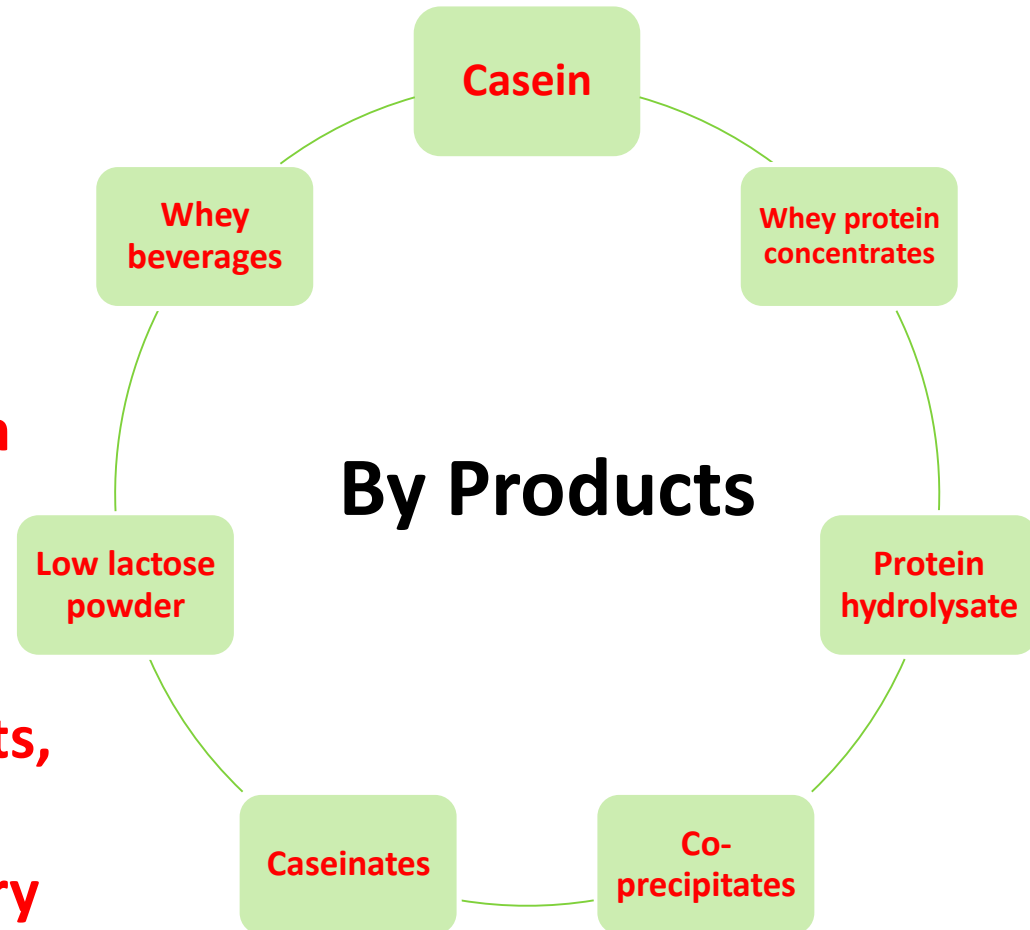


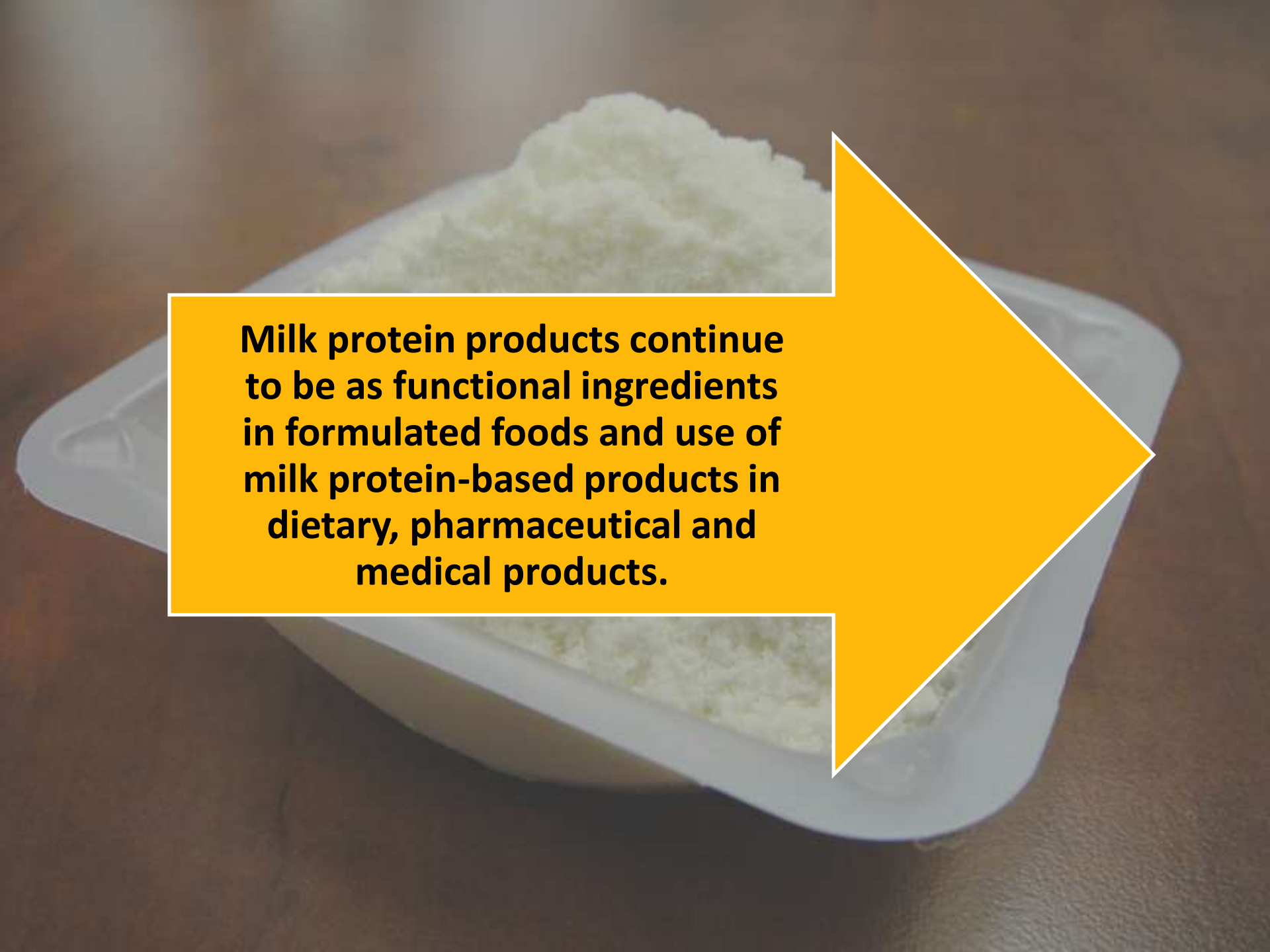
**Status, availability,
and issues involved in
the utilization of
dairy by-products in
India and abroad**



Global status, availability and utilization of dairy by-products

- Increasing interest for the utilization of by-products of the dairy industry.
- America, Europe, Australia and New Zealand have been the harbingers in the utilisation of by-products.
- Developed technologies for the utilisation of by-products, large automated plants and users for by-products in dairy industry.



A white plastic container filled with white powder, likely milk protein, is shown against a dark background. A large yellow arrow with a white outline points from the container towards the right side of the image. A yellow text box is overlaid on the container, containing the following text:

Milk protein products continue to be as functional ingredients in formulated foods and use of milk protein-based products in dietary, pharmaceutical and medical products.



