

isolated platinum atoms on oxide supports bind CO too strongly to be active. Rather, the authors find that metallic platinum sites on nanoparticles catalyze the reactions. Framing these results in terms of the coordination number, single platinum atoms correspond to the strong-binding regime at the left of the figure. The more highly coordinated sites on small nanoparticles are closer to the apex of the figure.

In contrast to previous work (9), Ding *et al.*'s results suggest small metallic Pt nanoparticles, rather than isolated Pt atoms, give rise to enhanced catalysis of CO. The applicability of these findings will depend on the elemental composition of the catalyst and electronic interactions between the support and the metal. For example, unlike platinum, making gold catalytically active requires atomically dispersed atoms rather than larger nanoparticles (15). Further work is needed to identify which exact sites on platinum nanoparticles (for example, terrace, edge, kink, or corner sites) are active for CO oxidation and water-gas shift catalysis. Of particular interest is the exploration of relationships between the rates of the CO oxidation/water-gas shift reactions on platinum and the generalized coordination number introduced by Calle-Vallejo and co-workers (see the figure).

The implications of reaction rate sensitivity to coordination number for heterogeneous catalysis are both subtle and far-reaching. The rational design of catalysts for heterogeneous processes requires a detailed understanding of the interplay of both the electronic structure of the catalyst surface and its local coordination environment. The insights described in (1, 2) highlight the immense opportunities for catalyst discovery and improvement provided by detailed understanding of the nature of active sites. ■

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FOOD SCIENCE

Designing a sustainable diet

Sustainability as dietary guidance created political debate

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In the United States, a vigorous debate is under way over government-issued dietary guidance. A February 2015 report by the U.S. Dietary Guidelines Advisory Committee (DGAC) recommended, for the first time, that food system sustainability be an integral part of dietary guidance in the 2015 Dietary Guidelines for Americans (DGAs) (1). With the final decision from the secretaries of Health and Human Services (HHS) and of Agriculture (USDA) about what parts of the DGAC recom-

POLICY mendations to include in the 2015 DGAs expected at the end of this year, we discuss the need to incorporate sustainability into dietary guidelines and the political maneuvering under way to excise it.

DGAs, which are updated every 5 years, have consistently recommended a diet higher in plant-based foods and lower in animal-based foods. This year DGAC concluded that “consistent evidence” suggests that such a dietary pattern is not only more healthful but also is associated with less environmental impact than the average American diet (1). This rationale has ignited controversy (2).

Dietary guidelines are not unique to the United States. The United Nations Food and Agriculture Organization (FAO) posts dietary guidelines by 67 national governments. The purpose of such guidance historically has been to educate people on how to avoid malnutrition. In the United States, DGAs are important information for nutrition professionals. Skeptics argue that DGAs are largely inconsequential. Adherence is problematic; only 4% of Americans meet DGAs, and

fewer than 40% of American adults meet the healthy weight recommendation (1, 3).

Nevertheless, DGAs have tangible influence on federal programs. DGAs inform meal content for example, for (i) military personnel; (ii) 8.6 million needy Americans served by the Women, Infants, and Children program; and (iii) 31 million children served through the National School Lunch Program. DGAC recommended that the government do a better job aligning fed-



eral nutrition assistance programs [e.g., the Supplemental Nutrition Assistance Program (SNAP)] with DGAs. There are no restrictions on how SNAP benefits can be used, although whether to limit benefits to healthy food purchases has been debated for years. If DGAC's recommendation is upheld, it would affect 47 million SNAP recipients and billions of dollars annually in government spending. The SNAP debate surely contributes to the DGA controversy.

SUSTAINABILITY. FAO defines sustainable diets as those with “low environmental impacts which contribute to food and nutrition security and healthy life for present and future generations” (4). By this or any other definition of sustainability, no

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country has achieved a sustainable diet. Current and emerging dietary patterns threaten human health in developing and developed countries (5, 6) and negatively affect long-term food security (7). It is thus not unreasonable that government-issued dietary guidelines take sustainability into account. The Netherlands, Brazil, and Sweden have already done so. Germany and the United States have active, but unresolved, discussions.

