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NEW PRODUCT DEVELOPMENT FOR DAIRY INDUSTRY IN KOSOVO

KOSOVO CLUSTER AND BUSINESS SUPPORT PROJECT

February 2006
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NEW PRODUCT DEVELOPMENT FOR DAIRY INDUSTRY IN KOSOVO

Kosovo Cluster and Business Support project “New product development for Dairy Industry in Kosovo”
Contract No. AFP-I-00-03-00030-00, TO #800

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PURPOSE OF ASSIGNMENT

The purpose of this assignment is to help two dairy processors make an excellent quality "Gouda" type[1] of cheese during the high milk production period of the year in order to take more milk off the market at a higher price. Gouda is an excellent quality cheese that is currently being imported from Switzerland at a very high price. Kosovo can produce quality Gouda cheese that is cost competitive with the imported Gouda during the high milk production season.

BACKGROUND

The Kosovo dairy sector is poised to take a giant step forward in the increased production of high quality milk. This production must be accompanied by the manufacturing and marketing of high quality dairy products. The dairy sector is a prime example of how an industry must progress in terms of technology and systems or be left behind in the world market. To launch the dairy industry in Kosovo to the next level of competitiveness, a focused approach that introduces technology to the dairy processor is critical. Furthermore, the processing and distribution of high quality cheese products combined with aggressive marketing and promotion of their nutritional benefits is needed to stimulate demand for dairy products made from locally produced milk. The ability for the sector to grow and prosper must be based on improvements in cost efficiency and quality control at each level of the dairy sector from the farm through the processor to the consumer. It is only through the introduction of technologies at each of these levels that the Kosovo dairy industry will increase the internal demand for dairy products. In order to find the market for raw milk there is interest to invest on new processing technology for new cheese products required by the market. The test development has been completed with KCBS, market research has been completed and the demand for Gouda cheese currently is high in local market especially by supermarkets.

There are seven commercial dairy processing companies currently operating throughout Kosovo. These companies have a total processing capacity of 55,000 liters of milk/day, but with potential to increase processing capacity to 100,000 liters/day with minor upgrades to existing equipment. Companies currently process from 30,000 liters a day of the largest, to 1,000 liters a day of the smallest and they supply a limited range of dairy products to the domestic market. Since the market is substantially served by imports, their immediate goal is to compete effectively with the imported products. The improvement of production and quality of raw milk in farms is increasing the needs for processors to research the possibilities to develop new dairy products that are currently imported, and to produce the same products with competitive price and high quality.

At present the quality of products ranges from poor to excellent. All processors have demonstrated the ability to produce high quality milk products and at present they produce a mix of packaged fluid milk, soft and firm yogurts, cheese and cream.

[1] The word "gouda" is defined as a special yellow cheese made in Germany.

EXECUTIVE SUMMARY

This final report is a compilation of interim reports, reports on the activities from meetings and visits to various organizations during my 12-day consultancy in Kosovo from February 6th to February 18th 2006.

The report contains the following documentation:

- Field visits to two dairy processors and making of an excellent quality Gouda & Cheddar type cheese and visits to six milk collecting centers
- General procedure for new product development
- Procedure for making Gouda and Cheddar cheese
- Recommendations on use of the new starter culture for improving the consistency and taste of semi-hard cheeses and new packing material
- Standards and inspection forms for milk collecting center

Potential of Kosovo dairy processing industry is great to improve position of the market and compete with import dairy products. In process of milk quality improvements and implementation of EU standards, new product development is first step to the export market. With high quality and standardized dairy products Kosovo can became competitive with imported dairy products.

New packing is one of the crucial parts. If they want to be competitive on the dairy market they have to reduce costs of production, improve packing and increase yields. Also dairy processors have to change the packing material and label. With new packing material they will reduce mould and yeast growing, increase yield, improve visual aspect of packing and increase competitiveness on dairy market.

Using sheep and goat milk in cheese production can be next step of increasing assortment of dairy products. Cheese made from sheep milk can be excellent product for export market. High price of sheep cheese on the world market and market demand for it can be future target for dairy industry in Kosovo.

The collecting centres for raw milk we visited in the villages satisfy basic hygienic criteria for collecting raw milk. Most of the milk collecting centres now operate profitably and they are independent. Situation is not satisfactory for milk testing at the milk collecting centres because there is no independent laboratory which will collect samples from all milk collecting centres and provide services to dairy plants, milk collecting centres and farmers. Now most of testing is done at milk collecting centres with no approved standard methods.

FIELD ACTIVITIES

Monday 06/02/06

Places of activities: KCBS office.

A schedule of activities for carrying out the projected tasks was agreed on the first working day at the meeting in the KCBS office. All the necessary technical pre-requisites for work were discussed. The goal is new product development of Gouda cheese and increase profitability of production. The training will have theoretical and practical part for the workers and printed education materials will be issued.

For implementation of the project, the following dairy plants were chosen: Rona-Ferizaj and Ajka-Prizren.

For second week, our plan is to visit milk collecting centers and dairy plants and also to cheek cheese fermentation. At the meeting it was also agreed that the project would consist off evaluation of milk collecting centers.

Each collecting centre will be visit and evaluate by questionnaire:

- Cleaning procedures
- Cleanles
- Toilet and Water supply
- Utensils and equipment
- Transfer and protection of milk
- Personnel
- Cooling
- Milk testing
- Record- Traceability
- Pest Control

In the afternoon we had a meeting with the owner of Ajka, Mr. Ramadan. We inform the manager of the planned activities of the project. On the meeting next topics were discussed:

- New product development
- Payment system (Will customers pay the right price)
- Customers demands
- Possibilities of selling the product

Tuesday 0702/2006

Places of activities: Rona

We inform the manager of the planned activities of the project Mr. Skifter gave us the following data for their process: the dairy plant produces white cheese and yellow cheese-kashkaval; they collect around 4.000 liters daily from 100- 150 farmers and they do not have payment system according to microbiological quality. Due to the problems with the quality of raw milk, they showed interest in establishing a system for payment according to the microbiological quality.

We made two cheese varieties: Gouda and Gouda with spices.

For making cheese we used same equipment for making kashkaval with some modification. Before starting we clean the equipment with NaOH and disinfected it with chlorine. After milk pasteurization (71°C, 5min), 200 L of milk was transfer in cheese vat. We used CHN-19 as

starter culture which is combination of 4 different cultures. All process was finished at 4.30 p.m. when the cheese curd was transfer in two deferent forms and pressed. Part of cheese curd was mixed with spices before it was pressed. The pressing continued until pH was 5.2. When cheese acidity was (pH 5.2), the cheese was transfer in brine (20%) for 24h /kg.

The written material with general procedure for cheese making and procedure for making Gouda was given.

Before we left it was given recommendation for cheese fermentation and packing.

Wednesday 08/02/2006

Places of activities: Rona

Before we start we cheek the cheese which was made one day before. The cheese was still in the brine.

