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Commentary. The big issue is ultra-processing
'Carbs'. The answer

Carlos Monteiro
Centre for Epidemiological Studies in Health and Nutrition
University of São Paulo, Brazil
Biography posted at www.wphna.org
Email: carlosam@usp.br

Introduction

Editor's note

This is the fourth is a serious of commentaries by Carlos Monteiro. Their theme is that when considering food, nutrition and public health, the key factor is not nutrients, and is not foods, so much as what is done to foodstuffs and the nutrients originally contained in them, before they are purchased and consumed.

That is to say, the big issue is food processing – or, to be more precise, the nature, extent and purpose of processing, and what happens to food and to us as a result of processing. Specifically, the big public health problem is 'ultra-processing', as defined in the first commentary published in *WN* last November. This is illustrated and symbolised by the mass-produced double cheese-and-bacon burger above. Such products are made at distance as separate items that are trucked in, assembled, and made ready-to-heat and ready–to-eat in fast food outlets.

In Carlos Monteiro's first commentary the conceptual framework for all the commentaries is outlined, together with evidence that it is above all energy-dense ultra-processed products, including sugared drinks, that are driving the global epidemic of overweight and obesity, with all that follows. It gives the necessary context for the commentaries that follow, including this one here.

Nutrition science is taught and practiced as a biochemical discipline. Practically all nutritionists categorise food in terms of its chemical composition, as do most lay writers. This almost universal perception of nutrition is evident in textbooks and scientific journals, and on food labels, journalism, and 'diet books'. The identification of food with its chemistry is a defining characteristic of modern nutrition science, which was invented in the early 19th century. Seeing food in terms of its chemistry has enabled the industrialisation of food systems. In particular, it has made possible the formulation of ultra-processed products from 'refined' or 'purified' chemical constituents of foods – oils, proteins, carbohydrates, and their fractions, together with 'micronutrients' – vitamins and minerals.

As stated before, this and my previous commentaries include only a few references. They could be copiously referenced. But I think there is no need. Almost all the points made derive from standard texts and references and other well-known sources, readily accessible on the internet by using Google or other search engines. The new reasoning is my own, together with that of my colleagues.

Discussion

Box 1

Carbohydrates: My view

Identification of food mainly with its chemical constituents at best has limited value, and in general has proved to be unhelpful, misleading, and harmful to public health. The example given here is carbohydrate. The great ranges of foods, drinks and products classed as high in carbohydrate, which include fruits and soft drinks, whole grains (cereals) and packaged pizza, potatoes and sugar, have very different energy densities, nutritional value, and biochemical and metabolic effects. Consumed regularly, some protect against overweight, obesity and chronic diseases, whereas others increase the risk of disability and disease. This is generally known and accepted by nutrition scientists, who nevertheless persist in using the term 'carbohydrate', and classing what are a vast variety of types of food and drink under 'carbohydrate', as if they are similar not just in terms of chemical composition.

But the fact that a food is mostly made up from carbon and hydrogen, and also oxygen, is not in itself meaningful in public health terms. The way to begin to shift the chemical paradigm is simply to stop using the term 'carbohydrate'. It is useless and misleading information. Use of the term blurs the fundamental differences between fresh and minimally processed foods, such as grains and fruits, ingredients such as sugar and flour, and ultra-processed products such as packaged pizzas and sugared breakfast cereals. Like other once popular chemical terms, such as 'phlogiston', 'carbohydrate' should be now be firmly steered into disrepute and oblivion. This should have a general salutary effect on the classification of foods. It will also mark more progress in the project to move nutrition away from the circumstances, state of knowledge and priorities of the 19th century, towards those of the 21st century, in which we live now.

This commentary has a challenging title. The 'answer' is to abandon the idea that nutrition is basically a chemical discipline, and specifically to stop using the term and the concept of 'carbohydrate' in any nutritional context. It is unhelpful and misleading.

Useless and misleading information: 1. The energy in bananas and in sugared cola drinks comes chemically almost all from carbohydrates

