The global market for milk sugars: milk/whey permeates and lactose

Focus on added value derivatives and applications

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Lactose and permeate at a glance

In the **Codex Alimentarius**, **lactose** is defined as "a natural constituent of milk normally obtained from whey with an anhydrous **lactose content of not less than 99.0% m/m on a dry basis**. It may be anhydrous or contain one molecule of water of crystallisation or be a mixture of both forms."

- Lactose is a disaccharide composed of the monosaccharides alpha-D glucose and beta-D galactose. It is a reducing sugar and therefore can contribute to Maillard browning in food sectors. Lactose is a useful source of dietary energy and a common excipient in pharmaceuticals as bulking or binder with the active principle.

Lactose is the **main dry component of cow milk** (44-49g/l). It is extracted from **milk/whey permeate** or **cheese/casein whey**. Lactose is then recovered through processes of **concentration** (by evaporation) and **crystallisation**. Sugar extraction takes place by **centrifugation**; afterwards, lactose is **refined**, **dried** and **milled ground**.

Several types of lactose products exist, to meet the needs of various end-users:

- the lowest grade of lactose for feed and for industrial uses (substrate for fermentation for instance)
- for food applications: food or edible grade
- for infant formula: food or edible grade with higher microbiological requirements
- for pharmaceuticals: the highest degree of purity

According to the **Codex Alimentarius**, **milk permeate** is the product obtained by removing milk proteins and milkfat from milk, partly skimmed milk, or skimmed milk by ultrafiltration. **Whey permeate** is obtained by removing whey protein, but not lactose, from whey. **Dairy permeate powders** are dried milk products characterised by a **high content of lactose** manufactured from permeates or obtained by other processing techniques involving removal of milk fat and milk protein and resulting in an end-product with the same composition as specified in the table on the right.