Raw Milk



Skim Milk



Cream



Casein Workshop

Whey Treat. Plant



Whey



Butter Workshop



33 l of Skim Milk

1 kg of Casein



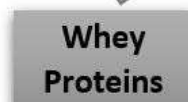
Casein



Caseinate



Lactose



Whey Proteins



Minerals



Butter



AMF

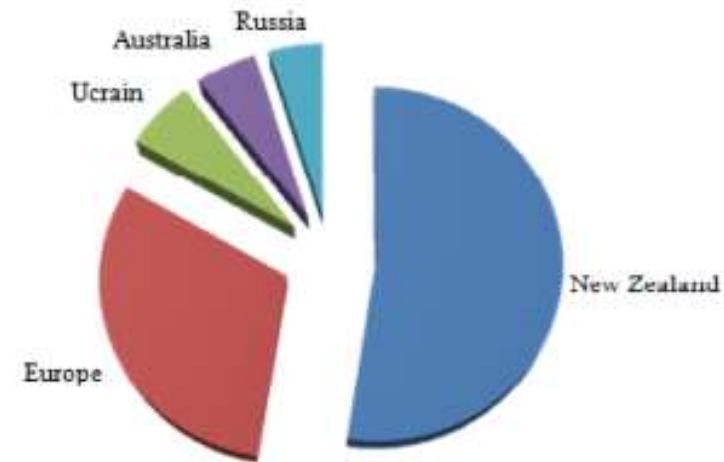
Skim Milk and its by products

- **Used for the manufacture of skim milk powder.**
- **Skim milk mostly utilized either in standardization of milk or preserved by removing moisture in spray dried form.**
- **Skim milk utilized in either of these two forms/consumed as liquid is not considered a by-product. Regarded as a by-product, only when it is either not economically utilized or utilized for the manufacture of derived by-products like casein in small quantities.**

Casein and Caseinates

- Large producers of casein are New Zealand, Netherlands and Germany.
- World market of casein/caseinates used in the food industry fluctuates between 2-2.5 lakh tonnes.
- Biggest importer of casein is USA, where food casein demand can be estimated at 20,000 tonnes per year and caseinates demand at 27,000 tonnes per year. Casein is utilized for the manufacture of imitation cheeses.
- Most of the casein produced is being exported and manufacture of caseinates is yet to pick up on commercial scale in India.

Casein production is approx. 3.5-4.3 lakh tonnes



World casein production-2005



Co-precipitates

- ✓ The manufacture of co-precipitates has several advantages like increased yield and higher nutritional value over that of casein.
- ✓ Manufacture of co-precipitates was not taken up in India at any time.

Milk protein hydrolysates

- ✓ Today protein hydrolysis has assumed a new dimension in the food industry.
- ✓ Milk protein hydrolysates is used in nutritional, dietetic and formulated foods, where a pre-digested form of protein is needed.

