Proceedings from the 13th Annual Marschall Invitational Italian Cheese Seminar

Various Authors

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Proceedings
From The
13th Annual
Marschall
Invitational
Italian
Cheese
Seminar
1976

Courtesy
Italian
Cheese
Sales
Marschall
Division
Miles
Laboratories
Inc.
P.O. Box 592
Madison
Wisconsin 53701
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NEW METHOD OF PROCESSING MOZZARELLA

By Roy A. Lenhardt, Sr.

For many years, new equipment has been developed and manufactured to assist the cheese maker in his profession, to increase his production, to decrease labor, to maintain and if possible improve product quality and to increase business profitability.

One such piece of equipment was marketed, that being the "Damrow" Double-0 Make Vat. This featured simplicity in design, enclosed, C.I.P. cleanable and few moving parts.

The Damrow Company, with the same basic principles in mind, have developed and are marketing a second piece of equipment called the "DMC".

The purpose of this equipment is to receive whey and curd from the Damrow Double-0 Make Vats, drain whey, form mat of cheese, retain curd for required time, mill and transfer to next operation.

The letters "DMC" are an abbreviation for Draining - Matting - Conveying.

OPERATIONAL PROCEDURES

Curd and whey are pumped from make vats to inlet manifold located on top belt for distribution. (1) The belts are started in motion at beginning of this cycle. During this distribution cycle whey is being drained off continuously through the belt (2) and mat begins formation. Retention panels form initial mat width at this stage. At end of distribution cycle, the belt continues to move for a distance of approximately 4'0". (3) This will separate mats. At this time belts are stopped until repeat of cycle. Mats turn over naturally when transferring to lower belt. (4) On lower belt the mat can stretch and flow an additional 2'0" in width. (5) At end of second belt, is located the mill (6) which will dice curd to size required.

The milled curd falls into feeder trough and auger (7). This unit can discharge from either end, center or both ends at once. The bottom of the housing acts as a sump for both whey and C.I.P. solution (8).
Power requirements for this unit basically is air, with drive rolls and mill using air cylinders. Presently auger is driven by electric motor but could be converted to air.

This unit C.I.P. cleanable and uses existing factory facilities.

In comparing the DMC to present making facilities, we find the following items:

Less floor space.
No or little electrical equipment.
Less piping and valving for product in, product out, whey and services.
No supporting equipment such as mills, elevators, etc.
Less maintenance.
Less labor in processing, maintenance and clean-up.

Simplicity in design with retention of proven methods for making cheese through this stage is the goal we believe we have achieved.
The following paper was presented by Paul Kahn, Manager, Marketing Research Packaging, American Can Company, American Lane, Greenwich, Connecticut 06830, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin on May 3, 1976.

ONE AND TWO MEMBER HOUSEHOLD FEEDING PATTERNS

By Paul Kahn

One of the most important demographic changes that has been taking place in the United States is the increasing number of one and two member households.

(Slide 1) In 1970, 46% of all American households consisted of one or two people only. In 1975, it rose to 51% and for 1980 it is projected that this group will have increased to 55% of all the households in the U.S.

There are many factors involved in this changing demographic pattern:
1. People are living longer.
2. Young people are leaving home to go to college and rarely do they return to their parental home. Frequently they maintain an apartment while in school and upon graduation either live alone, or share an apartment with someone (of either sex).
3. Young people are marrying much later in life (if at all). They are also having fewer children. The average family size in the U.S. is currently 2.97.
4. Finally, a major impact on the one and two member household is the changing role of women in our society. Generally, she is no longer satisfied with being a housewife. She is better educated than prior generations, has far greater range of interests and wants a career or at least a life with her own identity.

Realizing this trend in small family households, ACC wanted to know more about the feeding patterns, goals and needs of this segment in order to determine what new products and packaging opportunities were not being utilized.

Toward this end, we hired Yankelovich, Skelly & White (Slide 2) to conduct a study for us among this group to determine their attitudes and behavior. We examined seven areas of activities involving food.

(Slide 3) The first activity investigated was the food and eating goals and aims. The small younger single households indicate the direction of change.

For them, eating is a necessary but secondary activity: "Meals or meal times should not run your life", "Like filling a car with gas".

No ritualistic three meals a day at appointed times: emphasis on one good meal a day; or one lighter, one heavier meal; no breakfast or a beverage only; timing depends on hunger.

Nutritional needs subordinated, little interest, no desire to learn: "What's nutrition? Who cares?"; eating is for immediate gratification.
(Slide 4) Eating requires another accompanying activity or it is a waste of time.

Constraints on when, what and how to eat are resented: When is anytime you are hungry, a daily choice. What is whatever you feel like eating at the time. How is what suits the needs of the moment.

Group variations exist. Young single males hold these goals and aims most overtly intensively; reject traditional ways most strongly; want to have it their way. Young single females follow but have not come as far, somewhat more ritualistic and traditional.

Older single males have slowly accommodated, responding to their singleness, age, health, etc., to some of these eating goals; fewer meals, less emphasis on particular time to eat, responsiveness to hunger. They do not make an issue of it, however.

(Slide 5) Older single females, responding to early indoctrination, seek to follow traditional ways, often do not succeed and feel they are making mistakes.

Younger couples, in the framework of two persons' needs to meet, tend to espouse the singles' goals.

Older couples are most rigidly traditional, take providing meals at ritual hours as an end in itself.

(Slide 6) The second activity we examined was providing self with food, food shopping. Again, it is the younger small single households that show the changing life styles.

They buy for today, don't plan for tomorrow: Shop on day food is to be eaten (except some staples).

Buy what you want, unless it's too much, too big, too complex or lengthy to prepare -- buy small amounts; no leftovers to keep down waste, avoid remembering; recognize limited culinary skill, no desire for more; buy what can cope with, minimum experimentation.

Buy with more regard for what you want than for price; buying for one almost daily leaves impression of "no great expenditure", in spite of rising prices; no firm price referents, little experience to help.

(Slide 7) Older single women and older couples are different: plan quite systematically for food shopping in advance, try to shop weekly or about weekly, are planned leftover "freaks" for economy and efficiency, most cost conscious of all, favor prepackaged convenience foods but recognize cost, enjoy food shopping as a time-filling activity, and take culinary skill for granted.

(Slide 8) Next we look at food preparation for the younger people. Food preparation must be simple, require little muss and fuss: one-dish meals plus salad seems most acceptable; least number of pots, pans, utensils, both in kitchen and when eating; food which requires little watching, lingering over; food which avoids under and over-cooking as much as possible; food which accommodates to "eating anywhere" (coffee table, lap, etc.)

Food preparation should require about one-half hour, not longer: spending more time is a waste of time; spending more time detracts from more desirable activities; spending more time means "you goofed" in food selection; some prepackaged foods rejected because they take more time, not less (i.e. scrambled eggs in packaged breakfasts, frozen main meals),
Food preparation requires little aesthetics: food is to satisfy hunger not look particularly appealing; food combination are what you like, not what "goes together".

Again, there are variations between the segments of the small household population.

Foregoing most typifies young single males and older single males.

Young single females and young couples agree in principal but less intensely: will expend somewhat more time and effort; bring somewhat more culinary skills to the task; think of balanced, more aesthetically attractive meals more often; entertain exceptions more readily -- party or guest meals, where they try to demonstrate good performance as well as good attractive food.

Older single women are different: will upon occasion indulge themselves with foods which take time and effort, expect to do it for guests; expect food preparation to take longer sometimes but resort to fast convenience foods when energy is lacking.

