Why fruit flies eat practically anything

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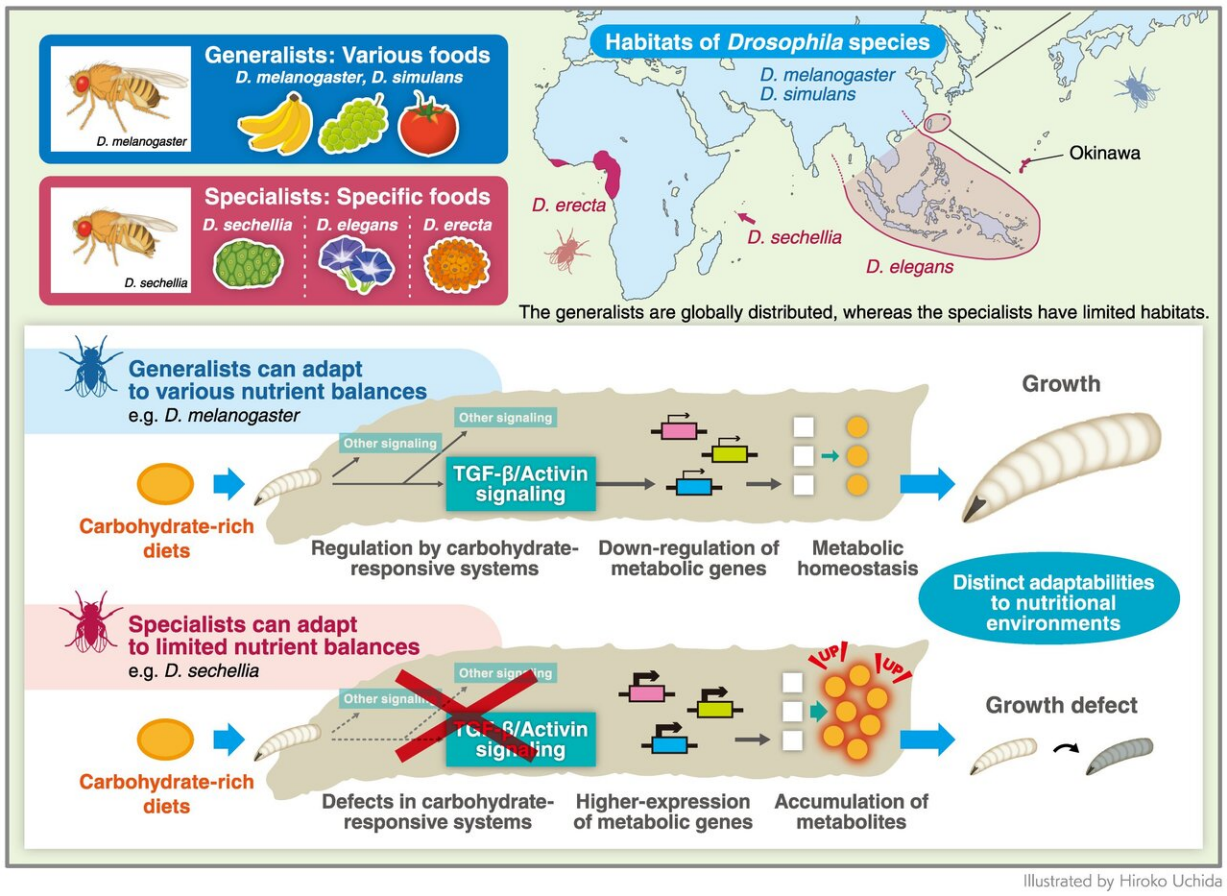

Graphical abstract from the paper. Generalists can adapt to high carbohydrate sources thanks to a robust TGF-b/Activin signaling pathway. Specialists on the other hand are not as adaptable and cannot survive in similar conditions. Credit: Illustrated by Hiroko Uchida

Say hello to the common fruit fly: a regular guest in most homes,

feasting on that banana peel you tossed into the garbage a few days ago.

Despite their name, these insects will feed on various kinds of plant matter. In a paper published in *Cell Reports* scientists describe that this diversity in diet stems from their flexible response to carbohydrates, giving us insight into how human food preferences evolved.

The fruit fly, or *Drosophila melanogaster* are a frequent subject of genetics research, and have provided answers on how genes function. Like the fruit fly, humans can also eat a wide range of food types, and are are known as "nutritional generalists." On the other hand, some genetic cousins of the fruit fly are known as "nutritional specialists," and can only feed on very specific plants. Many questions remain regarding why organisms have such differences in feeding habits, even within the same genetic family.

"Uncovering the differences in the molecular mechanisms between nutritional generalists and specialists can help us understand how organisms adapt to variable nutritional environments," explain Kaori Watanabe and Yukako Hattori of Kyoto University's Graduate School of Biostudies, who led the study. "In our investigation, we changed the nutrient balance in the food of different *Drosophila* species and compared their nutritional adaptability along with their transcriptional and metabolic responses."

The team began by examining whether larvae of generalists and specialists could adapt to three experimental diets: high protein, high carbohydrate, and protein-carbohydrate. As expected, generalist flies, including the common fruit fly, grew under all diets. Larvae of specialists, on the other hand, could not survive in carbohydrate-rich conditions.

These specialists are known to eat and reproduce on specific fruits or

flowers, and examining the nutritional profiles of their native diets showed that they are low-carbohydrate feeders. The team hypothesized that the difference between the flies lies in the genetic pathways that control their response to carbohydrates.

"A signaling pathway known as TGF-β/Activin signaling regulates the body's response to carbohydrates. In the generalists, this pathway is quite flexible and maintains metabolic homeostasis under different diets. In fact, there are about 250 metabolic genes that are downregulated when their diet is carbohydrate-rich," they explain.

In contrast, a specialist expressed these genes at higher levels, where they accumulated metabolites, culminating in reduced adaptation. The same lack of adaptation was also found when a gene in the TGF-β/Activin pathway named dawdle is disabled in the common fruit fly.

The results suggest that the generalists evolutionarily retained the robust carbohydrate-responsive systems through genome-environment interactions, whereas specialists lost them in consistent low-carbohydrate environments.

The research team concludes, "Considering that humans and flies share a number of genes and regulatory factors, we can begin to develop an interspecies comparative approach that provides an informative model system for addressing the genetic variability among humans in response to dietary intakes."

The paper, "Interspecies Comparative Analyses Reveal Distinct Carbohydrate-Responsive Systems among *Drosophila* Species," appeared on September 3 2019 in *Cell Reports*.

More information: "Interspecies Comparative Analyses Reveal Distinct Carbohydrate-Responsive Systems among Drosophila Species"

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