

MED TEST III Lebanon

Business case:

Valorization of whey in Lebanon's dairy sector

Challenge

Whey is a by-product of cheese production, making up 85-90% of milk. It also contains 55% of the nutrients in milk, including valuable amino acids, antioxidants, micronutrients, digestive enzymes, and high-biological-value proteins. The nutritional value and health benefits of whey have popularized the valorization of whey, and almost 60% of residual whey is globally used in the development of value-added products in the food and chemical sector, such as whey powders, proteins, functional foods, bioplastics, and biofuels.

In Lebanon, the dairy sector comprises 14% of the agro-food companies, which are estimated to generate 220,000 tons of whey annually. Still, despite the nutritional value of whey, this by-product remains unutilized by companies in Lebanon, and it is disposed of either untreated or semi-treated into rivers and sewage systems. This leads to environmental problems due to its high levels of organic matter which creates pollution, depletion of oxygen levels and harms aquatic life when disposed untreated or partially treated.

To unlock the opportunities for developing high-value products made of whey in Lebanon's dairy sector, businesses need support in adopting advanced techniques, such as ultrafiltration, nano-filtration and the know-how of fermentation processes, which represent challenges for most Small and Medium-sized Enterprises (SMEs) due to high investment and energy-demanding processes.

The scope of the pilot project

Since 2020, the United Nations Industrial Development Organization (UNIDO) has worked under the regional EU-funded SwitchMed programme to identify and showcase resource-efficient production methods in Lebanon's industrial sector. Working in close collaboration with the Ministry of Industry (MoI) and the Ministry of Environment (MoE), and with the support of the Association of Lebanese Industrialists (ALI), UNIDO launched under the MED TEST III project an initiative to demonstrate how Lebanese SMEs can effectively use whey.

The pilot project followed a three-folded objective:

- Contribute to developing value-added products from whey at affordable costs for dairy SMEs with relatively lower energy consumption demand.
- Incentivize innovative solutions to supply highly nutritious and affordable products to Lebanese families.
- Provide feasible alternatives for eliminating customary whey waste by transforming it into raw material, reducing the environmental impact of the dairy sector.

The approach

Beginning in 2022, UNIDO analyzed various whey-based product alternatives, considering technological requirements and market availability. Furthermore, the analysis aimed to identify liquid or semi-liquid product options that could be produced using existing dairy factory technology in Lebanon while also adding value to the process before considering biomass-to-energy alternatives. Given the current energy crisis in Lebanon,

energy-intensive concentration and drying technologies were not recommended, as they would lead to unfeasible costs for dairy producers.

Six Lebanese companies were evaluated based on equipment, product type and proximity to sensitive areas. One small and one large company were selected for assessing and piloting identified whey valorization processes potentially viable in the context of Lebanon.

The Lebanese University's Faculty of Agronomy (LU) significantly supported the sensory campaign and laboratory trials. Students and technical assistants from the LU were trained in sensory analysis, data collection, and processing.

Several experiments and formulations were conducted at a laboratory scale to test the products. A panel of over 100 individuals was formed, and a 9-point hedonic scale was used to rate the products based on various factors, such as flavour, appearance, mouthfeel, odour, saltiness, acidity, sweetness, and overall acceptability. Only samples that received the highest score were selected for industrial pilots and further improvements.

After conducting a sensory campaign, new product formulations were adjusted, and their physicochemical properties were analyzed. The resulting products were also evaluated economically to determine the potential benefits of incorporating whey into the product. This analysis involved comparing the "new" products that include whey with existing products. Additionally, experimental industrial-scale protocols were developed for the pilot companies.

A seminar was held to disseminate the study's results on whey-based products to more than 100 attendees from national and regional dairy companies in Lebanon, Jordan, and Palestine. The audience included private sector organizations and public institutions, and the seminar aimed to motivate dairy companies and investors to adopt whey-based products that apply to companies of all sizes.