Older couples are simply not in the same league: select the food and spend whatever time and effort is needed; don't consider the questions, food preparation, whatever it entails, is simply something to be done, a time filler; very responsive to husband's taste and health; worth any effort.

How do the younger single households serve and eat food? For this group, the precept is casual, adaptable to current circumstances, not responsive to traditional "rules": arrange to do something else while eating - TV, newspaper, book, paperwork - where that can be done best is the place to eat; be comfortable when you eat, devise functional ways to make this happen.

Avoid unnecessary traditional rituals of eating: tablecloths or mats, numerous utensils, folderol, etc., banished; adapt manners to what makes functional sense; don't adapt yourself to eating, adapt the eating to your needs.

Eating alone a lot of the time can be preferable: you can eat and do what you want; freedom from censure; no need to accommodate to others' choices, (not always the case, then go with friends to restaurants).

Again, group variations are very apparent: younger single males typify; younger single females are similar to principal but: do not deviate as far from older standards; never indicate eating alone is preferable; lean a bit more on attractiveness in the surroundings.

Older single men are much like younger single men but somewhat more adaptable and less positive in their views. They appear more often to resort to restaurant eating.

Older single women feel forced to adjust to eating alone and do it with some difficulty: sometimes use the functional approach of the younger; sometimes go to setting a table and following traditional rituals -- even for themselves alone.

Younger couples are casual, too, unless others are present; older couples seek to follow the eating practices of a lifetime but at a lower level of effort (eat in the kitchen, but with a table cloth, for example).

For food storage, again it is the younger small single households that point the direction of change.
Storing perishable leftovers is an irritant to be avoided (storing non-perishable staples is not): make all due effort to avoid storing perishable leftovers for several reasons: a) leads to waste; b) causes taking of responsibility to remember to eat, which removes an aspect of freedom to eat what you choose at a later time; will not, by definition, tastes as good.

Storing as yet unused perishables is OK, granted freezer capacity: providing it is a reasonable frequently desired food; providing a package is one serving or what is inside is loose so that one serving is removable (and preferably package is resealable); providing the food is not relatively easily obtainable fresh in an amount about equal to one serving.

(Slide 14) Storing food of whatever kind is not particularly a housekeeping virtue; rather a responsibility which trails on into the future; fresh foods, bought with attention to amount, exact only an immediate responsibility which soon ends.

Group variations still are apparent. All younger singles and younger couples feel much the same about storing food, though women find it somewhat easier to deal with and are adept at meeting the responsibilities.

Older single men accept some stocking of unused perishables to avoid shopping expeditions; generally dislike perishable leftovers.

Older single women see rewards in stocking foods, perisables or otherwise: not so much shopping required; can offer yourself a choice, in the home; will always be prepared for unexpected guests.

(Slide 15) Older couples are food stocking buffs: can shop once a week or less; take advantage of bargains; buy larger, cheaper amounts; can prepare a lot and save effort later; should save and use perishable leftovers.

(Slide 16) The last food related activity examined was cleaning up after eating for which a high degree of consistency existed among sub-groups. Not a desirable task for anyone, but hopelessly unavoidable.

Simplification of food preparation, serving and eating is seen as the only viable way of reducing the annoyance: younger people are not prepared to accept prepackaged foods in self-containers as a solution; older women do upon occasion; disposable dishes, etc., not acceptable because of implied cost; the implication of "cleaning up", therefore, is a factor in food selection, back at the start of the process.

A progression of disliked by younger men who are "all thumbs" and hate it; tolerated by women, younger and older, because they more readily accept the inevitability, but not liked; a run-of-the mill task for older couples, with established shortcuts in place, who sometimes even find a kind of togetherness it in (especially among the retired).

(Slide 17) There is a relative hierarchy of opportunity among sub-groups, based on overall dissatisfaction levels. The most dissatisfied are the young single men followed by young single women and younger couples. Generally satisfied with the status quo are older couples and older single women.

(Slide 18) Briefly, let us look at the type-distribution of "small households". As can be seen, there are three times as many older couples and older single women as there are younger households.
And finally, an interpretation of "small household" findings:

Likelihood of increasing resistance to supermarkets (jumbo size).

Concomitant growth of convenience/bantam food outlets: flexible hours.

Real opportunity for individual portion packaging: even at upcharge; including fresh product; including staples, e.g., bread, rice, noodles.

Opportunity for new single-portion, prepackaged one-dish entries: traded up, but not necessarily gourmet; probably not in frozen form.

Opportunity for single-portion snacks; e.g., four crackers and a piece of cheese.

Should probably stress individuality -- not "singleness".

Opportunity for new "service" business: home delivery

The interesting questions posed by this research is to what degree are younger people going to continue their casual, unorthodox eating behavior? And for how long? This has not yet been resolved, but it is safe to say that they will never return to the traditional rules that governed their parents.
The following paper was presented by Mr. Paul Kahn, Manager Marketing Research Packaging, American Can Company, American Lane, Greenwich, Connecticut 06830, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin on May 3, 1976.

SLIDE PRESENTATION OF ONE AND TWO MEMBER HOUSEHOLD FEEDING PATTERNS

By Paul Kahn

FOOD AND EATING GOALS AND AIMS

SMALL SINGLE HOUSEHOLDS - YOUNGER - THE DIRECTION OF CHANGE

Eating is a necessary but secondary activity

- "Meals or meal times should not run your life."
- "Like filling a car with gas"

No ritualistic three meals a day at appointed times

- Emphasis on one good meal a day
- Or one lighter, one heavier meal
- No breakfast or a beverage only
- Timing depends on hunger

Nutritional needs subordinated, little interest, no desire to learn

- "What's nutrition? Who cares?"
- Eating is for immediate gratification

Eating requires another accompanying activity or it is a waste of time

Constraints on when, what and how to eat are resented

- When is anytime you are hungry, a daily choice
- What is whatever you feel like eating at the time
- How is what suits the needs of the moment

Group Variations

Young single males hold these goals and aims most overtly intensively; reject traditional ways most strongly; want to have it their way

- Young single females follow but have not come as far, somewhat more ritualistic and traditional

Older single males have slowly accommodated, responding to their singleness, age, health, etc., to some of these eating goals; fewer meals, less emphasis on particular time to eat, responsiveness to hunger. They do not make an issue of it, however.

- Older single females, responding to early indoctrination, seek to follow traditional ways, often do not succeed and feel they are making mistakes.

Younger couples, in the framework of two persons' needs to meet, tend to espouse the singles' goals

- Older couples are most rigidly traditional, take providing meals at ritual hours as an end in itself.
ONE & TWO PERSON HOUSEHOLDS WILL REPRESENT AN INCREASING SHARE OF TOTAL HOUSEHOLDS

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<tr>
<td></td>
<td>63.5 Million</td>
<td>66.8 Million</td>
<td>73.4 Million</td>
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PROVIDING SELF WITH FOOD, FOOD SHOPPING
SMALL SINGLE HOUSEHOLDS - YOUNGER - THE DIRECTION OF CHANGE

Buying for today, don't plan for tomorrow

- Shop on day food is to be eaten (except some staples)

Buy what you want unless it's too much, too big, too complex or lengthy to prepare --
buy small amounts

- No leftovers to keep down waste, avoid remembering
- Recognize limited culinary skill, no desire for more
- Buy what can cope with, minimum experimentation

Buy with more regard for what you want than for price

- Buying for one almost daily leaves impression of "no great expenditure," in spite of recognizing rising prices
- No firm price referrents, little experience to help

Older single women and older couples are different:

- Plan quite systematically for food shopping in advance
- Try to shop weekly or about weekly
- Are planned leftover "freaks" for economy and efficiency
- Most cost conscious of all
- Favor prepackaged convenience foods but recognize cost
- Enjoy food shopping as a time-filling activity
- Take culinary skill for granted

PREPARING FOOD
SMALL SINGLE HOUSEHOLDS - YOUNGER - THE DIRECTION OF CHANGE

Food preparation must be simple, require little muss and fuss

- One-dish meals plus salad seems most acceptable
- Least number of pots, pans, utensils, both in kitchen and when eating
- Food which requires little watching, lingering over
- Food which avoids under and overcooking as much as possible
- Food which accommodates to "eating anywhere" (coffee table, lap, etc.)

