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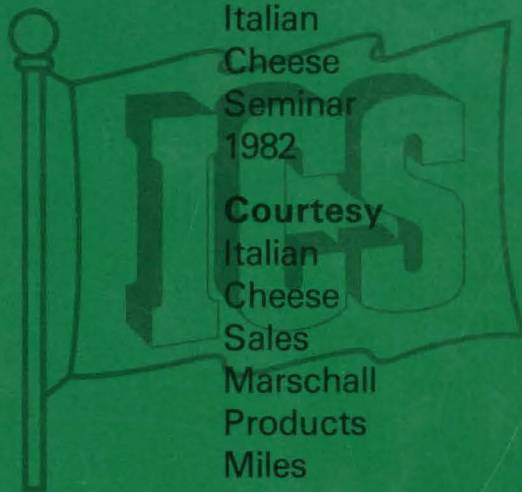
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Proceedings

From The
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PROCEEDINGS
FROM
THE NINETEENTH
MARSHALL INVITATIONAL ITALIAN CHEESE SEMINAR
HELD IN THE FORUM OF THE
DANE COUNTY EXPOSITION CENTER
MADISON, WISCONSIN
U.S.A.
SEPTEMBER 15 & 16, 1982

* * * * *

This publication has been compiled and made ready for distribution as a non-profit service to the Italian cheese industry by the Marshall Products, Miles Laboratories, Inc., P.O. Box 592, Madison, Wisconsin 53701, U.S.A.

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The following paper was presented by Norman F. Olson, Professor of Food Science and Director of the Walter V. Price Cheese Research Institute, University of Wisconsin, Madison, Wisconsin 53706, U.S.A. especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

THE EFFECT OF SALT LEVELS ON THE CHARACTERISTICS OF
MOZZARELLA CHEESE BEFORE AND AFTER FROZEN STORAGE

By Norman F. Olson

ABSTRACT

Salt concentration affected the body characteristics of mozzarella cheese during ripening and during storage after the freezing and thawing of cheese but had less effect on changes in characteristics caused by freezing. Cheese of higher salt content (about 2%) was rubbery and not meltable at 8 days of age. Meltability improved with aging but rubberiness persisted for at least 24 days. Freezing at rates similar to those used commercially produced bleached surface discoloration, acid flavor, noncohesiveness (brittleness) and occasionally free surface moisture immediately after thawing. Storage of cheese at 40°F after thawing markedly improved the body and flavor so that samples stored for 21 days were similar to unfrozen cheese. Freezing at fast rates (5 to 15 times faster than commercial rates) avoided the defects. Variations in salt concentrations did not alter the effects of freezing. Low salt cheeses softened at a faster rate during storage after thawing as compared to cheese containing high levels of salt.

Textural characteristics of many types of cheese, including mozzarella cheese, are significantly modified during ripening by such factors as microbiological growth and activity, moisture losses, enzymatic activity and salt diffusion (6, 9, 10). Generally, if there is no dehydration, cheese softens during ripening. De Jong (4) and Creamer and Olson (2) suggested that protein hydrolysis by milk clotting enzymes was responsible for the softening. Sodium chloride has a significant effect on cheese texture through its inhibition of microbial growth, control of activity of proteolytic enzymes and its effects on water binding properties of proteins.

There is commercial interest in arresting the changes in cheese during ripening to prolong its storage stability during marketing, especially those varieties of high moisture contents. Effects of freezing on cheese have been determined but Fennema (5) pointed out the lack of unanimity on the damage caused to cheese during freezing in a review of several studies on freezing cheese. Luck (7) concluded that frozen storage of cheese was suitable for Cream cheese and unripened Camembert and Brick cheeses but not suitable for Gouda and Cheddar cheese.

Shannon reported the effects of storage at -20.2°F and -0.4°F for 30 and 90 days on quality of Cheddar cheese (13). All samples were crumbly and 15 out of 40 were mealy after storage. Results of other studies suggested that

freezing of cheese may not adversely affect quality. Price reported on the possibility of frozen storage of 1-lb pieces of Cheddar cheese after suitable repackaging (12). He concluded that cheese could be held for up to three months under frozen storage with minimum apparent textural damage after thawing. In this report, it is suggested that minimum damage occurs when the temperature of cheese is reduced in less than 30 minutes through a range $\pm 2^{\circ}\text{C}$ of the freezing point. Price also reported that ice crystal formation occurred along curd particle interfaces.

This paper summarizes the research findings of Deborah L. Nelson (8, 11), M. Cervantes (1) and D. Dahlstrom (3). Nelson investigated the effects of salt concentration and age of cheese on the elasticity, meltability and stretchability of mozzarella cheese and its performance on pizza. Dahlstrom studied the effects of freezing and thawing, under commercial conditions, and subsequent storage after thawing on the properties of mozzarella cheese. Cervantes continued the work but looked at effects of faster freezing and salt concentration on properties of mozzarella cheese.

Experimental Procedures

Low-moisture, part-skim mozzarella cheese was purchased from a commercial cheese plant before or after brine-salting and transported directly to the University of Wisconsin for experimental treatment and analyses. Moisture, fat and salt concentrations were determined by standard, published procedures (1, 3, 8). The pH of cheese was measured by the quinhydrone electrode system. The firmness of cheese in Cervantes' research was determined with an MTS testing machine (1). The stretchability test used in Nelson's research was described at the 17th Annual Marschall Invitational Italian Cheese Seminar (11). Sensory characteristics of the cheese was determined by two experienced judges or by a larger technological taste panel.

RESULTS AND DISCUSSION

Salt Effects on Unfrozen Cheese

Commercial 5-lb loaves of mozzarella cheese were brine-salted for three time intervals to obtain the low, intermediate and high salt levels shown in Table 1. The - sign in Table 1 indicates low level of salt or age of cheese, + the high level and 0 the intermediate level. The range of salt concentrations, 1.06 to 1.88 fall well within the levels found in commercial cheese. The elasticity or rubberiness, stretchability, and meltability of the cheeses were determined by the Weissenberg test and are shown in Table 1. Sensory evaluations of the same cheeses on pizza by the technological panel are shown in Table 2.

According to the criteria shown in Table 3 which were established by Nelson (8), sample 1 (low salt, low age) in Table 1 exhibits moderate to pronounced elasticity. This would be based upon the height climbed being over 2 cm, the fracture time being less than 2 minutes, the point of fracture being at the edge of the pan and the texture (melting properties) being not smooth. The variation in salt at this young age does not seem to have a very significant effect since the protein structure in both samples 1 and 2 has not been broken down substantially. The hardening effect of salt is noticeable since the high salt cheese (sample 2) is extremely not smooth indicating low meltability.

This effect is noticeable also on pizza (Table 2) as sample 2 exhibited a low to moderate melt. The low stringing properties of this cheese on pizza probably resulted from lack of meltability.

Aging samples 1 and 2 had variable effects on characteristics of the cheeses. The low salt cheese (sample 3) lost some of its elasticity or rubberiness whereas the high salt cheese (sample 4) did not lose as much. Aging of both samples improved meltability (texture) both in the Weissenberg test and on pizzas.

Additional research should be done on effects of salt concentrations below 1% since our work suggests that substantial changes occur during aging of cheese containing little salt. Firmness of cheese as determined with the MTS compression tester indicated a substantial reduction in firmness of unsalted cheese during 21 days of storage at 40°F (1). However, the firmness of cheese containing 1.07% or 1.83% salt did not change significantly during storage for 24 days (Figure 1A). This suggests that variations in salt below 1% would have a much greater effect on firmness changes during storage than variations between 1 and 2% salt. However, other characteristics such as meltability and rubberiness as discussed earlier in this paper were effected by variations in salt content between 1 and 2%.

Effects of variations in salt concentration between 1.07 and 1.83% on selected properties of cheese are shown in Figures 1B, C and D. The intensity of salty taste did not differ greatly between the two samples at 8 days but was more discernible at 24 days. It is possible that more flavor developed in the low salt cheese which suppressed the salty taste whereas flavor development was not as great in the high salt cheese. The firmness scores by the sensory panel (Figure 4C) substantiated the lack of change during storage of unfrozen cheese as indicated by the open and blackened circles. Cohesiveness (Figure 4D) or lack of brittleness increased during storage of low salt cheese (open circles) reflecting the breakdown of cheese structure during aging. Cohesiveness of high salt cheese (blackened circles) did not change during storage and it had a more brittle body at 24 days as compared to the low salt cheese.

Freezing Cheese

Five pound loaves of mozzarella cheese were frozen at four rates. The three slowest rates encompassed commercial conditions in which boxes of cheese are palletized in a solid pile or by an open stacking method that allowed air to pass through the pallet load of cheese. The four rates were expressed as the time for the temperature of the cheese to change between 30°F to 20°F which is the region in which cheese freezes and is most likely to damage the structure of cheese. The rates, expressed as time to pass through the freezing zone, were 5.5 ± 0.5 , 26 ± 3 , 69 ± 8 and 125 ± 6 hours.

A large scale experiment involving 351 5-lb loaves of cheese was used to evaluate effects of the experimental variables of freezing rate, frozen storage temperature, thawing rate and tempering time after thawing and interactions of freezing rate and thawing rate, freezing rate and tempering time and thawing rate and tempering time. These experimental variables were evaluated for statistically significant effects ($P \leq 0.05$) on moisture content, compressive hardness, meltability, fat leakage, flavor score, body-texture score, and color uniformity of cheese.

Cheese evaluated immediately after thawing exhibited poorer meltability, greater fat leakage, acid flavor, free surface moisture, poor cohesiveness and bleached discoloration near the cheese surfaces. The cheese resembled high acid (low pH) cheese even though the pH of all samples was 5.20 ± 0.05 . The only experimental variable listed above which affected cheese characteristics most frequently was tempering time. It appeared as a significant main effect factor 52 times and 18 times in significant interactions. The other experimental variables had infrequent effects and did not consistently affect any particular characteristic of cheese at any stage of frozen storage of any batch of cheese. This was true for frozen storage temperatures between $+3^{\circ}\text{F}$ to -20°F , freezing rates between 23 and 130 hours and thawing rates between 12 hours to 60 hours. The freezing and thawing rates were defined as the time required for the product temperature to change from $+30^{\circ}\text{F}$ to $+20^{\circ}\text{F}$ or vice versa.

The effect of tempering time after thawing was evaluated in more detail over a shorter tempering time as shown in Figure 2. Intensities of sensory characteristics shown on a scale of 0 - 150 are average scores from two judges. Deviations between the judges were very small; consequently, the trends in Figure 2 accurately portray those from the two individuals. Intensity of acid flavor was quite high in samples immediately after thawing. This was observed also in similar samples in the large scale freezing study. Increased perception of acidity may have been related to the presence of more 'free water' in samples immediately after thawing. Moisture droplets were observed on freshly cut surfaces of cheese but were not evident in samples tempered for more than 3 days. The free water or serum could have made more immediate and intimate contact with taste buds to enhance the perceived acidic taste. Intensity of acid flavor decreased during tempering and approached the minimum level at 14 days. Aged flavor, which is an index of total flavor, was not apparent during the first 7 days of tempering but increased steadily thereafter.

The cheese became softer during tempering, but the intensity was relatively stable after 28 days. Cohesiveness increased (brittleness decreased) dramatically during the first 14 - 21 days of tempering. Results of cohesiveness evaluation substantiates results of the large scale freezing experiment which demonstrated that cheese was significantly more cohesive after 3 weeks of tempering as compared to the level of cohesiveness immediately after thawing.

Findings from the large scale and short-term freezing experiments indicate that cheese should not be used immediately after thawing. Cohesiveness approaches acceptable levels after 7 days tempering but is more suitable after 14 - 21 days. At this time, the acid flavor had dissipated and the aged flavor was not excessive. Since softening of cheese occurred steadily during tempering, the length of storage prior to use has to be a compromise between attaining optimum cohesiveness and avoiding excessive softening which would complicate shredding of cheese. It appears that a tempering time of 14 - 21 days would be desirable for part-skim mozzarella cheese containing about 48% moisture. Part-skim mozzarella containing less moisture (about 45%) exhibited less softening during tempering. It is likely that either freshly thawed cheese or cheese tempered over 45 to 60 days after thawing could not be shredded satisfactorily. The former would produce excessive fine particles and the latter would be too soft and pasty to be shred.

The adverse effects of freezing and thawing at the two slowest rates were not observed at the fastest freezing and thawing rates. It is possible that the faster rates minimized formation of large crystals of ice that would disrupt the structure of cheese. It would be difficult and impractical to attain such rates in commercial practice.

Salt Effects on Freezing

As shown in Figure 1, there was no statistically significant effect of salt levels on firmness and the sensory characteristics of frozen mozzarella cheese as compared to non-frozen cheese (1). This is interesting since the salt contents ranged from ca. 0.25 to ca. 2.3% in all the experiments and between 1.07 and 1.83% in those shown in Figure 1. Salt affects the degree of hydration of the protein and thus would affect the amount of freezable water. Since the salt is in the aqueous phase, the freezing point of the aqueous phase would be decreased for increased salt content and less ice would be formed at a given subfreezing temperature in samples with higher salt content. If it is assumed that all of the salt is in the aqueous phase, theoretically the amount of ice formed at -15°C in cheese initially with ca. 0.25% salt and 47% moisture is 44 g per 100 g cheese, whereas for cheese with ca. 2.4% salt, the amount of ice formed at -15°C is 34 g per 100 g cheese. Apparently this difference in amount of ice is not sufficient to cause detectable texture differences.

Unsalted cheese which was frozen at three days of age and then thawed underwent substantial softening during tempering for 21 days at 40°F . The firmness of cheese containing 2.4% salt which was frozen at 3 days of age did not change during tempering. The high salt cheese when frozen at 39 days of age exhibited some softening during tempering which probably reflects the effects of the body breakdown during that initial 39 days of ripening. The effect of variations in salt concentration between those extremes was not tested but it is likely that cheeses with less than 1% salt would soften to a greater extent during tempering than those containing 1 to 2% salt.

ACKNOWLEDGEMENTS

The contributions of Professor Daryl Lund, Deborah Nelson, Miguel Cervantes and Donald Dahlstrom in supervising and conducting the various phases of research reported in this paper are gratefully acknowledged. The research was supported in part by the College of Agricultural and Life Sciences and was funded by the Refrigeration Research Foundation, American Producers of Italian-Types Cheeses and the Quaker Oats Company.

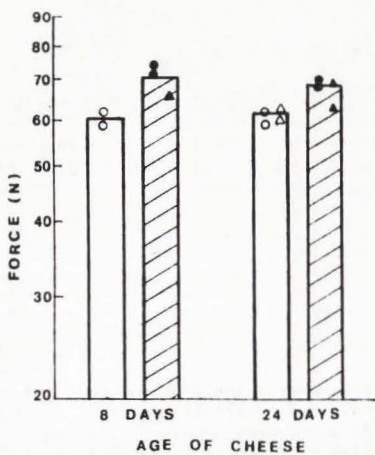
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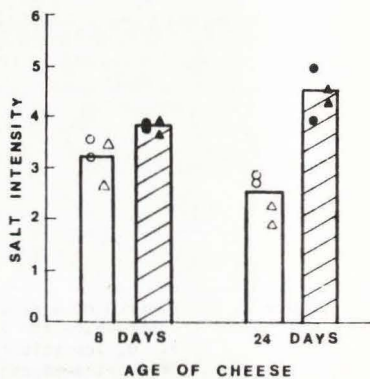
Figure 1.

Effects of age, salt and freeze-thaw cycle on force at 50% compression and sensory scores of mozzarella cheese. Experiment B. O, low salt (ca. 1.07%) non-frozen cheese; Δ , low salt frozen-thawed cheese; \bullet , high salt (ca. 1.83%) non-frozen cheese; \blacktriangle high salt frozen-thawed cheese.

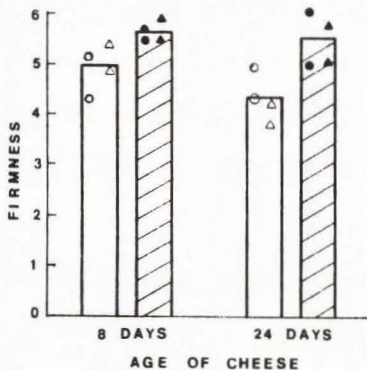
4-A. FORCE AT 50% COMPRESSION



4-B. SALT INTENSITY SCORES



4-C. FIRMNESS SCORES



4-D. COHESIVENESS SCORES

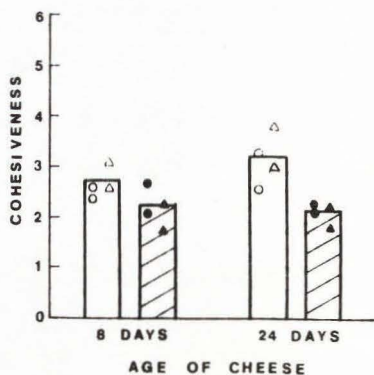


Figure 2. Results of short-term tempering time experiment which show intensities of selected criticisms of mozzarella cheese tempered for various intervals at 40°F after thawing.

<u>Variable</u>	<u>Symbol</u>	<u>Intensity</u>	
		<u>0 Score</u>	<u>150 Score</u>
Acid Flavor	Δ ————— Δ	None	Extreme
Aged Flavor	Δ - - - - Δ	None	Extreme
Body Firmness	□ ————— □	Very Soft	Very Hard
Body Cohesiveness	□ - - - - □	Very Brittle	Very Cohesive

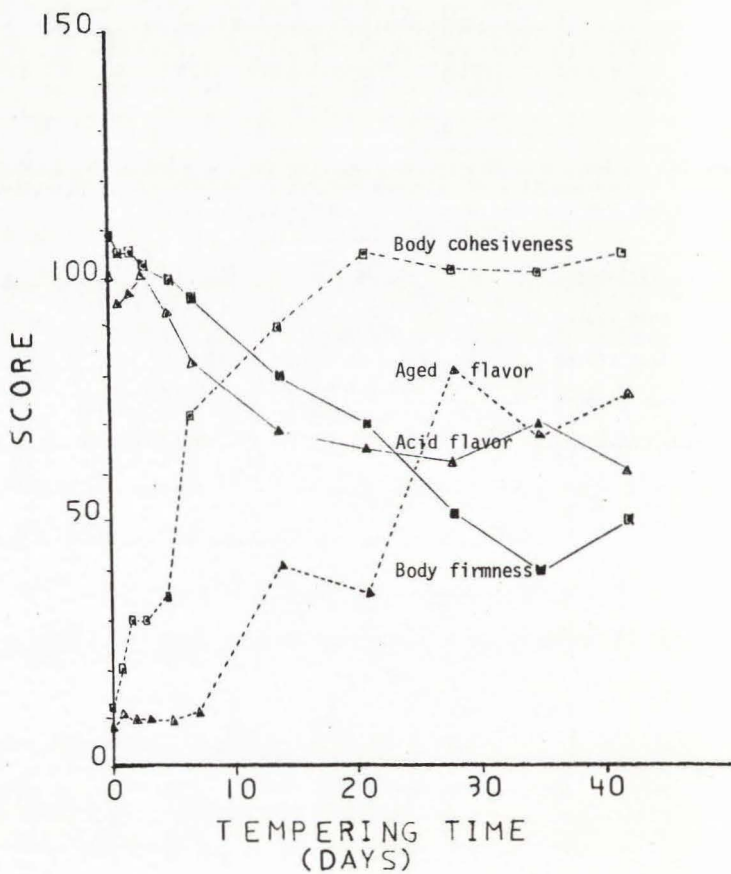


Table 1. Evaluations of four criteria from Weissenberg Test and moisture, fat, and salt.

