TATA CHEMICALS LIMITED

TCL'S PIONEERING STEP TOWARDS A BETTER TOMORROW

Through a perfect blend of scientific technology and inventiveness, Tata Chemicals created a superior version of Oligosaccharides.

CASE STUDY

YEAR OF IMPLEMENTATION: 2011

OVERVIEW

The citizens of India have recently experienced increase in prosperity. With this growth, though, the nation has incurred a rampant progression of lifestyle diseases. Digestive health, governed by Prebiotics, is considered the most integral component in the health portfolio. Prebiotics, especially Oligosaccharides, have numerous benefits. The use of Oligosaccharides assists the body in the improvement of bifid bacteria in the intestine that aids in digestive activity, the increased uptake of minerals such as calcium and magnesium, and the fact that Oligosaccharides replaces sugar ensuring a lower calorie intake without interfering with the body's insulin.

The technology utilised by most producers of Oligosaccharides has a low yield during the fermentation process, which results in a high amount of impurities and leads to costly downstream processing procedures. Tata Chemicals focused on this particular aspect, and used a combination of micro-organisms that completely consumes the raw material during the process which resulted in higher purity and better yields. Since Oligosaccharides are amongst the most dynamic Prebiotics, offer phenomenal lucrative opportunities with their growth in popularity, have limited competition, and are manufactured outside India, Tata Chemicals saw an opportunity to create a better and safer product that was manufactured in India. This improved impurity profile has led to increased acceptability for usage in pharmaceuticals, improved prebiotic activity and a better shelf life for the product.

INNOVATION

Tata Chemicals found that the Oligosaccharides available in the market possessed purity levels of an estimated 55-95%. A large amount of unreacted sucrose and other reducing sugars tend to remain in the solution, which has to be removed by extensive down streaming processes required for purification. This increases production cost for the products. The company decided to tackle this issue with goals to develop a better and safer product. What this resulted in was a platform technology, the same concept that had been used for other homologues.

First, Tata Chemicals targeted the elimination of sugars during the fermentation process. It found that the reaction was limited due to the presence of inhibiting by-products. The strategy that the company adopted was to remove them using a micro-organism so that the by-products could be converted without affecting FOS in any way. The method was tried by a number of micro-organisms, one of which finally yielded the desired results.

The company ended up with two micro-organisms, one that converted the Sucrose to FOS, and the other which altered the inhibiting by-products to more innocuous materials. The reaction from the process forced the conversion of 95%-100% of the sucrose, and the final product showed negligible reducing sugars. Not only did the simultaneous use of whole cells ensure elimination of enzyme extraction and immobilization on the polymer substrate, but it also made the entire process more economical. After concentration to 80 Brix, the liquid FOS resulted in having a stable shelf life and ensured that the Oligosaccharides would be

INNOVATION IN A NUTSHELL

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present in the formulation till the end dates of the products. In order to improve the product delivery to the customer, Tata Chemicals also worked with a number of permissible free-flowing agents to obtain a free-flowing FOS power, which in other circumstances is very hygroscopic. Since then, customers have become more willing to try out other applications as well as pharmaceuticals and food for diabetics due to negligible reducing sugars. With a great product that met customer needs, the company looked to becoming a prominent force as ingredient suppliers, formulations suppliers, and having a brand presence in final functional food. As this was considered a time-consuming endeavour, it has been searching for a low-cost model of acquiring competencies that it lacks through multiple partnerships.

As with any lucrative industry, there are a huge number of small but very specialized business units that have made their marks in their respective markets. Tata Chemicals is offering to scale-up their operations through its network, and have initiated partnerships so that these companies can benefit from its expertise. This has been perceived as a win-win situation for both parties, and the hope is that talks will lead to future joint ventures.

Since the technology available worldwide to produce pure oligosaccharides is cost intensive, the only way to make production feasible is if it were made in great volumes. Tata Chemicals was facing a challenge to demonstrate its technology at a lower scale and generate the market feedback and customer acceptance it desired for the product. Moreover, mitigating the risk of high investments while also producing competitive products in the same time frame proved difficult for the company. Tata Chemicals research team developed a pioneering technology by using microbial consortium so that the Oligosaccharides could be produced on a smaller scale, and at a very high purity, so that it could compete with the products sold internationally. While keeping the future in mind, it formed a business plan that could adjust to potential expansion and diversification.

In order to conduct a survey, Tata Chemicals partnered with numerous external agencies that assisted in process optimization and production of oligosaccharides on a smaller scale. While it lacked an in-house facility, it made use of its resources and optimized all the operations of the process. Furthermore, it designed its own pilot facility, and commissioned it at Sriperumbudur, Chennai. Tata Chemicals' new business is considered the perfect blend of science, technology, and business innovation.

The company's pure Oligosaccharides can be used safely by diabetics, are stable and notably exhibit significant prebiotic activity. This success opens up many more application areas in Functional Foods and Pharmaceuticals. The process improvement has enabled Tata Chemicals to offer the product as a free-flowing powder which has helped food formulators in their operational processes, and in maintaining or improving the product's texture.

THE CHALLENGE

Although the need to improve on and develop a substantially better product was easy to spot, Tata Chemicals faced certain challenges during the process. The first hurdle the company encountered came during the primary stages. It had to develop a non-infringing process that could eventually be patented. Since the market for Oligosaccharides was emerging at the time, it was very crowded in terms of patents from international companies. Tata Chemicals had to carry out research on the patents and look for gaps in the market. As none of the patents had considered new organisms or mixture, the company used this gap as a basis for a strategy.

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CHALLENGES FACED

- The company had to develop a non-infringing process that could eventually be patented.
- The team had to find a way to drive the reaction forward despite the presence of inhibiting products in the reaction solution.
- Tata Chemicals had to scale-up its facilities and process validation.

