



THE JOURNEY A CARROT TAKES FROM FIELD TO CONSUMER HAS CHANGED DRAMATICALLY IN RECENT YEARS. RETAILERS ARE SETTING HIGHER STANDARDS, CONSUMERS EXPECT CONSISTENT QUALITY, AND PROCESSORS MUST ORGANISE THEIR OPERATIONS MORE EFFICIENTLY WITH FEWER STAFF. AT THE SAME TIME, THERE IS GROWING PRESSURE TO MINIMISE WASTE AND MAKE THE BEST POSSIBLE USE OF RAW MATERIALS.

Behind the scenes of the carrot supply chain, a quiet but fundamental development is therefore taking place. Whereas processing and packaging used to rely mainly on fixed, mechanical processes and human judgement, smart technology, data analysis and automation are now playing an increasingly important role.

According to Ruurd Schut, Business Development Manager at JASA Packaging Solutions, a specialist in sorting, processing and packaging solutions, the key does not lie in technology itself. He focuses primarily on the way in which it is applied. "It's about being able to do more with the same carrot and better meet market demands," he emphasises.

A market that demands precision

The carrot market is highly fragmented. Processors no longer supply a single standard product, but must respond to varying requirements depending on the country, retailer and application.

"What a customer considers perfect depends entirely on the end use," explains Schut. "That is precisely where the challenge lies for processors today."

What is desirable in one market may be less relevant in another. Differences in length, diameter, colour and application (from fresh consumption to convenience products) demand flexibility and precision.

This diversity makes accurate sorting essential. At the same time, the availability of staff is declining, whilst costs and the pressure to improve efficiency are rising. The challenge therefore lies not only in what is technically possible, but rather in how companies can put this into practice.

From assessment to understanding

One of the most significant developments is the rise of optical sorting and AI-driven quality control. Modern systems analyse every individual carrot using advanced cameras.

During the process, a product is captured as many as 30 to 40 times, creating a detailed digital image. Based on this, systems can detect anomalies that are difficult for the human eye to spot.

Moreover, these systems are becoming increasingly intelligent. As a result, the focus is shifting from manual assessment to data-driven insights. Whereas sorting used to be based primarily on size, it can now be tailored much more precisely to quality and specific customer requirements. Significant strides are being made in the area of quality in particular, according to Schut: "Some anomalies are difficult to spot, but do have an impact further down the supply chain. By identifying them earlier, you can prevent problems and ensure more consistent quality."



INNOVATION BEHIND THE SCENES

Getting more value from the crop

The impact of artificial intelligence extends beyond the processing hall. Smart sorting contributes directly to a higher utilisation rate of the crop.

"You can determine much more accurately which product goes to which market," explains Schut. "This allows you to extract more value from the same batch."

In practice, this means, for example, that the correct weight per packaging unit can be calculated precisely. This prevents excessive over-weight – weight for which the grower is not paid.

Decisions on variety and cultivation strategy are increasingly made with the end market in mind and with an understanding of how the product will perform later in the supply chain. Here too, AI plays an essential role.

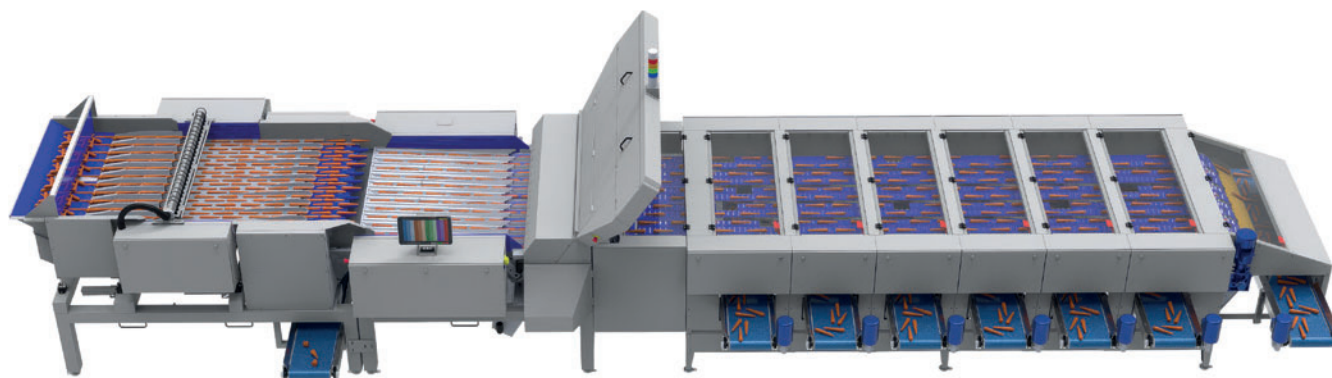
Packaging as the next step

Packaging is becoming increasingly important in the way carrots find their way to the consumer. Not only as protection for the product, but also as a means of

reducing waste and better meeting specific market needs. "Packaging has long since ceased to be the final stage of the process," says Schut. "It is an integral part of how you create value and become distinctive in the market."

Innovations are focusing, amongst other things, on more flexible packaging solutions and more sustainable materials. Think of packaging that is better suited to portion sizes or the moment of use. At the same time, there is growing attention to material use, with a clear shift towards recyclable and lighter packaging.

Packaging is thus increasingly becoming a link between processing and the consumer, where quality, sustainability and market positioning converge.





"Data allows you to run through different scenarios before you start processing."

Ruurd Schut

The rise of integrated processes

Alongside quality, efficiency is playing an ever-greater role. Modern processing lines are therefore increasingly automated and integrated.

Whereas operators previously had to adjust settings manually, systems today operate using digital programmes. A single programme selection sets up an entire line, coordinating sorters, weighers and packaging machines.

Maintenance is also becoming smarter. Machines continuously collect data on their own performance and can predict when parts require maintenance.

"You prevent downtime by looking ahead," says Schut. "That makes processes more reliable and easier to manage."

The processing environment is evolving into a data-driven environment in which processes are centrally monitored and optimised.

Data as a connecting factor

Every sorted carrot generates data. Analysing this data yields insights that extend beyond the moment

of processing. For example, processors can better predict how a batch will behave and what yields to expect.

"Data allows you to run through different scenarios before you start processing," says Schut. "That helps you make better decisions and use raw materials more efficiently."

When these insights are linked to crop data, a clearer picture emerges of the relationship between variety, growing conditions and market value. This also offers opportunities to develop varieties that are better suited to processing and market needs.

Collaboration as a catalyst

It is precisely this connection between the various links in the chain that makes collaboration increasingly important. Innovation does not arise within a single company, but at the interface between breeding, cultivation, processing and technology. For example, technology and breeding companies are working together on phenotyping and quality predictions using camera and data systems. "Real progress lies in combining knowledge," emphasises Schut. "If you understand how genetics, cultivation and processing are interlinked, you can make much more targeted improvements."

Looking ahead

What is developing behind the scenes is increasingly determining what becomes possible at the front end of the supply chain. Not as isolated innovations, but as a way of working in which choices, processes and market demand fit together seamlessly. That is where the opportunity lies to make a difference. ■