Sample	Variable		Criteria						
	Salt (%)	Age (days)	Height (cm)	Fracture Time (min)	Place of Fracture	Texture	% Moisture	% Fat	% Salt
1	1.06 -	8 -	2.95	1.13	edge	+(3) ³ +(3)	47.14	22.75	1.06
2	1.78 +	8 -	2.52	1.17	rod (1) ¹ edge (5)	--(3) -(2) +(1)	46.66	23.0	1.78
3	1.08 -	24 +	1.85	2.25	int (4) ² edge (2)	+	47.40	22.5	1.08
4	1.88 +	24 +	2.96	2.03	edge	+	47.54	22.0	1.88
5	1.62 0	16 0	3.11	2.01	edge	+(1) +(5)	47.11	23.12	1.62

1 - number in parenthesis indicates the number of times out of six trials.

2 - intermediate

3 -- extremely not smooth

- not smooth

+ fairly smooth

++ smooth

+++ extremely smooth

Table 2. Sensory evaluations of cheese and cheese pizzas.*

Sample	Melt	String	Texture	Flavor
1 Low level salt Low level age	Moderate	Very good	Squeaky Rubbery	Bland Sour milk
2 High level salt Low level age	Low-moderate Water/pooling	Low	Squeaky Rubbery	Too salty but flavorful
3 Low level salt High level age	High	Moderate	Rubbery	Slightly bland
4 High level salt High level age	High	Moderate	Chewy	Good
5 Intermediate salt Intermediate age	High	High	Rubbery	Good

*Refrigeration went out on second week of aging.

Table 3. Measurements and observations from the Weissenberg Test used to place cheese in four elasticity categories.

Elasticity Categories	Criteria			
	Height Climbed (cm)	Fracture Time (min)	Place of Fracture	Texture
No Elasticity	0	0	Rod	Extremely smooth
Little Elasticity	<2	>4	Intermediate	Extremely smooth
Moderate Elasticity	>2	2-4	Edge	smooth
Pronounced Elasticity	>2	<2	Edge	Not smooth

The following paper was presented by M. E. Johnson, Program Coordinator, Walter V. Price Cheese Research Institute, University of Wisconsin, Madison, 1605 Linden Drive, Madison, Wisconsin, 53706, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

A COMPARISON OF AVAILABLE METHODS
FOR DETERMINING SALT LEVELS IN CHEESE

By Mark E. Johnson

ABSTRACT

Comparative salt analyses were run on six different types of cheeses using each of four methods; Mohr, Volhard, an ion selective electrode and a chloride analyzer. The results of the Volhard, Mohr and chloride analyzer methods were similar for unaged cheese types, i.e., Mozzarella, Cheddar, Ricotta, Romano and Provolone, but concentrations detected with the ion selective electrode were lower than the other three methods. Similar results were obtained with aged cheddar with the exception that the Mohr test proved unreliable. A constant correction factor could be used to make the electrode results similar to the Volhard test.

Introduction

Traditional methods for determining salt (NaCl) concentration in cheese have used titration of the chloride ion (Cl^-) with silver nitrate (3) or back titration of silver nitrate with potassium thiocyanate (1). A considerable amount of silver chloride and silver cyanate is produced which must be disposed of properly. Currently, the Hazardous Waste Program at the University of Wisconsin requires that silver compounds be collected as a solid and buried in approved hazardous waste disposal sites. Using methods for determining salt in cheese that do not use silver nitrate would circumvent problems of collecting and disposing of silver compounds. McNaught (4) demonstrated the use of an ion selective electrode for detecting Cl^- in a variety of cheeses. Although the use of these types of electrodes is not new, it is only recently that interest in commercial applications has developed. Recently, a chloride analyzer (2) has been adopted for use in measuring salt concentration in cheese. This method generates considerably less silver chloride during the analysis than either of the two titration methods, i.e., Volhard and Mohr methods.

This paper is concerned with the feasibility of using an ion selective electrode system or the chloride analyzer method in lieu of the AOAC approved Volhard test or the quicker Mohr test.

Methods

Comparative salt analyses were run on six different types of cheeses; one week old cheddar, one year old cheddar, one week old Mozzarella, one week old Ricotta, three month old Provolone and one month old Romano cheese. Each cheese was analyzed using each of the four methods; Mohr (3) without use of correction factor, Volhard (1), Orion ion selective electrode (4) and Corning chloride analyzer procedures (2).

Preparation of cheese samples for the ion selective electrode analysis was done by placing 1.0 g of cheese into a 250 ml beaker to which was added 100 ml of 0.1 M HNO_3 . The beaker was covered with aluminum foil, the solution stirred and heated to 85° to 90°C for 20 minutes and then cooled to ambient temperature. The tips of the electrodes were immersed in the sample solution for 30 seconds and the potential recorded in millivolts. Samples or standards were not stirred. The electrodes were wiped with an acetone soaked tissue between each reading to clear the electrodes of fat. At least three readings taken at separate intervals were recorded for each cheese sample. Standards containing 0.1, 0.01, 0.007, 0.003 and 0.001 M NaCl in 0.1 M HNO_3 were used in the daily calibration of the electrode system. The system was recalibrated and standards run after every 15 to 20 readings. This was necessitated by the considerable drift that sometimes developed in our system. Computation of the amount of Cl^- in each sample was accomplished by using the regression equation obtained from averaging at least four separate readings of each of the NaCl standards.

Preparation of cheese samples for the chloride analyzer method was done by placing 5.0 g cheese into a 250 ml beaker to which was added 98 ml of distilled water. The beaker was covered with aluminum foil and heated to boiling. The samples were then analyzed as outlined in the manufacturer's instructions (2).

Results

A comparison of the Volhard, Mohr, ion selective electrode and chloride analyzer methods for determining salt content in all the cheeses tested is given in Table 1. The results of the Volhard, Mohr and chloride analyzer methods were similar for the unaged cheeses, i.e., Mozzarella, Ricotta, and young cheddar, Provolone and Romano, but concentrations detected with the ion selective electrode were lower than the other three methods except for Romano. Greater discrepancies were evident for the aged cheddar. The Volhard and chloride analyzer results were similar, the Mohr tests were higher and the ion selective electrode results were lower than the salt concentrations obtained by the Volhard and chloride analyzer methods.

The precision (repeatability) of the Volhard, chloride analyzer and ion selective electrode methods were similar with the exception of Romano cheese. The precision of the Mohr test varied considerably regardless of the type of cheese tested. We have noticed that the repeatability with the Mohr method between technicians is not good and would account for the large standard deviations in our results since they are averages of fifteen samples, five samples per technician. Individual variation between the five samples of each technician are much lower than the variation observed between technicians. Cloudiness of the test solutions tends to mask the brick-red color endpoint, resulting in much of the variation observed. This is especially true in aged cheeses where proteolysis during curing results in more complete dispersion of particulate matter when cheese is mixed in water.

Our experience has shown that at least duplicate samples must be prepared and analyzed and each of the samples tested at least twice to obtain reliable results with the selective ion electrode system. Single samples tested several times will not suffice. Also, it is critical that test samples and standards must be analyzed at the same temperature since fluctuations in temperature as little as 1°C may change the detected salt concentration. The results of this study indicate that the electrode system and current extraction procedure will not yield salt analyses equal to those obtained with the Volhard method. If a correction factor of 1.05 were applied to salt concentrations determined with the electrode system, the results would closely approximate the Volhard test regardless of the type of cheese tested, with the exception of Romano cheese (Table 1). Our results using the ion selective electrode system are similar to those reported by McNaught (4).

Conclusions

When accurate and precise salt determinations are required for cheese, the Volhard procedure would be the method of choice. The Mohr test is comparable to the Volhard test on young cheese and is easier, cheaper and quicker to run. It can be recommended for use when speed is necessary only on unaged cheese but is not recommended when testing aged cheese. The use of correction factors with the Mohr test as suggested by Dixon (3) was not necessary. The main disadvantage of using either the Volhard or Mohr methods is the inconvenience of safe disposal of silver compounds after testing. The chloride analyzer method is rapid, easy to run and the results are comparable to the Volhard method. It also greatly reduces the amount of silver compounds to dispose of and can conveniently be used when testing a small number of samples.

Although the ion selective electrode is not as similar to the Volhard procedure as the other methods, it is easier to run than the Volhard and does not involve the use of silver nitrate. This

method yielded lower salt analyses than the Volhard test but this discrepancy was fairly constant. A correction factor could be applied to make the test results similar to the Volhard test.

Both the ion selective electrode and the chloride analyzer methods would be especially useful procedures when a large number of salt determinations are to be made.

Table 1. Comparison of the Volhard, Mohr, Ion Selective Electrode and Chloride Analyzer Methods for Salt Analyses of Various Types of Cheeses.

<u>Cheese Type</u>	<u>Volhard</u>	<u>Mohr</u>	<u>Chloride Analyzer</u>	<u>Ion Selective Electrode</u>	<u>Correction Factor 1.05 x ISE</u>
-----% NaCl-----					
Mozzarella	1.80 ± .04	1.80 ± .07	1.75 ± .05	1.64 ± .04	1.72
Provolone	1.50 ± .02	1.56 ± .06	1.55 ± .02	1.43 ± .06	1.50
Ricotta	.86 ± .02	.83 ± .02	.86 ± .02	.84 ± .04	.90
Romano	5.39 ± .04	5.44 ± .04	5.33 ± .04	5.50 ± .10	----
Aged Cheddar	1.86 ± .02	2.10 ± .18	1.91 ± .02	1.73 ± .04	1.82
Young Cheddar	1.40 ± .02	1.43 ± .06	1.40 ± .02	1.33 ± .04	1.40

The Volhard and Mohr test results are the means obtained from 15 samples, with three technicians analyzing five samples each.

The chloride analyzer and ion selective electrode results were obtained from at least three separate samples with at least three readings made per sample.

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The following paper was presented by V. L. Zehren, Ph.D., Director of Manufacturing Practices, Schreiber Foods, Inc., P.O. Box 610, Green Bay, Wisconsin 54305, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

SODIUM LABELING OF CHEESE

By Vincent L. Zehren, Ph.D.

ABSTRACT

A set of proposed rules amending the food labeling regulations for sodium content was published June 18, 1982 by the Food and Drug Administration (FDA). The FDA Commissioner urges voluntary cooperation of industry to reduce the level of sodium in foods and to make low sodium foods available to the consumer. The proposal also: (1) specifies that the sodium content be included in nutrition labeling, (2) eliminates the dual declaration of the sodium content, (3) provides for potassium content information on a voluntary basis, (4) defines terms to describe the sodium level in foods, (5) provides for the appropriate use of terms like "without added salt", "unsalted", and "no salt added", and (6) provides for the use of comparative label statements. Cheese is affected by these rules. Salt, the common name for sodium chloride, is an essential ingredient in cheese and its use must be true to the varietal characteristics of the cheese.

The sodium content of foods has been a long standing issue. Prior to the Reagan Administration, we were besieged by a flood of new regulatory initiatives coming out of Washington. These initiatives included the December 21, 1979 joint publication of FDA, USDA, and FTC on the tentative positions of food labeling(3). The government included sodium in this myriad of labeling proposals.

The Reagan Administration has cancelled these 1979 burdensome food labeling proposals with the exception of sodium. Dr. Arthur Hull Hayes, President Reagan's Commissioner of the Food and Drug Administration (FDA), came to the agency from the Hershey Medical School where he was in charge of the hypertension clinic. His special interests concern the overuse of sodium in foods. Dr. Hayes believes that reducing a patient's sodium intake is the first line of treatment for hypertension and that dietary control is much preferred to a drug regimen. He found it difficult to set dietary control programs for his patients because of the lack of information concerning the sodium content of foods and the lack of the general availability of low sodium foods.

Dr. Hayes set two goals: (1) to provide more information to the public about the relationship between sodium and hypertension in general public health, and (2) to encourage ways to reduce the amount of sodium consumed by the public.

To meet these goals, he proposed: (1) to encourage food processors to reduce the amount of sodium in foods, (2) to propose the labeling of the sodium content of foods. Dr. Hayes formalized these proposals and they were published in the FEDERAL REGISTER(6)(7) June 18, 1982 for comments.

Anderson (1) stated that the Research Committee of the National Cheese Institute addressed Dr. Hayes' goals for a possible reduction of sodium in cheese. The scientific literature was not very rewarding. There was little to suggest how the salt content (and salt consists of about 40% sodium) could be adjusted downward and still maintain the organoleptic characteristics true to the variety of cheese. O'Connor (13)(14) verified salt cannot be used indiscriminantly for uniform quality. Salt is a mandatory ingredient and serves several functions(5) including: (1) it restrains the growth of undesirable organisms and favors the growth of desirable organisms, (2) expells moisture from the curd, (3) is responsible for characteristic body, texture, and flavor of the cheese.

Lawrence and Gilles(10) reported that finest grade New Zealand Cheddar cheese contained between 4.0- 6.0 percent salt in the moisture. The grade level falls off when the percent salt in the moisture ranges to a low of 3.7 and a high of 6.3.

Olson(15) reported the affect of salt on the properties of mozzarella cheese containing 1.1% salt versus 2.1% salt. 8-day old cheese was more meltable and stringy for cheese containing 1.1% salt. The rubberiness was the same for both salt contents. 30-day old mozzarella low salt cheese had greater changes than high salt cheese. The body was weak, pliable and less brittle.

These are examples indicating that salt is necessary and may not be used indiscriminantly. To satisfy Dr. Hayes' goal to encourage the use of less salt, it is important to keep salt at a level to be consistent with a safe product, organoleptic characteristics true to the variety of the cheese, and to assure wide consumer acceptance.

The first proposal published in the June 18th FEDERAL REGISTER, was a notice to the industry concerning the GRAS safety review of sodium chloride. The Commissioner listed several regulatory options and noted the practical difficulties in setting and enforcing limitations on the amount of salt that can be safely used in a particular food. Cheese was specifically mentioned as an example because the use of salt in cheese is prior sanctioned for cheese because the cheese standards were originally published in 1948 and included salt either as an optional or a required ingredient. Under the 1958 food additive law, prior sanctioned substances are not subjected to the pre-marketing safety review of food additives. However, prior sanctioned substances do remain subject to the general adulteration provisions of the Food, Drug & Cosmetic Law, which prohibit the use of added substances that may render the food injurious to health. In the case of salt, FDA would have the burden of showing that it is a "poisonous or deleterious substance" and they conceded that the current uncertainty about the precise role of salt as the basic causative factor for hypertension would make it difficult to prove the use of salt would render a food injurious to health. Because of this, the Commissioner stressed voluntary reduction of sodium in processed foods. The Commissioner said if there is no substantial reduction or if sodium labeling is not adopted in a reasonable time, he will propose additional regulatory action, including a change in the GRAS (Generally Recognized As Safe) status of salt. The Commissioner listed several regulatory options available to him, including a proposal to revoke the GRAS status of salt and then declare salt a food additive, which would prescribe the permitted uses and levels of salt in manufacturing foods. We would hope the Commissioner would not need to resort to this drastic course of action.

The Commissioner also expressed a need to market food lower in sodium. The cheese industry was well ahead of its time. There are already specific low sodium cheeses appropriately labeled as to their sodium content in the market. The cheese industry

petitioned years ago, and there are now standards of identity (4) for low sodium cheddar cheese and low sodium colby cheese to accommodate those who must medically manage their sodium intake. The standards allow no more than 96 milligrams of sodium per pound. Presently, the low sodium cheese labeling must meet the dietary labeling regulations for sodium. There are two requirements: (1) a quantity statement - milligrams sodium per 100 grams of food, and (2) the quantity per serving. The sodium content is not declared in the nutrition labeling format. These low sodium cheeses are in the marketplace but have a very low level of acceptance because the flavors are bland and atypical.

Research at the Walter V. Price Cheese Research Institute compared the composition and consumer acceptance of cheddar cheese made with sodium chloride compared to a 1:1 mixture of sodium chloride and potassium chloride. Lindsay et al(11) determined that the moisture, fat, and salt in the moisture are comparable. The parts per million (ppm) fatty acids were higher in cheddar cheese made with a mixture of sodium chloride and potassium chloride. A very important finding was that consumers significantly preferred cheddar cheese made with sodium chloride. That confirmed industry's experience. Low sodium cheeses need to be accepted by the consumer to be a factor in the marketplace.

The second proposed rule published June 18th, deals with the labeling of the sodium content of foods. The old dietary food sodium labeling regulations will be amended to conform to amended nutrition labeling regulations. The proposal is very specific.

Under the proposal, a statement of sodium content would be required whenever nutrition labeling is used. If and when the sodium labeling became a final rule, it would be necessary to change all the present nutrition labeling to include sodium content in its format.

The declaration of nutritional information shall specify "sodium content" or "sodium as milligrams (mg.)" per serving of food, expressed to the nearest multiple of 5 mg. and shall be placed on the label immediately following the statement on fat content (and fatty acid and/or cholesterol, if stated). If a food contains less than 5 milligrams sodium per serving, it may be declared to the nearest mg. increment between 0 and 5 mg. or alternatively "5 mg. or less".

It is not necessary to declare potassium. However, potassium may be declared voluntarily on the label following the sodium content. If the food contains less than 5 mg. potassium per serving, it may be declared to the nearest mg. increment between 0 and 5 mg. or alternatively "5 mg. or less".

The proposal also defines terms, descriptive terms, to describe the quantitative content of sodium in foods. Those descriptive terms may also be used on the label. The terms are:

1. Sodium free - contains 5 mg. or less of sodium per serving
2. Low sodium - contains 35 mg. or less of sodium per serving
3. Moderately low sodium - contains 140 mg. or less of sodium per serving
4. Reduced sodium - applied to foods that are formulated to serve as and are represented as direct replacements for foods containing at least four times the sodium content; a 75% reduction. The label must also provide comparative information per serving with that of the food it replaces.