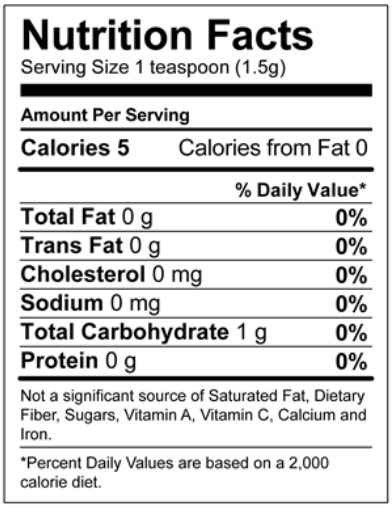
A very short history of carbohydrates

Food was first classified according to its chemical composition in 1827 by the British physician and chemist William Prout. He proposed that the divisions be sugars and starches, 'oily bodies', and 'albumen', the last two terms being forerunners of 'fats' and 'proteins'. The term 'carbohydrate' was first proposed by the German chemist Carl Schmidt in 1844. Chemically this is logical, since as the name implies, carbohydrates are compounds of carbon and hydrogen, together with oxygen. Humans were also analysed chemically, thus: 'The body of an adult has approximately the following percentage composition in terms of elements: oxygen 65, carbon 18, hydrogen 10, nitrogen 3' (and then minor elements). (1).

Identification of food with its chemical constituents, part of the project to establish chemistry as a master science, was an intrinsic part of the Industrial Revolution, begun in Britain, then in Europe and the US. Analysis of various types of carbohydrate enabled much more efficient manufacture of basic foods for industrial workers and soldiers, such as breads, other baked goods, and alcoholic drinks, as did the invention of increasingly efficient processing machinery, and the mixture of sugar, whose production and consumption soared in the 19th century (2), into cakes, biscuits, desserts, and a vast variety of other confections and products.

Up to the middle of the 20th century, the main public health nutrition problem in all including industrialised countries, was undernutrition and nutritional deficiencies. Foods high in any type of carbohydrate were identified as vital sources of energy, as were fatty and oily foods. A particularly influential manual, *The Chemical Composition of Foods* (3), was published by the UK Medical Research Council in 1940, as part of the

Second World War effort. It began: 'A knowledge of the chemical composition of foods is the first essential in the dietary treatment of disease or in any quantitative study of human nutrition'. Later editions of the manual dropped the word 'chemical' from its title. These have been adapted for many countries, and remain the 'bible' of nutritionists and dietitians. Its main tables classify food in terms of water, protein, fat, carbohydrate, and also various vitamins and minerals. More detailed tables now show values for different types of carbohydrate – starches, types of sugars, dietary fibre – without any indication of whether these are naturally contained in the food or added in manufacture (4).



Nutrition Facts

Serving Size 1 teaspoon (1.5g)

Amount Per Serving	
Calories 5	Calories from Fat 0
	% Daily Value*
Total Fat 0 g	**0%**
Trans Fat 0 g	**0%**
Cholesterol 0 mg	**0%**
Sodium 0 mg	**0%**
Total Carbohydrate 1 g	**0%**
Protein 0 g	**0%**

Not a significant source of Saturated Fat, Dietary Fiber, Sugars, Vitamin A, Vitamin C, Calcium and Iron.

*Percent Daily Values are based on a 2,000 calorie diet.

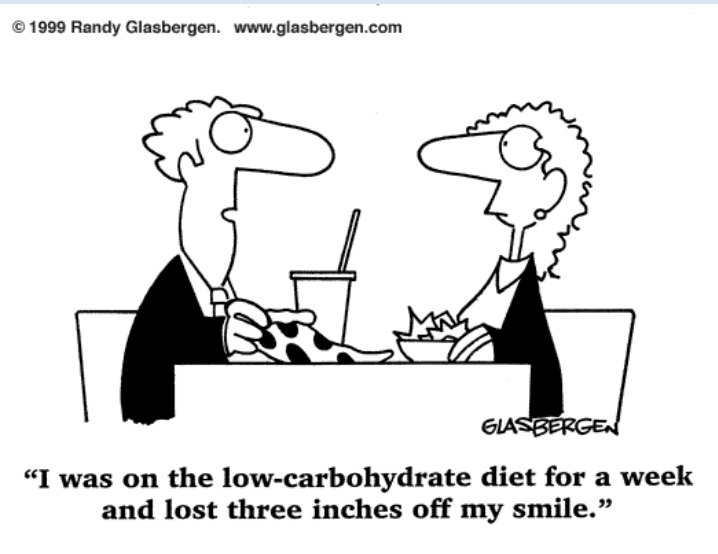
More recently, 'nutrition labels' have been devised in many countries by government officials, working together with industry and technical advisors. These started to be widely used in the US as from the mid 1970s and then Europe in the 1980s. The labels devised in the US influence those of other countries. They all maintain the 'big four' chemical constituents of food – energy, fat, protein, carbohydrate – as the main divisions, with some additions. Here above is a 'basic' label, which is for a type of infusion. More detailed labels may also include information on sugar and on dietary fibre, as subsidiary to the main category of 'carbohydrate'.

