

## **Purification Using Orochem's Proprietary** Simulated Moving Bed Chromatographic Separations





## API/Nutraceuticals

### Omega-3s



Omega 3 fatty acids are polyunsaturated fatty acids commonly found in marine and plant oils. These are considered essential fatty acids which are required by the human body but cannot synthesize them. Past research has proven that these fatty acids play an important role in brain functioning along with normal growth and development of the human body. It is also widely believed that they may reduce the risk of heart disease.

In recent years, there has been a 30-40% increase in the omega-3 fatty acids' global demand considering their wide applications. For many years these were only considered as dietary supplements but are now being widely used in nutraceutical and pharmaceutical grade manufacturing.

The SMB (Simulated Moving Bed) technology that Orochem has developed serves the purification needs of these fatty acids in different compositions. We have proved that we are able to purify up to 97-99% by composition of Eicosapentaenoic acid (EPA, 20 carbons and 5 double bonds), docosahexaenoic acid (DHA, 22 carbons and 6 double bonds) and  $\alpha$ -linolenic acid (ALA, 18 carbons and 3 double bonds) using our custom engineered adsorbent from different feed stocks commonly available in the market having lower percentages of EPA and DHA (< 20%). These purified streams can now be blended in required proportions as per the client requirements.

### $\alpha$ -tocotrienol

Alpha tocotrienol is a natural antioxidant and it protects glutamate-induced death of neuronal cells (brain cells). It is a member of Vitamin E family with 4 different isomers of trienols (alpha, beta, gamma, and delta) and 4 different Isomers of pherols (alpha, beta, gamma, and delta). Orochem has been successful in making high purity alpha-Tocotrienol from a crude palm oil extract feed using SMB technology.


Methods of purification of component of alpha-tocotrienol from palm oil have been disclosed in literature, but such methods comprise either separating all the isomers of tocotrienols from the remaining tocopherols or using a complex series of reactions to convert other forms of trienols to the alpha form. Such methods have not proved to be economical for commercial scale production.

The Orpheus adsorbent was used for this separation, which is a custom, modified Normal phase adsorbent from Orochem Technologies. This Orpheus adsorbent with SMB technology has resulted in efficient method of producing alpha-tocotrienol in pure form from palm oil extract with minimum processing steps and at low cost. Moreover, the process is useful for providing a continuous route and a simplified processing route to

providing pure alpha-tocotrienol as a major product essentially free of other tocotrienols and tocopherols including: beta-tocopherol, gamma-tocotrienol, delta-tocotrienol, gamma-tocopherol, delta-tocopherol, front end and back end carotenoids, and alpha-tocopherol as a by-product from palm oil extract.







## Sugars

### Tagatose separation

Tagatose is manufactured starting from Milk whey, which is major source of lactose. Lactose is hydrolyzed using enzymatic beads into monosaccharides, Glucose and Galactose. Unconverted lactose, salts can be separated from sugar mixture using Ion-exchange SMB process. Sugar mixture is then separated using ISOSEP SMB unit consisting Ion exchange resin that efficiently separates high purity Glucose and Galactose as product streams, (95-99 wt. % purity) with high recovery. Glucose stream can be concentrated and commercialized as high purity Glucose syrup whereas Galactose stream is enzymatically/chemically isomerized to Tagatose. TGSEP SMB unit, available from Orochem Technologies Inc., can separate Tagatose at 95-99 wt. % purity and high concentrations as well.

### Production Mannose from Palm kernel ferment

Mannose is a sugar monomer of the aldohexose series of carbohydrates. Mannose is important in human metabolism, especially in the glycosylation of certain proteins. Several congenital disorders of glycosylation are associated with mutations in enzymes involved in mannose metabolism.

Mannose can be recovered industrially by Palm kernel cake using enzymatic process. The feed stock consists of about 8.5% mannose, 1.2% glucose, 0.1% galactose, arabinose, phenolic compounds and biomass/proteins. Mannose can be separated from sugar mixture with a Proprietary resin using SMB process developed by Orochem Technologies Inc. The OROSEP SMB unit consisting resin efficiently separates high purity Mannose syrup as product streams, (95 wt. % purity) with high recovery. The syrups can be sold commercially or can be crystallized to obtain high purity mannose crystals (99.5%+ purity).

Orochem has been involved in the commercialization of this unit at 50,000L/day plant capacity. Orochem has also developed novel crystallization technique for the high purity mannose extract to yield 99%+ purity mannose crystals with very high yield (>95 wt%).

### Purification of Steviosides from Stevia leaves

Purification of Steviosides at very high purities from the extracts of Stevia leaves has been accomplished by our team at Orochem.



