COMMENTS

Misunderstandings Regarding Carbohydrates in Human Nutrition

Steve L. Martin

In a recent issue of American Antiquity*, two articles (Gill et al. 2021; Lyons et al. 2021) perpetuate the common misconception that dietary carbohydrates are an essential component of the human diet and that plants—the main source of dietary carbohydrates—must be consumed to promote health. In fact, carbohydrate is a nonessential macronutrient with adequate amounts of energy—the sole function of carbohydrates in the human diet—being produced via gluconeogenesis and ketogenesis in the absence of dietary carbohydrate. Additionally, both articles erroneously employ the term "dietary staple" in reference to geophyte consumption.*

Keywords: human nutrition, carbohydrates, geophytes, dietary staple, stable isotope analysis

En un número reciente de American Antiquity*, dos artículos (Gill et al. 2021; Lyons et al. 2021) perpetúan la idea errónea de que los carbohidratos dietéticos son un componente esencial de la dieta humana y que las plantas, la principal fuente de carbohidratos de la dieta, deben ser consumido para promover la salud. De hecho, los carbohidratos son un macronutriente no esencial con cantidades adecuadas de energía, la única función de los carbohidratos en la dieta humana, se produce a través de la gluconeogénesis y cetogénesis en ausencia de carbohidratos en la dieta. Además, ambos artículos emplean erróneamente el término "alimento básico" en referencia al consumo de geófitas.*

Palabras clave: nutrición humana, carbohidratos, geófitos, alimento básico, análisis de isótopos estables

Two articles in a recent issue of *American Antiquity* explicitly (Gill et al. 2021) and implicitly (Lyons et al. 2021) perpetuate a common misconception concerning human nutrition. Both articles argue the need for carbohydrates in the human diet. Additionally, both erroneously employ the term "dietary staple" in reference to geophyte consumption.

Gill and colleagues (2021) examine archaeobotanical remains from a site (CA-SRI-997/H) on the Northern Channel Island of Santa Rosa, California, to argue an early (11,450 cal BP) use of geophytes (*Brodiaea*-type corms and *Calochortus* bulbs) by the inhabitants. Lyons and colleagues (2021) discuss the discovery of a wapato (*Sagittaria latifolia*) garden of a site (DhRp-52) near the Fraser River, approximately 20 km from the coast of British Columbia.

According to Gill and colleagues, "rich in carbohydrates, geophytes were important in many coastal areas where protein-rich marine foods are abundant. On California's Channel Islands, scholars have long questioned how maritime peoples sustained themselves for millennia with limited plant resources" (2021:625). After a discussion of experimental return rates (measured as kcal/hr), Gill et alia (2021:634) argue that marine resources provided abundant energy for the Islanders and that "the caloric value of starchy plant foods may not be the primary factor in foraging decisions." Consequently, plant-derived carbohydrates played other dietary roles in

Steve L. Martin (slmartin9@verizon.net) ■ Cotsen Institute of Archaeology, University of California, Los Angeles, CA, USA

American Antiquity 87(3), 2022, pp. 611–613
Copyright © The Author(s), 2022. Published by Cambridge University Press on behalf of the Society for American Archaeology
doi:10.1017/aaq.2022.4

https://doi.org/10.1017/aaq.2022.4 Published online by Cambridge University Press

addition to being an energy substrate. What is the important role in this instance? We are informed, without citation, that carbohydrates are essential for metabolizing meat derived from marine sources (Gill et al. 2021:634). Surprisingly, carbohydrate return rates are then calculated for *Brodiaea*-type corms and are shown to be well over the recommended daily requirement (as indicated by the dietary reference intakes of the Institute of Medicine) and the authors state "that the carbohydrate value of geophytes was critical to Islander diets" (Gill et al. 2021:634). Subsequently, Gill and colleagues (2021:634) characterize "geophytes as a rich source of carbohydrates and calories" and, in conclusion, inform us that "such carbohydrate-rich plant foods can be an optimal solution to meeting energy, protein, and essential micronutrient requirements." Throughout, geophytes are described as a staple food.

