EVALUATION METHODS FOR QUALITY AND PRICE OF MILK AND DAIRY PRODUCTS

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Vermont's Only Grade A Commercial Dairy Bottling Goats' Milk
VERMONT'S OWN
Oak Knoll
DAIRY
Oak Knoll
DAIRY
Grade A Pasteurized
100%
Goats' Milk
Oak Knoll
DAIRY
Oak Knoll
DAIRY
Oak Knoll
DAIRY
Oak Knoll
DAIRY

Production of Quality Goat Milk and Its Products

- Fresh and normal goat milk from healthy, properly fed and milked animals, is a white, opaque liquid with a slightly sweet taste which has practically no odor (Le Jaouen, 1987).
- Production of quality goat milk should start at every farm level, because flavor and quality of the milk cannot be improved later in the processing stage (Park and Guo, 2006).
- The basic principle is that the better the milk, the better the processed products (Peters, 2000; Park and Guo, 2006).
- Milk quality is negatively affected by improper handling from many factors such as feeding, handling of animals prior and during milking, handling of the milk during and after milking, cooling and transportation, pasteurization, processing, packaging, and processing utensils (Peters, 1990; Haenlein, 1992).
- Off-flavor in goat milk can be attributed to the feeds, weeds, forages, chemicals, building materials, colostrum, estrus, mastitic milk, filthy utensils and strainer, unclean milking equipment, slow cooling, odors from bucks, barn and/or milk room.
- Good management of the entire farm system leads to good quality milk. The recommended milking procedure has to be practiced in a daily routine, maintain functioning and sanitary equipment, have healthy animals, and use recommended detergent, acid and sanitizers for cleaning and milking equipment.

Five major parameters are routinely checked by regulatory agencies for quality raw milk production

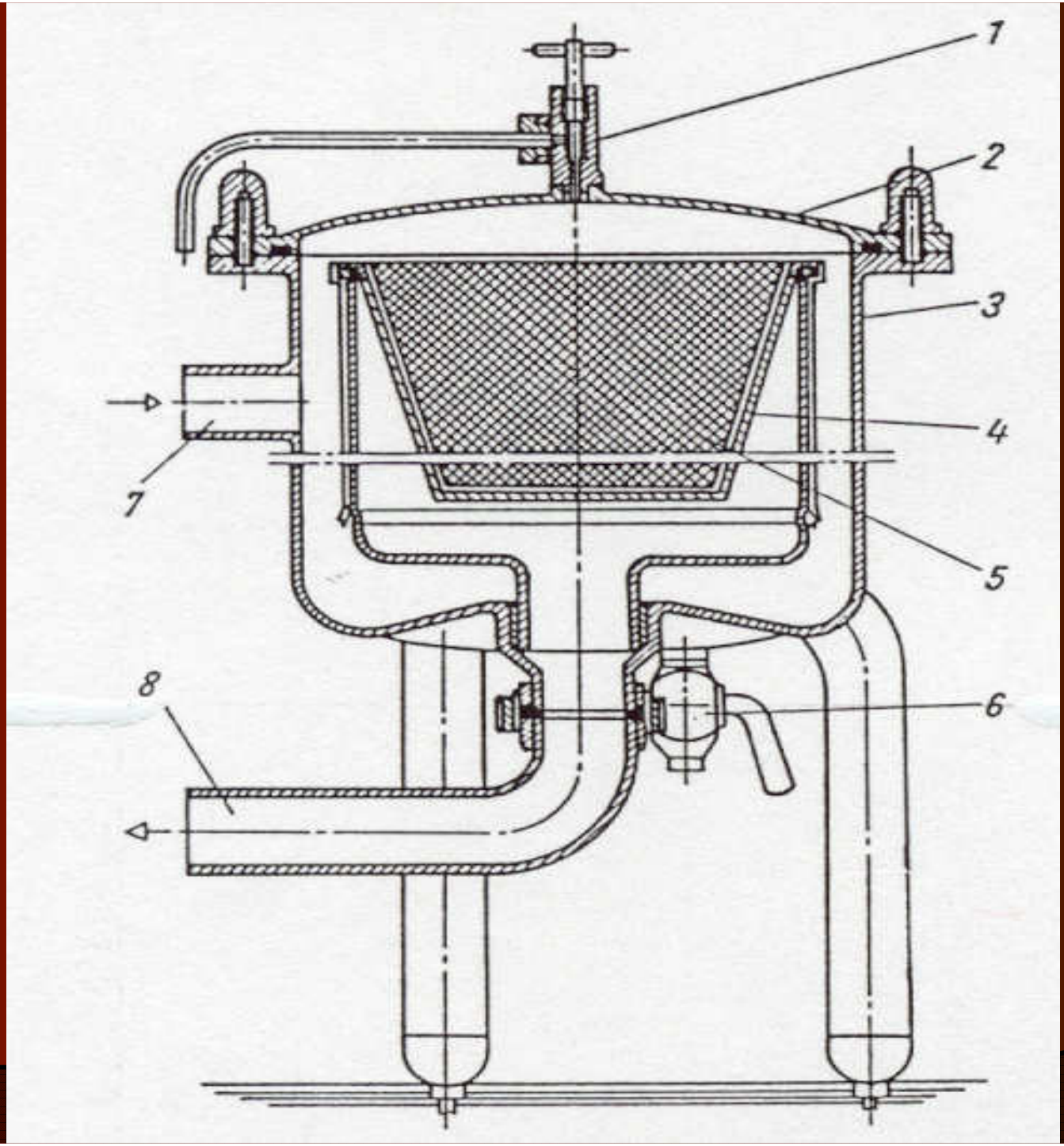
1. Nutritional constituents in milk.
2. Somatic cell counts as related to mastitis.
3. Bacteria counts as related to sanitary practices.
4. Adulteration and pesticide residue contents.
5. Flavor, taste, appearance and temperature.

