

RESPONDING TO AN INSATIABLE MARKET DEMAND FOR LACTIC ACID

A local biomanufacturing process for the production of lactic acid

Addressing a problem and fulfilling a market demand

Disruptive bio-based innovation: Ending the reliance on an imported platform chemical

Bio-based production is widely viewed as a central manufacturing element of the next bioeconomy. Currently in South Africa, there is not a significant emphasis on the manufacture of bio-based platform chemicals. However, the country has become Africa's largest consumer of green chemicals, such as bio-lactic acid. This creates a unique opportunity for local technology development that moves away from petroleum-based chemicals and supplies a local market that is currently reliant on internationally supplied green chemicals.

Lactic acid is an organic acid that is generally recognised as safe and is widely used in the food, pharmaceutical, cosmetics and industrial sectors. This bio-based platform chemical is currently imported to meet the South African demand. Consequently, local production would eliminate the country's reliance on international supply and help stabilise the cost of this raw material, mitigating the impact of currency fluctuations.

More importantly, the lactic acid bio-manufacturing process relies on the bioconversion of a sugar feedstock. Consequently, the development of a domestic lactic acid production technology could be a game-changer for the South African sugar industry. This would align with its diversification strategy aimed at introducing new products, aside from sugar, to establish additional revenue streams.

The technology on offer

A biomanufacturing process for lactic acid from sugar by-product

The CSIR has established a bioconversion platform that focuses on alternate pathways for chemical production. The platform is geared towards local production and replacing imports of bio-based platform chemicals, including lactic acid. This shift will have a direct impact on the bioeconomy. The current bioprocess enables the bioconversion of industrial feedstocks or by-products, such as sugarcane molasses or sugarcane juice, to produce lactic acid by an indigenous microorganism. The technology has evolved from the proof-of-concept stage to achieve a technology readiness level (TRL) of 6. This optimised bioprocess, conducted at a 30 L scale, demonstrates a conversion rate of over 85% for the sugar feedstock into the final product, with titres exceeding 100g/L during the upstream process. Additionally, multiple downstream processing methods have been developed and optimised resulting in a purified product ranging from 75% to 92%, making it highly suitable for diverse applications across the industrial, food and cosmetic sectors.

Value proposition and competitive advantage

An all-local recipe: Local raw materials, microbe and biomanufacturing genius

The bespoke bioprocess is exceptionally localised, utilising readily available raw materials and indigenous microorganisms to generate local advantages. It aligns seamlessly with government’s priorities, encompassing local manufacturing, job creation, social enrichment, environmental preservation and import replacement. The adoption of this technology will safeguard the local industry dependent on this raw material from the pricing fluctuations caused by currency shifts, while also creating avenues for global market competition.

The lactic acid produced is cost competitive and meets various industrial sector purity requirements, benefiting the local food, pharmaceutical, cosmetics and industrial sectors. South African retailers and product manufacturers can now compete internationally by using local bio-based products.

In the longer term, the technology heralds the beginning of an alternate chemical production industry in Africa. It offers a prospect for diversifying the South African sugar industry. Additionally, the chemical conversion of lactic acid into bioplastic will unlock new opportunities within the biopolymer industry, ultimately reducing its reliance on imported raw materials.