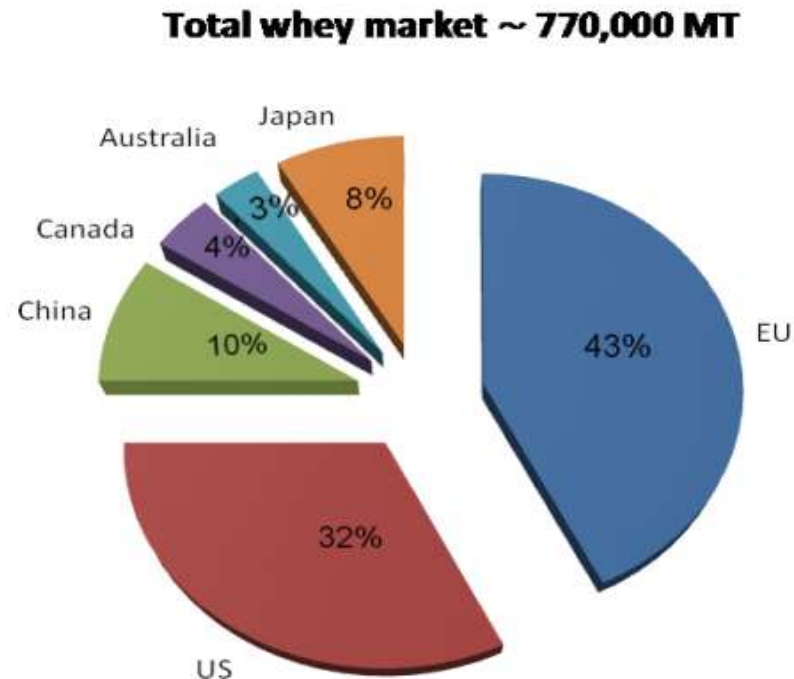
Whey and its by products

- **Largest by-product of dairy world. Cheese whey accounts for nearly 95% of total whey. In India, major source of whey (>70%) is from the production of chhana and paneer.**
- **The processing options for whey utilization:**
 - **Simple removal of water (spray/roller drying yield whey powder).**
 - **Increasing the ratio of protein in the end product (ultra filtration for manufacture of WPC, fractionation processes to produce protein isolates, heat treatment to produce lactalbumin).**
 - **Utilization of lactose in whey (treatment with lactase or heat/acid for lactose-hydrolyzed products, fermentation to lactic acid, citric acid and microbial biomass proteins).**
- **Techniques (membrane processing, hydrolysis, electrodialysis, ion-exchange, fermentation and protein fractionation) convert whey to major source of ingredients.**
- **Membrane separation system separates an influent stream into two effluent streams (permeate and concentrate). Main membrane systems in ascending order of pore size: RO, NF,UF,MF.**

Condensed and dried whey

- Whole whey that has been condensed and spray dried as such or after blending with certain other liquid ingredients.
- Feed industry is the largest consumer of dried whey and whey products.
- Small plants concentrate whey by RO for shipment to the larger plants. Medium sized plants concentrate whey by evaporation for large drying plants. Large plants concentrate their whey to high solids for lactose crystallization and drying.

Global overview of major whey markets



Whey drinks

- Liquid whey has been utilized for the manufacture of beverages and soups.
- Cheese whey is used to manufacture mixed vegetable, mushroom, tomato and spinach soups, whereas, paneer whey is suited for mango, lemon, banana and pineapple beverages.
- Commercial interest in fermented whey beverages: Germany, Holland, Australia and Switzerland.

Lactose production

- The production of lactose from whey continues to be one of the most important forms of whey's utilisation.
- Global market for lactose based goods is valued at over \$ 3 billion.

Demineralised whey

- Utilized whey (<5%) is demineralised by ion exchange/ electrodialysis prior to spray drying to produce dry demineralised whey for use in whey protein based infant formulas and nutritional products.

Whey protein concentrates

- New Zealand is the largest manufacturer of WPC by ultrafiltration (UF) process in the world.
- Functional WPC is the primary end product used as a substitute for non-fat dry milk and other protein ingredients.
The global whey protein market worth US \$ 3.8 billion in 2008.
- Whey protein fractions (lactoferrin, α -lactalbumin and colostrum/IgG alongside galacto-oligosaccharides (GOS) are showing interesting application opportunities.

Fermented products

- The lactose in whey can be converted by fermentation to lactic acid.
- Alcohol is also produced from the fermentation of lactose. Three plants in New Zealand presently produce alcohol cost effectively by the fermentation of lactose.

Buttermilk

- Produced when butter is made by churning cream/whole milk curd.
- Worldwide production of buttermilk is close to that of butter production (8.6 million tonnes in 2006).
- In US, commercial use of buttermilk was mainly for baking industry (39%), prepared dry mixes (33%), and dairy industry (23%) during 2002.
- Annual production of buttermilk in India is estimated at 35 million tonnes.
- Desi buttermilk has high nutritive and therapeutic value (preparation of kadhi, dhokla and idli).
- State dairy federations and private plants sell salted and spiced buttermilk (200 ml). Surat-based Sumul sell buttermilk (Sumul chhach).