As required by law, the DGAC based its report on scientific evaluations (4, 8). Opponents of the sustainability language assert that DGAC has overstepped its statutory bounds (2). But nothing in the 1990 DGA statute prevents inclusion of sustainability, and the DGAC argument that future food insecurity is predictable without attention to sustainability is relevant and compelling. Pending House and Senate appropriations bills that govern HHS and USDA propose new statutory language that would require the secretaries to consider diet and nutrient intake only, which would prevent sustainability considerations. DGAC sent a letter to

“The U.S. debate has awakened civil society... and has aligned public health and sustainability advocates.”

congressional appropriators protesting this “unduly narrow” restriction, which fails to consider topics already within the scope of DGAs, e.g., guidance on physical activity. It is increasingly likely that Congress will fail to pass these appropriations bills and instead will fund the government through a continuing resolution. Even in that scenario, the congressional language poses a serious challenge to the secretaries of HHS and USDA.

POLITICAL MANUEVERING. We believe the issue of scope is not the overarching concern but a political maneuver to excise sustainability from dietary discussions for four reasons. First, many industry leaders do not want any food disparaged, and a DGA process that evaluates sustainability will likely lead to conclusions that some foods are better than others. Although DGAs are advisory (not mandatory, except as previously described for government programs), the worry is that sustainability evaluations may lead to future regulation. Fear of regulation underlies industry protest of the current U.S. Food and Drug

Administration proposal to require labels for added sugar; industry may see transparency as a step toward a ban, as happened with trans fats.

The meat industry feels especially under attack. Much discussion of sustainable diets has focused on the increase in livestock production that will result from population growth and adoption of Western-style diets by an expanding middle class in the developing world. Whether from a health perspective (e.g., reducing coronary heart disease) or an environmental perspective (e.g., reducing methane emissions and deforestation) the dietary advice is the same: eat less meat (7). But reducing discussion to a meat-focused debate ignores larger points around food production. For example, it takes up to 2.8 liters of water to produce a single “heart-healthy” almond (9). With 80% of the world’s almonds grown in drought-stricken California, should consumers be advised to limit almond consumption and consider alternatives that consume fewer resources?

Second, sustainability has potential to move dietary guidance from a system based on food groups (e.g., fruits, vegetables, and protein) to individual foods within a food group (e.g., chicken versus beef). The environmental footprint may elevate certain foods over others. The Dutch 2011 dietary guidance presented four sustainability-related recommendations, including advice to eat two portions of fish per week (10). However, fishing has sustainability issues, and the recommendation was deemed “ecologically detrimental.” The Dutch Health Council is now evaluating the sustainability of individual fish species, with a new version of the dietary guidance expected this October.

Third, the sustainability discussion has potential to forge new political coalitions. The 2014 Brazilian dietary guidelines were adopted despite food industry protests over the recommendation to avoid ultra-processed food (e.g., chicken nuggets rather than freshly prepared chicken) (11). This bold approach may be attributed to engagement by civil society and the breakdown of the traditional coalition of farmers and agribusiness over ultra-processed food guidance, which garnered farmer support. The U.S. debate has awakened civil society to the potential influence of DGAs beyond food consumption and has aligned public health and sustainability advocates. Although not much difference is expected in 2015, the debate has activated political coalitions that could organize for the next DGA iteration in 2020.

Fourth, and perhaps most important, if the U.S. government adopts the DGAC’s reference to sustainability, it will sanction

and elevate discussion of sustainable diets. The U.S. government has been careful to relegate oversight of organic food to a government marketing program, which makes it safe for politicians to support organic as a matter of consumer choice without having to say whether it is healthier or has fewer environmental impacts than conventionally produced food. By acknowledging benefits of sustainability, the government would open itself up to greater demands for sustainability investments and would signal to consumers that such foods are preferred. Exponential growth in sales of organic, local, and sustainably harvested seafood suggests an appetite for sustainably produced food. People are motivated to change behavior for different reasons. Although shifting dietary choices for health reasons alone has not worked well, some people may be compelled to change diets to achieve sustainability goals.

In addition to the environmental impacts of food production, its economic sustainability must also be considered. The challenge is how to produce the most healthful foods in a way that sustains employment in the agricultural sector and minimizes adverse impacts on the environment. All major constituencies concerned with food security and health must wrestle with sustainability and dietary choices together. It is right and proper for the DGA process to lead the way. ■

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