Code of Practice

Milk Production and Handling from Farm to Processor in Fiji

Version 1.0 - December 2018

Contents

Acronyms

APC	Aerobic Plate Count
CFUs	Colony forming units
CIP	Clean in Place
CODEX	Codex Alimentarius
FCDCL	Fiji Cooperative Dairy Company Ltd
FDL	Fiji Dairy Ltd
FSANZ	Food Standards Australia New Zealand
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
HACCP	Hazard Analysis Critical Control Points
MCC	Milk Collection Centre
MoA	Fiji Ministry of Agriculture
MoH & MS	Fiji Ministry of Health & Medical Services
MRLs	Maximum Residue Levels (Pesticides and Antibiotics)
POPs	Persistent Organic Pesticides
PVC	Polyvinyl chloride
SCC	Somatic Cell Count
SOPs	Standard Operation Procedures
SPC	Standard Plate Count
TB	Tuberculosis
UHT	Ultrahigh temperature
UV	Ultraviolet
WTO	World Trade Organization

Glossary

Bacteria/bacterium	A large group of life forms that are too small to see but are found in every environment. Some sour milk, others cause illness and sickness. Chilling slows their growth.
Coliforms	A coliform count is an indication of the degree to which water, soils and other environmental material may have become contaminated with faecal matter.
Colostrum	The first fluid, rich in protein, secreted by mammals' mammary glands (i.e. udders) for several days just after giving birth.
Commercial sterility	The process that is applied to food (usually heat) to reduce the theoretical number of Clostridium botulinum spores by a factor of 106.
Contamination	The process during which microorganisms gain access to sterile food.
Contaminant	Any biological or chemical agent, foreign matter or other substance not intentionally added to food or feed which may compromise food safety.
Cross-contamination contamination	Cross-contamination occurs when a food process, a food product or a raw material contaminates other processes, food products or raw materials indirectly from one source to another, either with food safety hazards or with odour and changes to flavour.
Disinfection	The application of agents suitable for use in the food industry to kill most vegetative forms of pathogens and other microorganisms (but not necessarily all bacterial and fungal spores, mycobacterium, rickettsia or viruses).
Disposal system	A subterranean or ground-level tank or other vessel, sewerage system, dam or farmland into or onto which effluent maybe discharged.
Effluent	Any liquid or solid waste (i.e. manure) emanating from a milking area.
E. (Escherichia) coli	A bacterium species that can cause diarrhoea in humans if present in food – usually gaining access from unwashed hands.
Faeces/faecal matter	Solid, undigested food waste produced by animals.
Farm dairy	The building and surrounding yards used for the milking and associated handling of cows or other animals up to a distance of 20 metres from the structures, pit or area where the cows are milked. Commonly called 'the shed', 'milking shed' or 'milking parlour' in some countries.
Feed	Any material/s, whether processed, semi-processed or raw, intended to be fed directly to food-producing animals.
Feed additive	Any intentionally-added ingredient not normally consumed as feed by itself, whether or not it has nutritional value, which may or may not affect the characteristics of feed or animal products.
Feed ingredient	A component, part or constituent of any combination or mixture making up a feed, whether or not it has a nutritional value in the animal's diet, including feed additives.

Medicated feed	Any feed which contains veterinary drugs.
Microorganisms	Microscopic life forms, including bacteria, viruses and fungi.
Milking machine cluster	The part of the milking machine connecting the cow to the milk line or milk receiver comprising the liners, shells, claw, short and long pulse and milk tubing.
Pest	Any unwanted species of plant or animal that may have a detrimental effect for humans, their activities or the products they use or produce, or for animals or for the environment. The term refers to small animals, birds, and insects that destroy crops, spoil food or spread disease in fields or on farm premises.
Potable water	Water of sufficiently high quality that it can be consumed by people or used with a low risk of immediate or long-term harm (refer to SANS 241).
Prerequisite Programme (PRP)	A term for the basic conditions and activities that are necessary to maintain a hygienic environment throughout the food chain, suitable for the production, handling and provision of safe end food products. The term may include such elements as: Good Agricultural Practice (GAP), Good Hygiene Practice (GHP), Good Laboratory Practice (GLP), Good Manufacturing Practice (GAP), Good Distribution Practice (GDP), Good Veterinarian Practice (GVP), Good Production Practice (GPP) and Good Trading Practice (GTP).
Somatic Cell Count (SCC)	Somatic Cell Count (SCC) is a measure of the amount of white blood cells present in milk. A higher presence of white blood cells means the producing cow is sending more cells to her udder to guard or fight off invading microorganisms.
Standard Plate Count/Aerobic Plate Count	This is a standard procedure in which a sample of food is applied to an agar plate, which is then incubated so that each bacterium multiplies and a visual colony is formed that can then be counted.
Staphylococcus aureus	A species of bacterium that can be pathogenic to humans that is frequently found in milk produced by cows with mastitis.
Sterility	Food free of microorganisms.
Record document	Any document that provides objective evidence of actions undertaken or results achieved.
Veterinary drug	Any substance applied or administered to any food-producing animal whether for therapeutic, prophylactic or diagnostic purposes or for modification of physiological functions or behaviour.
Withholding or withdrawal period	The time during which an animal or its products cannot be used for human consumption following the application of a plant (including pasture) or a veterinary drug to the animal. A withholding or withdrawal period ensures that foodstuffs do not contain any residues in quantities in excess of established residue limits.
Waste	Any unwanted or undesired material including hazardous materials and food products that are not fit for human consumption.

1. Overview

1.0. Introduction

Milk has long been part of human society, from first civilisations to now. That's because milk – and the products that can be made from it – can be highly nutritious and pleasant to drink. Throughout the ages, milk from cows, goats, camels, horses, buffaloes and even giraffes has been drunk fresh or fermented for consumption.

Today, cow's milk is readily available for entire populations. It is prepared by a chain of partners who harvest milk from cows and transport, preserve and package it for consumers' convenience. Each member of that chain has the responsibility to ensure that the milk and milk products they handle are in the best possible condition and safe for people to consume.

In Fiji, two public service bodies – the Ministry of Health and Medical Services (MoH & MS) and the Ministry of Agriculture (MoA) – work with the dairy industry to ensure public safety. This is because dairy products that do not meet certain food standards, dictated by Fiji laws and regulations, can endanger human health. As a general rule, farms, restaurants and food processors that do not meet these standards are not given license to operate.

THIS CODE OF PRACTICE PROVIDES ALL PARTNERS WITH ADVICE ON HOW TO PRODUCE TOP QUALITY MILK FOR THE BENEFIT OF PRODUCERS, PROCESSORS AND ALL THE PEOPLE OF FIJI. IT IS AN INDUSTRY-AGREED DOCUMENT THAT WILL BE SUBJECT TO PERIODIC REVIEW AS REQUIRED.

1.1. Obligations under Current Legislation

Throughout the world, national food laws or rules are in place to protect domestic consumers. In Fiji, at the time of writing, there are no mandatory standards specifically in place for milk production. While the country's Dairies Act 1965 is still in effect, its relevance is much reduced in present day.