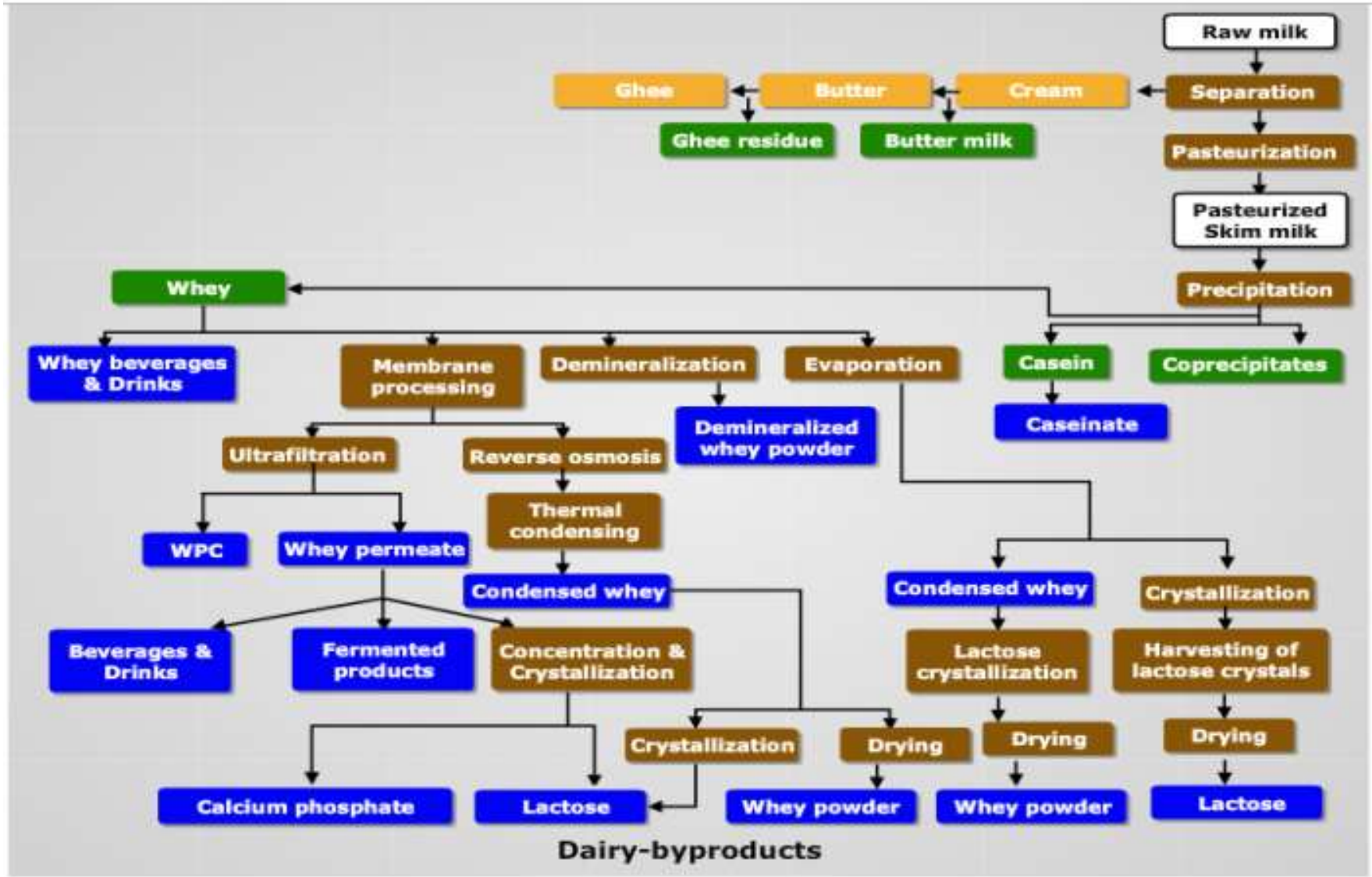


Butter Oil/Ghee-Residue

- Brownish sediment obtained by filtration of ghee after heat clarification.
- Butter oil/ ghee-residue is not generally used anywhere in world.
- According to a estimate, about 33% of total milk produced in India is diverted for ghee making (Dairy India, 2007).

By-products and Issues Involved in Their Utilization

- 1. Skim milk, buttermilk, ghee residue and whey** are the main dairy by products.
- Utilization of dairy by-products improves plant economy, makes valuable nutrients available for humans and reduces environmental pollution originating from dairy waste.
- Economic disposal of by-products is an essential pre-requisite to profitable dairying.
- Indian problems associated with the production and utilization of dairy by-products are: **low per capita availability of milk, higher proportion of buffalo milk, poor quality of raw milk, lack of organized manufacture of products, high cost of new technologies, lack of adequate technology, in-house R & D, proper infrastructure, indigenous equipments and plants.**

