

PRESS RELEASE

November 3, 2025

INTERVIEW

Peracetic acid disinfection – safe and sustainable hygienization for the industrial washing of fresh produce

In a recent scientific statement, the European Food Safety Authority (EFSA) highlighted the importance of continuously and effectively monitoring water disinfection during the industrial washing of fresh foods such as fruit, vegetables, and salad leaves. Within this context, the German company KRONEN GmbH from Kehl am Rhein and the Spanish company Citrosol are setting new standards with their joint solution: KRONEN Citroicide[®] PLUS. In the following interview, Eric Lefebvre, Technical Director and Managing Director of KRONEN, and Martín Mottura, I+D Manager at Citrosol, discuss the technology, its practical benefits, and their new scientific findings.

Mr. Mottura, why has the EFSA conducted new studies regarding the topic of water hygiene when washing fresh produce, and what are its central findings?

Martín Mottura: The EFSA has produced a series of expert reports analyzing the microbiological risks involved in the use of process water when processing fresh and frozen fruit and vegetable products. The results of the fourth part of this series of studies, which focuses specifically on fresh-cut products, clearly confirm that without water disinfection, the microbial load increases significantly. In five of a total of 19 industrial scenarios investigated, no disinfection was used – and the bacterial count was much higher. Furthermore, evidence of pathogens was only found in these five cases. The EFSA therefore emphasizes that effective disinfection can only be guaranteed with continuous monitoring of the disinfection parameters.

How does Citroicide[®] technology help ensure reliable disinfection?

Martín Mottura: The Citroicide[®] fresh-cut system is based on peracetic acid (PAA) and enables precise, automated, and continuous monitoring of the disinfectant concentration in the wash water. An integrated sensor measures the concentration in real time and ensures that it remains constantly within the optimal effective range.

Peracetic acid is particularly effective across a wide pH and temperature range, does not produce any hazardous by-products such as chlorates or trihalomethanes, and fully conforms with EU and U.S. regulations. It is also certified for use in organic farming and organic food production. The connection to the digital platform CitroFy enables all data to be evaluated and remotely monitored, ensuring traceability and process reliability.

Mr. Lefebvre, how is this technology integrated into KRONEN washing machines?

Eric Lefebvre: We can integrate and even retrofit the Citrocide® technology into all of our KRONEN washing machines. One example is the helical washing machines in the HEWA series. These machines have been developed especially for easy cleaning and the best possible hygiene, with optimal accessibility, smooth surfaces, and a hygienic design.

Combining them with the Citrocide® fresh-cut system facilitates automatic, reliable, and efficient monitoring of the water hygiene. The system continuously regulates the disinfectant concentration and the water renewal. As a result, we can ensure that the disinfection effect remains constant while optimizing water consumption at the same time. All in all, the joint solution developed by KRONEN and Citrosol enables a hygienic, efficient, and user-friendly washing process.

What are the differences between peracetic acid and chlorine in terms of their effectiveness and application?

Martín Mottura: Both substances are generally effective when it comes to disinfecting wash water and products. Peracetic acid, however, offers clear advantages regarding safety, environmental compatibility, and handling. While chlorine requires precise pH regulation, pre-rinsing, and post-rinsing, and regular concentration checks, peracetic acid remains stable and reliable without requiring any complex additional measures.

Furthermore, chlorine produces disinfection by-products (DBPs) such as chlorates or trihalomethanes, which are viewed critically, while peracetic acid breaks down completely into non-toxic residues, namely water, oxygen, and acetic acid. As a result, it is at least as effective as chlorine but much more sustainable and safer for humans and the environment.

What concrete advantages does this provide for processing companies?

Eric Lefebvre: Our customers benefit twofold: On the one hand, the products offer a higher level of microbiological safety, which is particularly essential in the case of delicate products such as salad leaves or cut vegetables. On the other hand, the system enables the sustainable use of water resources because it requires less fresh water.

The automatic control also reduces the use of chemicals, and the processes are documented to ensure traceability, which supports companies in their efforts to comply with quality and audit requirements.

How do you both rate the importance of the new EFSA results for the industry?

Martín Mottura: The EFSA has very clearly underlined that the disinfection of the process water is not an optional step but a significant hygiene measure. Without it, there is a risk of cross-contamination. Our technology shows that modern, monitored PAA systems can already meet these requirements in the present day.

Eric Lefebvre: I think that the results clearly confirm our joint concept. The combination of intelligent disinfection and hygienically designed machines offers

our customers real added value, enabling them to manufacture safe, high-quality products while also saving resources.

