

MEDTEST III

WHEY VALORIZATION INITIATIVE

WHEY-BASED FRUIT JUICES



Implemented by:



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

SwitchMed is co-funded by:



Generalitat de Catalunya
Departament d'Acció Climàtica,
Alimentació i Agenda Rural



Agència de Residus de
Catalunya



Italian Development
Cooperation
Ministry of Foreign Affairs
and International Cooperation

● 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

Whey-based fruit juices are beverages prepared from acid whey and fresh fruit juice (single strength). They are refreshing, thirst-quenching, and healthy. They are considered functional beverages as they comprise valued nutraceutical components derived from both the fruit and the whey. Whey-based fruit juices can also be prepared from concentrated juices.

● Raw Materials

Acid whey, fruit juice (apple, lemon), drinking water, sugar, sodium alginate, apple and lemon flavors. Acid whey is obtained as a by-product of Labneh (or concentrated yogurt) production. The proposed product will add value to a material flow that is commonly lost in Lebanese dairy production.

● Product Formulation

Fifteen formulations of acid whey and fresh juices (apple, orange, lemon) were tested. The formulations that were produced at pilot scale following initial laboratory trials, and that received the highest sensory acceptability scores were those prepared from apple and lemon juice as per below ratios:

FORMULATION (PILOT SCALE)	ACID WHEY (% V/V ¹)	FRESH JUICE (% V/V ¹)	WATER (% V/V ¹)
Apple 30	30	70	-
Lemon 30	30	30	40
Lemon 50	50	30	20

For a 100 mL blend, 1 mL flavor and 0.1 g sodium alginate are added. Sugar is used at a concentration of 8% (w/v²) in apple juice, and of 16% (w/v²) in lemon juice.

● Physicochemical Properties

PHYSICOCHEMICAL ATTRIBUTE	APPLE 30 (WHEY 30%)	LEMON 30 (WHEY 30%)	LEMON 50 (WHEY 50%)
Total solids (%)	18.1	19.0	20.1
Fat content (%)	0.1	<0.1	<0.1
Ash content (%)	0.6	0.6	0.8
Protein (%)	0.5	0.2	0.2
Carbohydrates (%)	16.9	18.1	19.0
Calorific value (kcal/100 ml)	71	74	78
Brix (%)	17.5	16.4	16.6
pH at 25°C	4.0	2.7	2.8



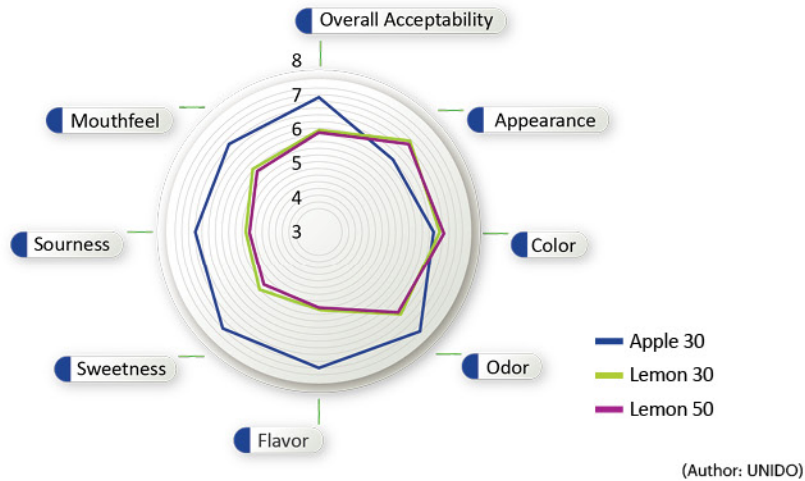
(Credit: Kufotos)

¹Volumen/Volumen.

²Weight/Volume.

● Sensory Properties

The sensory analysis conducted on a large scale (around 125 panelists from different Lebanese regions) revealed that whey-based apple juice was highly liked by panelists, getting an overall acceptability score of 6.9. On the other hand, whey-based lemon juice was moderately appreciated, with an acceptability score of 5.9 for both samples.