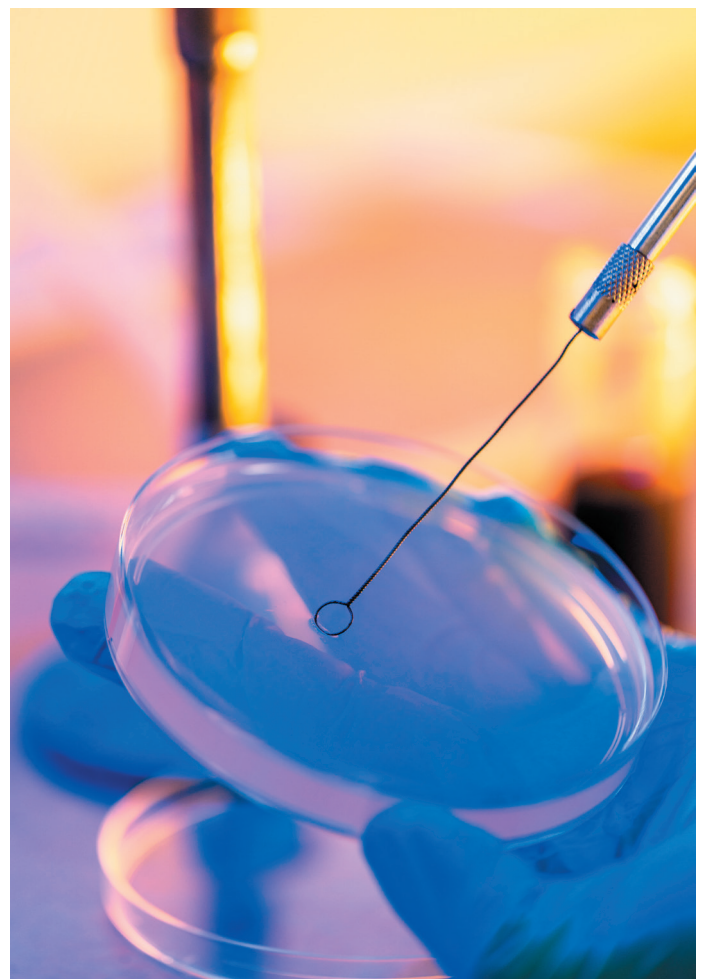
Market opportunity

A rising lactic acid demand on the back of a bioplastic surge

Globally, the production of bio-based chemicals and polymers has already reached an annual estimate of 50 million tons, generating revenue exceeding USD5.4 trillion. This global market is dominated by bio-based platform chemicals (building blocks), bio-based (green) solvents and biofuels. These products are manufactured directly from biomass, either through chemical or enzymatic processes, or by converting biomass using microorganisms during fermentation.



Sugarcane molasses is utilised as a media component for the production of lactic acid.



Streaking of the indigenous microorganism that is crucial in the upstream process of lactic acid.

The global market for lactic acid alone reached USD3.1 billion in 2022 and is expected to grow at a compound annual growth rate of 8% to USD5.8 billion by 2028. However, lactic acid is available in various grades, depending on its purity and intended application. The use of lactic acid across multiple sectors, including pharmaceuticals and the food and beverages industry, is expected to increase demand. Furthermore, one of the most significant areas of global interest in lactic acid lies in bioplastics, a sector that has experienced remarkable growth over the past decade as the market for sustainably sourced plastics has shifted dramatically toward renewable materials.

In South Africa, the market size for imported lactic acid, primarily targeted for use in the industrial and food sectors, amounts to approximately R105 million annually. However, a key driving force for the adoption of this platform chemical is its conversion into bioplastics for use in the bioplastic industry, which currently represents a USD9 billion annual global market.

Business opportunity

Become a lactic acid producer to supply the food, pharmaceutical and other industrial markets

The technology is available to a local licensee through CSIR C³, offering opportunities as a standalone business or for integration into established commercial industries, including the local sugar industry. Additionally, there is potential for joint ventures with small-scale sugarcane farmers and independent millers. International licensing and commercialisation avenues are also available.

The CSIR is committed to facilitating ongoing enhancements and the development of new technologies through research and development partnerships.

Investment and return on investment

Invest to capitalise on an established market need and a burgeoning new need

An investment of R20 million over a two-year period is required to facilitate the technology’s scale-up, conduct pre-commercial feasibility assessments for integration into existing industries and support business development. Subsequently, there will be a three-year plan for establishing and commissioning a manufacturing plant, projected to cost approximately R60 million.

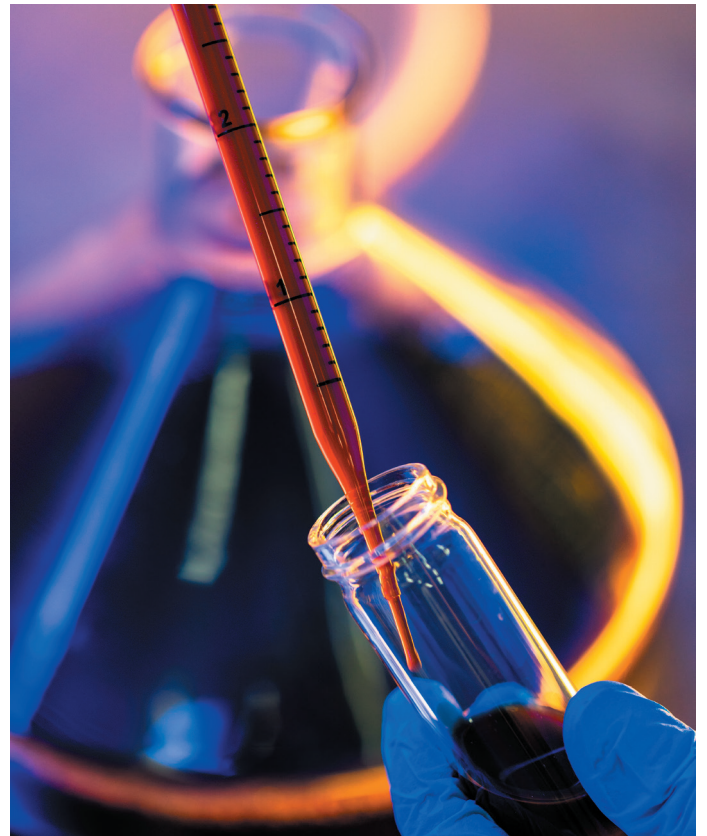
The anticipated revenue from replacing imports in the local South African lactic acid market is estimated to range from R105 million to R120 million annually. Entry into the global market sector for bioplastics – at a conservative 2% market share – is valued at approximately USD116 million to USD125 million annually.

