

Technical Bulletin No. 3

# Milk Processing Technologies for Small-Scale Producers

by  
Abebe Tessema and Markos Tibbo



International Center  
for Agricultural Research  
in the Dry Areas



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## About the authors

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## Foreword

This Technical Bulletin is the third in a series produced by the Women's Livelihoods and Dairy Goat Project being implemented in Afghanistan and Pakistan. This IFAD-funded project aims to improve rural livelihoods in marginal, conflict and post-conflict areas of the two countries.

There are large numbers of small-scale livestock keepers in Afghanistan and Pakistan, and traditional milk processing methods (e.g. cheese making) are well known in many areas. Many of these producers seek to improve the quality of milk products, for home consumption and especially for sale. However, little effort has been made so far to promote simple, improved processing technologies suitable for small-scale producers. Such technologies can create better market access for these producers, and improve household nutrition as well as consumer health.

This booklet describes simple, appropriate processing technologies for producing value-added milk products such as yogurt, butter and cheese. It is intended to serve as an extension aid for farmers and women farmer facilitators working with communities in both countries. It will also be helpful in other countries and regions where conditions are similar. These techniques are particularly important in the Afghanistan-Pakistan region, where zoonotic diseases (e.g. tuberculosis and brucellosis) are common, affecting both livestock and people. The guidelines suggested in this booklet will help to improve the quality of milk and milk products, and reduce transmission of these diseases. This booklet will also be useful to anyone engaged in small-scale dairy enterprises.

I would like to thank all those involved in the preparation, review and translation of this Technical Bulletin.

Barbara Rischkowsky  
Acting Director, DSIPS Program  
ICARDA

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## 1. Introduction

Most farmers keep only a few dairy animals. Therefore milk production is not stable throughout the year, but fluctuates with the season. These farmers would like to obtain more milk and dairy products for family consumption. They would also like to sell milk and dairy products on the market, to earn more income. To do this, they need to learn simple processing methods to improve the quality of milk and milk products such as butter, cheese and yogurt.

## 2. What are the advantages of milk processing?

- Provides regular income
- Improves nutrition
- Selling processed milk products is more profitable than selling fresh milk
- Generates employment
- Improves quality and safety

## 3. Pasteurization

Pasteurization is the first step in milk processing. Pasteurization means heating every particle of the milk or milk product to a specific temperature for a specified period of time (63°C for 30 minutes). This destroys bacteria and other micro-organisms that may affect consumers' health. It makes the milk safe and healthy, and also improves the keeping quality, \* so that milk and milk products can be stored for longer periods without being spoilt.

### Simple method of pasteurization

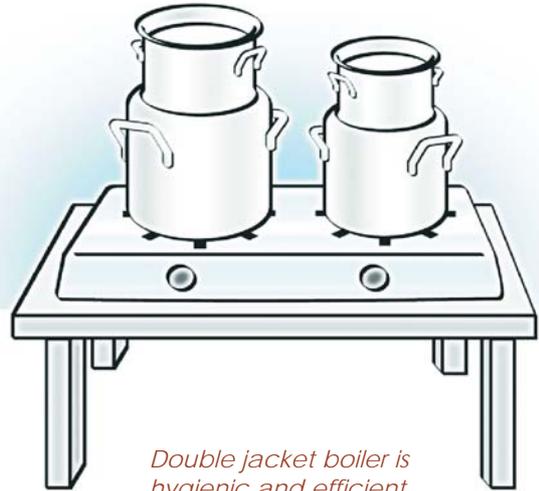
Many farmers pasteurize their milk by direct boiling. However, direct boiling is unhygienic, because it can lead to contamination from outside particles or bacteria. Direct boiling is also inefficient, i.e. it requires more energy (more fuel or firewood).

Indirect heating is a better way to pasteurize milk. Place the milk can inside a larger metal vessel containing water, so that the water forms a jacket around the milk can. Heat the larger outside vessel using an open flame, or gas stove, or electrical hot plate.