We discussed with the owner of dairy plant how to standardize product and increase yield.

Before we start with milk processing we check milk on chemical parameters:

- Acidity 18°
- Fat - 4.07
- S- 8.28
- Density - 28.43
- Protein - 3.20
- Added water-3.22 %

The procedure for making cheese was same like the day before. My responsibility was to control the process and give recommendation during the cheese making process.

General Procedure for cheese making is:

- Handling Rennet
- Milk preparation
- Cutting the Curd
- Determination of curd cutting time
- Curd size
- Manual cutting
- Cooking
- Draining
- Washing
- Curd Handling
- Pressing
- Salting
- Ripening processes: chemical and physical changes
- Packaging
- Factors Affecting Yield
- Ingredients labeling
- Producing food safety products- HACCP

Thursday 09/02/2006

Places of activities: KCBS & Ajka

Meeting with the representative of dairy plants: ABI, Devoli, Ajka, Rona, Bilmety. We discussed for opportunity of sheep milk collection and export to Greece. Every year 3 million liters of sheep milk is exported from Macedonia. The sheep milk was paid 0.56 cents per one liter to local farmers. There is a lot of demand for sheep milk in Greece. Because the local dairy plants are not interesting in sheep milk processing, to increase profitability of local farmers a good opportunity is to collect sheep milk and export it in Greece.

After the meeting Mr. Ramadan who is the owner of dairy plant Rona we went to Prizren were his plant is located.

We made preparation for next day and check the equipment. They already had experience in Tilset production and all necessary equipment for Gouda production. He bought second hand equipment from Switzerland. He sells Tilset cheese at local store but the price is to high-7.5 € per kg.

One of the reasons why they can not sell more cheese is packing. Packing and labeling are very inadequate. If they want to be competitive on the dairy market they have to reduce cost of production, improve packing and increase yield. Also he has to change the packing material and label. With new packing material he will reduce mould and yeast growing, increase yield, improve visual aspect of packing and increase competition on the market.

Friday 10/02/2006

Places of activities: Ajka

Regarding previous agreement we made cheese from 220L of milk.

We use KCBS Lactoskan for milk testing.

- T=25.8 C
- PH=5.58
- Fat= 4.59%
- Density = 23.26
- L= 3.62
- Pr. = 6.93
- Added water=19.44%

Owner has lot of experience in Tilset cheese making and in the future Rona can be plant for developing new type of cheese and can become very competitive. For cheese making we used the same equipment for making Tilset. We only changed forms for cheese pressing. Milk was pasteurized on 72ºC for 5min.After pasteurization milk was transfer in cheese vat. Procedure for cheese making was the same like in Rona. When cheese curd was ready it was filled in forms and pressed until pH was 5.2. After pressing cheese was transfer in brine (20%) for 24h. At the end of the day we demonstrated to the owner new packing material, which are used in most cheese factory in the word, especially for processing high quality products. With new packing material they can improve product quality, reduce growing of yeast and mould, increase yield and improve market competition.

For all procedure of cheese making, we issued printed material.

At the end of the day I explained using new mix of starter culture. New starter culture is mixtures of *Streptococcus lactis, Leuconostic cremoris* and *Streptococcus diacetylactis.* With new mixture it will need less time for aging and cheese will be ready for selling after 1 month.

Saturday 11/06/06

Meeting at the office with Zijadin and writing educational material for cheese processing procedure.

Monday 13/02/2006

Places of activities: Rona, Ajka, Prizren

During our visit to dairy plant Rona and Ajka we checked cheese and aging process. The owner of the dairy plant Ajka informed us that the yield of cheese is 8.5 litters per kg. We discussed for factors affecting yield. Milk casein is the principal yield-determining factor. Casein contributes absorbed water and minerals as well as its own weight. Cheese quality limits the ratio of moisture/casein, a ratio which corresponds to MNFS. Fat is also a principal yield component. Fat interferes with sunrises and, therefore, also contributes more than its own weight, but if other conditions are adjusted to maintain constant MNFS, then fat contribution to yield is dependent only on the conversion factor of fat from milk to cheese (i.e., fraction of milk fat recovered in the cheese). 1% increase in Cheddar cheese moisture causes about 1.8% increase in cheese yield, partly because more moisture means more whey solids and salt are recovered in the cheese (e.g., given 90 kg cheese/1000 kg milk, a moisture adjustment to 36% would result in 91.6 kg cheese/1000 kg milk). An extra 0.1% salt means an extra 0.14% yield of Cheddar cheese if the moisture content is increased appropriately. Milk quality factors are: somatic cell counts, psychotropic bacteria, protein quality etc. Increasing time and temperature of milk pasteurization increases cheese moisture, retention and the recovery of whey proteins and soluble solids. There is no consensus on how much is desirable but it's safe to say that it depends on the type of cheese and the quality standards of the manufacturer.

Process control parameters:

- Careless cutting
- Heating too fast at early stages of cooking
- Salting too soon after milling of Cheddar allows rapid salt uptake, which in turn causes rapid synerisis and increased solubility of casein. Yield is, therefore, reduced by losses of protein, fat and soluble solids.
- High temperatures during pressing causes loss of fat.
- Proteolytic cultures or coagulating enzymes cause protein losses before and after cutting.
- Washing removes soluble solids.
- Working as in Mozzarella processing removes fat and soluble solids. Loss of soluble solids is minimized by equilibration of the wash water with the cheese moisture.

Principles of yield optimization

With respect to yield the cheese maker's objectives are to:

- Obtain highest MNFS (moisture in non-fat substance) consistent with good quality to maximize moisture and the recovery of whey solids
- Standardize milk to obtain maximum value for milk components consistent with good quality (e.g., adjust P/F to maximize cost efficiency).
- Minimize losses of fat and casein in the whey

Tuesday 14/02/2006

Trip to Macedonia –Skopje

We took forms and starter culture for making cheddar cheese. In the afternoon we visited dairy plant Disi-Milk and we had a meeting with Mr. Saso who is the owner of the plant. They also produce mozzarella which they sell in restaurants for 4.5 €.He explained that the price is very good and he is satisfied with it. Next step will be to sell mozzarella at Vero and Tinex. Now he is looking for a new packing for mozzarella because this type of cheese has to be pack in brine. It can be done in Kosovo because nobody produces fresh mozzarella for the restaurants.

Wednesday 15/02/2006

Visit to the milk collecting centers:

Durakovac:

We had chance to speak with person who is responsible for milk receiving and testing. They have equipment for testing the acidity and fat. Milk collecting center is in very good shape. The cleaning of the premises, equipment for intake of milk and utensils is done by using ordinary detergents for home cleaning and without use of proper brushes for cleaning the equipment. Disinfection of the premises and equipment with proper chemicals is not applied.

Also the pump is not made from stainless steel and it could cause a problem for cleaning and disinfection.