Nevertheless, a number of so-called 'horizontal standards' exist that apply to all foods that are designed to protect consumers. For example, the dairy industry in Fiji is bound by the Food Safety Regulations 2009, which are under review.

The Food Safety Regulations 2009, which are the working documents mandated by the Fiji Food Safety Act 2003, are based on the requirements of the international Codex Alimentarius, which literally translates to 'food code'. Codex recommends global standards for all food products, whether processed, semi-processed or raw. For milk, the Codex standards are flexible to allow variations in production and handling throughout the world.

The Fiji Food Safety Act 2003 sets out penalties for certain offences, including the adulteration of food. In addition, industry rules exist in the form of Standard Operating Procedures (SOPs) prepared and administered by Fiji's only dairy processing company – Fiji Dairy Limited.[1]

Fiji is also a signatory to the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), which sets out how governments can apply food safety and animal and plant health measures. The measures in the agreement are backed by scientific facts and methodologies.

[1] The SOPs are dated 2013 and may not take into account recent developments and advances in milk handling.

The aims of the SPS Agreement are as follows:

1. The protection of animal and plant life and health within a territory from risks arising from the entry, establishment, or spread of pests, disease, disease-carrying organisms, or disease-causing organisms.
2. The protection of human life and health within a territory from risks arising from diseases carried by animals, plants, or products thereof, or from the entry, establishment, or spread of pests.
3. The protection of human and animal life and health within a territory from risks arising from additives, contaminants, toxins, or disease-causing organisms in foods, beverages, or feedstuff.
4. The prevention or reduction of the risks of other damage within a territory from the entry, establishment, or spread of pests.

1.2. Working Together

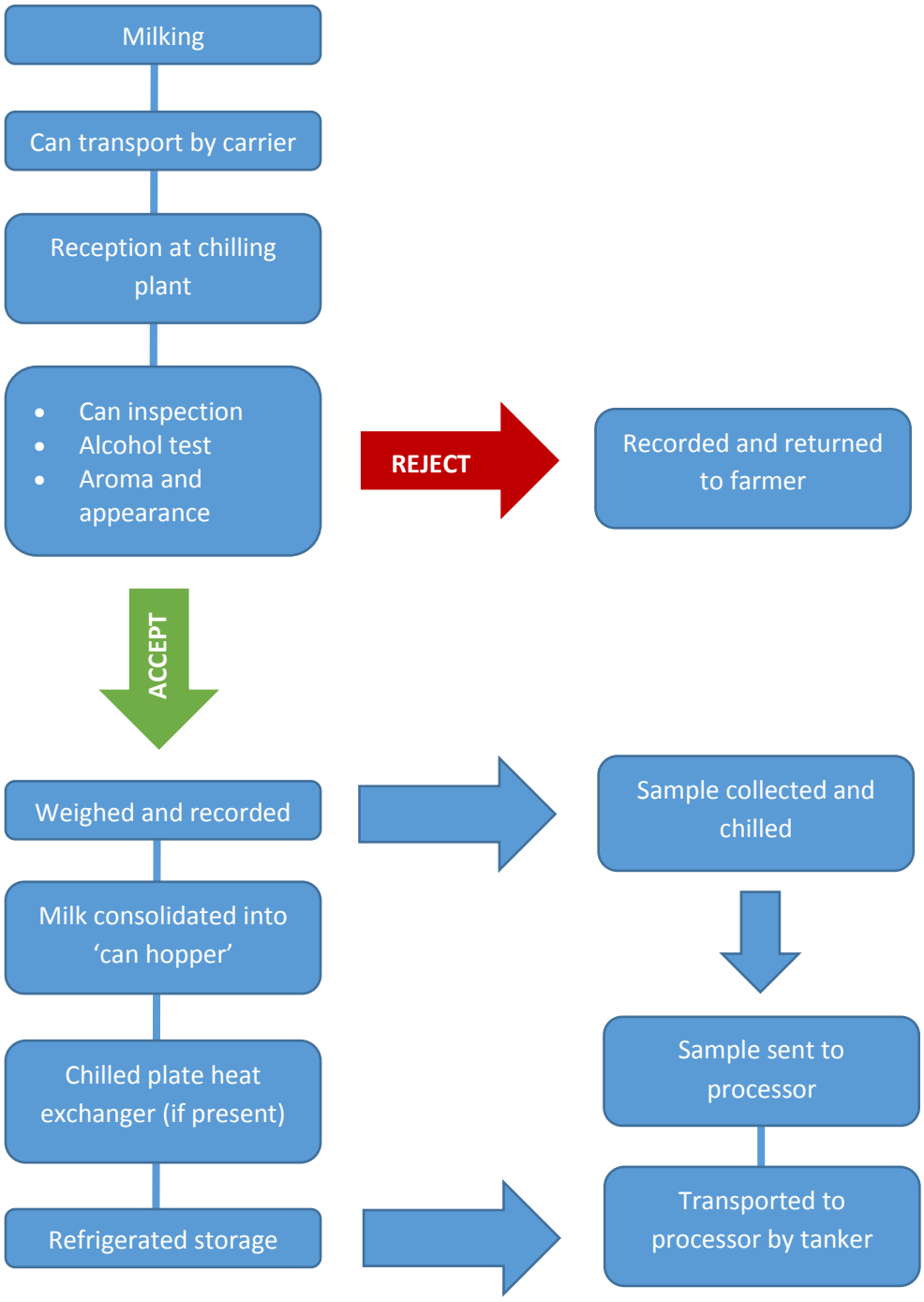
The purpose of this Code of Practice is to highlight the responsibilities of each partner in the Fiji diary chain, as they prepare products for consumers – from farmers and dairy cooperatives through to Milk Collection Centres (MCCs) and processors. All partners are obliged, ultimately by legislation and regulations, to produce milk of the highest possible quality. This is to keep Fiji locals and visitors safe and ensure they can have faith in the milk products produced in the country.

To achieve this goal, a farm-to-plate approach must be applied. Such an approach considers all legal and voluntary standards relating to the composition of milk products, food safety, animal health, animal feed, milking facilities, the transportation of milk, processing plants and storage.

A schematic representation of the Hazard Analysis and Critical Control Points (HACCP) system in relation to the Fiji dairy industry is given in Figure 1 (Page 8). The HACCP system is founded on each partner or member of the chain being part of the process, right down to farm helpers and tanker drivers. If one person does not do their best, they let the whole chain down.

THE AIM IS TO PRODUCE MILK OF A QUALITY THAT ENGENDERS TOTAL CONFIDENCE IN ALL PARTNERS AND, ULTIMATELY, CONSUMERS

Figure 1. Schematic representation of the HACCP system in relation to the Fiji dairy industry.



2. General Milk Hygiene

2.0. Introduction

There are millions of types of bacteria known to us. Most are harmless and a necessary part of our healthy planet; however, some are troublesome and can cause food poisoning if they get into food intended for human consumption. Others interact with food to make it taste bad. For example, some bacteria react with milk sugar (lactose) to form acid which sours and curdles milk.