Quality of Raw Milk tested by Individual Dairy Processing Plants

1. Standard plate count (SPC)
2. Direct microscopic count (DMC)
3. Freezing point determination (Cryoscope)
4. Presence of inhibitory substances (antibiotic screening test)
5. Sensory evaluation
6. Preliminary incubation (PI) – SPC
7. Direct microscopic somatic cell count (DMSCC)
8. Acid degree value (ADV)
9. Laboratory pasteurization count (LPC)
10. Thermoduric spore count
11. Fat content
12. Total solids content (can also include protein content)
13. Sediment test


CARC

Filteration of farmstead milk for further processing (Le Jaouen, 1987)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3M Petrifilm Plate Techniques

ADGA members on National Conference Interstate Milk Shipments On the Problem of Somatic Cell Count legal thresholds:

1. The Coulter Counter is not reliable for goat milk.

2. The only officially acceptable method to confirm high cell counts in goat milk is the DMSCC using the special pyronine Y-methyl green stain (Standard Methods/Dairy Products 1985, pp. 229-230), or another appropriate method determining DNA contents.

3. The Fossomatic counter may be accurate in mid-lactation, but results need to be confirmed with the pyronine-Y stain method.

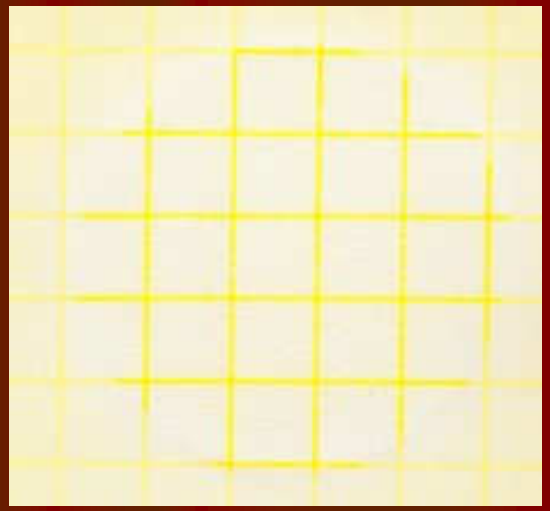
ADGA members on National Conference of Interstate Milk Shipments On the Problem of Somatic Cell Count legal thresholds: (Cont'd)

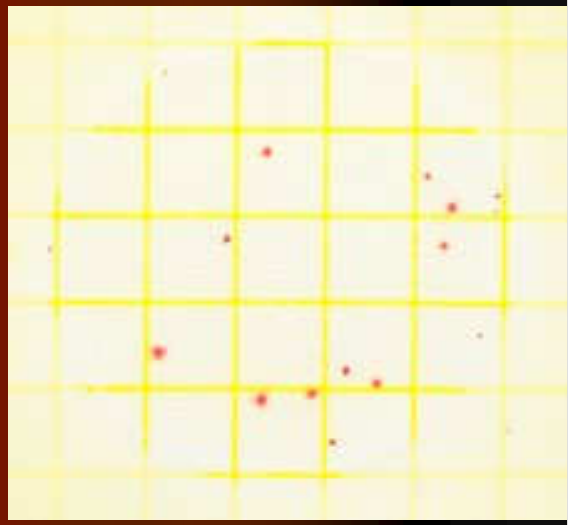
4. The CMT can be used as a screening test but high counts must be confirmed with the pyronine-Y stain.

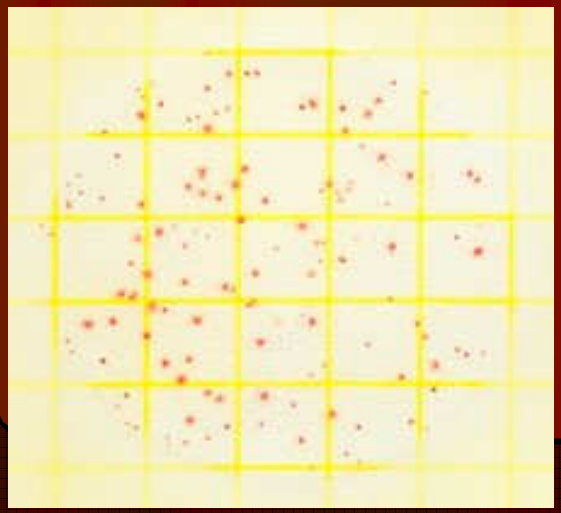
5. SCC levels of normal goat milk increase from Spring to Fall well above the cow threshold of 1 million/ml, starting about 4 months after kidding, coinciding with start of estrus and late stage of lactation.

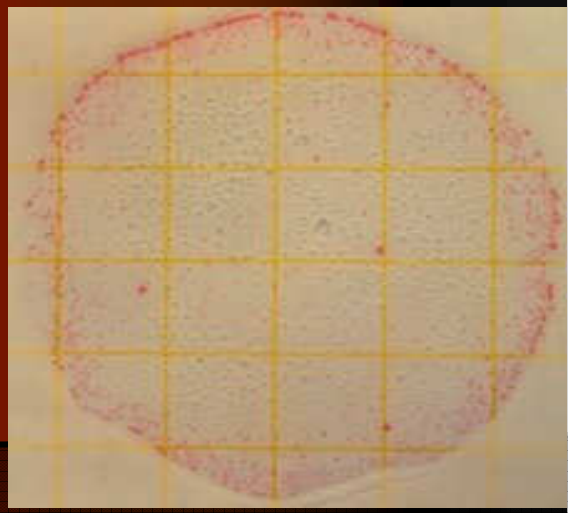
6. Easily achievable SCC levels of 100,000 – 300,000 SCC/ml in cow milk are unusual in even high quality managed goat herds.

