

MEDTEST III

WHEY VALORIZATION INITIATIVE



**SPREADABLE
CHEESE**

Implemented by:



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

SwitchMed is co-funded by:



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● The MED TEST Project

The SwitchMed-MED TEST project is one of Lebanon's most significant programs on resource efficiency. Funded by the European Union, the MED TEST project has, since 2014, under the lead of the United Nations Industrial Development Organization (UNIDO), demonstrated the business case for resource efficiency in over 165 industries across the food, chemical, and plastics sectors in eight countries of the southern Mediterranean.

In Lebanon, the MED TEST II (2014-2018) and MED TEST III (2019-2024) projects identified 257 resource efficiency measures that resulted in an average energy savings of 30%, water savings between 3% to 40% and a reduction in materials use by 1%. Implementing these measures has resulted in annual cost savings of 4.9 million Euros for the 23 participating companies. Additionally, it has helped reduce CO2 equivalent emissions by approximately 13,000 tons per year, solid waste generation by about 5,000 tons per year, and water consumption by more than 80,000 m³/year. Most of these measures have a short payback period averaging 1.4 years.

As part of the MED TEST III project, UNIDO analyzed various whey-based product alternatives that could be produced using existing dairy factory technology in Lebanon while also adding value to the process. The pilot project aimed to develop affordable, low-energy-consuming, and highly nutritious products for Lebanese families while reducing the environmental impact of the dairy sector by transforming customary whey waste into raw material.

● Product Definition

The whey-based spreadable cheese developed by the SwitchMed MED TEST III project is a light and nutritious processed cheese essentially produced from natural dairy ingredients without the addition of vegetable oils.

● Raw Materials

The key raw materials are sweet whey and milk powder. Other raw materials include citric acid, emulsifier (di, tri and orthophosphate), stabilizer (guar gum), and salt. Optional ingredients include butter and flavours like Kashkaval and Cheddar cheese flavors. Butter may be substituted with cooking cream derived from milk. For this project, formulations included the use of butter and Kashkaval and Cheddar flavors additionally to plain spreadable cheese (no special cheese added).



(Credit: Freepik)

● Product Formulation

Twelve formulations of spreadable cheese with sweet whey and milk powder as principal raw materials have been designed by the MED TEST III project using experimental design methodology. The formulations that were produced at pilot scale following initial laboratory trials, and that received the highest sensory acceptability scores were as follows:

Formulations of spreadable cheese made from sweet whey and milk powder as main ingredients

CHEESE SAMPLE	*SWEET WHEY (KG)	MILK POWDER (KG)	BUTTER (KG)	EMULSIFIER (KG)	GUAR GUM (KG)	CITRIC ACID (KG)	SALT (KG)	FLAVOR (KG)	CHEESE YIELD (KG)
Plain cheese	1.03	0.4	-	0.02	0.01	0.005	0.005	-	1.47
Butter cheese	1.03	0.4	0.1	0.02	0.01	0.005	0.005	-	1.57
Kashkaval flavor	1.03	0.4	-	0.02	0.01	0.005	0.005	0.004	1.47
Cheddar flavor	1.03	0.4	-	0.02	0.01	0.005	0.005	0.004	1.47

*Whey density = 1.03 kg/L.

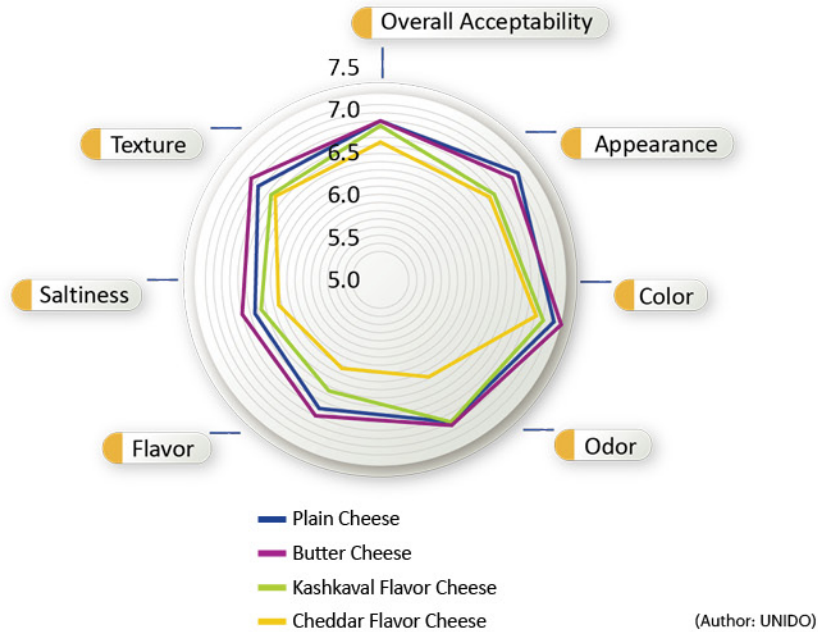
● Physicochemical Properties

The physicochemical properties of the spreadable cheeses made from sweet whey and powder milk as main raw materials are as follows.