A team of bioprocessing experts

The research and development efforts are led by a CSIR chief researcher, who has over 25 years of experience in the biotechnology sector, nationally and internationally. The CSIR team of bioprocessing experts brings a wealth of knowledge in scaling up technologies for commercialisation and providing support to industry, as well as small, medium and micro enterprises.

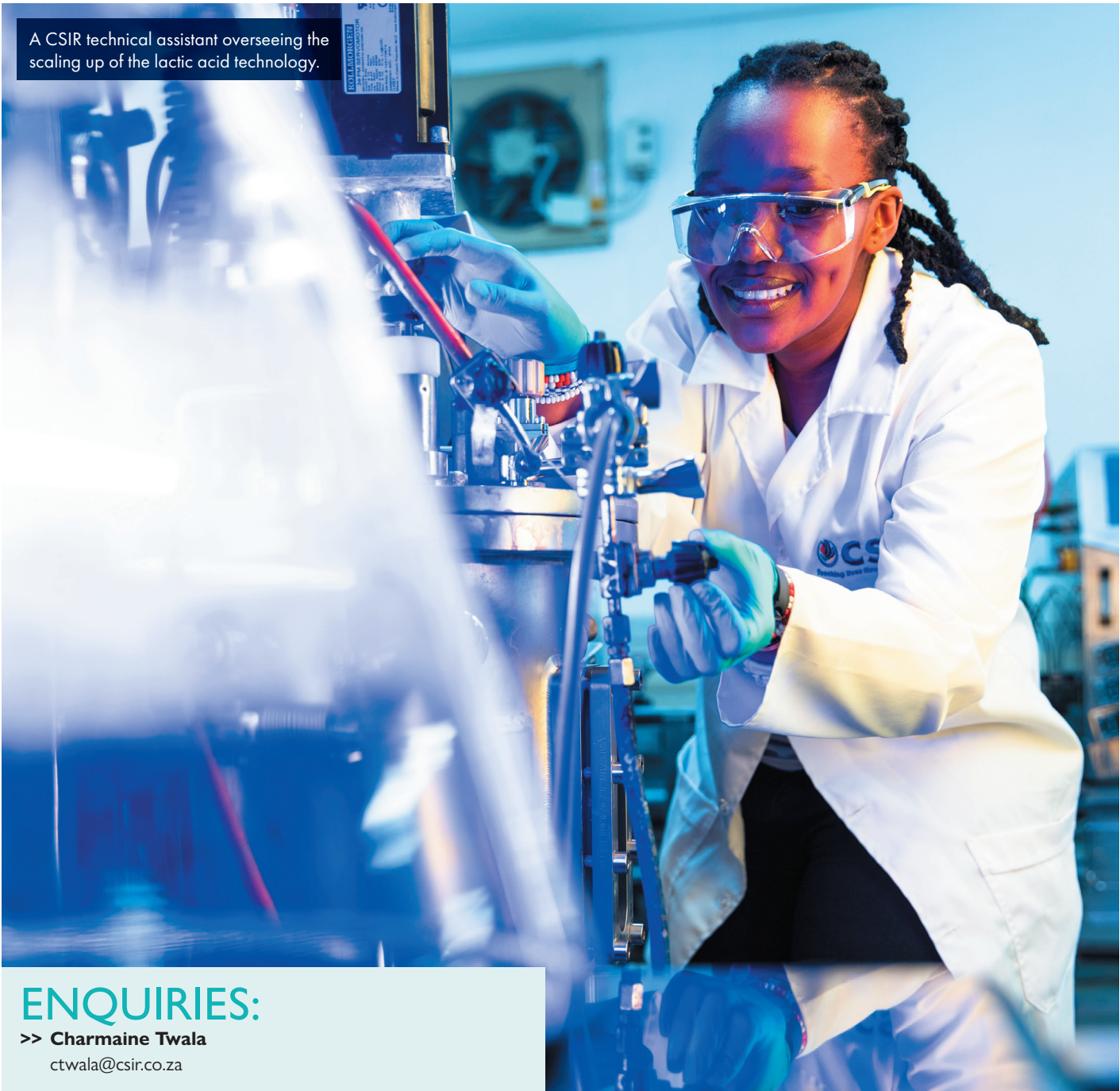
The team will also leverage and integrate existing capabilities in chemistry, polymer processing and bioplastics, and will use existing infrastructure at CSIR facilities, such as the Biorefinery Industry Development Facility, Biomanufacturing Industry Development Centre and Nanomaterials Industry Development Facility. These CSIR-established centres serve as hubs for technology development and market-facing facilities, accelerating the translation and commercialisation of innovative technologies.

The CSIR has strong capabilities in synthetic chemistry and bioprocess engineering. To expedite commercial implementation, additional expertise will be recruited and developed in areas such as process engineering, microbial engineering, metabolic modelling, as well as polymerisation and polymer formulation.



Aseptic sampling during the fermentation processes.

A CSIR technical assistant overseeing the scaling up of the lactic acid technology.



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LACTIC ACID APPLICATIONS



Yoghurt



Sourdough



Beauty products