The Joint Expert Committee on Microbiological Levels in Food (a sub-committee of Codex) does not insist on international standards for milk, since hygiene standards and post-milking treatments vary throughout the world; however, in Fiji, the recommended levels are currently suggested by Fiji Dairy Ltd to be 20,000 colony forming units (CFUs) per ml.

Sources of bacteria include:

- Dirty udders and teats of cows
- Dust and manure on the hind legs of cows
- Sneezing and coughing of persons who do milking
- Lesions, boils and wounds of persons who do milking
- Dirty hands and clothes
- Dirty milking equipment
- Dirty water
- Dirty walls and floors and dust from the environment

Useful microbiological guidelines, modified from European Union/Food Standards Australia New Zealand standards, are given in Appendix 3.

Standard No. 1 – General Hygiene

Everyone involved in the production, handling, transportation, processing and sale of milk and milk products in Fiji must be responsible for ensuring milk and milk products are safe and suitable for human consumption.

Recommended best practice

- Avoid areas where the environment poses a threat to the safety of milk.
- Control pests, animal diseases and plants.
- Control contaminants from the environment, facility, equipment, personnel, animals, feed and water.
- Control and manage the diseases of animals and plants in such a way that they do not pose a threat to milk safety.
- Adopt practices that ensure safe milk production.

PROCESSORS MAY HAVE THE FINAL RESPONSIBILITY IN WHAT IS SENT OUT TO CUSTOMERS, BUT ENSURING MILK/MILK PRODUCTS ARE SAFE DEPENDS ON ALL PREVIOUS PARTNERS PLAYING THEIR PART

2.1. Milk Temperatures

Mammalian offspring are entirely dependent on milk for growth and development in the early part of their lives. Cow's milk is rich in vitamins, minerals, proteins, fat and carbohydrates (lactose). But while satisfying the needs of a new-born calf, it is also an excellent medium for bacterial growth.

Milk is 37°C when it is collected during milking – the ideal temperature for the multiplication of many human-disease causing organisms (pathogens). Some of these organisms can double their numbers in six minutes at this temperature.

Bacterial numbers increase rapidly at temperatures common in Fiji, so it is important to chill milk as quickly as possible. This is possible at MCCs. Prior to collection, simple cooling techniques such as keeping cans away from direct sunlight and placing them in a basin or trough of cold water in the milk room can help. The milk cans should be kept in these conditions until just before collection, when they should then be transferred to a purpose-built roadside can stand to await pick-up.

Standard No. 2 – Milk Temperatures

Regardless of what milking practice is used, milk should be cooled to 7°C (at which the rate of bacteria growth is much lower) as quickly as possible after milking and kept at this temperature until delivery to processors. An exception is permissible if milk is to be consumed immediately after collection or, for example, it is going to be processed immediately (i.e. used for cheese making when there is no need for prolonged storage).

THE QUALITY OF MILK IS INFLUENCED BY BACTERIA; THE LOWER THE BACTERIA COUNT, THE HIGHER THE QUALITY

2.2. Environmental Hygiene

Milk is a high-risk commodity, susceptible to contamination from soil, faeces and surfaces, including all milk-handling equipment. Ultimately, farm environments play a significant role in the quality of milk produced by dairy farmers in Fiji.

Rust is common in Fiji and of particular concern as flakes can find their way into milk cans and equipment. Metal drums containing poisonous chemicals (for application to fields and crops) can rust and leak, spilling dangerous chemicals into the environment and potentially causing illness in animals and consumers. Petrol and lubricants pose the same risk if stored in metal drums. In addition, cleaning materials that are safe when diluted are often highly poisonous in the more concentrated state in which they are delivered.

As a further complication, cows' udders are close to the ground/soil, where bacteria are found in high numbers. Soil is often contaminated with droppings (faeces) from cows. Splashing is common in dairies, so it is important to keep animals and all surfaces as clean as possible. Discarded waste or rubbish can also become a threat to animals' health, safety and, ultimately, milk quality.

Standard No. 3 – Environmental Hygiene

All areas of dairy farms should be kept clear, tidy and free of waste and litter. Products or materials that could potentially contaminate milk should not be stored at the farm dairy, where they are not essential for milk handling or premises cleaning. Animal remedies and cleaning materials that are needed at the farm dairy should be kept in a secure area away from the milk.

Recommended best practice

- Pit toilets, which are used in some rural areas, must be sited well away (suggested 45 metres) from dairies – not only to prevent flies, but also because they can overflow during floods and cyclones. Note that the Fiji Dairies Act states *"no earth-closet, latrine, cesspool, dust-bin or rubbish or manure heap shall connect with any building used by a dairy or be permitted to exist within 18 metres of any well or tank containing water or any water tap on the premises of the dairy".*
- Compost and rubbish bins should be kept well away from farm dairies and should be covered when not in use.
- Overhanging trees should always be trimmed back, and pipes and other overhead items cleaned regularly.
- Diseased cows should not be allowed near the milking area.
- Flies, cockroaches and birds are also capable of transferring microorganisms from animal faeces to milk equipment, so these should also be managed through general cleanliness of the milking area.
- Birds perching on pipes are a particular hazard as droppings can fall into important tanks and cans.
- Roofs, valleys, gutters and outside structures should be kept clear of debris, including insects and dead birds.
- All buildings should be kept clean and tidy in order to eliminate sites that may attract microorganisms, insects and vermin.
- All animals, including chickens, pigs, dogs and cats, should be prevented from entering the milk room/milking area.

2.3. Bacteria and Disease

Just the same as humans get disease from bacteria, so do cows. Prior to each milking session, cow health should be assessed by visual assessment of the animal and careful inspection of the udder. The following diseases are of particular relevance to dairy farmers.

2.3.1. Mastitis

Mastitis is an inflammation of the mammary gland and udder tissue and is a major endemic disease of dairy cattle. It usually occurs as an immune response to a bacterial invasion of the teat canal by the variety of bacterial sources present on the farm, and can also occur as a result of chemical, mechanical, or thermal injury to the cow's udder. Mastitis can cause distress in animals and reduced milk yields. Information outlining steps that can be taken to control mastitis is given in Appendix 4.

2.3.2. Tuberculosis (TB)

Bovine TB is a disease caused by a specific type or species of bacteria called M. bovis. Bovine TB usually affects cattle, but it can affect practically all mammals, causing a general state of illness, coughing and eventual death.

The name Tuberculosis comes from the nodules, called 'tubercles', which form in the lymph nodes of affected animals. M. bovis is a different type of bacteria to the bacteria M. tuberculosis that usually causes disease in humans; however, it can still be transmitted from animals to humans as well as other animals such as chickens, dogs and cats.

Because the course of the disease is slow, an animal can spread TB before it begins to show clinical symptoms. Two major ways the disease is spread is (a) movement of infected but undiagnosed domestic animals and (B) contact with infected wild animals. Once an animal is diagnosed with TB, it must be removed from the herd.