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The appendix of this report is a listing of the sodium content in milligrams (mg.) in the edible portion of the cheeses. The information is taken from USDA Agricultural Handbook 8 and contains the mean and standard error, mg./100 grams, the number of samples tested, and the mg./serving, generally a 1 ounce serving or as otherwise stipulated(2). Almost all cheeses contain more sodium than indicated for a "moderately low sodium food." The only cheeses, based on this data, that would qualify as "moderately low sodium" are cream, gruyere, mozzarella, low moisture mozzarella, part-skim mozzarella, neufchatel, whole milk ricotta, and swiss.

The USDA data, however, is of only limited value for use for sodium labeling. A more complete databank, either developed by industry or individual companies, is needed for assurances that the sodium information is not misrepresented. The proposal stipulates that the sodium content and potassium content shall be determined by the flame photometric or atomic absorption spectrophotometric methods of the Association of Official Analytical Chemists (AOAC). In addition, the proposal also states that a food with a label declaration of sodium shall be deemed misbranded unless the sodium content of the composite is no greater than 20% in excess of the sodium value declared on the label. There is considerable variation in the salt content within a single cheese and individual cheeses within a vat. This is especially true for brine salted cheese. There are even large variations for non-brined salted cheese. For example, O'Connor(12) reported a spread of 0.45% salt for the individual 40 lb. blocks of cheddar in the vat. Other vats showed spreads of 0.38, 0.36 and 0.19 percent for individual vats. Of course, the salt content of each vat of cheese varies, depending on many factors. Geurtz et al(8)(9) have published a series of papers dealing with the transport of salt in cheese and determined that the fat content, initial cheese moisture, pH, shape, temperature and concentration of the salt influenced the salt uptake in the cheese. The cheesemakers will need to exercise vigilant control to prevent misbranding in stating the sodium content on the label.

The labeling proposals also will permit the use of the terms "unsalted", "no salt added", and "without added salt" on the label. It points out that the term salt means sodium chloride and that salt is not synonymous with sodium. The terms "unsalted", "no salt added", and "without added salt" may only be used when no salt is added in processing and the food that it resembles and for which it substitutes is normally processed with salts. Sodium labeling must be provided on the label.

To summarize, the proposals published June 18, 1982 have a significant impact on the cheese industry. Commissioner Hayes is striving to achieve sodium labeling as well as a voluntary reduction of sodium in foods. He plans to monitor this program. If his ideas are not adopted, he can take other initiatives such as declaring salt as a food additive, which would prescribe the permitted uses and levels of salt in manufactured foods.

SODIUM IN mg. IN EDIBLE PORTION*

PRODUCT - CHEESE	mg/100g.		NO. SAMPLES	mg/1 OZ.
	Mean	± Std. Error		
Blue	1395	102.2	12	396
Brick	560	37.2	9	159
Brie ⁽¹⁾ (Footnotes shown on next page)	629			178
Camembert	842	62.4	10	239
Caraway ⁽²⁾	690			196
Cheddar	620	21.1	24	176
Cheshire	700		4	198
Colby	604	26.3	12	171
Cottage, Creamed	405	25.5	22	457/4 oz.
Cottage, Creamed, with fruit added	405			457/4 oz.
Cottage, Dry curd ⁽³⁾	13	3.6	6	14/4 oz.
Cottage, Lowfat, 2% fat	406			459/4 oz.
Cream	296	16.9	18	84
Edam	965	122	9	274
Feta	1116	100.4	4	316
Fontina**	—			—
Gjetost	600		1	170
Gouda	819		3	232
Gruyere ⁽⁴⁾	336			95
Limburger	800		1	227
Monterey	536	49.2	4	152
Mozzarella	373			106
Mozzarella, Low moisture	415			118
Mozzarella, Part skim	466			132
Mozzarella, Low moisture, part skim	528	54.9	11	150
Muenster	628	27.4	11	178
Neufchatel	399	20.2	12	113
Parmesan, grated ⁽⁵⁾	1862	296.6	4	528 ⁽⁸⁾
Parmesan, hard ⁽⁶⁾	1602	255.2	4	454
Port du Salut ⁽⁷⁾	534			151
Provolone	876	50.2	12	248
Ricotta, made with whole milk	84	29	4	104/½ cup
Ricotta, made with part skim milk	125	27.2	8	155/½ cup
Romano	1200		1	340
Roquefort	1809	157.4	4	513

* Taken from U.S. AG Handbook 8:1

** Dashes denote lack of reliable data for a constituent believed to be present in measurable amount.

<u>PRODUCT- CHEESE</u>	<u>mg/100g.</u>		<u>NO. SAMPLES</u>	<u>mg/1 OZ.</u>
Swiss	260	22.3	14	74
Tilsit, made with whole milk	753		2	213
American, Pasteurized Process	1430	65.79	13	406
Pimento, Pasteurized Process	1428			405
Swiss, Pasteurized Process	1370	64.66	6	388
<u>PRODUCT - CHEESE FOOD</u>				
American, Cold Pack	966		1	274
American, Pasteurized Process	1189	88.86	9	337
Swiss, Pasteurized Process	1552		1	440
<u>PRODUCT - CHEESE SPREAD</u>				
American, Pasteurized Process	1345	51.00	9	381

- ① Values based on addition of salt in amount of 1.6% of finished product.
- ② Values based on addition of salt in amount of 1.7% of finished product.
- ③ Values are for unsalted product.
- ④ Values based on addition of salt in amount of 0.8% of finished product.
- ⑤ Values were obtained by combining data for hard and grated samples on a moisture-free basis and recalculating results to a moisture content of 17.66%. Nutritive values shown do not apply to hard and shredded forms. Hard product contains approx. 29% water and shredded product contains approx. 25% water.
- ⑥ Values were obtained by combining data for hard and grated samples on a moisture-free basis and recalculating results to a moisture content of 29.16%. Nutritive values shown do not apply to shredded and grated forms. Shredded product contains approx. 25% water and grated product contains approx. 17% water.
- ⑦ Values based on addition of salt in amount of 1.3% of finished product.
- ⑧ 1 tablespoon (5g) contains 93 mg.

The following paper was presented by Mr. R.E. Gerner, Director of Technical Services, The Schlueter Company, P.O. Box 548, Janesville, Wisconsin 53547, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

ULTRAVIOLET BRINE/WATER PURIFICATION

WITH ROTARY DRUM STRAINER FILTRATION

By Ray E. Gerner

ABSTRACT

New developments in ultraviolet brine sterilization and continuous Rotary Drum Strainers are rapidly revolutionizing brining procedures. The old style cheese plant brining operations with layers of undissolved salt; the build up of cheese solids, fat and foam in brine solution; and without temperature or bacteria control are undergoing gradual improvements. Now a crystal-clear, salt water solution can be recirculated over a CONTINUOUS STAINLESS STEEL ROTARY DRUM STRAINER to remove cheese solids, fat and foam. Further, an ULTRAVIOLET RADIATION SYSTEM can improve the general sanitation maintenance of brine solutions to provide effective bacterial control. Ultraviolet Sterilization and Rotary Drum solids separation can:

1. Minimize brine solution disposal problems.
2. Reduce sewage/B.O.D. charges.
3. Reduce salt requirements due to longer use and eliminate absorption of salts into cheese solids, fat and foam.
4. Improve bacterial environment both in solution and in the air.
5. Eliminate need for chemical additives thereby avoiding off-flavors and chemical disposal problems.

INTRODUCTION

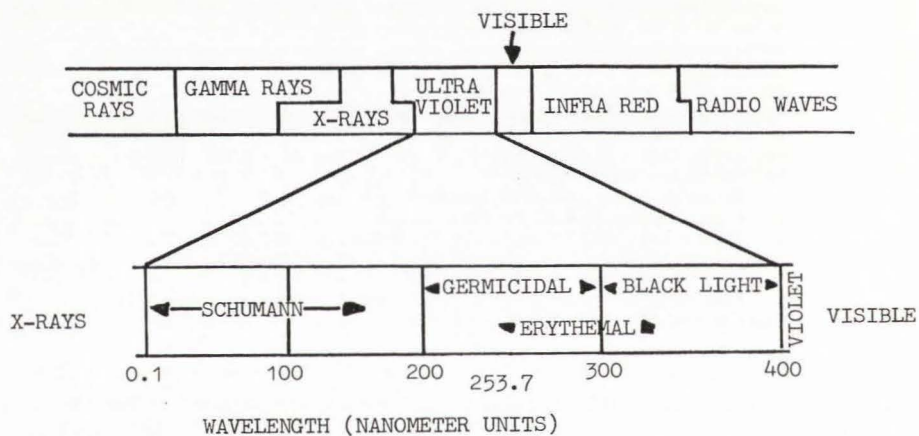
Exhibit 1 - ULTRAVIOLET BRINE PURIFICATION WITH ROTARY DRUM STRAINER FILTRATION

The Stainless Steel Rotary Drum Strainer head box receives both the brine solution and cheese solids particles. The rotating wedgewire cylinder with 0.005 inch openings separates the salt solution from the solids which ride freely on top of the wedgewire without vibrations or clogging.

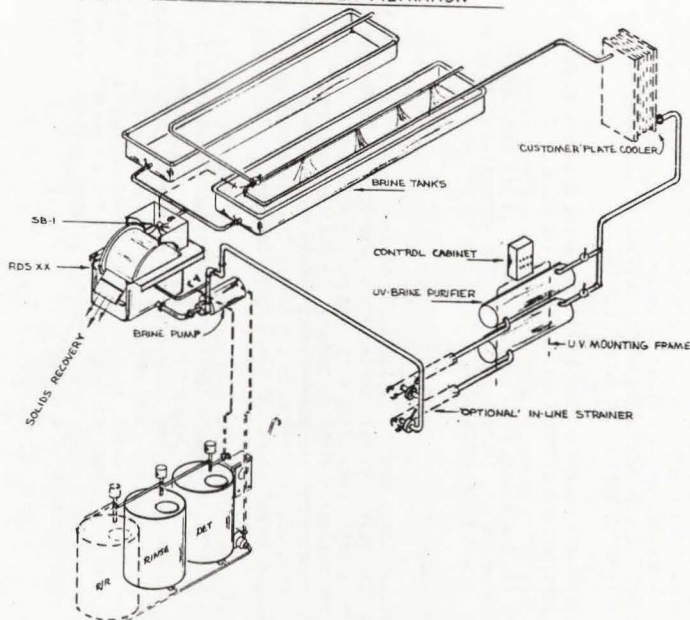
The adjustable blade removes solids on each turn of the drum. The wedgewire openings are self cleaned each time the drum turns.

The salt water solution is then pumped through the ultraviolet purification units and is subjected to short wave ultraviolet rays which kill the bacteria and other microorganisms.

The purified brine solution then is passed through the plate cooler or heat exchanger enroute back to the brine tanks. Misting or spraying the purified cooled brine solution over the top of the cheese provides uniform salting similar to pit brining by submersion.



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1. REDUCE BOD / SEWAGE
2. REDUCE WATER / SALT REQUIREMENTS
3. BACTERIAL CONTROL WITHOUT CHEMICALS
4. TOTAL 'CLEAN-IN-PLACE' CAPABILITIES
5. UNIFORM BRINE DISTRIBUTION

[illegible]

Germicidal Ultraviolet Lamps are manufactured of special short wave transmitting glass or quartz. These contain no phosphors and, therefore, allow 90% of the radiant emission at the 253.7 nm mercury spectral line.

Exposure to germicidal ultraviolet is necessary to kill bacteria and is based on time and intensity. High intensities for a short period of time, or low intensities for a long period of time, are fundamentally equal in their lethal action on bacteria.

An ultraviolet unit is constructed of a stainless steel cylinder with water tight sealed quartz jackets and with germicidal lamps inserted inside of the quartz liners. The control package includes ballast and starters and, optionally, has available UV sensor equipment. Ultraviolet radiation produces no ozone.

The killing of bacteria, viruses and other microorganisms by short wave ultraviolet is dramatized on these slides made through a microscope which magnified paramecia 200 times. A normal paramecium (A), after 30 seconds of treatment becomes distended (B), continues to swell by the weakening of the cell walls (C), and, finally dies of internal explosion which bursts its outer skin (D).

The cost of operation will depend on local utility rates, however, as many as 1000 gallons of brine solution can be purified for as little as 5¢.

Other applications for the Rotary Drum Strainer are: (1) for the separation of fines, (2) as a pre-filter before the clarifier, (3) for the separation of curd and (4) for the reduction of solids in effluent.

CIP SANITATION PROCEDURES

The quartz ultraviolet lamps must be periodically cleaned to provide effective transmission of ultraviolet rays. In this sense, it is just like sunlight shining through a clean window versus reflecting off a dirty window. The UV Units are constructed to withstand CIP recirculation washing, however, limitations are that temperature changes from wash solution to cold water rinses should never have an extreme of more than 40°F change. Most Ultraviolet Units and Rotary Drum Strainers can be CIP cleaned as part of the normal plant CIP clean up procedures.

With today's emphasis on environment and ecology, further benefits can be realized from Liquid Solids Precipitation by decanting the spent detergent and pre-rinse solutions into the Liquid Solids Separator. These detergent solutions are decanted off with only the liquid sent to the sewer, thereby minimizing soluble solids that could enter the effluent from the detergents. Plant waste and solids can likewise be collected through the floor drains into a special collector sump and sent over a Rotary Drum Strainer or Liquid Solids Precipitator. In future years, we will see even further advancements whereby a decanted solids solution will be ultraviolet purified before entering municipal systems.

SUMMARY

From both an economical and ecology standpoint, ultraviolet purification of brine solutions and rotary drum separation of solids from liquids will play a major role in the future of cheesemaking.

The following paper was presented by Mr. Neil A. Van Dyke, P.E., Associate, FOTH & VAN DYKE and Associates, Inc., P.O. Box 3000, Green Bay, Wisconsin, 54303, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

WASTEWATER MANAGEMENT: MEETING THE REQUIREMENTS

By Neil A. Van Dyke, P.E. and
Paul E. Thormodsgard, P.E.

ABSTRACT

The challenge of wastewater management can be met by systematically diagnosing existing operational conditions and by identifying process and wastewater treatment alternatives. Important elements in developing a management plan include: a) evaluation of user charge system (if any), b) in-plant waste survey, c) process modification/optimization, d) educational programs, and e) pretreatment or complete treatment systems.

The dairy industry has traditionally been faced with the challenge of production, quality and cost control, and consumer acceptance of the product. The ability to successfully meet these challenges has impacted directly upon the profitability of those engaged in the dairy industry. The decades of the 70's and 80's brings a new challenge for the dairy industry - the challenge of wastewater management, which also impacts directly upon profitability.

A fundamental part of coping with these new requirements requires an intimate understanding of the terminology of wastewater management. By necessity, dairy industry management must become familiar with terms such as POTW, sewer use ordinance, user charges, BOD₅, suspended solids, pretreatment, EPA/DNR, and discharge permit. Briefly, these terms may be defined as follows:

POTW - Publicly owned treatment works.

Sewer Use Ordinance - The ordinance by which a POTW or local authority regulates the users of a wastewater collection and treatment system.

User Charges - The basis by which system users pay for costs of wastewater treatment in a POTW.

BOD₅ - An accepted test procedure for measuring the organic strength of wastewater; it is normally a major factor in determination of the user charge and sizing of a treatment facility and is measured in mg/l or lbs.

Suspended Solids - Another measure of the strength of wastewater; represents solids in the waste stream which can be removed by filtration; also a factor in user charge systems and is measured in the same units as BOD₅.

EPA/DNR - Federal/State regulatory agencies which regulate the disposal of treated effluents into public waters or onto the land.

Discharge Permit - A permit required by Federal and State agencies to discharge treated wastewater into public waters or onto the land.

Pretreatment - Treatment methods which are employed for reduction of pollutant strength prior to discharge to a POTW. Pretreatment may be mandated by virtue of the sewer use ordinance or may be utilized as a cost-effective means of reducing overall treatment costs.

Wastewater Treatment Options

Two options for treatment of dairy wastewater generally exist. These include treatment of the waste effluent in a POTW or, alternatively, in a treatment facility managed by the industry. Where both options are available to the plant, the choice should be based on considerations which include:

1. Economic Analysis of Each Option
2. Public Relations Factors
3. Management Philosophy of the Company

Under the POTW alternative, the dairy industry must comply with the provisions of the sewer use ordinance and the user charge system. The sewer use ordinance will establish limitations regarding discharge of wastewater into the collection and treatment system.

Typically, these limitations may include:

1. A specified pH range normally of 6.0 to 9.0 is common.
2. Limitations on slug loads.
3. Requirements for spill protection.
4. Limitations on toxic pollutants.
5. Limitations on pollutant concentrations and/or hydraulic loads.

Limitations such as those described above are required to permit the optimum operational performance of the treatment works. POTW's which are still unable to comply with specified conditions of their discharge permit may even further restrict system users such as cheese plants.

Industries which treat their own wastes without use of a POTW will be liable directly for the requirements of their own discharge permit. The permit will establish effluent standards as well as reporting and testing requirements.

Whether treatment is provided in a POTW or in your own facility, wastewater treatment is an expensive proposition which requires considerable attention by dairy industry management.

The chief objective is therefore to identify and implement the most cost-effective alternatives available for wastewater management. In developing a wastewater management plan, consideration should be given to the following points:

1. User charge system evaluation (if connected to POTW).
2. In-plant waste survey.
3. In-plant modifications.
4. Educational programs.
5. Pretreatment.
6. Total treatment.

User Charge System

The user charge system adopted by the POTW establishes the basis for assessing charges for treatment of wastewater. It is absolutely essential that the user charge system be fully understood by dairy industry management. The treatment costs assessed to industrial customers at one Wisconsin POTW are summarized as follows:

Flow	\$650.00 per million gallons (MG) discharged
BOD ₅	\$0.25 per lb.
Suspended Solids	\$0.14 per lb.
Total Phosphorus	\$1.75 per lb.

For illustrative purposes, we shall consider a typical dairy wastewater with the following characteristics:

Flow	75,000 gpd	
BOD ₅	2,000 mg/l	1,251 lbs/day
Suspended Solids	700 mg/l	438 lbs/day
Total Phosphorus	50 mg/l	31 lbs/day

The monthly treatment charges are calculated as follows:

<u>Billing Parameter</u>	<u>Monthly Totals</u>	<u>Unit Cost</u>	<u>Total Cost</u>	<u>% Total</u>
Flow	2.25 MG	\$650.00/MG	\$ 1,463	10%
BOD ₅	37,530 lbs.	\$ 0.25/lb.	\$ 9,383	65%
SS	13,136 lbs.	\$ 0.14/lb.	\$ 1,839	13%
T.Phos.	930 lbs.	\$ 1.75/lb.	\$ 1,628	12%

TOTAL MONTHLY TREATMENT COST

\$14,313/Mo. 100%
\$171,756/Yr.

