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Fruit fly study challenges theories on evolution and high-carb diets

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A single mitochondrial DNA mutation common in animals could play a role in obesity and other health problems associated with a diet high in carbohydrates.

This was one of the implications of research led by UNSW scientists who looked at how different diets affected fruit fly populations. The researchers observed a surprising difference between two sets of the Drosophila melanogaster fruit flies when feeding them alternate diets high in protein and high in carbohydrates.

Fruit fly larvae with a noted mitochondrial DNA (mtDNA) mutation showed a pronounced increase in development when eating high carbohydrate diet of banana, but stagnated on a high protein diet of passionfruit.

Conversely, fruit fly larvae without the mtDNA mutation thrived on the high protein diet, but dropped in frequency when put on carbohydrates.

UNSW School of Biotechnology & Biomolecular Sciences Professor Bill Ballard, who led the study, says the research is a rare demonstration of positive selection at work in evolution.

"What is unique about this study is we've identified one mutation in the mitochondrial genome, that when fed a specific diet is advantageous and causes the frequency of flies in a population cage to increase," he says.

"Then when you swap the diet back to a high protein diet, the flies with the mutation go down in numbers and the other flies without the mutation go up."

The study, which was an exhaustive six-year collaboration between authors from research institutions in Australia, the US and Spain, challenges the neutral theory of molecular evolution that says changes in species at the molecular level are random, not caused by natural selection and provide no benefit or disadvantage to the species.

UNSW Ph.D. student Sam Towarnicki, who is equal first author of the paper, explained why this was more than just a random, neutral mutation.

"The selective advantage is this: the larvae possessing the mutation fed on high carbohydrate diet grow up nice and early and become adults before the others on the protein diet [also with a mutation]," he says.

"And we found a 10 per cent difference in the development just in one generation between those two groups, which is huge.

"And because we followed 25 generations, those increases compound over time which delivers much bigger numbers and a huge selective advantage."

Given that humans share 75 per cent of the same genes as fruit flies, and have the same mtDNA genes, it is certainly an intriguing prospect that the same mutation inherited in human mtDNA may metabolise carbohydrates in a similar way.

Professor Ballard says while confirmation of this would be "another NHMRC grant away and years of surveying and testing", the idea is worth exploring.

He says knowledge of a person's 'mitotype' could help explain why a diet high in carbohydrates may induce obesity and diabetes in some but not others.

"But, the news is not all bad for people harbouring the mutation," he says.

"Sure, you would need to manage your carbohydrate intake when you are younger, but if you are unfortunate enough to develop Parkinson's Disease, a high carbohydrate diet will help you maintain weight.

"So a consequence of our study is to open up a new area for the development of specific diets and drugs to treat Parkinson's' Disease."

And far from fighting disease and reducing health problems, the knowledge could help people plan and fulfil life-choices.

"The most obvious implication from our work is that people should start to manage their diets to match their genotypes to fulfil their specific goals. This is the growing field of 'Nutrigenomics'," Professor Ballard says.

He uses the analogy of the different physical requirements of a football team: some players need speed, some need to bulk up while others may need layers of fat.

"Knowing a person's mitotype will help each person optimise their diet to fulfil these goals, and it would also help a person choose which sort of role they may be best suited for."

"A second example is that our energetic goals change over time and so the food we feed our body should also change. A goal for some might be to increase fertility while increasing longevity may be the goal for older folks.

"So knowing our mitotype will help us determine the best diet to fulfil life-choices."

Provided by University of New South Wales

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