Differing views are held about the safety of raw milk from animals infected with TB; however, it is agreed that normal heat treatment procedures at the processing end of the value chain (i.e., prior to packaging) are sufficient to ensure consumers' safety. For consumption at home, by farming households, do not drink raw milk. Milk should be boiled or pasteurized before consumption.

2.3.3. Brucellosis

Brucellosis of cattle, also known as 'contagious abortion' and 'Bang's disease', is caused by infection with the bacterium *Brucella abortus*, which can also cause disease in humans. Brucellosis in cattle causes abortion or premature calving of recently-infected animals, most often between the fifth and eight months of pregnancy.

Infected bulls can transmit the disease to cows at the time of service by infected semen. Infected cows frequently suffer from retained placenta (afterbirth), have weak calves, are difficult to breed again and sometimes become sterile. Milk produced from an infected cow may also harbor the organism, which creates a public health hazard as *Brucella abortus* causes 'undulant fever' in humans.

There is no treatment for Brucellosis in cows; however, prevention is possible. This is done through the vaccination of heifer calves. Vaccination must be done by an accredited veterinarian at calf ages varying from two to four months using a standard dosage vaccine or, from four to 12 months, using a reduced dosage vaccine.

In Fiji, each calf must be identified as 'officially vaccinated' in compliance with state and federal regulations. Quarantines are imposed on infected herds by MoA staff until the herd has been certified free of the disease.

Standard No. 4 – Diseases

Every effort should be made to prevent and treat diseases in milk-producing animals and diseased animals must be removed from herds.

It is good practice to foremilk cows by drawing one or two streams of milk carefully from each teat into a cup or black sheet of plastic material. The first milk drawn is always higher in leukocytes and bacteria and should be discarded. The practice of removing one or two streams of milk is also a quick screening test for abnormal milk.

Any evidence of TB or Brucellosis should be reported immediately to the MoA and MoH & MS officers responsible for that location.

In the event of evidence of mastitis, the steps detailed Appendix 4 should be undertaken.

2.4. Personal Hygiene

Even healthy humans are carriers of large numbers and types of bacteria, viruses and fungi. Microorganisms are found in highest amounts around the nose and throat, the toilet areas and hair. Most go unnoticed because they do not produce symptoms. However, microorganisms that go unnoticed in one person may cause sickness in another. And symptoms such a running nose, diarrhea and boils or lesions on the skin will likely cause sickness in others.

As such, food handlers in any food preparation and handling situation have the potential to cause food infection or contamination, which may pose a threat to public health. To help prevent the spread of disease, food workers must always wash their hands immediately after going to the toilet and those with cold or flu symptoms or boils should not be permitted near food areas. Smoking and eating in the milking area should also be avoided because this is how microorganisms from the nose and mouth can be transferred to the hands.

Standard No. 5 – Personal Hygiene

Workers in contact with milk or milk products should wash their hands using soap and clean water immediately after toileting and those with cold or flu symptoms or boils/lesions should not enter food handling areas. Workers should wear clean dry clothes when harvesting or handling milk.

2.5. Food Safety

Food safety can be achieved by implementing a well-documented and well-maintained Food Safety Management System (FSMS) based on HACCP principles (i.e. each partner or member of the chain is part of the process, right down to farm helpers and tanker drivers).

Such a system should be supported with records that act as checklists and detail responsibilities and corrective actions where necessary. Documentation may be electronic or printed and should be readily available and easily understood.

The requirements of any FSMS are usually based on what is required by regulation (compulsory), as well as what is recommended by industry standards and customers' requirements and safety.

3. Dairy Farms

3.0. Introduction

Everyone involved in the production, handling, transportation, processing and sale of milk in Fiji should consider themselves to be part of continuous chain, with each member relying on all partners to play their part as best they can. However, as with all value chains, is it no surprise that significant effort is directed towards the origin of the product (i.e. the farm). This is because it is extremely difficult to improve quality resulting from prior oversights (i.e. down the track).

In order for all subsequent partners in the chain to have confidence in the ultimate quality of the country's milk, it is important that farmers meet certain structural and procedural standards that enable quality production. Farmers should also be aware that simple, additional inputs can increase farm incomes, such as adding an extra cow to the herd, ensuring feed is available throughout the dairy cow's life and keeping animals as healthy as possible to minimise the possibility of bacterial infections.

Fiji's current milk supply chain is dominated by small farmers milking 10 cows or less; however, bulk supplier farms also have an important part to play. As with small-scale farms, they must meet certain standards and follow best practice in relation to environmental and personal hygiene, animal well-being, construction and layout of farm premises, water and the milking process.

Standard No. 6 – Dairy Farms

Small-scale and bulk supplier farmers must always follow best practice in relation to environmental and personal hygiene, animal well-being, construction and layout of farm premises, water and the milking process.

Recommended best practice

Good Agricultural Practices, or GAPs, are voluntary procedures that can be changed to suit any production system. They help ensure the safety of fresh produce for human consumption and can also support good animal welfare. For farmers selling milk on the open market in Fiji, the following GAPs will greatly reduce the potential for on-farm contamination and/or animal distress.[2]

- Every effort should be made to reduce negative impacts on the landscape, environment and life (i.e. avoiding contamination of land for grazing, food, water and air).
- Every effort should be made to prevent chemical and medical residues from entering the food chain.
- Non-therapeutic use of antibiotics or hormones should avoided.
- Avoid feeding animals with animal wastes or animal matter to reduce the risk of alien viral or transgenic genes, or prions such as mad cow disease.
- Minimise the transport of live animals by foot, rail or road to reduce the risk of epidemics (i.e. TB and Brucellosis).
- Prevent waste run-off (i.e. nitrate contamination of water tables)[3], nutrient loss and greenhouse gas emissions (i.e. methane from cows).
- Apply traceability processes on the whole production chain.
- Cows should be de-horned in a manner that causes no distress to the animal and in such a way that regrowth does not occur.

[2] GAPs are dictated by Codex standards and relate to (a) the application of Persistent Organic Pesticides (POPs) and common agricultural chemicals and (b) Maximum Residue Limits (MRLs) relating to pesticides, antibiotics and herbicides.
[3] The use of heavy metals, nitrate, nitrite and melamine throughout Fiji is unknown.

- Milk from antibiotic-treated animals must not be used for a period described by the antibiotic manufacturer on the label. The holding period after the administration of veterinary drugs can be found in the Dairies Act, which is under review.
- Animals that have been diagnosed as unhealthy (by veterinary examination) should be segregated to avoid cross-infection.

3.1. Construction and Layout of Farm Premises

The design and construction of buildings and facilities on dairy farms, as well as the materials used, must permit easy and adequate cleaning and disinfecting (see Figure 2). This will ensure that a high level of hygiene is maintained. Wherever possible, access to milking areas should be restricted only to those who are trained in milking practices and farm partners. Signs reflecting this should be displayed prominently even if they are homemade (Figure 4).