Istog:

During our visit we had met Halil Bulyciho who is responsible for intake of milk at the collecting centre and he gave us the following data: the collecting centre daily delivers around 2000 liters of milk to Abi and Goljaj dairy plant; the milk is collected from 125 farmers; the price of the milk is determined by the percentage of milk fat and added water in the collected milk. Only alcohol test with 75 % alcohol is performed at the intake of the milk for determining the freshness of the milk. Separate test of each farmers are performed incidentally and irregularly.

They pose 2 x1100 L, before receiving milk is tested for acidity and fat.

Lazan:

Association- Agro flora

Mr.Brahim Mulaj is responsible person for managing the milk collecting centre. He gave as the following data: the milk collecting centre collects 1200L per day. They have capacity to collect 2000L of milk. The premises satisfy the basic hygiene criteria for collecting of raw milk: floor is covered with ceramic plates, cold and hot water is provided, drainage for waste water and basic equipment for maintaining the hygiene at the premises. Milk is stored in lacto freezer and it is kept on proper temperature until dispatch. For determination of the milk quality only the alcoholic test with 75 % alcohol is applied. The cleaning of the premises, equipment for intake of milk and utensils is done by using alkali and acid solution.

Hygiene is on very high level and they possess written instruction for all procedure. Also they check milk on microbiological status using the method with “blue metilen test”.

Raushic:

The owner is Bedri Kastrati. Milk collecting centre is new and they are in process of starting with milk receiving. Equipment is also new and it is the only milk collecting centre equipped with milk filter.

Thursday 16/02/2006

New product development -Cheddar cheese

We made cheddar from 200L of milk. For making cheese we used the same equipment for making kashkaval. After pasteurization we used mix from two starter culture *Streptococcus lactis* and *Leuconostic cremoris*. After curd cooking and salting (2%) curd was transfer in forms. For pressing we improvised, because for pressing we needed pneumatic equipment. (172 kPa)

During all process we discussed with owners for deference between Gouda and Cheddar cheese. The owners are interested for new packing bags supplier. Most of imported cheese is packing in the same materials. During the day some forms of cheese were packed in red color paraffin. That type of packing is excellent for aging cheese and to be recognized by the costumer like high value product.

During the day we visited milk collecting centre in Lepine. They did not collect milk and most equipment which was donated from other project was missing.

Before we left dairy plant we took cheese samples.

Friday 17/02/2006

Writing report and preparing material for meeting with USAID. At the meeting we presented cheeses, which were made at Dairy Plants Ajka and Rona. During discussion we exchanged same ideas for next step.

We had another meeting with Mr. Ramadan who is the owner of dairy plant Ajka and we exchanged same ideas for future activities.

Saturday 18/02/2006

Writing report and visit to dairy plant Rona to check cheese after pressing.

TASK FINDINGS AND RECOMMENDATIONS

1. Results of work with two dairy processors to develop commercial processing of "Gouda" cheeses made from locally produced milk.

Two dairy processors were trained to made Gouda cheese and one of them was trained for Cheddar. At Rona dairy plant we made Gouda cheese and Gouda with spices from 380 liters (42 kg cheese) of milk and 220 liters of milk for making Cheddar (25kg cheese). At Ajka dairy plant we made Gouda and Gouda with spices from 180 liters of milk

The written material with general procedure for cheese making and procedure for making Gouda was given.

2. Details on assistance provided to processors with changes in operations, tools, management and marketing that is necessary to implement commercial processing of Gouda cheese.

The following changes and instruction was provided to both dairy plants:

How to increase production yield:

- Milk casein is the principal yield-determining factor. Casein contributes absorbed water and minerals as well as its own weight. Cheese quality limits the ratio of moisture/casein, a ratio which corresponding to MNFS.
- Fat is also a principal yield component. Fat interferes with syneresis and, therefore, also contributes more than its own weight, but if other conditions are adjusted to maintain constant MNFS, then fat contribution to yield is dependent only on the conversion factor of fat from milk to cheese (i.e., fraction of milk fat recovered in the cheese).
- Cheese moisture. A 1% increase in Cheddar cheese moisture causes about 1.8% increase in cheese yield, partly because more moisture means more whey solids and salt are recovered in the cheese (e.g., given 90 kg cheese/1000 kg milk, a moisture adjustment to 36% would result in 91.6 kg cheese/1000 kg milk)
- Cheese salt. An extra 0.1% salt means an extra 0.14% yield of Cheddar cheese if the moisture content is increased accordingly.
- Milk quality factors: somatic cell counts, psychotropic bacteria, protein quality etc.

Increasing time and temperature of milk pasteurization, increases cheese moisture retention and the recovery of whey proteins and soluble solids. There is no consensus on how much is desirable but it's safe to say that it depends on the type of cheese and the quality standards of the manufacturer.

Principles of Yield Optimization

With respect to yield the cheese maker's objectives are to:

- Obtain highest MNFS (moisture in non-fat substance) consistent with good quality to maximize moisture and the recovery of whey solids
- Standardize milk to obtain maximum value for milk components consistent with good quality (e.g., adjust P/F to maximize cost efficiency).
- Minimize losses of fat and casein in the whey

3. Recommendations on the appropriate production process, equipment, management, marketing and packaging for new cheeses for commercial processing.

Cutting the Curd:

Proper cutting is extremely important to both quality and yield. Improper cutting and handling the curd results in the loss of fines that means small curd particles which are not recovered in the cheese. Unlike whey fat, fat trapped in fines; is not recovered by whey cream separation. Therefore, both fat and protein losses occur when shattered curd results in fines too small to be recovered in the cheese.

Determination of curd cutting time:

Both early cutting when the curd is fragile and late cutting when the curd is brittle cause losses of fines. Several means are used to determine cutting time.

Manual testing:

The curd is ready to cut if it breaks cleanly when a flat blade is inserted at 45o angle to the surface and then raised slowly.

Some plants cut by the clock. This may be OK as long as all conditions are uniform from day to day and adjustments are made for any change in milk composition or properties.

If setting temperature is high as for Swiss types, the curd firms rapidly and cutting must begin early when curd is still somewhat soft to prevent over setting. Agitation should begin immediately to prevent matting.

Curd size:

Curd size has a great influence on moisture retention. Hence, there is an obvious relationship between cheese moisture and the prescribed curd size:

High temperature and low moisture varieties such as Italian hard cheese require the smallest curd. Cutting continues until the curd cutting is the size of rice grains.

Medium moisture cheeses like most washed varieties and Cheddar are cut to Omega cm cubes.

High moisture varieties like soft ripened cheese are cut with 2 cm knives or the curd is simply broken sufficiently to be dipped into forms.

Small curd size will result in greater fat and SNF recovery because large curds tend to get crushed resulting in the loss of 'fines'. Smaller curds will also dry out faster and, therefore, other factors such as cooking temperature and stirring out may have to be adjusted according to curd size.

