

Looking Beyond Traditional Dairy Products - Fascinating World of Functional Dairy Products & Ingredients

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Scenario of Indian Food & Dairy Industry

India is world's largest milk producer, accounting for more than 16% of world's total milk production, is the world's largest consumer of dairy products.

The total amount of milk produced has tripled from 23 million tonnes back in 1973 and expected a production level of 135-140 million tonnes by 2015.

As per CRISIL Research estimates, the size of the Indian dairy and milk products industry stood at around Rs. 3,050 billion (≈50 billion USD) in 2012-13.

The size of the Indian food industry was said to be about Rs. 8,80,000 crore (140 billion USD) in 2006-07. It is expected to grow to Rs.1,320,000 crore (212 billion USD) by 2015 with the expanding contribution of processed food from 43 percent to 53 percent.

While India's food processing industry, estimated at around 140 billion USD, is growing at around 8-10 percent annually, the country's food ingredient sector is growing at around 15 percent.

Functional Foods & Nutraceuticals

Various academic institutions and national authorities have tried to define functional foods. The simplest definition is "foods that provide health benefits beyond basic nutrition," which was approved by the International Food Information Council (IFIC).

The expert report by the Institute of Food Technologists (IFT) defined functional foods as "foods and food components that provide a health benefit beyond basic nutrition". These substances provide essential nutrients often beyond quantities necessary for normal maintenance, growth and

development, and/or other biologically active components that impart health benefits or desirable physiological effects.

The International Life Sciences Institute (ILSI), Europe and European Commission's Concerted Action on Functional Food Science in Europe (FUFOSE) defined functional foods as follows: "a food product can only be considered functional if, together with the basic nutritional impact, it has beneficial effects on one or more function of the human organism thus either improving the general physical condition or/and decreasing the risk of the evolution of diseases". FuFoSE also developed a working definition of functional foods as foods that are "satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutrition effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease".

In 1989, Dr. Stephen first coined the term "nutraceuticals," which is derived from "nutrition" and "pharmaceutical," which are both key contributors to human wellness. There is no absolute disparity between foods and drugs in terms of their functionality; the distinction has to be made case by case. According to Dr. Stephen, nutraceuticals can be defined as "a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disease".

As for functional foods, many definitions of nutraceuticals have been developed in the past two decades. The simplest definition of nutraceutical is "foods for specified health use (FOSHU)" as set forth by the Nutritional Improvement Law Enforcement Regulations of Japan.



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Lachance defined nutraceuticals as “naturally occurring bioactive compounds that have health benefits”.

Health Canada officially defined nutraceuticals as “a product isolated or purified from food, generally sold in medicinal form”.

It was estimated that the global functional food market revenue for the year 2013 was around \$175 billion. With an annual average growth rate of about 10-15% the global market for functional food forecast is to exceed \$230 billion by 2015.

In 2013, top global functional food markets by country/region were: Japan (40%); US (38%); Europe (14%) & Australia (8%). India does not account for < 1% any significant production of functional foods.

In these contexts, we should also look beyond traditional dairy products – to the fascinating new world of functional dairy products & ingredients.

Milk & Dairy Products as Functional Foods / Nutraceutical

Milk and dairy products have been associated with health benefits for many years due to their rich content of specific proteins, bioactive peptides, vitamins, minerals (highly absorbable calcium), and conjugated linoleic acid. Increasing recent findings have revealed the health benefits of milk and dairy products through an array of bioactivities such as modulating digestive and gastrointestinal functions, controlling probiotic microbial growth and immunoregulation, accelerating bone growth, and maintaining bone health.

Recently, studies have been conducted to determine new health benefits of milk and dairy foods, such as maintenance of cardiovascular health, prevention of obesity and diabetes (low-fat milk), and antitumor activity (especially colorectal, bladder, and breast cancers). For example, numerous cohort studies demonstrated that higher intake of dairy foods, particularly low-fat milk, is associated with a decreased risk of colorectal cancer. This function of dairy foods may not solely result from their calcium content; other potential chemopreventive components are present, which include vitamin D, butyric acid, sphingolipids, conjugated linoleic acid, and probiotic bacteria in fermented dairy

products, such as yogurt. However, cancer prevention is also affected by the human genetic background; therefore, this function of dairy foods can vary in different consumers.