Figure 3. Example of a dairy farm layout.

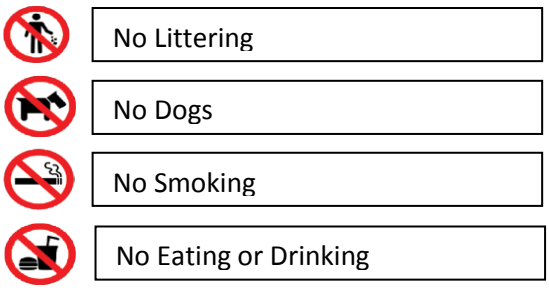
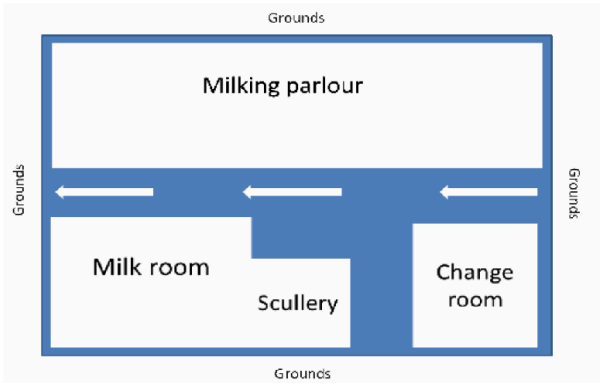


Figure 4. Example of warning signs that could be displayed on farms and in MCCs.



Standard No. 7 – Farm Premises

Farm premises shall be designed and constructed in such a way as to maintain an appropriate degree of hygiene and to minimise the likelihood of cross-contamination.

Places where cows are milked should be regarded as ‘exclusive’ zones, where access is restricted to those engaged in producing milk. Vermin and other animals apart from milking cows should be excluded. People untrained in hygienic practices should be excluded if possible. Where family members not engaged with farm tasks and suitably trained, such as children, are visiting the farm dairy, they should be under close supervision of a responsible adult and should be instructed to obey simple hygiene rules.

Recommended best practice for small-scale farms

- A dairy farm should consist of:
  - An area where animals are milked.
  - A milking room where milk is received from the milking parlour, where it is cooled and stored.
  - A changing room for staff where appropriate food handling attire and personal cleaning facilities are available.
  - A scullery for the washing, cleaning and disinfection of milk containers and other unfixed apparatus and equipment.
  - A holding yard for the inspection of animals and a raceway for tagging, dehorning, artificial insemination practices and other animal treatments.
- Farm dairies should be sited in consideration of easy access for cows, easy drainage for water (that avoids contamination of waterways) and with consideration of the predominant wind direction (commonly south-easterlies in Fiji) for maximum cooling and ventilation. Be aware, however, that too much wind can blow dust and dirt into the milking area.
- All areas of the milking area should be well-ventilated. This avoids the growth of bacteria through the quick drying of wet areas and also ensures both the milker and cow are comfortable when temperatures are high (milk yields decrease at temperatures higher than 21°C).
- The milking area must have sufficient clean water for washing and should be well ventilated and have good lighting.
- The farm dairy should be fitted with lockable cupboards or rooms where veterinary and farm chemicals can be stored.
- The grounds of a dairy farm should be managed in a way that prevents the access of animals such as dogs, chickens, pigs and cats – as well as unauthorised persons (i.e. unsupervised children and untrained family members).

Recommended best practice for bulk supplier farms

- Farm buildings should be maintained in good condition according to industry guidelines; deteriorated floors, ceilings and walls can harbor insects and vermin.
- Design features should minimise the risk of contamination from any source, including dust, flies, birds or other animals.
- Doors, walls and floors should be smooth (good quality, smooth cement is adequate), impervious to water and free draining.
- Running water should be available to rinse hands, protective clothing, udders and equipment whenever they become soiled. Clean dry clothes should be worn by all milkers and milk handlers.
- All light and other electrical outlets should be fitted with standard approved water proof covers to enable comprehensive hosing of the entire area.
- A hose of sufficient volume and force is recommended to wash equipment and cow standings thoroughly during and after milking.
- To avoid dislodging accreted droppings and dirt, exposed pipes must be cleaned after each milking cycle.

THE FARM DAIRY, NO MATTER WHAT SIZE, SHOULD BE REGARDED AS A VALUED FACILITY WORTHY OF CAREFUL MAINTENANCE AND CARE

3.2. Water

Water is essential in dairy production and its availability should be a priority for all farmers. An adequate supply of potable water is of paramount importance to both animal nutrition and maintaining hygiene in the milking process.

Many small-scale farms in Fiji are on town water supplies; however, others are isolated and must find their own water supplies. Where town or local clean water supplies are unavailable, rainwater from the roof may be an alternative source; however, this may be contaminated with bird droppings, leaves, insects and dust.

Water is supplied to bulk supplier farms by the Fiji Water Authority under the standard mains reticulation system; however, its quality and pressure can vary according to load, filter maintenance, sedimentation procedures and chlorine addition.

For both small-scale and bulk supplier farms, checklists to ensure consistency in potable water supplies are necessary. Routine chlorination may be a practical solution for water supplies with potential contamination.

Recommended best practice

- Recommended standards for potable (drinking) water quality are given in Appendix 1, based on WHO guidelines.
- To collect rainwater from the roof, the cheapest option is to use bamboo guttering as an alternative to the more common PVC; bigger farms may choose to fit a pressure pump.
- Water storage solutions are sometimes available through grants or subsidies from government agencies.
- There should be no standing water (pools of water that do not flow) on dairy farms and special attention must be paid to gutters, open drains, potholes and pools.
- Inadequate drainage or incorrectly-sloped surfaces can cause water to become stagnant.
- Storage tanks and reservoirs for water must be covered to prevent the contamination of water by birds, rodents, organic and inorganic matter – and should be inspected weekly. The air vents to these tanks and reservoirs must also be insect and rodent proof.
- Flexible hoses, if used on dairy farms, must be suitable for food use, e.g. made of food grade material.
- They should not be immersed in any liquids unless they are designed for this purpose. If immersed, they should be included in cleaning programmes and then properly stored on a reel or equivalent and covered with end caps.
- Hot water is much more effective at removing soiling, so water heating facilities are ideal; however, they not necessary with appropriate cleaning agents.

3.3. Hygienic Milking Practices

Milking takes place either once or twice a day in Fiji; hence, it is of utmost importance to reduce the risks associated with the practice that may adversely affect the safety of the product.

For milk to get to consumers, it must pass through the chain shown in Figure 1.

The number of foodborne diseases caused specifically by milk and dairy products in Fiji is unknown; however, every effort should still be made to eliminate risk.

Under traditional, small-scale dairying, milking is done predominantly by hand as machines may not be economical for only a small number of cows. Manual milking is labour-intensive and may compromise milk quality if not done carefully.

