Technews

National Dairy Development Board

For Efficient Dairy Plant Operation

January-February 2000 No.24

QUALITY RAW MILK I

This bulletin includes technical information based on latest development on products, systems, techniques etc. reported in journals, companies' leaflets and books and based on studies and experience. The technical information on different issues is on different areas of plant operation. It is hoped that the information contained herein, if employed in the dairy plant, will help in making its operations more efficient.

The theme of information in this issue is **Quality Raw Milk**. It may be understood that the information given here is by no means complete.

In this issue:

TECHNEWS FOR COOPERATIVE DAIRIES

The first issue of the **Technews**, March-April 1996, was issued in March 1996. The theme was 'Cleaning and Sanitation'. The technical bulletin was started with the objective of providing the dairy cooperatives with practical technical information for efficient dairy plant operation. All these years the **Technews** has been unfailingly providing technical information on different themes, and the cooperatives have very warmly welcomed it. And now they await its every issue very eagerly.

The cooperatives have now entered into a new millennium. With new challenges, with new milestones to achieve, with a new resolve to achieve highest quality and efficiency standards.

And the **Technews** will continue assisting the cooperatives in the very important task.

1. INTRODUCTION

Quality of milk in India has hitherto been largely judged on the basis of its fat and solids – not fat contents. No serious attention has been paid by the processors to improve microbiological quality of milk, with the result that the **bacterial count in raw milk received at dairy's reception dock ranges from a few to tens of lakh per ml. of milk.**

Many milk processors shrug off this with the argument that the pasteurization after all kills all pathogens and most of other bacteria, so there is no cause to worry. Others add that normally in India the milk is boiled before consumption, so where is a need to bother about producing milk with low bacterial count.

Is there really no cause to worry at high bacterial count in raw milk? This issue of **Technews** highlights some relevant aspects of microbiological quality of raw milk.

2. LOW BACTERIAL COUNT IN RAW MILK ESSENTIAL

Let us examine some of the important effects of high bacterial count in raw milk.

1) **Thermal killing of bacteria in milk, such as by pasteurization, is influenced by initial bacterial count**, temperature and time. Bacterial destruction by heat is logarithmic. Thus, with higher bacterial count in milk, to obtain a certain final bacterial count, either higher temperature needs to be employed or longer time or a combination of both. Generally it is preferred to increase the heating temperature somewhat, rather than increasing the time. Higher pasteurization temperatures than normal results in the following (see also **Technews** issue 15, July-August 1998 on 'Milk Pasturization'):

- **Bacterial spores can be activated and germinated.** The organisms then grow and spoil milk.
- **Bacterial inhibitors, such as immunoglobulins and lactoperoxidase system are inactivated. Consequently, the growth of bacteria is stimulated,** higher the temperature more the growth. Still higher temperatures may lead to formation of stimulants, such as formic acid, which enhance the growth of lactic acid bacteria,

and hence the acid production.

- More denaturation of whey protein takes place which reduces the oxygen potential **promoting lactic acid bacterial growth.**

- Protein decomposition products, such as peptides and amino acids, are formed **which promote bacterial growth.**

- Further, heat processing of milk only kills bacteria, **it does not remove them.** The dead cells remain in milk as scum, more the bacterial count in raw milk, more the scum in the product.

2) **Some bacteria**, such as *Bacillus* spp *(B. cereus, B. mycoides, B. subtilis, B. stearothermophilus)* and *Clostridium* spp *(C. botulinum, C. perfringens, C. tyrobutyricum)*, **form their spores**. Most of these survive pasteurization temperatures. Higher the initial bacterial count in the raw milk, more the spores. These spores subsequently germinate, grow and spoil milk, and pose health risk, too.

3) **Some bacteria produce toxins** : eg., *Bacillus spp (B. cereus, B. subtilis, B. licheniformis)*, *Staphylococcus aureus*, *Clostridium* spp *(C. tyrobutyricum, C. botulirum, C. perfringens)*, *Escherichia coli*, *Shigella* spp. More toxins will be produced if milk has large bacterial count. Most of the **toxins** are stable at pasteurization temperatures, and **remain in the product**. This poses health risk to the consumer.

4) **Some bacteria also produce enzymes,** like psychrotrophs *(pseudomonas, Achromobacter, Flavobacterium, Alcaligenes)* produce heat-resistant proteases and lipases. Higher bacterial count will result in higher production of enzymes. While proteases attack proteins, lipases attach fat, thus **causing purid and rancid off-flavours in milk.**

5) Spoilage bacteria produce acid and off-falvours in milk : **higher bacterial count in raw milk increasing the spoilage speedily. These defects are not corrected by pasteurization.**

6) Lowering of the temperature retards the growth rate of most of bacteria, **but psychrotrophs proliferate even at a temperature as low as 4°C.** Hence, high count of these bacteria in raw milk will result in not only increased bacterial load due to their growth, but also higher production of enzymes.