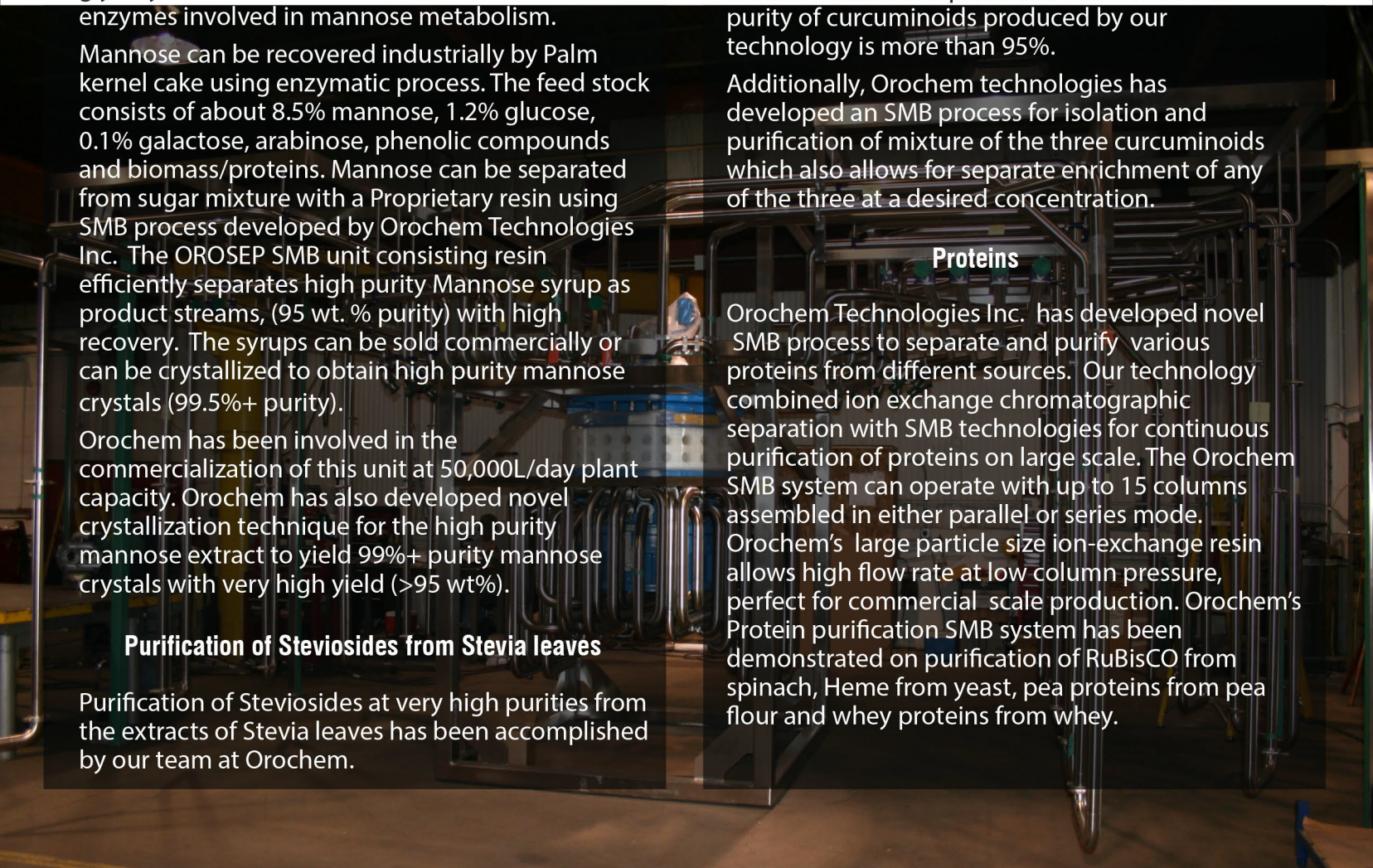
## Carotenoids

$\beta$ -Carotene is highly lipophilic, strongly colored red-orange pigment abundant in plants and fruits. Orochem technologies has developed an SMB process for purification of  $\beta$ -carotene from natural sources such as palm oil and paprika. Our unique technology allows manufacture of highest purity  $\beta$ -Carotene from palm oil where it is present at concentration of ~350 ppm along with ~ 200 ppm of  $\alpha$ -carotene or from paprika (~ 15 ppm in dry matter).

## Curcumin

Orochem Technologies Inc. has developed novel SMB process to separate and purify curcuminoids from turmeric oleoresin. Our technology combined a novel chemical extraction system with SMB technologies for continuous purification of curcuminoids on large scales. The SMB system consists of columns with large particle size resin that allows high flow rate at low column pressure assembled in either parallel or series mode. The purity of curcuminoids produced by our technology is more than 95%.

Additionally, Orochem technologies has developed an SMB process for isolation and purification of mixture of the three curcuminoids which also allows for separate enrichment of any of the three at a desired concentration.



## Proteins

Orochem Technologies Inc. has developed novel SMB process to separate and purify various proteins from different sources. Our technology combined ion exchange chromatographic separation with SMB technologies for continuous purification of proteins on large scale. The Orochem SMB system can operate with up to 15 columns assembled in either parallel or series mode. Orochem's large particle size ion-exchange resin allows high flow rate at low column pressure, perfect for commercial scale production. Orochem's Protein purification SMB system has been demonstrated on purification of RuBisCO from spinach, Heme from yeast, pea proteins from pea flour and whey proteins from whey.

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