Money doesn't grow on trees

An Australian biotechnology start-up has raised AU$5 million from investors to commercialise a new type of cellulose fibre that it says is 'plant-free and environmentally friendly'. The company says it raised most of the money at the listing of Nanollose Ltd on the Australian Stock Exchange in October 2017, while pledging to spend most of the funds on its supply chain. Nanollose claims its fibre, which is derived using microbes that convert biomass waste products from beer, wine and food, could be an alternative to lyocell, viscose or other cellulose derived textile fibres. **Tom Hinchcliffe** reports.

Biotechnology firm Nanollose has produced a cellulose fibre that it says is 'plant-free', and could be used by industry an alternative to cotton and tree pulp which are commonly used in the manufacture of conventional cellulose-based textiles.

The company says that its 'microbial cellulose' has an ecological advantage because it does not require considerable amounts of agricultural land and/or the associated inputs. By contrast, microbial cellulose doesn't need light or land and is instead 'grown' using a fermentation process from a range of industrial organic and agricultural wastes and by-products.

Nanollose, which has yet to commercialise the technology, has not yet generated any material revenue or profits, but essentially aims to provide a fibrous, edible soil-less substrate that can be used to germinate seeds in the horticulture market as a potential alternative to soil and other seed-raising mixtures.

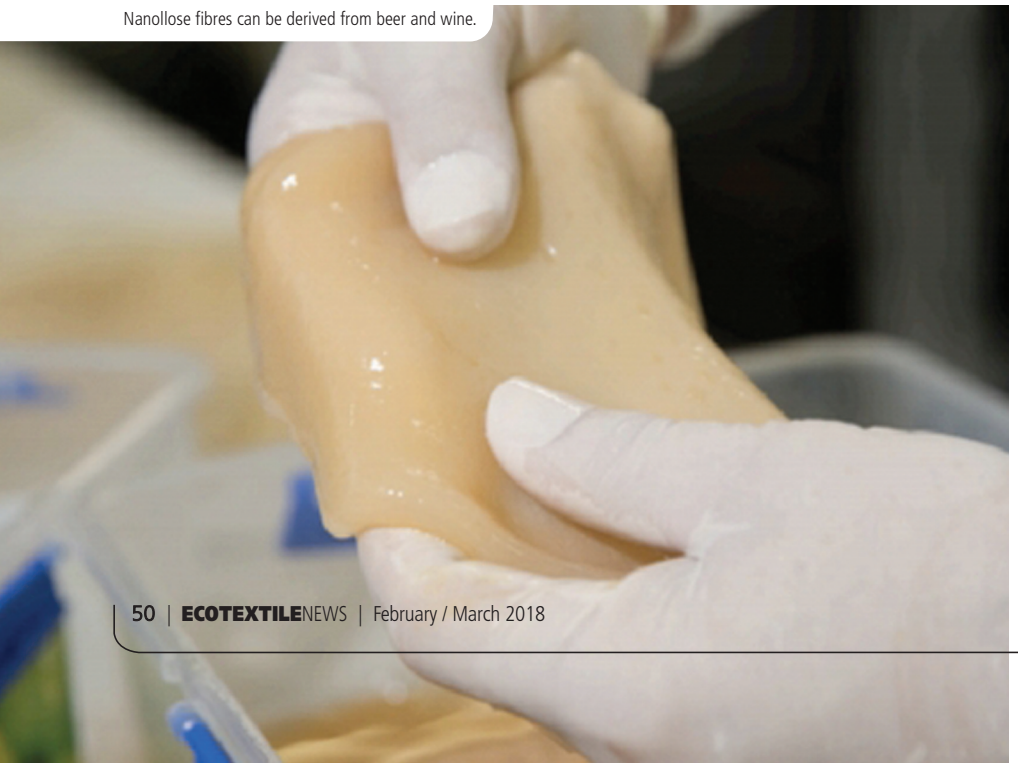
How it works

The developers say the chemical structure of microbial nanocellulose is similar to plant-based cellulose, but is produced from a sustainable fermentation process that uses Nanollose's Plant-Free cellulose fibres which derive from the non-infectious, non-harmful bacteria *Gluconacetobacter xylinus* (formerly known as *Acetobacter xylinum*). *Gluconacetobacter* is also used in the production of many natural balsamic vinegars and kampuchea tea.

These fibres are then collected as a very dense, tightly packed non-woven material. The solutions used can include, but are not limited to, the waste or byproducts from the production of beer, wine and or desiccated coconuts. Fermentation involves inoculating the waste products with *Acetobacter xylinum* and allowing it to grow over several weeks depending on the temperature. Optimal growth is achieved at about 30°C. Fermentation can be conducted in either static or agitated conditions. Different forms of microbial nanocellulose are produced under these different conditions.

