

Health benefits of low protein-high carbohydrate diets depend on carb type

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Image of a fork.Credit: Sourced from Pexels.

Researchers at the University of Sydney's Charles Perkins Centre have conducted the largest-ever study of nutrient interactions by examining the health of mice on 33 different diets containing various combinations of protein to carbs, and different sources of carbohydrate.

They found that a low-protein (10% of dietary energy), high-[carbohydrate](#) (70%) [diet](#) produced either the healthiest or unhealthiest metabolic outcomes of all 33 diets, depending on the kind of carbs.

When carbs were made up mainly of [resistant starch](#), a form of starch that is resistant to digestion and is fermented by bacteria in the gut, the [low protein diet](#) was the healthiest of all diets. When the carbs were a 50:50 mixture of fructose to glucose, the same make-up as [high fructose corn syrup](#) (the primary sweetener used in the US packaged food and beverage industries) the low-protein diet produced the worst outcomes.

The study, which took three years to complete, is published in *Nature Metabolism* today.

"While the study was conducted in mice, the results appear to explain the disparity between healthy, low-protein, high-carbohydrate diets and growing levels of obesity and co-morbidities associated with highly-processed modern-day diets which are also protein-diluted and high in refined carbohydrates," said Professor Stephen Simpson, senior author and Academic Director of the University's Charles Perkins Centre.

"We found that the molecular make-up of a carbohydrate and how it is digested shapes the behavioral and physiological response to reduced levels of protein in the diet, impacts how the liver processes nutrients and alters the gut bacteria.

"These findings could explain why consuming low protein-high carbohydrate diets that avoid high fructose corn syrup, limit readily digestible processed starch and are abundant in resistant starch (which in a human diet would be whole grains and legumes such as beans and lentils) are associated with good metabolic health."

The work builds on the team's ground-breaking 2014 Cell Metabolism study, which showed low protein-high carbohydrate diets in mice resulted in the longest lifespan and best cardiometabolic health during mid-and early late-life.

For the 2014 study, the researchers used readily digestible starch as the main carbohydrate source, so the logical next step was to examine what happens if you alter the source of carbohydrate. The present study confirms the earlier findings and extends them to show the importance of the type of dietary carbohydrate, helping explain why the longest-lived human populations on earth, such as the traditional Okinawan Japanese have a low-protein, high-carbohydrate diet, but when protein is diluted in the human food supply by processed refined carbohydrates, the health outcomes are not so favourable.

Low-protein diets are not all equal

Dr. Jibrán Wali, lead author of the new study, said that all low-protein diets are not equal. A low protein-high carbohydrate diet is a setting to gain maximum health benefits from the carbs that are accessible to bacteria in the colon (e.g., resistant starch) but can also be a means to maximize the adverse effects of highly processed carbs.

"We found that the 50:50 mixture of glucose to fructose created the highest levels of obesity in mice, even when calorie consumption was comparable to other carbohydrates. This suggests that a calorie is not a calorie when it comes to carbohydrates, or even to different sugars and that consumption of glucose and fructose in combination promotes obesity and poor metabolic health," said Dr. Wali, NHMRC Peter Doherty Biomedical Fellow at the Charles Perkins Centre and School of Life and Environmental Sciences.

The researchers say this finding may come as a surprise to many, as

while there is consensus that excess calories from sugar cause weight gain and metabolic disease, there is an active debate on which form of sugar (sucrose, high fructose corn syrup, glucose, fructose) is the most detrimental.

"The findings could have immense practical benefits," said Professor David Raubenheimer, Leonard P. Ullmann Chair in Nutritional Ecology at the Charles Perkins Centre and School of Life and Environmental Sciences and co-author on the study.

"For many people wishing to improve their diets, carbohydrates have become the enemy. Some go to extreme lengths, virtually removing them from their diets. Our results suggest this could be a mistake. Reducing certain kinds of carbohydrates, like high fructose corn syrup, would have benefits. But avoiding the digestion resistant forms, which are found in many plant foods, risks losing benefits of a nutrient that is high in the diets of the healthiest and longest-lived populations on Earth," continued Professor Raubenheimer.

"The results of this study help explain why it is best to stay away from foods such as cakes, pizzas and confectionary and supports filling your plate with wholegrains such as brown rice, oats and quinoa, legumes such as lentils, beans and chickpeas, and opt for plenty of vegetables including [sweet potato](#), pumpkin, and beets," said Dr. Rosilene Ribeiro, a dietitian and a researcher in the School of Life and Environmental Sciences and a co-author on this study.

About the study

The pre-clinical study of male mice explored the impact of 33 diets with different ratios of protein to carbohydrate, and different types and combinations of carbohydrate (fructose, glucose, sucrose, digestible native starch and resistant starch) with fat intake fixed.

The mice were permitted to eat as much as they wanted for 18 to 19 weeks during which time the researchers comprehensively examined their metabolic health and analysed the gut microbiome.

The study employed the use of the geometric framework for nutrition developed by Professors Stephen Simpson and David Raubenheimer. It enables researchers to consider how mixtures of nutrients and their interactions influence health and disease, rather than focusing on any one nutrient in isolation which has been the downfall of many previous nutrition studies.

What would the diet look like in humans?

While the current study was conducted in mice, a sample menu for a low-protein, high resistant starch diet in humans is listed below.

Breakfast: Porridge and fruit. AM snack: Raw vegetables such as carrots, snow peas, tomatoes. Lunch: Brown rice and quinoa salad made with fresh vegetables and chickpeas. PM snack: Wholegrain bread with hummus. Dinner: Plenty of vegetables (at least half of the plate) such as beans and sweet potato and a small piece of lean meat or fish. Dessert: Fruit.

More information: *Nature Metabolism* (2021). [DOI: 10.1038/s42255-021-00393-9](https://doi.org/10.1038/s42255-021-00393-9)

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