Food preparation should require about one-half hour, no longer

- Spending more time is a waste of time
- Spending more time detracts from more desirable activities
- Spending more times means "you goofed" in food selection
- Some prepackaged foods rejected because they take more time, not less (i.e., scrambled eggs in packaged breakfasts, frozen main meals)

Food preparation requires little aesthetics

- Food is to satisfy hunger not look particularly appealing
- Food combinations are what you like, not what "goes together"
Group Variations

Foregoing most typifies young single males and older single males

Young single females and young couples agree in principal but less intensely:
- Will expend somewhat more time and effort
- Bring somewhat more culinary skills to the task
- Think of balanced, more aesthetically attractive meals more often
- Entertain exceptions more readily -- party or guest meals, where they try to demonstrate good performance as well as good attractive food

Older single women are different -
- Will upon occasion indulge themselves with foods which take time and effort; expect to do it for guests
- Expect food preparation to take longer sometimes but resort to fast convenience foods when energy is lacking

Older couples are simply not in the same league
- Select the food and spend whatever time and effort is needed
- Don't consider the question; food preparation, whatever it entails, is simply something to be done; a time filler
- Very responsive to husband's taste and health; worth any effort

SERVING AND EATING FOOD

SMALL SINGLE HOUSEHOLDS - YOUNGER - THE DIRECTION OF CHANGE

The precept is casual, adaptable to current circumstances, not responsive to traditional "rules"

- Arrange to do something else while eating; TV, newspaper, book, paper work -- where that can best be done is the place to eat
- Be comfortable when you eat, divise functional ways to make this happen

Avoid unnecessary traditional rituals of eating
- Tablecloths or mats, numerous utensils, folderol, etc., banished
- Adapt manners to what makes functional sense
- Don't adapt yourself to eating; adapt the eating to your needs

Eating alone a lot of the time can be preferable
- You can eat and do what you want
- Freedom from censure
- No need to accommodate to others' choices, (not always the case; then go with friends to restaurants)

Group Variations

Younger single males typify; younger single females are similar to principle but:
- Do not deviate as far from older standards
- Never indicate eating alone is preferable
- Lean a bit more on attractiveness in the surroundings
Older single men are much like younger single men but somewhat more adaptable and less positive in their views. They appear more often to resort to restaurant eating.

Older single women feel forced to adjust to eating alone and do it with some difficulty.

- Sometimes use the functional approach of the younger
- Sometimes go to setting a table and following traditional rituals -- even for themselves alone.

Younger couples are casual, too, unless others are present; older couples seek to follow the eating practices of a lifetime but at a lower level of effort (eat in the kitchen, but with a table cloth, for example)

CLEANING UP AFTER EATING

High Degree of Consistency Among Sub-Groups

Not a desirable task for anyone, but hopelessly unavoidable

Simplification of food preparation, serving and eating is seen as the only viable way of reducing the annoyance

- Younger people are not prepared to accept prepackaged foods in self-containers as a solution; older women do upon occasion
- Disposable dishes, etc., not acceptable because of implied cost
- The implication of "cleaning up", therefore, is a factor in food selection, back at the start of the process

A progression of dislike for cleaning up is noted;

- Most disliked by younger men who are "all thumbs" and hate it
- Tolerated by women, younger and older, because they more readily accept the inevitability, but not liked
- A run-of-the mill task for older couples, with established shortcuts in place, who sometimes even find a kind of togetherness in it (especially amongst the retired)

STORING FOOD

SMALL SINGLE HOUSEHOLDS - YOUNGER - THE DIRECTION OF CHANGE

Storing perishable leftovers is an irritant to be avoided (storing non-perishable staples is not):

- Make all due effort to avoid storing perishable leftovers for several reasons: a) leads to waste; b) causes taking of responsibility to remember to eat, which removes an aspect of freedom to eat what you choose at a later time; will not, by definition, taste as good.

Storing as yet unused perishables is OK, granted freezer capacity;

- Providing it is a reasonable frequently desired food
- Providing a package is one serving or what is inside is loose so that one serving is removable (and preferably package is resealable)
- Providing the food is not relatively easily obtainable fresh in an amount about equal to one serving
Storing food of whatever kind is not particularly a housekeeping virtue

- Rather a responsibility which trails on into the future
- Fresh foods, bought with attention to amount, exact only an immediate responsibility which soon ends.

Group Variations

All younger singles and younger couples feel much the same about storing food, though women find it somewhat easier to deal with and are adept at meeting the responsibilities.

Older single men accept modest stocking of unused perishables to avoid shopping expeditions; generally dislike perishable leftovers.

Older single women see rewards in stocking foods, perishables or otherwise:

- Not so much shopping required
- Can offer yourself a choice, in the home
- Will always be prepared for unexpected guests

Older couples are food stocking buffs:

- Can shop once a week or less
- Take advantage of bargains
- Buy larger, cheaper amounts
- Can prepare a lot and save effort later
- Should save and use perishable leftovers
HIERARCHY OF OPPORTUNITY AMONG SUB-GROUPS

(Based on overall dissatisfaction levels)

MOST DISSATISFIED

Young Single Men

Young Single Women

Younger Couples

Older Single Men

Older Single Women

Older Couples

GENERALLY SATISFIED WITH STATUS QUO
**TYPE-DISTRIBUTION OF "SMALL HOUSEHOLDS"**

(Rough Estimates -- Census)

<table>
<thead>
<tr>
<th>Type</th>
<th>Number (Thousands)</th>
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<td>Young Single Men</td>
<td>1,300,000</td>
</tr>
<tr>
<td>Young Single Women</td>
<td>1,000,000</td>
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<tr>
<td>Young Couples</td>
<td>5,200,000</td>
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<tr>
<td>Older Single Men</td>
<td>2,600,000</td>
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<tr>
<td>Older Single Women</td>
<td>7,100,000</td>
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<tr>
<td>Older Couples</td>
<td>14,600,000</td>
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<tr>
<td>Young Singles</td>
<td>2,300,000</td>
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<tr>
<td>Younger &quot;Small Households&quot;</td>
<td>7,500,000</td>
</tr>
<tr>
<td>Older Singles</td>
<td>9,700,000</td>
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INTERPRETATION OF "SMALL HOUSEHOLD" FINDINGS

1. Likelihood of increasing resistance to supermarkets (jumbo style)
2. Concomitant growth of convenience/bantam food outlets
   -- flexible hours
3. Real opportunity for individual portion packaging
   -- even at upcharge
   -- including fresh product
   -- including staples, e.g., bread, rice, noodles
4. Opportunity for new single-portion, prepackaged one-dish entries
   -- traded up, but not necessarily gourmet
   -- probably not in frozen form
5. Opportunity for single-portion snacks
   -- e.g., 4 crackers and a piece of cheese
6. Should probably stress individuality -- not "singleness"
7. Opportunity for new distribution outlet
   -- e.g., vending machines at work locations
8. Opportunity for new "service" business
   -- home delivery
The following paper was presented by Dr. Victor Dzenis, President, Pasta Filata International, Inc., 100 Hawthorne Ave., Bloomfield, New Jersey 07003, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

PRODUCTION OF UNIFORM MOZZARELLA PORTIONS AT HIGH SPEEDS

By Dr. V. Dzenis

The purpose of this presentation is to take a good look at one phase of mozzarella production. Namely - the making of mozzarella portions, review the present status of manufacture, recognize the deficiencies, and suggest the solution.