Under static conditions the process is regulated by air supply and the yield depends on the concentration of available carbon in the solution. Microbial nanocellulose can be produced in approximately 18 days. This is a potential key advantage over plant-based cellulose, which takes much longer to produce. For example, trees used in the production of plantbased cellulose take many years to grow and cotton generally takes about six months from planting before being ready for harvest.

Nanollose fibres can be derived from beer and wine.



Alcohol

The company was formed in 2014 after Gary Cass worked with designer Donna Franklin to produce a dress made from microbial cellulose using the beer fermentation process, which was first showcased at the World Expo in Milan in 2015. While Cass admits that he was not completely happy with the final texture of that particular fabric, he believes significant investment into the new technology process will perfect it for use in a range of garments and other end uses. The company says the fibre has been developed at a time when major textile manufacturers are being encouraged to move towards 'greener' processes by retailers and brands.

Chief executive, Nanollose, Alfie Germano said: "What we are doing is facilitating a need for a change in our industry. Big clothing brands and textile manufacturers need to have a far better, more robust and ecologically sustainable story about how they secure products. As an industry we have realised that we are taking too much from the earth and it has to stop."

The company says it will bolster the strength, durability and washability of the fibre with the money raised, while continuing its research into making conventional textiles and other products more 'environmentally-friendly'.

Working with the industry

In regard to scaling up the technology and ensuring Nanollose has a reliable source of waste raw material, the company told *Ecotextile News*: "Nanollose is currently in discussions with several large microbial cellulose (the major component of Plant-Free cellulose fibres) suppliers throughout South East Asia and, in the near future, will look further afield globally for other locations that will be suitable for the mass production of microbial cellulose."

The company says it intends to partner with these suppliers to further research and develop alternative growing conditions that will ensure a reliable source of the waste raw material, with these alternative growing conditions and waste raw material including the use of food and liquid waste streams not currently being used for the production of microbial cellulose.

Nanollose admits that its early stage costs are high, but claims it can reverse engineer to meet market demands and develop at scale. The company says it is currently in talks with potential partners to facilitate the infrastructure for the scaling up project, while Nanollose would potentially fund it.

When asked if the microbial cellulose have any unique performance properties compared to traditional plant-based rayon or viscose, Nanollose told *Ecotextile News* that "From Nanollose's preliminary data, plant-free rayon fibres will have some unique performance properties compared to traditional plant-based rayon. Early data is showing some promising results with Nanollose determined to produce a plant-free rayon that is, at the very least, compatible if not superior to plant-based rayon when comparing fibre strength, absorbance, breathability, abrasion resistance, ease of dyeing and comfort."

One of Nanollose's goals is to improve the sustainable supply of cellulose into the rayon market, while millions of tonnes of trees are cut down for the production of rayon fibres. Another environmental issue with using trees as a cellulose source for the production of rayon is the Kraft industrial process that removes contaminates such as hemicellulose and lignin. Plant-free cellulose fibres do not contain these contaminants, therefore do not require the Kraft processing that trees are subjected to. The company says, another option would be the vertical farming of plant-free cellulose fibres. With *Gluconacetobacter* growing and producing Plant-Free cellulose fibres in liquid vats, Nanollose claims that these vats can be stacked up on top of each other.

Nanollose has also confirmed that the polymers will be used to make staple fibres, as it aims at specific textile end uses. These include a focus on six major markets – fashion and furnishings, horticulture, medical, food, hygiene, along with paper and packaging.

In a statement relating to the patented Nanollose technology and how it is applied at the fermentation state, the company said: "Nanollose's intellectual property will range from the growing of the plant-free cellulose fibres using a range of waste streams, to the spinning and extrusion stage of process and everything in-between."

Moving forward, Nanollose now plans to engage with several research partners with the intention of dyeing trials on the plant-free cellulose fibres later this year. Meanwhile, the project is still currently at lab-scale, manufacturing at readiness level (MRL) 3-4, but the company says it aims to move on to a MRL 9 in low rate production in 2018.

Web: www.nanollose.com ■

What could Nanollose be used for?

- Fashion and furbishing – Plant-free rayon as an eco-friendly alternative to plant-based rayon and other woven and non-woven materials
- Horticulture –An edible soil substitute for seed germination and plant growth
- Medical – Capable of scaffolding animal tissue for regenerative medicine
- Food – A sugar-free, fat-free, gluten-free dietary fibre
- Hygiene – With a very high fluid holding capacity, used in the female hygiene and diaper industries
- Paper and packaging – With high purity can be utilised as high-end paper products e.g. audio speakers. Also, the ability to convert into a biodegradable plastic e.g. cellophane]