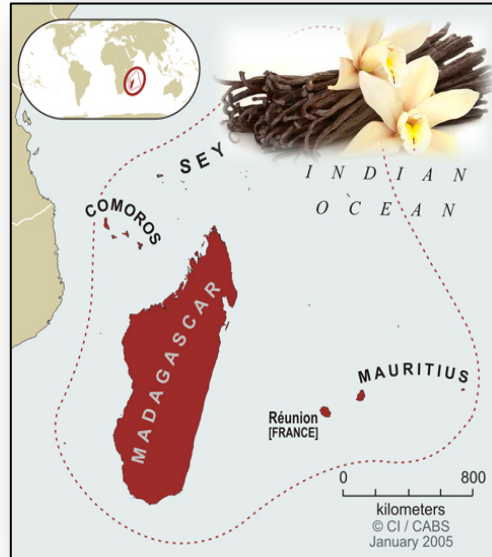


# VANILLA

**PRODUCT:** Natural vanilla flavour (vanillin) is sourced from the cured seed pod of the vanilla orchid.

**STATUS:** Switzerland-based synthetic biology company, Evolva, has constructed new metabolic pathways in microbes to produce several key flavour compounds found in vanillin.

**AFFECTED COUNTRY/REGION:** An estimated 200,000 people are involved in the production of cured vanilla beans *per annum*.<sup>1</sup> Madagascar, Comoros and Reunion historically account for around three quarters of the world's vanilla bean production. Other producers include: Indonesia, China, Mexico, Uganda, Democratic Republic of Congo, Tanzania, French Polynesia, Malawi, Tonga, Turkey and India.




**MARKET:** Natural vanillin sells for \$1,200-\$4,000 per kilogram (kg). The world market for botanically-derived vanilla is approximately \$240 million *per annum*.

**COMMERCIALIZATION:** Near-term. Evolva reports it is now scaling up production and will launch a commercial product in 2014.

## INGREDIENTS, FLAVOURS, FRAGRANCES AND SYNTHETIC BIOLOGY A NEW AND EMERGING ISSUE FOR CBD

This case study illustrates recent developments in synthetic biology that could impact the \$22 billion global flavour and fragrance market and the livelihoods of producers of natural commodities. These developments impact the sustainable use of biodiversity and fair and equitable sharing of benefits from the genetic resources that produce natural plant products. The world's largest producers of food ingredients, flavors and fragrances are all now partnering with Synthetic Biology companies to develop biosynthetic versions of key high value natural commodities such as saffron, vanilla, vetiver and patchouli - replacing botanical sources. These in turn are just a few out of hundreds of economically important natural plant compounds whose production may be switched to synthetic biology production in a very short time frame. No inter-governmental body is addressing the potential impacts of synthetic biology on the conservation and use of biodiversity and on the livelihoods of those who depend on agricultural export commodities (including high-value flavors, fragrances, essential oils, etc). The Convention on Biological Diversity is the most appropriate forum to address this new and emerging issue.

Vanillin – the world's most popular natural flavor – is sourced from the cured seed pod of



the vanilla orchid (*Vanilla planifolia*). Production of natural vanillin is time consuming and labour intensive: 1 kg of vanillin requires approximately 500 kg of vanilla pods and hand-pollination of approximately 40,000 flowers.<sup>2</sup> Natural vanillin sells for \$1,200-\$4,000/kg. The annual world market for naturally-sourced vanillin is approximately \$240 million; an estimated 200,000 people are involved in the production of about 2,000-3,000 metric tonnes of cured vanilla beans.<sup>3</sup> Madagascar and other island nations in the Southwest Indian Ocean (Comoros, Reunion) historically account for around three quarters of the world's vanilla bean production. Export earnings in the region are highly dependent on vanilla bean cultivation. An estimated 80,000 families cultivate vanilla orchids in Madagascar on approximately 30,000 hectares. In Comoros, an estimated 5,000-10,000 families depend on vanilla bean production. Approximately 4,000 farm families in indigenous communities of Mexico cultivate vanilla orchids; approximately 8,000 families in Central Africa (Uganda, Democratic Republic of Congo, Tanzania) depend on vanilla bean production. In recent years Indonesia and China have become major vanilla bean producers; other vanilla bean producers include French Polynesia, Malawi, Tonga, Turkey and India.