Today almost everything in the retail food market is offered "cut to size". Only uniform parcels of declared content lend themselves to effective distribution. Compliance with such a requirement has been an additional challenge to the cheese manufacturer. This need arrived at some industries sooner and at some later. For many years we remember butter available as a neatly formed bar, one exactly alike the other. The times when a housewife demanded a chunk of butter to be cut from a barrel, lies prior to World War II.

Certainly, many questions had to be solved before industry was able to execute the switch from offering the bulk of the product to relatively minute convenient parcel sizes. The problem was not merely to divide the large piece into many smaller pieces, Besides starting with a product of good quality, the portioning had to be executed, observing certain aspects related to preservation of these qualities, over a reasonable period of time. New equipment, new materials and far higher packaging performance speed was required to make this goal attainable and practical.

The time of change, in this respect, arrived at the door of Italian Cheese Industry not too long ago. It has been only 15 years since we know the first commercially functioning mozzarella forming device making cheese portions of accurately uniform weight. It was designed by Dzenis Laboratories in Bloomfield, New Jersey and compared to today's capacity standards was a rather small machine, but it was all the Italian Cheese Industry had at that time. In the meantime additional stages of mozzarella production besides portioning have been successfully mechanized: such as cooking and mixing. Thus, the groundwork has been prepared for the introduction of high speed packaging equipment borrowed from related industries. All these improvements, or more precisely, substituting the difficult manual tasks of cheese making with mechanical work horses brought relief to the profession.
If mozzarella quality of today averages a far better grade than in the past, we can then surmise that this would have not been quite possible had not other more pressing areas of production been absolved first, with complete satisfaction. I would dare to state that the present order of mozzarella manufacturing methods not only allow the devotion of more attention to the quality angle of the product, but has also attached and retrieved the younger generation to this profession which otherwise would have been looking elsewhere for satisfaction.

Today the Italian Cheese Industry is moving ahead with unprecedented vigor. Whereas 15 to 20 years ago a cheese manufacturer making 3000 lbs. a week was doing well, today he is making 10,000 lbs. a day using roughly the same number of personnel. All this has brought forward a different kind of problem. While it is one thing to produce a singular or relatively restricted quantity of product with an exceptional quality, making far larger quantities of the same in the same manner begins to tax equipment, personnel and other facilities which cannot be solved by simply expanding or multiplying the number of people in the plant. I will not be much off the mark stating that from the managerial point of view the most desirable way of manufacturing would be to arrive at a concept which provides implementation of production flow basically independent from human element, at the same time providing the best possible product at a healthy output per hour.

Leaving alone the curd making in the cheese factory, pasta production and its weight-wise portioning is generally an accomplished fact. Curd delivered to the cooker appears at the other end of the machine, already as a cheese portion of final size. The next station of operation would be the brining and beyond it - the packaging.

It would appear that there is already almost complete continuity of operation between the input of raw curd and the output of mozzarella. However, there is a gap which is hampering this operation to a great degree when it comes to increasing production within the same work area, utilizing the same manpower and ending up with a uniformly good product in the space of an 8 hour shift.

If the objective of the manufacturer is to produce low moisture mozzarella with the consideration of the shape of the cheese portion as being relatively unimportant, then the present manner of production using commercially available molding machines is very well suited for this task. Firm cheese can stand some abuse in handling. As a matter of fact, some manufacturers prefer a slight distortion of product and perhaps see it as a marketing advantage, for it could suggest a product made almost by hand. It may be so, and actually it is partly so; because from the molding machine on up to packaging operation, cheese is being handled by hand. However, this situation prevails not because the manufacturer intentionally attempts to give
each cheese package an individual look, but rather because this is still an uncontrolled area in which there have been no other alternative to streamlining this phase of the operation.

If low moisture cheese can be handled through packaging machines with an approximately 10% rejection factor as a result of extensive deformation, which does not allow it to fit the cavity of the packaging machine, it would be completely impossible to handle high moisture mozzarella in the same manner. The high moisture mozzarella is much too tender to be left alone in cold water or salt brine unsupported for firming up purposes prior to packaging. These cheese portions would experience distortion to an unmanageable degree as they are discharged from the molder and pass through the final stages of production.

To help the situation, the high moisture mozzarella is received by a worker as it is discharged from the molder and is placed into a receptacle or tray of required dimension. The filled trays are then placed into cold water until the cheese is firm enough. Afterwards they are emptied into salt brine. The following operation is extremely important if the cheese has to be of rectangular dimension. This actually amounts to reshaping of a cylindrical piece of cheese into a piece having more pronounced edges.

The rectangular piece of cheese has become a general trend and manufacturers who grasped this at an earlier point have experienced larger gains. Many others followed because it was so obvious. The rectangular piece, as such, lends itself to a smoother passage through the packaging machine and thus has a larger degree of certainty for complete encapsulation. Furthermore there is a greater resistance to distortion, providing a much longer shelf life, apparently because or larger base on which to support its own weight. There is also considerably larger area to accommodate suitable labels for purposes of both appeal and identification. In order to produce this rectangular piece of cheese there is a requirement of 3 workers to handle extruded cheese from the molder totalling approximately 1500 lbs. per hour. Anything exceeding this capacity calls for an additional molder and 3 more workers. The end result is a fairly uniform product having a packaging rejection rate of between 5-10%.

We foresaw this situation a number of years ago and would like to show you a solution whereby the circle between the input of curd and packaged cheese can be closed. We suggest mozzarella production with a combined molding-cooling arrangement which will enable you to obtain perfectly uniform pieces of cheese throughout the whole production process. This arrangement mechanizes the handling of cheese implementing sufficient cooling while still being held in the enclosure. The ready made pasta is charged into receptacles and is immediately cooled. Afterwards it is discharged onto a conveyor for delivery into a modified type salt brine facility where the cooling of cheese is completed. We have such an installation in operation for several years.
The following are advantages of this equipment:

1. To manufacture a high and low moisture mozzarella as a completely automated system.

2. Making very accurate portions not only weightwise but also stable dimensionally. Accomplished by having the portion already cold when it is released from the molder-cooler. We have samples of cheese made in such manner at our booth and you are welcome to examine them.

3. The concept of this design provides a larger production capacity and if hooked up in tandem it will produce 7500 lbs. an hour.

4. Elimination of 3 workers collecting mozzarella from molder who only could provide a production capacity of 1500 lbs. per hour. Thus there could be elimination of 15 workers if production rate is 7500 lbs. per hour.

