “organic acid production” (2), disregards the partial coefficient of endogenous organic acid production in capturing only the dietary partial coefficient of organic acid excretion and hence overestimates the alkalinity of a net alkaline diet (4). That is, the formula works but only when the diet is net acid producing and estimates not “organic acid production” but “organic acid excretion” on net acid-producing diets (4) in an adult age group (ie, inadequate for children and adolescents) (5) and within a broad definition of health (4).

Independent studies have reliably shown that there is organic acid excretion even on net alkaline diets (6, 7). This has been explained by a ketoacid production-excretion on net alkaline diets, although not on net acid diets (7, 8), which would allow constant organic acid production corrected for body size (4, 5, 9), regardless of whether the diet is net alkaline or acidic (4, 6–8). Instead of accepting the limitation of this formula (4), the authors provide a convoluted correction by defining 4 whole-body fat percentages—3%, 10%, 15%, and 20%—in reference to net acid excretion (NAE) as indexed by net endogenous acid production (NEAP). In effect, the authors state that as fat increases, the coefficient of plant to animal food decreases; in other words, NEAP decreases. Indeed, the authors undertake a covert correction for the unaccounted endogenous ketoacid production (4) without ever stating it. A retraction from an earlier original research finding (3), which reported that most hunter-gatherer diets were net alkali producing, to presently report in this study the very opposite, ie, that most hunter-gatherer diets would have been net acid producing, not once attending to the basic flaw in the formulas (4) that led to 2 completely different study results, is a bit mistaken. Furthermore, the use of artificial terminology such as plant-to-animal food ratio, at least in terms of core acid-base dynamics, is also misleading: it would be enough to call it food. Finally, the observation of a relatively constant intercept value for the authors’ published equations 3, 4, 5, and 6 hints at a constant organic acid excretion corrected for body surface area (4–6, 9). I thank the authors for providing the proof for which I have been working.

The author reported no conflicts of interest.

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Reply to S Berkemeyer

Dear Sir:

We thank Berkemeyer for calling attention once again to the question of how to compute, from diet composition data, the contribution of endogenous organic acid production (EOAP) to net endogenous acid production (NEAP). We take the opportunity to call the readers’ attention to our previous detailed explanation that EOAP’s contribution to daily NEAP depends on the amount of organic anions excreted daily in the urine, those excreted organic anions representing organic acids endogenously produced that the body does not metabolize to carbon dioxide and water and whose conjugate bases (organic anions) excreted in the urine must have left retained an equivalent amount of hydrogen ion as a component of NEAP (1). Inasmuch as experimental data indicate that diet composition modulates the rate of organic anion excretion (2–5), we remain skeptical of Berkemeyer’s premise that the contribution of EOAP to NEAP depends only on body size across all diets, net acid– and base–producing diets. We made our best estimate at organic anion excretion rate from experimental data showing that this rate in the steady state can be estimated from the so-called unmeasured anion content of the diet (3).

On another note, we maintain that the results of our current study (6), showing that substantial numbers of historically studied, living hunter-gatherer societies consume net acid–producing diets, do not necessarily conflict with those of our earlier study (7), which estimated that Homo sapiens’ ancestral lineage of hunter-gatherer societies consumed predominantly net base–producing diets. We have pointed out that the former are distributed worldwide and are characterized by high intercultural differences in eating behavior, whereas the latter lived for millions of years in East Africa. Moving out of Africa and distributing worldwide would likely entail consumption of novel diet patterns, as exemplified in the extreme by arctic hunter-gatherer societies (8). Indeed, as Marlowe (9) pointed out, it seems that “Holocene foragers represent a new niche that appeared only with the climatic changes and faunal depletion at the end of the last major glaciation.” Thus, it is necessary to distinguish between the dietary patterns of modern and our ancestral hunter-gatherers. The penultimate paragraph of the Discussion in our current article elaborates the argument (6). In their editorial commenting on our current article, Eaton et al (10) also make that point.

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