Manual cutting:

Manual cutting is done with cutting harps, made by stretching stainless steel wire over a stainless steel frame. Total cutting time should not exceed 10 minutes (preferably less than 5 minutes) because the curd is continually changing (becoming overset) during cutting. The knives should be pulled (not pushed) quickly through the curd so has to cut the curd cleanly.

Automated cutting:

With mechanical knives, curd size is determined by the design of the vat and agitators, the speed of cutting (rpm) and the duration of cutting. In Double 'O' vats for Cheddar and American varieties, cutting is normally at a speed of about 4 rpm for 7 - 13 minutes, corresponding two a total of 30 to 50 revolutions. It is important that the knives are sharp and cut the curd cleanly rather than partially mashing the curd or missing some pieces altogether.

There is evidence that curd particle size at draining in mechanized Cheddar cheese is influenced by cutting time, cutting speed, and subsequent agitation such that:

Short cutting times and low rpm result in small particle size at draining and larger losses of fines.

With increasing cutting time (more total revolutions), curd particle size at draining reaches a maximum which corresponds to a maximum in fat recovery.

Further increased cutting time causes decreased curd size at draining with little effect on fat recovery.

Healing:

Curd should be agitated gently or not at all after cutting to prevent formation of fines. The exterior of the freshly cut curd is fragile so some time is needed for the edges to close up (heal) and prevent the loss of fat and protein to the whey.

Cooking:

The combination of heat and the developing acidity (decreasing pH) causes syneresis with resulting expulsion of moisture, lactose, acid, soluble minerals and salts, and whey proteins. It is important to follow the cooking schedule, closely. Cooking too quickly causes the curd to shatter more easily and forms a tough exterior on the curd particles which prevents moisture release and hinders development of a smooth texture during pressing

Draining:

Most cheese is drained in the range of whey pH 6.1-6.4 (curd pH 6.0 - 6.3). Draining time should be uniform at about 20 min to prevent variation from vat to vat. Cheddar types may be stirred out 1 to 3 times as required to obtain required curd moisture.

Washing:

Lactose content can be adjusted by moisture removal (syneresis), fermentation, or leaching with water. By leaching lactose with water it is possible to make a high moisture cheese (such as brine brick or Muenster) and still achieve a final pH of about 5.0 - 5.2. The temperature of the wash water will determine the moisture content of the curd. Sometimes relatively hot water (e.g., Gouda) is used to dry the curd and develop its texture.

Traditionally washing was accomplished by removing Omega to 2/3 of the whey and replacing it with water and agitating for about 15 min. This process results in the dilution of large amounts of whey which must be re-concentrated or dumped. It also creates problems where curd tables have less capacity than setting vats. The solution is to remove more whey and add less water

Curd Handling:

Most brine or surface salted varieties are dipped directly into the forms or pressed under the whey. In the absence of salt, the curd is fused to form a smooth, plastic mass. The hoops are turned at regular intervals to promote uniform drainage, symmetrical shape, and a smooth finish.

Some varieties such as Gouda and Swiss are pressed under the whey before draining. This encourages formation of smooth texture and prevents incorporation of mechanical openings in the cheese due to trapped air or pockets of whey.

For Cheddar, American, varieties the curd is kept warm in the vat or drain table and allowed to ferment to pH 5.2 -5.4. Cheddar and American varieties are salted in the vat.

Pressing:

Pressing varies from little or none for soft cheese up to 172 kPa for firm Cheddar cheese. The warmer the curd, the less pressure is required. Mechanical openings may be reduced by vacuum treatment before, during or after pressing.

Salting:

Almost all cheese is salted by one of three methods: before pressing as in Cheddar and American varieties, surface salting after pressing, or brine salting.

Purposes of Salting

Promote further syneresis

Slow acid development

Check spoilage bacteria. Lactic are more salt tolerant than pathogens and spoilage bacteria.

Promote controlled ripening and flavor development.

Salty flavors

Brine salting:

Concentration 16 - 25% NaCl

Time:

20 kg cheese, 5 days or sometimes several weeks

3-5 kg, 24 h

250 - 350 g, 1 - 4 h

New brine should be treated with about 0.1% of CaCl2 to prevent conversion of calcium and hydrogen caseinate to sodium caseinate. The latter has high water holding capacity, so the cheese takes up water from the brine and the cheese surface becomes soft and slimy.

Brine pH should be adjusted to the pH of the cheese. Normally a pH of 5.2 - 5.6 is adequate.

If the pH is too high, ion exchange causing sodium caseinate is encouraged.

If the pH is too low, there is insufficient Ca/Na exchange and the cheese is too hard and coarse.

Brine must be cleaned regularly by filtration, preferably micro filtered. UV sterilization combined with filtration is also used.

Brine must be continuously agitated to prevent density fractionation (lower concentration brine on top) and dilution of the brine around the cheese.

If cheese is floated rather than immersed in the brine, the exposed surface of the cheese should be drying salted.

Not pushed) quickly through the curd so has to cut the curd cleanly.

Packing:

Vacuum shrinking packing is strongly recommended. Vacuum and/or gas flush (N2 and CO2) in gas and moisture proof films are common. Vacuum alone is not recommended because complete evacuation of oxygen is difficult and small unsightly mould spots often appear.

Gas flush with CO2 or blends of CO2 and N2 effectively prevent mould growth.

CO2 is water soluble so it is absorbed into the water of the cheese and the package becomes tight.

N2 which is not water soluble is useful for applications, such as shredded cheese and cheese curd, where a loose package is desired.

The next step is to develop a marketing plan that targets wholesale buyers, retail buyers, and consumers.

Marketing is an ongoing function of business you should never stop gathering information about your consumers and buyers. Staying abreast of new market trends enables you to react quickly to changes in consumer demands.

These days, consumers are health conscious. They read labels with great interest, paying attention to nutritional information. Producers who understand and adapt to market demands for healthy products will stay profitable, while others will lose their share of the market. Take a trip down the food aisles and you will see labels that announce products that are organic, salt free, low fat, etc. The makers of these products are all responding to market demand. Market demand is consumer driven: consumers demand and producers and retailers respond. From your initial notion that you might have a saleable product until the time you retire from business, you must constantly be attuned to the market.

The goal of your marketing plan will be to realize maximum profits by finding the right combination of the elements of the Four P's: product, price, placement, and promotion. '

Promotion:

In order to sell your product, promote it to wholesale buyers and to consumers through a combination of efforts: public relations, advertising, and sales promotions. There are two target groups to reach: those who would buy the product for resale, and the consumers who will buy the product directly from you or from retailers. Each target group can have a specific type of promotion.