5. Elimination of trays and their upkeep.

6. The space requirement for one molder-cooler unit is approximately 8 x 10 feet.

7. The coolant is 45° F. cold water which is being recirculated.

8. The cleaning is provided for in a completely automated manner without manual scrubbing.

9. With such automatic molding-cooling arrangement cheese can be made of various sizes and shapes.

10. The new molding-cooling arrangement allows for payroll utilization of workers involved, for purchase of needed equipment. Thus there is no additional expense, instead it is a redirection of expenditure in exchange for larger productivity and better merchandise.

The effectiveness of such an operation is indicated by temperature drop in mozzarella within 30 minutes as follows:

Temperature of pasta charged into molder-cooler is approximately 130° F. The temperature of discharged mozzarella from molder-cooler after approximately 6-7 minute cooling cycle is: inside 80-85° F. and outside 60-65° F. The condition of cheese portions at this temperature allows them to endure discharge onto conveyor for transit into salt brine without deformation. Following a 20-25 minute cooling period in salt brine, with the brine having a temperature of 36° F., the 12 oz. mozzarella portion indicated a 38° temperature on the inside.

Having such a programmed setup in a plant which can convert the curd within a 30 minute period into dimensionally stable and highly uniform cheese packages with an inside temperature reading of 38° F., at a production rate limited by the capacity of cooker or packaging machine, with no personnel inbetween except in a supervisory facility, mozzarella operation becomes a well organized affair.
Such an arrangement of production lends itself to incorporation in any plant independent of the type of equipment used at the present time. It is rather a supplement to the existing line. The ability to produce consistently uniform cheese portions throughout the day offers the utilization of high speed packaging equipment at full speed and even the further consideration of automated feeding of the packaging machine as all portions match the cavities.

With this in mind we are welcoming your visit at our booth for any additional information in this regard and trust that we will continue serving your needs, be they large or small.

Summary

At the present stage of operation, better appearance, increased shelf life of the product and higher plant productivity can be achieved through further mechanization. A high degree of uniformity of the end product, itself of good quality, is an indicator of a successful operation. Today available technology permits immediate implementation of necessary steps to achieve these goals for the continuing growth of the Italian Cheese Industry.
A NATIONAL SURVEY OF MOZZARELLA CHEESE QUALITY

By Professor K. M. Nilson and Mr. F. A. LaClair

INTRODUCTION

The purpose of this National Survey was to present the Italian cheese industry with a detailed analysis of the overall quality of mozzarella cheese. With the ease in which cheese is transported and marketed throughout the country it was felt that a national survey would be interesting and beneficial.

With the help of Marshall's Laboratories, 60-5 lb. loaves of cheese were collected from 4 different regions in the United States. Five samples from the Western States, 8 samples from the West-Central States, 28 samples from the East-Central States, which included Wisconsin, and 19 samples from the Eastern States were collected. A total of 30 plants participated in the survey.

Samples were shipped via UPS, Air Freight, or Parcel Post. They were refrigerated upon arrival and analyzed within 2 to 3 weeks after arriving. Eleven different analyses were performed on each sample. The test and a brief explanation of each procedure is as follows.

Standard Plate Count - Total counts were run according to Standard Methods for the Examination of Dairy Products. Dilutions of 1/1000, 1/10,000, and 1/100,000 were made on each sample.

Coliforms - These were also run according to Standard Methods. A dilution of 1/10 was used for this test.

Yeast and Mold - Also run according to Standard Methods, with exception that yeasts and molds were identified and recorded separately. Dilutions of 1/10 and 1/100 were used for this test.

Butterfat - Butterfat was run according to Wilsters text on "Practical Cheesemaking" with the exception of using a 4½ gram sample of cheese instead of a 9 gram sample. With this method the results are doubled. Duplicate samples were run on all cheese and checked within 0.5% accuracy.

Moisture - Moisture was determined by the Mojonnier method, using 0.5g cheese sample with 2g water. Duplicates were run on all samples and checked within 0.5% accuracy.

Salt - The simplified Quantab method for salt analysis was used. The procedure was followed as found in Wilsters text "Practical Cheesemaking". The analysis for this text was also run in duplicate.

pH - The pH was determined by using a Beckman pH meter with the double-glass probes. Each sample was shredded and checked dry while taking a pH reading.
Meltability and Fat Leakage - Meltability tests were conducted to determine which cheese melts most readily. The percent meltability is determined by taking a cylindrically shaped sample of cheese, using a No. 10 cork borer. These samples are then measured and sliced into 5 mm. discs. Each disc has an area of about 0.38 sq. inches when measured by a planimeter. Then 5 discs from each sample are placed onto Whatman No. 42 filter paper. The discs and filter paper are then placed into a forced draft oven at 230°F for 5 minutes. After 5 minutes the samples are removed and percent meltability is calculated as follows:

\[
\text{A-B} \times 100 = \% \text{ meltability} \\
A = \text{Area of melted disc} \\
B = \text{Area of original disc}
\]

Fat leakage was determined from the same discs of cheese used for determining meltability. As the cheese melts the free fat and aged cheese has a tendency to leak. This fat soaks into the filter paper and forms a grease ring around the disc of cheese. The percent fat leakage is calculated as follows:

\[
\text{A-B} \times 100 = \% \text{ Fat leakage} \\
A = \text{Area of Fat ring and disc} \\
B = \text{Area of original disc}
\]

Flavor - A 1-5 scale was used in determining flavor of mozzarella cheese. A 5 rating was good cheese. ½ point was assessed for each criticism found to be slight, ¾ point for moderate, and 3/4 point for a definite criticism.

Body and Texture - Body and texture of each sample was analyzed at the same time the cheese was flavored. The same 1-5 scale was used, again using ½ points for each criticism.

COMPOSITION OF MOZZARELLA

The composition of the "low moisture" mozzarella cheese in this survey compared very favorably with averages cited by Professor Kosikowski\(^1\) in his text "Cheese and Fermented Milk Foods". The percent butterfat and the fat in the dry matter was slightly lower in the surveyed cheese (Table I); however, the moisture content was about the same. The largest variation was in the salt content of the cheese. Literature\(^1\) cites an average of 1.0% salt, whereas the average of this survey was 2.12%, with a range of 1.0-4.5% (Table I).

Only one sample out of 60 had a moisture content over 52% - which would classify it as high moisture cheese, but the fat content in the dry matter was below the 45% minimum for high moisture cheese (33.9%). Therefore it was classified as a low moisture cheese.

\(^1\)Kosikowski - Cheese and Fermented Milk Foods
Table 1. Composition of Mozzarella Cheese by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Samples</th>
<th>Fat %</th>
<th>Fat D.M.*</th>
<th>Moisture %</th>
<th>Salt %</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Region</td>
<td>5</td>
<td>21.8</td>
<td>40.6</td>
<td>46.5</td>
<td>2.0</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18-25</td>
<td>33-47</td>
<td>44-49</td>
<td>1.6-2.8</td>
<td>5.1-5.4</td>
</tr>
<tr>
<td>West Central Reg.</td>
<td>8</td>
<td>20.19</td>
<td>39.5</td>
<td>47.2</td>
<td>2.0</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-24</td>
<td>24-44</td>
<td>45-51</td>
<td>1.0-3.5</td>
<td>5.0-5.4</td>
</tr>
<tr>
<td>East Central Reg.</td>
<td>28</td>
<td>21.2</td>
<td>40.9</td>
<td>48.2</td>
<td>2.4</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-26</td>
<td>32-48</td>
<td>45-56</td>
<td>1.3-4.5</td>
<td>4.7-5.4</td>
</tr>
<tr>
<td>Eastern Region</td>
<td>19</td>
<td>23.6</td>
<td>44.0</td>
<td>46.3</td>
<td>1.8</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-27</td>
<td>33-51</td>
<td>44-51</td>
<td>1.1-3.0</td>
<td>4.9-5.5</td>
</tr>
<tr>
<td>Av. All Regions</td>
<td>60</td>
<td>22.0</td>
<td>41.7</td>
<td>47.3</td>
<td>2.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Comp. Surv. Ave.</td>
<td></td>
<td>23.7</td>
<td>44.7</td>
<td>47.0</td>
<td>1.0</td>
<td>5.1</td>
</tr>
<tr>
<td>Literature Ave.*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Kosikowski - Cheese and Fermented Milk Foods  
*DM - Dry Matter

