Many producers in the agri-food chain are investing in upgrading residual streams. By this so-called valorisation process Corporate Social Responsibility (CSR) targets may be achieved. Importantly the value of production flows can be increased. Production flow often contain valuable components that are currently disposed of as e.g. cattle feed, for little financial return. TNO’s support involves assistance in searching for and upgrading such components.

The food industry is committed to sustainable production processes. Water, energy, resource efficiency and upgrading residual process streams are key drivers for innovation in the industry. Process streams that contain valuable components are currently often unsuitable for human consumption. These streams can be upgraded by removing certain components e.g. anti-nutritional factors. This approach allows such streams to be made suitable as a valuable food ingredient and subsequent for human consumption. Also liquid raw materials, often contain many functional components which, following selective extraction, may be used in a wide range of interesting applications. These applications might span different food, non-food, personal care or even pharmaceutical industrial use. Manufacturers wishing to explore this option must be able to adapt their production processes flexible, quickly and efficiently.

**INDUSTRIAL RELEVANCE**
Using for instance TNO’s industrial relevant selective separation techniques, we help companies to develop appropriate processes. With a keen eye on industrial relevance, TNO is capable of designing and utilizing the appropriate units of operations within existing food production processes. This enables industry to remain profitable, yet operate their production processes in a more sustainable way.
MILD ADSORPTIVE SEPARATION
TNO develops flexible techniques for selective separation and fractionation of proteins/peptides, sugars, and other functional ingredients. Our focus is on mild adsorptive separation. This allows components to be extracted (or interfering components to be removed) effectively and selectively. The advantages of this method are the mild process conditions used (low temperature), and its suitability for food-grade production processes. TNO harnesses its broad knowledge of process technology, food chemistry, and physical chemistry to design customized separation processes.

NOVEL INGREDIENTS VIA FERMENTATION OF WASTE STREAMS
Fermentation is already used within the food industry for a long time. Typical examples of fermented foods are beer, wine, bread, yogurt, and cheese. The use of fermentation for these products is to extend the shelf life. Nevertheless the process of fermentation can be used in a much broader scale for other types of products or alternative production processes. TNO is exploring possibilities in this field based on combinations of novel and existing technologies. Using our extensive microbiological expertise on fermentation of bacteria, yeast and fungi, combined with our diverse microbial strain collection, novel routes to valorise waste streams can be exploited. Within this approach our screening platforms on functionality, productivity and health benefits, as well as the available analytical tools, play an important role in screening and identifying components made by fermentation of waste streams. Some examples of potential ingredients are e.g. vitamins, antimicrobial components, fibres, oligosaccharides, specific tastes and organic acids for natural preservation of food products.

NEW SOURCES FOR INGREDIENTS
Biomass is a promising source of new raw materials and organic compounds and building blocks. These streams may contain many types of valuable ingredients and are in the agri-food chain abundantly present. An example TNO is working on is using algae as a new source for food ingredients. They grow very rapidly, and can be cultivated and harvested in relatively simple ways. Capturing carbon dioxide by algae significantly adds to a more sustainable world by providing a vital route to improve your footprint manufacturing materials in renewable fashion. Effluent polishing of waste water, often containing lots of valuable nutrients to grow algae, is other example of valorising these waste streams. To make a sustainable business case with algae all ingredients must be put to value. Therefore, ingredients must be extracted from the algae in just the right way preserving its value and functionality.

MILD AND EFFICIENT OPENING OF CELL WALLS
Using innovative cell disruption technology, TNO has managed to break open algae with a very tough cell wall in a mild and energy efficient way. This is an important step in the cascading bio-refining process to generate profitable applications for algal ingredients for food, feed and non-food applications. In the context of the GAIA (Getting Algae Ingredients Applied) consortium TNO is developing various applications for algae ingredients, in partnership with algae producers and end-users. Currently, the algal ingredients are produced on a pilot scale, for the purpose of application testing. TNO builds a mobile bio refinery pilot that is capable of processing relevant qualities of biomass, including algae and obtain function proteins as well as other relevant ingredients e.g. polyunsaturated lipids, pigments, carbohydrates and phytochemicals.

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TNO initiates technological and societal innovation for healthy living and a dynamic society.

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