Lyons and colleagues (2021:506) state that "root foods, which supplied vital nutrients and carbohydrates to Northwest Coast communities, were highly sought-after trade commodities and dietary staples." After calculating production rates, they argue that the geophytes in question made up "a significant contribution to the diet of residents and likely neighboring communities" (Lyons 2021:509). Later, they characterize geophytes as "carbohydrate rich, non-grain resources" (Lyons 2021:515).

Carbohydrates exclusively function in energy (typically measured in calories) production and storage in human metabolism. Carbohydrate is a nonessential macronutrient (Harper 1999) with adequate amounts of energy being produced via gluconeogenesis and ketogenesis in the absence of dietary carbohydrate (Cahill 1970). There is no carbohydrate deficiency syndrome in humans, and animal studies in which dietary carbohydrates are effectively eliminated do not suffer negative health consequences (e.g., Kennedy et al. 2007; Pichon et al. 2006; Renner and Elcombe 1967). Dietary fiber, a carbohydrate, resists human digestion and absorption; therefore, it is not considered a nutrient. Furthermore, the absence of a dietary-fiber deficiency syndrome in humans precludes it from being considered essential in any sense.

As the Arctic ethnologist Vilhjálmur Stefánsson conclusively demonstrated, humans do not need to consume plants, the main source of carbohydrates in most human diets, to survive. Stefánsson subsisted on nothing but animal products for an aggregate of nine years during 11 years of polar explorations (Stefánsson 1913, 1921) without ill effect (Leib 1926). To allay the skeptical concerns of colleagues, Stefánsson and fellow arctic explorer Karsen Anderson submitted themselves to a supervised experiment in which they ate nothing but animal products for one year, after which there was no evidence that either man suffered any negative health effects (e.g., Lieb 1929; McClellan and Du Bois 1930).

A food is considered a staple if it supplies a majority of a population's annual energy and nutrient needs. Stable isotope analyses for prehistoric populations on the California Channel Islands, which span the past 8,000 years, conclusively demonstrate that marine resources (namely, finfishes and shellfish) consistently provided the majority (>80%) of protein in the diet (e.g., Fauvelle and Somerville 2021; Goldberg 1993; Harrison and Katzenberg 2003; Rick et al. 2011; Schober and Molto 2011; Walker and DeNiro 1986). Likewise, stable isotope analyses for prehistoric coastal populations of British Columbia, including the Fraser River delta, which span the past 6,000 years, indicate that marine resources (namely, salmon and marine mammals) consistently provided nearly all (>95%) of the protein in the diet (e.g., Cannon et al. 1999; Chisholm et al. 1982, 1983; Schwarcz et al. 2014). Therefore, to argue any terrestrial food resource as a dietary staple for either of the peoples in question here is erroneous.

The archaeobotanical evidence clearly indicates the production and collection of geophytes by the populations in question. They had cultural significance, possibly as a trade item; however, in terms of nutrition, their role was insignificant, and geophytes cannot be characterized as a dietary staple. It may seem trivial to call into question the use of a term such as "dietary staple." However, one of the hallmarks of scientific objectivity is the unambiguous use of terminology, either defined directly or through citation, to avoid purely semantic disputes and allow for the logical analysis of hypotheses.

https://doi.org/10.1017/aaq.2022.4 Published online by Cambridge University Press

Acknowledgments. No permits were needed for this research.

Data Availability Statement. No original data were presented in this comment.

References Cited

Cahill, George F., Jr.
1970 Starvation in Man. *New England Journal of Medicine* 282:668–675.

Cannon, Aubrey, Henry P. Schwarcz, and Martin Knyf
1999 Marine-Based Subsistence Trends and the Stable Isotope Analysis of Dog Bones from Namu, British Columbia. *Journal of Archaeological Science* 26:399–407.

Chisholm, Brian S., D. Erle Nelson, and Henry P. Schwarcz
1982 Stable-Carbon Isotope Ratios as a Measure of Marine versus Terrestrial Protein in Ancient Diets. *Science* 216:1131–1132.
1983 Marine and Terrestrial Protein in Prehistoric Diets on the British Columbia Coast. *Current Anthropology* 24:396–398.

Fauvelle, Mihael, and Andrew D. Somerville
2021 Spatial and Temporal Variation in Fisher-Hunter-Gatherer Diets in Southern California: Bayesian Modeling Using New Baseline Stable Isotope Values. *Quaternary International* 601:36–48.