Calculation of billing components, such as those illustrated above, provides management with an insight into the relative significance of each billing parameter and permits the development of a detailed strategy for cost reduction.

For example, in the above illustration, BOD₅ represents approximately 65% of the total billing and is obviously an area in which substantial cost reductions may be possible. The other areas in decreasing magnitude would be suspended solids, phosphorus, and flow.

It is important to remember that data generated from an industry's effluent monitoring system provides the basis for calculating treatment charges. It is advantageous for a dairy to insure that flow and sampling data are truly representative of actual conditions. Procedures which can be employed to this end include:

- a. Collecting samples from a well mixed area of the flow stream.
- b. Samples should be taken in proportion to the volume of flow.
- c. Periodically checking the calibration of flow monitoring equipment and independently verifying analytical results by splitting samples for testing with more than one lab.
- d. Assign, train, and hold one person responsible for the routine inspection, operation, and maintenance of monitoring equipment.

In-Plant Survey

In developing a strategy for wastewater management, it is essential that the individual waste streams which comprise the total effluent be identified and characterized. In other words, the flow and pollutant concentrations from each source must be known. Such a survey permits an identification of problem areas and reduces one complex problem into a number of more clearly defined and possibly simpler problems.

For illustrative purposes and with reference to our previous example, we shall assume that an in-plant survey was conducted to pinpoint the source of BOD₅ loading and that three waste streams were identified with flows and BOD₅ concentrations as follows:

	Flow (gal/day)	BOD ₅ (mg/l)	BOD ₅ (lbs/day)	% of Total BOD	% of Total Vol.
Stream 1	67,000	575	321	26%	89.3%
Stream 2	6,900	5,000	288	23%	9.2%
Stream 3	1,100	70,000	642	51%	1.5%
Plant Total	75,000	2,000	1,251	100%	100%

The significance of our illustrated example is obvious. If waste Stream 3 can be eliminated, (comprising only 1.5% of the total volume) monthly BOD charges will be reduced by 51% with a monthly cost savings of \$4,815 (\$57,780/yr.)

In-Plant Modifications

One approach to managing wastewater involves in-plant modifications. Such an approach is a good one because it is directed toward the source of the problem. After each process waste stream has been characterized, a thorough evaluation should be made which addresses the following points:

1. Can the waste material be recycled or disposed of in a manner other than the process sewer?
2. Can the quantity of waste be reduced by process optimization or modification?
3. Can equipment replacement or increased automation be used to advantage?
4. Is the process prone to operator error? Can operator procedures be modified which reduce the waste discharge? Can housekeeping procedures be improved?

Published reports (1,2,3) describe a number of possible techniques to reduce water consumption and waste generation. Several of these techniques are summarized as follows:

1. Optimize CIP systems by making provision for product recovery and for re-use of final rinse water. This area may also be instrumental in controlling pH and reducing phosphorus amounts in the wastewater.
2. Dispose of sludge material collected from automatic separators or clarifiers by means other than the process sewer.
3. Equip hose stations with automatic shutoffs to promote water conservation.
4. Install liquid level controls to prevent system overflows.
5. Thoroughly drain all lines, tanks, and processing vats before rinsing. Modify systems as required to promote proper drainage.
6. Develop alternative uses, such as animal feed, for waste products originating from recoverable rinses, spilled product, and spillage collected from drip shields and system leaks.
7. Utilize production scheduling techniques to minimize frequency of start-ups and shutdowns on waste generating stations, and optimize the sequence of processing to avoid unnecessary clean-up between products.
8. Utilize engineering techniques in expansion and remodeling projects which minimize waste generation.
9. Consider water usage and waste discharge criteria in the selection of equipment, processes, and systems.

Educational Programs

As a result of an in-plant survey, management may find that a substantial part of the waste load is operator related, i.e. operator action or inaction which adversely affects the discharge. Under these circumstances, an educational program directed toward waste management can be used to advantage. The employee educational program (4) may include a number of techniques and topics as follows:

1. Explain the need for water conservation and waste prevention. Describe the importance of successfully controlling waste materials in terms of benefits to the employees and community.
2. Explain the terminology of wastewater management.
3. Cite examples of good practices for reducing water usage and waste. Utilize slides and other illustrations depicting poor practices.
4. Seek the active participation of employees in attacking water and waste problems.
5. Insure that the program is on-going and continuous. Inform employees on the results of their efforts and continue to emphasize areas where further attention is required.

Pretreatment

Pretreatment is another alternative available to the dairy industry for wastewater management. It may be employed as a sole remedy to reducing wastewater treatment costs, or perhaps more cost-effectively in combination with other in-plant measures previously discussed. Assuming that pretreatment is not mandated by the sewer use ordinance, the justification for pretreatment is largely a question of economics. The cost savings in the form of reduced treatment billings must be weighed against the capital and operating expense which will result from the pretreatment facility. Alternatives which should be explored to determine the optimum pretreatment system include:

1. Should all waste streams be pretreated or is it more cost-effective to pretreat only one or two of the streams?
2. What is the optimum level of pretreatment, i.e. is the optimum concentration of effluent BOD₅ 1,000, 500, or 200 mg/l?
3. What are capital expenditures and annual operation and maintenance costs vs. current user charge costs? (Note: various tax incentives should be included in analysis.)

Complete Treatment

The alternative for complete treatment requires that the wastewater be treated sufficiently well to meet the requirements of the discharge permit. Additional requirements of the permit may include a sludge management plan and periodic sampling and reporting requirements.

Several treatment processes can provide excellent effluent quality in the treatment of dairy plant wastewater (5). These include activated sludge, oxidation ditch, aerated lagoon, biological discs, and land application methods. The criteria for selection of an optimum system includes effluent requirements, site limitations, wastewater characteristics and variability, design life, and costs.

Summary

The wastewater management alternatives available to the dairy industry are varied and complex. The optimum solution will be dependent upon the particular requirements of each facility and may include process modifications, educational programs, and pretreatment or complete treatment of wastewater. With sufficient management attention and employee cooperation, the challenge of wastewater management is one which can be met.

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The following paper was presented by Mr. Joachim E. Manning, Bio-Control Engineering Manager, Cutter Laboratories, Inc., Berkeley, CA 94701, U.S.A., especially for the 19th Annual Marshall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

MAXIMIZING THE INHIBITION OF PHAGE THROUGH AIR FLOW CONTROL

By Joachim E. Manning

ABSTRACT

Bio-Control environmental systems which are virtually free of all airborne particulates, both inert and microbial is recommended for the control of bacteriophage contamination for cheesemaking facilities. High quality aseptic isolation for critical process areas is achieved by HEPA/LAF control in tandem with proper area sanitation as well as effective Bio-Control handling techniques.

What a pleasure it is to address you on the occasion of the 19th Annual Marshall Italian Cheese Seminar! This event affords me an opportunity to share with you some available technology that has been of considerable benefit in other industries. My professional background is in Bio-Control engineering and I have spent many years with NASA and in the pharmaceutical profession where I have designed and applied Bio-Control environmental systems. The aim of such systems is the creation of aseptic process environments for sterile operations. It is the introduction of some of this technology into the cheesemaking industry that I want to talk about today.

My main interest today is in developing some facility design recommendations to control bacteriophage contamination of the cheesemaking process. Recently, through the help of Norm Wood, I had a crash course in the villainous role of bacteriophage in cheesemaking, and I have come to understand how phage control represents a vital challenge to cheesemakers, Italian and otherwise.

The phage is a particularly meddlesome contaminant because it is so widespread in all environments, not only in cheese factories. As cheese manufacturing has grown to its current immensity in the food industry, the disastrous effects of phage contamination can wreak economic havoc on a scale that demonstrates the inadequacy of current phage control measures. The degree of menace posed by phage contamination to cheesemakers requires the infusion of new means for control.

Bacteriophage is a viral protein of inordinately small sizes, roughly 200 millimicrons long and 70 millimicrons wide at the head. Shaped like a tiny sperm, a phage is actually not technically a living thing; instead, it responds favorably to contact with certain bacteria in optimal environments. One such optimal environment is in bacterial starter cultures for cheeses, a prime target for the phage contamination which attaches itself to these valuable bacteria, penetrates them, pours its genetic material inside the bacteria, where more phages develop, ultimately bursting the bacteria in a process called Lysis. It's the story of Alien on a microscopic scale, and left unchecked, phages can put a stop to cheese production.

Those of you who are aware of the papers by Verle M. Christensen, the President of the Marshall Division of Miles Laboratories, and Mr. Harold L. Rasmussen, know that the specific sources of phages are difficult to pin down in general terms, but within the world of the cheese factory, phages are present on surfaces (wall, floors, drains,

equipment, etc.) and in the air. What I can say about the sources of phage contamination reviews their observations; phages are prevalent in environments that further their survival, and such environments necessarily include sites that encourage the bacteria in which they multiply. In particular, phages are prevalent in the dust and whey of cheesemaking facilities.

In fact, phages thrive in the presence of the bacterial organisms in cheese starter cultures. Within 20 to 30 minutes after attack by an analogous phage particle a cell will lyse, releasing hundreds of additional phage particles. The net result is that acid production in the vat is slowed if not halted by phage contamination resulting in a vat of undergrade cheese, which is costly to the cheese factory.

As I mentioned, phages appear on surfaces in cheese processing areas and also in the air. The control of phages in such areas, of course, begins with proper sanitation of all surfaces in cheese vat areas; this includes not only equipment in direct contact with starter cultures but also walls, floors, drains, etc., in areas where starter cultures are called upon to "do their job" in vats. Meticulous sanitation procedures for all surfaces in the process area provide a good start to control phage contamination. Such sanitation requires the use of chlorinated cleaning solutions followed by sterile rinsing of equipment to discourage the presence of phages in contact with starter cultures. Most cheese manufacturers observe well-planned sanitation of their process areas, and these measures help to increase the efficiency of their production efforts.

However, the other source of phage contamination is through "aerosol transport" of the phage. Material suspended in air is called an "aerosol;" dust - smoke - microbial flora - any material whose particle size is small enough to stay suspended. So, we are talking about an invisible world, but which is filled with many dangers. Because phages are miniscule viral protein structures, they can be carried anywhere in the atmosphere by the aerosol route. They can be transported by themselves or in microscopic bacterial and particulate agglomerations throughout manufacturing process areas. The result is that surface sanitation can be virtually negated as the processing steps are undertaken. You should know that air often contains millions of particles per cubic foot and each of these particles is capable of harboring phages. Therefore, the prime challenge is to remove all such phage aerosol particles from the air in which the critical starter culture activity is undertaken.

As recently as ten years ago, it was doubted that air could be filtered to the extent of eliminating bacteriophage virus. Whereas air filtration systems can remove particulates of 0.3 microns diameter and larger from the air, the phage, which is smaller than that, was believed capable of passing through such filters. Doubts about the efficiency of air filtration, based as they were on numbers, as well as a lack of sophistication about high efficiency air filtration technology, did little to encourage the implementation of bio-control environmental systems in cheesemaking process areas. What was lacking was an analytical approach to the problem of engineering the environments in which cheeses are produced. And what I would like to recommend is that the technology for dramatically reducing the risk of airborne phages in such environment exists.

One of the first principles of bio-control engineering technology is that you must define the critical process in any operation. The critical process is that process most vulnerable to contamination. Assuming that contamination in raw materials and surfaces have been eliminated or at least controlled, the critical process can still be exposed to the atmosphere. Thus, we are speaking of a "high-quality atmospheric isolation" of sensitive areas. Therefore, critical processes, such as starter culture

activity, must be effectively isolated from other less critical processes, such as raw milk storage. Once the critical processes are identified, every effort to shield them from the potential contaminants of the atmosphere must be taken.

One of the basic tools of isolating critical processes is creation of separate areas for those processes. For instance, it is clear that raw milk holding tanks should be separated from the pasteurizing and vacreator equipment. However, it is not enough to place different sensitive operations in single rooms, if those operations are vulnerable to airborne contamination. Therefore, the air in which such operations take place must be filtered of phages and the aerosol particles that harbor them.

Two important techniques that address and largely eliminate these problems are High Efficiency Particulate Air filtration (HEPA) and Laminar Air Flow (LAF). HEPA filtration utilizes banks of filter material that can remove up to 99.97% of all particulates 0.3 microns in diameter from air. Laminar air flow is the result of containing the movement of air so that it is unidirectional within a space. The combination of HEPA filtration and Laminar air flow is highly effective in creating sterile, particulate-free process environments, and it is often referred to as HEPA-LAF.

Whereas it is not my intention to bore you with extensive details of "aseptic air-flow dynamics," I must, however, say a few words about the combined benefits of HEPA-LAF environments. Although we seldom see it, air is an amazingly fluid material, deferring in its movement to almost any substantial matter it encounters. The creation of Laminar air flow, however, forces all the air in a given space to flow in the same direction. If some objects breaks the air flow in such an environment, the total unidirectionality of the air flow ultimately corrects the turbulence and random direction initiated by the object. This property of Laminar air flow is extremely important, because it creates what is called a self-clean down capability for environments in which Laminar air flow appears. Self-clean down capability is the ability of a contamination controlled system to purge itself of contamination.

When such air is filtered with HEPA filtration, the result provides a means for removing microbial aerosols from the atmospheres of critical spaces. In the pharmaceutical industry, for example, where certain manufacturing processes must be carried out in absolutely sterile environments, we have found that HEPA-LAF aseptic air isolation of critical operations can assure the purity of the end product, particularly when terminal product sterilization is not possible. The benefit of HEPA-LAF isolation is that the process is made clean and kept clean without in any way affecting the process itself. Filtered air is particularly well suited to the job of assuring environmental bio-cleanliness; air is largely inert, and its use as a transport vehicle for removal of aerosolized phage contamination makes imminently good engineering sense.

It must be remembered that HEPA-LAF aseptic isolation achieves its high rate of success in tandem with proper area sanitization, as well as effective bio-control handling techniques. To round out this brief discussion, we must stress that bio-controlled environments result from an interdisciplinary approach. The design for such facilities not only acknowledges high efficiency filtration and controlled air flow characteristics, but also an awareness of the specific activities carried out in the critical area. The bio-control system for a plasma fractionation operation is never the same as for a surgical theater. The bio-control engineer takes into account the job being done, the materials being used and the contaminants being eliminated.

If we analyze the general process layout in a cheesemaking facility, we can definitely see that starter culture areas must be isolated, because they are the most vulnerable

to phage contamination. So, the first step is to contain the starter cultures in a separate room. I recommend that the air in such a room be HEPA filtered and that the air flow around the culture containers exhibit Laminar air flow characteristics. In this way the potential phage-bearing particulates can be eliminated. To assure this, the room should have a slightly positive air pressure (that is, if a door were opened, the air inside would go out, not vice versa). A positive pressure of 0.05 inches on a water gauge is recommended. Also, exhaust grilles that receive the contaminated air should be placed in the direct line of the Laminar air flow so that the particulates have precious little opportunity to be re-introduced into the environment, thus, re-endangering the critical process. As air is recirculated through the filtration system, virtually all particulates generated in any one "pass" are eliminated, and the culture development proceeds apace. One more remark about the location of exhaust grilles - exhaust grilles must not be placed high in the ceiling over exposed cheese vat locations - updraft created in such configurations allow aerosol particles to collide and agglomerate and re-enter sensitive process areas by fall-out.

The cheese vats themselves should be maintained in a separate room in which HEPA-LAF environmental control, with horizontal air flow over the vats, is implemented. In this way, aerosol contamination is minimized, positive air pressure is maintained, and the aerosol route is aseptically controlled and constantly purged. Open whey holding tanks should be kept away from the cheese vat areas, because, as we know, the whey harbors enormous quantities of phages, and aerosolized phages can easily be re-introduced into the atmosphere, from which they can re-settle into the cheese vats.

Now, if separate rooms for processing areas are not feasible, as in a smaller operation, then the design of the single-room cheese factory can exploit the benefits of HEPA-LAF technology to "bio-isolate" various critical processes to eliminate the danger of product contamination through phages. A general rule of thumb is that filtered air flow patterns should shield the most sensitive areas, that is, the starter culture areas, pasteurization areas and the cheese vat areas. Less sensitive areas, such as the whey holding tanks can receive filtered air flow from the higher-risk areas. Besides using HEPA-LAF air shielding, physical shielding such as plastic drapes can also isolate the critical processes.

The benefits of HEPA-LAF technology with regard to phage control cannot be too carefully stressed. As I mentioned, phages are carried in the air on lifeless particulates, on airborne bacteria and even by themselves. When the phages reside on other particles, the HEPA filtration can easily eliminate them, because such particles are almost invariably larger than 0.3 micron diameter. However, even phage themselves, much smaller than 0.3 micron, are impeded by the HEPA filtration; the airborne phage bodies, in such situations experience Brownian movement, a variety of vibration that, in effect, increases the amount of space the phages occupy. The net effect is that surprisingly few phages can pass through the HEPA filter, dramatically reducing the phages' ill effects in starter cultures and cheese vats.

The introduction of new technological elements into established processes does require some capital investment. However, you may take heart that much of the development in bio-control engineering technology of late has been the refinement of "downsize" versions of earlier HEPA-LAF implementations. The appearance of small HEPA-LAF installations that isolate only the processes and items requiring bio-clean isolation has done much to guarantee the cost-effectiveness of adopting this technology in industries where previously it was deemed too expensive. In the cheesemaking industry, the implementation of bio-controlled processing areas has yet to be evaluated, but I am fairly confident that well-designed bio-controlled environments that are not over-engineered can easily prove their cost-effectiveness in immediate reductions in product

Loss due to phage contamination.

In summary, I hope that all you participants in Marschall Products' Italian Cheese Seminar can realize the dimensions of phage contamination in this simple equation:

Phage Source Intensity X Transport Means = Starter Culture Failure Rate

Quite simply, the goal of bio-control environment engineering is not only to reduce if not totally eliminate both the intensity of phages at their sources, but also to cripple their means of transport so that the starter culture failure rate is accordingly reduced. By examining your current process environments and implementing the correct bio-control solutions to phage contamination problems, you can significantly increase the output and quality of your operations.

Thank you for your kind attention.