Seven objections to 'carbohydrates'

'Carbohydrate' is a chemical term, part of the 19th century project to define nutrition as a chemical science. This conceptual framework has survived for nearly 200 years, with an increasing number of elaborations and qualifications, and despite evident anomalies and paradoxes (9). Among all the sciences, its longevity, and almost unquestioned acceptance within the scientific community, is remarkable, and possibly close on unique. It never made much sense biochemically, because different forms of carbohydrate have very different metabolic effects, depending on their nature and also on the matrix of which they are part as contained in food.

Box 2

The 'anti-carb' craze – a chemical muddle



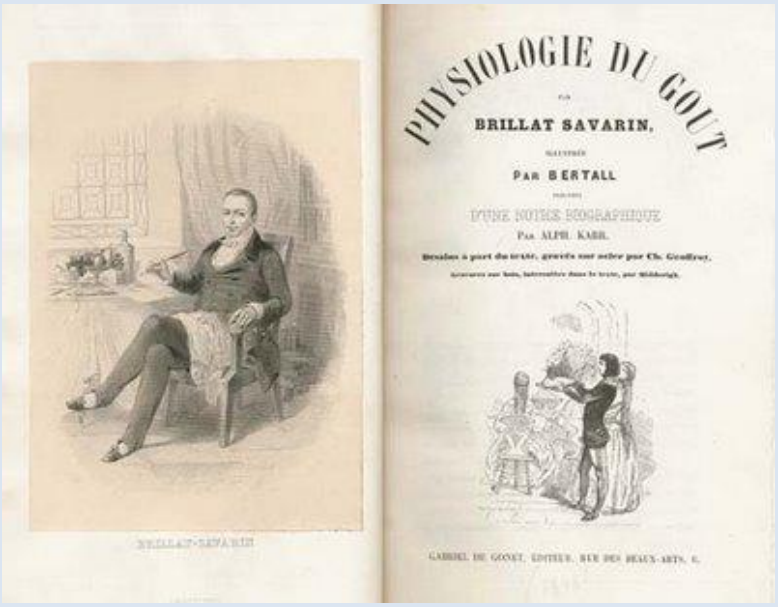
Dr Atkins and the anti-carb craze

The most notorious example of muddle caused by use of the term 'carbohydrate' as if it is meaningful, has been, and still is, what is often called the 'Carb Craze' (or rather, the 'Anti-Carb Craze'). This swept the US and many other countries at first beginning in the 1970s, and then again in the 1990s and into this century. The best-known weight reduction regime in the US and worldwide has been that of the 'anti-carb' 'dieting doctor' Robert Atkins (5,6). It is said that just before he died in 2003, around one in ten adults in the USA and UK were 'doing Atkins'.

Dr Atkins's dieting regime has horrified almost all conventional nutritionists and medical professionals interested in obesity, who have accepted the general consensus that reducing regimes should be low in dietary fat. The Atkins Diet, by contrast, is very high in animal protein and animal fat, and in its first phase very low in every type of food containing a lot of any sort of carbohydrate. Dr Atkins's original main claim is that every type of food containing substantial amounts of carbohydrates make you fat. As he said in the 1970s: 'Super Don'ts. Put these out of your life and your recipes. Bread, cereal, corn, ice cream, ketchup, macaroni, milk, potatoes, pulse vegetables, rice, spaghetti, sugar, sweets/chewing gum, water biscuits.' (5)

In his second phase, in the late 1990s, he persisted in being identified as 'anti-carb'. But he narrowed his attack: 'When I speak of carbohydrates, I'm referring to the unhealthy ones – sugar and white flour, milk and white rice, processed and refined foods of all kinds, junk food and the like.' (6). This is a different story. He was no longer attacking carbohydrates in general, but mainly refined or processed sugars and starches, used as food ingredients, and as contained in ultra-processed food. If he had abandoned use of the word 'carbohydrate' and, instead, specified that he was mostly attacking products that contain a lot of processed starch and sugar, and

often fat as well, that are energy-dense, it would have been clearer why his regime evidently works as well as any other, at least for a while (7). But he apparently enjoyed annoying conventional professionals, and was no doubt was well aware that his fame was bound up with his 'war on carbs'. Abandonment of the term 'carb' probably would have been bad for sales. But the confusion, which still persists in the scientific literature and also influential popular publications, is caused by use of the concept and term 'carbohydrate' as if this is valid. It is not.