\* Keeping quality or keeping power is a term to describe how long the milk remains sweet, palatable and suitable for direct consumption. Milk with good keeping quality fetches good market prices. Milk that is sour or otherwise unpalatable cannot be sold for direct use, however rich it may be in fat and other solids.



*Open pan is unhygienic and inefficient*



*Double jacket boiler is hygienic and efficient*

#### **Other methods of pasteurization**

- Batch pasteurization: 63°C for at least 30 minutes. This is suitable for small-scale producers and farmer cooperatives.
- High temperature short time (HTST) pasteurization: 72°C for at least 15 minutes. This is suitable for processing large quantities of milk, e.g. more than 250 liters at a time.
- Ultra high temperature (UHT): 135°C. This is used by big factories. It requires special machinery. UHT milk can be stored for 6 months even without refrigeration.

## **4. Components of milk**

Milk contains many different components like water, fat, protein, lactose and ash. The most important component is butterfat, which gives milk its special creamy taste and color. Butterfat is used to make many different products such as cream, butter, butter oil and ghee. The amount of butterfat in milk depends on species (cow, goat, etc) and the breed. Goat milk contains 3 to 5.6% butterfat. Cow milk contains 3.2 to 5.5%. Sheep milk contains 6.4 to 9%.

## **5. Making different products from milk**

In the remaining part of this booklet, we describe how to make various milk products like cream, butter, yogurt and cheese, and how to handle and maintain the equipment needed.

## 6. Cream separation

The first step in making cream, butter, ghee, etc is to separate cream from the fresh milk. This can be done by gravitational separation or centrifugal separation.

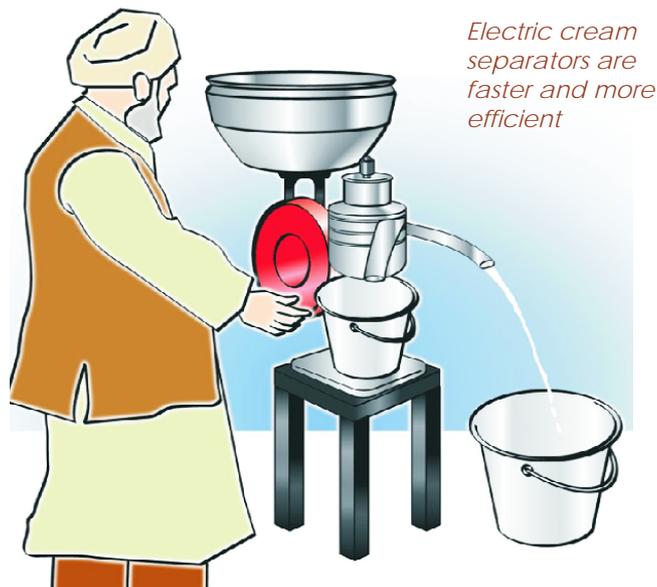
- **Gravitational separation:** allow the milk to settle. The cream is lighter than the other milk components. It rises to the top, and can be separated.
- **Centrifugal separation:** this requires a simple machine called a centrifuge. The centrifuge can be driven (i.e. rotated) by hand, or by an electric motor.

### What is centrifugal separation?

- Centrifugal separation can be used for any liquid, to separate different components.
- Milk is placed in a bowl, which is then rotated. When it rotates, the heavier portion (i.e. the skim milk) moves to the outside, and the lighter portion (cream) moves towards the center of the bowl. Therefore the two portions can be separated.
- The speed of rotation can vary from 2000 rpm in small manual separators to 20,000 rpm in large electric separators.



*Manual cream separators are ideal for using at home*



*Electric cream separators are faster and more efficient*

### Effect of temperature

- Freshly drawn or uncooled milk is ideal for skimming, i.e. most of the cream can be easily separated.
- If the milk is too cold (below 22°C), some of the fat becomes solid, and skimming efficiency is greatly reduced.
- Milk must therefore be heated to liquefy the fat. Heating the milk to 45°C gives the best skimming efficiency.

