VACULIQ – THE SYSTEM FOR JUICE, SMOOTHIE AND PUREE?

A CLEAR AND UNAMBIGUOUS "YES" SAYS VACULIQ GMBH & CO KG FROM HAMMINKELN/GERMANY

When it comes to fruit processing, "We have well over 250 applications with the most diverse kinds of fruit and vegetables under our belts," according to Development Manager Norbert Siewert. That has lead to completely new production and sales opportunities for production plants.

With the experience of 5 development stages in the last 3 years, Vaculiq can today confidently assert that the process technology of the entire Vaculiq system has reached industrial top level.

THE PROCESS:

1. A pumpable, pasty mass is produced from the raw material using grinding and/or shredding equipment.
2. Since the Vaculiq system functions excluding atmospheric oxygen, the quality of the juice benefits if the maceration is also performed without oxygen influx. That is possible for example with an in-pipe shredding technology as well as colloid grinders. All other mashing systems can of course also be used, but in the case of some mashes, they lead to unwanted oxidation prior to the separation process.
3. The mash is fed with a slight vacuum (1) (0-1 bar) to the delivery point (2) of the effective vacuum in the system. Here it arrives at the vertically arranged vacuum chamber (3) with a vacuum of 500-750 mbar. A cylindrical filter sieve is fitted tightly into this chamber (4).
4. A continuously rotating spiral shaft in the filter sieve (5) keeps the inner surface of the filter sieve and its holes free by means of scraper lips. The spiral shaft has spiral channels between the scraper lips through which the mash is fed past the cylindrical filter sieve and the outer wall of the sieve by the applied vacuum.
5. The vacuum draws the liquid phase through the holes of the filter sieve. The filter sieves have holes sizes of: 60-80-100-150-200-300-500-750 und 1000 µm. The mash becomes increasingly dry as it is slowly fed upward by the spiral shaft and then becomes the actual pomace once it leaves the vacuum area and is compressed in the spiral channels up to the point that it leaves the system at the pomace discharge (6).
6. The extracted fluid phase is fed to the next processing steps via the vacuum pump (7), usually pasteurization or High Pressure Preservation (HPP).

Fig. 1 all © Vaculiq GmbH & Co. KG

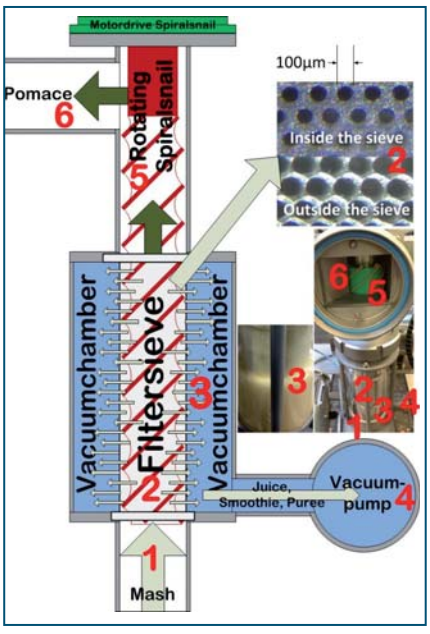

Fig. 2

Fig. 3 and 4: The Vaculiq 1000 from Food Pilot, ILVO, Flanders' Food, Belgium

The machine is cleaned up to 80 % Cleaning in Place (CIP). Inspection and cleaning of the filter sieve as well as the spiral shaft are the only steps that have to be done by hand.

The Vaculiq can be custom-tuned by adjusting 6 parameters, thus allowing very specific results to be achieved.

Here are the parameters in detail:

1. Continuously adjustable feed velocity from 300-5240 KG/h.
2. Continuously adjustable vacuum from 0-750 mbar.
3. Spiral shaft inclination: 32°und 38°
4. Spiral channel: number and depths in mm: 2-20, 3-17, 4-13, 5-10, 6-7, 7-4.
5. Continuously adjustable spiral shaft rotation speed from 20-95 rpm
6. Filter sieve hole sizes: 60-1000 µm.

Filter sieves with hole sizes from 60-100 µm are generally used for juice production, 150-300 µm for smoothie production and for puree production 300-1000 µm.