Flavor, Body & Texture

A 1-5 scale was used in determining the flavor and body and texture of the cheese. A 5 rating was good; no criticisms detected. One fourth points was assessed for each criticism found to be slight, 1/2 point for pronounced and 3/4 point for a definite criticism. Three judges from the Animal Sciences Department evaluated the cheese for flavor. Common flavor defects found were: flat, acid, bitter, salty, and coarse. Body and texture was graded using the same scale of 1-5. Common defects were open (gas or mechanical), soft, and mealy.

In table 2 is found the data on flavor and body and texture. The average flavor score was 4.00 in the Western region, with only 5 samples being representative. The East-Central region (28 samples) fell slightly above this average with a 4.20 score. Whereas, the West-Central region, with only 8 samples had the highest flavor score of 4.5. The cheese from the Eastern part of the U.S. had an average score of 4.3. All regions score on Body & Texture was close, ranging from 4.3 to 4.55.
Table 2. Flavor, Body and Texture Scores

<table>
<thead>
<tr>
<th>Region</th>
<th>No Samples</th>
<th>Flavor</th>
<th>Body &amp; Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Region</td>
<td>5</td>
<td>4.00</td>
<td>4.35</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>2.50-4.50</td>
<td>3.75-4.75</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West-Central Region</td>
<td>8</td>
<td>4.50</td>
<td>4.50</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>4.00-5.00</td>
<td>4.00-4.75</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East-Central Region</td>
<td>28</td>
<td>4.20</td>
<td>4.55</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>2.50-5.00</td>
<td>3.50-5.00</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Region</td>
<td>10</td>
<td>4.30</td>
<td>4.40</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>3.50-5.00</td>
<td>3.75-4.75</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average for all Regions</td>
<td>60</td>
<td>4.5</td>
<td>4.45</td>
</tr>
</tbody>
</table>

*Both flavor and body & texture were scored using a 1-5 scale: with 5 being no criticism.

Melting Qualities of Mozzarella Cheese

Meltability and Fat leakage was determined on each sample to see how well or how poorly the cheese melted and how much fat was retained when the cheese was melted. The procedure followed was one published by Dr. Norman Olson, University of Wisconsin.

The data was compiled in 2 ways (Table 3), hoping that the information would be used as a standard or guidelines by the Italian Cheese industry. First, the melting qualities were classified according to FDA regulations on mozzarella cheese. The cheese was divided into 2 FDA categories; Low moisture and low moisture-part skim cheese. In Table 4 the data shows that the low moisture cheese melts more easily than the part skim cheese and also the fat loss or separation upon melting is greater. Of course, this is due primarily to the initial higher fat content of the cheese. The average melting qualities for all cheese was found to be 27% meltability and 67% fat leakage. One of the whole milk cheese samples had a fat leakage of 203%. Secondly, the melting qualities were established for each of the 4 regions.
participating in the survey. These averages (Table 4) represent all of the cheese. The meltability varied from 23% in the West to 29% in the East and the fat leakage varied from 52% in the West-Central to 87% in the East.

Table 3. Melting Qualities of Mozzarella Cheese by FDA Classification of Cheese

<table>
<thead>
<tr>
<th></th>
<th>No. of Samples</th>
<th>Meltability</th>
<th>Fat Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>Low Moisture</td>
<td>21</td>
<td>36</td>
<td>99</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>17-59</td>
<td>22-203</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Moisture-Part Skim</td>
<td>39</td>
<td>23</td>
<td>50</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>5-43</td>
<td>0-131</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of All Cheese</td>
<td>60</td>
<td>27</td>
<td>67</td>
</tr>
</tbody>
</table>

Table 4. Melting Quality of Cheese by Region

<table>
<thead>
<tr>
<th></th>
<th>No. of Samples</th>
<th>Meltability</th>
<th>Fat Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>Western Region</td>
<td>5</td>
<td>23</td>
<td>64</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>6-39</td>
<td>22-101</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West-Central Region</td>
<td>8</td>
<td>28</td>
<td>52</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>15-29</td>
<td>20-79</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East-Central Region</td>
<td>28</td>
<td>27</td>
<td>60</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>8-59</td>
<td>0-180</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Region</td>
<td>19</td>
<td>29</td>
<td>87</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>5-58</td>
<td>29-203</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of All Cheese</td>
<td>60</td>
<td>27</td>
<td>67</td>
</tr>
</tbody>
</table>
Bacterial Analysis

Bacterial analysis was run on all the cheese to determine total count, yeast and mold count, and coliform count.

The average total counts (Table 5) for all regions ranging from 5,000,000 in the east to 9,000,000 in the West-Central region per gram cheese. However, on individual samples the range was from less than 30,000 to greater than 30,000,000 per gram.

Table 5. Bacterial Analysis of Cheese by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Samples</th>
<th>Total Count Per Gram</th>
<th>Yeast Per Gram</th>
<th>Mold Per Gram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Region</td>
<td>Average 5</td>
<td>7,000,000</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>120,000-30,000,000</td>
<td>0-90</td>
<td>0-20</td>
</tr>
<tr>
<td>West-Central Region</td>
<td>Average 8</td>
<td>9,000,000</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>40,000-30,000,000</td>
<td>0-110</td>
<td>0-10</td>
</tr>
<tr>
<td>East-Central Region</td>
<td>Average 28</td>
<td>7,000,000</td>
<td>164</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>30,000-30,000,000</td>
<td>0-1,000</td>
<td>0-120</td>
</tr>
<tr>
<td>Eastern Region</td>
<td>Average 19</td>
<td>5,000,000</td>
<td>1992*</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>30,000-30,000,000</td>
<td>0-21,000</td>
<td>0-10</td>
</tr>
<tr>
<td>Average for Country</td>
<td>60</td>
<td>6,600,000</td>
<td>713</td>
<td>3</td>
</tr>
</tbody>
</table>

*2 samples from one plant had over 10,000 yeasts/gram
1 sample out of 60 contained coliforms (40/gram)

The yeast and mold counts ranged from 24 per gram in the West-Central region to 1992 per gram in the East. But this isn't indicative of the total picture as 45 of the 60 samples had less than 100 yeast cells per gram cheese. Only 2 samples of cheese showed greater than 20,000 per gram. Twenty four samples of the 60 contained no yeast.

Only 8 samples of the 60 samples contained molds. The average for each region ranged from less than one to 5 molds per gram cheese in the East-Central region. Only one sample contained more than 20 molds per gram.

The coliform analysis was run to check for possible post pasteurization contamination in the cheese. This was a bright spot as far as the Italian Cheese industry is concerned. Only one sample out of 60 was found to contain coliform organisms. The particular sample had 40 coliforms per gram of cheese.
Food & Drug Regulations on Mozzarella Cheese

The Food and Drug Administration has adopted standards and guidelines for all Italian cheeses produced in the United States. These guidelines were published as amended in the Federal Register, Volume 34-8908, June 4, 1969.