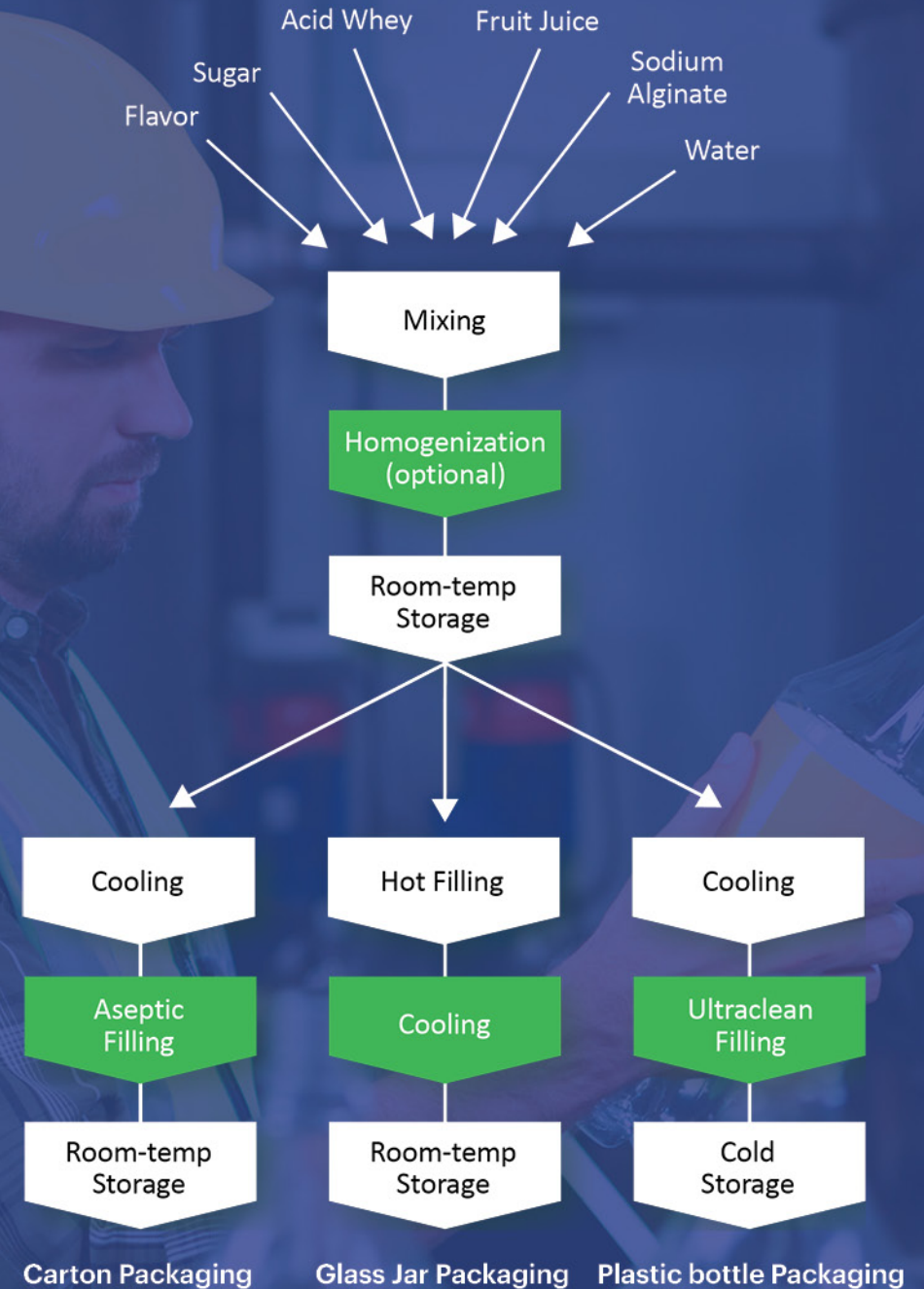


● Production Process

The following description corresponds to a standard process for producing whey-based fruit juices, suitable for cartons, glass jars, or plastic bottle packaging.

Acid whey and, if applicable, water, are added to fruit juice (whether fresh or reconstituted from concentrate) in the appropriate ratios specified on page 5. Subsequently, sugar, sodium alginate (0.1%), and flavor (1%) are incorporated. All these ingredients are carefully blended in a tank at room temperature. The resulting blend undergoes homogenization (optional) and is then subjected to pasteurization at 95°C for 15 seconds.

For carton packaging, the blend is cooled, aseptically filled, and subsequently stored at room temperature. In the case of glass jar packaging, the blend is hot-filled, followed by cooling and room temperature storage. Finally, for plastic bottle packaging, the blend is filled within an ultra-clean environment, cooled, and then it must be refrigerated.



● Technological Requirements

The equipment needed to produce whey-based fruit juice are as follows:

- | | |
|--------------------------------------|---|
| A) Storage Tank For Acid Whey | E) Filling Machine
(for glass, plastic, or carton) |
| B) Mixing Tank | F) Labeling Machine |
| C) Pumps | G) Cooling tunnel
(only for glass hot filling) |
| D) Plate-Heat Exchanger | |

● Investment

The manufacturing of whey-based fruit juices can be easily carried out in any existing juice production line, either fruit juices, nectars, or drinks, as all the necessary equipment is already present. This eliminates the need for capital expenditure (CAPEX). The implementation of such a line within the dairy industry in Lebanon would mean a high investment that could not be justified considering the estimated market volumes and the competition within the industry. However, dairy companies equipped with Ayran lines can produce whey-based fruit juices without any additional investment, using plastic bottles similar to those used for Ayran.



● Economic Benefits

The apple and lemon whey-based fruit juices should be introduced as a brand-new product category, as the addition of whey transforms the beverage into a functional drink. Nevertheless, an economic analysis was conducted to compare the new product with Non-From Concentrate (NFC) premium juices. The analysis builds backward on the retail price of NFC and assumes average margins through the value chain to estimate the direct material cost for this product.

Comparing recipe costs, the proposed products are expected to have 25% lower material production cost than that of NFC fresh juices on average. Furthermore, the average consumer retail price for the whey-based fruit juices could be approximately 19% cheaper than that of the fresh juices.

● Recommendations

● COLLECTION OF ACID WHEY:

If the whey-based fruit juices are produced in a juice factory, there is a need to collect clear acid whey from dairy industries (with no solid particles). The collection process must be conducted on the same day of production using a clean and refrigerated tanker. In the plant, acid whey must be used the same day; otherwise, it must undergo pasteurization at 95°C for 2 minutes, followed by cooling to 4°C and used within one week.

● LABELING:


The label “shake before use” should be used as usual in this type of drink.


● MARKETING AS FUNCTIONAL JUICE:


The whey-based fruit juices represent a NEW category of juices that can be marketed as Functional fruit juices so that the market strategy can highly influence the perception of this product compared to less healthy options.

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For more information on the UNIDO activities within the SwitchMed initiative, please contact us at u.dolun@unido.org