The following paper was presented by Dr. Robert C. Lindsay, Department of Food Science, University of Wisconsin-Madison, Madison, WI 53706, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

QUANTITATIVE ANALYSIS OF FREE FATTY ACIDS IN

ITALIAN CHEESES AND THEIR EFFECTS ON FLAVOR

By Robert C. Lindsay

ABSTRACT

A recently developed method for routine, accurate measurement of free fatty acids in cheeses has been adapted for use with Italian varieties. A survey of commercially available Mozzarella, Provolone, Parmesan, and Romano cheeses showed a wide range of concentrations of flavor-important short-chain free fatty acids. These data were confirmed by sensory analysis, and support contentions of food processors that the flavors of commercial Italian cheeses vary widely making flavor standardization difficult in prepared foods. Increasing concentrations of free fatty acids were found in cheeses during aging or curing, and concentrations of major, even-numbered, short-chain free fatty acids are good indices of flavor intensity in Italian cheeses. However, they fail to adequately predict flavor quality. Current evidence indicates that branched, short-chain free fatty acids are key to the flavor quality of cured Italian cheeses, and quantitative methods are needed for these trace-concentration flavor compounds for predicting flavor quality of Italian cheeses.

Italian cheese consumption has greatly increased in recent years, and much of this increase can be attributed to their popularity as ingredients in a wide variety of prepared foods. Further, a great deal of this demand can be directly related to the desirable, distinctive flavors provided to foods by Italian cheeses. The free fatty acids or FFA have long been recognized as the class of compounds responsible for the flavors of aged cheeses, and the lipase enzyme technology available today has been developed to assist in providing the characteristic flavors to each variety.

Even though free fatty acids have long been recognized as key to cheese flavors, and gas chromatography has been successfully used in the analysis of fatty acids, information in the literature is inadequate to support the development of quality control procedures for close monitoring and control of cheese flavor quality and intensity. For some time now we have been involved in an intensive research program to develop accurate and dependable methods of analysis for free fatty acids in dairy products. Additionally, similar efforts have been directed towards a systematic assessment of the flavor properties of the individual free fatty acids and various combinations of free fatty acids. In this paper a new method for the quantitative analysis

of free fatty acids in cheeses will be reviewed, and its application to Italian cheeses will be discussed. Additionally, attention will be directed towards a new group of flavor-active short-chain free fatty acids that appear to be responsible for much of the distinctive flavors which develop during longer-aging of Italian cheese varieties.

Information on the role of free fatty acids in cheese flavors can be found in recent summaries by Haug and Dooley (1) and Shahani and coworkers (3). A detailed discussion of the effects of pregastric esterases and lipases in Italian cheeses has been presented by Shahani at an earlier Marschall Italian Cheese seminar(2). However, the data presented in this earlier work is very questionable, if not totally unreliable, because of hydrolysis of milkfat to free fatty acids caused by reagents in the procedures. These difficulties have been overcome in the method reported by Woo and Lindsay (4, 5), and the procedure has been adapted for use with Italian cheeses.

Basically, the new procedure involves the removal of lactic acid by a special partition pre-column (Figure 1a), which is then followed by the isolation of free fatty acids from cheese extracts on an alkaline arrestant column (Figure 1b). After concentration, gas chromatography is used to separate and quantitatively measure recovered free fatty acids, and a typical gas chromatogram of free fatty acids in Cheddar cheese is shown in Figure 2. The short-chain acids with 4 to 10 carbon atoms are responsible for the aroma contribution of free fatty acids while the longer chain acids contribute taste properties, especially those related to soapiness. Analysis of free fatty acids in Italian cheese varieties require minor adjustments in the procedure for Cheddar cheese, namely for amount of acid added to adjust the pH to 1.5 and for amount of total free fatty acids in relation to sample size used.

Most of the earlier literature describing the flavor effects of free fatty acids in cheese report relative mole percents (mole %) of each acid in the group, but do not present actual quantitative data for acids present. While this convention presents qualitative comparison profiles, it fails to accurately relate the quantitative or intensity aspect of each fatty acid present. Thus, for the purposes of assessing flavors of Italian cheeses in current studies, data are presented in actual concentration on a parts per million (ppm or mg/kg) wet weight basis.

Typical quantitative free fatty acid profiles for several cheese varieties are shown in Table 1. The low concentrations of all free fatty acids for Mozzarella cheese is readily apparent, and this is expected based on the flavor of this cheese. Nevertheless, the concentration of $C_{4:0}$ is sufficient to contribute to the overall characteristic flavor of Mozzarella. The data for the free fatty acids of Cheddar and Swiss cheeses reveal that Cheddar is less dependent on a high intensity of free fatty acid flavor than is Swiss cheese. Comparison of the free fatty acid profiles of Provolone, Parmesan, and Romano cheeses show a substantial variation both quantitatively and relatively between the three varieties. It is tempting to make some assessments relating to the flavor quality of each based on these data. However, sensory analysis of these products indicated that the absolute quantities of the short-chain free fatty acids provides flavor intensity information, but does not reveal the basis for the peccorino and piccante flavors of the cheeses. Thus, other factors beyond these free fatty acids appear to be responsible for the unique flavors, and more will be discussed about these later.

Since the measurement of the major even carbon-numbered short-chain fatty acids provides a means of indexing flavor intensities of Italian cheeses, several samples of each were surveyed to determine the degree of variability existing in today's commercial cheeses. Typical results are shown in Table 2 for Romano cheeses. Noting specifically the $C_{4:0}$ through $C_{10:0}$ free fatty acids, it can be seen that substantial variability occurred between samples. In terms of flavor strength, for example, sample #3 would be approximately twice as strong as sample #1. However, knowing this information it would be possible to standardize and/or blend to achieve cheese flavor strengths suitable for controlled ingredients in formulated foods. The sample of grated Romano was included to illustrate the total flavor strength represented in this product, but it must be remembered that the concentrations presented here are on an "as is" basis for each cheese product.

Extended aging or curing is now required to achieve the development of desired flavors in Romano and Parmesan. As a part of the overall experiment, several samples were analyzed at selected intervals during aging, and some of these data are included in Tables 1 and 2. Generally, the individual free fatty acids in a given cheese increased with time, but the Mozzarella and the Romano samples did not show increases over the times indicated for each. Sensory analysis showed the flavors of the Parmesan and Romano cheeses to be increasingly characteristic, but considering the free fatty acid profiles of mature cheeses (Tables 1 and 2), further increases in concentrations of the major free fatty acids would not appear to account for the mellowing of the flavors.

Evidence at this point indicates that a group of branched, short-chain fatty acids that are present as minor normal constituents of milkfat are released by esterases, and finally reach levels which influence the flavor of aged Italian cheeses. In Figure 3, the small peaks shown between the major peaks of $C_{4:0}$ and $C_{12:0}$ represent these compounds. The concentration of these new fatty acids is much less than those of the traditionally studied fatty acids, but their flavors are more potent than the usual acids. Recently, 2-ethyl hexanoic acid ($H_3C-CH_2-CH_2-CH_2-CH(-CH_2-CH_3)-COOH$) has been reported to yield the goatly flavor typical of goat's milk, and it can be considered as characteristic of this group of unique flavor compounds. The very low concentrations of these fatty acids preclude their direct measurement by the method used in this study for the major free fatty acids in Italian cheeses. However, current efforts are directed towards the development of routine, sensitive methods for their measurement so that this very important aspect of the flavor quality of Italian cheeses can be dealt with. With this information, and that from the newly developed method for the major free fatty acids, uniform flavor quality can be assured to food processors, and this can only lead to enhanced Italian cheese utilization.

TABLE 1. FREE FATTY ACID PROFILES OF TYPICAL COMMERCIAL CHEESE VARIETIES.

CHEESE SAMPLE	FFA CONCENTRATION (ppm)								Total
	C _{4:0}	C _{6:0}	C _{8:0}	C _{10:0}	C _{12:0}	C _{14:0}	C _{16:0}	C _{18's}	
<u>Mozzarella</u> (Part Skim)	54	7	1	120	12	27	76	156	363
<u>Provolone</u>	386	139	56	94	114	198	352	388	1727
<u>Parmesan</u>	502	174	98	223	163	368	621	662	2811
<u>Romano</u>	1756	843	328	942	428	448	785	1224	6754
<u>Swiss</u>	345	21	25	53	88	267	930	1197	2926
<u>Cheddar</u>	56	45	29	22	35	76	216	365	844

TABLE 2. FREE FATTY ACID PROFILES OF COMMERCIAL ROMANO CHEESES.

CHEESE SAMPLE	FFA CONCENTRATION (ppm)								Total
	C _{4:0}	C _{6:0}	C _{8:0}	C _{10:0}	C _{12:0}	C _{14:0}	C _{16:0}	C _{18's}	
COMMERCIAL AGED ROMANO									
#1	1756	843	328	942	428	448	785	1224	6754
#2	2680	1478	607	1350	1006	1063	1857	2748	12789
#3	3027	1416	421	1188	761	775	1245	1272	10105
COMMERCIAL GRATED ROMANO									
#1	5508	2814	1061	2074	1902	2581	4796	4424	25160

TABLE 3. EFFECT OF AGING ON THE FREE FATTY ACID PROFILES OF ITALIAN CHEESES.

CHEESE SAMPLE	FFA CONCENTRATION (ppm)								Total
	C _{4:0}	C _{6:0}	C _{8:0}	C _{10:0}	C _{12:0}	C _{14:0}	C _{16:0}	C _{18's}	
<u>PARMESAN (w/C-Powder)</u>									
69 days aging	536	170	80	372	237	477	714	444	3030
134 days aging	840	223	90	277	258	432	728	803	3651
<u>ROMANO (w/kid lipase)</u>									
71 days aging	3034	1454	377	1264	694	576	1138	1118	9655
128 days aging	3027	1416	421	1188	761	775	1245	1272	10105
<u>PROVOLONE (w/kid-lamb)</u>									
62 days aging	267	124	40	77	49	93	185	249	1084
123 days aging	520	206	51	115	87	105	180	242	1506
<u>MOZZARELLA</u>									
61 days aging	23	5	9	5	14	24	73	101	255
81 days aging	19	11	10	87	29	54	92	119	421

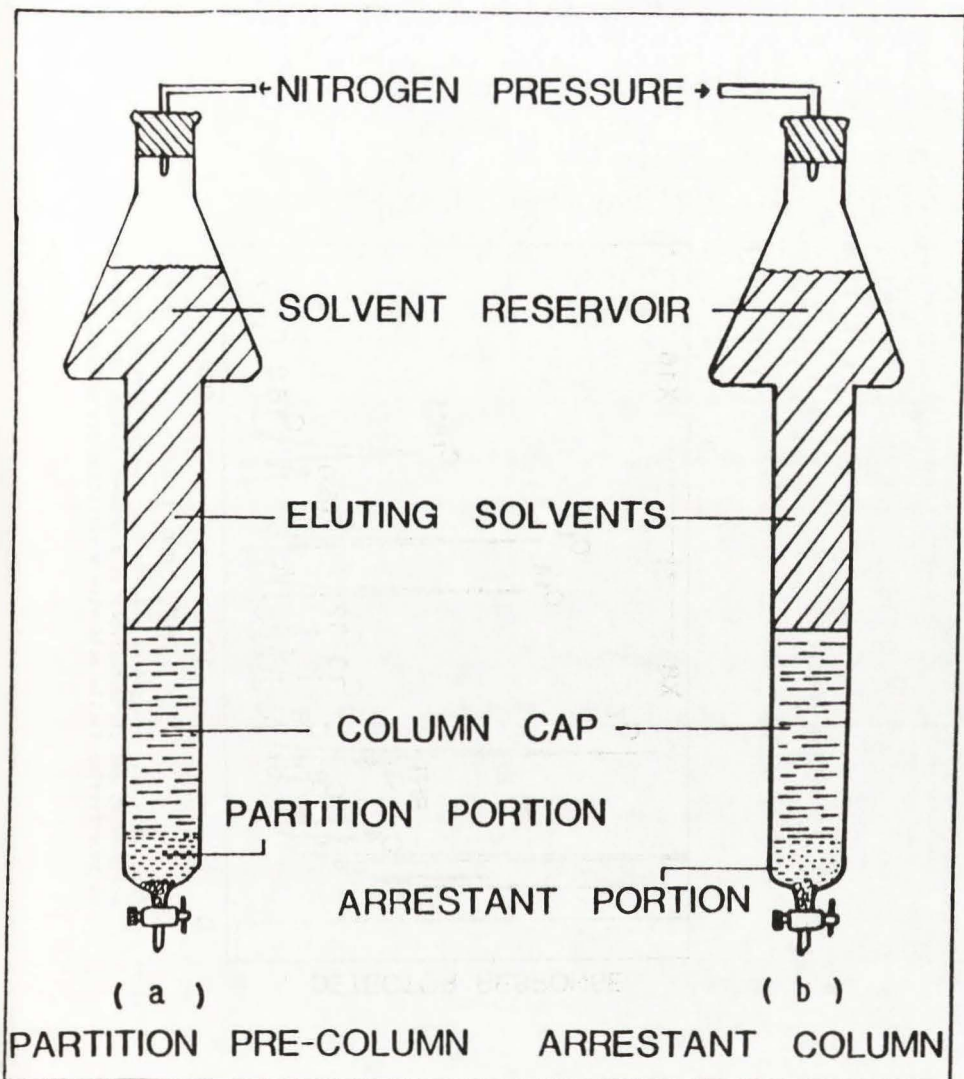


Figure 1. Construction of partition pre-column (a) for removing lactic acid from extract of FFA, and construction of arrestant column (b) for isolation of free fatty acids from cheese.

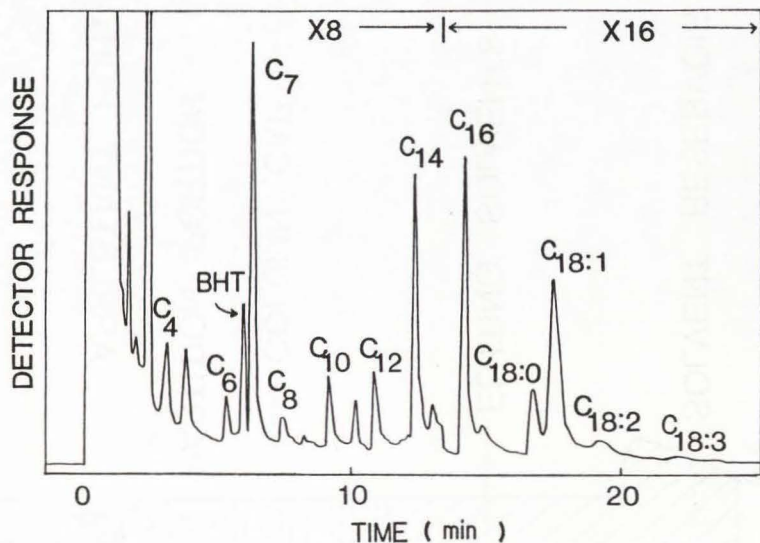


Figure 2. Free fatty acid profile of aged Cheddar cheese showing separation achieved by gas chromatography on a DEGS-PS column after removal of interfering lactic acid with a partition pre-column.

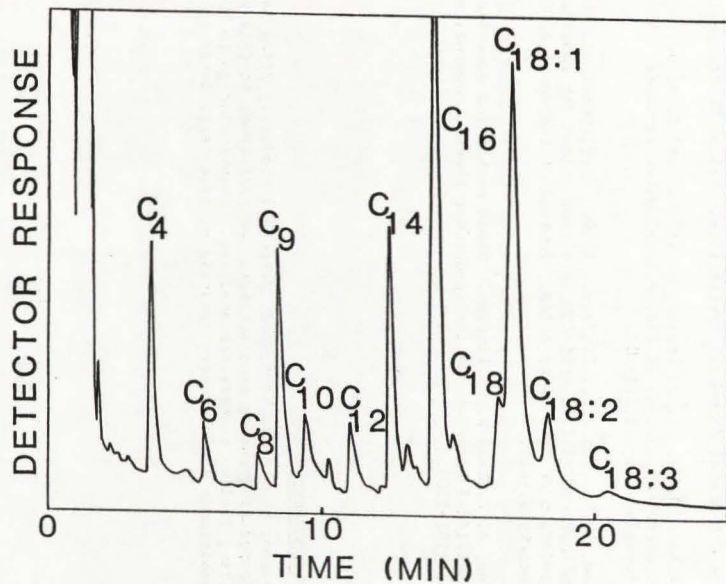


Figure 3. Free fatty acid profile of aged Parmesan cheese using DEGS-PS gas chromatography column programmed from 70 to 190°C at 10°/min.

