

Translation of the following article: Gunter Festel, Michael Baumann, Tim Friedrichson, Joachim Venus, Jan Biering, Florian Mischke, *Mitobene als gesundheitsförderndes Erfrischungsgetränk aus Bierwürze*, Brauerei Forum, August 2023, p. 8-10.

Mitobene as a health-promoting refreshing drink from beer wort

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The Swiss start-up Cerefort has developed a drink called Mitobene, which is made from cereals using a patented fermentation process and has a high D-lactate content. This high D-lactate content has a health-promoting effect by positively influencing mitochondrial function.

Cerefort GmbH was founded in 2022 by a team of biotechnologists, molecular biologists and chemists. The company is based in the canton of Nidwalden near Lucerne in Switzerland. Together with the Leibniz Institute for Agricultural Engineering and Bioeconomics (ATB) in Potsdam and the Versuchs- und Lehranstalt für Brauerei (VLB) in Berlin, Mitobene was developed as a health-promoting soft drink made from beer wort.

Mitobene improves mitochondrial activity. Mitochondria are the primary source of metabolic energy. Therefore, vitality and well-being depend on mitochondrial function. As we age, mitochondria tend to be less dense and more fragmented, producing less energy.

Based on research by Max Planck scientists, it has been shown that the compound D-lactate can revitalize mitochondrial function [1]. D-lactate stabilizes the membrane potential of mitochondria and contributes to cell and neuron survival [2]. This is supported by further studies in which D-lactate showed a neuroprotective effect [3].

Mitobene as innovative product

With the intake of Mitobene, the daily intake of D-lactate can be significantly simplified, as quantities of 100 ml are already sufficient. Mitobene thus enables the intake

of D-lactate in a concentrated form equivalent to the consumption of 1 kg of Bulgarian yogurt, which is often consumed by Parkinson's patients. Some Parkinson's patients who have been consuming homemade Bulgarian-style yogurt for some time report a subjective improvement in symptoms.

Mitobene is produced by fermentation of beer wort. In the case of the Mitobene product, it is a lactic acid bacterium that can utilize very specific carbohydrates in beer wort and effectively produce D-lactic acid without the formation of other by-products. With the increasing acid formation, the pH value in the medium gradually decreases and must be regulated as continuously as possible to an optimum value.

Mitobene tastes only slightly acidic despite its high D-lactate content. Since Mitobene is largely neutral in taste and odour, the beverage is perfect as a blending component for a range of basic products. Mitobene can be mixed with fruit juices, milk or yogurt, for example. Since only a small amount of Mitobene is required, the character of the base product is fully preserved.

Systematic product development

After many trials with fruit juices and molasses, unhopped beer wort proved to be the best substrate for fermentation with the special lactic acid bacteria.

A first scale-up trial was carried out in the 5 hl brewing system of VLB's pilot brewery. For this trial, a wort was prepared in the brewing house and first atmospherically boiled in the wort kettle without hops to create a sterile substrate. After subsequent hot break separation, this wort could be cooled down to 30°C in the whirlpool via the wort cooler. Deviating from the actual brewing process, the wort for this trial was knocked out again into the wort kettle and not into a fermentation tank.

On the one hand, this is due to the increased microbiological safety, as live lactic acid bacteria only have to be kept in the hot area of the brewery. On the other hand, the subsequent lactic acid fermentation at 30°C poses a certain challenge for the brewery, as such temperatures cannot easily be kept constant in the fermentation cellar. Therefore, it was decided to use the so-called "Kettle Souring" process.

After approx. 3.5 days of fermentation at a constant pH value and constant 30°C, a sufficient lactate concentration was achieved. Finally, the batch was boiled again to kill the lactic acid bacteria and a hot separation was carried out before the product could be cooled and bottled (see Fig. 1).

The secret of the Mitobene process is pH control to obtain a D-lactate content of over 30 g/l. Usual lactic acid fermentations of beer wort and other substrates, e.g. in the production of Berliner Weisse, come to lactate values of 5 g/l maximum. A patent application was filed for the process, including pH control, and an apparatus was developed that measures the pH value in real time during fermentation and corrects it according to the specifications (see Fig. 2).

Important for good process control is the analytics, which have been specially adapted for this process. At present, most process parameters are still recorded offline, i.e. the samples taken periodically are subsequently measured by HPLC [4] to determine the content of sugars, lactic acid including their optical purity as well as any by-products that may have arisen.

Health promoting effects

In a first explorative study, the participants, who were healthy individuals and also Parkinson's patients, received a defined daily dose of Mitobene for 6 weeks. Blood was taken before the start and after the end of the intake. The parameters of mitochondrial activity were measured by the German diagnostic laboratory Biovis in Limburg and the Bioenergetic Health Index (BHI) was determined.

The BHI is of particular importance in this context. The principle of the bioenergetic profile is based on the measurement of mitochondrial oxygen consumption rates. One advantage of this test is that several parameters are determined, which in their entirety allow a statement about the health of the mitochondria. After 6 weeks of taking Mitobene, the BHI index improved, especially in the Parkinson's patients.

Based on the first study, another study was conducted in 2022. The participants, who were healthy individuals, took 100 ml of Mitobene daily over a period of 1 month. Physical performance was assessed daily according to a standardised procedure.

