

Novel process separates whey proteins into high-value ingredients

Natalya Clark discusses a novel way for the separation of α -lactalbumin and β -lactoglobulin in whey.

Natalya Clark présente une nouvelle manière de séparer la α -lactalbumine et la β -lactoglobuline dans le lactosérum.

Natalya Clark diskutiert eine neuartige Möglichkeit der Trennung von α -Lactalbumin und β -Lactoglobulin in Molke.

A new concept in refining whey enables the dairy processor to fractionate whey proteins into specialised high value added ingredients. With this new process, α -lactalbumin and β -lactoglobulin in whey can be separated to achieve the two high purity products.

The benefits of this are:

- Isolation of proteins directly from unclarified crude whey.
- High capacity combined with high flow rate.
- Fractionation of whey proteins to specialised products.
- High purity and high value products.

The separation of α -Lg and β -La to produce α -Lg depleted β -La product is challenging when using membrane filtration as the molecular size of the two proteins is similar; 18 300 and 14 000, respectively. Existing separation technologies for these two proteins have been insufficient, cost-inefficient, complex and not eco-friendly.

But this can now be achieved by using Upfront's Rhobust Whey Refinery.

EBA technology

The company has developed this process based on the expanded bed adsorption (EBA) technology, which enables the dairy processor to extract and process proteins from industrial solutions like whey to high value added ingredients.

The key components of Rhobust Whey Refinery are the Rhobust Flex chromatography system and the Fastline adsorbent media for high performance processing.

The adsorbent media must feature a higher density than the feed stream in order to obtain an acceptable flow rate during operation, keeping the resin in a stable fluidised state in the column.

The density is controlled using

an inert, high density core made of an inorganic material, while the polymer phase surrounding the inorganic particles is made from cross-linked agarose.

The system provides the producer with a self-contained system ready to operate on any type of whey without prior pre-treatment.

Using the Rhobust EBA One Step process, the crude whey can be treated directly in the chromatographic column, thus avoiding the traditional clarification and pre-treatment steps, which represents a significant improvement. The impurities in the whey pass unhindered through the chromatography column together with lactose, minerals, fat globules and the various low molecular weight substances. The



Fig. 1. EBA eliminates pre-treatment of the whey and ensures high capacity and fast flow rate.



Fig. 2. Rhobust Whey Refinery is a cost-efficient concept for whey protein separation.



resin absorbs the proteins which can then successively be eluted with buffers at different pH values. This basically eliminates the cumbersome pre-treatment of the whey necessary in the more conventional processing. While chromatography usually has been connected with complicated processing, large chemical consumption and excessive water consumption, the Rhobust EBA One Step system eliminates these concerns.

The use of chemicals are minimised due to low concentration of buffer solutions, which are partially recovered by means of conventional membrane processing and likewise the water is reused through

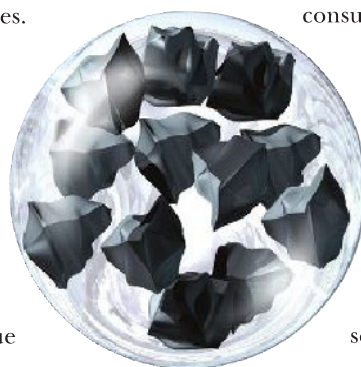


Fig. 3. Adsorbent close-up: High density particles encapsulated into agarose matrix

application of advanced water recovery technologies.

Whey contains a wide range of proteins with exceptional nutritional and functional properties. The content of protein in whey is approximately 5–7g/l. The α -lactalbumin has a concentration in whey of approximately 0.6–1.7 g/l depending on the type of whey and the treatment of the milk prior to cheese or casein production. By using the EBA chromatographic technology the α -lactalbumin can be isolated from whey and converted into a powder.

The processing of whey is started with the loading of the whey and washing of the column. In the first elution step the β -Lg is removed from the column with a NaCl/lactate buffer and in the second step the α -LA is eluted by means of a mild NaOH solution. The α -LA solution has a α -La/ β -Lg ratio of 4-6, which makes it suitable for infant formula.

Eluate is concentrated by ultrafiltration to about 20 per cent protein followed by spray drying to form a white free flowing α -La enriched Whey Protein Isolate (WPI) depleted of β -Lg. The water consumption is minimised through buffer reuse, which also reduces the consumption of chemicals.

As a by-product the β -Lg eluate can be concentrated and spray dried. β -Lg is increasingly used for gelation and emulsification in a wide range of food formulations.

Conclusion

Rhobust Whey Refinery is a cost-efficient concept for whey protein separation. The EBA technology eliminates pre-treatment of the whey and ensures high capacity and fast flow rate. The water recycling system reduces water consumption to a minimum and together with mild buffer solutions and a chemical recovery system it is possible to reduce cost to a minimum and reduce the environmental impact.

UpFront Chromatography A/S has carried out cost calculations on the production of α -La and β -Lg-enriched WPI from crude whey. In order to make such calculations it is necessary to make several assumptions. The cost on water, chemicals, energy, and labour differs across countries. This calculation is based on the average prices in northern Europe and may be considered as the upper level of costs around the world. Also, the calculation does not include interest and depreciation. □

Natalya Clark is with Upfront Chromatography A/S, Copenhagen, Denmark. www.upfront-dk.com. The company develops and manufactures innovative products and technologies for extraction and recovery of biotherapeutics, functional biomolecules, macromolecular complexes, and even living cells, directly from bioreactors and industrial side-streams.



Fig. 4. By using the EBA chromatographic technology the α -lactalbumin can be isolated from whey and converted into a powder.