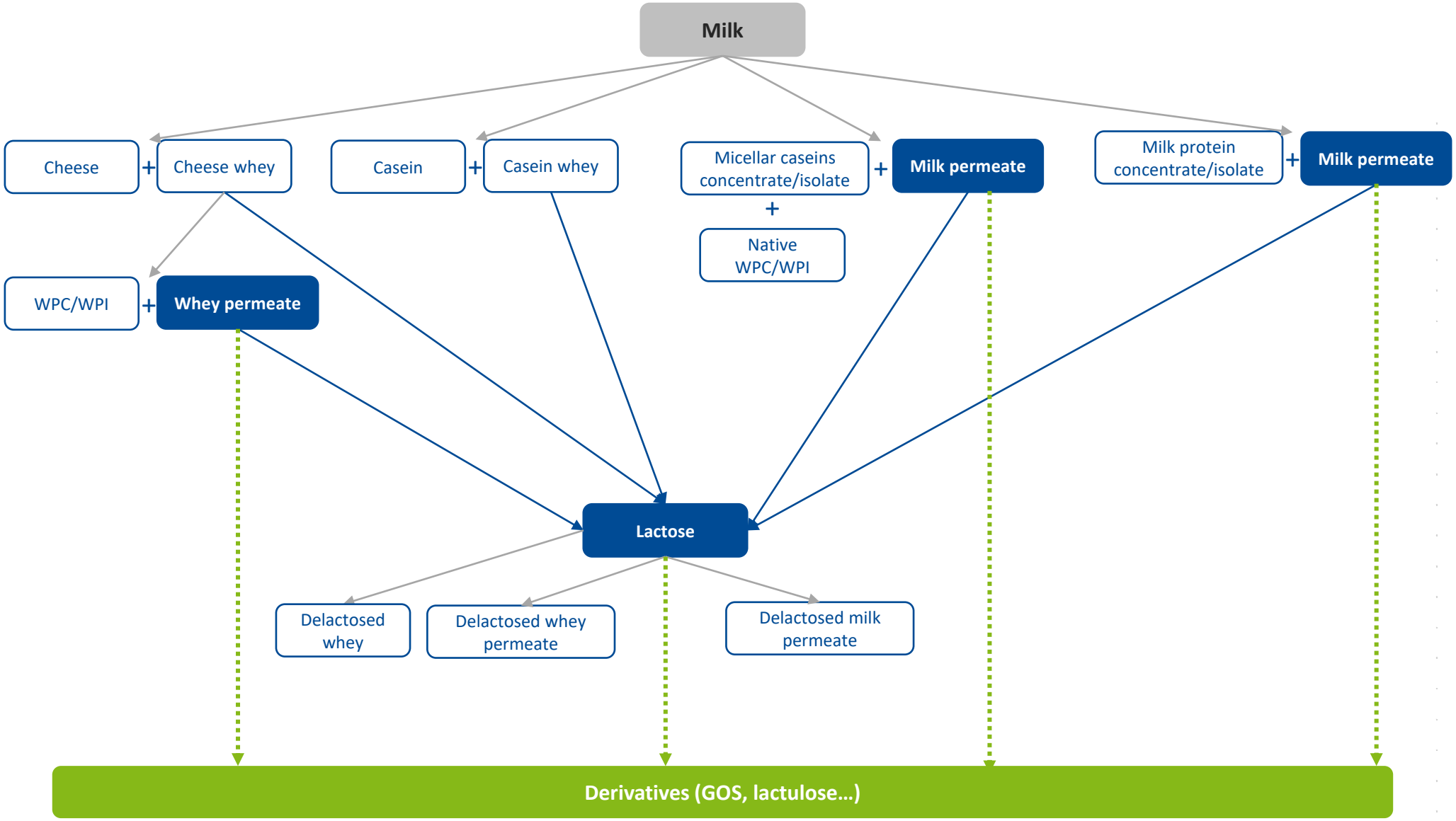
Lactose regulatory definition

		Codex alimentarius	European Pharmacopoeia
Lactose content on dry basis		> 99.0%	> 99.8%
Sulphuric ash content on dry basis		≤ 0.3%	≤ 0.1%
Water content	120°C - 6h	≤ 6.0%	n.a.
	80°C - 2h	n.a.	≤ 0.5%
	Karl Fisher	n.a.	4.5 - 5.5%
pH (10%)		4.5 -7.0	n.a.
Appearance of the solution		n.a.	< JB 7
Optical rotation		n.a.	54.4 - 55.9
Absorbency on three wave lengts		n.a.	400 nm < 0.04 210 - 220 nm < 0.25 270 - 300 nm < 0.07
Heavy metals		n.a.	< 5 ppm
Microorganism count		n.a.	< 100
E. Coli		n.a.	not detected

Permeate definition (Codex Alimentarius)

	Dairy permeate powder	Milk permeate powder	Whey permeate powder
Minimum lactose, anhydrous (m/m)	76.0%	76.0%	76.0%
Maximum nitrogen (m/m)	1.1%	1.1%	0.8%
Maximum milk fat (m/m)	1.5%	1.5%	1.5%
Maximum ash (m/m)	14.0%	12.0%	13.0%
Maximum moisture (m/m)	5.0%	5.0%	5.0%

Route to Lactose and Permeates



Lactose: a slightly growing market with multiple applications

Global lactose production is estimated at around 1'500 kt in 2020, almost 90% of which comes from Europe, the United States and New Zealand.

- Lactose production growth in these regions is driven by growing raw material availability, whey being more and more processed into concentrated powders and by the development of lactose derivatives like lactulose, lactitol and GOS. Moreover, the dynamism of the supplement market is also in favour of growing lactose demand which is used as bulking agent.

The global production of around 300 ktons of MPC/MPI and MCC/MCI would generate theoretically around 380 ktons of milk permeate powder. Similarly, the global production of more than 700 ktons pw of WPC/WPI in 2020 would generate theoretically around 3,500 ktons of whey permeate powder. However, the global market of milk and whey permeate is far below this as large volumes are used internally, for protein standardisation, or sold in liquid form for animal feed.

Gira currently estimates that **food and infant formula each** represent around 1/3 of lactose applications.

- Inside food, chocolate and bakery are the main sub-sectors.