## Maintenance of cream separator

It is important to maintain the cream separator properly. Always remember the following:

### Cream screw adjustment

- The cream screw regulates the ratio of skim milk to cream. It should be adjusted so that the fat content of the cream is about 33%.
- If cream is too thin (i.e. fat content is too low), it reduces the quantity of separated milk available for other uses and increases the volume of cream to be handled. Low-fat cream is also more difficult to churn efficiently, i.e. butter production is reduced.

### Cleaning

- Flush the separator with warm skim milk or warm water.
- Flush the bowl with clean water until the discharge from the skim milk spout is clean.
- Dismantle the bowl and all parts (bowl, bowl cover, discharge spouts, float, supply tank and buckets) and wash with a brush, hot water and detergent (Bleach 4%).
- Rinse with very hot water and allow the parts to drain in a clean place protected from dirt and flies. This should be done after each use.

### Oiling

- Frequent oiling is not necessary.
- When oiling is necessary, remove screw in gear cover.
- Put enough oil in oil holes, also in screw hole.
- Do not use too much oil, or it will just be wasted.

## 7. Milk standardization

Milk standardization means adjusting the fat content in milk to the exact percentage required. Different products require different percentages. The percentage can easily be calculated and adjusted.

## 8. Preparation of butter

To produce butter, you have to make the butterfat more concentrated. Butter should contain 80% fat, 16% moisture, and 2% milk solids non fat (SNF). It may contain a small amount of salt (2%) to improve shelf life and taste. However, excess moisture (more than 20%) reduces the quality of butter.

### Equipment required for butter churning

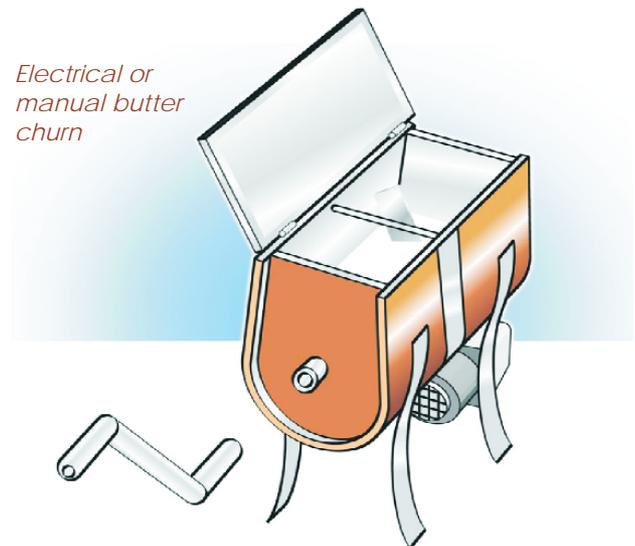
- Centrifugal separator (manual or electrical)
- Dairy thermometer
- Heater
- Stirrer
- Butter churn (manual or electrical)
- Butter working table
- Grease-proof paper
- Chiller or refrigerator

### Procedure

- Fill the churn one-third to one-half full of cream. Never more than one-half.
- Go on churning until the butter granules reach the size of grains of wheat. The granules should be firm but not very hard.
- Do not churn beyond this point, otherwise it will be impossible to wash out the buttermilk.
- The cream should not become hot during churning. Keep the temperature as low as possible (12-15°C) during churning.



*Measuring milk temperature*



*Electrical or manual butter churn*



*Traditional butter churn*



*Improved manual butter churn*

## 9. Preparation of ghee

- Ghee is anhydrous (dry) butterfat. It contains 99.9% butterfat. Ghee is made by removing moisture from cream or butter, by evaporation.
- Ghee is used for cooking.
- Ghee can be made from either cream or butter. Making it from butter requires less energy.
- Heat the butter over a slow fire until all the moisture has evaporated and the temperature rises to about 120-125°C.