Dairy products can be considered nutraceuticals without any fortification; furthermore, almost all types of nutrients can be fortified in milk. Various fortified dairy products are consumed by target populations, including elderly individuals, infants, youth, and pregnant women. Each population exhibits their own health needs, and fortified dairy foods can provide more nutraceuticals than the dairy product itself. For instance, vitamin A and lutein are the most commonly fortified ingredients for infant visual development; choline, DHA, arachidonate, and taurine are also fortified for infant brain development.

Milk and dairy products provide all the necessary nutrients for healthy living for human beings of all age group. For the neonates, the colostrum produced by the mother during the 48–72 hours postpartum is the only source of all the necessary nutrients and the protection against microbial infection through the immunoglobulins. Babies obtain nourishment for several more months from milk with the additional benefits from the associated bacteria such as the bifidobacteria in their gut, especially breast-fed babies. For adults, milk and dairy products are consumed for their sensory qualities, nutritional value and for their many bioactive components.

Although adverse reactions to some of the components in milk and dairy products are experienced by a very small sector of society, that does not make them unhealthy products to be avoided by the larger sector of society. The benefits of consuming dairy products far outweigh any negative health risk linked to dairy products. The bioactive compounds derived from protein for example, especially the bioactive peptides, have an important part to play in improving human health. They have been shown to act as antioxidants in reducing cholesterol and blood pressure; they have anti-carcinogenic, anti-inflammatory, immunomodulators, anti-microbial and wound healing properties, and also provide protection of tooth enamel from acid erosion. The health benefits of milk fat should not be underestimated, especially regarding some of the



fatty acids such as conjugated linoleic acid (CLA) and fat-soluble vitamins. The dairy industry has been very active in providing the consumer with a variety of products ranging from low-fat, low-lactose or lactose-free for those with lactose intolerance as well as some hypoallergenic milk formulations.

The nutrients from milk and dairy products include proteins and peptides with their complete range of all the essential amino acids. Milk and dairy products also provide a number of physiological properties : the fat and the presence of both saturated and some unsaturated fatty acids, with the latter shown to have an important physiological role such as with the conjugated linoleic acid (CLA); lactose and other minor oligosaccharides; the major and essential minerals such as calcium, magnesium as well as phosphorous; and vitamins, especially the fat-soluble vitamins A, D, E and K as well as some of the water-soluble vitamins such as B₁₂, riboflavin and C. Milk is the only source of nourishment for the neonates as well as one of the important nutritious food for adults. These nutrients provide the necessary elements for growth and maintenance of the human body. Infants can thrive just by consuming milk for several months, obtaining all the necessary nutrients for growth. Milk also provides the additional physiological properties of promoting the health of the baby and protecting against diseases through its immunoglobulins and other whey proteins.

Based on all these facts, milk and dairy products as well as individual components are considered an important constituent of functional foods and have seen an increase in their production in the last few decades.

The emphasis in the last few decades has been on firmly establishing milk, dairy products and certain components of milk origin (such as whey protein) as an important segment of functional foods, nutraceuticals and bioactive compounds. Some of these functional foods of milk origin have included fermented milk products with probiotics, whey proteins (whether concentrate, isolate or as nutraceutical material such as α -lactalbumin, β -lactoglobulin, lactoferrin, lactoperoxidase and other minor constituents) and bioactive peptides from protein hydrolysis and oligonucleotides. Others milk constituents include the fatty acid conjugated Linoleic acid (CLA), calcium and lactose derivatives (lactulose, lactobionic acid, tagatose, galactooligosaccharides-GOS) etc (**Table-1**).

Many of these functional dairy ingredients are now commercially produced by European & US companies & find increasing applications in formulation of Infant, Adult, Medical as well as Sports Nutrition Products in the category of “Functional Foods”. In India still the field is nascent; both for production of functional dairy ingredients as well as functional foods.