SAMPLE	PLAIN CHEESE	BUTTER CHEESE	CHEESE WITH KASHKAVAL FLAVOR	CHEESE WITH CHEDDAR FLAVOR
Moisture content (%)	63.6	57.5	63.6	63.6
Fat content (%)	9.0	14.7	9.0	9.0
Fat on dry matter (%)	24.7	34.5	24.7	24.7
Ash content (%)	3.4	3.4	3.4	3.4
Protein (%)	8.7	7.9	8.7	8.7
Carbohydrates (%)	15.3	16.5	15.3	15.3
Caloric value (kcal/100ml)	177	230	177	177
Chlorides, as NaCl (%)	0.7	0.7	0.7	0.7
pH at 25°C	5.6	5.6	5.6	5.6

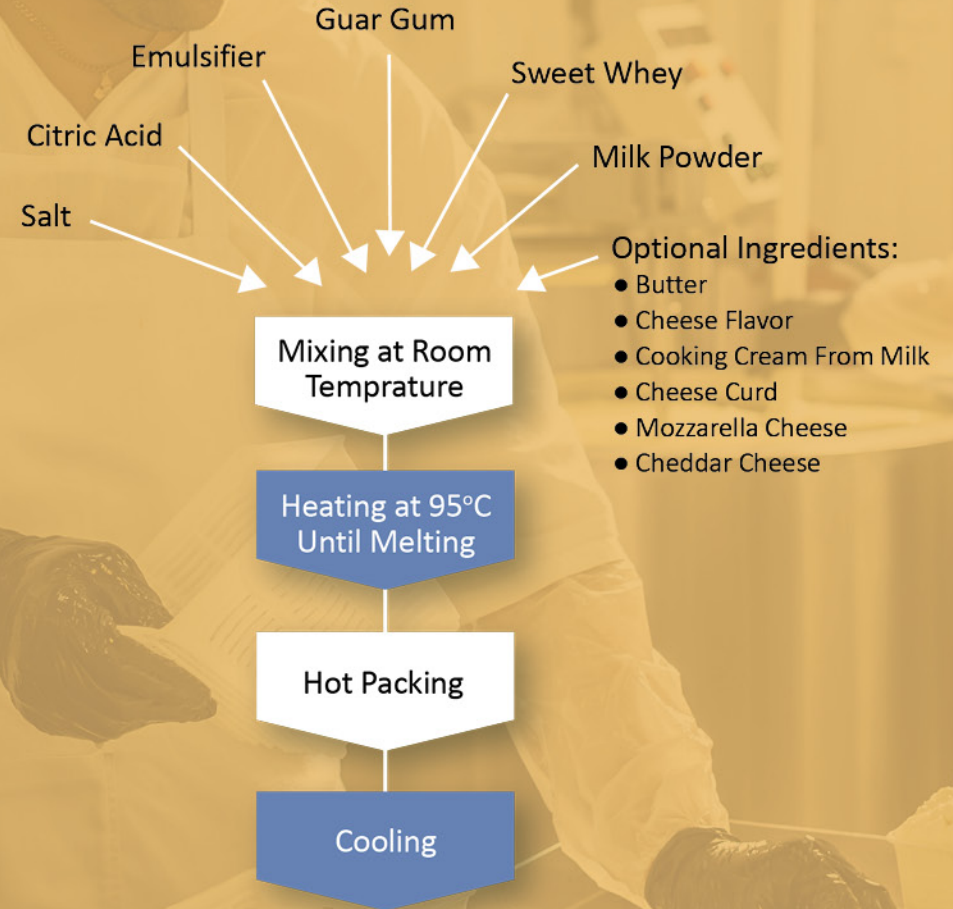
● Sensory Properties

The sensory analysis conducted at a large scale (around 125 panelists from different Lebanese regions) for spreadable cheese made from sweet whey and powder milk, as the main raw materials, revealed that the samples of butter cheese, plain cheese and Kashkaval flavored cheese received a good acceptability score of 6.8. However, the cheddar flavored cheese received a slightly lower score of 6.6.



● Production Process

All ingredients are added to a mixer-cooker and mixed at room temperature under vacuum. Guar gum is incorporated gradually to prevent powder agglomeration. The mixture is heated gradually to attain 95°C and is kept for 5 min with gentle mixing until melting. The melted cheese is poured into sterilized glass jars, and then stored under refrigeration at 4°C.