## 10. Preparation of yogurt

- Yogurt is a semi-solid fermented milk product. There are many different types of yogurt.
- To make yogurt, use fresh milk of good bacteriological quality, free from antibiotics and dairy sanitizers.
- Do not use colostrum and mastitic milk for making yogurt.
- Steps in making yogurt are described on page 12.

## 11. Cheese production

- Cheese is a very profitable product. There are more than 2000 types of cheese. In this booklet we will describe a few types that can be easily made from goat milk.
- Nine liters of milk will give one kilo of cheese.
- The milk must first be separated into skim milk and cream, and standardized to ensure that milk has the correct fat percentage.
- After standardization, sub-pasteurization is needed, to eliminate all contamination. Heat the milk to 63-65°C for 30 minutes.

### Brine cheese

Brine cheese is a group of white cheeses made and preserved in concentrated salt solution. There are different types of brine cheese, including Feta, Halloumi, and Queso Blanco. Different types can last for two weeks or even 5-6 months. Brine cheese was originally made in the Mediterranean countries and the Middle East. It is popular in Egypt and Sudan.

- Feta cheese: will keep for 5-6 months in brine solution.
- Halloumi cheese: will last several months in sealed containers. It can be eaten as plain cheese, or fried with onions and green pepper, making a very nice snack.
- Queso Blanco cheese: ideal for small-scale milk producers. Because it is a fresh cheese, it must be kept in a refrigerator. Queso Blanco cheese can be eaten directly, or with bread. It can also be fried without losing its shape.

How to make Feta, Halloumi and Queso Blanco cheese? This is explained on pages 13 to 16.

## 12. Summary

- To produce high quality dairy products, you must use high quality milk.
- You need 'starter culture' to make yogurt and cheese. You can buy 'starter culture' from shops. If you do not have starter culture, use fermented milk made from very clean, high quality milk.
- Different types of starter culture give different flavor to the final product. Try different types of starters to see which flavor is better for your consumers.
- Instead of selling raw milk, you can easily convert it to butter, yogurt or cheese, at home. This will give you a higher price, and also prevent spoiling of extra or unsold milk.

## How to make Yoghurt

Prepare yogurt milk (Filtration, Standardization)

↓  
Heat the milk (90-95°C for 30-45 min)

↓  
Cool to inoculation temperature (42°C)

↓  
Inoculate with 2% yogurt culture

↓  
Pack in sachets or cups (150 or 250 ml)

↓  
Incubate at 42°C (3-4 hrs)

↓  
Place in cold room (4°C)

↓  
Ready for sale or consumption

*Pour milk into  
clean cups to  
make yogurt*



## How to make Dry Yoghurt (Labneh)

Prepare yogurt milk (Filtration)

↓  
Heat the milk (90-95°C for 30-45 min)

↓  
Cool to inoculation temperature (42°C)

