

hs-tumbler's trajectory mixer cleared for industrial rollout

Ham mixed in seconds, not hours; reduces energy use by 80 percent; eliminates stirring, kneading and brine injection; 7.2 tons per hour; 12-second batch swaps

OSNABRUECK, LOWER SAXONY, GERMANY, April 24, 2025 /EINPresswire.com/ -- German startup [hs-tumbler](https://www.hs-tumbler.com/) has completed validation for industrial use of its patented 'trajectory mixer', a novel alternative to conventional tumbling systems. The

technology will enter first large-scale application in ham production this summer. Unlike conventional tumblers that take hours, the high-speed system mixes meat and brine in seconds, ensuring uniform texture and flavour.



“

We can process three times what the largest mixer available on the market can do over the same time period with 80 percent less energy consumption”

*Bernhard Hukelmann,
Managing Director of hs-tumbler*

With 80 percent energy efficiency, the high-frequency mixing movements eliminate traditional stirring, kneading, and brine injection process, improving hygiene and efficiency. Applications include cooked cuts, marinated meats and vegetable proteins to pizza dough and cosmetics.

Scheduled to enter volume production at a ham factory in Germany this summer, the trajectory mixer passed validation at the German Institute for Food ([DIL - Deutsches Institut für Lebensmitteltechnik](https://www.dil.de/)). The rigorous

tests confirmed its speed advantage: the hs-tumbler mixer can handle 7.2 metric tons per hour, with batch swaps averaging just 12 seconds— approximately 1,000 times faster than conventional methods—not only improving hygiene and flexibility but also enabling producers to complete new inline production methods.

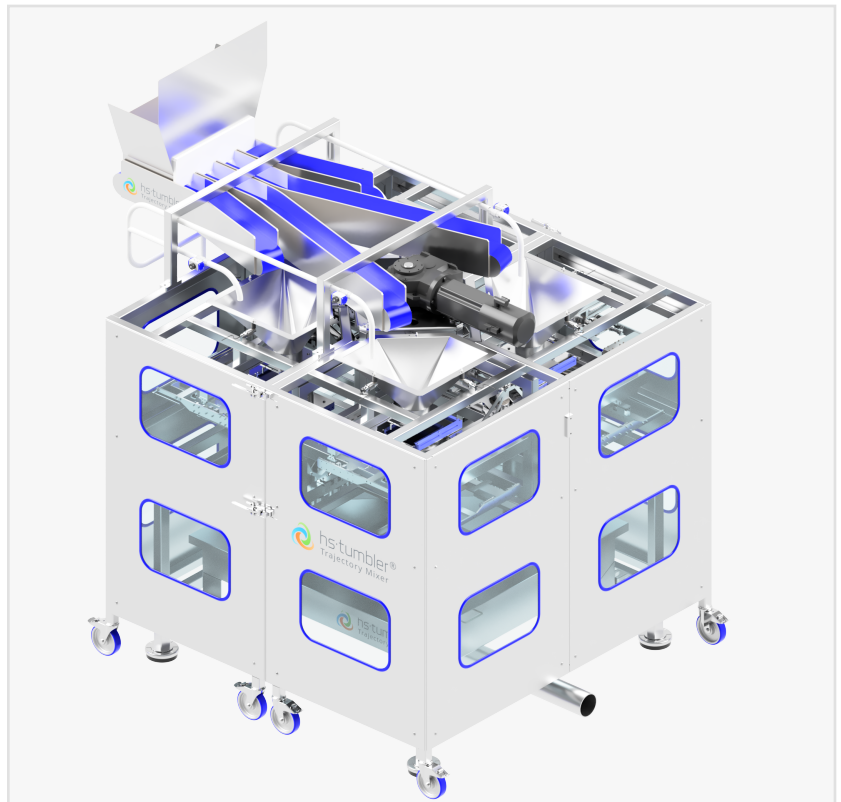
Evaluations at [Klevertec](https://www.klevertec.com/), an independent research centre at Kempten University of Applied

Sciences, proved that the patented system can successfully mix ham without brine injection—thereby removing a time-consuming, labor-intensive and hygiene-critical step in meat production since traditional brine injectors are difficult to clean, often contributing to contamination risks.