Brillat-Savarin had the right idea

The French philosopher and gastronome Jean Anthelme Brillat-Savarin is well-known for his saying that 'The fate of nations is determined by what they eat'. He was also a 'diet doctor'. His advice is clearer and more useful than that of Dr Atkins or indeed most any other modern dieting regime, if only because he never used the term 'carbohydrate', which at the time of publication of his book in 1825 (8) had not been coined.

Writing as a 'natural philosopher', not afraid to adduce knowledge from all sorts of fields, he pointed out that carnivorous animals never become fat: 'Think of the wolves, jackals, birds of prey, crows, etc.' He also pointed out that free-ranging herbivorous animals rarely get fat except sometimes in old age, but when intensively reared 'they gain weight quickly'. In addition: 'Obesity is never found either among savages or in those classes of society which must work in order to eat, or which do not eat except to exist.' By 'work' he means manual labour.

While like Dr Atkins he was opposed to starchy or floury foods, he concentrates his attention on energy-dense foods. Thus his advice to a 'charming fat lady' included: 'You love soup, so have it made *à la julienne*, with green vegetables, cabbages, and root vegetables. I must forbid you to drink it made with bread, starchy pastes, and flour.' Veal and poultry should be preferred. 'Shun everything made with flour, no

matter in what form it hides; do you not still have the roast, the salad, the leafy vegetables?'

He also pointed out the deceptive nature of sugared foods. Writing at a time when consumption of sugar, even among wealthy people, was very much lower than it generally is now, of obesity he said: 'Starch produces this effect more quickly and surely when it is mixed with sugar.' And he noted in particular the effect on appetite: 'The mixture of sugar with flour is all the more active since it intensifies the flavour,' and: 'We seldom eat sweetened dishes before our natural hunger has been satisfied.' We all have experienced the sense that after a big meal, we have a little room left for dessert.

Useless and misleading information (2). Over 80 per cent of the energy in rice and in meringue as a dessert or topping, chemically comes from carbohydrate

1 The energy value of carbohydrate itself is misleading

Every nutrition student, and every dieting regime follower, knows that whereas fat is itself maximally energy-dense, delivering 900 kilocalories in every 100 grams, carbohydrate, along with protein, is far less energy-dense, at less than 400 kilocalories in every 100 grams. This information, which has given carbohydrates in general 'a good name', and which is touted by the sugar industry ('only 17 calories in a teaspoon of sugar') is misleading. While some unprocessed foods and also ultra-processed products are fatty, fats and oils are not consumed by themselves.

Foods that contain little or no carbohydrate but which contain a lot of water as well as some fat, such as meat and oily fish, are relatively low in energy density, as well as being very nourishing. Foods that are high in carbohydrate and which also contain fats and oils, and little water, such as pizzas and all sorts of baked goods and sweet and savoury snack products, are very high in energy density. Bread is more energy-dense than leaner cuts of meat. Sugar by itself, because of containing no water, is

energy-dense. Combined with processed starches and fats in the form of a vast number of ultra-processed products, it is very energy-dense. Sugared soft drinks, because of being mostly water, are technically not energy-dense, but the evidence that they 'fool' the body into over-consumption is compelling (10).

2 Like other chemical terms, 'carbohydrates' is mystifying

'Fats and oils', and 'alcohol', are nutritional terms that correspond to substances in food and drink that are experienced by the senses. Together with 'proteins' and 'vitamins' and 'minerals', 'carbohydrates' are abstractions, that mean nothing to people until they think they know what they mean – and often not then, either. It is fairly easy to translate 'proteins', by saying 'grains and beans eaten as staple foods will give you the proteins you need' or, in materially rich countries 'meat, fish and cheese are good sources of proteins'. Likewise, it's simple to say 'make sure your family enjoys a variety of vegetables and fruits every day and every week, these will supply vitamins and minerals'. But there is no coherent message for 'carbohydrates'. The advice to long-distance runners to 'carbo-load' before a race, is actually advice to consume a lot of metabolically relatively slow-release pasta. And as for the 'no-carb' dieting craze, see Box 2 above.

3 The term makes false connections between very different foodstuffs

As stated and illustrated above, from the personal and public health points of view, the fact that the energy in fruits and soft drinks, grains (cereals) and sweet desserts, chemically comes mostly or almost entirely from carbohydrates, is useless and actually misleading information. A great range of fresh and minimally processed foods, commercial and culinary ingredients, and ultra-processed products, are high in carbohydrates. These all supply energy – but so do all foods, and all drinks other than water. The relative energy-density of foods, ingredients and products containing relatively large amounts of carbohydrate is mostly a function of the degree and intensity of their processing.

