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Technical Bulletin No. 2

Milk Quality Control

by
Abebe Tessema and Markos Tibbo

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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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About the authors

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Foreword

This Technical Bulletin is the second 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.

Milk quality control and assurance is extremely important for the dairy industry. It protects the health of producers and consumers, and ensures that producers are able to sell their products at fair prices. In rural areas in Afghanistan and Pakistan there has been little or no effort to promote available, simple technologies for milk quality control.

This Technical Bulletin is intended to serve as an extension aid for facilitators and livestock producers to improve the quality of milk and milk products. This is particularly important in areas where zoonotic infectious diseases such as tuberculosis and brucellosis are prevalent, affecting the health of both animals and people. Transmission of such diseases can be greatly reduced by following the guidelines described in this booklet.

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

There is a huge demand for safe, high-quality foods with a long shelf-life. However, milk and milk products are biochemically unstable, i.e. they deteriorate very quickly. The food industry uses various systems for quality and safety management, e.g. ISO 9000, Total Quality Management (TQM), Hazard Analysis and Critical Control Point (HACCP), etc. These systems are very effective, but complex and expensive. This booklet describes simple, low-cost methods for milk quality control, which will help you produce and sell dairy products of consistent good quality.

2. What is milk quality control?

Milk quality control is the use of various tests to ensure that milk and milk products are safe, healthy, and meet the standards for chemical composition, purity, and levels of bacteria and other micro-organisms.

3. Why do we need a quality control system?

A quality control system will test milk and milk products for quality, and ensure that milk collectors, processors and marketing agencies follow the correct methods. Having such a system will cost a lot of money. But it is important to have a good system, because it will provide benefits to everyone involved in the dairy industry.

- Milk producers: with a good quality control system, farmers can get a fair price in accordance with the quality of milk.
- Milk processors: the milk processor who pays the farmer can be sure that the milk is of good quality and is suitable for making various dairy products.
- Consumers: they will pay a fair price, e.g. moderate price for medium quality, high price for excellent quality.
- Government agencies: with a good system, the government can protect the health of consumers, prevent contaminated and sub-standard products, and ensure that everyone pays or receives a fair price.

All this is possible only if we have a proper system for quality testing and assurance, which conforms to national or internationally acceptable standards.

4. Quality control on the farm and at milk collection centers

Quality control must begin at the farm where the milk is produced. Farmers must use the correct practices for milk production and handling; and observe government regulations about adulteration of milk, use of veterinary drugs on lactating animals etc.

At the milk collection center, all milk from different farmers (or bulked milk from different collecting centers) must be checked before processing. This checking, using organoleptic, bacteriological and chemical quality tests, will ensure that milk is safe and healthy.

5. What causes abnormal appearance or smell in the milk?

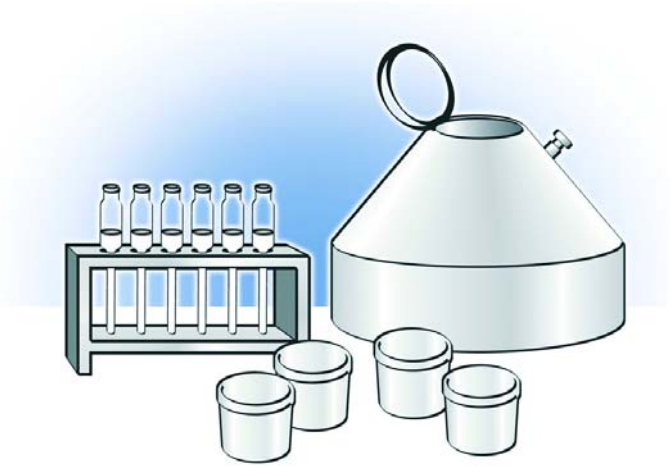
- Advanced acidification or souring
- Chemical or drug taints or discoloration, e.g. contamination with sanitizing agents (phenolic compounds), disinfectants, etc.

- Type of feed, e.g. milk from animals fed with malting residues will have a particular flavor
- Boiling of poor-quality milk
- Presence of smoke or other atmospheric taints
- Bacterial taints
- Spontaneous rancidity of milk from animals in late lactation
- Oxidation due to presence of heavy metals (e.g. copper) and exposure to light

6. Separation of milk fat

Raw milk always contains fat. In fresh, good quality milk, the fat is completely mixed with the milk. If raw milk is allowed to stand for some time, the fat globules will rise to the surface in a phenomenon called 'creaming'. In other words, in old milk, the fat separates from the milk and forms a layer on top. This separation can occur for various reasons:

- Milk previously chilled and subjected to excessive agitation during transport
- Previous freezing and thawing of the milk
- Adulteration by other solids (may also show as sediments or particles)
- Boiling: if milk fat is hardened it is indication of poor quality



Butyrometer is used to measure fat content of milk

Samples with marked separation of milk fat should be completely rejected.

7. Milk sampling techniques

There is no need to test the whole quantity of milk – we can test only a small sample, to check the quality. Accurate sampling, however, is essential for a proper quality control system. Liquid milk in cans and bulk tanks should be thoroughly mixed to disperse the milk fat. Then, a sample for testing is taken from the can, using a plunger or a dipper. In the case of packed products, representative samples must be taken to make sure that the samples actually reflect the whole batch.

Milk sampling materials

You do not need costly equipment for sampling. Just a few simple materials used in our day-to-day activities are enough.