It is, therefore, clear that higher bacterial count in raw milk results in :

- higher bacterial count in product,
- poorer quality product (higher acidity, higher toxins, off-flavour, lower shelf life, more bacterial dead cells)
- less safe product, and
- higher processing costs.

Therefore, a low bacterial count and a low contamination by microorganisms must be the first aim.

3. NATIONAL AND INTERNATIONAL DEMANDS

In India, generally, raw milk is not rejected or paid less on the basis of its poor microbiological quality, nor is any incentive paid if it is of very good bacterial quality.

This practice is not likely to remain so for long.

The end product quality now is not considered adequate, **the raw milk quality is considered equally important**, such as in the hazard analysis and critical control point (HACCP) system suggested by the Codex Alimentarius Commission. Many countries have set up stringent raw milk microbiological standards, as shown in Table 1.

Table 1 : Bacterial count – standards of some countries

Country	Total Bacteria count in lakh per ml of milk	
	Highest Grade	Rejection threshhold
Australia	< 0.2	0.5
Belgium	<1	-
Canada	< 0.5	1
Germany	< 1	-
Denmark	< 0.3	4
France	<0.5	5
U.K.	<0.2	2
Japan	<3	10
New Zealand	<0.25	-
Sweden	<1	-
USA	<0.25	3

(Source : IDF, Bacteriological Quality of Raw Milk, IDF, Brussels, 1996)

The international demand of microbiologically good raw milk has its reverberations in Indian dairying, too. Trade liberalization, entry of multinationals in Indian dairy market and consumer consciousness about quality have all additionally made it imperative to seriously take actions to improve microbilogical quality of raw milk. Moreover, India's share in international dairy trade has to increase substantially in future. **And this makes the improvement in raw milk quality, microbioligically, absolutely essential.**

4. BACTERIAL GROWTH IN MILK : TEMPERATURE EFFECT

In milk bacteria multiply rapidly, different genre at different rate. Temperature of milk influences bacterial growth greatly. **Most bacteria grow very slowly at low temperature. Psychrotrophs (pseudomonads), however, grow fairly well at lower temperature,** even at 4°C, see Table 2.

Table 2 : Generation time of some groups of bacteria in milk at different temperatures

Bacteria	Generation time h, at		
	5°C	15°C	30°C
Lactic acid bacteria	>20	2.1	0.5 (30 min)
Pseudo-monads	4	1.9	0.7 (42 min)
Colifor-ms	8	1.7	0.45 (27 min)
Heat resistant Strepto-cocci	>20	3.5	0.5 (30 min)

(Source : Walstra, P. et al, Dairy Technology : Principles of Milk Properties and Processes, Marcel Dekker, New York, 1999)

Thus, while the generation time for most bacteria at 30°C, the normal atmospheric temperature, is around 30 minutes, they take hours – from 4 to more than 20 – to multiply at 5°C. The effect of this multiplication at different temperatures can be seen in Table 3.

Table-3 : Effect of milk temperature on its bacterial count and keeping quality (initial count 2300 per ml.)

Milk temp. °C	Count after 24 h per ml	Keeping quality * h
4	2,500	> 75
10	12,000	30
16	1.8 lakh	19
20	45 lakh	11
30	140 crore	5

* Keeping quality : Storage time during which milk remains suitable for processing (count not more than 10 lakh per ml.)

(Source : Walstra. P. et al. dairy Technology : Principles of Milk Properties and Process, Marcel Dekker, New York, 1999)

Cooling raw milk promptly to low temperatures, say 4°C, therefore, controls the growth of bacteria and improves milk quality tremendously. However, higher initial bacterial count in milk due to contamination would negate these benefits considerably.

5. APPROACH AND STRATEGY FOR PRODUCING QUALITY RAW MILK

The objective of quality raw milk production, of any cooperative dairy, should be to meet international standards. **The target should be microbial count per ml. of milk** (variously called as specific plate count – SPC, total bacterial count – TBC, or colony forming units – CFU) at the dairy dock **of not more than 1 lakh for chilled milk collected in tankers and not more than 5 lakh for unchilled can-collected milk.**

These targets are more than achievable : Some dairies have surpassed the in some production centres already.

And the task is not really so formidable as it appears or as one thinks it. The truth is that **no one has sincerely attempted it.** The task nevertheless is mammoth.

What then should be the approach to tackle it? The NDDB has already included 'Quality' as one of the five thrust areas in its 'Perspective 2010' plan for dairy coopratives, has had extensive dialogues with them and has initiated action on it : NDDB is providing the cooperatives financial support and technical guidance.