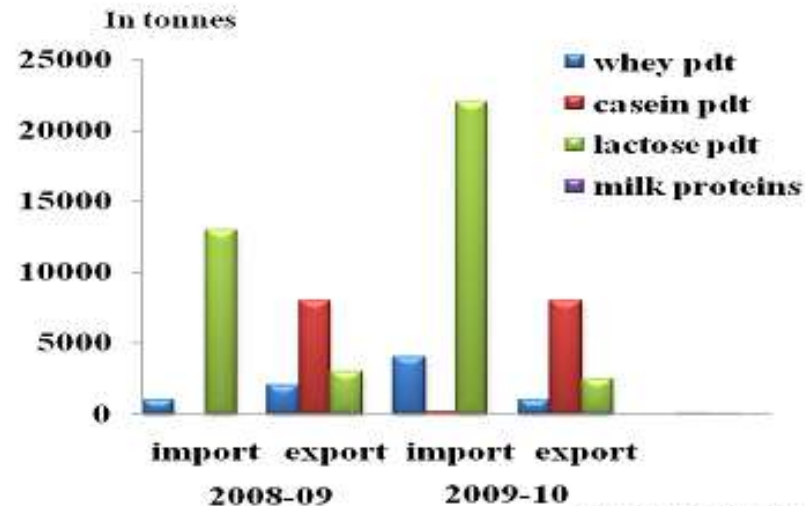


1. Skim Milk and Its By-Products:

1. Skim milk is produced by separation of cream from milk in dairy processing.
2. Rich in SNF content and used for standardization of milk, preparation of skim milk powder and coffee whitener.

Co-precipitates:

- ✓ Well established technology.
- ✓ Poor solubility especially of the high calcium co-precipitates has been responsible for their non-acceptability/non-production on commercial scale.



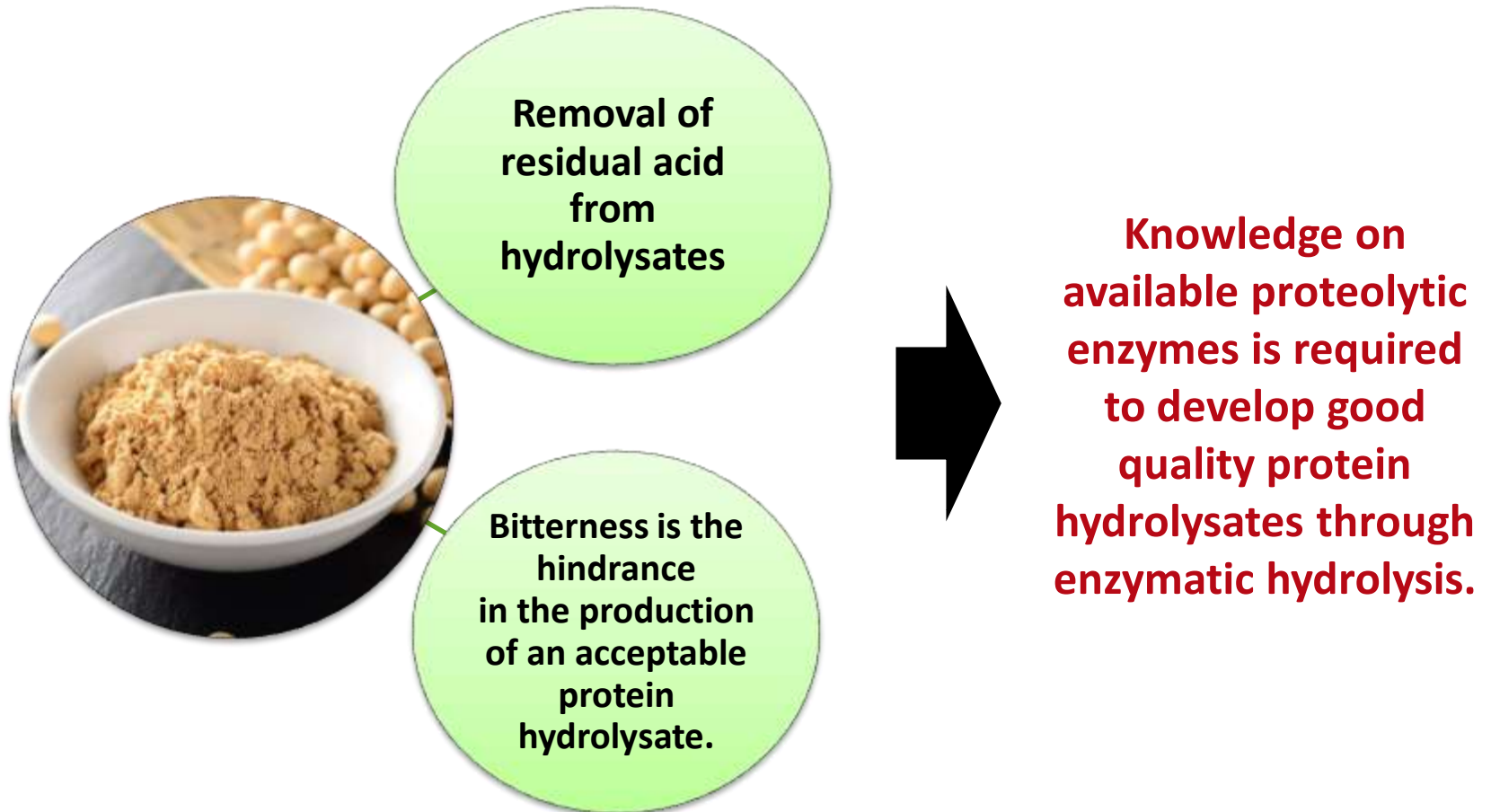
(Source: D.G.C.I.S. Kolkata)

