Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Entec UK Ltd, ERM
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# Cleaner Production SME Case Study

# CP CLINICS TO PROMOTE CLEANER PRODUCTION (CP) IN DAIRY SECTOR

## DAKAHLEYA GOVERNORATE, EGYPT

### Introduction

Small-scale milk processing factories in Dakahleya were experiencing a range of production-related issues, including high milk spoilage rates, high salt concentration in the cheese and low yields in cheese production. In addition, they were causing significant pollution to the environment (particularly in terms of salt and organic content), due to discharge of whey.

To help the dairy micro, small and medium sized enterprises (MSMEs) overcome some of these problems, and to promote the concept of Cleaner Production (CP), a CP Clinic was established at the headquarters of Dairy Processors' Development Association in Dakahleya in Dakahleya (DPDA) with the support of the SEAM Programme.

**Dairy Processors Development Association, Dakahleya**

- ***Established***: April 2002.
- ***Purpose***: to develop small milk processing factories so that they can produce high quality products in compliance with relevant Egyptian standards.
- ***Services***: representation of members in official and trade events; provision of technical training and support through co-operation with international donors and dairy institutes.
- ***Members***: to date, a total of 30 members, representing 10% of small milk processing factories in Dakahleya.

### Structure and Objectives of the CP Clinic

The CP Clinic was set up as a counselling service where the MSMEs could meet with dairy sector experts to discuss any issues that related to the sector in general or to specific factories.

The main objectives of the CP Clinic were to:

- Facilitate interactions between the various stakeholders in the dairy sector;
- Introduce attendees to the range of CP services offered by the sector expert;
- Increase interest and opportunity for consultants/institutions to provide CP related services to the MSMEs;
- Expand the portfolio of services of MSME associations;
- Increase awareness of CP and its benefits among MSMEs by providing customised CP solutions;
- Help develop low investment-moderate returns projects at MSMEs to improve their profitability and reduce pollution at source.

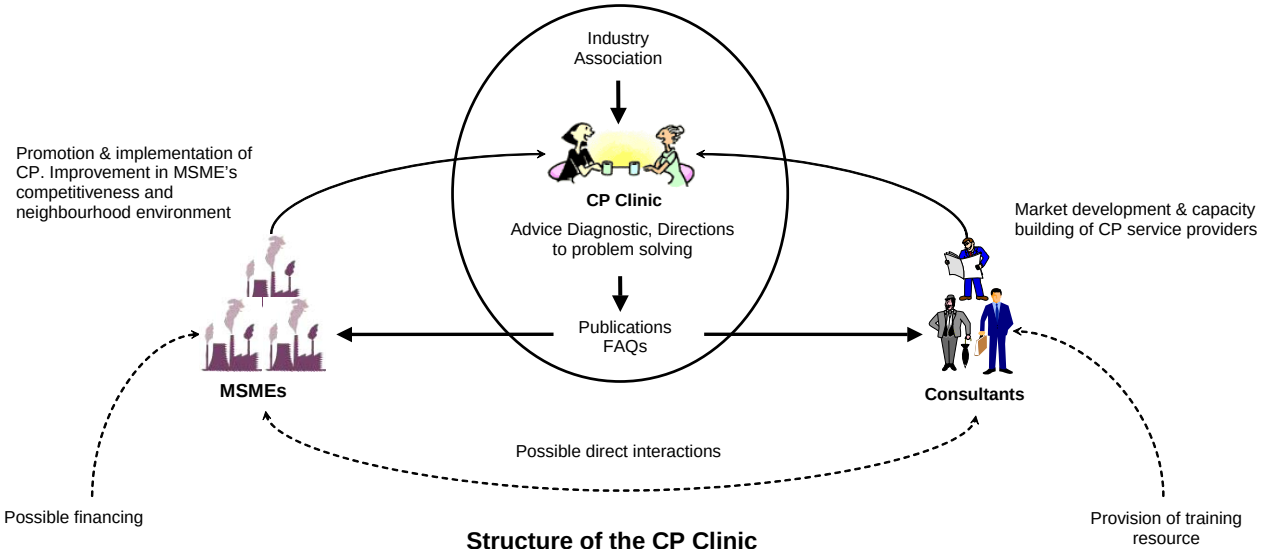
### Conducting the CP Clinics

The CP Clinic was set up at the DPDA's headquarters and conducted by a dairy sector expert with experience in CP.