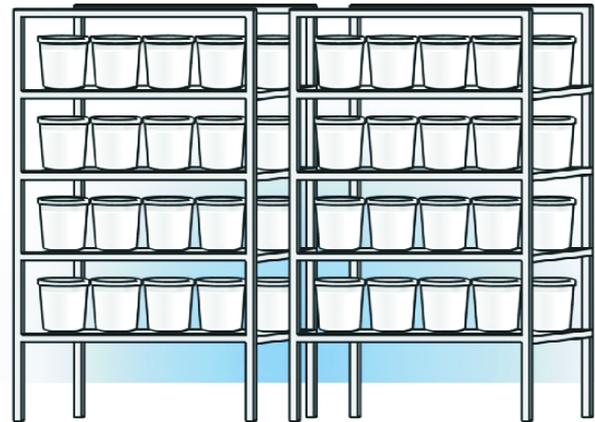
↓  
Inoculate with 2% yogurt culture

↓  
Transfer the curds to cotton bag

↓  
Leave the curd to drain at room temperature overnight

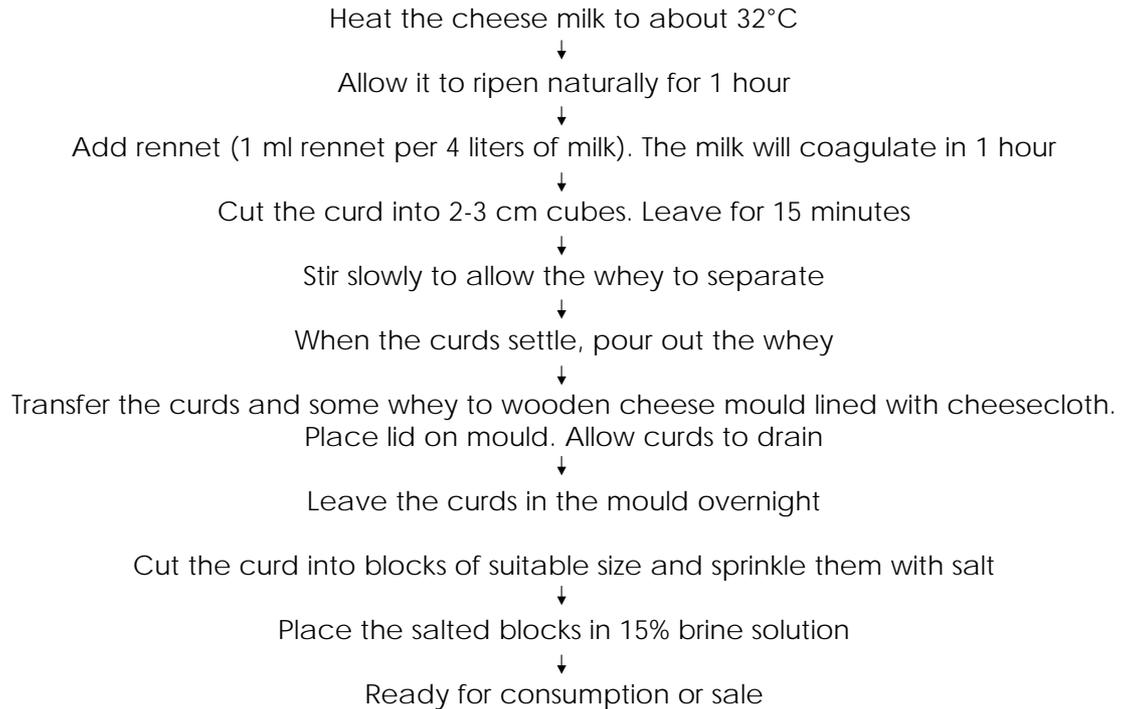
↓  
Distribute into clean cups or large containers