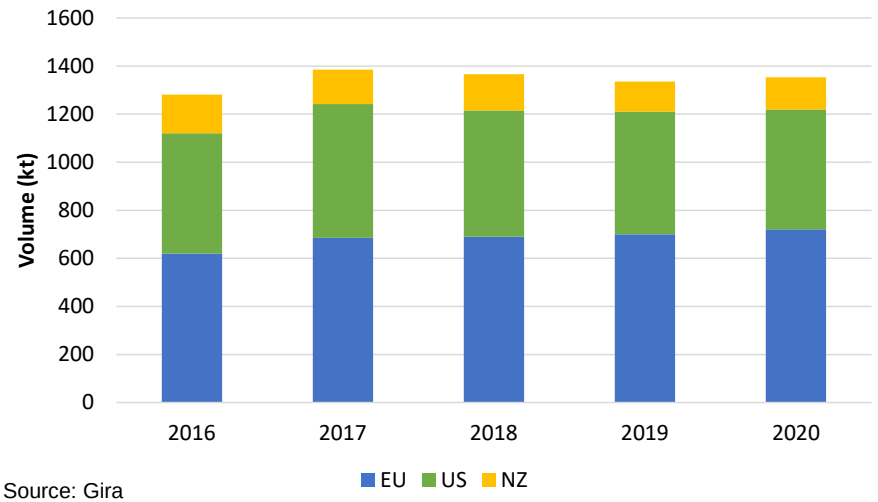
The **pharmaceutical sector** would represent around 20% of lactose uses. The remaining part is distributed between **feed**, use for **standardisation of milk** and **further processing** into derivatives such as lactitol and lactulose, mostly used by the pharmaceutical sector, and galacto-oligosaccharides (GOS), largely used as a probiotic for infant formula.

- A small share of lactose for further processing is also valorised as a substrate of fermentation to produce various molecules like Human Milk Oligosaccharides (HMO), whose demand is currently booming for the infant sector, but also for adult nutrition.

Permeate is used to **produce lactose**. It can be demineralised and dried to be used in **infant formula and food** with the same benefits as lactose. Given the low price of permeate, it is crucial to make processing costs as low as possible. That is why uses of permeate **in liquid and concentrated forms** are developing.

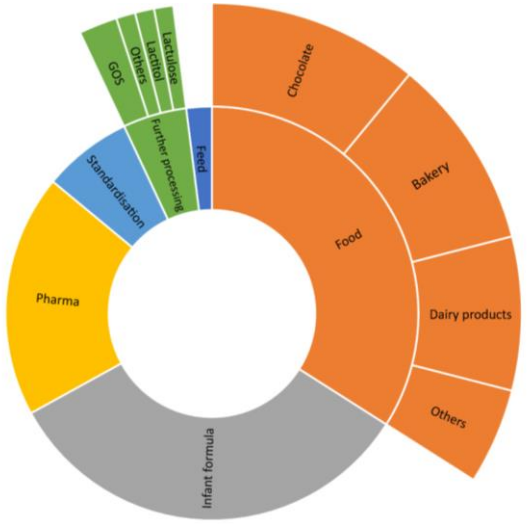
- In liquid form, permeate is mainly used for feed or dairy products and permeate concentrates are used in biotechnologies as a substrate of fermentation.