VACULIQ SYSTEMS ARE AVAILABLE IN THE FOLLOWING MODULE DIMENSIONS:			
	Length mm	Width mm	Height mm
Vaculiq 1000 from 500 – 3,500 KG/h Average: 1.500 KG/h	1.880	600	1.700
Vaculiq 2000 from 1,000 – 7,000 KG/h Average: 3.000 KG/h	1.880	770	1.700
Vaculiq 4000 from 2,000 – 14,000 KG/h Average: 6.000 KG/h	1.880	1.100	1.700
Vaculiq 8000 from 4,000 – 28,000 KG/h Average: 12.000 KG/h	1.880	1.980	1.700

VACULIQ SYSTEMS ARE CURRENTLY OPERATING IN THE FOLLOWING AREAS:

Fruit processing:

Juice production: Apples, pears, quince, pomegranate, sea buckthorn, strawberries, blackberries, blueberries, currant, raspberries, cherries, pineapples, peaches, oranges.

Smoothie production: Pears, kiwi, peaches

Puree production: Bananas, peaches, pears

Vegetable processing: Carrot juice, tomato juice, tomato puree, celery juice, ginger juice.

Others: Mustard, soy, rose hip.

Statement Hochschule Geisenheim University (Institute for Wine Analysis and Beverage Research)

Vaculiq – further scientific approaches

The "Vaculiq" system represents a workable process-technology alternative for juice extraction from fruit mashes due to the simple process technology, space-saving installation and low process costs. The Hochschule Geisenheim University was involved from the very beginning in investigating the fundamental suitability of the Vaculiq system for juice extraction. It was thus possible to demonstrate comparisons with conventional juice extraction systems and the results were published in the article "Die unterdruckgeführte Wendelfilterentsaftung mittels Vaculiq-System – erste Erfahrungen" (FLÜSSIGES OBST, 08-2010, 345-350).

Additional interesting areas of application open up following process-technology optimization of the system derived from practical experience. Especially when clear juices without oxidation influences are desired or when juice extraction manifests a particular influence on aroma formation. Furthermore, these juice extraction conditions influence stability and changes of secondary plant substances. New opportunities are also indicated for production of viscous juices, currently in high demand among customers. In combination with practical experience, additional detailed scientific investigations at the Hochschule Geisenheim University will demonstrate new fields of application and new potential product characteristics.

Aroma

More than anything else, it is the sensory differences between the juices produced with Vaculiq and those from conventional juice extraction systems that demonstrate the influence of the vacuum during extraction. The greater part of the constituents contained in aroma are first generated as an oxidation product through cell disruption, mash rest time and pressed juice. A specific analytical qualification and quantification of aromatic constituents of extracted juices produced with the conventional and vacuum methods has not yet been performed and will be part of future investigations.

Enzymatic browning of berry fruit

Anthocanins are susceptible to oxidative influences. Investigations performed at the Hochschule Geisenheim have shown that the rest times play a significant role in the production process. This has been observed especially in the processing of strawberries where a strong peroxidase activity results in considerable negative influences on anthocanin stability. Rapid processing times as in the Vaculiq process cycle and immediate pasteurization represent interesting approaches for further investigation.

High-viscosity pure juice

Among consumers, there is an observable trend toward juices with higher viscosity and larger pulp content. "Smoothies" are very popular with customers and are sometimes marketed in the high-price segment. Since smoothies are generally mixtures of extracted juices and purees, there are recurring problems with turbidity stability.

The varying matrix of extracted juices and strained fruit components then needs to be stabilized with elaborate homogenization procedures. The Vaculiq system with its flexible sieve inserts here offers enormous potential. It is possible to produce high-viscosity juices with the special sieve inserts where the pulp-serum matrix can remain stable without homogenization. Process-technology optimizations and comparisons with conventional products would be worthwhile here, complementing current ongoing investigations into homogenization characteristics of fruit products.

Carrot processing

The Hochschule Geisenheim has extensive experience with carrot processing and the increased transfer of carotenoids in the juice phase (Deutsche Lebensmittel-Rundschau, Jhrg. 99, Heft 7, 2003). A significant increase of quality-determining constituents also in vegetable processing is to be expected as a result of increasing the solids content. The two-stage cell disruption developed in Geisenheim, with subsequent decanter juice extraction, should be investigated in direct comparison with the Vaculiq juice extraction with respect to its rate of transfer of carotinoids in the juice phase. Initial practical tests have shown a high potential with respect to a fundamental increase in yields.

Tomato products

Tomato juice is not an extracted juice but a finely strained product. Processing temperature is important here both in order to prevent enzymatic reactions with respect to oxidation, and also with respect to turbidity stability (cold-break, hot-break). The negative factor here is the high rate of oxygen absorption of the product, caused by the high rotation speeds in the straining equipment. The sieve inserts of the Vaculiq system correspond to those of a straining machine from a process-technical standpoint. However, the low rotation speed of the spiral and the juice extraction in a vacuum means that there is no oxygen influx.