↓  
Ready for sale or consumption

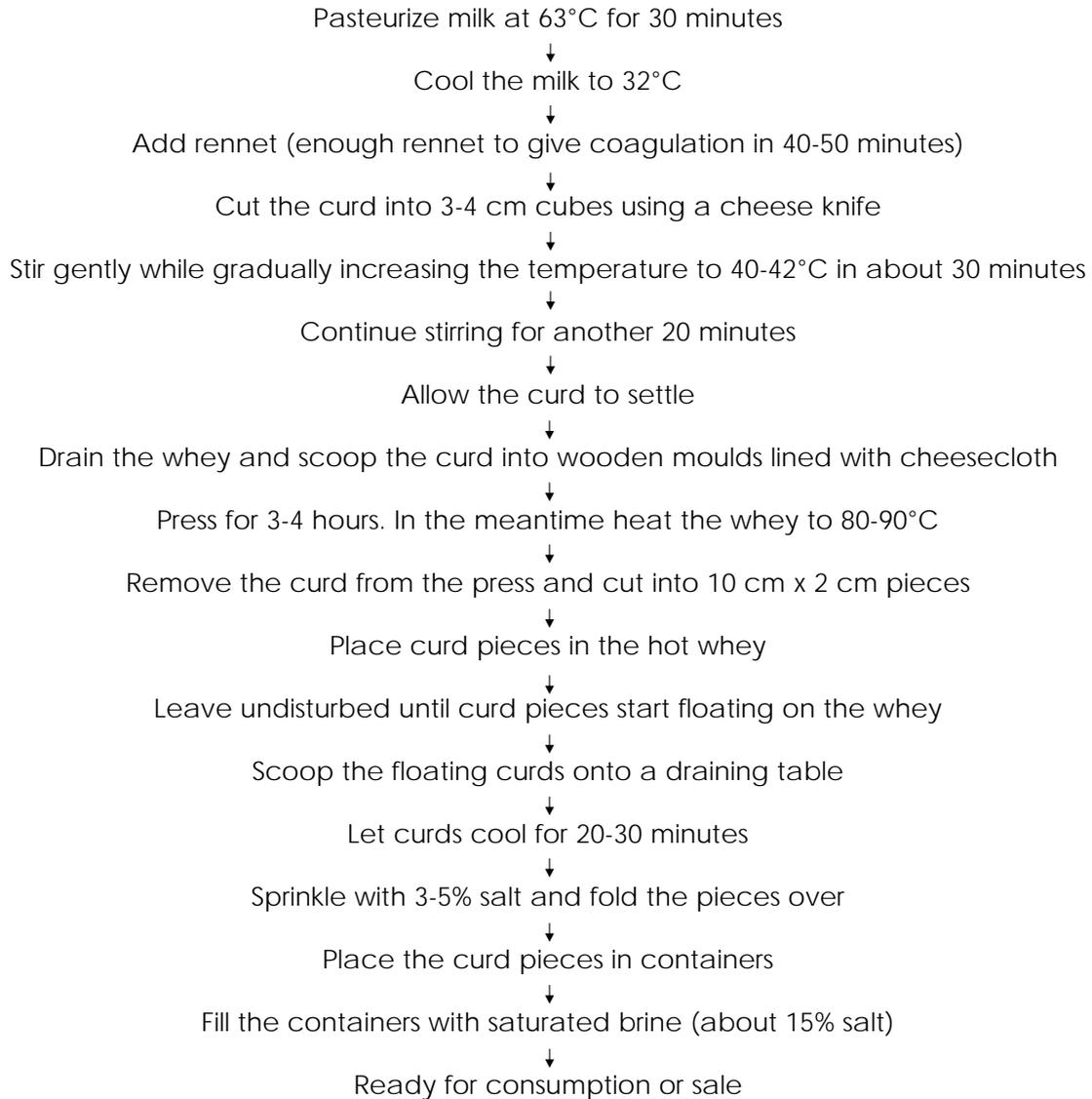


*Close the cups and keep them in a rack*

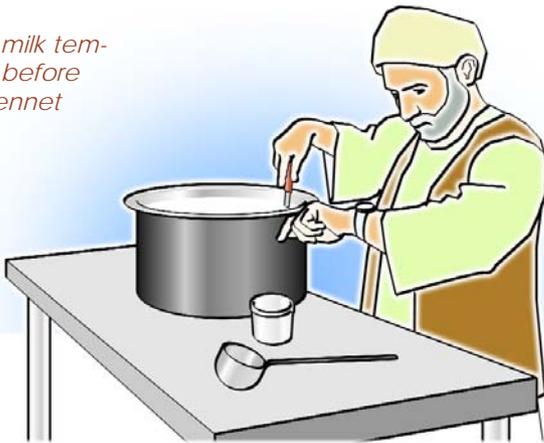
## How to make Feta cheese



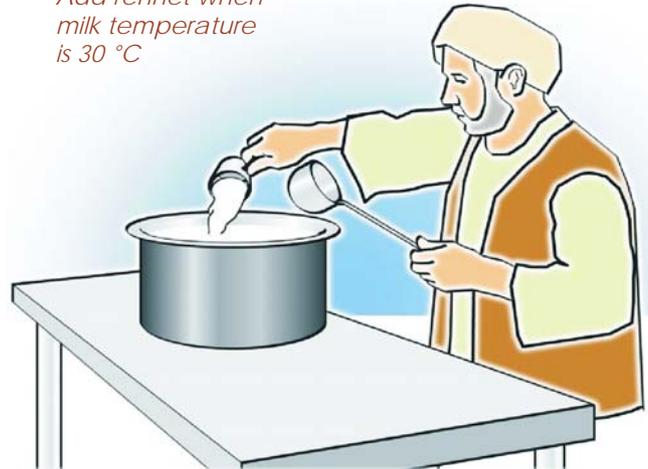
## How to make Halloumi cheese



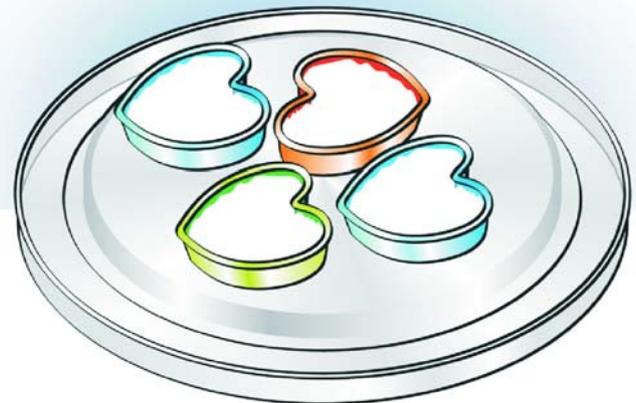
*Measure milk temperature before adding rennet*



*Add rennet when milk temperature is 30 °C*



*Scoop the curd into a plastic mould*



*Press the curd pieces for 3-4 hours*

## How to make Queso Blanco cheese

Heat milk in a double jacket vat or double boiler until temperature reaches 82°C

↓  
Add lemon juice to the milk while stirring

↓  
The milk will form curd immediately when the pH reaches about 4.6

↓  
Slowly stir the coagulated milk for a further 5 minutes to ensure thorough mixing of lemon juice and milk

↓  
Leave undisturbed for 15 minutes

↓  
Filter the curdled milk through cheesecloth to drain the whey. The whey can later be used for cooking.

↓  
Add salt (30 grams salt per kilo of cheese curd) to increase shelf-life

↓  
Place the salted curd in rectangular or round moulds and press it with a heavy weight (at least 10-15 times its weight) for 12 hours