Milk Proteins & Their Important Functional Components

- Milk Protein Concentrate (MPC)- contains 40–90% milk protein.
- Acid & Rennet Casein
- Caseinates (Sodium, Calcium, Ammonium & Potassium salts)
- Whey Protein Concentrate (WPC)

Table 1-Partial list of bioactive components in milk that have human health implications

Milk Fat Components	Milk Protein Components	Other Milk Components
Conjugated Linoleic Acid	Whey proteins	Calcium
Omega-3-Fatty Acids	Casein	Lactose
Oleic Acid	Lactoferrin	Vitamin A, D, K
Vaccenic Acid	α -lactalbumin	Oligosaccharides
Phospho/Sphingolipids	Peptides	Nucleosides
Butyric Acid	Milk Fat Globule Proteins	Probiotics
13-Methyltetradecanoic Acid		Potassium
Ether lipids		Phosphorus



- Whey Protein Isolate (WPI)
- Whey Protein Hydrolysate (WPH)
- α -lactalbumin
- β -lactoglobulin
- Bovine lactoferrin- A naturally occurring iron-binding protein found in milk that has been shown to have important and diverse biological functions. The abundance of lactoferrin in human milk is an indication of its role in infant nutrition, with human infants ingesting up to 3 g of lactoferrin per day from breast milk during the first week of life. Lactoferrin may be an important component of the immune system because of its potent antimicrobial activity that provides protection against a multitude of infectious agents. Lactoferrin has also been shown to have anti-inflammatory and antioxidant activities as well as enhancing iron status in vulnerable groups such as infants.
- Bovine serum albumin (BSA)
- Immunoglobulins (especially from colostrums). Bovine colostrums is the first milk produced after birth and is a rich natural source of nutrients, particularly immunoglobulins, antimicrobial peptides (e.g. lactoferrin and lactoperoxidase) and other bioactive peptides including growth factors. In combination with the milk that is subsequently produced, it is important for the nutrition, growth, development and immunological defence of the newborn infant. It is produced as a by-product of the milk industry and is commercially sold as a health food product to promote general health. There is however increasing evidence that it may be useful for the specific treatment of both neonatal and adult gastrointestinal disease. There are also a number of studies which have shown that colostrums may act in stimulating and modulating the immune system. Bovine colostrums has been shown to have positive effects when used in treating side-effects of Type 2 diabetes, on bone growth and development, in surgery and in respiratory infections. Bovine colostrums is also widely taken as a supplement by athletes to improve exercise performance and recovery.

There is also increasing scientific evidence to show that the many biological factors present in bovine colostrum have beneficial effects on human health. Multiple peptide growth factors are present in colostrum, including transforming growth factor (TGF) $-\alpha$ and $-\beta$, insulin-like growth factor (IGF) -1 and -2 , epidermal growth factor (EGF) and granulocyte colony stimulating factor (G-CSF). Colostrum contains multiple specific (antibody) and non-specific (e.g. lactoferrin) antimicrobial factors in addition to several cytokines, including interleukin (IL)- 1β , IL-6, IL-10, tumour necrosis factor (TNF)- α and granulocyte-, macrophage- and granulocyte/macrophage colony-stimulating factors. Natural bioactive substances in colostrum also include nucleosides and nucleotides which have been shown to be gastro-protective. Both the specific and non-specific constituents of colostrums may have relevance to immune modulatory and antimicrobial activity when given to neonates or adults.

Bioactive Peptides From Casein and Whey Proteins

- In general, bioactive peptides range in size from 3 to 20 amino acids, although they can be larger in some cases. The activity of each bioactive peptide is dependent on the amino acid composition and sequence. Release of the peptides from the native protein can be achieved through the action of digestive proteases, or through fermentation with proteolytic bacteria. These peptides may also be released during transit through the human gastro-intestinal tract (GIT) by human proteolytic enzymes.
- The biofunctionalities of milk and whey proteins and peptides include: antibacterial, antiviral and antimicrobial action in general; anti-inflammatory action; anti-thrombotic action; protection against metabolic syndrome, e.g., hypertension, serum lipid levels, glucose balance and body mass index; and protection against cancer and obesity.
- Milk bioactive peptides are those which exhibit antihypertensive activity by inhibiting a key enzyme involved in the regulation of blood



