Biotech is the new alchemy

Henry Nicholls, BMN News

Biotechnologists have used cheap raw materials to create 'natural' vanillin, the highly prized ingredient that gives vanilla its characteristic flavor. But commercial success is being hindered by a skeptical European attitude to this modern-day alchemy, they fear.

Vanillin

Each year, about 10,000 tons of vanillin is chemically synthesized. Most of this is used in the food and fragrance industry. However, there is a huge market for 'natural' vanillin extracted from vanilla pods, says Jürgen Rabenhorst, Director of Biotechnology at German-based firm Symrise (http://www.symrise.com).

Commercial vanilla plantations, in countries such as Madagascar and Indonesia, contribute to the 2200–2400-ton annual harvest of vanilla pods. But the prized ingredient vanillin constitutes only 2% of this yield, so there are less than 50 tons per year for the whole world, says Rabenhorst. Its rarity makes natural vanillin extremely valuable, worth more than US$10,000 per kilo, he says, and that's 'without even mentioning handling costs'.

But taking the biotech approach, Symrise has managed to obtain concentrated amounts of 'natural' vanillin from ferulic acid, a closely related molecule. This is achieved by classical fermentation catalyzed by a strain of *Amycolatopsis* bacteria, and can yield more than 10 g of vanillin per litre. However, ferulic acid still costs around 100 Euros (US$120) per kilo, so the search was on for an alternative and cheaper substrate.

Cheaper candidates

At about one tenth the cost of ferulic acid, eugenol was a candidate. This is, and has been for more than a century, the starting point for the chemical synthesis of vanillin. But Rabenhort's aim was to end up with a 'natural' vanillin using biology rather than chemistry.

One problem was that eugenol has antimicrobial properties, making fermentation using microorganisms tricky. However, a strain of *Pseudomonas* isolated from soil did the job. 'We needed to find a *Pseudomonas* that could survive and convert ferulic acid down the right pathway,' he said.

Using this strain in combination with the *Amycolatopsis*, Rabenhorst was able to turn relatively worthless eugenol into valuable vanillin – a modern-day spin on alchemy. The additional step of blocking activity of vanillin dehydrogenase led to the accumulation of even larger amounts of vanillin, he says.

However, because European legislation insists that products are labelled to reveal any genetically modified organisms involved in their manufacture, Symrise has decided to put further research on hold until the hostility of the European consumer towards such technology subsides.

The triple bottom-line

Nevertheless, this has done little to dampen the optimism of industry leaders. The European biotechnology community should not be put off current research projects, says Steen Riisgaard, president of the Danish company Novozymes (http://www.novozymes.com), one of Europe's biotechnology forerunners.

'We have to work hard to convince society' about the benefits of biotechnology, he told *BioMedNet News* (http://news.bmn.com). One problem that Europe faces, by contrast with the USA, is that research is necessarily fragmented. 'In the USA, they can make one big initiative,' he said. Without a coherent European strategy to foster industrial biotechnology, Europe will fall behind the USA and Japan, he warns.

Switching from chemical to biological processes has 'very far-reaching potential for the environment,' said Riisgaard. Biotechnology, he insists, can bring benefits to the economy, the environment and society – the so-called 'triple bottom-line'.

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