Total Aerobic Plate Count



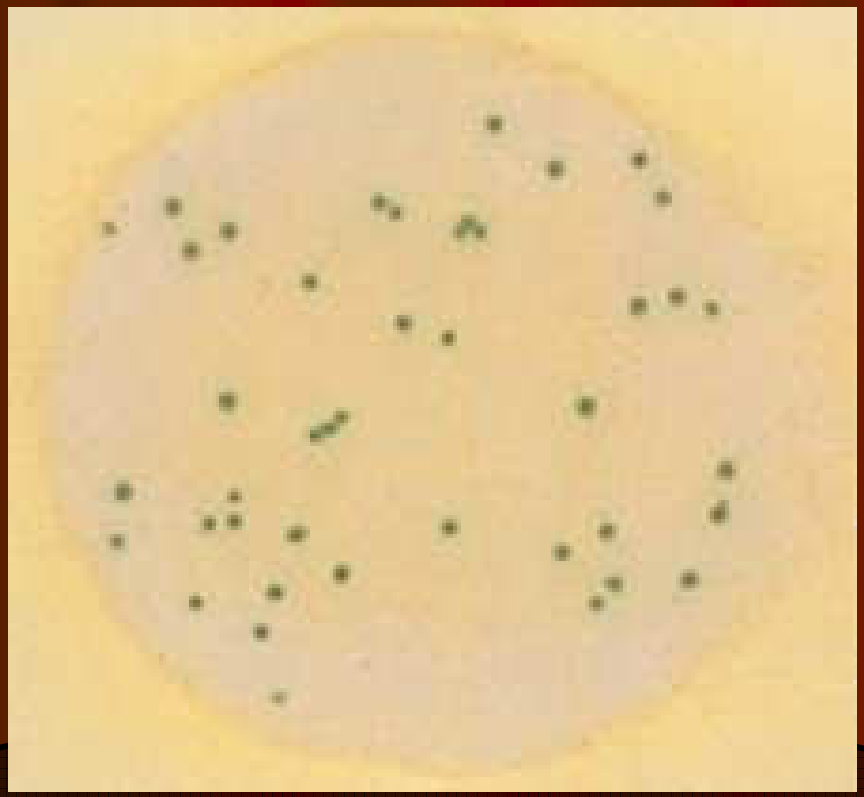




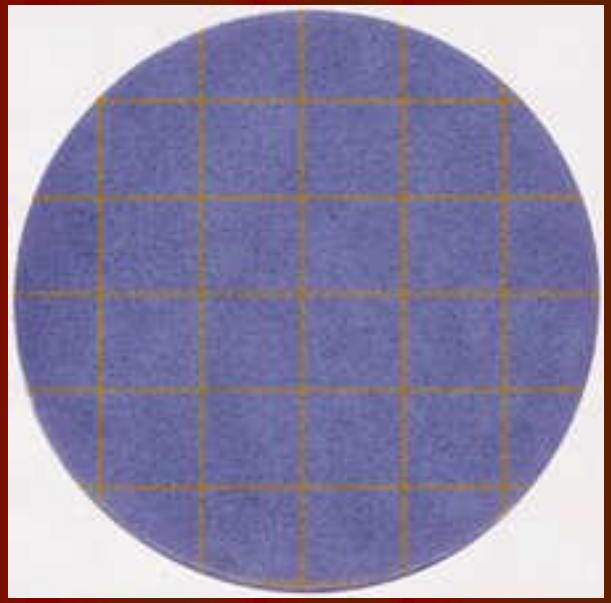


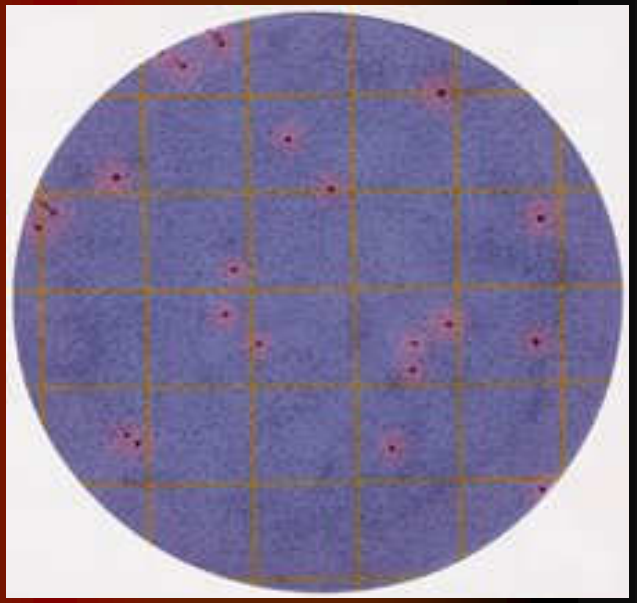
E. coli and Coliform counts

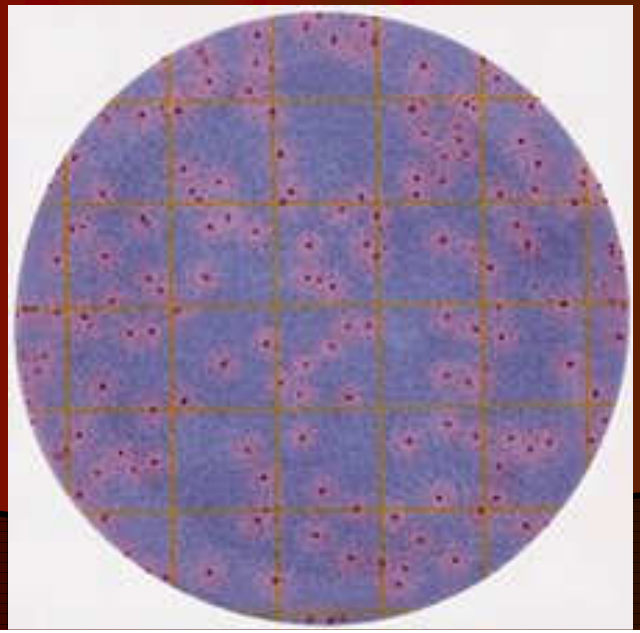
Yeast and Mold counts

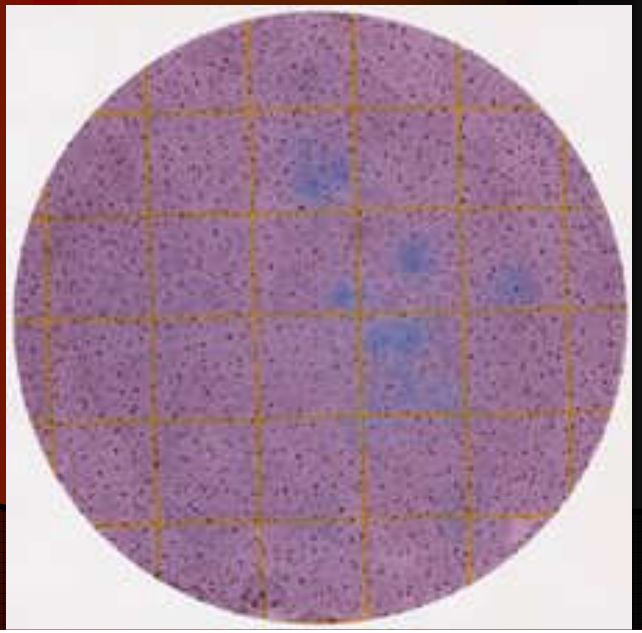


Staphylococcus aureus count









Grade A raw milk for pasteurization

- Temperature: Cooled to 45°F (7°C) or less within two hours after milking, provided that the blend temperature after the first and subsequent milkings does not exceed 50°F (10°C).
- Bacterial limits: Individual producer milk not to exceed 100,000 per ml. prior to commingling with other producer milk. Not to exceed 300,000 per ml. as commingled milk prior to pasteurization.
- Antibiotics: Individual producer milk: No detectable zone with the *Bacillus subtilies* method or equivalent. Commingled milk: No detectable zone by the *Sarcina lutea* Cylinder Plate Method or equivalent.
- Somatic cell count: Individual producer milk. Not to exceed 1,500,000 per ml.

Grade A pasteurized milk and milk products

- Temperature: Cooled to 45°F (7°C) or less and maintained thereat.
- Bacterial limits: 20,000 per ml.*
- Coliform: Not to exceed 10 per ml.: Provided that , in the case of bulk milk transport tank shipments, shall not exceed 100 per ml.
- Phosphatase: Less than 1 microgram per ml. by the Scharer Rapid Method or equivalent.
- Antibiotics: No detectable zone by the *Sarcina lutea* Cylinder Plate Method or equivalent.

Effect of Somatic Cell Counts on Cheese Yield

	Low group	High group	Difference
Wisconsin mastitis test score	11	16	5
Somatic cell count (cells/ml)	529,000	667,000	138,000
Cheese yield potential (lbs/cwt)	9.52	9.26	0.27
Gross margin/cwt	$ 2.01	$ 1.78	$ 0.23

