The Economist

Decaffeinating waste

Brewing a solution

Genetic engineering may clean up the processing of coffee

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COFFEE is big business. One consequence is a lot of caffeine-rich waste which cannot be thrown away willy-nilly because caffeine is a pollutant. It inhibits both the germination of seedlings and the growth of adult plants, so it must be collected and dumped at approved sites.

This is a pity for two reasons. One is that it increases the cost of a cup of coffee. The other is that the waste is rich in nutrients. If it could be decaffeinated, it might be used as animal feed—thus adding to coffee companies' revenues rather than subtracting from them. But that would require a cheap way to decaffeinate it. Which is what Jeffrey Barrick of the University of Texas at Austin and his colleagues hope they have found. Their research, published in *Synthetic Biology*, suggests the answer lies with genetically modified bacteria.

Waste not, want not

The idea of using bacteria to decaffeinate waste is not new. Past studies showed that a species called *Pseudomonas putida* can chew the molecule up. But it does so in small quantities, and no one knew enough about it to work out how to increase its efficiency. Dr Barrick thought the best way round this was to take the caffeine-chewing mechanism out of *P. putida* and put it into *Escherichia coli*, a species biologists are good at manipulating.

He and his colleagues therefore extracted the cluster of *P. putida*'s genes that encode the caffeine-chewing enzymes and transferred them into *E. coli*. And not just any old *E. coli*. The strain they picked lacked a gene from the pathway the bug usually uses to synthesise guanine, one of the four chemical bases that act as the genetic code in DNA. This was to test whether the transfer had worked, because the transplanted biochemical pathway turns caffeine into xanthine, a molecule *E. coli* can make into guanine without the missing gene. Since nothing can reproduce without guanine in its DNA, the researchers had merely to sit back and see if their engineered bugs multiplied in the presence of caffeine. Sadly, they didn't.

An examination of the problem showed that the transferred gene cluster was missing a crucial piece. That, they fixed using a patch from a third species, *Janthinobacterium*. Then they tried again. This time the bacteria bred like billy-o.

The next step will be to see if what works in a lab also works on an industrial scale. If it does, then coffee companies should see their costs reduced, and other producers of waste that requires specialised disposal will have a new line of inquiry to pursue.

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