In all of the test persons, there was a continuous increase, which reached a plateau after about 2 weeks. The subjective evaluation showed an increase of 47.5%. This study thus showed that Mitobene has a positive influence on physical performance.

Cooperation partners sought

As the strengths of the team at Cerefort lie in the early stages of product development, from the evaluation of scientific results to the development of a production pro-

cess, Cerefort is now looking for cooperation partners for further product development and market launch.

The goal is to realise a quick implementation by licensing to breweries and beverage producers with their production and distribution possibilities. Prototypes have already been developed (see Fig. 3).

Implementation in the brewery is possible without any problems, as existing equipment can be used. This is especially true in view of the fact that the beverage could also be of interest to the fitness market, since mitochondrial fitness is a prerequisite for athletic performance.

Literature

[1] <https://parkinson.mpi-cbg.de> (abgerufen am 11.06.2023)

[2] Toyoda, Y.; Erkut, C.; Pan-Montojo, F.; et al.: „Products of the Parkinson's disease-related glyoxalase DJ-1, D-lactate and glycolate, support mitochondrial membrane potential and neuronal survival”, *Biol Open*, 2014, 3(8), 777-784

[3] Castillo, X.; Rosafio, K.; Wyss, M.-T.; et al.: “A Probable Dual Mode of Action for Both L- and D-Lactate Neuroprotection in Cerebral Ischemia”, *Journal of Cerebral Blood Flow & Metabolism*, 2015, 35(10), 1561-1569

[4] Alexandri, M.; Hübner, D.; Schneider, R.; Fröhling, A.; Venus, J.: “Towards efficient production of highly optically pure D-lactic acid from lignocellulosic hydrolysates using newly isolated lactic acid bacteria”, *New BIOTECHNOLOGY*, 72, 2022, 1-10

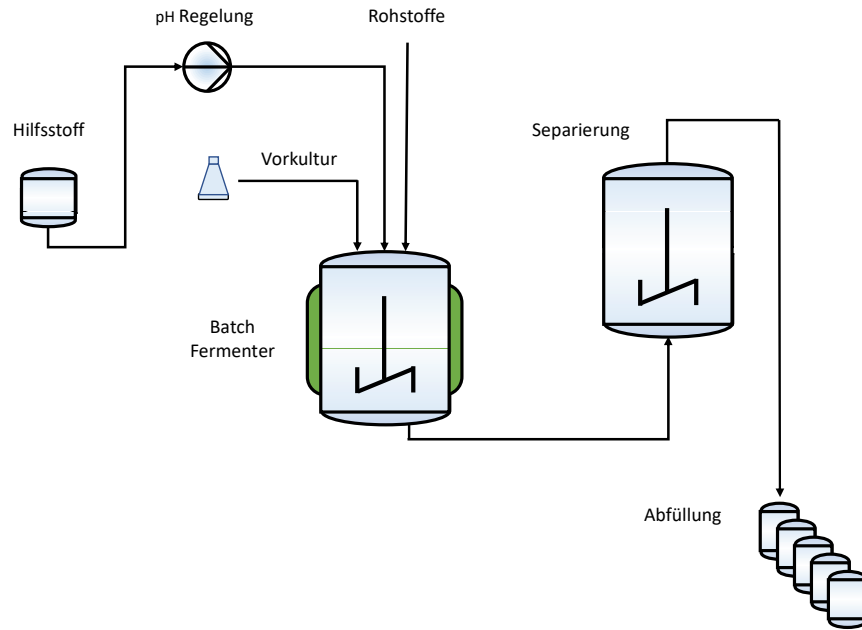


Fig. 1: Schematic of the 5 hl brewing system of the pilot brewery. Filling took place in kegs for storage for further use.

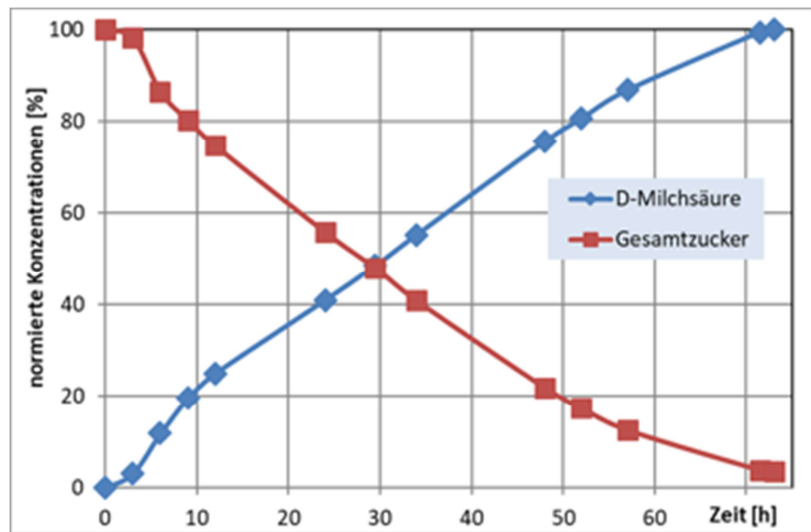


Fig. 2: Formation of D-lactic acid (D-lactate) in unhopped wort during the pure culture fermentation of a specific strain of lactic acid bacteria with correspondingly correlated consumption of total sugar



Fig. 3: Bottled Mitobene for use as a component in mixed drinks with various possible flavours.