Milking machines use negative pressure (i.e. a vacuum) as opposed to positive pressure to extract milk from the gland and teat canal. They mimic the natural removal of milk from the udder by calves, as they are based on the 'suckling' mechanism.

Milking by machine saves time, improving the efficiency of milking; however, the process is reliant on a regular supply of power.

Standard No. 8 – Hygienic Milking Practices

Milking activities should ensure the production of safe and high-quality raw milk at all times.

Total cleanliness should be ensured at all stages of milking.

The area around the farm dairy should be kept clean at all times. Grass should be kept short within at least 2 metres of the milking shed, to discourage rodent access.

Cow teats should be wiped or washed clean before milking between animals. If cloths are used, they must be rinsed in water containing iodophor or another approved sanitiser between each animal to avoid cross-contamination.

After milking, utensils and surfaces should be rinsed in iodophor or another approved sanitiser and allowed to dry. Excess solutions of sanitiser can be used to swill down the milking area, which can then be allowed to dry prior to the next milking schedule.

Cover the milk after milking to prevent airborne contamination from things like birds, overhead pipes, dust and cow faeces from splashing.

Milk containing flakes, strings, blood or other signs of abnormality should be discarded.

Complete checklists to ensure that clean down procedures are complete (Appendix 2).

Recommended best practice

- Dogs and other animals should be restricted and not permitted in the milking area.
- Clean all surfaces that contact milk before milking, including the cow's udder, your hands, clusters and any milk-receiving vessels pipes tanks and cans.
- Always practice good personal hygiene, i.e. milkers must wear clean clothes and clean and dry their hands before milking, to avoid contamination of the cow and the milking system. Hands must also be washed after handling any cow known or suspected of being infected.
- If milking by machine, ensure the vacuum pressure in the milking machine remains constant, avoiding fluctuations. To remove the milking machine, first switch off the vacuum, then remove the cluster gently. The cluster should never be pulled off while the vacuum is still on.
- In hand milking, the hand grasps the whole length of the teat. The thumb and forefinger pinch off the upper end of the teat as the other fingers squeeze inward and downward. The increased pressure inside the teat relative to the atmospheric pressure outside forces the milk out through the sphincter.
- Care must be taken that the milk is not leaked onto the floor, as this can be a source of infection for other animals and workers.
- Animals showing any signs of disease should be milked last.
- After milking, the whole teat must be dipped with a reputable teat antiseptic solution. This effectively controls mastitis, reducing the new infection rate by about 50%. An effective teat dip will also dilute or remove the residual milk film from the teat surface, and control teat lesions, again reducing the opportunity for bacterial growth and the incidence of new infections.

- Clean the milking area, including equipment such as buckets, cans and drums, after every milking, using fresh water and a mild disinfecting solution so that it is dry before the next milking.
- Instructions for use of cleaning chemicals should be clearly visible to the user and the cleaning cupboard should contain measuring and application devices.
- Make sure water used for washing does not drain into rivers or other waterways, but is adequately treated in such facilities as a soak pit or sewerage handling system.

3.3.1. Cleaning Materials

Cleaning materials should be stored in a secure and safe location, to avoid cross contamination with the milk. Sanitisers, sterilants, brushes, cloths and other cleaning materials should be stored in a dedicated room or cupboard to avoid contamination or misuse. Cleaning materials should be carefully maintained so that brush bristles and fluff and cotton from cloths do not contaminate milk.

Care must be taken to ensure that directions for use of cleaning chemicals are followed correctly. Standard procedures for the concentration, temperature, pH and exposure time of detergents and sanitisers should be followed, as indicated in the guidelines of the manufacturers – usually found on the bottle/packet. Instructions for use should be clearly visible to the user and the cleaning cupboard should contain measuring and application devices.

3.3.2. Milk Cans

Milk is transported to chilling centres in cans, which are used throughout the Fiji dairy sector by both small and medium-sized farms. Their cleanliness is a vital feature of maintaining milk hygiene and, as such, cans are inspected at chilling centres. It is also vital that cans are stored away from direct sunlight. A guide to cleaning milk cans is provided in Appendix 5.

3.4. Animal Welfare

To ensure high quality milk, dairy cows must be treated humanely at all times. Cows should always be kept calm prior to entering the milking facility and separated from suckling calves.

They must also be provided with clean, water daily and sufficient fresh feed suitable for dairy cows, free of matter that can cause harm to the animal.

Feed may consist of planted pasture or crop residue. Pastures such as feed grass and legumes may be planted in areas that are unfavourable for the cultivation of other crops.

Such feed crops can often be inter-planted with other crops without any negative effects and indeed may increase income. Crop residues from cereals, sugar cane, groundnuts, soy beans and maize may also be used as feed.

Standard No. 9 – Animal Welfare

Farmers must, at all times, respect animal well-being (freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury or disease; freedom to express normal behaviour; and freedom from fear and distress).

Recommended best practices

- Do not rush or stress animals as they enter or leave the milking area, keep them as cool as possible and allow them to take their own time.
- Ensure that all steps are taken to keep animals healthy; keep paddocks free of rubbish that could injure or choke animals.
- Use all services available (i.e. government, industry and non-government advisors) to ensure all steps are taken to keep animals in the best possible condition.

- Avoid milking animals while restrained in the field, due to hazards.
- Injection of the hormone oxytocin to promote milk let-down should not be practiced except under veterinary advice.
- When milking by hand, milkers should follow the 'full hand' method and avoid the 'knuckling' method, which is painful to the animals and may damage the teats.

3.5. Control Measures

Milking is a daily activity on dairy farms, so it is important that staff/family members follow all clean-down procedures. Should the normal milker not be available due to sickness or family commitments, the ‘stand in’ must understand their responsibilities and be familiar with the checklists given in Appendix 2.

Control charts and checklists are a great way of scheduling and keeping track of farm dairy clean-downs and maintenance (see Appendix 2). They can list procedures that must be addressed hourly, weekly and even annually.

For bulk supplier farms, which see a lot of milk each day, equipment must be dismantled and cleaned according to an agreed schedule, to avoid the accumulation of deposits such as milk fat and milk stone, which regular Clean in Place (CIP) regimes often fail to dislodge.

Control measures should be introduced at all points of milking, i.e. pre-milking animal health checklist, pre-milking cleanliness of milking area checklist, milk handling at time of milking checklist and handling of milk after milking checklist.

4. Milk Transfer/Collection

Milk from farms generally arrives at Milk Collection Centres (MCCs) with varying standards of hygiene. It is accepted or rejected on the basis of passing an alcohol test[4] and a sensory test and the condition of the milk cans (see Figure 1).[5]

It is crucial that milk samples tested by Fiji Dairy Ltd reflect the quality of the original consignment. This can be achieved by chilling the milk sample immediately on receipt of the consignment by immersing it into an ice/water slurry.

If the milk is accepted, based on the results of the alcohol and sensory tests, it becomes the property of the processor (i.e. Fiji Dairy Ltd). It is mixed in a bulk container, filtered, cooled and transported to the processor. From there, quality control parameters are currently underscored by SOPs prepared and administered by Fiji Dairy Ltd.

