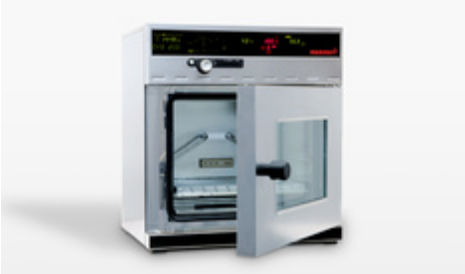
Low temperature vacuum drying – gentle on bacteria and the environment

Freeze drying, the most common means of drying starter cultures and probiotics, is very energy-intensive. Furthermore, some bacterial strains do not survive the freezing process.



Cooled **vacuum drying oven** VO developed by **Memmert**

In the laboratory of the Technical University of Munich, tests in a cooled Memmert vacuum drying oven contribute to the development of gentler and more energy-saving low temperature vacuum drying technologies.

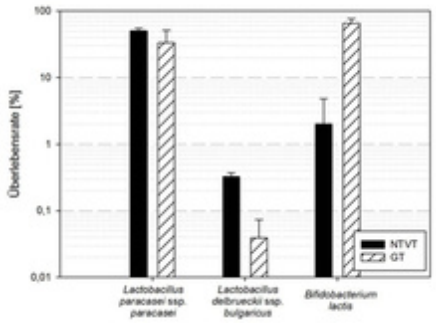
Probiotics require new production processes

The consumers' demand for natural immune system boosters, more power in everyday life, as well as better health or less cholesterol leads to a significant annual growth of the functional food industry. **Probiotics**, health-fostering **bacteria cultures**, “for life”, are booming.

Particularly lactic bacteria and bifidobacteria promote intestinal health and thus strengthen the immune system. Furthermore, **bacteria cultures** are used in the production of sausages, sourdough or dairy products as well as in fermentation, stabilisation or in flavouring. Until they get packed, **probiotics** still have some process steps ahead of them that influence their stability and viability. In particular, they could be negatively influenced by drying, storage in powder form and interaction with the product itself.

Gentle vacuum drying at low temperatures

Normally, probiotic bacterial strains and starter cultures are dry-frozen to preserve them until use. That means, they are first deep-frozen and afterwards dehydrated in a vacuum. This procedure, however, has two major disadvantages in practice: Firstly, it consumes a very high amount of energy and secondly, some **bacterial strains** do not survive temperatures below zero. Dr. Petra Först, Professor Ulrich Kulozik and their team at the Chair of Food Process Engineering and Dairy Technology at the Technical University of Munich focus on the development of low temperature **vacuum drying** (LTVD) for industrial processes.



Maximum survival rates of diverse bulgaricus strains with a residual humidity of 6 to 7 %, depending on the drying process applied (low temperature vacuum drying (LTVD) and freeze drying (FD)) [2]

Thanks to this **drying process**, unstable substances can be dried at moderate temperatures above zero without causing too much damage to the cell structure. In the Journal of Biotechnology [1], the scientists from Freising published their first results from their work using three **bacterial strains**. The quintessence is shortly summarised in a corresponding press release in one sentence [2]: The optimal **drying process** depends on the respective **bacterial strain**. For instance, the strain Lactobacillus bulgaricus, showed a ten times higher yield after LTVD than after **freeze drying**. Furthermore it is stated, that the fact that other **bacterial strains** show a disparate behaviour, could be traced back to the different fatty acid compositions in the bacterial cell membranes.

Up to 40 % less energy costs thanks to low

temperature freeze drying

The project engineer in charge, Dipl.-Ing. Simon Bauer, projects a promising future for **low temperature vacuum drying** in the food and pharmaceutical industry. Besides the gentle treatment of cell cultures, energy cost savings of up to 40 % compared to **freeze drying** are for sure one of the strongest arguments in times of increasingly scarce resources. Furthermore, the initial investment costs are lower, the process is less time-consuming and vacuum dried probiotics - compared to freeze dried bacteria cultures – can be stored longer, even at higher temperatures. [3]

Cooled vacuum drying oven for laboratory application

For further research, a cooled laboratory **vacuum drying oven** with a temperature range of +5 °C to +80 °C has been developed in cooperation with the Schwabach-based company **Memmert** on the basis of their **vacuum oven** VO 200. A fundamental objective of the series of experiments is the determination of the perfect combination of temperature and pressure. Experiments are performed at different pressures between 10 and 30 mbar and surface temperatures between 15 °C and 35 °C, resulting in minimal sample temperatures of approximately 0 °C.

The **vacuum drying oven** is equipped with a programmable digital pressure control. In the future, it will be possible to deploy vacuum/temperature ramps to determine which temperature drop in the sample leads to the perfect metabolic activities of the cell cultures at which residual humidity. A sensor positioned at the sample measures and logs the temperature of the **bacterial strains** during **vacuum drying**.

Determining the dry content and water content in a vacuum

Using a Memmert vacuum oven VO, the quality assurance department of a pharmaceutical expert in Paraguay determines the dry content of gel capsules in accordance with USP (United States Pharmacopeia) standard 731 and the water content in accordance with USP 921.

more information

Controlled scenarios in the laboratory

The **Memmert low temperature vacuum drying oven** enables new applications in the food and pharmaceutical industry. For example, programmed and controlled transport

and storage scenarios can be applied to determine the behaviour of active ingredients or volumes at different pressure and temperature conditions.

The compact Peltier cooling has been integrated in control technology and in numerous programme and documentation functions of the standard **vacuum oven VO**. Thanks to this feature, the **low temperature vacuum drying oven** can also be deployed for the conservation of sensitive master cultures. Drying parameters and the temperature in the **bacterial culture** can either be directly logged in the internal data logger or transferred to an external computer using special software. Further advantages of Peltier technology are its high control precision of ± 0.1 K, its smooth running as well as energy-saving and environmentally-friendly cooling without coolants. Of course, as far as technically feasible, temperatures outside the previously mentioned +5 °C to +80 °C range could be realised as well. If you have any questions concerning the cooled **vacuum drying oven**, please contact the Memmert custom products team at myatmosafe@memmert.com.

Memmert low temperature vacuum drying oven

An overview of focus topics

- Food research
- Drying processes
- Vacuum drying, vacuum drying oven
- Low temperature drying
- Vacuum drying oven
- Probiotics, starter cultures

Memmert coolable laboratory equipment

Cooled incubator IPP
Climatic test chamber CTC
Constant climate chamber HPP
Climate chamber ICH
Storage chamber IPS
Peltier cooling unit for waterbath

Picture credit/Source: Memmert, Istockphoto.com/humonia

[1] Bauer, S.A.W.; Schneider, S.; Behr, J.; Kulozik, U.; Foerst, P.: Combined influence of fermentation and drying conditions on survival and metabolic activity of starter and probiotic cultures after low temperature vacuum drying. J. Biotechnology, Online preliminary publication under http://www.sciencedirect.com/science/article/pii/S0168165611003099

[2] TUM researchers develop environmentally friendly process to improve storage stability of probiotics, press release 07/06/2011, Technical University of Munich - Chair

for Food Process Engineering and Dairy Technology

[3] Foerst, P, Kulozik, U, Schmitt, M, Bauer, S, Santivarangkna, Ch (2011) Storage stability of vacuum-dried probiotic bacterium Lactobacillus paracasei. Food Bioprod. Proc. 10.1016/j.fbp.2011.06.004

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