Terms for Milk Quality – Cont'd

B. Measurement of acidity of milk:

1. Titratable Acidity:

a. It is determined by adding NaOH (0.1 N) solution to raise the pH of the milk to about 8.3.

b. One ml of the base equals 0.1% lactic acid.

c. %TA = ml 0.1 N NaOH x .009 x 100/gram of sample

2. SH (Soxhlet-Henkel) value:

a. It indicates how many ml of NaOH (25 mol/ml) are required to neutralize 100 ml of milk. One ml of 2% alcoholic phenolphthalein solution is added as indicator.

b. SH value of fresh milk ranges 6.4 – 7.0

c. SH value of raw milk <5.0 indicates mastitis.

d. SH values of 8.0-9.0 gives sour taste, and coagulate.

Table 1. Minimum Pasteurization Temperature and Times

Product	Temperature	Time	
1. Milk	145°F (62.8°C)	30 minutes	LTLT
	161°F (71.7°C)	15 seconds	STHT
	191°F (88°C)	1 second	UHT
	194°F (89°C)	0.5 second	
	201°F (94°C)	0.1 second	
	204°F (96°C)	0.05 second	
	212°F (100°C)	0.01 second	
2. Milk products of 10% fat or more or added sugar (half/half, cream, chocolate milk)	150°F	30 minutes	
	166°F	15 seconds	
	191°F	1 second	
	194°F	0.5 second	
	201°F	0.1 second	
	204°F	0.05 second	
	212°F	0.01 second	
3. Eggnog and Frozen dessert Mixes	155°F	30 minutes	
	175°F	25 seconds	
	180°F	15 seconds	

Microbiological Standards for Some Grade A Dairy Products (FDA Grade A Milk Ordinance & Code 1, 1978)

Product	Standard Plate Count/ml	Coliform Count/ml
Raw milk, at pickup	100,000	no standard
Raw milk, at balance Tank of pasteurizing unit	300,000	no standard
Pasteurized milk and Milk products	20,000	<10
Condensed milk	30,000	<10
Cottage cheese; wet, dry-	; <5,000-<20,000	<10
Whey	30,000	<10
Ice Cream	<20,000-<50,000	<10
Butter	<5,000-<20,000	-
Milk powder	<20,000-<50,000	no standard
Non-fat dry milk	30,000	<10