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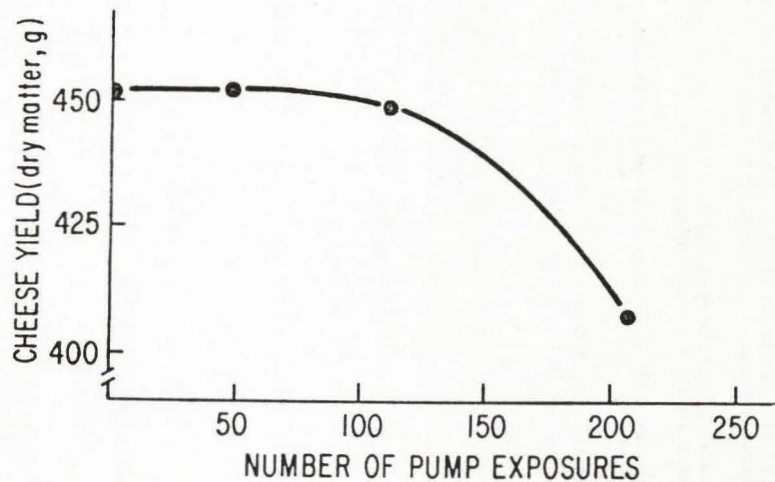


FIGURE 1. Effect of Pumping on Cheese Yield

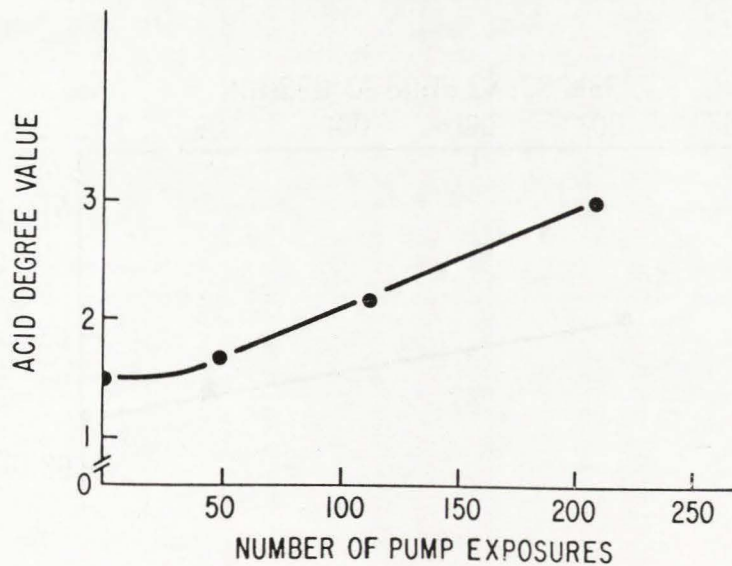


FIGURE 2. Effect of Pumping on the Acid Degree Value of Milk

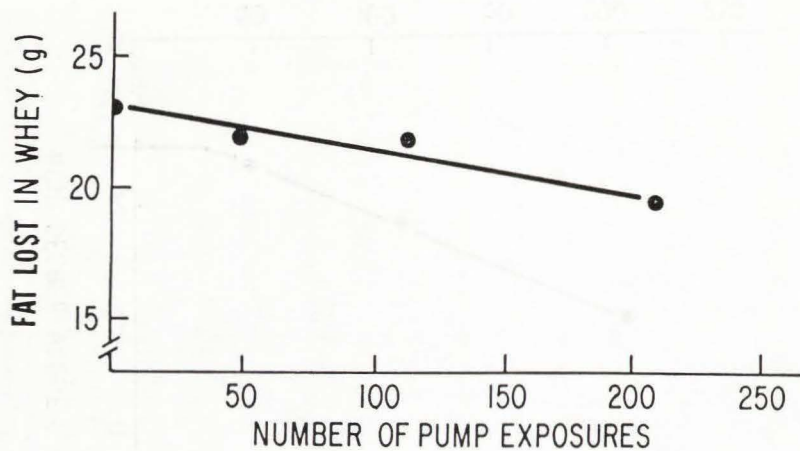


FIGURE 3. Effect of Pumping on the Fat Lost in Whey

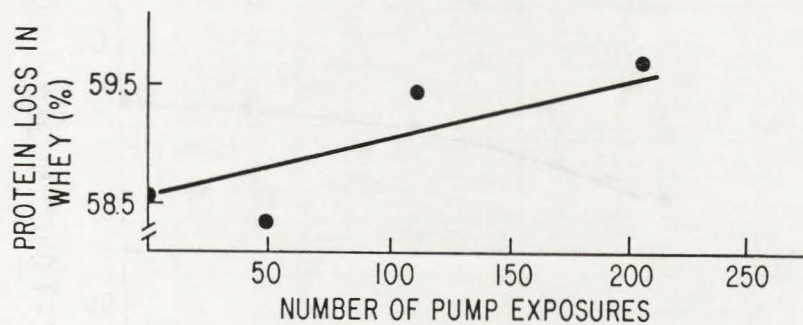


FIGURE 4. Effect of Pumping on Protein Lost in the Whey

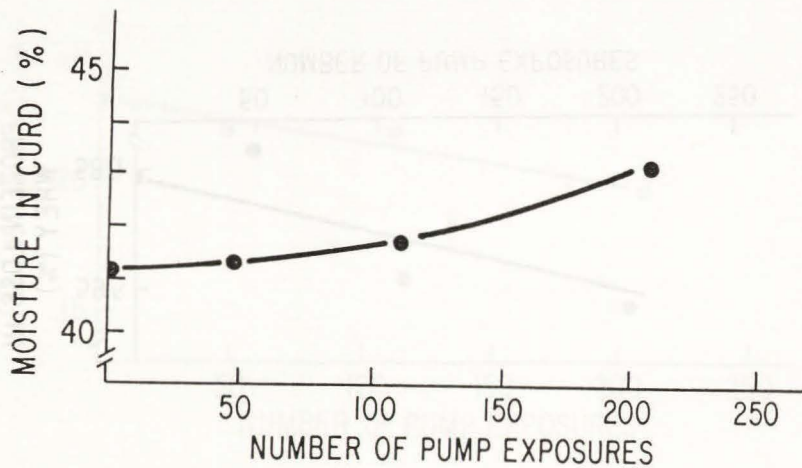


FIGURE 5. Effect of Pumping on Moisture in the Cheese Curd

The following paper was presented by Dr. Robert R. Zall, Professor, Department of Food Science, Stocking Hall, Cornell University, Ithaca, New York 14853, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

MEMBRANE TECHNOLOGY IN MAKING ITALIAN CHEESE

By R. R. Zall, Ph.D.

ABSTRACT

By pre-conditioning milk using membrane concentration or enrichment schemes, it is possible to better automate the making of Italian cheese. While there appears to be little or no standard of identity problems to overcome by using membrane technology in cheesemaking, it is prudent to make sure that, as a cheese processor, you do not infringe on patents.

It is reasonable to believe that cheesemaking in the near future may well begin on farms when farmers integrate heating and membrane processing plants into milk harvesting operations. Significant technological innovations in making Italian cheese can be achieved by using membranes while maintaining quality, safety, and nutritive value of finished goods.

We have the ability to vary delicate constituents in milk at will by using ultrafiltration/reverse osmosis membranes to concentrate or fractionate milk instead of waiting years by breeding cows to adjust milk composition for cheesemaking. Imagine, if you will, a scenario where some constituents of milk can be optimized at milking time for making Italian cheese right on the farm by adjusting the milk fat/protein/carbohydrate/salt content by using ultrafiltration equipment.

Milk destined for automated cheesemaking systems can be pre-conditioned for end use needs prior to being picked up and delivered to cheese plants in tailor-made condition for processing into cheese products of your choice. The state of the art for using membranes is sufficiently well-developed at this time so it is possible right now to integrate membrane technology into day-to-day cheesemaking operations. But, before management buys membrane plants, it ought to consider some issues not generally discussed.

Up Front With Some Basic Questions

Our European friends certainly seem to be using membrane technology more to their advantage on their side of the "pond" than we do. Foreign cheesemakers appear to be more innovative than we are and use membranes to automate cheesemaking processes for some obvious economic advantages. Some people suggest that new methods or more efficient schemes for cheesemaking in the States is falling behind technology abroad because the American cheese industry is subject to more controls than workers overseas. In fact, I was recently contacted by technicians that felt the Italian cheese industry could be troubled by using membranes because it affected standards of identity regulations. More specifically, the use of membranes to make some varieties of cheese might be considered to change traditional cheesemaking practices. I really do not think such statements are true, at least not so in my

state, New York. The definitions and standards for identity of milk and milk products used for making cheese do not appear to limit raw material manipulations for making Italian cheese. For example, Ricotta can be made with milk, skimmed milk, and milk solids mixed with an acidifying agent, cultures, vinegar, fermented whey, citric acid, rennet, etc.

Milk for Provolone cheese, pasta filata cheese, and caciocavallo can be made from milk adjusted by separating part of the fat or by adding cream, skim, concentrated skim, non-fat dry milk, etc.

Mozzarella cheese can be made with part skim. Low moisture varieties and other variations can be produced by separating milk fractions and by milk with added cream of skim or both.

What is restricted and rightly so seems to be finished product composition and processors must provide label statements of optional ingredients. From my point of view, I do not see restrictions for using membrane technology nor do I see problems with more common standards of identity. In fact, key people in our Department of Agriculture and Markets agree with me and were asked to comment on such allegations as part of the background material for this paper.

Sanitation

Cheese plants in individual states may require health department or some type of regulatory approval to use membranes. It has been my experience over many years that processors can obtain equipment approval based upon performance and approval for use will be readily available to us when we deal up front with people concerned with protecting consumer health using reliable facts. The regulatory agencies have always given us permission to try new systems. I suggest you work with the USDA, FDA and others together with equipment manufacturers in securing approval to use membrane hardware in your own plants when you contemplate purchasing the equipment.

Patents

What about patents? Will the way you use membranes in your operations to make cheese infringe on patent rights of some second or third party? I suspect there could be some special type of problem for some uses but I'm not sure where or how these might fit your own case. For example, I along with Cornell University, hold a patent to thermalize milk on dairy farms. We do this not to impede its use but more with the goal to protect the industry so it will have free access to utilize our ideas and research data.

United States Patent Number 3,914,435, by Maubois et al., for example, deals with manufacture of cheese from ultrafiltered milk. Cheese made from heat-treated milk without conventional draining of whey is addressed. The patent had stormy years getting through the American patent office and I'm not really sure how much of it or if any will affect the Italian cheese industry. Milk before or after ultrafiltration in this patent involves a heat treatment at 110-150°C (centigrade, not Fahrenheit) which makes it somewhat unrealistic for use as an Italian cheesemaking method. Nevertheless, it might be prudent to discuss such matters with legal counsel and most companies, it seems, have lawyers on their payrolls just as a matter of convenience.

What's the Point?

The point to be made, however, is that considerable information has already been generated by researchers around the world working on cheesemaking schemes using ultrafiltration. What must not be ignored, of course, is that there are considerable amounts of cheese now being made without fanfare by private companies using membranes as tools who do not publish papers about their work. One only has to surmise that some cheesemaking systems must be working well when cheese is being made by secret processes which include membranes.

Some Technical Problems

It has been reported by researchers using concentrates that when milk is concentrated or when milk proteins are enriched by passing milk through membranes, the retentate (milk concentrate) takes on added buffering capacity. Tests such as acidity or pH of such milk are difficult to read and cheesemakers find that traditional guidelines used in cheesemaking become somewhat different. It has also been reported by people attending a conference on cheesemaking by ultrafiltration at Cornell this past June that it takes more culture to convert UF processed milk concentrate into cheese than would be needed in non-fortified cheese milk. I didn't find this situation to be so in three larger factories when making cottage cheese from UF milk but then our inoculums for short sets falls in the 4-5% range of milk used. On the other side of the coin, less rennet will be needed in making cheese with UF concentrated milk than non-membrane processed material.

The pertinent point to consider regardless to what is being discussed would be that it is common sense for plant people to experiment with small batches of cheese in their own factories before rushing out to buy a membrane plant to process milk. Too many managers seem to want to fuss with designing UF/RO plants rather than dwell on how best to use UF/RO concentrates. You will waste money and time by not doing appropriate in-house basic bench work studies to learn how best to marry membranes into your own cheesemaking operations. Retentates have to be compatible with other cheesemaking practices and the practices vary widely in plants on an individual basis.

Pre-Cheese Concentrates

Some of the reasons for using membranes to concentrate milk or separating select components in milk in making Italian cheese would be to make cheese better, or just as good but quicker, or perhaps to increase cheese yields. An ultrafiltration process for making Mozzarella cheese, for a case in point, was developed where the cheese retained most whey proteins. Finished product made in conjunction with membranes contains the same composition and quality as cheese made by traditional methods. The inventor of the process claims that 100% of the fat and 95% of the milk proteins can be utilized in making Mozzarella thus increasing cheese yield by as much as 18%.

When ultrafiltration is combined with diafiltration, which is a technique to adjust the lactose content of milk using a water flushing step, cheese milk solids can be adjusted to that amount present in cheese as the final product. After such treatment, ultrafiltered milk is standardized, temperature adjusted for culturing, and made into cheese blocks by adding culture and rennet at appropriate steps. When the cheese reaches its proper pH, the cheese will be cut into pieces, heated, stretched, and then put into molds; cooled, salted and packed for distribution.

Basically, there are four membrane systems you might use to make pre-cheese concentrates which can be purchased from about 14 different manufacturers. Dr. Wayne Modler, from the Food Research Institute of Agriculture in Canada, recently reviewed ultrafiltration hardware for cheesemaking at Cornell's International Conference on "Making Cheese by Ultrafiltration" and cited tubular, plate and frame, spiral wound, and hollow fiber. Regardless of configuration, each is designed to concentrate proteins and allow smaller weight molecules (water, lactose, minerals, and non-protein nitrogen) to permeate the membranes. Figure 1 shows a schematic diagram of the movement of milk through such systems.

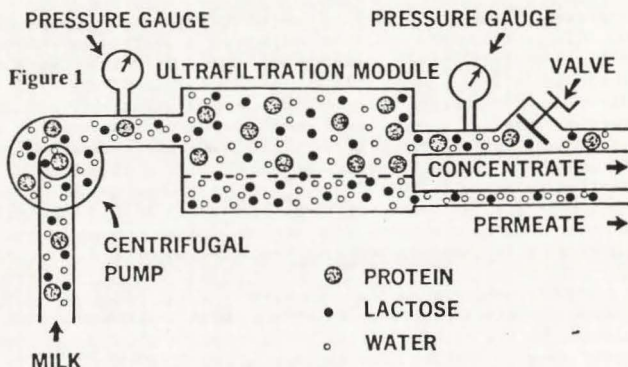


Figure 1. Ultrafiltration Schematic Diagram

As I See It

It appears reasonable to me to expect dairy farmers to incorporate ultrafiltration and reverse osmosis membrane systems into their milking operations. The stumbling block for making milk a better dairy ingredient was solved by blanching milk on farms which is now beginning to be used on farms around the world. Thermalized milk is a process which changes some basic characteristics of milk so as to increase cheese yields. The process becomes part of the milk harvesting technique by heat-treating, cooling and storing milk as produced on the farm. Recent work carried out by my research group at Cornell has shown that part of the whey proteins in raw milk can be attached to casein micelles by subjecting milk to a mild and short heat treatment. A term used by the Cornell group to identify the heating method so as not to confuse it with pasteurization to the general public was "milk blanching."

What seems to be the next natural step to the heating of milk on farms would be to have farmers use membranes to rearrange milk composition directly on their farms so raw materials will fit automated processing schemes better (1,2,3,4). Dairy farmers ought to be willing, for a fair fee, to pre-process milk destined for

special purposes. Cheese, yogurt, and other products lend themselves nicely to automated and continuous processing methods and work well when pre-conditioned with membrane systems. The functional properties of milk proteins appear to be enhanced when milk is concentrated without being exposed to more conventional but harsh heating methods. Membrane processed proteins are less denatured when they are concentrated for cheesemaking with membranes and as such provide cheese milk with additional stabilization and emulsification properties.

It is fair to comment that membrane technology is certainly not a laboratory curiosity. Membrane systems have been around for use commercially for more than 10 years. I know this to be so because I was the project manager for the first industrial membrane plant used in the United States which was a 300,000 pound per day UF/RO whey processing plant on line in N.Y. in 1971 by the Crowley Food Company.

Then, as now, some people were prone to think that we were dreamers. Time has proven them wrong because it is obvious that membranes are here to stay because the use of such equipment generates added profits to more forward thinking cheesemakers.

Some of us have been very vocal in stating that traditional cheesemaking and conventional dairy food processing methods are energy intensive. It is feasible and worthwhile to apply innovations like using membranes, milk blanching and other integrated energy saving systems like using winter coldness into making cheese. Significant economies in energy and labor can be obtained by using such schemes while increasing cheese yields plus maintaining product quality, safety and nutritive value.

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The following paper was presented by Dr. Donald L. Wallace, Manager, Quality Assurance and Laboratory Services, Marschall Products, Miles Laboratories, Inc., P.O. Box 592, Madison, Wisconsin 53701, especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

CHYMOSIN AND THE STANDARDIZATION

OF ANIMAL COAGULANTS

By Donald L. Wallace, Ph.D.

ABSTRACT

Chymosin has taken on added significance recently which relates to its increased use as a measure of calf rennet quality. Chymosin is the primary enzyme in calf rennet responsible for clotting milk and, because of its characteristics, it is particularly well-suited to the making of high-quality cheese. Calf rennet should contain a minimum of 80 percent chymosin. This will insure the classical cheesemaking performance that the industry expects.

In the last few months, chymosin has become a topic of considerable discussion among cheesemakers and between cheesemakers and rennet suppliers. This subject is not really new; in fact, it's a very old subject within the rennet manufacturing business. But only in recent months has the issue become a point of concern to the cheesemaker. The primary reason for this probably results from efforts to hold down costs, increase yields to the highest possible level and get good flavor development. Porcine pepsin and bovine rennet are less expensive than calf rennet extract, so increased proportions of these in calf rennet have been used to reduce costs. However, the use of porcine pepsin and/or bovine rennet in calf rennet extract can introduce use factors that can cause cheese manufacturing and quality problems if the percentages vary considerably from manufacturer to manufacturer; or within one manufacturer's product.

This also relates to competitive pricing where pricing needs to be related to composition. There is a large difference between the cost of manufacture of a high-quality calf rennet that contains mostly chymosin as compared to one that does not. We think it is good that the cheesemaker has now become concerned about the real value of the rennet extract he uses. We also think it is appropriate in a gathering such as this, to bring into perspective what chymosin is, what the proportion should be in a good rennet extract and why this is important in cheesemaking. This concern by the cheesemaker will undoubtedly result in the supplier having to correctly identify his product and price it accordingly.

Milk clotting enzymes are known to be produced in the gastro-intestinal tract of the young milk-fed calf. This mechanism facilitates milk digestion. Included in this mechanism is the production of chymosin which clots milk in the calves' stomachs. This, in turn, retains the coagulated milk solids so muscular action in the abomasum (fourth stomach of the milk-fed calf) allows for digestion of the milk

curd in the stomach of the animal. The discovery of this milk-clotting activity ultimately led to commercial production of rennet in Europe in the late-1800s and by Marshall Dairy Laboratory in the United States in the very early part of this century. Generally, calf rennet is obtained by aqueous extraction of the fourth stomach of the unweaned or milk-fed calf. It is available today as a highly standardized reliable product for the manufacture of quality cheese. In the 1960s, the demand for calf rennet began to outstrip the supply of calf stomachs because of decreasing numbers of calves slaughtered and the increasing production of cheese. This short supply of calves' stomachs continued to intensify until today the production of calf rennet meets approximately 20 percent of the total demand. In recent months we have seen some increase in the supply of calf stomachs. You have also seen a corresponding drop in price for rennet extract.

Two proteolytic enzymes in rennet are of importance in this discussion. The first, and the one responsible for the milk clotting specifically, is chymosin. The term chymosin was first used by Deschamps in 1840. Fifty years later in 1890 the term rennin was introduced for the same enzyme by Lea and Dickinson. These terms are interchangeable and this has caused some confusion to those not familiar with the scientific literature. Rennin is the name accepted by the Commission on Enzymes of the International Union of Biochemistry, whereas chymosin is the term used in Europe and by the International Dairy Federation in its documents concerning this subject area.

Also present in all animal rennet preparations is the enzyme pepsin. Although Porcine Pepsin is sometimes mixed with calf rennet as in the case of Marshall's Chymo-Set®, this presentation will deal with only naturally occurring bovine pepsin as it is found in calf rennet. Pepsin is an enzyme with the ability to partially hydrolyze protein in the acid condition of the stomach. It clots milk also but has, at the pH of milk at setting, much greater proteolytic activity in relation to its clotting activity than does chymosin. Additionally, the activity of this enzyme is greatly reduced at the pH of milk versus the pH of the stomach. This is of great importance to the body and texture of the cheese.

What do we expect of a good calf rennet? It is well known that most proteolytic enzymes will clot milk under conditions favorable to the enzyme's activity. However, for cheesemaking it is important that the enzyme will clot milk under the conditions of cheesemaking that yield a desirable curd and make an important contribution to ripening. Since mother nature provided the young milk-fed mammals with an enzyme to clot milk, namely chymosin, it is natural to assume that this enzyme is an ideal enzyme for the purpose of clotting milk. Milk-coagulating enzymes that are commercially successful have to be specific enough, yet not too proteolytic, to closely duplicate that of pure calf rennet extract.