↓  
Remove the cheese block from the press and cut to suitable sizes

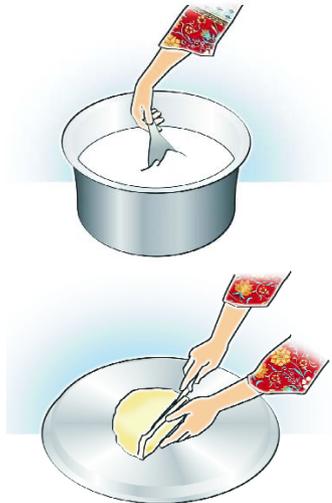
↓  
Ready for consumption or sale



*Filter out the curdled milk*



*Filter it through cheesecloth*



## Project Partners

The IFAD-funded Women's Livelihoods and Dairy Goat Project is being implemented by ICARDA in partnership with institutions in Pakistan and Afghanistan.

**Pakistan:** Pakistan Agricultural Research Council, National Agricultural Research Centre (NARC), Barani Livestock Production Research Institute, University of Arid Agriculture, Rawalpindi, National Rural Support Programme, Centre for Advanced Studies in Vaccinology and Biotechnology, Arid Zone Research Centre, Animal Sciences Institute, Dairy Technology Section of NARC, Livestock and Dairy Development Department, Balochistan.

**Afghanistan:** Livestock Department of the Ministry of Agriculture, SERVE - Eastern Region Community Development Project, Dutch Committee for Afghanistan, Food and Agricultural Organization of the United Nations (FAO).



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