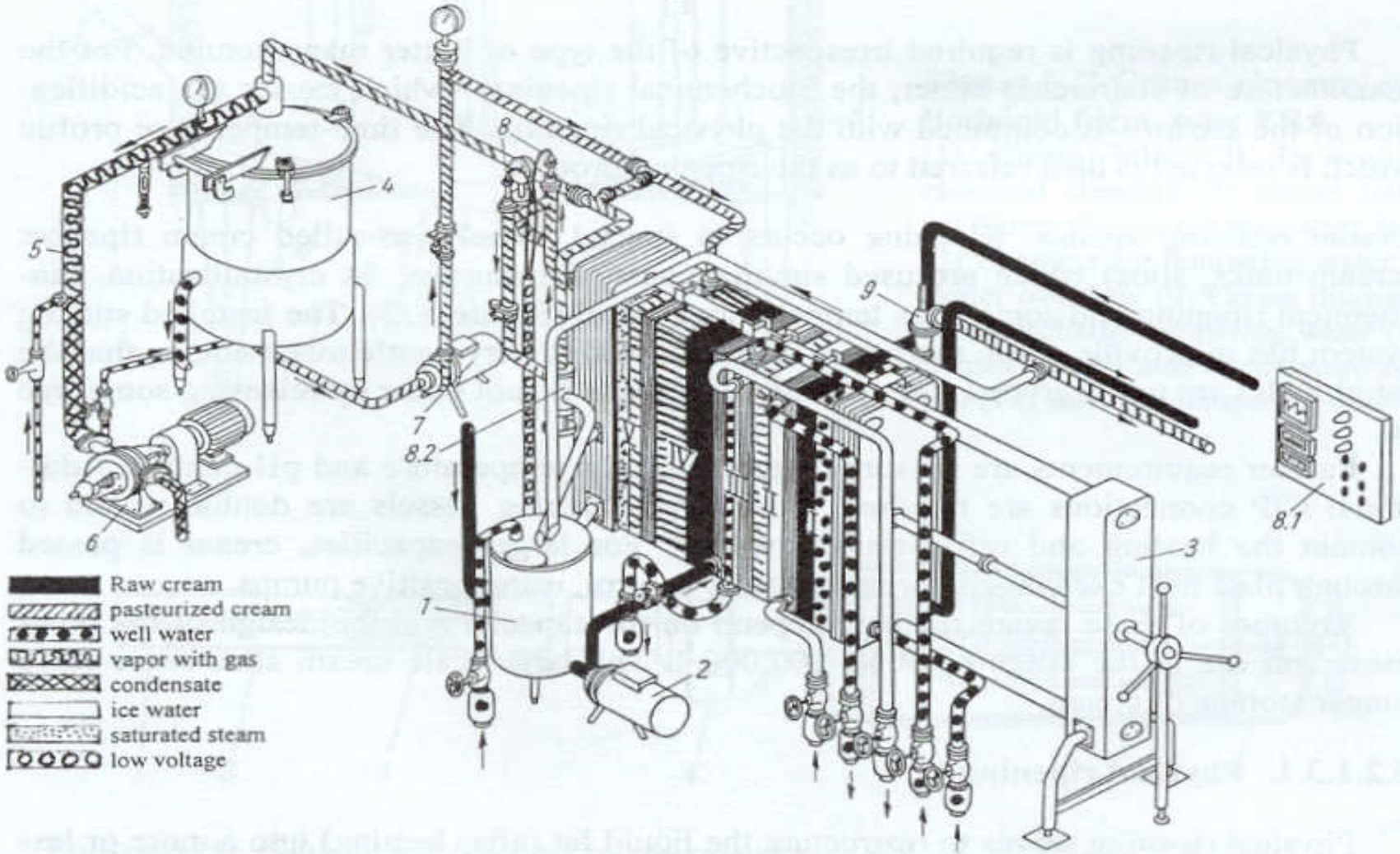
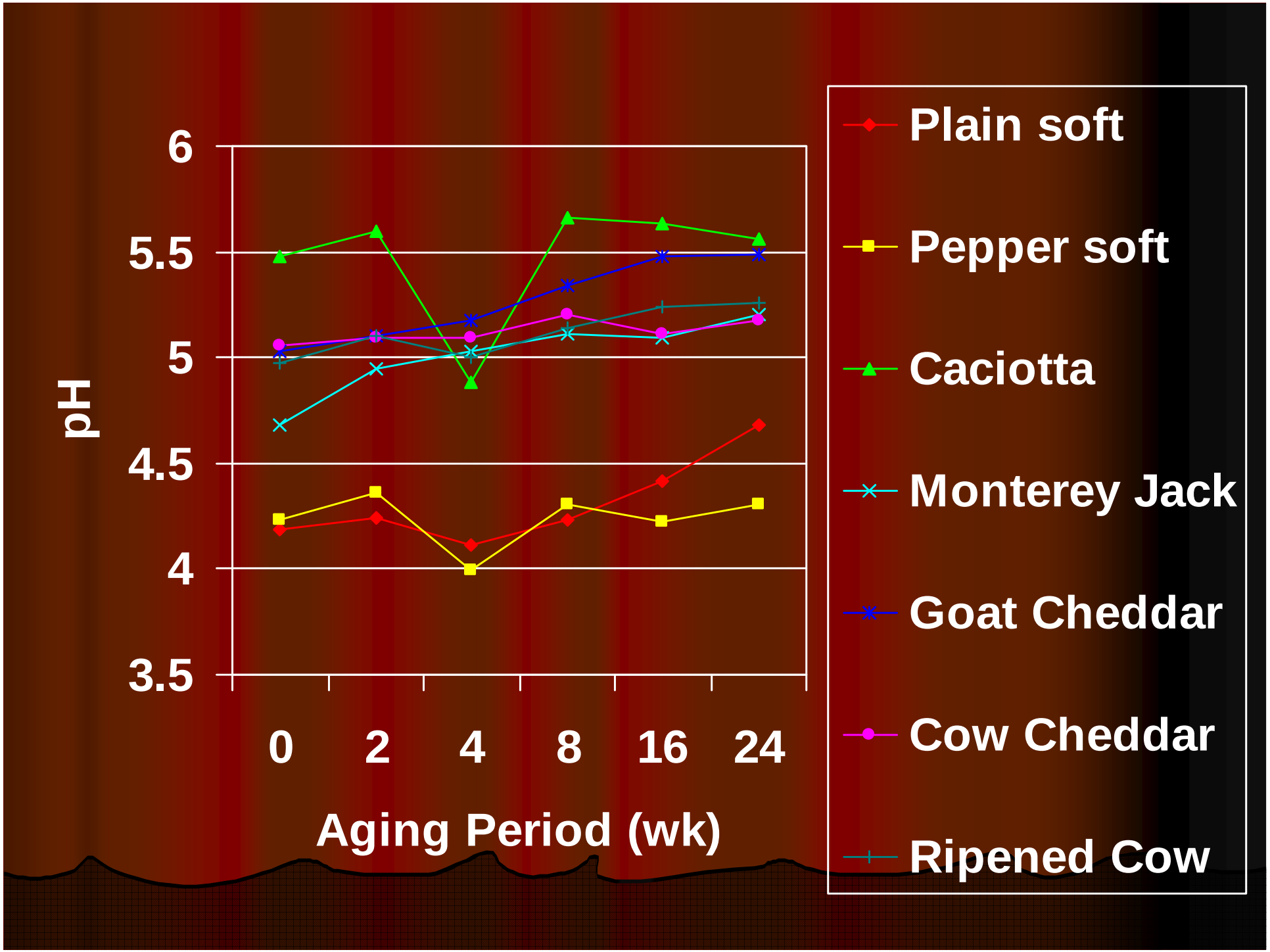