Data on India's import and export of dairy by-products during 2008-2010

Protein hydrolysates:

Breakdown products of protein in the form of peptides and amino acids as a result of hydrolysis of protein either by acid, alkali or proteolytic enzymes.

Acid and alkali hydrolysis of protein- complete/partial destruction and racemisation of most of amino acids.



Casein and caseinates:

- ✓ Prepared from skim milk and used in food preparations, specialized foods and manufacture of plastics etc.
- ✓ The technology of production of caseins from cow milk is well established but technological modifications are required for manufacture of casein from buffalo milk.

Good quality product

- Large, mechanical and automatic plants are required for handling of milk (2 lakh Lt per day).
- Facilities for proper utilization of whey in large quantity.

Economic constraints for the production of spray dried caseinates

- High drying cost
- Low bulk density
- High packaging
- Storage and transportation costs

2. Whey and its by products:

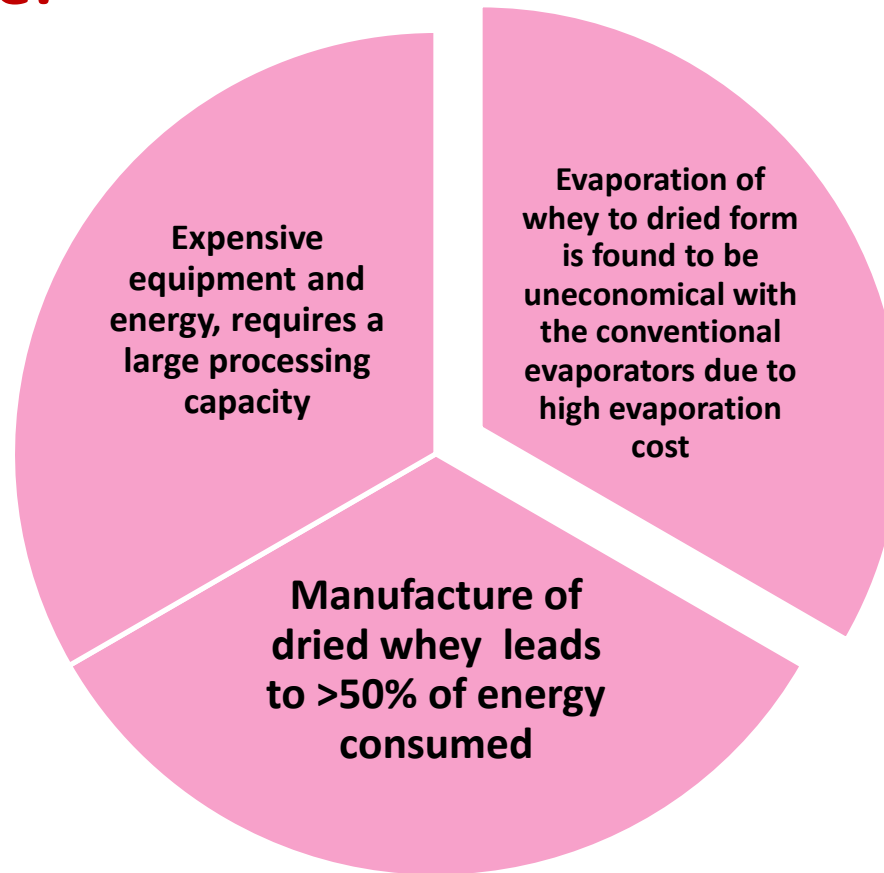
- 1. Whey, the greenish translucent liquid is obtained during manufacture of cheese, casein, chhana, paneer, chakka and co-precipitates and one of the major disposal problems of the dairy industry.**
- 2. Presence of organic matter (6-7% total solids) in the form of protein, lactose, fat, minerals and water-soluble vitamins, its disposal causes environmental pollution.**
- 3. High cost of processing and handling leads to large amount of whey disposed off as raw whey.**
- 4. Acid whey (cottage cheese whey) because of high mineral content (0.7-0.8%) and low pH, poses difficulties in commercial utilization and remains unutilized.**
- 5. Salty flavour of whey based products**