4. Results of visits to 10 milk collecting centers. Identification of the best milk collecting center in order to recommend as a model GMP implementation, what centers should have, what are the needs before implementation of a standard. List of the items and procedures that MCC should implement in order to completed standard

Evaluation of current situation on milk collecting centre level:

The collecting centres for raw milk we visited in the villages they satisfy basic hygienic criteria for collecting raw milk:

The floor is covered with ceramic plates, cold and hot water is available, waste water disposal and basic equipment for maintaining the hygiene of the premises is also available. The milk is store in lacto freezers where it is kept on proper temperature until delivery to the dairy plant.

For determination of the milk quality only alcohol test is performed with 75% alcohol or titration method with NaOH and indicator colour.

Cleaning of the premises, equipment for intake of milk and utensils is done with ordinary detergents for domestic use and disinfection of the premises and equipment with proper chemicals is not performed.

The temperature of the milk at the intake is not controlled. We also noticed that most of the farmers are transporting the milk in inadequate vessels, with narrow hols where visual control can not be applied.

List of the items and procedures that MCC should implement in order to completed standard,

see Annex 1

5. Recommendations with exact steps to follow up in order to implement model GMP in one Milk collecting center (MCC).

Most of milk collecting centers possess basic requirements.

My recommendations are:

- Categorize all milk collecting centers in category according to milk collection inspection form. (Annex 1)
- Prepare list of equipment that are not used for food and have to be replaced.
- For each of milk collecting centre prepare list of improvements which have to be done.
- Provide formal training for all employees at milk collecting centre for GMP and basic training for milk testing (chemistry and microbiology)
- Visit all three category of milk collecting centre to confirm improvement which was done.
- Prepare list of recommendation for each collecting centre.
- One month after giving the recommendation, choose and nominate the model of GMP MCC

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

During the project implementation, I have developed new cheeses at 2 dairy processors in Kosovo. Based on results and working directly with the processors, I came to the following findings:

In future, dairy processors have to concentrate on increasing assortments of dairy product. Regarding the market requirement, processors will have to make an effort to replace imported dairy products with domestic ones. Local processors in future will not have to copy imported dairy products. Most important is the development of domestic brand and promoting. I strongly recommend working with sheep farmers to increase sheep milk production and in future standardize the original type of cheese like Sara cheese, and develop new type of cheeses, which will be made from sheep and cow milk.

My recommendations for future activities are:

1. Working with dairy plant to increase assortment of dairy product. In same period of time working also with sheep farmers to standardize cheese production at farms, increase production of sheep and goat milk. It will be excellent if dairy plant or farmers receive some donation in equipment like forms for cheese pressing which will help them in standardizing cheese production and improve visual aspect of products.
2. Packing improvements have to be done together with new product development. If processors want to be competitive on the market they have to implement new packing technique. With present packing material most cheese products are not attractive to customers and can not compete with imported dairy product. Next, you have to consider the consumers. Your market research has identified your target consumers. You need to keep this profile in mind when you design your package and your label. The package should relate to the product. The consumer should be able to tell what the product is, based on the type of package: box, jar, bottle, plastic jug. Your market will also determine the package. If your product is sold primarily as a gift, it may require a slightly different presentation than a product sold primarily in a food store alongside mass marketed products. The packaging should give consumers an idea of the cost of your product. If you have a slightly higher retail price, your packaging should reflect that. It implies that the product is a specialty item, and consumers will expect to pay a bit more. The way the product will be used may influence decisions about the flexibility, the overall size, the closure, and other such issues. Availability and shipping costs are also a consideration. Also think about store display. Shelf space is limited, and some grocers and retailers will have requirements for your product. If your package deviates from the standard shelf height for products like yours, you may find it hard to get your product into certain stores. Talk to retailers, grocers, and distributors and talk to the container manufacturer about these issues.
3. In order to sell your product, promote it to wholesale buyers and to consumers through a combination of efforts: public relations, advertising, and sales promotions. There are two target groups to reach: those who would buy the product for resale, and the consumers who will buy the product directly from you or from retailers. Each target group can have a specific type of promotion. After period of time when will be increase domestic cheese production can be organize one per yare promotion of deferent type of cheese. Is very important on promotion have to be involved small cheese producers from sheep and goat milk. Same promotion can be use to make

promotion of lamb meat- cheese and lamb which is unique products from Balkan region and first stapes promotion for export. All cheese has to be control by Government Vet. services

4. Next step will be making market research of other country to get information of dairy products and prices. All information can be used by local processors to get more information for competition if they want to export dairy products. Trade shows can be a great way to get your product into the hands of consumers, retailers, buyers, and brokers. But before you sign up for a trade show, you must evaluate a number of issues:
   - What is the cost of doing the show?
   - Will it allow you to reach your target audience?
   - Review your production capability could you fulfill the increased number of orders you might get?
   - How does the show fit into your marketing plan and your business plan?
5. What impact will the show have on your cash flow and production projections?

   One of the best ways to learn about specific shows and to gather general information about trade shows, competitors, and the industry is to go to a show as a visitor. Walking the aisles and talking to some of the exhibitors is time well spent. There is no better way to prepare yourself than to see what you are up against. Attend a specific show that you are thinking of exhibiting in. If you can arrange to visit the show before you sign up, you will learn a lot about how to showcase your product. There are different kinds of trade shows and exhibition opportunities. At retail shows, you sell directly to the consumer. At wholesale trade shows, you will sell to buyers. Some regional and local shows will allow both retail and wholesale sales, but on separate days. A retail show will allow you to expose your products to consumers and to sell to them at retail prices. The net effect is more revenue per unit, but no real market penetration in terms of establishing retail outlets for your product. Selling well will help you establish that there is consumer acceptance for your product. And selling at a retail show will help you to understand pricing and consumer reactions. The advantage of a wholesale trade show is that you are meeting and selling to the trade, which will help you to get your product placed in retail locations. You may not make as much money in the short run, but you are building your business and trade awareness of your product. Trade shows also provide an opportunity for doing some valuable market research. For beginning of export promotion use already existing fair in other country like Ohrid cheese and vine festival to promote same dairy products.

ANNEXES

ANNEX I: MILK COLLECTION CENTER INSPECTION FORM

1. CLEANING FACILITIES

- Two-compartment wash and rinse vat of adequate size
- Suitable water heating facilities
- Water under pressure piped to milk collection center

2. CLEANLINESS

- Floors, walls, windows, tables, and similar non-product contact surfaces clean
- No trash, unnecessary articles, animals or fowl

3. TOILET AND WATER SUPPLY

Toilet:

- Provided; conveniently located
- Constructed and operated according to Ordinance
- No evidence of human wastes about premises
- Toilet room in compliance with Ordinance

Water Supply:

- Constructed and operated according to GMP
- Complies with bacteriological standards
- No connection between safe and unsafe supplies; no improper submerged inlets

4. UTENSILS AND EQUIPMENT

Construction:

- Smooth, impervious, nonabsorbent, safe materials; easily cleanable; seamless hooded pails
- In good repair; accessible for inspection
- Approved single-service articles; not reused
- Utensils and equipment of proper design

Cleaning:

- Utensils and equipment clean

Sanitization

- All multi-use containers and equipment subjected to approved sanitization process

Storage:

- All multi-use containers and equipment properly stored
- Stored to assure complete drainage, where applicable

Single-service articles properly stored

5. TRANSFER AND PROTECTION OF MILK

Protection from Contamination:

- No overcrowding
- Product and CIP circuits separated
- Improperly handled milk discarded
- Immediate removal of milk
- Milk and equipment properly protected
- Sanitized milk surfaces not exposed to contamination
- Air under pressure of proper quality

Chemical Control

- Cleaners and sanitizers properly identified
- Drug administration equipment properly handled and stored
- Drugs properly labeled (name and address) and stored
- Drugs properly labeled (directions for use, cautionary statements,
- active ingredient)
- Drugs properly used and stored to preclude contamination of milk

6. PERSONNEL

Hand-Washing Facilities:

- Proper hand-washing facilities convenient to milking operations
- Wash and rinse vats not used as hand-washing facilities

Personnel Cleanliness:

- Hands washed clean and dried before start working, or performing milk house functions; rewashed when contaminated
- Clean outer garments worn

7. COOLING

- Milk cooled to 8C or less within 2 hours after receiving milk.
- Recalculated cooling water from safe source and properly protected; complies with bacteriological standards
- An acceptable recording device shall be installed and maintained when required

8. MILK TESTING

- Acidity
- Inhibitors
- Chemistry
- Microbiological
- Sediments
- Samples of milk are testing in other laboratory

9. RECORD –TRACEABILITY

Records are available for each farmer

Record is keeping for one year

- Written procedures (milk receiving ,testing ,coding ,cleaning)

10. PEST CONTROL

Insect and Rodent Control:

- Fly breeding minimized by approved manure disposal methods
- All milk house openings effectively screened or otherwise protected; doors tight and self-closing; screen doors open outward
- Milk house free of insects and rodents
- Approved pesticides; used properly
- Equipment and utensils not exposed to pesticide contamination
- Surroundings neat and clean; free of harborages and breeding areas
- Feed storage not attraction for birds, rodents or insects

ANNEX II: GENERAL PROCEDURES

NEW PRODUCT DEVELOPMENT - Gouda

Date: 07.02.2006

KCBS: Zijadin Gojnovci

Consultant: Vladimir Kokarev,

FAMILY: Semi-hard Washed Cheese

Varieties: This is the largest and most diverse group of cheese including Gouda, Edam, Colby, Brick, Montasio, Oka, Muenster and many others.

pH Control: The distinguishing feature of this cheese is the practice of washing to remove lactose. Part or all of the whey is removed and replaced with water to leach lactose from the curd. The objective is to limit the amount of lactose to a level which permits sufficient lactic acid development to produce a minimum pH of 5.0 - 5.2, but not enough to ferment and produce cheese pH less than 5.0.

Moisture Control: The amount of syneresis is controlled mainly by the temperature and time of cooking and by the temperature of the wash water. Higher temperatures during cooking or washing cause the curd to contract and expel moisture. Also, important are the rate of acid development and salting treatments. Washed curd cheese typically has moisture contents of 40 - 50%. With few exceptions, such as, part skim Mozzarella, production of a rennet coagulated cheese with a moisture content of 40% or greater requires a washing treatment to remove the substrate for lactic acid fermentation, i.e., lactose.

Curing: 2 weeks up to 9 months

Type	Cheese	Moisture	Protein	Total Fat	Total Carbohydrate	Fat in Dry Matter	Ash	Calcium	Phosphorus	Salt	pH1
Semi-hard Washed	Colby	40.0	25.0	31.0	2.0	51.7	3.4	.68	.46	.65	5.3
	Gouda	41.5	25.0	27.4	2.2	46.9	3.9	.70	.55	.82	5.8
	Edam	41.4	25.0	27.8	1.4	47.6	4.2	.73	.54	.96	5.7
	Fontina	42.8	24.2	25.5		44.6	3.3			1.2	5.6
	Havarti-	43.5	24.7	26.5		46.9	2.8			2.2	5.9
	Danish	41.8	23.4	30.0	1.1	51.6	3.7	.72	.47	1.8	6.2
	Munster										

GENERAL PROCEDURE:

Handling Rennet

- Repeatable performance depends on accurate measurement. For most varieties the quantity of rennet is selected to set the milk to a firm coagulum in 30 - 40 min. Measure the rennet accurately and monitor to ensure that coagulation rate is uniform from day to day.
- Rennet must be diluted (about 20 times) in water and well mixed when added to ensure uniform distribution.
- Use nearly the same dilution each time to improve the consistency when adding the diluted rennet to the vat.
- Watch out for chlorine. It is imperative that the dilution water contains no chlorine. Only 2 ppm of chlorine will destroy 40% of rennet activity in 3 minutes. Similarly, do not sanitize the container used for the rennet with chlorine.
- Another water quality issue is pH. Typically hard water also has pH greater than 7.0 which also decreases rennet activity.
- Finally, dilute immediately before adding the rennet to the vat. After the brined rennet is diluted in water, its activity declines quickly.

Milk preparation

Here are the principal considerations:

  - Pasteurization temperature: higher temperatures increase yield by increased recovery of whey proteins, but a suggested maximum with respect to curd quality is 72C, 5min.
  - Temperature history: if the milk is pasteurized and immediately sent to the setting vat, it will be necessary to adjust the mineral balance by adding calcium chloride.
- The jury on selection of coagulant always seems to be out. I tentatively suggest that microbial coagulants are not advisable for high temperature varieties for reasons of heat stability and not advisable for other varieties unless other setting and conditions are under tight control. The preferred choices, then, are rennet and recombinant rennet.

- The amount of rennet must be carefully determined. Because rennet is costly, it is desirable to minimize its use, but this can be false economy if curd properties are compromised. Poor setting means increased losses of both fat and protein as fines.

- Temperature control must be accurate and uniform through out the vat, because both the enzyme activity and the subsequent process of micelle aggregation are extremely temperature sensitive. Inaccurate or no uniform temperature during setting will result in local areas of under or over set curd which in turn causes loss of fines during cutting.
- Soft curd results from:
  - Over heat treatment
  - Low setting temperature
  - Homogenization
  - Colostrums or mastitis milk
- Firm curd results from:
  - High calcium
  - Low pH
  - Standardization to high protein content

Cutting the Curd

Proper cutting is extremely important to both quality and yield. Improper cutting and handling of the curd results in the loss of fines which means small curd particles that are not recovered in the cheese. Unlike whey fat, fat trapped in fines; is not recovered by whey cream separation. Therefore, both fat and protein losses occur when shattered curd results in fines too small to be recovered in the cheese.

Determination of curd cutting time

Both early cutting when the curd is fragile and late cutting when the curd is brittle cause losses of fines. Several means are used to determine cutting time.