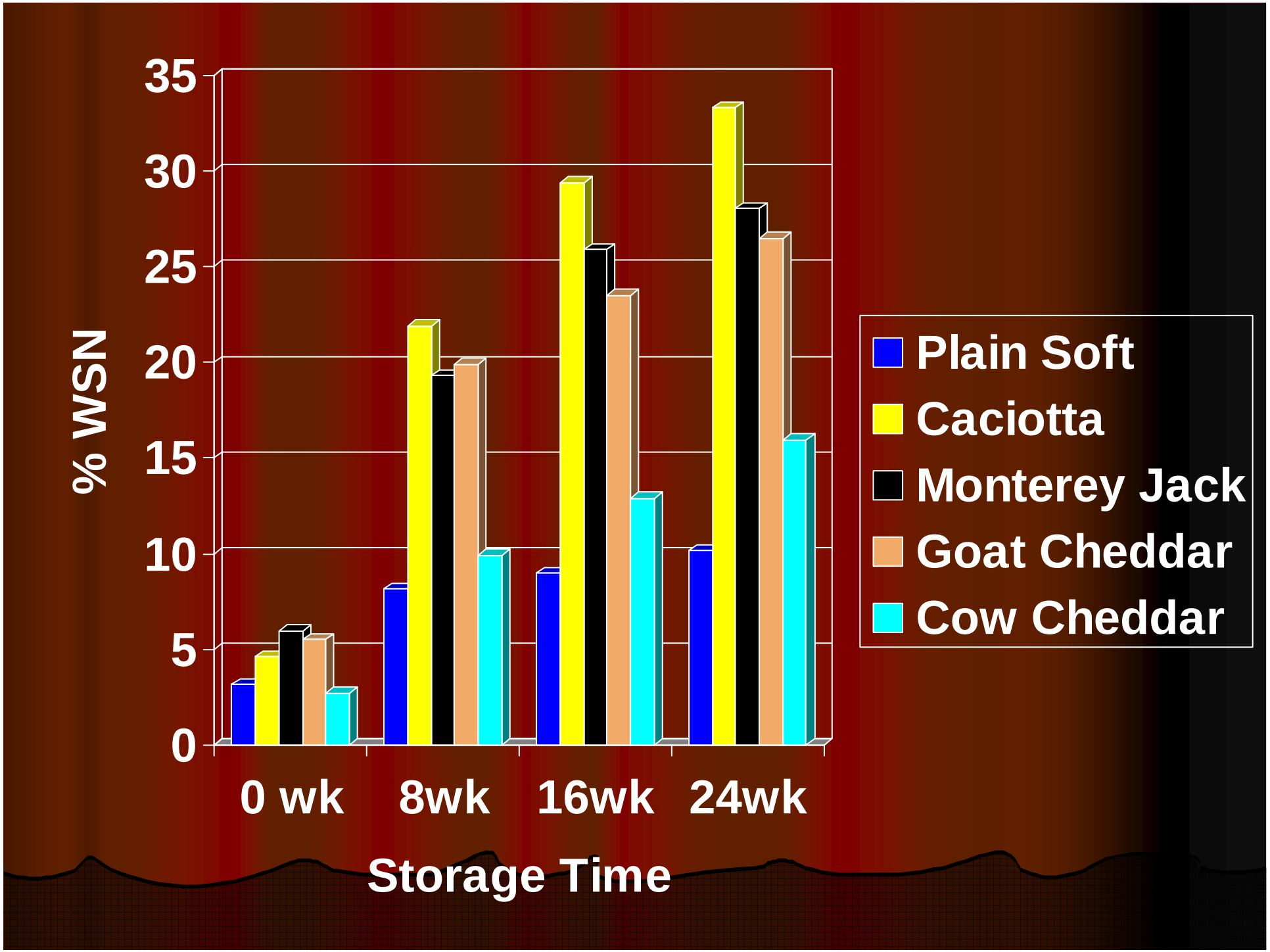
Figure 6./1 Process line for cream treatment; flow rate 5000 l/h