FDA has classified mozzarella cheese into 4 categories: low moisture; low moisture-part skim; mozzarella; and part-skim mozzarella. The low moisture cheese must have more than 45% moisture, but not greater than 52%. The fat in the dry matter shall be less than 45% but not less than 30%. The moisture content in mozzarella and part-skim mozzarella shall be greater than 52% but not greater than 60%, whereas the fat in the dry matter for mozzarella shall not be less than 45%, the fat in part-skim mozzarella is less than 45% but not less than 30%.

The mozzarella cheese that was submitted as part of the National Cheese Quality Survey fell into 2 of the 4 FDA cheese categories; low moisture and low moisture part-skim cheese. Of the 60 samples submitted 21 were classified as low moisture and 39 samples were low moisture part-skim cheese.

The moisture content of the low moisture cheeses ranged from 44-51% (Table 6), with an average of 46.4%. Only 2 samples fell below FDA standards and that was by only 0.4 of one percent. None of the samples exceeded the 52% maximum for this cheese. The percent fat in the dry matter ranged from 35-51% with an average of 46.1%. Three samples fell below the minimum, one sample by as much as 10.0%.

The low moisture part-skim cheese ranged from 44-56% moisture, with an average of 47.7%. Three samples fell below the minimum moisture content while one sample exceeded the maximum by 4.0%. The fat in dry matter ranged from 32-46% with an average of 39.4%. Only one sample fell outside FDA Standards. This sample contained about 1% more fat in the dry matter.

The total fats ranged from 15 to 27% with an average of 23.6% for low moisture cheese and 20.6% fat average for low moisture-part skim cheese.

Table 6. Composition of Mozzarella Cheese

<table>
<thead>
<tr>
<th></th>
<th>No. of Samples</th>
<th>Moisture</th>
<th>Fat</th>
<th>Fat/DM*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Moisture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>21</td>
<td>46.4</td>
<td>23.6</td>
<td>46.1</td>
</tr>
<tr>
<td>Range</td>
<td>44-51</td>
<td>21-27</td>
<td>35-51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 45%&lt;52%</td>
<td>Not &lt; 45%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Moisture-Part Skim</td>
<td>39</td>
<td>47.7</td>
<td>20.6</td>
<td>39.4</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>44-56</td>
<td>15-25</td>
<td>32-46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 45%&lt;52%</td>
<td>&lt;45%&gt;30%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DM - Dry Matter
CONCLUSIONS

With 30 cheese plants participating from throughout the country, and these plants submitting 60 cheese samples, this survey represents an overall picture of the kind and quality of low moisture mozzarella cheese being produced in the United States.

Out of the 60 cheese samples, 5 would have been rejected on flavor alone (8%). If this is indicative of the total picture, then we can say 92% of all mozzarella cheese manufactured in the country is of a good quality.

With 8 exceptions, the cheese analyzed fell within the limitations set by FDA.

With the help of participating cheese plants, we hope this survey on mozzarella cheese quality will be meaningful and assist you in maintaining an excellent quality cheese now being produced here in the United States.
NEW IDEAS IN PACKAGING CHEESE

By Gunter Kruse

Ladies and Gentlemen - at this time, I would like to thank you for this opportunity to talk with you on my subject "New Ideas In Packaging Cheese."

The entire nation - and indeed the entire world - are looking forward to the production from...U.S. farms. World food demand is as high as it has ever been - and will rapidly increase in the future.

The cheese industry, a vital part of the high quality nutritious food production should and will be very important for the nation's and world's still growing population.

The challenge to the manufacturers is to produce more than ever before - despite rising production costs, - short supplies of important inputs, and the uncertainties of the future.

An increasing problem for cheese manufacturers is to find a way to automate production, so that they can maintain or increase the level of productive capacity, and - at the same time, reduce the labor cost in the finished product.

Certainly.....we are also concerned with good uniform quality and the protection of the product from mould and other hazards.

The following eight types of cheese packaging are mostly utilized in the ... U.S.:

2. Foil sheet wrap, sealed in century press.
3. Cellophane roll sheet, primarily used on short hold cheese.
4. 500 pound barrels and 640 pound boxes with plastic liner - usually not sealed and generally utilized for short hold cheese.
5. Pre-made multi-layer bag, vacuumized by the nozzle entering the mouth of the bag and heat sealed.
7. Pre-made shrink bags, vacuumized heat sealed and shrunk in hot water bath.
8. Pre-made multi-layer bag, vacuumized and heat sealed in vacuum chamber machine.

Vacuum packaging obviously has certain advantages, - due to the replacement of air in the filled bag before heat sealing, - compressing of the cheese when necessary, maintaining the moisture level in the product and unwrapping the blocks or other shapes before mechanical processing (cutting) after aging.

Upon several occasions, - cheese packaged under - high vacuum .... aged faster, and evidenced a more rapid chemical break down thus enhancing flavour.

Many of you have seen different systems in the industry and liked or disliked certain features on the machines available. When I became involved in packaging cheese 11 months ago...I found that the chamber vacuum packaging machine offered several advantages on certain cheese over the vacuum nozzle-heat seal, vacuum clipping or vacuum heat-seal shrink systems.
The clipping systems, widely used in connection with shrinkable materials for short hold cheese are not vacuum proof or air tight.

The vacuum nozzle - heat seal systems offer advantages only to some cheeses requiring a low vacuum - I am referring by low vacuum to approximately 12 to 24" mercury. The vacuum - heat-seal - shrink system furnishes a medium vacuum of up to 27" mercury but the shrink bags are very sensitive to wrinkles producing a high percentage of leakage due to the one sided heat seal and the low sealing bar pressure (approximately 120 lbs. total) applied. Depending on the temperature in the shrink water bath, the corners are more or less rounded on the cheese blocks.

Swissvac machines, including the unit you can see here in the exhibition hall, are reaching a vacuum of up to 29.5" mercury, depending on the size vacuum pump, size of vacuum valves in the machine and the distance between vacuum pump and vacuum packaging machine.

The vacuum line configuration is of utmost importance and one should avoid sharp bends or angles. We found that the most ideal distance between vacuum pump and machine should not measure more than 10 feet. A high vacuum can certainly not be applied to all cheeses, but rather to a few types - like for instance - American cheddar, Mozzarella and others. Therefore, the machine should have controls to adjust the vacuum time rather than the vacuum mercury level. We installed two Potentiometers - one for coarse and the other for fine adjustments to vary the time during which the vacuum valve remains open, thus altering the degree of vacuum in the chamber. Mechanically operated 2" vacuum/air input valves with excellent gas flow characteristics - are preferred to electro-mechanical valves of a smaller diameter and increased turbulence.

Some manufacturers placed their cheese blocks before wrapping in paracote - for 30 to 45 minutes into a vacuum chamber with approximately 22" mercury. - The vacuum chamber can be eliminated when the appropriate vacuum is applied in the vacuum chamber packaging machine.