Of the four major components for cheesemaking, namely milk, lactic acid-producing bacteria, salt, and rennet, rennet holds the special position of importance because it is responsible for converting milk, which contains only about 2.6 percent casein, into a gel. One part of calf rennet to 5,000 parts of milk or 1 part of pure chymosin per 5 million parts of milk is all that is required to bring about this change. In other words, it takes very small amounts of the chymosin in rennet extract to bring about the conversion of casein into curd.

Milk clotting takes place in two phases, a primary phase in which the enzyme cleaves kappa-casein to destroy its stabilizing effect on the casein micelle, and

a secondary non-enzymatic phase in which the clot forms in the presence of calcium ions. The first phase of clotting has to be accomplished specifically and efficiently without too much non-specific proteolysis. The second phase, although non-enzymatic in nature, is dependent upon the rate of activity in the first phase of clotting. The characteristics of the enzymatic action in the first phase greatly influence the calcium requirement of the second phase. Added calcium has little effect on curd formation when chymosin is used, in comparison to the greater effect when porcine pepsin is the enzyme. This is a reflection of the difference in specificity of these two enzymes under the conditions of cheesemaking.

There is also a third phase of enzyme activity which, although not involved with the clotting of milk during the first two phases, does make a significant contribution to the ripening of cheese. This third phase is the proteolytic action of enzymes during ripening which is important to the development of desirable body, texture and flavor in the cheese.

Since chymosin's function is to initiate the first phase of clotting, naturally a greater proportion of this enzyme in relationship to other enzymes will result in a more efficient clotting of the milk. However, cheesemaking is much more complex than just clotting milk. When we look at the entire cheesemaking process, it is obvious that proteolysis plays a central role in obtaining proper body, texture, and flavor development during aging. A great deal of research is recorded in the scientific literature on proteolysis in cheese and its contribution to the finished product. We also know that proteolytic enzymes can originate from sources other than the coagulant used, such as the milk and the starter. Most enzymes from the milk are generally undesirable since they usually are produced by psychrotrophs growing in milk and are known to give a low quality cheese from a flavor standpoint. It is generally accepted though, that the proteolytic enzymes from the starter bacteria will also contribute to the body, texture and flavor of cheese.

In addition, it is not known how much chymosin and pepsin individually contribute to the proteolytic processes going on in cheese. The scientific literature does not clearly answer whether good quality cheese can be made from pure chymosin or if some pepsin needs to be present. A few studies showed that pure chymosin would not result in good cheese, whereas others indicated that it would.

We are of the opinion that some pepsin is probably necessary for more consistent quality cheese. We also feel that there is the possibility of underdevelopment of body and texture in cheese made with pure chymosin. However, since all commercial calf rennet contains some pepsin, this is an academic issue except as it relates to how much pepsin should be allowed in calf rennet. The extractions of young, milk-fed calf stomachs, no matter whether prenatal or neonatal, will have pepsin activity.

Generally, the amount of pepsin in calf rennet from premium stomachs will vary within the 5-20 percent range depending on the age and diet of the calf, the time of day when slaughtered, extraction process conditions, etc. Therefore, unless costly purification steps and/or batch blending were employed, commercial calf rennet will contain these amounts of pepsin.

So what should you expect from a chymosin-pepsin ratio in authentic calf rennet? Our data from many years of producing calf rennet indicate that there should be a

minimum of 80 percent chymosin and never more than 20 percent bovine pepsin present in the product. This will ensure that you receive the value for which you are paying since only the premium calf stomachs will yield these chymosin levels. If the chymosin content falls below 80 percent, then it is likely that either older calf stomachs are being extracted or pepsin has been added.

Historically, Marschall has tested the bovine pepsin content of its calf rennet as an ongoing method of determining the quality of calf rennets purchased. Normally, Marschall's calf rennet will contain 85 to 92 percent chymosin, depending on the quality of the stomachs used in the extraction process.

In conclusion, the chymosin content of calf rennet is important in making high-quality cheese and is a factor in determining rennet quality. A rennet extract with a chymosin content below 80 percent may affect cheese manufacturing procedures and cheese quality. Further studies need to be made to ascertain the importance of a low percentage of bovine pepsin in rennet extract as it relates to variations in acidity of milk delivered daily at the plant and to cheese yields and cheese flavor.

Your interest in and concern about various coagulants and their composition is important to your cheese operations. Changes are occurring rapidly in the manufacture and supply of milk coagulants, including rennet extract. Therefore we will welcome any comments and questions to keep you abreast of these changes as we see them and how they will affect your business.

The following paper was presented by Mr. D.L. Peterson, Promotions Director, American Dairy Association of Wisconsin, 4337 West Belt-line, Madison, Wisconsin 53711, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

THE "REAL" SEAL--YOU SHOULD BE USING

IT TO SELL REAL ITALIAN CHEESE

by D. L. Peterson

ABSTRACT

The "REAL" Seal is a registered trademark for the identification of real dairy products and pizza made from real cheese. The Seal is rapidly gaining acceptance with cheesemakers and dairy processors as well as food retailers. The "REAL" Seal is being extensively advertised to promote its use by marketers and its recognition by consumers. Dairy farmers are committed nationwide to the Seal and its promotion. It provides a consumer service and a positive base for advertising. Many of the nations largest cheese marketers and food retailers are presently using or planning to use the Seal on their packaging and in their advertising programs.

I hope there is no one present here today who doesn't know about the "REAL" Seal and is not able to recognize it.

I wish I could say the Seal is here because its time has come. The truth is, its time is long overdue. I apologize for that. We should have been offering and using such a Seal for many, many years.

The "REAL" Seal can play a major role in maintaining the market for real dairy products.

The "REAL" Seal had its beginning on the West Coast six years ago. Wisconsin began to use it three years ago and it became a national program two years ago. In the past six months interest and adoption on packaging of the "REAL" Seal symbol has built at a greatly accelerated rate. We now have some 800 signators to the "REAL" Seal User Agreement nationwide. They include dairies, cheesemakers, cheese processors, supermarket chains, grocery headquarters, private label suppliers, as well as, pizza processors. Included among retail signators are Safeway, Kroger, Winn Dixie, Southland, Jewel, Stop and Shop, Kohls, Dillons, Certified Grocers of California and Chicago, IGA, Federated and Shurfine. I'm sure you recognize the names, and am equally sure many of you do business with them.

Yes, the "REAL" Seal Program is rapidly gaining acceptance. It must, if it is to become an effective force in combating imitations in the marketplace. The "REAL" Seal is becoming that effective force.

I will not, today, dwell on the history of imitation cheese and dairy foods. You certainly know that history well. The dairy industry has lost some 75% of its butter sales, 65% of its whipping cream sales, 65% of its coffee cream sales and the list goes on. In total, perhaps 30% of the dairy market has been lost to imitations.

What about cheese? Has 5% of the total market been lost? More? Is 30% of the mozzarella market lost? Is 35% lost? The loss is growing. Does it have to continue to 40%?, 45%?, 50%?, 60%?, 70%?. . . as some are predicting. I hope and think not.

But in order to slow or stop the inroads of imitations we must prepare and be prepared.

We must learn not to rely on legal barriers--laws to ban sales, but use them when and where possible--not rely on them.

We must know our products and those of the imitators. Know the advantages of imitations (price is the big one). Know the advantages of your real products (nutrition, consumer acceptance and flavor). Advertise and sell these advantages.

We must learn not to listen to the major imitators when they say, "We just want a small segment of the market" or "We are only producing for a supplemental market" or "We only desire to fill a special market". All of these statements have been made. The truth is that the major marketers of imitation cheeses want the "lions" share of the cheese market.

We must, most importantly, listen to the consumer. A 1980 research study (1) gave us information as to how consumers think and what they desire in labeling. In this study, 93% wanted authentic and imitation cheeses clearly marked.

They are confused. Many think processed cheese is simulated. They don't know, but they want to know. Seventy-six percent of the consumers felt the words real, authentic or natural would help them distinguish between authentic and simulated products. Shoppers want easily read, straight-forward labels.

Here's where the "REAL" Seal Program can be of great value in showing your customers (consumers) that you want to provide them with easily read, straight-forward labels. So, let's look at the "REAL" Seal.

REFERENCE

1. Consumer Research Study, 1980. U.D.I.A. & California Milk Advisory Board

LIGHTS OUT

Slide 1

Blank

Slide 2

"REAL" Seal

This is the "REAL" Seal.

A registered trademark

A consumer service to allow easy recognition of real dairy products

A positive basis for advertising

A marketing and merchandising tool to trigger positive associations and recall of the flavor and nutrition of real dairy products. . .at the buying point of decision

A real opportunity to tie your promotions with ADA promotions using the "REAL" Seal as a common thread

A valuable tool for your publicity and public relations

and A rallying, uniting force for the entire dairy and cheese industry

Slide 3

"REAL" Seal
on Cheese

A simple, easily seen trademark that means:

This cheese is a domestic product

. . .Is a 100% dairy product

. . .Meets federal and state standards

Slide 4

"REAL" Pizza

On frozen pizza, the "REAL" Seal trademark means and shows that 100% REAL cheese is the cheese ingredient. (or 100% real Mozzarella, whatever is correct)

Slide 5

\$75,000,000

Dairy farmers are committed to this "REAL" Seal. It is estimated that every 1% of the dairy market lost is a 75 million dollar loss to dairy farmers. I know personally in Wisconsin (and it's equally true nationwide) that dairy-farmers are insisting on the "REAL" Seal and promoting its use and recognition is the number one priority. Dairy farmers recognize the fact that our major competitor (and yours) is the imitations.

Slide 6
Good Housekeeping
Seal

They want the "REAL" Seal to be as well known as the Good Housekeeping Seal

Slide 7
Wool Mark
Cotton Symbol

Wool Mark and the
Cotton Symbol

Slide 8
Print Adver.

This commitment of dairy farmers means advertising. In national magazines this year these ads have or will appear in such magazines as *House and Garden*, *Parents*, *Newsweek*, *Cuisine*, *Bon Appétit*, *Better Homes & Gardens*, *Ladies Home Journal*, *McCall's*, *Redbook*, *Good Housekeeping*, *Sunset* and *Family Circle*. A total circulation of 46 million is involved.

Slide 9
National
Outdoor

And outdoor advertising, too. You may have seen this

Slide 10
Outdoor

or special postings (in the east) like this

Slide 11
Wisconsin
Outdoor

or, in Wisconsin, our first ever effort to combine "REAL" Seal ads for dairy products and pizza.

Slide 12
Chicago
Buses

In Chicago, now, buses are carrying the same message.

Slide 13
TV-Price

On television, many of you are aware of the commercials being run.

Slide 14
TV-Wisconsin

In Wisconsin you may see or have seen this individual telling consumers to "Look For The 'REAL' Seal".

Slide 15
Radio

Radio, too, is being used in many markets nationwide.
Dairy farmers are committed.

Slide 16
"REAL" Seal

If you're in cheese marketing or any related industry, you too, need to commit to take advantage of what is being done to promote the "REAL" Seal and to increase consumer awareness of it.
Here are examples of Seal usages:

Slide 17
Kasson

Kasson located in Brillion, Wisconsin, uses the Seal on packaging to remind retailers,

- Slide 18
Kasson
- on labels, too, to remind customers and even on display packs.
- Slide 19
Frigo
- Frigo's of Lena, Wisconsin, has newly designed packaging for Italian consumer packages.
- Slide 20
Falbo's
- Falbo's of Melrose Park, Illinois, use the Seal on their Ricotta.
- Slide 21
Lone Elm
- Lone Elm Cheese, Vandyne, Wisconsin, on bulk packaging.
- Slide 22
Baker
- Baker of St. Cloud, Wisconsin, makers of Mozzarella and String cheese.
- Slide 23
S & R
- S & R of Plymouth, Wisconsin, on bulk Salamini packaging and individual packages of grated cheeses.
- Slide 24
Leprino
- Leprino of Denver, Colorado, on fresh Ricotta and on Mozzarella.
- Slide 25
Tolibia
- Tolibia of Fond du Lac, Wisconsin, on their five pound crumbled Blue and consumer as well as larger sized packaging.
- Slide 26
Agreement
- Become a signator to the agreement.
- Slide 27
"REAL" Seal
- Place it on your labeling.
Use it in your advertising.
- Slide 28
"REAL" Pizza
- If you sell to frozen pizzamakers, get them involved too. The seal is the same, but added wording is required. "Made with 100% Real Cheese" or "made with 100% Real Mozzarella".
- Slide 29
Agreement
- They too, must be a signator to an agreement. It is a different Food Processor Agreement.
- Slide 30
Frozen Pizza
Packaging
- Frozen pizzamakers are using the "REAL" Seal. Here you see labels and material from some of the frozen pizza marketers in this area.
They use the Seal in their advertising, too.
- Slide 31
Blank
LIGHTS UP
- Competition works here in American. If our dairy packaging and pizza proudly proclaim "REAL" your customers will know, will look, will ask for "REAL".
- The "REAL" Seal can be a major force in the saving of the markets for real cheese.
- It does work. The "REAL" Seal is a growing factor in the cheese business. Let it work for you.

The following paper was presented by Mr. Edward J. Lump, Executive Vice President, Wisconsin Restaurant Association, 122 W. Washington Ave., Madison, WI 53703, USA, especially for the 19th Annual Marshall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

ITALIAN CHEESE SALES OPPORTUNITIES:

THE RESTAURANT AND INSTITUTIONAL MARKETS

By Edward J. Lump

ABSTRACT

There are great opportunities to sell additional volumes of Italian cheeses to foodservice industry markets: 1) the market is large, diverse and still growing; 2) foodservice has gone from being an industry of luxury to one of necessity; 3) there are market forces that enhance the sale of cheese; 4) to take advantage of the opportunities, one must understand the distribution system and potential product utilization -- selling must be accomplished through established channels of communication.

The foodservice industry is composed of both restaurants and institutions, and it represents a unique opportunity for the sale of Italian cheeses. An obvious example is the large volume of mozzarella cheese marketed, particularly to pizza restaurants. However, outstanding volume opportunities exist in other types of outlets, not only for mozzarella, but also for lesser-known and used varieties such as parmesan, provolone, ricotta and gorgonzola. These opportunities are, by and large, being missed.

The cause of these missed opportunities, I believe, is that the industry has not really looked at the marketing system that exists for selling to foodservice outlets, and utilized the strengths and weaknesses of that system to market their products. It cannot be assumed that the same system used to successfully market to the grocery industry will work in the foodservice area.

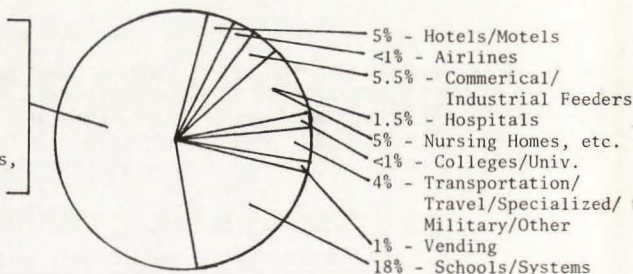
One reason this is true is that the foodservice industry is not necessarily displaying a product for consumer selection, but is a consumer itself. The industry consumes the products it uses in a narrow range of items referred to as a menu, and on a very repetitive basis. It is difficult, therefore, without a substantial sales effort, to succeed in getting a product into usage; once it is in usage, however, the volume opportunity is substantial.

Before we go any further in trying to understand the opportunities for sales, I think it is necessary to explore some facts about foodservice.

1. The foodservice industry consists of many types of outlets. Below is a breakdown.

60% - Restaurants

includes table, booth, counter, drive-in, carry-out, cafeterias, drug, department and variety stores, supermarkets



2. Foodservice sales: Nationally, it is projected that foodservice sales will top \$136 billion during 1982. In Wisconsin, we look for \$2 billion in sales. Foodservice sales have more than doubled in the last decade, from \$43 billion in 1970 to \$114 billion in 1980.
3. Meals consumed: Today, one of every three meals is consumed away from home, and the foodservice industry is receiving 37% of all consumer expenditures for food, which is up from 33% in 1970.
4. Sales to foodservice: Food and beverage purchases by the foodservice industry will total over \$60 billion in 1982. Almost \$3 billion of that will be dairy products, and approximately \$1.5 billion will be cheese.
5. Size of units: Eating and drinking places are mostly small businesses. Of all units, 94% have annual sales under \$500,000; 85% are single units; 61% are sole proprietorships or partnerships. Chains and franchises have grown in importance, but an important point must be remembered: while chains usually do their purchasing centrally and in volume, deliveries are still made to small, individual units.

This phenomenal growth has really taken place in the last 15-20 years, and more specifically within the last decade. It is important to note that this growth trend continues, even in the present economy, although at a somewhat more modest pace. The National Restaurant Association is only projecting a 1% growth in sales in 1982.

Why has there been this growth? Quite simply stated, the foodservice industry was formerly one of luxury; in the 1980's, it has become one of necessity. There are two reasons for this change:

1. There are more and more two-income households. When both people are working, there is a greater necessity for dining out at breakfast and/or lunch, and because it is so difficult to put a meal on the table after a long work-day, it becomes necessary to dine out at dinner as well.
2. The price/value relationship continues to look good. Often, food cost increases can be offset by innovation (new ideas, menus, portions, creativity). To see this, one need only look at the tremendous influx of ethnic foods, such as Mexican, Japanese, Greek and Italian. These foods offer opportunities to the restaurateur to present to the customer, very profitably, items that are difficult to prepare at home, and to present them at a reasonable cost.

However, there is still a great deal of luxury dining because.

1. Usually two-income households have more disposable income that can be used for entertainment.
2. The price of a meal at a restaurant often competes favorably with other activities such as theaters, sporting events, etc.
3. The foodservice industry's ability to create atmosphere is simply inexhaustible. When we think we have seen the last word in restaurant design, another new idea or concept comes to the forefront.
4. Free time will continue to increase. The four-day work-week will be more of a reality.

I think the above facts can help us to see that the foodservice industry is a big industry, and that it will become larger and more diverse as American consumers search for new tastes and entertainment experiences. This represents a tremendous opportunity for foods with quality and versatility, such as Italian cheeses.