***Awareness workshop***: this was held at the headquarters of DPDA for both members and non-members, to inform them about the CP Clinics, it's benefits and how they could take part. It also served to increase awareness of DPDA with MSMEs in the area.

***CP Clinic***: The dairy sector expert was available for a series of two-hour consultations at DPDA one day each week.

A total of eleven factories attended during which problems and possible solutions were discussed. Commonly encountered problems related to the quality and testing of raw milk and final products, pasteurisation and the development of new products (see section on "Frequently Asked Questions (FAQs)").




**Structure of the CP Clinic**

The CP Clinic was also used to disseminate CP best practices, including two demonstration projects previously implemented by SEAM.

***Follow-up visits***: were carried out to assist factories with the implementation of solutions suggested in the CP Clinic and to help replicate CP demonstration projects previously carried out by SEAM (see below). A nominal fee was charged for each visit.

**SEAM demonstration projects replicated in dairy sector MSMEs**

| Factory name and location | SEAM demonstration project |
|---|---|
| **Project category: Process optimisation/new technology** | |
| Gehad El Halawany, Sherbein | Equipment Changes Prove Profitable in Curd-Whey Separation (*available as a SEAM case study*) |
| Hamdy Mohamed El Zohairy, Dekernes | |
| Abdel Hady Shehab, Talkha | |
| Mohamed Saleh, Talkha | |
| Aly Kamal Samak, Talkha | |
| **Project category: Housekeeping and hygiene** | |
| Mohsen Shaalan, Bosat Karim El Deen | Practicing Hygienic Milk Processing Pays! (*available as a SEAM case study*) |
| Mohamed Atwa, El Wekala | |
| Mohamed Salah, Talkha | |
| Hameed Atwa, Sherbein | |
| Atia El Benawy, Sherbein | |
| Abdel Hameed El Adl, Raas El Khaleeg | |
| Othman Abdel Haleem, Sherbein | |

## Benefits from the CP Clinics

The various benefits generated by the CP Clinics included:

- Developing the awareness of CP in the local cheese manufacturing sector and emphasising its' benefits for productivity and business;
- The identification (through discussions held with MSMEs) of a number of issues that were common throughout the sector. These ranged from relatively straightforward problems that could be resolved by minor process changes (see "Frequently Asked Questions (FAQs)") to more complex interventions related to process optimisation and improved hygiene. Addressing these issues through DPDA will mean that the findings can be more easily shared and replicated throughout the sector;
- The opportunity to disseminate information and replicate existing CP projects;
- Stimulation of interest in the MSMEs for working together and exchanging information;
- An increased awareness of DPDA and how it can assist milk processing factories in Dakahleya;
- The creation of interest in both DPDA and in the CP Clinic in other areas. Factories in other areas (e.g., Fayoum and Sohag) have requested DPDA to help set up similar associations and to introduce CP in their area. These groups have established a relationship to help promote CP and to address concerns on a common basis.

Additional sector specific information that may be useful for dairy sector MSMEs is also available in the form of separate fact sheets titled - "Common Defects in Cheese" and "Probable Causes of Certain Characteristics in Butter".

## More Information

Further information can be obtained from the Egyptian Environmental Affairs Agency. Additional Cleaner Production information can be downloaded from the SEAM website *http://www.seamegypt.org*.

SEAM Programme
Egyptian Environmental Affairs Agency
30 Misr Helwan Agriculture Road, Maadi, Cairo
Tel: 20 (02) 5259648, Fax: 20 (02) 5246162

Dairy Processors' Development Association in Dakahleya
14 Ahmed Samak St. from Salah Salem next to train station
Talkha, Dakahleya
Tel/fax: (+02 50) 253 33873

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SEAM Programme

Support for Environmental Assessment and Management (SEAM) is a multi-disciplinary environmental programme funded by the UK Department for International Development and implemented in Egypt by the Ministry of State for Environmental Affairs, Egyptian Environmental Affairs Agency, Entec UK Limited and ERM.

SEAM: Cleaner Production

- Small to Medium Size Enterprises (SMEs): SEAM has undertaken over 100 rapid Cleaner Production Opportunity Assessments (CPOA) in SMEs and implemented 30 demonstration projects.
- Medium to Large firms: SEAM has carried out industrial audits in 32 factories in the textiles, food and oil and soap sectors and implemented 23 demonstration projects.
- Guidelines for conducting CPOAs, case studies, guidance manuals and sector assessments are available from the SEAM website.