- pressure, namely angiotensin-I-converting enzyme (ACE). Indeed, ACE-inhibitory peptides from casein are already commercially available in fermented food products such as Calpis (Calpis, Co. Ltd., Tokyo) and Evolus (Valio, Finland). In both cases, the bioactive peptides consist of the casein-derived amino acid sequences V-P-P and I-P-P.
- Milk proteins also contain a suite of peptide sequences which interfere with the formation of thrombi, known as the anti-thrombotic peptides. Interestingly, the most potent food-derived antithrombotic peptides have been released from κ -casein.
 - The casein phosphopeptides (CPPs) are phosphorylated peptides which have a high content of negative charge and can therefore bind divalent cations. CPPs have been shown to prevent enamel demineralization and exhibit anticariogenic activity and are available commercially in products such as mineral drinks, nutritional supplements for children, confectionary and products for dental care.
 - Cytomodulatory peptides have also been identified, particularly from a variety of fermented dairy products suggesting that they are released by bacterial proteolytic digestion. These peptides exert activity by affecting the viability of cancer cells. For example, a significant anti-proliferative effect was observed on Caco-2 cells following treatment with whey peptides derived from the waste stream of Mozzarella di Bufala Campana cheese production.
 - Peptides derived from β -casein have been shown to influence a wide array of immune functions including lymphocyte proliferation, phagocytic activity of macrophages, cytokine levels and antibody synthesis.
 - Casein and whey proteins have also proven to be a rich source of opioid peptides which exhibit pharmacological properties similar to opium. The major opioid peptides are derived from β -casein, and are hence called β -casomorphins.
 - Whey proteins such as lactoferrin, α -lactoglobulin and bovine serum albumin also contain opioid peptides encrypted within the primary sequence, which have been associated with several biological activities ranging from antihypertensive to immunomodulatory, anti-depressant to anti-secretory and anti-diarrhoeal.
 - Bioactive peptides derived from milk proteins have the potential to impact on the immune response through both direct and indirect mechanisms. Considering that correct development of the immune system is perhaps one of the most fundamental biological elements to long-term health, such peptides may have a crucial role to play in staving off chronic diseases including allergy, inflammation, autoimmune diseases and even cancer.
 - κ -Caseins constitute ca. 12% of total casein in bovine milk and have been identified as a significant source of bioactive peptides exhibiting immunomodulatory potential. Caseinomacropptide (CMP), also known as glycomacropptide (GMP), is a 64 amino acid peptide derived from κ -casein and contains N-acetylneuraminic acid (sialic acid) at varying concentrations (0–5U). Due to the action of chymosin on κ -casein, CMP is produced in the neonatal stomach and is also produced during cheese manufacture (10–15% of milk whey) from the milk clotting process. In addition to its bifidogenic properties in the human gut, bovine CMP has been shown to potentially alter the status of the immune system.
 - One of the first antimicrobial peptides identified from bovine casein, referred to as isracidin, was released from α s1-casein B following digestion with chymosin. Isracidin has a molecular weight of 2770Da and consists of amino acids 1–23 of α s1-casein B. As well as exhibiting antimicrobial properties, isracidin has been shown to exert immunomodulatory effects both *in vitro* and *in vivo*.
 - Casein and casein digests have also been shown to aid in prevention of milk protein intolerances.
 - Several bioactive peptides are produced during fermentation of milk, especially due to



proteolytic enzymes of starter bacteria, which act on casein & whey proteins.

- Bifidobacteria are naturally present amongst the gut microbiota and can be categorized as symbionts, on account of the many beneficial health effects which have been associated with the genus. In this respect, dietary strategies involving the consumption of probiotics and bifidogenic prebiotics, to increase the content of bifidobacteria in the gut, have received extensive attention. Human milk is a rich source of oligosaccharides, which are known to stimulate the growth of bifidobacteria. As a consequence, infant formulae derived from bovine milk has been supplemented with probiotic mixes such as fructo- and galacto-oligosaccharides (FOS and GOS) to promote the growth of bifidobacteria and decrease the numbers of pathogenic microbes. However, bovine casein and whey proteins have also been linked to the growth promotion of beneficial gut bacteria.

Bioactive Compounds Associated with Milk Lipids, Lactose, Minerals & Enzymes

- Lactoperoxidase is a peroxidase enzyme secreted from mammary gland into colostrums and is a member of the hemeperoxidase family of enzymes. Lactoperoxidase is an effective antimicrobial agent and, as such, is already used as a preservative in a range of food products, cosmetics, ophthalmic and oral hygiene products.
- Milk Fat Globule membrane (MFGM)- has attracted great attention as a potential source of functional ingredients with respect to its essential fatty acids, liposoluble vitamins and phospholipids. Phospholipids are asymmetrically located on the MFGM; phosphatidylethanolamine (PE), phosphatidylserine (PS) and phosphatidylinositol (PI) are located on the inner membrane, while phosphatidylcholine (PC) and sphingomyelin (SM) are on the outside.
- Ganglioside- It is the generic term used for acidic glycolipids (sugar containing lipids).

gangliosides occur naturally in the milk fat globule membrane both in human and bovine milk, and are integral components of cell membranes. Fonterra's Ganglioside 500 and 600 are excellent sources of mono-sialo ganglioside 3 (GM3), di-sialo ganglioside (GD3) and phosphatidyl serine. Each of these components has been linked to infant learning and development. Animal data further suggests that physiological levels of dietary gangliosides increase the ether phospholipid content of normal intestinal mucosa. This data points to a role for dietary gangliosides in helping maintain gut health and balancing the immune system.