Lactose production in EU, US, NZ, 2016-2020



Source: Gira

Breakdown of lactose applications



Source: Gira

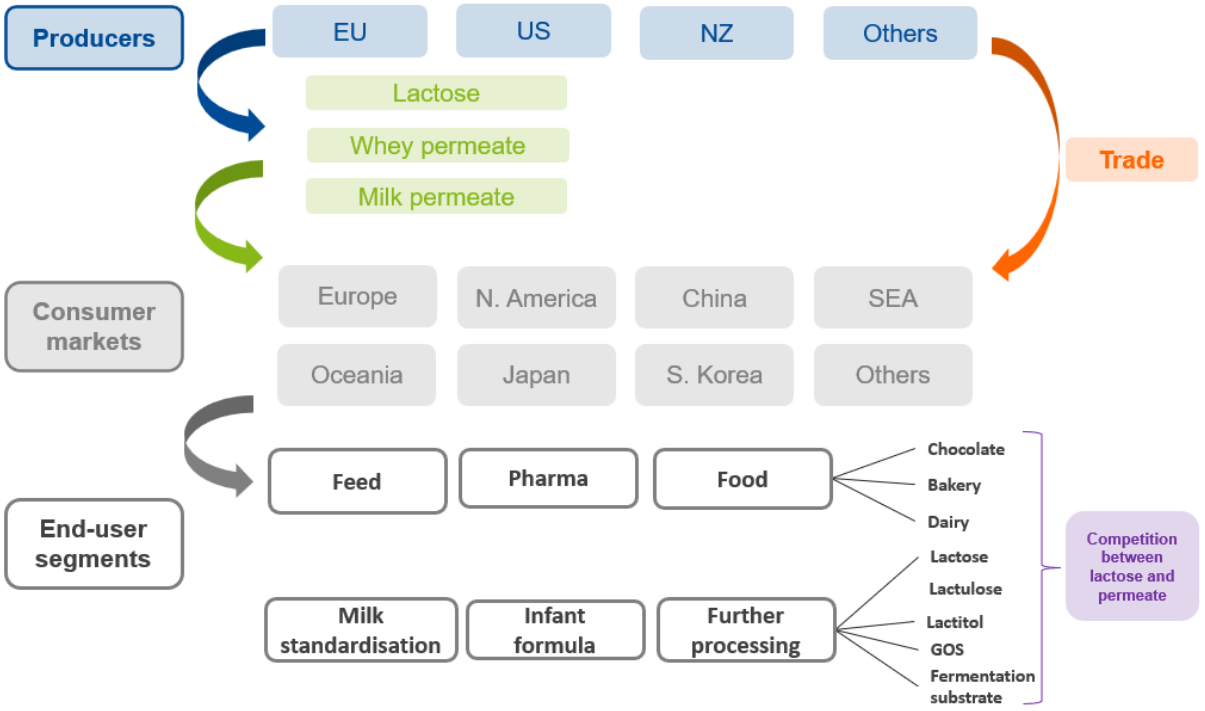
Objectives and content of the study

This study will address the characteristics of the global markets of lactose, milk and whey permeate:

Production analysis (2022, 2023e, 2028f) in volume by geographical areas
- Lactose
- Milk and whey permeate

Trade analysis (2022, 2023e, 2028f) by exporters and importers, in volume and value for lactose
- Estimate of main trade flow for permeate

Consumption data and analysis for lactose and milk/whey permeate:
- By geographical areas
- By application: milk standardisation, feed, food (divided in sub-segments), infant nutrition, pharmaceutical sector and further processing (lactose extraction from permeate, substrate for fermentation)
  - Analysis on the global demand of main lactose derivatives: lactulose, lactitol and GOS. **A special focus will be completed on GOS**, given its importance in the infant nutrition market and the growing demand as a probiotic in adult nutritional sector too.
  - **A focus will be completed on HMO,** whose global demand is forecast to surge in coming years. HMO is produced by precision fermentation (lactose can be used as a substrate for micro-organisms) and is expected to compete with GOS notably in the infant nutrition sector.



Price analysis by types of lactose and applications.

Competitive environment analysis:
- Main global producers of lactose and permeate
- A special focus will be done on milk and whey permeate as potential alternative to lactose, particularly in food sectors, as well as lactose by-products (molasses and mother liquors) issues

Conclusion:
- Opportunities and supply "gaps" existing in the market
- Key factors of success

Deliverables: Results of the study will be delivered through a written report and a presentation

Written Report:

- The report will be released in a PowerPoint "report format" (similar to the style of this proposal), in English. Depending on content and formatting, we estimate that the report will be 40 pages.
- **The report will answer the following strategic questions:**
  - Where are the future opportunities for lactose and permeate producers in terms of geographical areas and applications
  - How to create added value? Pharma grade? Lactose specialties for food? GOS production?
  - How will be the demand in the infant nutrition sector?
  - How will lactose continue to compete with permeate in food/feed applications?
  - How to deal with byproducts and wastewater management?

Presentation of key findings:

- A one-hour session, addressing the results and conclusions of the study.
  - This should comprise presentation of key findings and Q&A session.