- Manual testing. The curd is ready to cut if it breaks cleanly when a flat blade is inserted at 45^{o} angle to the surface and then raised slowly.
- Several mechanical devices based on oscillating viscometer, thermal conductance and sonication have been tested experimentally.
- Some plants cut by the clock. This may be OK as long as all conditions are uniform from day to day (is that every true??) and adjustments are made for any change in milk composition or properties.
- If setting temperature is high as for Swiss types, the curd firms rapidly and cutting must begin early when curd is still somewhat soft to prevent over setting. Agitation should begin immediately to prevent matting.

Curd size

Curd size has a great influence on moisture retention. Hence, there is an obvious relationship between cheese moisture and the prescribed curd size:

- High temperature and low moisture varieties such as Italian hard cheese require the smallest curd. Cutting continues until the curd cutting is the size of rice grains.
- Medium moisture cheeses like most washed varieties and Cheddar are cut to Omega cm cubes.
- High moisture varieties like soft ripened cheese are cut with 2 cm knives or the curd is simply broken sufficiently to be dipped into forms.

Small curd size will result in greater fat and SNF recovery because large curds tend to get crushed resulting in the loss of 'fines'. Smaller curds will also dry out faster and, therefore, other factors such as cooking temperature and stirring out may have to be adjusted according to curd size.

Manual cutting

Manual cutting is done with cutting harps, made by stretching stainless steel wire over a stainless steel frame. Total cutting time should not exceed 10 minutes (preferably less than 5 minutes) because the curd is continually changing (becoming overset) during cutting. The knives should be pulled (not pushed) quickly through the curd so has to cut the curd cleanly.

Automated cutting

With mechanical knives, curd size is determined by the design of the vat and agitators, the speed of cutting (rpm) and the duration of cutting. In Double 'O' vats for Cheddar and

American varieties, cutting is normally at a speed of about 4 rpm for 7 - 13 minutes, corresponding two a total of 30 to 50 revolutions. It is important that the knives are sharp and cut the curd cleanly rather than partially mashing the curd or missing some pieces altogether.

There is evidence that curd particle size at draining in mechanized Cheddar cheese is influenced by cutting time, cutting speed, and subsequent agitation such that:

- Short cutting times and low rpm result in small particle size at draining and larger losses of fines.
- With increasing cutting time (more total revolutions), curd particle size at draining reaches a maximum which corresponds to a maximum in fat recovery.
- Further increased cutting time causes decreased curd size at draining with little effect on fat recovery.

Healing

Curd should be agitated gently or not at all after cutting to prevent formation of fines. The exterior of the freshly cut curd is fragile so some time is needed for the edges to close up (heal) and prevent the loss of fat and protein to the whey.

Cooking

The combination of heat and the developing acidity (decreasing pH) causes syneresis with resulting expulsion of moisture, lactose, acid, soluble minerals and salts, and whey proteins. It is important to follow the cooking schedule, closely. Cooking too quickly causes the curd to shatter more easily and forms a tough exterior on the curd particles which prevents moisture release and hinders development of a smooth texture during pressing

Draining

Most cheese is drained in the range of whey pH 6.1-6.4 (curd pH 6.0 - 6.3). Draining time should be uniform at about 20 min to prevent variation from vat to vat. Cheddar types may be stirred out 1 to 3 times as required to obtain required curd moisture.

Washing

Lactose content can be adjusted by moisture removal (syneresis), fermentation, or leaching with water. By leaching lactose with water it is possible to make a high moisture cheese (such as brine brick or Muenster) and still achieve a final pH of about 5.0 - 5.2. The temperature of the wash water will determine the moisture content of the curd. Sometimes relatively hot water (e.g., Gouda) is used to dry the curd and develop its texture.

Traditionally washing was accomplished by removing Omega to 2/3 of the whey and replacing it with water and agitating for about 15 min. This process results in the dilution of large amounts of whey which must be re-concentrated or dumped. It also creates problems where curd tables have less capacity than setting vats. The solution is to remove more whey and add less water

Curd Handling

Most brine or surface salted varieties are dipped directly into the forms or pressed under the whey. In the absence of salt, the curd is fused to form a smooth, plastic mass. The hoops

are turned at regular intervals to promote uniform drainage, symmetrical shape, and a smooth finish.

Some varieties such as Gouda and Swiss are pressed under the whey before draining. This encourages formation of smooth texture and prevents incorporation of mechanical openings in the cheese due to trapped air or pockets of whey.

For Cheddar, American, and Pasta Filata varieties the curd is kept warm in the vat or drain table and allowed to ferment to pH 5.2 -5.4. Pasta Filata varieties are then worked in warm water while Cheddar and American varieties are salted in the vat.

Pressing

Pressing varies from little or none for soft cheese up to 172 kPa for firm Cheddar cheese. The warmer the curd, the less pressure is required. Mechanical openings may be reduced by vacuum treatment before, during or after pressing.

Salting

Almost all cheese is salted by one of three methods: before pressing as in Cheddar and American varieties, surface salting after pressing, or brine salting.

Purposes of Salting

- Promote further syneresis
- Slow acid development
- Check spoilage bacteria. Lactic are more salt tolerant than pathogens and spoilage bacteria.
- Promote controlled ripening and flavor development.
- Salty flavors

Brine salting:

- Concentration 16 - 25% NaCl
- Time:

  20 kg cheese, 5 days or sometimes several weeks

  3-5 kg, 24 h

  250 - 350 g, 1 - 4 h

- New brine should be treated with about 0.1% of $CaCl_2$ to prevent conversion of calcium and hydrogen caseinate to sodium caseinate. The latter has high water holding capacity, so the cheese takes up water from the brine and the cheese surface becomes soft and slimy.
- Brine pH should be adjusted to the pH of the cheese. Normally a pH of 5.2 - 5.6 is adequate.
  - If the pH is too high, ion exchange causing sodium caseinate is encouraged.
  - If the pH is too low, there is insufficient Ca/Na exchange and the cheese is too hard and coarse.

- Brine must be cleaned regularly by filtration, preferably micro filtered. UV sterilization combined with filtration is also used.
- Brine must be continuously agitated to prevent density fractionation (lower concentration brine on top) and dilution of the brine around the cheese.
- If cheese is floated rather than immersed in the brine, the exposed surface of the cheese should be dry salted.

Vat salting

- For vat salted cheese, uniform salt content depends on accurate estimate of the weight of unsalted curd, accurate weighing of salt and consistent processing conditions.
- Salt uptake is:
    - Increased by increased acidity (lower pH) at salting.
    - Decreased by increased time between milling and salting due to healing of the cut surfaces on the curd particles.
    - Increased by increased curd moisture content.
    - Decreased for larger curds.
- For Cheddar and American varieties the salt content as a percent of moisture (S/M) should be greater than 4.0%.