(1) Buffer tank with floating device (2) Centrifugal pump (3) Plate heat exchanger (I Raw cream cooling, II Ice water cooling, III Fresh water cooling, IV Heat exchanger for heat recovery, V Heater) (4) Deaeration chamber (5) Injection condenser (6) Water ring vacuum pump (7) Centrifugal pump (8) Thermometer (8.1) Control panel for regulating and switching devices (8.2) Switching valve (9) Thermometer

Quality Evaluation of Dairy Products/Cheeses

- **Quality of dairy products are changed during manufacturing, refrigeration, distribution and storage.**
- **Qualities of all dairy products including cheeses are influenced by several parameters, such as chemical, microbiological, rheological and sensory scores of the products.**
- **Proteolysis and lipolysis are two primary processes in cheese ripening with a variety of chemical, physical, microbiological, textural, and rheological changes which occur under controlled environmental conditions.**
- **Studies showed that cheese quality is greatly influenced by levels of peptides, amino acids, and free fatty acids resulting from proteolysis and lipolysis.**


6
5.5
5
4.5
4
3.5
pH
0
2
4
8
16
24
Aging Period (wk)
Plain soft
Pepper soft
Caciotta
Monterey Jack
Goat Cheddar
Cow Cheddar
Ripened Cow


35
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20
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% WSN
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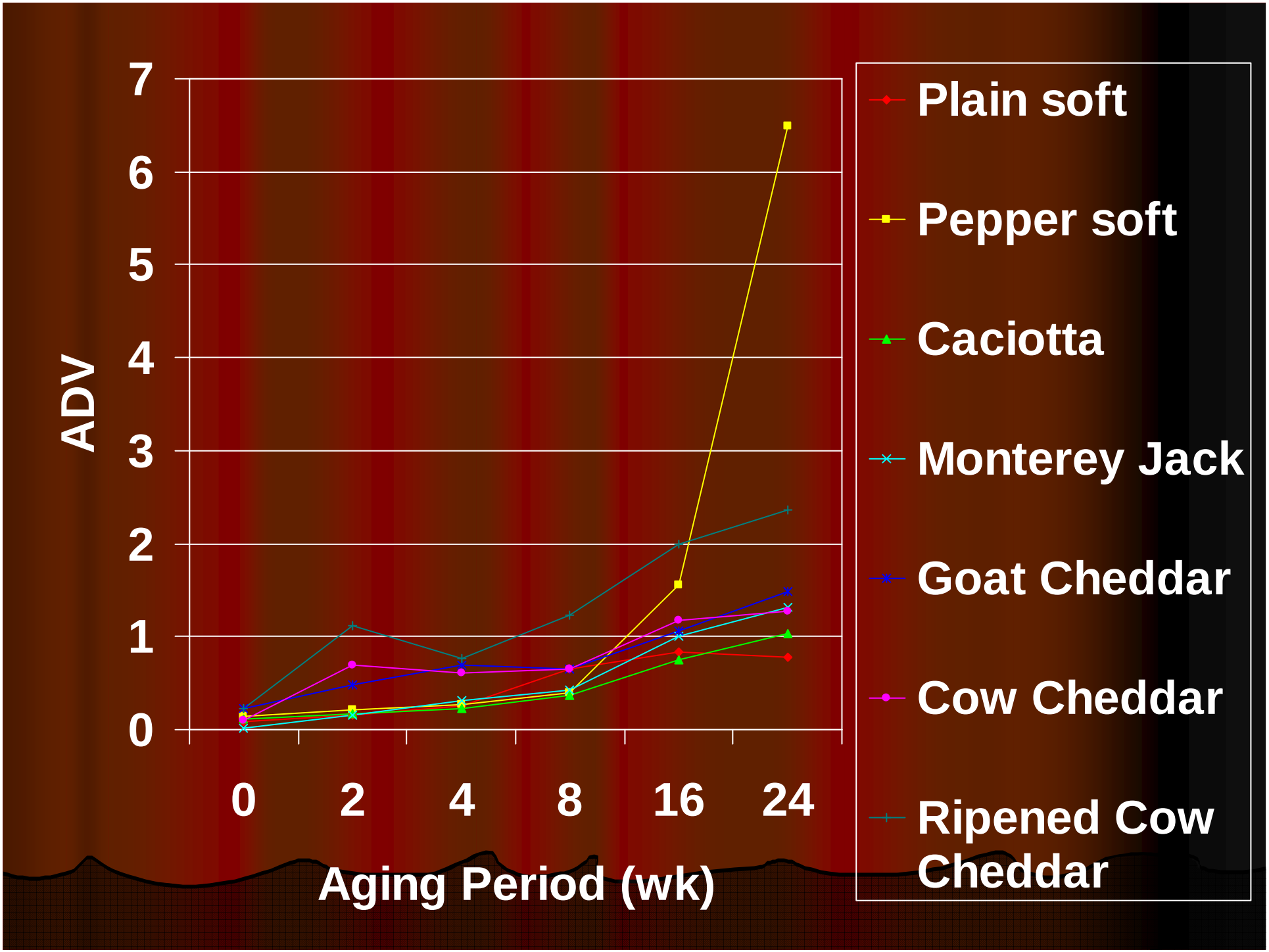
Storage Time
Plain Soft
Caciotta
Monterey Jack
Goat Cheddar
Cow Cheddar