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At Liban Lait, we are committed to reducing our environmental footprint. The MED TEST III project has proved to be instrumental in providing us with technical assistance and innovative ideas to achieve this goal while reducing costs. Finding a value-added alternative for using our acid whey is relevant to this goal. Additionally, we can offer the Lebanese people a product with improved nutritional features. We will continue to work towards this goal with full dedication.

Marc Waked
CEO, Liban Lait

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The results and key takeaways

The following value-added product categories were selected for development:

Ayran (Acid whey)

A typical product for the Mediterranean region that can be improved with an increased nutritional value by replacing water or yogurt contents with acid whey. The outcome is a product with higher concentrations of protein and carbohydrates in the final product. During the project, 28 formulations were tested to determine the best option for Ayran.

Fruit juice (Acid whey)

Incorporating whey in juice production is an effective way to maximize the nutritional benefits of acid whey and manage waste. This technique capitalizes on the liquid form of whey and adds nutritional value to juices that are typically not fortified with

additional nutrients. Currently, no similar products are available in the Lebanese market, so this presents a great opportunity for dairy or juice companies to create more nutritious options as healthier alternatives to soft drinks. The project developed 15 formulations to determine the optimal product.

Spreadable cheese (Sweet whey)

Whey can be used instead of water to produce spreadable cheese, making it more nutritious. Since there is a limited local production of spreadable cheese, most of the products consumed are imported. The introduction of this new product by the SME dairies could replace imports, create a new line of products, and generate additional income along the local dairy value chain in Lebanon. A total of 12 formulations were tested for the project.

Type	Final formulation (highest acceptability)	Market Potential (High - Medium - Low prospect/Established)	Technology & Investment Capital Expenditure (CAPEX)	Cost benefits
Ayran (Acid whey)	50% whey:50% milk. 40% whey: 50% milk: 10%water. 40% whey: 60% milk: 10%water. Mint flavor	High prospect	The product can be manufactured by Ayran producers using existing production lines. No CAPEX needed.	Between 4 - 10% of lower production costs.
Fruit juice (Acid whey)	Apple flavor: 30% whey:70% juice: 0% water Lemon flavour: 30% whey:30% juice:40% water	High prospect	Whey-based juices can be produced using the same production facilities for juice production factories. No CAPEX is needed	25% lower material production cost compared to Non-from Concentrate (NFC) premium juices.
Spreadable cheese (Sweet whey)	Sweet whey and milk powder with 1) Butter, 2) Kashkaval flavor, or 3) Cheddar flavor	Established	CAPEX varies according to installed capacity. Ex: 122k Euro => 100 tons/year 170k Euro => 500 tons/year	Between 14-30% less material production costs compared to standard spreadable cheese.

Conclusions/Upscaling recommendations

This pilot project has motivated the dairy sector and other stakeholders in continuing exploring productive uses of whey, applying the lessons from the MED TEST III pilot project. Specific examples for how the application of whey has been adopted are:

- **Adding whey to juice:** Junet, a medium Lebanese company that participated in UNIDO's whey dissemination seminar, is developing trials to incorporate whey in one new beverage product. The product is expected to target national and international markets as a new enriched beverage, mainly for children. At the same time, Al Pinar, a Palestinian dairy beverage company that also attended the seminar, is applying trials for using whey in juices. The products are under development, and both companies have received support from UNIDO MED TEST III project teams.
- **Using whey in spreadable cheese:** Based on the project results, KMR, a small Lebanese dairy company specializing in cheese production, has undertaken new development for spreadable cheese. Through the technical assistance received, eight varieties of spreadable cheese have been developed using sweet whey, and new formulations are being tested as options for more product varieties.
- **Market and feasibility study for whey:** Interested in moving forward with spreadable cheese production using whey, Skaff Dairy receives support with a market study, which will provide more detailed information for the technical and economic feasibility of a new production line in its dairy facilities.

For more information about the pilot products, please refer to the product fact sheets available through the QR codes below,



Case study for whey-based Ayran



Case study for whey-based fruit juice



Case study for whey-based spreadable cheese



For more information contact:



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