Leading Functional Dairy Ingredient Manufacturers In The World

Arla Foods Ingredients, Sweden

- Alpha-lactalbumin
- Casein glycomacropetide
- Functional Milk Proteins
- Protein Hydrolysates
- Lactose
- Milk minerals
- Osteopontin
- Phospholipids & MFGM
- Permeate
- Whey protein concentrate
- Whey protein isolate

Arla Foods Ingredients have high-tech application centres in Argentina and Denmark.

<http://www.arlafoodsingredients.com/products/>

Fonterra, New Zealand

NZMP is the dairy ingredients brand of Fonterra.

- WPC
- WPI
- MPC
- MPI



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- Casein
- Caseinates
- Europro (Fonterra Europe has recently launched a new range of whey protein ingredients exclusively sourced in Europe under the brand name europro)
- Milk fat (anhydrous milk fat, milk fat fractions and specialised milk fat blends)
- Phospholipid Concentrates (Phospholipid Concentrate 700 contains phospholipid levels 5000 times that of native milk, including high levels of sphingomyelin, an important phospholipid for cell growth and regulation)
- Gangliosides (Ganglioside products are milk-derived ganglioside concentrates suited for use in infant formula, dietary supplements and nutritional products.
- Lactoferrin
- Protein Hydrolysates

<http://www.fonterra.com/nz/en/NZMP+Ingredients/Our+Ingredients/>

Saputo, USA

- WPC
- WPI
- Whey Powders
- Lactose
- Caseins (Acid & rennet)
- Dairy lipid blend (Combolak)

<http://www.saputoingredients.com/products.aspx>

Glanbia Nutritionals, USA

- Lactose
- TruCal, a milk mineral complex from a natural dairy source, offers a balanced mineral profile that maximizes the health potential of essential minerals such as calcium, magnesium, phosphorus and other trace minerals by ensuring optimum absorption by the body.
- Solmiko milk protein concentrate (MPC) and milk protein isolate (MPI)

- Avonlac whey protein concentrates offer excellent nutritional value. Available with protein content from 34% to 80%.
- Provon whey protein isolates are a highly purified, pure source of whey protein.
- Thermax® 34 and Thermax® 70 whey protein concentrates and Thermax® 690 whey protein isolate are unique, heat-stable whey proteins for use in various applications where processing involves high heat.
- PepForm® is a revolutionary patent-pending peptide carrier technology designed to improve the solubility and absorption of bioactives including branched chain amino acids. While the general insolubility of free form aminos can create poor beverage experiences, PepForm technology allows amino acids to remain soluble and stable, opening the door for more end use applications. PepForm technology also significantly increases the bioavailability of amino acids, with better efficiency and absorption than free form aminos like leucine.
- PepForm® Leucine Peptides – 40% leucine content, a key amino acid that triggers muscle synthesis through the mTOR pathway.
- PepForm® 2:1:1 BCAA Peptides – Ideal proportions of leucine, isoleucine and valine to trigger muscle synthesis through the mTOR pathway. Also aids in muscle recovery.
- PepForm® Arginine Peptides – Arginine is converted to nitric oxide in the body. It supports healthy blood flow and nutrient delivery. It also supports endothelial function.
- PepForm® Glutamine Peptides – Glutamine supports exercise recovery, cellular energy and healthy immune function. It also maintains normal gastrointestinal function.
- PepForm® Tryptophan Peptides – Tryptophan aids in mood, memory, stress support and sleep.
- Prolibra is an all-natural, patented ingredient for healthy weight loss. In clinical studies, Prolibra has been shown to promote fat loss, retain lean muscle mass, and lower glycemic index.