**CURRENT R&D:** In 2010, Switzerland-based synthetic biology company, Evolva, entered a 4-year agreement with the Danish government's Council for Strategic Research to develop a commercially viable and environmentally acceptable production route for biosynthetic production of vanillin. Scientists have already constructed a yeast-based fermentation route to both vanillin and other vanilla flavour components. In 2009 Evolva researchers described the creation of a *de novo* pathway to produce vanillin from glucose in two yeast strains; the new pathway involves bacterial, mold, plant and human genes.<sup>4</sup> In 2009 the global vanilla market, both natural and artificial, was valued at approximately \$650 million. Evolva believes that its fermented vanillin can capture up to \$360 million of the total global market.<sup>5</sup> The company claims it is now producing vanillin in engineered yeast at a price that is competitive with higher priced artificial vanillin. Evolva will scale up the process in 2012 and plans to launch commercially in 2014.


The CEO of Evolva, Neil Goldsmith, acknowledges that the company's fermented vanillin is not equivalent to the cured vanilla bean, but he says that the taste profile of vanillin produced by engineered yeast is more complex and closer than artificial vanillin to the natural vanilla flavor.<sup>6</sup> Evolva intends to make several molecules involved in the complex flavour profile of natural vanilla. Commercial viability ultimately depends on many factors; however, if Evolva succeeds in producing a vanillin flavour that can be scaled-up at a fraction of the cost of natural vanilla, it has the potential to provide a bio-based substitute for some portion of the natural vanilla bean flavour market.

#### **INTELLECTUAL PROPERTY RELATED TO BIOSYNTHESIS OF VANILLA:**

- US8,105,786: Method of producing a low molecular weight organic compound in a cell. Assignee: Evolva SA. Published: 31 Jan 2012
- EP2388333A3: A method of producing a low molecular weight organic compound in a cell. Assignee: Evolva SA. Published: 4 April 2012

#### **FOR MORE INFORMATION**

ETC Group has published several documents explaining and analyzing the impact of Synthetic Biology on biodiversity and livelihoods including *Extreme Genetic Engineering - An introduction to*



*Synthetic Biology, The New Biomasters - Synthetic Biology and the Next Assault on Biodiversity and Livelihoods* and *The Principles for the Oversight of Synthetic Biology* available on our website  
[http://www.etcgroup.org/en/issues/synthetic\\_biology](http://www.etcgroup.org/en/issues/synthetic_biology)

The Potential Impacts of Synthetic Biology on the Conservation & Sustainable Use of Biodiversity:  
A Submission to the Convention on Biological Diversity's Subsidiary Body on Scientific, Technical  
& Technological Advice (A Submission from Civil Society)  
<http://www.etcgroup.org/en/node/5291>

## REFERENCES

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- <sup>1</sup> Personal communication with Michel Grisoni, CIRAD (Centre de coopération internationale en recherche agronomique pour le développement), based in Reunion. All estimates for vanilla production and agronomic practices provided by Michel Grisoni.
- <sup>2</sup> Hansen, E. H., B. L. Møller, G. R. Kock, C. M. Büchner, C. Kristensen, O. R. Jensen, F. T. Okkels, C.E. Olsen, M. S. Motawia and J. Hansen, "De novo biosynthesis of Vanillin in Fission yeast (*Schizosaccharomyces pombe*) and Baker's yeast (*Saccharomyces cerevisiae*)," *Applied and Environmental Microbiology*, 75, 2009, pp. 2765-2774.
- <sup>3</sup> Personal communication with Michel Grisoni, CIRAD.
- <sup>4</sup> Hansen *et al.*, "De novo biosynthesis of Vanillin"
- <sup>5</sup> Personal communication with Evolva CEO, Neil Goldsmith, 5 October 2011.
- <sup>6</sup> *Ibid.*