Transport systems impinge significantly on milk quality. Maintenance of equipment, operator training and especially chilling during transport have significant impacts on quality. For bulk supplier farms, bulk tanks must be cleaned and disinfected after each milk collection and kept in good condition.

Standard No. 10 – Milk Transfer/Collection

At all times, milk must be protected from contamination during transfer and storage.

MCC staff are responsible for keeping milk in good condition and their procedures should be checked against any existing formal SOPs.

Any signs of spoilage such as unusual smells or appearances (i.e. sediment or clotting) should be recorded and reported immediately.

MCCs should be equipped with cooling systems; cooling methods depend on the volumes of milk involved (i.e. ice banks or a direct expansion chiller on the storage vats).

MCCs must be regularly inspected for signs of deterioration. Regular maintenance checks are necessary to ensure things like flaking concrete or paint are minimised (see checklists in Appendix 2).

Recommended best practice

- Access to MCCs should be restricted and limited to dairy staff chain partners only.
- Refrigerated tankers are preferred for milk collection (i.e. those used by Fiji Cooperative Dairy Company Limited) and cost-benefit analyses of extra refrigerated tankers should be undertaken in case of break down.
- It is advisable to have ample storage capacity at fixed centres in case of unforeseen circumstances (i.e. tanker break down)
- Vermin proofing should be installed at chilling centres with feed supplies; polythene strip curtains are commonly used for airborne pests.
- There is compelling evidence that cooling milk on farms should be pursued wherever possible, to avoid bacterial acid formation.

[4] Determining the outcome of the alcohol test is somewhat subjective although operators receive regular training. Over the long-term, results of alcohol tests should be reviewed against other quality tests to reaffirm reliability and signpost farms that require assistance or further training.

[5] Results of these screening tests are recorded and distributed to farmers.

5. The Processor

Milk processing in Fiji produces a range of milk-based products, including ready-to-drink UHT milk in cartons, flavoured milks, limited-shelf life pasteurised milk, yoghurt and cheese. Processing practices are monitored by internal procedures, including HACCP accreditation.

All of the products produced must meet the standards mandated by the country's Food Safety Regulations 2009 and the Codex standards on which they are based. Therefore, it is necessary to enforce SOPs that recognise hazards along the entire production chain and minimise risk.

As outlined in Section 4, milk from farms generally arrives at milk collection centres with varying standards of hygiene. It is accepted or rejected on the basis of milk-can cleanliness, passing an alcohol test and sensory test. At the same time, a sample is taken for later testing at the processor. Once assessed, the milk quality is used to determine the grade of the milk and thus the remuneration to farmers.[6]

There should be quality indicators or criteria made available to farmers relating to the acceptance/rejection of milk and pricing, i.e. regarding fat content (using the Gerber or other recognised method) and number of microorganisms.

Inspection methods are as follows:

- Protein sedimentation shall be examined by using 75% of ethyl alcohol.
- Specific gravity shall be determined for calculation of the 'total solids' and 'solid not fat', which indicate the addition of water.
- Added water will be assessed using the freezing point depression test.
- Fat content should be determined using the Gerber Method.
- Total solids should be determined by drying to constant weight.
- Indirect testing should be used to determine the number of microorganisms in raw milk (the methylene blue or resazurin reduction tests).
- Total bacterial counts should be determined using the Aerobic Plate Count (APC) method in raw milk on arrival and on final products.
- Testing for somatic cell counts in raw milk.
- Antibiotic residue testing.
- Testing for hydrogen peroxide contamination and other contaminants as needs are identified.

[6] Hence, it is important that on-farm milk quality tests are relevant to Fiji Dairy Ltd's own tests.

Appendix 1: Guidelines for the Microbiology of Safe Drinking Water

According to WHO guidelines, indicator organisms such as *E. coli* (the indicator organism of choice for faecal pollution) must not be detectable in any 100ml sample of treated water entering the drinking water distribution system. using methods approved by or equivalent to those provided by ISO. Pathogenic agents such as *E. coli* have several properties that distinguish them from other drinking water contaminants:

- Pathogens are discrete and not in solution.
- Pathogens are often clumped or adherent to suspended solids in water.
- The likelihood of a successful challenge by a pathogen, resulting in infection, depends upon the invasiveness and virulence of the pathogen, as well as upon the immunity of the individual.
- If infection is established, pathogens multiply in their host. Certain pathogenic bacteria are also able to multiply in food or beverages, thereby perpetuating or even increasing the chances of infection.

In the majority of cases, monitoring for indicator bacteria provides a high degree of safety because of their large numbers in polluted waters; however, continued reliance on assumptions surrounding the absence or presence of *E. coli* does not ensure that optimal decisions are made regarding water safety.

Pathogens more resistant to conventional environmental conditions or treatment technologies may still be present in treated drinking water in the absence of E. coli. Protozoa and some enteroviruses are more resistant to many disinfectants, including chlorine and may remain pathogenic in drinking water following disinfection.

WHO guidelines suggest that water quality can be usefully divided into a number of categories and the levels of contamination associated with each category should be selected in the light of local circumstances. An example of a typical classification scheme is presented in Table 1, based on increasing orders of magnitude.

Table 2. Example of a classification and colour-code scheme for thermotolerant (faecal) coliforms or E. coli in water supplies.

Count per 100ml	Category and colour code	Remarks
Nil	A (blue)	In conformity with WHO guidelines
1-10	B (green)	Low risk
10-100	C (yellow)	Intermediate risk
100-1000	D (orange)	High risk
>1000	E (red)	Very high risk

Appendix 2: Checklists for Dairy Farms and MCCs

Appendix 2a. Daily Clean Down Procedures for Dairy Farms

Line item	Checked by	Sanitiser/cleaning agent used	Dilution (e.g. 1/10)	Residence time (how long the sanitiser has to sit there)	Repairs and upgrades required
Floors					
Walls and windows					
Ceilings					
Doors					
Bench tops					
Sinks					
Drains and draining channels					
Pipes					
Storage bins					
Cleaning brushes and cloths (animals)					
Cleaning cloths and brushes (area)					
Dry waste disposal					
Exposed beams and pipes					
Milk containers					
Wiping cloths					

Appendix 2b. Weekly Clean Down Procedures for Dairy Farms

Line item	Checked by	Sanitiser/cleaning agent used	Dilution (e.g. 1/10)	Residence time (how long the sanitiser has to sit there)	Refurbishment required
Ceiling					
Exposed pipes and beams					
Walls and windows					
Parlour					
Shelves and benches					
Feed troughs					
Floor					
Approach					
Can shade					

Appendix 2c: Daily Clean Down Procedures for MCCs

Line item	Checked by	Sanitiser/cleaning agent used	Dilution (e.g. 1/10)	Residence time (how long the sanitiser has to sit there)	Action required
Floors					
Walls and windows					
Ceilings					
Doors					
Bench tops					
Sinks					
Drains					
Milk line pipes					
Plate heat exchanger					
Cleaning utensils					
Storage cupboard					
Dry waste disposal					
Exposed beams					
Milk Vats					
Rinsing tanks					
Contact Cloths brushes					