- ROLIBRA® 190 is a patented, all-natural, whey-derived ingredient that targets fat during weight management. In two clinical trials, subjects lost significantly more fat than the control group. In addition, subjects retained more lean mass, which is critical for long-term, healthy weight management.
- PROLIBRA® 290 is a patented, instantized, all-natural, whey-derived ingredient that targets fat during weight management. In two clinical trials, subjects lost significantly more fat than the control group. In addition, subjects retained more lean mass, which is critical for maintaining body metabolism and burning more calories, resulting in long-term, healthy weight management.
- Salibra bioactive whey fraction promotes intestinal health and overall well-being. A rich source of lactoferrin and immunoglobulins, Salibra has an excellent flavor profile, high solubility and superior emulsification properties.

<http://www.glanbianutritionals.com/products>

Davisco Foods International, Inc., USA

- Whey protein Concentrate
- Whey Protein Isolate- BiPRO-contains superior functionality, solubility, nutritive properties and clean flavor.
- Alpha-lactalbumin
- Hydrolysed Whey Proteins- BioZate - A new generation of whey protein hydrolysates that contain specific natural peptides produced through a highly controlled process.

<http://www.daviscofoods.com/specialty/index.html>

Ingredia Nutritional, France

- Milk protein isolates
- Micellar Casein
- Soluble milk proteins
- Milk protein Hydrolysates – Protein hydrolysates are pre-digested by enzymes in a way that the process is identical to a human digestion. Ingredia Functional offers micellar

casein hydrolyzates and soluble milk protein hydrolyzates. The protein ratio is at least at 80% on dry matter end the hydrolyze ratio vary from 10 to 25%.

- TONE UP is a highly fluid, delicious and healthy ready-to-drink beverage for the market of sport and diet nutrition. It contains 35 g superior quality native proteins per 250 mL.
- Lactium® is an unique, patented, proprietary milk protein hydrolysate which contains a bioactive with relaxing properties clinically proven to reduce stress-related symptoms such as: Mood swings, Sleep disorders, Food cravings, State of tension, Relationships troubles, Chronic pains, Digestive disorders, Impaired memory& concentration.
- Osteum™ is a unique dairy ingredient & has a complete action on the bone remodelling mechanism; it helps provide calcium to the bones. Osteum™ is a proprietary combination optimized to promote bone growth as well as prevent bone and joint diseases. Osteum™ benefits from the combined action of: Native micellar calcium coming from Ingredia's native protein, which is the most bioavailable complex for calcium, Vitamin D2, natural vitamin D which acts like an hormone to help your body to absorb and use calcium & Vitamin K2, natural vitamin K which activates a protein required to bind calcium to the mineral matrix. Osteum™ is water-soluble at the recommended dosage, heat stable under any sterilization techniques and does not display any « off-flavor » in applications
- Prodiel Colostrum
- Prodiel Lactoferrin

<http://www.ingredia-nutritional.com/unique-bioactives/dairy.html>

FrieslandCampina–DMV International, Netherlands

World's largest dairy cooperative.

- Caseinates
- Whey Protein Concentrates



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- Lactoval® HiCal - is a natural milk mineral complex rich in Calcium, Phosphorus, and Magnesium.
- Hyvital Casein Phosphopeptides- are partly hydrolysed casein proteins. They contain Phosphorylated peptides and offer a good taste.
- Hyvital Whey 8016 - is a partly hydrolysed whey protein. It has excellent taste and contains 16% di- and tri-peptides. .
- Hyvital Whey 8022 chilsonated- chilsonated is a compacted, partly hydrolysed whey protein.
- Lactoval® HiCal micronised- The fine particle size of Lactoval® HiCal micronised prevents sedimentation. Used in dairy applications with long shelf life.
- Hyvital Whey 8022- is a partly hydrolysed whey protein. It is a source of BCAA that play an important role in protein synthesis. It has a good taste.

<http://www.dmv.nl/products.html>

Skill Up gradation Suggestions For Dairy Technocrats

- Knowledge of functional food industry & ingredients
- Good Manufacturing Practices (GMP)
- QA-Advanced instrumentation knowledge & operation (HPLC, GC, MS etc.), calibration of equipments.
- Membrane technology
- Advanced spray-drying technology
- Dry-blending technology

- High Hydrostatic Pressure Technology
- CO₂ Supercritical Fluid Extraction Process
- EHS (Environmental Health & Safety) knowledge
- HMI (Human Machine Interface) Proficiency.

Suggested Further Reading

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