The scientific method presented its own issue for Tata Chemicals. The team had to find a way to drive the reaction forward despite the presence of inhibiting products in the reaction solution. It used a combination of micro-organisms so that one could drive the reaction forward, and the other would remove the reaction-inhibiting products. Another challenge was to identify the micro-organisms that would utilise reducing sugars without affecting the final product. These were isolated from the site of sugar companies.

The feasibility of the entire manufacturing process was also a major hurdle. Tata Chemicals had to scale-up its facilities and process validation. Due to its lack of physical property, outsourcing was deemed the best option. However, the company could not find a single company that could cater to all of its needs. It broke the process down into three parts - Fermentation and Biotransformation, Downstream processing and Purification, Concentration and Spray Drying after which it identified partners for each activity and validated the process.

THE IMPACT

From an economic standpoint, the high purity Oligosaccharides that possess negligible reducing sugars paves the way for new application areas in the market. The potential for higher profit margins, increased volume usage and economical prices for the consumer gives Tata Chemicals a competitive edge over other businesses in the industry. While the profit margins in real terms will not be recognized until the production plant has been expanded to the next level, the samples shared with the customers have started portraying Tata Chemicals as an innovative company in the Wellness market. Since there is no other manufacturer of this product in the country, Tata Chemicals is considered a pioneer in this field.

In terms of benefitting the environment, the company uses only aqueous media and no solvents. Its low energy intensive processes are carried out at ambient temperatures and no hazardous waste products are generated during the process. These factors result in reduced effluent treatment, and a diminished carbon footprint as Tata Chemicals commercializes its process.

THEIR JOURNEY POST INNOVISTA

Tata Chemicals achieved a phenomenal feat with its new product. By using microbial consortium so Oligosaccharides could be produced at high purity levels and a smaller scale, it provided the Indian market with an innovative product that could compete with the international market.

The company has created a better and safer product that is reasonably priced and resonates well with its consumers in the market it is situated in. Tata Chemical's pure Oligosaccharides are not only safe for diabetics, but are also are stable and display considerable prebiotic activity. Most significantly, Tata Chemical's immense success has opened up many more application areas for companies present in the Functional Foods and Pharmaceuticals industries.

Major milestones achieved

2011: Completed pilot trials and techology validation at 1000L level and optimized all the unit operations of the process. Filed us and Indian Patent. Established Nutraceuticals Solutions Business as separate Umbrella for health and nutritional products. Received Tata Innovista Award in Promising Innovation Category.

2012: Designed own pilot plant and intiated the pilot plant constructions. US patent granted.

2013: Commissioned 300 MTPA pilot plant and started commissioning of process equipments and process fine tuning.

2014: Full fledge production started and produced 280MT of product in first year of commissioning.

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THE SOLUTION

- Tata Chemicals carried out research on the patents and looked for gaps in the market. As none of the patents had considered new organisms or mixture, the company used this gap as a basis for formulated a strategy.
- It used a combination of micro-organisms so that one could drive the reaction forward, and the other would remove the reaction-inhibiting products.
- The company broke its process down into three parts - Fermentation and Biotransformation, Downstream processing and Purification, Concentration and Spray Drying after which it identified partners for each activity and validated the process.

2015: Produced 450 MT of product. Plant received GMP certification. Product has been approved by major food agencies like; FSSAI, KOSHER, HALAL. Started spray dryer and powder FOS product.

2016: Achieved 550 MT of production, taped 30 national and international customers and received a number of repeat orders. Received GRAS certification for US market. Completed Texicological Study and found safety of the product. Clinical trials are in progress in support of health claims. Received management approval for expansion of 5000 TPA production plant.

The company has achieved multiple milestones in its ambition to create this innovation. In 2011, the company concluded pilot trials and technology validation at 1000 L level, and also optimized all the unit operations of the process. It filed for the US and Indian patents in the same year, and established the nutraceuticals solutions business as a separate entity under health and nutritional products. As commendation, its advancement received the Tata Innovista Award in the Promising Innovation Category.

In 2012, Tata Chemicals was granted its US patent, designed its own pilot plant and initiated the plant's construction. A year later, the company commissioned a 300 MTPA pilot plant and started authorizing the process equipment, and worked on fine-tuning the process. Within a year of commissioning the process, full-fledged production began, and 280 MT of the product was made. In 2015, Tata Chemicals produced 450 MT of the product. In the same year, the plant received GMP certification, and the product was approved by major food agencies such as FSSAI, KOSHER, HALAL etc. The company then started the spray dryer and powder FOS products.

Last year, it developed 550 MT units in production, tapped 30 national and international customers, and received a large number of repeat orders. It received GRAS certification for the US market, and completed a toxicological study to determine the safety of the product. Moreover, Tata Chemicals has lined up clinical trials to support the health claims of the product. The company has also received management approval for the expansion of a 5000 TPA production plant.

FOS- TCL Technology

- Conversion 99% against 70% earlier
- Microe IC002 does not interfere or digrade the FOS. It converts only the reducing sugars.
- Patent application no. 2360/MUM/2009, PCT/IN2010/000674, 520/MUM/08 and PCT/IB2009/51027

RESULTS ACHIEVED

- A safer and improved product
- An economical manufacturing process
- Tata Chemical's success has opened up many more application areas in the Functional Foods and Pharmaceuticals

ABOUT TATA CHEMICALS LIMITED

A part of the Tata Group, Tata Chemicals Limited is a global company with interests in businesses that focus on essentials for LIFE: Living, Industry and Farm Essentials. Tata Chemicals' vision is to be a leader in corporate sustainability, focussing on the three elements of people, planet, and profits.