Pen and notebook

Sampling bottle

Calculator

Funnel

Plunger

Dipper

Spirit flame and lighter

8. How to preserve milk samples for different tests

Some tests (e.g. color, smelling, tasting, clot on boiling, and alcohol test) can be done on the farm as well as at the milk collection center. Other tests such as lactometer test to detect adulteration or density (specific gravity) of milk, butter fat content, chemical and bacteriological tests may only be possible at the milk collection center or at a dairy laboratory. Hence, milk samples should be preserved in good condition until the test can be done. As soon as you take a milk sample at the milk cooling center, put the sample in an ice box or ice pack, before taking it to the laboratory.

Butterfat content: If testing is not possible immediately, milk samples can be preserved with chemicals like Potassium Dichromate (1 tablet or ½ ml 4% solution in ¼ litre sample bottle). Milk samples that have been kept in a refrigerator or ice-box, however, must first be warmed in a water bath at 40°C, then cooled to 20°C, and mixed. After that, a sample is taken for butterfat determination.

Bacteriological tests: If the laboratory cannot start work on a sample immediately, the sample must be cooled to near freezing point, and kept cool until the test can be done.

9. Common milk grading techniques

Good quality dairy products can only be made from good quality milk. Therefore, it is important to grade milk, so that poor quality samples are rejected and only good quality milk is sold to retailers and processors. To do this, farmer cooperatives and milk traders must know how to test the milk they produce or receive from individual farmers. Similarly, dairy staff must have knowledge of various quality control tests. They should be able to identify off-flavors, and understand what causes these problems.

Here, we describe four simple quality control tests. These tests will meet the requirements of most farmer cooperatives, collection centers and small-scale processing units. If the tests are done properly and consistently, it will ensure that poor quality milk is rejected, and only good quality milk is sold to processing factories, milk bars and shops.

Measuring milk temperature

9.1 Organoleptic test

This is the simplest test: just looking (eyesight) and smelling. If the milk has a bad smell, or abnormal color, or contains particles, it should be rejected.

9.2 Clot on boiling (COB)

This test is quick and simple. It allows you to check whether the milk has high acidity (pH <5.8). High-acid milk should be rejected. The test allows you to identify colostral milk (which is produced in the first few days after parturition) or mastitic milk. Colostral milk should be rejected, because it has a very high percentage of whey proteins, which create problems when the milk is boiled or heated during processing.

Materials

- Test tube or spoon
- Paraffin burner or Bunsen burner

Procedure

Boil about 2 ml of milk in a test tube or spoon or any other suitable container.

Results

If there is clotting, coagulation or precipitation, the milk has failed the test and should be rejected.

9.3 Alcohol test

The alcohol test is more sensitive than the COB test. COB only detects milk which is highly acidic (pH <5.3). The alcohol test detects even medium-acidity milk (pH <6.4). Therefore, milk which passes the COB test, may fail the alcohol test. Colostrum and mastitic milk may also fail the alcohol test.

Materials

- Alcohol gunner or syringe
- Beaker or glass
- 68% alcohol *

Alcohol test is more sensitive than COB test

Procedure

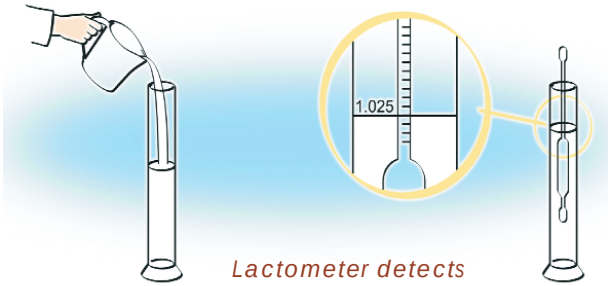
1. Put equal volumes of milk and 68% alcohol in a test tube (e.g. 2 ml of milk in 2 ml of 68% alcohol).
2. Invert the test tube several times, keep your thumb pressed tightly over the open end of the tube.
3. Examine the tube to see whether the milk has coagulated. If it has, fine particles of curd will be visible.

Results

If the milk is of good quality, there will be no coagulation, clotting or precipitation. If the milk has become acidic (pH below 6.4) it will flocculate. To quickly see whether milk is acidic, you can use a litmus paper. For more accuracy, a titration test can be done in a laboratory.

9.4 Lactometer test

Farmers, milk traders, transporters and shops often add water and other substances to milk, to increase their profits. This is a common problem, but can be easily tested with a lactometer, which is an instrument used to measure the density of milk. Pure milk has a density (specific gravity) of 1.026 to 1.032 grams per ml. Addition of water or other substances changes the density. Addition of water reduces the density, while addition of solids increases the density considerably. If density is outside the normal range, it means the milk has been adulterated.



Lactometer detects adulteration of milk

*To prepare 68% ethanol solution, mix 68 ml of absolute alcohol (96% alcohol) with 28 ml of distilled water.

Materials

- Measuring cylinder 200-250 ml
- Lactometer

Procedure

First, ensure that the milk temperature is about 20°C. Hot milk should be left to cool at room temperature for at least 30 minutes. If the milk was cooled below 10°C, warm it to 40°C, and then cool it to 20°C. Mix the milk sample and gently pour about 200 ml into a measuring cylinder. Slowly dip the lactometer into the milk and leave it. It will sink a little and then stop. Now take the lactometer reading just above the surface of the milk.

To calculate chemical composition such as milk total solids (% TS) and solids non fat (SNF), lactometer results can be combined with a Butyrometer test (also known as Gerber butterfat test).

10. Summary

It is important to have a quality control system, to ensure that only good quality milk is sold. This booklet has described a simple quality control system:

- how to take samples
- how to preserve samples for laboratory tests
- how to conduct your own simple tests, on the farm and at the collection center

By using this simple quality control system, you can ensure that you produce good quality milk. This will protect the health of consumers, improve your reputation as a quality milk supplier, and also increase your profits.