Line item	Checked by	Sanitiser/cleaning agent used	Dilution (e.g. 1/10)	Residence time (how long the sanitiser has to sit there)	Action required
Floor cloths and brushes					
Sample bottles					

Appendix 2d: Weekly Clean Down Procedures for MCCs

Line item	Checked by	Sanitiser/cleaning agent used	Dilution (i.e. 1/10)	Residence time (how long the sanitiser has to sit there)	Repairs required
Ceiling					
Exposed pipes and beams					
Walls					
Shelves					
Refrigerator					
Pipes					
Tanks					
Floors					
Cleaning brushes					
Sample dipper					

Sample dipper tank					

Appendix 3: Microbiological Guidelines based on European Union/Food Standards Australia New Zealand (FSANZ) Standards

CATEGORY	**MICROORGANISM**	**LIMIT**	**SAMPLING PLAN**			
			Number of samples taken (n)	The number of samples out of n that may exceed the maximum set for m (c)	Analytical value that differentiates between good quality from marginally acceptable quality (m)	Analytical value that differentiates between marginally acceptable quality from unacceptable quality (M)
Raw cow milk intended for processing	APC at 30°C	10^5 cfu/ml	5	2	500 cfu/ml	10^3 cfu/ml
Raw cow milk intended for direct human consumption	Staphylococcus aureus Salmonella	Absent in 25ml	5	0		
Pasteurised drinking milk	APC at 30°C	5 x 10^4 cfu/ml				
	Staphylococcus aureus		5	2	100/cfu/ml	500/cfu/ml
	Pathogenic organism	Absent in 25ml	5	0		

CATEGORY	MICROORGANISM	LIMIT	SAMPLING PLAN			
			Number of samples taken (n)	The number of samples out of n that may exceed the maximum set for m (c)	Analytical value that differentiates between good quality from marginally acceptable quality (m)	Analytical value that differentiates between marginally acceptable quality from unacceptable quality (M)
	APC at 21^{o} (after incubation at 60^{o} for 5 days)		5	1	10^{4} cfu/ml	10^{5} cfu/ml
UHT milk UHT milk	Coliforms APC at 30^{o} after 15 days	Absent 10 cfu/0.1ml	5	0		
Frozen milk-based products	Salmonella	Absent in 1g	5	0		
	Listeria monocytogenes	Absent in 1g	5	0		
	Staphylococcus aureus (guideline)		5	2	10cfu/g	100cfu/g

Appendix 4: Addendum to Chapter 1 – Steps to Get Mastitis Under Control in Fiji

Mastitis should improve once the following steps are complete. They will protect new cows and, as a result, the number of infected cows will slowly fall as the old cows leave the herd. If the mastitis situation does not improve, farmers should ask for veterinary advice.

1. Make sure your milking machine is working well

Teat damage from malfunctioning milking machines is a major cause of infection spread (i.e. the vacuum level is too high or cups remain on for too long) so test and service your machine regularly and replace worn out liners.

2. Teat spray or dip after every milking

Teat sanitation is absolutely essential after milking as it kills bacteria on the teat, which reduces new infection levels by about 50%. Note that by disinfecting cows' teats, you are protecting other cows from getting infected – not curing the infected ones.

3. Find clinical signs of mastitis quickly

Check for clinical signs of mastitis every two or three days. Use a black sheet of plastic so you can easily see any white clots that appear. Farmers should consider the situation 'clinical' if the clots are there for more than two squirts. Other clinical signs of mastitis include heat, pain and swelling. The milk may also be very thick or watery, dark coloured and possibly even containing blood.

4. Treat clinical infections immediately

Start by stripping the affected quarter out twice a day (i.e. milk out as much of the bad milk as possible). Antibiotics may be prescribed, but only on veterinary advice. The recommended treatment is usually three tubes. Keep the treated milk out from the milk you are drinking or selling.

5. Dry off quarters with repeated clinical signs

Quarters with more than two or three clinical infections in reasonably quick succession should be dried off. Note that the other three quarters will increase their production a lot to compensate for the dried-off quarter.

6. Check the type of bacteria causing the problem

Milk samples can be taken from badly-infected cows and sent for culture testing at veterinary laboratories. This can help develop better treatment plans and advice on management practices.

7. Practice good hygiene and milking routines

Make sure the milking machine is properly cleaned after every milking. Keep the milking area clean by washing out before and after milking. Wash hands before milking. Milk badly infected mastitis cows last. Wearing gloves for milking is recommended.

Antibiotics to treat mastitis

Antibiotics may be prescribed to treat mastitis, but only on veterinary advice. The recommended treatment is usually three tubes of Lactaclox LC, i.e. one tube per affected quarter every 12 hours over three consecutive milkings.

For example:

Day 1 – Tube after morning milking
Day 1 – Tube after evening milking
Day 2 – Tube after morning milking

Milk should not be collected for human consumption the end of the recommended withholding period stated on the label. For Lactaclox LC, that is 60 hours or 2½ days after the last treatment.

Other recommendations

- Clearly mark the treated cow and quarter to be treated.
- Fully milk out the quarter before administering antibiotics.
- Kill the bacteria on the teat end with cotton wool soaked in alcohol/methylated spirits.
- Make sure the nozzle of the antibiotic tube stays perfectly clean.
- Insert the antibiotic tube nozzle into the teat canal only about 2mm to 3mm.
- Infuse the contents of the antibiotic tube into the teat opening and gently massage the antibiotic up into the teat.
- Immediately after treatment, dip or spray the treated quarters with teat sanitiser. If using a sprayer, protect the tip with rubber tubing so it is less easily damaged and continues to spray evenly.
- Record treatment details on a chart at the parlour so that other milkers can check treatment details and the milk discarding period.

Image 1: Sample dipper.

Image 2: Dip teats in sanitiser or spray them after every milking to cover as much of the teat skin surface as possible.

Image 3: You can get good coverage using a Cambrian sprayer.

Appendix 5: Addendum to Chapter 2 – Can Cleaning

There are a lot of steps to getting better quality milk, but this is one easy one. Milk is accepted or rejected by Milk Collection Centres on the basis of milk-can cleanliness. Cleaning milk cans well costs next to nothing and benefits every dairy farmer.

Once a bucket or milk can, dipper or jug is dry, any bacteria on the surface do not grow. If you have cleaned it well, the numbers will not increase. If you leave it wet, any bacteria that are left behind feed on the small amounts of milk residue left there and multiply quickly in Fiji's warm climate. The answer is clear: drain and dry.

Recommend best practice

- Drain and dry all milking equipment, including cans, dippers and jugs, after cleaning.
- Store cans and lids on narrow rails with plenty of airflow – or hang on a hook.

Milk cans stored on a narrow rail.

A milk can hanging from a hook.