Whey drinks:

- ✓ Whey based beverages (plain, carbonated, alcoholic and fruit flavoured) have been developed and marketed.
- ✓ New whey drinks are based on blends of fruit juices and whey. Whey-containing beverages include products from deproteinated milk serum, fermented dairy-type beverages containing whey, and flavoured milk-type products containing whey or whey components.
- ✓ Alcoholic whey beverages may still be available but whey beer and whey wine is of **limited importance**.
- ✓ **Flavour losses** with some fruit juices containing whey drinks may be encountered in UHT processing of the product, especially in the direct type machines employing a flash cooling vacuum chamber.
- ✓ **Technological problems** interfere with final product quality.

Concentrated and dried whey:

- ✓ **Advantage:** Processing whey into powder lead to no by-product residues to be treated separately.
- ✓ **Disadvantage:**



Note: Evaporators should be operating at their maximum capacity and efficiency.

Whey protein concentrate (separation of whey proteins):

- ✓ UF process produce highly functional WPC as the primary end product for applications as a substitute for non-fat dry milk and other protein ingredients.
- ✓ Although UF of whey is in commercial use, the process generates a **UF permeate as a by-product rich in lactose and minerals** that creates a waste disposal problem.

Demineralized whey:

- ✓ Ion-exchange and electro dialysis processes are used to demineralize whey.
- ✓ These processes can be utilized only for **large scale operation and their high capital cost, high running cost and problem of resultant effluents** are the limitations of these processes.

Lactose:

- ✓ Lactose production from whey is economically feasible on large scale.
- ✓ Sweet whey is preferred because of its high lactose and low ash content.
- ✓ For acid whey, **neutralisation is necessary** leading to change the whey characteristics and increase the cost of manufacture.
- ✓ Lactose can be produced by using UF permeate as a raw material, but UF permeate (acid whey permeate) has very high calcium content. Removal of approx. 50% calcium is necessary to **avoid difficulties during evaporation, which makes the process costly.**

Milk mineral products:

- ✓ Prepared by precipitation of calcium phosphate in whey UF permeate under suitable conditions of concentration, pH, time and temperature.
- ✓ Valuable nutritional supplement in today's osteoporotic world.

3. Buttermilk:

- ✓ High nutritional value and increasing public awareness warrants for the economic utilization of this important by-product.
- ✓ Sweet cream buttermilk produced in organized sector is preferred for processing and utilization in different products.
- ✓ The spray dried buttermilk powder is **less free flowing and dusty because of high fat content (reduces shelf-life)**.

4. Ghee residue:

- ✓ From the scattered small scale household production of desi ghee in villages, ghee residue remains unutilized.
- ✓ Ghee residue at organized sector **can be utilized for the manufacture of chocolate burfi, samosa filling etc.**