

PERSPECTIVE



Tricks of the trade

Processed foods that dilute protein content subvert our appetite control systems, say **Stephen J. Simpson** and **David Raubenheimer**.

The weight of evidence indicates that the primary driver of the obesity epidemic in recent decades has been increased intake, rather than decreased energy expenditure. Not surprisingly, much research has focused on the source of these extra calories, with vigorous debate over whether fats or carbohydrates (especially refined sugar) are the main culprits.

But this approach misses a fundamental point. The obesity problem is best understood not as the result of the overconsumption of a single macronutrient, but from a skewing of the proportion of each macronutrient in our diet — notably the dwindling quantity of protein in processed food products. The paucity of protein relative to fats and carbohydrates in processed foods drives the overconsumption of total energy as our bodies seek to maintain a target level of protein intake.

BALANCING ACT

An optimal diet includes a mixture of foods that provide dozens of different nutrients in appropriate amounts and in the right proportions. Consuming such a balanced diet is essential for the growth and maintenance of all organisms, and for reproductive fitness.

So it's no surprise that animals, including humans, have evolved exquisite appetite systems to control the consumption of proteins, carbohydrate and lipids, as well as micronutrients such as sodium and calcium¹. These systems work independently to push the organism towards eating a well-proportioned diet: a lack of one nutrient will signal "eat more", while an excess of another will signal "eat less".

As long as the animal eats the foods that it evolved to consume, this balance is maintained. The trouble comes when it eats a diet with a disproportionate quantity of a particular macronutrient, either because of a lack of appropriate foods in the environment or because its appetite control systems have been fooled or subverted. This is now happening in humans, as we live in a foodscape scarcely recognizable to our forebears.

In humans, as in many other animals, the appetite prioritizes protein over carbohydrate or fat². The evolutionary explanation is straightforward: eating too little protein compromises growth, development and reproduction.

Many processed food products are protein-poor but are engineered to taste like protein. Many people therefore eat far too much fat and carbohydrate in their attempt to ingest enough protein. In this way, engineered foods subvert the appetite control systems that should be helping to balance the consumption of macronutrients. The results are striking. In the United States, the typical diet saw a 0.8% decline in protein concentration between 1971 and 2006. During this same period, the consumption of calories from carbohydrates and fats increased by 8%, a trend reflected in the rising prevalence of obesity³, but protein intake remained almost unchanged.

The substitution of carbohydrates and fats for protein is driven by economics. Food manufacturers have a financial incentive to replace

protein with cheaper forms of calories, and to manipulate the sensory qualities of foods to disguise their lower protein content. This leads to savoury-flavoured food that makes us think we're eating protein when in reality it is loaded with carbohydrates and fats. The manufacturers of animal feed have similar incentives to add carbohydrates, resulting in fatter livestock (and pets). The higher cost of protein drives consumers to buy cheaper processed food loaded with fat and carbohydrates — an effect that disproportionately affects people on tighter budgets.

EVADING EVOLUTION

The range of processed food becoming available is evolving faster than our appetite control systems. Simple sugars and fat were rare in our ancestral environment and highly prized. This may be why modern humans tend to favour the fatty and sugary foods that now surround us, and would also account for the trend in agriculture and industrialization towards producing readily digested carbohydrates and fats.

Populations accustomed to a high-protein diet, such as hunter-gatherers, may be most at risk in moving to a modern diet where protein is in short supply. If their physiology reflects their ancestral diet, they may have appetite systems that strive for an even higher protein intake than populations whose ancestors switched earlier to an agricultural lifestyle with a high-carbohydrate diet.

Much of the discussion of diets focuses on calorie counting and simplistic attempts to demonize elements of a normal diet. However, these approaches fail to capture the inherently multidimensional nature of nutrition. It is clear that the balance of nutrients — especially protein, fat and carbohydrate —

has profound effects on many critical physiological functions, including appetite, energy intake, obesity, cardiometabolic health, ageing, immunity and the microbial ecology of the gut^{1,4}. Teasing apart these interactions, and providing dietary interventions that can help alleviate their negative effects on health, requires a more integrated view of nutrition than is offered by the hegemony of the calorie or the search for a single culprit. ■

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