4 Because classed as a carbohydrate, sugar can be perceived as beneficial

Sugar, which chemically is 'purified' or 'refined' carbohydrate, was the nutritional and dietary phenomenon of the 19th century, coincidental with the invention and development of modern nutrition science. It is a crucial ingredient in a vast number of processed products. Between 1800 and 1900, in some European countries, consumption of sugar rocketed from under 10 kilograms, to about 40 kilograms, per person per year. The pattern in the US closely followed. The supply of increasingly cheap calories, in a form that could be added to most foods and any drinks, was until after the middle of the 20th century seen as a great benefit, as it still commonly is in and on behalf of impoverished countries. This boosted the image of sugar as a supplier of quickly absorbed energy, and still does. The sugar industry and its

associated organisations tend to position sugar as a carbohydrate, when promoting or defending its product.

5 Sugar has replaced fat in a vast range of processed products

In general, dietary fat, itself energy-dense, has a bad image, whereas carbohydrate, itself less energy-dense, has a relatively good image. In the US, consumption of total fat has decreased since the 1980s, while rates of overweight and obesity have rapidly increased. One likely reason for the rise in overweight and obesity is that manufacturers have replaced some fat in ultra-products with 'refined' or 'purified' sugar and starch, declared on nutrition labels as 'carbohydrate' (often now with subsidiary information about sugar and dietary fibre). The new types of product, often advertised as 'reduced fat' or 'low fat' and seen by the consumers as 'safe', are likely to be as high in energy density as the fattier products they have replaced.

6 Foods high in carbohydrate may be beneficial or harmful to health

Nutrition is taught and practiced as a discipline and profession that is meant to protect health. Basic nutritional terms, whether used in an academic or popular context, should therefore always aim to indicate whether a food, ingredient, product, or any element in food, is liable to be beneficial or harmful to health, and in what amounts. Of all the chemical terms used to classify food, 'carbohydrate' most conspicuously fails this test.

7 The conceptual framework of nutrition needs revision

The example of carbohydrate indicates that nutrition should no longer be seen as basically a chemical discipline. This has radical implications for the teaching and practice of nutrition as a science and profession.

Conclusion

Classification of food in terms of its chemical composition, in any nutritional context, is generally unhelpful. In particular, the term 'carbohydrate', which chemically applies to a vast range of fresh and minimally processed foods, industrial and culinary ingredients, and ultra-processed products, is useless and misleading information. Like other chemical concepts that have proved to be without value, the term should no longer be used.

References

1 Nicholls L. Carbohydrates and fats. [Chapter 1]. In: *Tropical Nutrition and Dietetics*. Fourth edition, revised by Sinclair H, Jelliffe D. London: Baillière, Tindall and Cox, 1961.
2 Mintz S. Production. [Chapter 3]. In: *Sweetness and Power. The Place of Sugar in Modern History*. New York: Viking, 1985.
3 McCance R, Widdowson E. *The Chemical Composition of Foods*. London: Medical Research Council, 1940.
4 *McCance and Widdowson's The Composition of Foods*. Sixth summary edition. London: Royal Society of Chemistry/ Food Standards Agency, 2002.
5 Atkins R. *Dr Atkins' Diet Revolution*. New York: Bantam, 1972.
6 Atkins R. *Dr Atkins' New Diet Revolution*. New York: Avon, 1992. Mass paperback, 1999.
7 Kennedy E, Bowman S, Spence J, Freedman M, King I. Popular diets: Correlation to health, nutrition, and obesity. *Journal of the Americam Dietetic Association* 2001; **101** (4): 211-220.
8 Brillat-Savarin JA On obesity [Meditation 21]. *The Physiology of Taste. Or, Meditations on Transcendental Gastronomy*. Fisher MJK (trs). Washington DC: Counterpoint, 1999. First published in French, 1825.
9 Kuhn T. Anomaly and the emergence of scientific discoveries. [Chapter VI] In: *The Structure of Scientific Revolutions*. Second edition. Chicago, Ill: University of Chicago Press, 1970.
10 Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: A systematic review and meta-analysis. *American Journal of Public Health* **97** (4): 667-675.

Acknowledgement and request

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CAM states: This commentary was drafted and revised following many discussions. Geoffrey Cannon drafted the boxed texts for revision and approval by me. I regard him as my co-author. All the 'ultra-processing' commentaries have benefited from discussions I have had in the last two years or so with my Brazilian colleagues Inês Castro, Renata Bertazzi-Levy, and Rafael Claro, and also with Geoffrey Cannon and Fabio Gomes, who are all co-authors with me of other papers, published and in preparation. They share authorship with me of the 'ultra-processing' concept and its expression as shown here. I have no conflicts of interest.