But the work is to be done **in the and by the cooperatives**. An approach for the implementation of the programme is outlined below:

i) **Firm resolve and commitment by the management.** Without this no result can be achieved. The management needs to formulate an appropriate quality policy, actively involve itself in its implementation, provide necessary facilities and monitor the progress and results.

ii) **Education.** It has been conclusively demonstrated that in most cases, **the raw milk quality deteriorates during its handling at the milk society** rather than at the producer level. Hence, all persons associated with raw milk production and handling – producer, society staff and transport staff – with special attention on society staff, need be educated on what precautions be taken to produce and handle milk of high quality.

iii) **Facilities**. The management should arrange for all necessary facilities required to produce good quality milk : producer's milk utensil, milk handling vessels/ equipment, cleaning facilities, chillers if feasible, testing equipment.

iv) **Monitoring**. Progress of the programme imple-mentation and its results should be regularly monitored by the management.

v) **Corrective action.** If the results are below planned/target, the reasons should be found and immediate corrective actions taken. For this, testing milk at various stages of handling, periodically, will be necessary.

The management should coordinate the above through its 'Quality Representative' – a senior manager – responsible for the task.

The bacteriological quality of milk depends on the following four basic factors :

- Animal health,
- Overall hygiene, which controls contamination,
- Temerature of milk, and
- Time till delivery at dairy dock.

Therefore, the strategy for producing quality milk needs to be based on them. Figure 1 shows such a strategy.

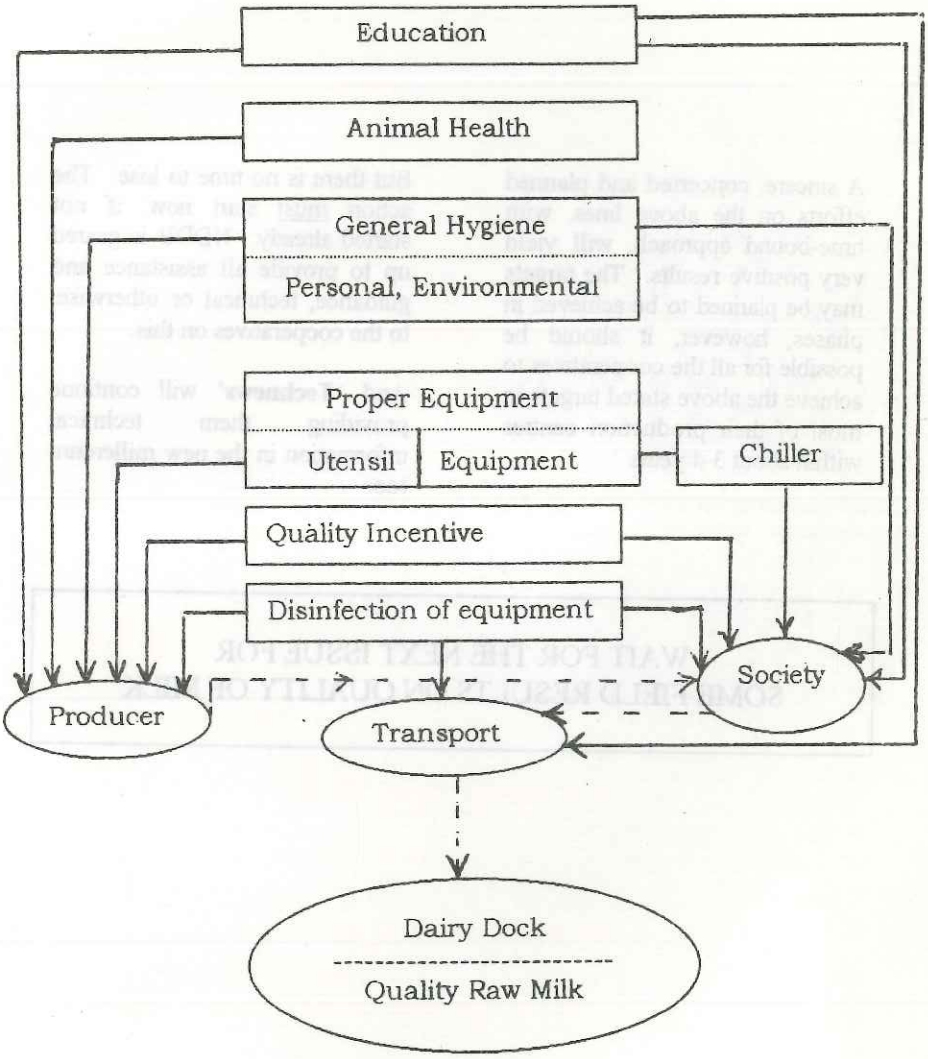

Fig.1 : Strategy for quality raw milk production

A sincere, concerted and planned efforts on the above lines, with time-bound approach, will yield very positive results. The targets may be planned to be achieved in phases, however, it should be possible for all the cooperatives to achieve the above stated targets in most of their production centres within about 3-4 years.

But there is no time to lose. The action must start now, if not started already. NDDB is geared up to provide all assistance and guidance, technical or otherwise, to the cooperatives on this.

And '**Technews**' will continue providing them technical information in the new millenium too.

WAIT FOR THE NEXT ISSUE FOR
SOME FIELD RESULTS ON QUALITY OF MILK