(Author: UNIDO)

● Technological Requirements

The implementation of a spreadable cheese production line can be easily done in existing cheese dairy companies as most equipment are already present. However, new components are needed to operate the new production line, mainly:

- **Storage tank for sweet whey.**
- **Mixer-cooker:** it needs to be equipped with a double jacket to allow for efficient steam circulation, enabling rapid heating of the product. Additionally, it should have the option of operating under vacuum to ensure uniform cheese production.
- **Filling and labeling machine.**

It is worth noting that local manufacturers exist in Lebanon for the mixer cooker and the filling and labelling machines. There are three locally manufactured cooker capacities available (50 kg, 100 kg, and 200 kg).

● Investment

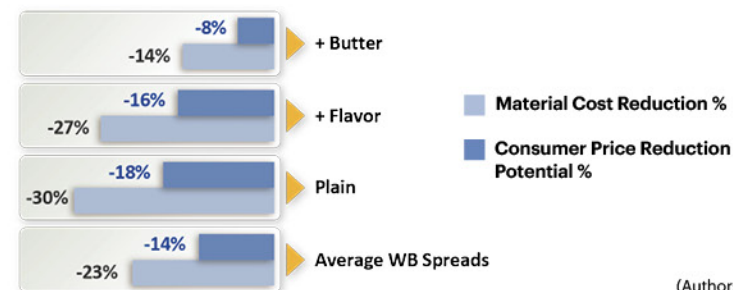
The estimated investment in spreadable cheese processing line depends on the production capacity of the plant. Below is the investment needed for the production of spreadable cheese for different production capacities calculated with local manufacturers prices. The pre-requisites are as follows:

- The factory has already cheese production and drains off the sweet whey;
- There is available space for accommodating the needed equipment;
- The factory operates 300 days/year (all type of milk for cheese production);
- The production of spreadable cheeses should follow after the Daily Primary cheese production (drain off & cool Fresh Whey);
- Production hours are stipulated by the mixer/cooker batch size. Locally manufactured mixers/cookers exist in batch sizes of 50 kg, 100 kg and 200 kg which are considered in the estimations below. The number of batches that can be processed per hour are estimated as net production (including the filling and the emptying of the cooker). Each batch lasts 15- 20 min corresponding to around 3 batches /hour.

CAPEX NEEDS (USD) (Local manufacturers prices)	PRODUCTION CAPACITY (TONNES/YEAR)			
	100	200	300	500
Whey collection tanks, pumps, etc.	\$ 5,000	\$ 10,000	\$ 15,000	\$ 25,000
Shear mixer-cooker	\$ 40,000	\$ 50,000	\$ 50,000	\$ 50,000
Filling/labelling machine (using glass jar as reference)	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000
Miscellaneous, valves & fittings etc.	\$ 25,500	\$ 30,000	\$ 31,500	\$ 34,500
Others (e.g., cooling tunnel, etc.)	\$ 11,050	\$ 13,000	\$ 13,650	\$ 14,950
CAPEX total	\$ 121,550	\$ 143,000	\$ 150,150	\$ 164,450

● Economic Benefits

The spreadable cheeses made from sweet whey and powder milk as main raw materials are cheaper than imported spreadable cheeses. The material production cost is expected to be in average 23% lower than that of imported spreadable cheeses available in the market and their average consumer retail price is cheaper by around 14%.



● Recommendations

● SWEET WHEY COLLECTION:

Sweet whey must be collected under strict hygienic conditions in a refrigerated tank. It must be used the same day to prepare the spreadable cheese, otherwise it must be pasteurized at 95°C for 2 minutes and kept refrigerated at 4°C until its use. Under these conditions, sweet whey may be conserved for 2-3 days.

● MIXING SPEED:

The speed of mixing must be high at the beginning of the process to ensure the dissolution of all ingredients in the medium, especially milk powder and guar gum. At the end and during cheese melting, the mixing speed should be lowered to avoid air incorporation in the product.

● ADDITION OF GUAR GUM:

Guar gum must be added progressively at room temperature to avoid powder agglomeration.

● CHEESE AS AN ADDITIONAL INGREDIENT:

Spreadable cheese can also be made by incorporating cheese in the form of cheese curd or small cuts of cheeses like cheddar or mozzarella. The addition of cheese has a good potential to improve sensory outcomes but the product is expected to be more expensive than the one produced mainly from sweet whey and powder milk. Sensory evaluation conducted at a small scale, and to be validated at a larger scale, revealed an increase in acceptability scores up to 8.2 when adding cheese compared to the spreadable cheese made without this ingredient.


Local production of spreadable cheese is of high added value as it would lower imports, boost the local manufacture of production equipment (ex. cooker-mixer), while valorizing the sweet whey and producing a product with a lower retail price for consumers than imported ones.


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