Ripening processes: chemical and physical changes

Cheese ripening is basically about the breakdown of proteins, lipids and carbohydrates (acids and sugars) which releases flavor compounds and modifies cheese texture. The biochemical and biophysical processes involved have only partly been elucidated. Here we include only a few practical principles of ripening.

General Principles

- Ripening varies from nil for fresh cheese to 5 years for some hard ripened cheese. Like a good wine, a good aged cheese should get better and better with age.
- Ripening processes are broadly classified as interior and surface ripened.
    - Cheese which depends mainly on interior ripening (most hard ripened cheese such as Cheddar and Italian types) may be ripened with rind formation or may be film wrapped before curing. Having said that, I hasten to add, that traditional Italian types are always rind ripened. Cheddar and American varieties are the only ripened cheeses which (in my view) are not drastically altered by film wrapped curing.
    - Cheese which depend mainly on surface ripening include smear ripened and mould ripened
- In the broadest terms there are three sources of cheese flavor:
    - Flavors present in the original cheese milk, such as natural butter fat flavor and feed flavors.
    - Breakdown products of milk proteins, fats and sugars which are released by microbial enzymes, enzymes endogenous to milk, and enzyme additives.
    - Metabolites of starter bacteria and other microorganisms. These include products from catabolism of proteins, fats and sugars.
- Flavors and texture development are strongly dependent on:
    - pH profile
    - Composition
    - Salting
    - Temperature
    - Humidity

- EXPERIENCE.

As a general rule factors which increase the rate of ripening increase the risk of off flavor development, and reduce the period of time when the cheese is saleable

Packaging

- Vacuum and/or gas flush (N_2 and CO_2) in gas and moisture proof films are common.
  - Vacuum alone is not recommended because complete evacuation of oxygen is difficult and small unsightly mould spots often appear.
  - Gas flush with CO_2 or blends of CO_2 and N_2 effectively prevent mould growth.
    - CO_2 is water soluble so it is absorbed into the water of the cheese and the package becomes tight.
    - N_2 which is not water soluble is useful for applications, such as shredded cheese and cheese curd, where a loose package is desired.
- High density plastic (rigid containers) is used for fresh cheese such as cottage.
- Oxygen permeable wrap such as grease proof paper and foil-laminated but unsealed wraps, are preferred for surface ripened soft cheese

Factors Affecting Yield

- Milk casein is the principal yield determining factor. Casein contributes absorbed water and minerals as well as its own weight. Cheese quality limits the ratio of moisture/casein, a ratio which corresponding to MNFS.
- Fat is also a principal yield component. Fat interferes with syneresis and, therefore, also contributes more than its own weight, but if other conditions are adjusted to maintain constant MNFS, then fat contribution to yield is dependent only on the conversion factor of fat from milk to cheese (i.e., fraction of milk fat recovered in the cheese).
- Cheese moisture. A 1% increase in Cheddar cheese moisture causes about 1.8% increase in cheese yield, partly because more moisture means more whey solids and salt are recovered in the cheese (e.g., given 90 kg cheese/1000 kg milk, a moisture adjustment to 36% would result in 91.6 kg cheese/1000 kg milk)
- Cheese salt. An extra 0.1% salt means an extra 0.14% yield of Cheddar cheese if the moisture content is increased accordingly.
- Milk quality factors: somatic cell counts, psychotropic bacteria, protein quality etc.
- Increasing time and temperature of milk pasteurization increases cheese moisture retention and the recovery of whey proteins and soluble solids. There doesn't seem to be any consensus on how much is desirable but it's safe to say that it depends on the type of cheese and the quality standards of the manufacturer.
- Process control parameters
  - Careless cutting.
  - Heating too fast at early stages of cooking
  - Salting too soon after milling of Cheddar allows rapid salt uptake which in turn causes rapid synerisis and increased solubility of casein. Yield is, therefore, reduced by losses of protein, fat and soluble solids.
  - High temperatures during pressing cause loss of fat.
  - Proteolytic cultures or coagulating enzymes cause protein losses before and after cutting.
  - Washing removes soluble solids.

- Working as in Mozzarella removes fat and soluble solids. Loss of soluble solids is minimized by equilibration of the wash water with the cheese moisture.

Principles of Yield Optimization

With respect to yield the cheese maker's objectives are to:

(1) Obtain highest MNFS (moisture in non-fat substance) consistent with good quality to maximize moisture and the recovery of whey solids

(2) Standardize milk to obtain maximum value for milk components consistent with good quality (e.g., adjust P/F to maximize cost efficiency).

(3) Minimize losses of fat and casein in the whey

Gouda

Gouda cheese originated in the Netherlands and is similar to Edam. Normally Gouda has a higher fat content than Edam but fat in dry matter does vary from 30 - 50%. In Canada, Gouda cheese must contain a minimum of 28% fat (49% fat on dry matter basis) and a maximum of 43% moisture. Gouda is made in round or block forms and the cheese vary in weight from 600 g to 20 kg. A gas-forming culture is used to induce eye formation.

Procedure

1. Standardize milk to protein/fat ratio of 1.07 and pasteurize.

2. 1 - 2 ml of annatto per 1000 kg of milk may be added during the winter months.

3. Add 0.75% starter culture. Mixtures of *Streptococcus lactis* and *Leuconostic cremoris* and *Streptococcus diacetylactis* are recommended. Ripen until an increase of 0.005 - 0.01 in titratable acidity is achieved.

4. Measure 190 ml rennet/1000 kg of milk. Dilute the rennet with 10 volumes of water and add the mixture to the milk.

5. When curd cuts cleanly, cut curd into 0.5 - 1.0 cm cubes taking 10 - 15 minutes. Stir curd to float in whey for an additional 20 - 30 minutes. Whey pH should be 6.4 - 6.45.

6. Run off one-third of whey and slowly add water at 60C to give final temperature of 36 - 38C. The volume of water should be 20 - 25% of the amount of milk. Add the water slowly during 15 - 20 min with continual stirring. Continue stirring for another 15 min. after all the water is added.

7. Allow curd to settle, and press under the whey by covering the curd with steel plates for at least 10 min. In commercial practice this is accomplished by moving the curd and some of the whey onto a press table.

8. When curd is consolidated under the plates, drain the whey and cut to fit cloth-lined hoops. Press at 14 psi for 5 - 8 hrs with occasional turning. After the first turning increase the pressure from 14 - 28 psi. The pH after pressing should be 5.3 - 5.5.

9. Immerse in 20% salt brine for periods as indicated below. The pH should be 5.15 -5.25.

Edam 1.5 - 3 kg	3 days
Gouda 0.5 kg	20 hours
Gouda 1 kg	1 1/2 days
Gouda 10 kg	4 1/2 days
Gouda 20 kg	7 days

10. Pack in plastic film and incubate at 15C, 4 - 6 weeks. Then store at 10^0C for 6 - 12 months.

The pH of Gouda cheese increases during ripening. At 8 weeks the pH should be 5.3 - 5.5.