Benefits of Cleaner Production

- Cleaner production assessments systematically review the factory's operations and processes, focusing on reducing wastage, improving efficiency and reducing pollution.
- It can REDUCE: production costs, losses of valuable raw materials, on site treatment costs, energy and water costs, the volume of solid and liquid waste generated, and the risk of spills and accidents.
- ….and IMPROVE: productivity, income from financial savings and reuse of waste, employee safety, legislative compliance and company image.

# Frequently Asked Questions (FAQs) for Traditional Cheese Making Factories

### *What is the source of milk contamination with microbes?*

Fresh milk from a healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers. Microbes can enter milk via air, feeds, unclean utensils (see below – a suitable vessel depicted on the left, 2 unhygienic vessels on the right), poor water supplies, unhealthy cows and general unhygienic milking practices and conditions.

### *How can I control milk contamination with microbes?*

It is more effective to exclude micro-organisms than to try to control microbial growth once they have entered the milk. Microbial growth can be controlled by cooling the milk as most micro-organisms reproduce slowly in colder environments. Cooling milk also slows chemical deterioration.

### *What is the normal pH of good raw milk?*

Fresh cow milk has a pH of between 6.5 and 6.7. Values higher than 6.7 indicate mastitic milk and values below pH 6.5 indicate the presence of colostrum or bacterial deterioration.

### *How can I measure milk pH?*

A rough estimate of pH may be obtained using paper strips impregnated with an indicator. Accurate measurements are obtained using pH meters.

### *What is the density of normal milk, and how can I measure it?*

The density of milk averages 1.032, i.e. 1 ml of milk weighs 1.032.

A lactometer is used to determine specific gravity of milk. The temperature of the milk should be 20°C. If the temperature of the milk is between 17 and 24°C, the following correction factors are used to determine L (specific gravity):

| Temp (°C) | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|
| Correction | –0.7 | –0.5 | –0.3 | 00 | +0.3 | +0.5 | +0.8 | +1.1 |

For example if the lactometer reading is 30.5 and the temperature is 23°C:

**corrected lactometer = Lc = 30.5 + 0.8 = 31.3**

### *How can I detect milk adulterated with water or skimmed milk?*

If a lower than normal fat test is obtained combined with a high (1.035) specific gravity then milk skimming should be suspected. If a lower than normal fat test is obtained combined with a low (1.020) specific gravity then the addition of water should be suspected.

### *We are a small-scale traditional dairy plant. Are there any simple tests to assure microbiological quality of received raw milk?*

Methylene blue reduction test is a simple test used to test microbiological quality of raw milk. The length of time milk takes to decolourise methylene blue is a good measure of its bacterial content and hence of its hygienic quality. When the oxygen has been utilised the methylene blue is reduced, changing in colour from blue to white.

### *What is pasteurisation?*

Pasteurisation is the most common process used to destroy bacteria in milk. In pasteurisation, the milk is heated to a temperature sufficient to kill pathogenic bacteria, but well below its boiling point. This also kills many non- pathogenic organisms and thereby extends the storage stability of the milk. There are two types of pasteurisation systems - continuous and batch.

*HTST pasteurisation (continuous):* Numerous time/temperature combinations are recommended but the most usual is 72°C for 15 seconds followed by rapid (less than 2 minutes) cooling to below 10°C. This is normally referred to as High Temperature Short Time (HTST) treatment. It is carried out as a continuous process using a plate heat exchanger.

*LTLT pasteurisation (batch):* Batch pasteurisation is used where milk quantities are too small to justify the use of a plate heat exchanger. In batch pasteurisation, fixed quantities of milk are heated to 63°C and held at this temperature for 30 minutes. The milk is then cooled to 5°C using ice or cold water before packing.

### *Are there some tests to assure milk stability to pasteurisation?*

The alcohol clot-on boiling tests, together with the acidity test, are used on fresh milk to indicate whether it will coagulate on processing. Milk that contains more than 0.21% acid, or calcium and magnesium compounds in greater than normal amounts, will coagulate in alcohol test. Clot-on boiling test measures the same characteristics as the alcohol test but is somewhat more lenient (0.22 to 0.24% acidity, as opposed to 0.21% for the alcohol test).