ADV
7
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5
4
3
2
1
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0
2
4
8
16
24
Aging Period (wk)
Plain soft
Pepper soft
Caciotta
Monterey Jack
Goat Cheddar
Cow Cheddar
Ripened Cow Cheddar

Milk Pricing System

A. Butterfat differentials Pricing

- **Butterfat differentials are the amount by which the price of farm milk is increased or decreased for each "point" (0.1%) of butterfat test.**
- **The procedure used to calculate butterfat differentials in most US Federal Milk Order markets is to multiply the average wholesale price by 0.115 at Chicago, effective Dec. 1, 1983 (USDA support price for Grade A butter is $1.4325/lb)**
- **At this price, the butterfat differential for farm milk is approximately 16.5 cents (1.4325 x 0.115).**
- **Use of butterfat differentials to price farm milk assumes that fat and solids-not-fat prices and contents fluctuate together.**

Milk Pricing System

B. Component pricing

- Milk fat and protein are the two major variable constituents in milk.
- Lactose remains fairy constant at about 5%, and minerals at about 0.7%, but protein and fat vary considerably between seasons.
- On the average, farm cow milk contains about 3.7% milk fat and 8.55% solids-not-fat, including about 3.2% protein.
- A one point (0.1%) change in milk fat test is normally associated with as 0.4 point (0.04%) change in solids-not-fat, and in protein.

Milk Pricing System

C. In Component Pricing System, goat milk farmers have a disadvantage with protein:

- **Goat milk has higher N content than cow milk, but the former has higher nonprotein nitrogen, which gives good health benefits, but implicated with a lower milk pricing.**

D. Calculation of 4% fat-corrected milk (4%FCM)

4% FCM = 0.4 x kg milk yield + 15 x kg fat yield

Milk Pricing System

E. Product Prices

- The USDA purchase prices for butter, nonfat dry milk, and Cheddar cheese are calculated from the support price for milk.
- During the period of October, 1980-December 1, 1983; The purchase price for butter, $1.49/lb; nonfat dry milk, $0.94/lb; and Cheddar cheese, $1.395/lb ($1.8628/lb; 1998)
- **Per Hundredweight Milk;**
  a) A gross price to plants per **hundredweight of milk is $14.32.**
  a) 4.48 lbs butter x $1.49 = **$6.68 butter value** in 100 lbs milk.
  b) $14.32 - $6.68 = $7.64/8.13 = **$0.94/lb** USDA purchase price for **nonfat dry milk.**

Average performance of dairy GOAT BREEDS in different countries

Country Goat breed	Lactation length (day)	Yield (kg)		
		Milk	Fat	4% FCM
Cyprus				
Damascus	255	510	20	504
France				
Poitevine	230	520	20	508
Greece				
Native	230	160	9	199
India				
Jamunapari	220	215	9	221
Norway				
Nordie	275	650	24	620
Switzerland				
Saanen	282	745	26	688
Turkey				
Kilis	270	270	13	303
USA				
Alpine	288	869	31	813
Nubian	288	710	32	764
US Toggenburg	292	870	30	798

(Haenlein, 2007)

Average performance of dairy SHEEP BREEDS in different countries

Country Sheep breed	Lactation length (d)	Yield (kg)		
		Milk	Fat	4% FCM
Czechoslovakia				
Prmenka	162	162	12	245
France				
Lacaune	165	270	20	408
Germany				
East Friesian	300	632	41	868
Greece				
Chios	210	218	17	342
Israel				
Israel Awassi	270	495	33	693
Italy				
Comisana	150	132	11	218
Spain				
Manchega	210	300	28	540
Turkey				
Awassi	120	168	11	232

Haenlein (2007)

Comparative profitability of two systems of goat farming

GREECE	Intensive farming	Extensive farming
Gross return/goat/year, $	134.94	66.24
Expenses/goat/year, $	110.89	58.69
Labor, %	39.1	51.8
Feed, %	42.8	31.6
Capital, %	12.2	13.4
Housing, %	4.4	2.1
Others, %	1.5	1.1
Net return/goat/year, $	24.05	7.55

Comparative profitability of two systems of goat farming

FRANCE	Milk sold from farm	Cheese sold from milk on farm
Milk production/goat/year, kg	553	461
Price/kg milk, $	0.40	0.94
Gross return/goat, $	243.83	584.00
Production cost/goat/year, $	118.17	190.83
Net return/goat/year, $	125.66	393.17
ITALY		
Net return/goat/year, $	74.93	112.00

USA	Average herd production, kg milk/goat/year	Break-even price/kg milk
	680	0.52
	907	0.39

CONCLUSIONS

1. The basic principle for production of quality dairy products is the better the original milk, the better the processed products.

2. Milk is highly perishable, and its quality is easily deteriorated by improper handling of feeding, animals prior and during milking, handling of the milk during and after milking, cooling and transportation, pasteurization, processing, packaging, and processing utensils, etc.

CONCLUSIONS – Cont'd

3. Each processing plant should establish appropriate quality control systems for each point of manufacturing facilities.

4. All personnel involved (farm level, transport, dairy plants) in production, processing, distribution, and marketing of dairy products must follow the required regulations (PMO) enforced by appropriate regulatory agencies (e.g. FDA, APHA).

5. Four important requirements for Grade A dairy products are: i) safe to drink, ii) good flavor, iii) relatively free from spoilage bacteria and somatic cells, and iv) composition.

THANK YOU!!