There are also forces at work in the market place that help people like yourselves to sell their products:

1. Competition: As we've said before, the restaurant industry is diversified, competitive, dynamic and creative. Operators at all levels are constantly looking for ways to promote and merchandise their product. What ingredients are better suited to competitive merchandising than cheeses? The sky's the limit when it comes to taste, blendability, variety, color and quality.
2. Nutrition: As more and more people dine out more often, they become more concerned about balanced meals. The days of people going to a restaurant for an occasional treat and not worrying about what they're eating are gone forever. Because of the nutritional value of cheese, it has a large role to play. I'm sure you're all aware that one of pizza's big selling points is that not only does it taste good, it is also a highly nutritional meal.
3. Consumerism: This movement is here to stay. People want to know what goes into the food they eat. As a result, there is more pressure for "truth in menu." This is where the use of "Real" seal offered by the American Dairy Association is particularly important. After all, a restaurant operator who uses the finest, freshest and highest quality ingredients money can buy and signifies it by displaying this seal, is far better off than a restaurateur who says nothing at all, and a foodservice operator cannot begin to sell his customers on the acceptability of substitutes.

Selling to Foodservice

The way to tap this market is to look very carefully at the way products are currently being distributed to foodservice, and how your products fit into that distribution network. One must also look at how cheeses might be used by the various outlets. Finally, the available channels of communication to the foodservice industry must be thoroughly explored.

1. Distribution network: Currently, foodservice outlets may buy their cheese one of four ways:
 - A. Direct from a local cheesemaker (a small percentage).
 - B. From a local dairy product distributor (the same one who distributes milk, butter, cream, etc.).
 - C. From one or more multi-line foodservice distributors (the largest group purchase this way). These are people who handle very diverse products, ranging from ketchup to some meats.

D. From a full-line distributor (one-stop-shop outlet). A survey I did when I was a consultant for the American Dairy Association of Wisconsin indicated that the average restaurant seems to be buying cheese from two to three different supply sources. This distribution system is fairly efficient as far as the foodservice operator is concerned, but as a marketing tool to your industry, it leaves a great deal to be desired. With the exception of the restaurateur who buys direct and therefore takes an active role in selection of high quality cheese, the balance of the industry receives little or no information on cheese availability or useability from his supplier. The reason is that the supplier will be either a poorly-qualified salesman or the supplier will be handling so many items that those emphasized by his sales force will be the higher profit items and/or those that contain promotional allowances. Little time will be spent trying to develop the cheese market.

In many cases, the broker or distributor salesmen will have extremely limited knowledge of cheese when asked for information by the customer. There are ways to overcome defects in this distribution system, and even to use them to your advantage, but they all require a commitment on the cheese industry's part to educate the salesmen that will be representing them to the restaurant industry, and also to provide the demand from the restaurateur for the product. This means advertising and informing the restaurateur about the useability of your products and creating a desire on his part to place them on his menu.

2. Possible uses of Italian cheeses:

- A. Deep-fried mozzarella (marinara).
- B. Fontina and ham (continental).
- C. String cheese:
 - i. hors d'oeuvre at the bar.
 - ii. child pacifier
 - iii. relish tray
- D. Italian cheese and sausage plate.
- E. Grated and shredded cheese on the salad bar.
- F. House dressing made with gorgonzola.
- G. Limitless varieties of sandwiches.

These are just a few ideas that come to mind -- and all add class, mystery, merchandisability and taste to the menu of any outlet.

However, while all foodservice outlets are competitive and creative in their quest for success, their menus are limited and items must be literally "sold" on to them. (Note: we sometimes think that institutional outlets are different from restaurants in that they have a captive audience. But this is usually not true. They compete with nearby restaurants, home lunches and bag lunches. Their food has to be creative for them to succeed, as well.)

3. Advertisement and education: Both of these activities are really advertising, and they combine to "sell" items into the menu. Advertisements must carry not only factual information, but also merchandising ideas such as recipes

and menu descriptions. Pictures are very important; it is difficult for an operator to visualize what an item will look like from a recipe alone. It is the picture that sells.

Once the material is developed, it must be widely distributed to the trade. The question is, "How can this be accomplished?"

- A. Brokers/distributors: These people need factual and attractive support material, both to show the client and to convince themselves of the product's worth. However, even when the material is available, there is a great deal of competition for the salesman's time and he may or may not distribute the material effectively. Opportunities to distribute the material may also be lacking.
- B. Professional salesmen representing the manufacturer: These are essential to the marketing process. They work with and train distributor salesmen, and see that the advertising is well-utilized. They can also call on larger foodservice outlets directly.
- C. Direct mail: Where it is not feasible to have a professional salesman, it is possible to distribute materials via direct mail. Mailing lists for outlets in any locale are available from the state restaurant associations. (Note: Most institutional feeders will also belong to these associations, or the association will know how to obtain such a list of these units.)
- D. Foodservice trade magazines: If you wish to reach a large market, national trade magazines such as Foodservice Marketing and Nation's Restaurant News are good vehicles. However, if you are a smaller company and desire to reach a local market, the most effective magazine may be your local restaurant association publication. In the case of Wisconsin, we publish our magazine 11 times per year, and it gets to exactly the right audience at a very economical price.
- E. Trade shows: Almost all state restaurant associations put on trade shows annually. In the case of Wisconsin, we have approximately 350 exhibitors in our trade show held each March. We will have about 10,000 restaurateurs from all over the state attending and viewing the exhibits. This type of show is an excellent place to distribute informational material and recipes, or to sample product and answer questions. Sometimes potential exhibitors will indicate they have a broker who handles their product in the show already. I wish to reiterate that, in many cases, the broker will not spend time with your product, and there is no substitute for you being there yourself. You can always refer an interested customer to the distributor in his area.

In summary, to effectively sell your product to the foodservice industry, you need to follow the methods used by other industries who are successfully marketing their products. They follow a format somewhat like this:

1. Professional salesmen making regular sales calls.
2. Providing merchandising and menu ideas regularly.
3. Advertising in foodservice trade magazines.
4. Participating in trade shows.

If you follow this format, I can almost guarantee that you'll open up rich and vast new markets for your products.

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The following paper was presented by Mr. Robert Anderson, Executive Director, National Cheese Institute, Inc., 110 N. Franklin Street, Chicago, Illinois 60606, U.S.A., especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

NEW DAIRY INDUSTRY LEGISLATION - IT'S ANTICIPATED

EFFECTS ON THE CHEESE INDUSTRY

By R.F. Anderson

ABSTRACT

The government and the dairy industry are reassessing the 50 year old dairy program. New legislation has been passed which freezes dairy supports at last years levels, but authorizes the Secretary of Agriculture to deduct fifty cents per hundred weight from the proceeds of all milk sold by farmers. The purpose of the legislation is to encourage farmers to reduce milk production in line with supply and demand. The problem of surplus dairy products already in government warehouses and the need for increased use of dairy products at home and abroad has not been answered. However, active industry support of non-governmental programs such as "Cheese Adds a Slice of Life III," will help encourage cheese consumption.

Speaking as an observer of our times and not as the spokesman for any organization, I welcome this opportunity to comment on the recently enacted dairy legislation contained in the "Budget Reconciliation Act" and its anticipated effects on the cheese industry. It has been said, change is the essence of progress. If something isn't going right, change it. The hitch comes with the definition or determination of when things aren't going right and what, if anything, to do about it. Congress concluded something wasn't going right with the dairy support program and made modest changes to cut the cost of the program.

In 1950, Dr. Edwin Nourse, an eminent economist and political analyst, expressed his concerns about "groupism." He saw the tendency of the then newly organized groups to make demands which, if granted, were certain, in his judgement, to be detrimental to the economy. He saw that the groups usually demanded from the economy more than they as a group were willing to contribute. And he saw politicians, instead of rejecting excessive or economically dangerous demands, meeting demands through a continuous process of general inflation that he predicted would ultimately undermine the basic strength of the economy.

As we now know, the concerns of Dr. Nourse were not heeded. The 60's and 70's saw an increase in regulations and a rash of governmental answers to group demand. Regulators proliferated and embraced the philosophy of protecting rights by controlling rights. Too often new regulation called for a reciprocal regulation to counter the impact of the first regulation - and so, on and on, the screws tightened on our freedoms. We came perilously close to what Tocqueville foresaw a century and a half ago. We approached a new kind of despotism - the despotism of the benefactor - known as "Big Brotherism."

The nation seemed to stop struggling to preserve individual freedoms and, instead, let government planners design and operate a theoretical utopia. We almost forgot that individual human liberties are tied closely to economic freedom and that our society hinges on the proper division of responsibility between business and government.

The 80's started out with a distinctly renewed struggle to realign responsibilities. Government regulations and regulators are being questioned. Business people show signs of becoming more responsive to society's requirement.

All of this leads to current dairy legislation and its effects on the cheese industry. Actually, dairy supports are but a small part of the overall problems generated by the government over-spending its budget.

In the past 50 years, the Federal Government has developed many programs designed to encourage farmers to adjust production to demand. A series of laws has tried to perform this task beginning with efforts to correct the economic crisis which enveloped this country in 1933. These laws involved most sectors of agriculture in some manner; usually, a quota system tied to crop loan. Production control programs were supplemented by marketing agreements. The first such agreement for milk was in the Chicago Market and it became effective August 1, 1933.

During World War II, legislation raised the level of support for milk and butterfat to 90 percent of parity. After the war, the range of parity was established between 75 and 90 percent. In 1981, the parity concept was dropped in favor of a set price of \$13.10, but the 1982 legislation reestablishes the parity concept for 1984.

The dairy price support program has historically imposed on the processors of milk the financial risk associated with certain manufactured dairy products, including cheddar cheese. The government puts a floor under milk prices and the commercial market is obliged to respond. The cheese maker becomes the surrogate purchasing agent for the government. Surplus milk not required by the commercial market is converted to cheese that is offered to the government. Most of the time this sharing of responsibilities between the government and the dairy industry has performed properly.

However, the production of milk since 1979 outpaced consumption because government exceeded its responsibilities and the dairy farmer reacted to the signal to increase milk production. Declining profits in other farming activities, lower feed cost for example, encouraged dairy herd expansion. The Commodity Credit Corporation has spent nearly \$5.7 billion dollars in the past three years to purchase and handle the surplus milk.

This situation called for the current reassessment of priorities. In the final analysis, it is apparent the dairy industry - from producer to retailer - must deal with the problem. Governments around the world, with a dairy industry component in their economy, are reaching a similar conclusion. Unlimited government intervention in the market place, with taxpayer's money used to purchase excess milk production, is being curtailed. Governments are looking for ways to reduce their involvement in the dairy industries.

The initial motives of the producers, 50 years ago, to seek government help to keep the flow of milk available and the response of governments to that appeal are understandable. But, as milk prices climb and milk becomes an expensive surplus item, the reaction of citizens both in their roll as consumer and taxpayer, is also understandable.

Governments are listening to those taxpayers and are sending a message to producers to reduce milk production. The dairy industry, at the same time, must also listen to those same citizens, as consumers, by looking for ways to increase consumption of dairy products.

In short, a better balance of supply and demand that will reduce or eliminate the cost to the government. Will the new dairy legislation accomplish these goals? Under the new dairy bill, the price support level for manufacturing-grade milk, which is used for making cheese, butter and nonfat dry milk, will be continued at the current level of \$13.10 per hundred pounds for the 1983 and 1984 fiscal years, ending September 30, 1984. For fiscal 1985, beginning October 1, 1984, the support will be set at the percentage of parity which \$13.10 represented on October 1, 1983. In order to further encourage reduction of the dairy surplus, the Secretary of Agriculture is authorized, beginning October 1, 1982, to provide for a deduction of 50 cents per hundred pounds from the proceeds of all milk sold by farmers, with the funds paid to the USDA to offset the cost of handling surpluses. Authority for the deduction would end, however, as soon as projected annual government surplus purchases for the fiscal year fall below 5 billion pounds milk equivalent. Further, the Secretary is authorized to provide for an additional 50 cent assessment, beginning April 1, 1983, if projected government surplus purchases are above 7.5 billion pounds (but this second assessment would end whenever projected purchases fall below 7.5 billion pounds). If this second assessment is levied, however, the Secretary must also provide a system under which individual farmers can get refunds--escaping part or all of the additional assessment--if they reduce production (in removing either of the assessments, the Secretary can act at any time during a fiscal year that projection of surpluses falls below the trigger levels). The compromise bill eliminated a House proposal for a referendum among farmers on a checkoff to be used to finance milk promotion, and also eliminated a House-proposed dairy board which would have administered price supports and surplus disposal.

The bureaucratic system needed to collect and audit the funds is being readied. When it is completed, one thing seems certain--each dairy plant will have to figure one check for each producer and a single composite check based on total milk receipts for the government. If a further 50¢ deduction is required, the plants and/or government will also have to implement a refund procedure. This part of the law seems overly complicated and may be changed.

Only time will tell if this price disincentive will persuade dairy farmers to bring milk production more in line with consumer demand. The question is whether the message is strong enough? In my judgement, an increase in the price of grain and beef would influence the farmer's decision to reduce production as much as the dairy support price; probably more. Grain prices are down, but meat and poultry prices appear firm and could induce some extra dairy cow culling.

Cheese support prices will not be lowered under current legislation as they will be calculated on the basis of a \$13.10 support level. About the only chance for a price increase when the new announcement is made October 1, would be an adjustment in the make-allowance, an adjustment not likely to be made.

All in all, it appears the new legislation will reduce the cost to the government and should give needed stability to the market and encourage commercial sales of cheese. This, coupled with active promotion of cheese, will tend to bring the demand side of the supply-demand equation into balance. Cheese consumption has more than doubled in the past twenty years and the potential for further increase still exists.

From the cheese industries stand point, there is UDIA's American Dairy Association and its October "Cheese Adds A Slice Of Life" \$3.5 million promotion. This successful program is timely and, from early indication, will again be a well received event.

Currently, market stability and aggressive promotion are helping the cheese industry overcome the negative influences of the recession. Events in 1983 and beyond, as they effect the cheese industry, will depend on many factors, including the newly enacted dairy legislation, but the influence of price, promotion, and public prosperity will be the most important factors.

A discouraging and challenging aspect of this whole exercise is contained in the press release put out by the House Ag Committee on the Budget Reconciliation Bill. Representative William Wampler, R-Va., ranking minority member of the committee, said: "I have mixed feelings about this agriculture portion of the reconciliation bill. On the one hand, I believe the conferees have--as I had hoped--put together a better bill with more solid savings than that which passed the house. But I continue to be concerned...we will be back addressing many of the same issues and programs in next year's reconciliation bill because the projected savings estimates did not result in similar 'actual' spending cuts."

That is the challenge. The government has enacted revised dairy support legislation tailored more to meet federal budget restraints than to correct a problem. If the dairy industry doesn't get its act together and bring supply and demand closer together, it appears congress feels compelled to keep trying to cut the cost of dairy supports to a politically acceptable minimum.

The following is an abstract of the keynote luncheon address presented on Thursday, September 16, 1982, by Dr. C. Bronson Lane; Executive Director, Dairy and Food Nutrition Council of Florida; Secretary, American Cultured Dairy Products Institute; P.O. Box 7813, Orlando, Florida 32854, especially for the 19th Annual Marschall Invitational Italian Cheese Seminar, held in the Forum of the Dane County Exposition Center, Madison, Wisconsin, on September 15 and 16, 1982.

PRODUCT QUALITY AND PROMOTION QUANTITY-

KEY STEPS TO INCREASED CONSUMPTION OF DAIRY PRODUCTS

By C. Bronson Lane, Ph.D.

Abstract

Sales and consumption of dairy food products, particularly cheese, could drop precipitously in the years ahead if present trends continue. According to analysts, a number of factors are responsible for the bleak prognostications, especially the technological advancements in development of imitations. Today's sales figures indicate that five percent of people picking up imitation cheeses are taking them home with them - up from two percent in 1978. It is also being projected that the ersatz cheese commodities will capture more than fifteen percent of the cheese market by 1985, and could take up to half of the market by the end of the century.

The United Dairy Industry Association has formulated a vulnerability listing for dairy products. The list is based upon current utilization of milk equivalency (100 pounds of milk to make 10 lbs. of cheese, etc.) along with projected marketing breakthroughs by manufacturers of imitation foodstuffs. Cheese heads the vulnerability list, primarily because it is the highest milk equivalent user and because the growth in consumption has increased from 7.7 pounds per capita in 1950 to 17.8 pounds in 1981.

The dairy industry can and must take some positive steps to impede the marketing inroads of imitations and increase per capita consumption of its product mix. The following actions are suggested:

- Eliminate "dairy product dropouts" using sound quality control principles. We can't afford to subject consumers to a quality gamble as the stakes are too high. All products must be at optimal palatability at the time of purchase and possess adequate shelf lives. Excellent raw milk quality coupled with good manufacturing, distribution, and storage practices will protect dairy foods from premature body and flavor degradations.

- Support school feeding programs and assist foodservice personnel in their endeavors to increase student participation in the lunch program which will lead to greater consumption of milk and other dairy products.

- Increase investment in innovative advertising and promotion campaigns which will create greater consumer demand for milk and milk products. Studies have shown that one can expect a two dollar return for every dollar expended for promotion of select dairy foods. Additionally, special emphasis events such as the Wisconsin Cheese Festivals have resulted in "dramatically increased sales" of Wisconsin Cheese in those markets where these two-week promotions are held, according to John Onckon, General Manager of American Dairy Association

of Wisconsin.

- Convert merchandising mayhem to marketing muscle with strategic placement of products and aesthetically appealing displays.

- Invest in and support new product development which will expand commodity lines that will appeal to a greater segment of the market. String cheese, for example, is an innovative product developed more than 25 years ago by Mr. Sam Lupo in California, and given more recent impetus in the midwest by Mr. Francis Baker and others. While the product has already gained wide consumer acceptance, there are many more market areas where its potential is still largely untapped. A curd cousin of mozzarella, string cheese is stretched and extruded in thin ropes and sold in sticks about five inches long. It peels lengthwise in strips for eating, "goes well" with a number of beverages, and is a popular alternative to traditional snack foods.

- Implement use of the "REAL" Seal. This identifying insignia for genuine dairy products provides a public service, cuts through the clutter of conflicting media messages, enhances the perceived value of milk and milk products, and provides for a multiplicity of advertising "tie-ins."

- Eliminate the concerns held by confused consumers who have been bombarded with sensationalist, unjustified, and unscientific claims that milk and dairy foods consumption can be allegedly detrimental to health.

- Support "subtle sell" nutrition education programs which encourage the use of the basic four food group approach in meal planning. Additionally, the industry must go on the offensive against the food faddists and dietary hucksters who often demean dairy foods and promote eating plans which are more harmful than helpful.

- Invest heavily in basic research pertaining to dairy foods. Just recently, for example, it has been discovered that consumption of certain cheeses may help protect against development of dental caries, and that increased use of calcium rich dairy products may lower blood pressure in select population groups and preclude the onset of osteoporosis.

The dairy industry can take pride in the fact that it still offers consumers the most nutrient dense foods at reasonable costs. But, it must be understood that our products won't "sell themselves." Aggressive promotion and marketing of high quality dairy foods is imperative; lest we perish.

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