What is your conclusion?

Eric Lefebvre: The cooperation between KRONEN and Citrosol combines the best of both worlds: mechanical engineering made in Germany and the leading hygiene solutions in Europe from Spain. With KRONEN Citrocide® PLUS, we are setting a new standard for safety, sustainability, and efficiency in the industrial washing of fresh foods.

Literary sources referred to in the interview:

- Petri, E., Virto, R., Mottura, M., & Parra, J. (2021). Comparison of peracetic acid and chlorine effectiveness during fresh-cut vegetable processing at industrial scale. *Journal of Food Protection*, 84(9), 1592–1602. <https://doi.org/10.4315/JFP-20-448>
- López-Gálvez, F., Gil, M. I., Truchado, P., Selma, M. V., Allende, A. (2020). Chemical disinfection in wash water for fresh produce: Chlorine vs. peracetic acid. *Food Control*, 113, 107199. doi:10.1016/j.foodcont.2020.107199
- Ölmez, H., & Kretzschmar, U. (2009). Potential alternative disinfection methods for fresh-cut industry. *LWT – Food Science and Technology*, 42(3), 686–693. <https://doi.org/10.1016/j.lwt.2008.08.001>
- EFSA Wiley Online Library (Open Access): <https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2025.9170>

TABLE
Comparison: peracetic acid vs. chlorine in industrial disinfection

Criterion	Chlorine (NaOCl)	Peracetic acid (PAA)
Effectiveness (wash water / product)	Very good / good (20–200 ppm, 1 min.)	Very good / very good (100 ppm, 1 min.)
pH dependence	Highly pH-dependent (optimally 6–7.5)	Effective across a wide pH range
Influence of organic contamination	Strongly impairs the effectiveness	Almost no influence
By-products (DBPs)	Formation of chlorates, THMs, and other residues	No hazardous by-products
Handling / monitoring	Complex: pH checks, pre-washing, and post-washing required	Simple: automatic concentration adjustment
Organic approval (EU / U.S.)	Not approved	Approved for organic use
Environmental & operational safety	Corrosive, irritant, hazardous substance	Environmentally friendly and safe to use
Rinsing necessary	Yes – pre-washing and post-washing recommended	Only rinsing with fresh water at the end of the process

Studies and tests – for example those conducted by Petri et al. (2021), López-Gálvez et al. (2020), and Ölmez & Kretzschmar (2009) – show that peracetic acid is at least as effective as chlorine but easier to handle, more environmentally friendly, and suitable for organic farming. KRONEN and Citrosol therefore consider it to be the future-proof alternative for reliable water hygiene when processing fresh foods.

Sources: information from various sources, including FAO, WHO, Codex Alimentarius, EFSA, EPA, USDA, and FDA, as well as scientific publications

About the interview participants

Eric Lefebvre is the Technical Director and a Managing Director of KRONEN GmbH. He is responsible for the company's technical development and innovation strategy and he contributes many years of experience in international mechanical engineering for the food processing industry. His work mainly focuses on hygienic design, automation, and sustainable production solutions that meet the high demands of the fresh-cut sector.

Martin Mottura is the I+D Manager at Citrosol S.A. In this role, he specializes in post-harvest technologies to ensure the microbiological quality of fruit and vegetables and he works on the research and development of innovative hygienization and disinfection systems, for example those based on peracetic acid solutions. As the author of several scientific articles, he is active in European research networks and he is considered to be an expert on process water hygiene in the fresh-cut industry.

About KRONEN GmbH

KRONEN is a family-managed, globally operating producer and supplier of stand-alone machines, special-purpose machines, and high-tech processing facilities for the fresh-cut industry. The product program of KRONEN and its partners covers fruit, vegetable, and salad processing: from preparing, cutting, washing, drying, dewatering, peeling and sterilizing right through to packaging.

KRONEN also offers machines for the processing of meat and fish, special vegan products, baked goods, and pet food.

The company, which is based in Kehl am Rhein, Germany, and has a second production site in the nearby city of Achern, currently employs more than 130 members of staff, has representatives in over 80 countries worldwide, and supplies its products to more than 120 nations all over the globe.

With more than 45 years of experience in food technology, KRONEN prides itself on its quality awareness and constantly strives to achieve the best possible solutions in its day-to-day work. The machine manufacturer focuses on taking a sustainable, holistic approach toward the hygienic, reliable, and resource-friendly production of fresh foods. KRONEN considers itself to be a think tank that provides innovative solutions to benefit its customers and meet all their needs. It guarantees top-quality advice and planning expertise in close cooperation with the industry and research establishments.