### *How can I assure pasteurisation efficiency?*

You can use phosphatase and lactoperoxidase tests depending on heat treatment applied in your plant. Lactoperoxidase enzyme is relatively heat stable; it is not inactivated by pasteurisation (72°C x 15 seconds) but is destroyed when milk is heated above 80°C. The absence of lactoperoxidase in milk indicates that the milk has been heated to at least 80°C. Alkaline phosphatase has a pH optimum near 9 and is inactivated by heating milk to 72°C for 15 seconds. Its absence indicates that milk has been properly pasteurised.

### *How can I make cheese from pasteurised milk?*

You can follow the same procedures and conditions as raw milk, but you should add calcium chloride and a suitable culture starter**.** Calcium chloride ($CaCl_2$) is added at the rate of 10 - 20 grams per 100 litres of milk (or 0.02% maximum) to restore the calcium level changed during handling and heating processes. Correct calcium level is required for proper coagulation using rennet. A starter culture in cheese making is a harmless, active micro-organism that by growing in cheese milk and curd assists the development of mature cheese with desirable characteristics of flavour, aroma, pH, texture and body. Starter is activated in sterilised skim milk and added at the rate of 1 - 3% of the quantity of cheese milk. The choice of starter depends on cheese type, cooking temperature and salting level.

### *How can I make milk and whey separation more efficient?*

Efficiency of separation is influenced mainly by four factors: the speed of the bowl, residence time in the bowl, the density differential between the fat and liquid phase and the size of the fat globules. Other factors that affect the skimming efficiency are the quality of the milk and maintenance of the separator. A mechanical stirring vat is illustrated below:

### *What are the kinds of chemicals used for equipment cleaning and sterilisation?*

Detergents are chemical agents that assist in the cleaning process by dissolving the deposited dirt, thereby making its removal easier. Sodium salts are the commonest and cheapest detergents. Sodium hydroxide is commonly used.

Chemical sterilisers are agents which, when added to water at a specific concentration, reduce the number of micro-organisms on previously cleaned surfaces to very low levels. The active sterilising ingredient is usually iodine, chlorine, nitric acid or quaternary ammonium compounds. In the absence of a suitable chemical steriliser, the equipment can be scalded with water at 80°C.

### *What are the effective procedures I have to follow for equipment cleaning?*

Before using any detergent or steriliser, remove as much of the dairy product as possible from the surface of the equipment. Following are the steps for cleaning and sterilisation:

1. Prewash the equipment with clean, cold water. Wash the equipment with warm water (50°C) to remove fatty material.
2. Wash the equipment with a detergent solution.
3. Drain the detergent solution. Rinse the equipment at least three times with clean cold water to remove all traces of the detergent.
4. Sanitise the equipment using one of the compounds mentioned above. Chlorine compounds are particularly corrosive and should only be used in accordance with the manufacturer's instructions.
5. Rinse the equipment again with clean water to remove all residues of the sanitising agent.
6. Once washed and rinsed the equipment should be stored in a clean, dry, dust-free area.

### *What preservatives can I use for milk?*

It is suggested to use the lactoperoxidase system approved by Codex. Formalin is illegal and affects consumers' health.

### *Sometimes I get an off-flavour when producing Domiaty Cheese?*

The reason could be that there is microbial contamination. See ***Dairy Sector Fact Sheet on Common Defects in Cheese*** for information on common cheese defects.

### *What are the types of Feta Cheese?*

There are two types of feta cheese currently available in the market; cast feta cheese made through ultrafilteration in modern dairy plants and an imitation of Feta cheese made by mixing skim milk powder, vegetable oils and other additives. This type is made by the informal sector and some traditional plants.

### *What do I do if the yoghurt produced has a flat taste and whey synersis defects?*

Yoghurt quality could be improved by using milk with higher fat and solid contents. Also, selection of a starter culture producing more viscosity and flavour compounds will improve the quality.

### *What are the procedures for Mozzarella Cheese Production?*

Mozzarella cheese could be manufactured with the same equipment and procedures used for Roumy cheese with some modifications. Maximum cooking temperature is about 38°C. The curd blocks at pH 5.2 - 5.4 are cooked and stretched in water at a temperature of about 80°C.

### *What do I do to avoid getting Domiaty Cheese with gas holes?*

The cheese could be contaminated with coliform bacteria, which indicates unhygienic conditions. It is suggested to improve the hygiene conditions, especially whey draining tables; a stainless steel whey draining table is shown below.