Bacteria beat the heat

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How do some microorganisms manage to exist and even thrive in surroundings ranging from Antarctica to boiling hot springs? A team of scientists from the Weizmann Institute's Plant Sciences Department, led by Prof. Avigdor Scherz, has found that a switch in just two amino acids (the building blocks of protein) can make a difference between functioning best at moderate temperatures and being adapted to living in extreme heat.

The results of their research, which recently appeared in *Nature*, might have implications for future attempts to adjust crops to differing climate conditions or improve enzyme efficiency in industrial processes.

The team compared two different kinds of bacteria – one found in moderate environments and the other, an intense-heat lover. Both were photosynthetic (that is, using the sun's energy to create sugars for food). The focus of the research was a reaction that takes place in enzymes in the photosynthetic "reaction center" of the bacterial cell. While gradually raising the surrounding temperature, the scientists timed this reaction to see how reaction rates changed as things heated up.

A general rule for enzyme reactions states that as the heat rises, so does the reaction rate. Contrary to this rule, and the scientist's expectations, both reaction rates peaked at a certain point, and remained steady thereafter. For each enzyme, the peak occurred in the bacteria's "comfort zone." Further comparisons of the enzymes, which were nearly identical, turned up differences in just two of the hundreds of amino acids making up the enzyme sequence. When the scientists replaced these two amino acids in the enzyme adapted to the moderate temperatures with those of the heat-loving enzyme, they observed an increase of about 10 degrees in the average temperature at which the reaction rate peaked.

Scherz: "This study shows that enzyme efficiency is tuned to the average temperature of the bacterial habitat, rather than the immediate conditions. This may protect the cells from harmful swings in enzyme activity. We can envision using this knowledge, for instance, to facilitate enzymatic reactions in different applications, enhance crop production in areas subject to extreme temperature changes or create new resources for biofuel production that will not only provide more biomass per acre, but absorb more of the greenhouse gas, carbon dioxide, as well."

Source: American Committee for the Weizmann Institute of Science

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