For more information, please visit www.kronen.eu

About Citrosol S.A.

Citrosol is the European market leader in post-harvest technologies and treatments for fruit and vegetables. The company was originally established as a specialist in post-harvest treatments and technologies for citrus fruits. For more than ten years – and based on intensive research and development activities – Citrosol has been developing solutions that extend the shelf life and marketability of avocados, bell peppers, tomatoes, peeled garlic, and other types of fruit and vegetables. Citrosol is currently working on the successful market launch of its solution for fresh-cut production, the Citricide® Fresh-Cut System. This technology significantly reduces the water and CO₂ footprint when manufacturing fresh-cut products. With all its treatments and technologies, Citrosol makes a significant contribution toward reducing loss and food waste in the processing of fresh fruit and vegetables.

Citrosol's innovative hygienization and disinfection solutions enable the company to set new standards in terms of food safety and sustainability.

For more information, visit www.citrosol.com

Contacts:

Kira Krollpfeiffer

Tel.: +49 7854 9646 160

Fax: +49 (0)7854 9646-5160

E-mail: kira.krollpfeiffer@kronen.eu

Christina Maier-Streif

Tel.: +49 7854 9646 161

Fax: +49 (0)7854 9646-5161

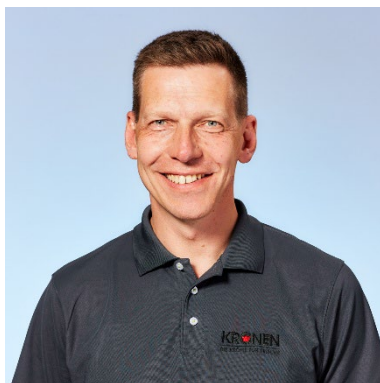
E-mail: christina.maier-streif@kronen.eu

Citrosol S.A. photo material:



Martín Mottura is the I+D Manager at Citrosol S.A. He specializes in post-harvest technologies to ensure the microbiological quality of fruit and vegetables. As the author of several scientific articles, he is active in European research networks and he is considered to be an expert on process water hygiene in the fresh-cut industry.

KRONEN GmbH photo material:



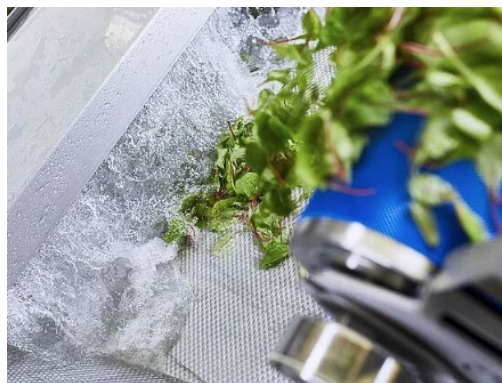
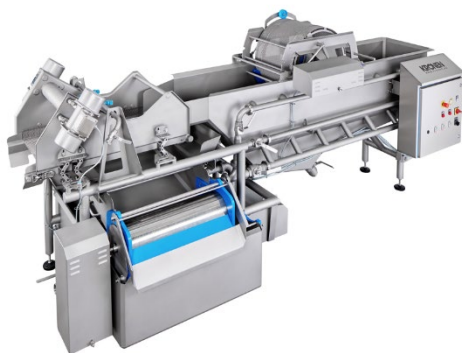
Eric Lefebvre has been the Technical Manager of KRONEN since 2010. He has additionally been a Managing Director since 2018. In this position, he is also responsible for the company's hygiene

strategy and he manages a multitude of research projects conducted in close cooperation with universities, research establishments, and the industry.



Left: The Managing Directors of KRONEN GmbH from left to right: Johannes Günther, Stephan Zillgith, Eric Lefebvre

Right: KRONEN's headquarters and production facility for food machines are based in Kehl am Rhein, Germany. From here, the company delivers its solutions to around 120 different countries worldwide.



KRONEN's HEWA washing machines (pictured: the HEWA 3800 with vibration outfeed) for fruit, vegetables, salad leaves, herbs, and other foods have been optimized in terms of hygiene and easy cleaning. Their design concept also ensures maximum hygiene.



The KRONEN product range features a number of high-capacity washing machines for cut and whole products alongside machines for cutting, peeling, drying, or disinfecting fresh produce.