Gill, Kristina M., Todd J. Braje, Keven Smith, and Jon Erlandson
2021 Earliest Evidence for Geophyte Use in North America: 11,500-Year-Old Archaeobotanical Remains from California's Santarosae Island. *American Antiquity* 86:625–637.

Goldberg, Carol F.
1993 The Application of Stable Carbon and Nitrogen Isotope Analysis to Human Dietary Reconstruction in Prehistoric Southern California. PhD dissertation, Department of Anthropology, University of California, Los Angeles.

Harper, Alfred E.
1999 Defining the Essentiality of Nutrients. In *Modern Nutrition in Health and Disease*, edited by Maurice E. Shils, James A. Olson, Moshe Shike, and A. Catharine Ross, pp. 3–10. Lippincott Williams & Wilkins, Baltimore.

Harrison, Roman G., and M. Anne Katzenberg
2003 Paleodiet Studies Using Stable Carbon Isotopes from Bone Apatite and Collagen: Examples from Southern Ontario and San Nicolas Island, California. *Journal of Anthropological Archaeology* 22:227–244.

Kennedy, Adam R., Pavlos Pissios, Hasan Otu, Bingzhong Xue, Kenji Asakura, Noburu Furukawa, Frank E. Marino, et al.
2007 A High Fat, Ketogenic Diet Induces a Unique Metabolic State in Mice. *American Journal of Physiology Endocrinology Metabolism* 292:E1724–1739.

Lieb, Clarence W.
1926 The Effects of an Exclusive, Long-Continued Meat Diet. *Journal of the American Medical Association* 87:25–26.
1929 The Effects on Human Beings of a Twelve Months' Exclusive Meat Diet. *Journal of the American Medical Association* 93:20–22.

Lyons, Natasha, Tanja Hoffmann, Debbie Miller, Andrew Martindale, Kenneth M. Ames, and Michael Blake
2021 Were the Ancient Coast Salish Farmers? A Story of Origins. *American Antiquity* 86:504–525.

McClellan, Walter S., and Eugene F. Du Bois
1930 Clinical Calorimetry: XLV. Prolonged Meat Diets with a Study of Kidney Function and Ketosis. *Journal of Biological Chemistry* 87:651–668.

Pichon, Lisa, Jean-François Huneau, Gilles Fromentin, and Daniel Tomé
2006 A High-Protein, High-Fat, Carbohydrate-Free Diet Reduces Energy Intake, Hepatic Lipogenesis, and Adiposity in Rats. *Journal of Nutrition* 136:1256–1260.

Renner, Ruth, and A. M. Elcombe
1967 Metabolic Effects of Feeding "Carbohydrate-Free" Diets to Chicks. *Journal of Nutrition* 93:31–36.

Rick, Torben C., Brendan J. Culleton, Carley B. Smith, John R. Johnson, and Douglas J. Kennett
2011 Stable Isotope Analysis of Dog, Fox, and Human Diets at a Late Holocene Chumash Village (CA-SRI-2) on Santa Rosa Island, California. *Journal of Archaeological Science* 38:1385–1393.

Schober, Teresa M., and J. Eldon Molto
2011 Marine Resource Consumption in Ancient California. *Pacific Coast Archaeological Society Quarterly* 45(1/2):31–47.

Schwarcz, Henry P., Brian S. Chisholm, and Meghan Burchell
2014 Isotopic Studies of the Diet of the People of the Coast of British Columbia. *American Journal of Physical Anthropology* 155:460–468.

Stefánsson, Vilhjálmur
1913 *My Life with the Eskimo*. Macmillan, New York.
1921 *The Friendly Arctic: The Story of Five Years in Polar Regions*. Macmillan, New York.
1946 *Not by Bread Alone*. Macmillan, New York.

Walker, Phillip L., and Michael J. DeNiro
1986 Stable Nitrogen and Carbon Isotope Ratios in Bone Collagen as Indices of Prehistoric Dietary Dependence on Marine and Terrestrial Resources in Southern California. *American Journal of Physical Anthropology* 71:51–61.

Submitted October 13, 2021; Accepted November 23, 2021

https://doi.org/10.1017/aaq.2022.4 Published online by Cambridge University Press