Methodology: We will use our tried and tested combination of 3 primary research approaches in order to obtain the broadest possible coverage across the key aspects to help identify the market drivers to be analysed and forecast:

1- Internal database on the dairy sector compiled from 12 years of Gira Dairy Club data and the 2nd edition of the Technical Ingredients study (2020)

2- Extensive documentary research covering all aspects of the product supply chains and the markets to be analysed

- All available documentation: trade press; company, retailer and association websites; national and customs data; consumer and sector studies
- Gira's own extensive dairy ingredient production, trade and consumption databases built up over 30 years of sector experience.

3- A large program of interviews:

- Dairies based in Europe, the United States and Oceania
- End-users in the different applications (food with a focus on chocolate, dairy and bakery), infant nutrition, pharmaceuticals as well as lactose derivatives producers (focus on GOS, lactulose, lactitol and HMO).
- Associations, authorities and experts.

Gira will combine the qualitative and quantitative insights, to build an image of the potential size and sophistication of the evolving market worldwide.

Our Company

Over the last 25 years we have **built up a leading reputation and client base in the international dairy sector**. A list of our more recent dairy clients is provided at the end of this proposal.

- Gira has **carried out several assignments in recent years for worldwide dairy companies** in areas and product sectors similar to those to be covered in this study.
- Gira has **produced one of the first multiclient studies on technical dairy ingredients in 2017/2018 and 2020/2021** and we **regularly produce multiclient studies** relating to several of the **ingredient and end-user sectors and all countries covered in this study**. The most relevant being the annual Gira Dairy Club (GDC), for which the latest list of GDC members is on page 9.
- Gira is **active in strategy consulting and market research in most food and drink sectors worldwide**. More details are available on www.girafood.com.
- Gira's **extensive network of international experts, contacts and clients** in most dairy sectors means that it is **uniquely qualified to carry out this innovative and highly challenging research and analysis project**. Experience has also shown that our long-standing reputation for research and consultancy in the global market opens doors for us to the most informed and competent sources of information.

The Gira Team

Christophe Lafougere is CEO of Gira, and directly responsible for all Gira assignments in the worldwide dairy sector. He has been directing all Gira's consulting and research activities in the dairy sector for over 30 years covering every aspect of production, collecting, processing and marketing, in the major dairy producing and consuming regions of the world.

Mylène Potier is the project manager of this study. She has a PhD in Human Nutrition with particular reference to milk proteins and she is responsible within Gira for all studies and research on technical dairy ingredients. She has managed the both editions of the Technical Dairy Ingredients study. She supervises a team of consultants with experience gained over many years from individual and multiclient studies in the dairy sector.

Guy Kientz, is a Senior Advisor with Gira. He has held several senior management positions in the food ingredients industry, including dairy, in various companies in Europe, the United States and Asia Pacific. He brings his expertise in strategic consulting, project management and M&A.

Timing

Work will start in January 2024, with the **report** being available to clients in **April 2024**.

Subscription

Subscription to the complete study programme and a presentation as previously set out costs **EUR 15 000** (before any applicable taxes).
Dairy Club Members will benefit from a 15 % discount. The subscription price will increase after the work has started.

Gira can deliver either a focus only on lactose or on milk and whey permeate. Please contact us if you are interested in this option.

Payment will be invoiced and requested as follows:

- 50% at the start of work
- 50% on delivery of the final report.

In the unlikely event that insufficient Founder Client subscriptions are obtained, Gira reserves the right to not start work on the study.
In this case, existing subscription contracts will become null and void.

Gira's dairy-sector clients

Dairy-Sector Clients

Agropur	EU Commission	Mueller
Agrial/Eurial	Eucolait	Nestlé
ALIC	Fedegan	DMK
Alpma	FIT	Rupp
Arla Foods	Fonterra	Savushkin
CHR Hansen	Friesland Campina	Sealed Air
Coveris	Glanbia	Sodiaal
Dairygold	Kerry	Unilever
DanTrade (Danone)	Lactalis	USDEC
DSM	Laïta	Valio
Dupont (IFF)	Meggle	Yili
Emmi	Mondelez	

Members of GDC 2023

Agropur	FIT
Arla Foods	Fonterra
Bel	Inalpi
BordBia	Lactalis
CHr Hansen	Land'OLakes
Comital	Sodiaal
Danone	Tirlan
DMK Group	USDEC
DSM-Firmenich	Valio
Emmi Group	Virbac
Eurial	
EU Commission	
Ferrero	

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