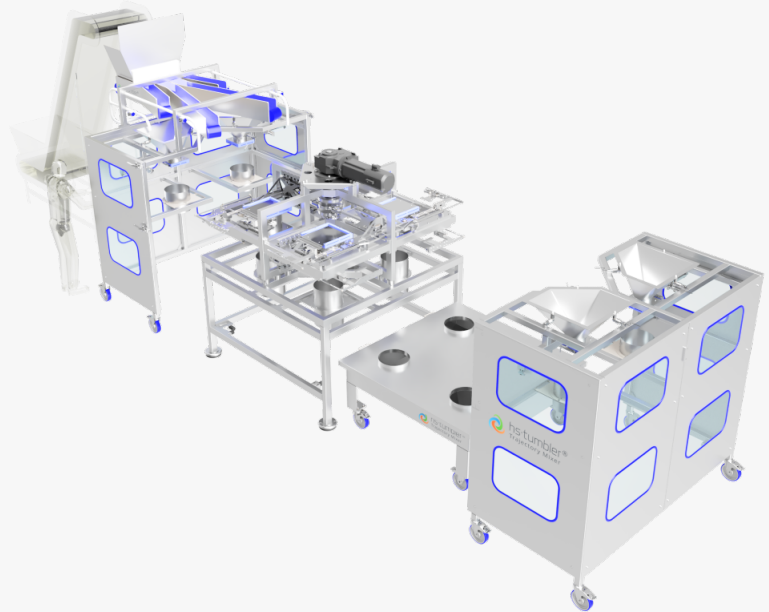
“These results align with our calculations, confirming not only the superior speed of the system and its near-continuous production capabilities, but also that it bypasses the brine injection step,” says Bernhard Hukelmann, Managing Director of hstumbler, and inventor of the system. “With industrial approval now secured, we look forward to large-scale implementation at ham factories”.

First large-scale production
Production in a German meat factory marks the first large-scale application, while smaller units are already used in Europe, Japan, and North America. Measuring 2.6 by 2.6 meters, the industrial trajectory mixer is competitively priced and offers a viable alternative to traditional tumblers and mixers. Benefits include increased output, enhanced product quality, and improved energy efficiency.

The system is expected to optimize output by significantly reducing meat loss during cleaning cycles and enabling precise brine dosing. Its energy efficiency together with the elimination of auxiliary equipment like brine injectors result in substantial cost savings—delivering a return on investment in under two years.



The trajectory mixer can perform batch changes in 12 seconds



The trajectory mixer can process up to 7.2 tons of meat per hour

“We can process three times what the largest mixer available on the market can do over the same time period with 80 percent less energy consumption,” says Hukelmann.

The mixing of meat and additives is critical for achieving uniform distribution of meat, brine, spices, and other ingredients. Careful mixing ensures cohesion and tenderness, consistent taste and texture, and facilitates the tenderizing process, laying the foundation for the high quality and distinctive characteristics of sausages and hams.

The efficiency of trajectory mixing is based on vibration principles and adhesion forces within the mix. Like a hummingbird’s wings tracing precise, looping patterns, the trajectory mixer guides process material at high speed along defined paths—such as figure-eight or pretzel shapes—allowing the mixing quality to be tailored to the material, whether it's pizza dough, marinades, or cosmetics. This ensures controlled, uniform, and multidirectional massaging and mixing.

Physics principles behind the patent

The system applies “Lissajous curves”—a principle from physics representing patterns formed by interacting perpendicular harmonic waves. In the trajectory system, these curves arise from two coordinated motions applied to the processing container. Timed precisely, they create crossover points that generate shear and tensile forces, promoting self-mixing through container movement rather than tumbling or using agitators.

“As a physicist, I have long believed that the interwoven patterns created by Lissajous figures could have a good mixing effect when applied practically to materials in a controlled environment. We have now demonstrated that this effect is actually uniform across the whole product,” says Hukelmann.

With no mixing implements required, the trajectory mixer vessel is also efficient to clean. Cooked ham requires the addition of liquids for the mixture, which traditional curing injectors deliver directly into the meat via multiple needles for uniform distribution. However, this method is often imprecise in brine dosing and can cause oozing, leading to microbiological contamination risks. The trajectory mixer eliminates this step, ensuring hygienic processing and improved product quality.

A smaller model of the trajectory mixer is available, handling batches of up to 4 kilograms. In addition to food applications, the system is suitable for mixing a wide range of materials—from powders to highly viscous materials.

Seven months ago, hs-tumbler was one of ten startups selected by Mondelez International to explore technologies for the future of snacking, including cocoa processing, sustainable packaging, and enhanced sensory experiences.

At the IFFA - International Trade Fair for Meat Processing and Production, held in Frankfurt from May 3 to 8, hs-tumbler will present its trajectory tumbler at its stand in Hall 11, D09.

About hs-tumbler

Founded in 2021 by Bernhard Hukelmann, hs-tumbler GmbH is an innovative German startup company headquartered in Quakenbrück, Germany. As of 2024, the company is jointly managed by Hukelmann and Andreas Leitze. Specializing in advanced mixing technologies, hs-tumbler has developed and patented the trajectory mixing system, which utilizes high-frequency movements along precise, two-dimensional curved paths to achieve efficient and homogeneous mixing of materials across various industries, food processing, pharmaceuticals, cosmetics and chemicals. Already 20 systems are in operation in the US to Japan. At Anuga FoodTec 2024 in Cologne, hs-tumbler GmbH was honored with the prestigious International FoodTec Award in Gold for its innovative trajectory mixer. In 2024 Mondelez selected hs-tumbler to be part of its CoLab Tech program.

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