Dipl.-Ing. Michael Ludwig VDI

Statement from Food Pilot Belgium

Within the Flanders' Food 'Food Pilot', connected to the Flemish Institute for Agricultural and Fisheries Research (ILVO), and the Flemish Institute for Technological Research (VITO), a research project called 'Processing of pome fruit into high added value products' was recently carried out. The goal of the project was to develop a phytonutrient-rich food product based on waste streams from pome fruit cultivation and processing industry by using innovative and food friendly drying and separation techniques. To reach this goal, the project was divided into two parts. In an initial part, a feedstock characterization was conducted to compare 55 different apple and pear cultivars based on 50 health-related phenolic compounds. Furthermore, product (mostly juices) and by-products from the current processing industry were evaluated. Large differences in phenolic profile were found between the cultivars. It was also demonstrated that the current methods used in the apple juice industry, and especially pressing systems, largely affect the phenol composition. These two conclusions were the triggers to initiate the second part of the project: an explorative research into novel systems in juice making and their influence on the phenolic composition of juices.

Due to the fact that the activity of polyphenoloxidase during juice making is one of the main causes of the disappearance of phenolic compounds during juice making, a 'pressing' system had to be found which was able to inhibit PPO activity during pressing. Furthermore, from the economical point of view, the system must satisfy the following conditions: comparable juice yield and throughput like other medium scale presses, low energy cost and linear extendable from small to large scale production environments. We found that all these characteristics were represented in the spiral – filter juice extractor system from VACULIQ. Two case studies were performed on a Vaculiq 1000 system, one on low quality apples, and one on the B-type pears (rebut) which form significant waste streams in the fruit cultivation in Flanders.

In the case of low quality apples, a parameter optimization was conducted (applied under pressure and spiral frequency in relation to the feed pump frequency, mesh size filter in relation to turbidity of the obtained juice) based on a central composite design. Yields up to 75 % were obtained, which was satisfactory given the quality of the feedstock. Furthermore, in each experiment, samples were taken from the apple mash, pomace and juice to evaluate the enzymatic degradation during pressing. No significant losses for all 50 phenolic compounds included in the project were demonstrated during juice making using the Vaculiq 1000 system. This finds its origin in the fact that during juice extraction, the dissolved oxygen in the juice is largely lowered due to the applied vacuum, which results in the

'inactivity' op polyphenoloxidase. An additional advantage was that bright 'yellow' juices were obtained. This demonstrates the potential of the vaculiq system to deliver a functional juice with potentially a high consumer appreciation. More- over, it was demonstrated that the by-product generated during juice making (apple pomace) contains higher amounts of phenolic compounds which results in higher valorization possibilities.

For B-type pears, the undesirable browning is more pronounced, the vaculiq systems also shows very good results. Due to control over the milling and the freely adjustable feed pump frequency, browning could be avoided under optimal parameter settings. In conclusion, with the vaculiq system is it possible to convert a "fit-for-purpose feedstock" to a higher quality end- product and at the same time deliver a high quality by-product (pomace) not hampering subsequent valorization possibilities.

The Food Pilot is the ideal venue for agro-food companies to perform pilot tests. Companies can test new concepts or products before producing them on an industrial scale. New equipment can also be tested before purchase, and technicians and food processing experts can be trained using the Food Pilot's equipment. The Food Pilot has several versatile pilot units, which makes it possible to mimic an industrial production line and perform pilot tests under semi-industrial conditions. The Food Pilot also offers high-level technical and scientific expertise. The Food Pilot has its own internal control laboratory. For more specific analyses, Food Pilot staff can also access the multidisciplinary research laboratories of the Technology and Food Science Unit of the Institute for Agricultural and Fisheries Research (ILVO-T&V). ILVO's specialized equipment and expertise make even highly specific analyses accessible to the agro-food industry.

Even unusual questions or problems can be addressed by the Food Pilot's flexible and creative staff and versatile infrastructure. Confidentiality is always guaranteed towards our customers.

Participating organizations

The Food Pilot is an initiative of Flanders' FOOD and the Institute for Agricultural and Fisheries Research (ILVO), with the support of the Society for the Promotion of Innovation in Science and Technology in Flanders (IWT-Vlaanderen). www.foodpilot.be

AUTHOR

Norbert Siewert
Vaculiq GmbH & Co. KG; D-46499 Hamminkeln – Germany
www.vaculiq.com