Another critical function is the heat sealing capacity of the equipment in question. Depending on the wrapped materials used, - (A tough durable puncture resistance 3-Ply Bag is mostly preferred, to reduce the leaker rate - Here I am thinking in terms of less than one half percent - a double sided impulse heat seal and the sealing pressure applied), are essential for a successful operation. Moisture or impurities in the sealing area can prevent a good seal. However, if a sealing pressure of approximately 32 pounds per square inch of seal area - or - a total of 880 pounds of the seal bars is applied, the moisture or the impurities are pressed out of the sealing area before the double sided impulse heat seal takes place. - The design of the sealing wires - plus the aforementioned pressure allow a good seal even through wrinkles, pleats and product in the sealing area. Increased life of nichrom sealing wires tensioned by springs, require less electrical energy to seal the 3-ply film, because of positive sealing bar pressure. Again, we are controlling the sealing time, not temperature, with two potentiometers - wired in series.

Gas flushing device - an optional extra - when actuated, gas flushes automatically following the evacuation cycle of the chamber. - - - The Quantity of gas is adjustable.

Swissvac machines are equipped either with a loading tray, roller deck - or an automatically operating discharge conveyor belt to remove the finished product from underneath the hood via an exit chute onto a packing table or conveyor belt.
To complement our vacuum packaging machines, we are recommending for high vacuum a very efficient and reliable, vacuum pump also on display with a displacement capacity of approximately 150 to 200 cfm. Certainly any other vacuum pump with sufficient capacity can be utilized.

With reference to the cheese bags, I would like to comment as follows: superior oxygen barrier with oxygen permeability or less than 0.1 CC per 100 square inch per 24 hours and superior moisture barrier with moisture permeability of 0.18 grams per 100 square inch per 24 hours, retards mould formation and retains moisture content respectively. Naturally, the bags should be USDA approved and known for their toughness, durability, excellent puncture resistance and seal response.

On most of our initial tests and following installations, we worked together with other companies -- thus enabling us to offer complete systems.

By complete systems I am not only referring to the packaging machine, vacuum pump and bags, - but also to loading tables and conveyors to streamline operations. If you are interested, I can show you some sketches, drawings and photos after this presentation.

On one particular installation in the U.S., we were able to decrease the labor force by 25% - the remaining labor force was working less than before turning out at least 50% more production and in addition we saved 30% of the floor space area, when compared with a usual paracote wrapping operation.

Recent survey in Great Britain, Ireland and Canada (I am naming these countries since they are in a similar manufacturing situation as we are) tells that approximately 75% of their markets involve --- Swissvac equipment to package their cheese. The 40 pound block by far outnumbers any other size block manufactured.

The capability of the vacuum packaging machine should not be limited for one application. Different shape or size products should be covered within the size range of the unit, excluding the change of major components.

In case of changing market demands, it is imperative - that all heat sealable materials - inclusive shrink films - can be utilized on the equipment.

We are very proud, that our astronauts starting with the Appolo program, were feeding in space and on the moon from pouches packaged on Swissvac equipment. -- The pre-cooked food was vacuumized, heat sealed, retorted and exposed to cobalt X-rays thus eliminating all living micro-organisms. -- The food can practically be consumed in 100 years from now, without requiring refrigeration.

In retrospect, I would like to reiterate the most important points one should look for when purchasing vacuum packaging equipment:

1. Mechanical sealing pressure to seal through wrinkles, folds, grease, moisture or product.
2. Double sided impulse heat seal.
3. Fully adjustable controls for sealing and vacuum cycles.
4. Size of vacuum valve for optimum evacuation. 29" mercury achieved in 10 seconds, lesser vacuum levels in shorter time span.
5. Automatic cycling - Operator closes hood and the evacuation, sealing, venting and hood opening sequence is automatic.
6. Automatic discharge of finished product.

Just a few days ago, I learned from our principals in Europe, that in Great Britain and Ireland most cheese blocks, after vacuum packaging, are not placed in a heavy
protective carton with veneer liner as practiced in the U.S. - But rather placed on open pre-formed fibre glass or plastic trays holding approximately 8 blocks per layer. This way, not only the expensive carton and veneer liner is eliminated but the cheese can visually be inspected at any time during storage. - Vacuum packaged cheese does not lose its shape, even without the use of veneer lined heavy cartons.

The goal of every cheese maker should be, to eliminate mould, improve the quality of his product and increase shelf life especially when cheese is aged over 3 months. To achieve this goal, you probably would accept a change in your working procedure and a comparable small capital investment. — I will not deny, that some of you have bought other equipment and are happy with what you have. Granted, some packaging machines offered today, are better than the paracote hand wrapping systems — Provided, the equipment you are using or will be using — is doing an effective job for you, at a capital investment level you can afford. — —

Statistics show, that the best time to buy anything is 35 years ago.
The following paper was presented by Dr. C. A. Ernstrom, Department Head, Nutrition and Food Sciences, UMC 87, Utah State University, Logan, Utah 84322, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

**DISTRIBUTION OF MILK CLOTTING ENZYMES BETWEEN CURD AND WHEY - THEIR SURVIVAL DURING CHEESE MAKING**

by C. A. Ernstrom

A dramatic increase in U.S. cheese production from 1.4 billion pounds in 1955 to 2.9 billion pounds in 1974 (8) (9) was accompanied by a decrease in the availability of calf stomachs (vels) used for rennet manufacture. The shortage of calf rennet was international in scope, and precipitated a special FAO conference in Rome in 1968 to consider the world shortage of rennet for cheese making (4). During this period cheese makers resorted to increasing use of substitutes for traditional rennet. It is questionable whether calf vells available in the United States in 1973-74 could have filled more than 25% of the nation's need for milk clotting enzymes.

Since nearly all proteolytic enzymes will clot milk under proper conditions, it is not surprising that hundreds of proteolytic enzymes from many sources were investigated as possible substitutes for calf rennet. Most of them have proved completely unacceptable for cheese making, and only a very few have emerged to become commercially acceptable. Even those that have found commercial acceptance do not behave exactly like rennin. They are generally more proteolytic and tend to break down the body of cheese and sometimes cause bitterness. It is doubtful if any of them could be used for cheese making were it not for the fact that some of the rennet substitutes are quite unstable and to a large extent are destroyed during cheese making. Others even though quite stable, have poor affinity for the curd, and very little remains in the cheese.

The distribution of milk clotting enzymes between curd and whey as well as their stability during cheese making will obviously determine the amount of enzyme activity available in the curd to catalyze changes during curing. Whether these changes are important, of little consequence or detrimental to cheese quality has been debated in the literature for years (2) (6) (7). Even though the amount of rennet used in the cheese vat affects the rate of protein breakdown during curing, the effect is far from spectacular (3). Reducing the normal usage of rennet by one-half has little effect on the body and flavor of Cheddar cheese. On the other hand, excessively high concentrations of rennet have reportedly produced bitterness during curing. Bitterness and excessive protein decomposition also have been characteristic of cheese made with all but a very few non-rennin coagulants. Swine pepsin is very proteolytic at acid pH values, but is quite unstable above pH 6. This enzyme most probably does not survive the cheese making operation, and for this reason can be used for Cheddar cheese without producing body or flavor defects in the cured product.

A microbial protease derived from the fungus *Endothia parasitica* is quite susceptible to heat destruction, and while unsuitable for use in Cheddar cheese, can be used in Swiss and other varieties where high cooking temperatures result in destruction of the enzyme.
Although we have tried several times, we have been unable to show that any rennet activity survives in Swiss cheese that has been cooked at 129 F.

Concerns about the presence of residual milk clotting enzymes in dried or concentrated whey have been expressed by the whey processing industry. Since about 83% of the two major commercial fungal milk clotting enzymes added to Cheddar cheese milk is distributed to the whey, and since there is no destruction of these enzymes in the whey during cheese making, elimination of activity from whey must be accomplished during whey processing. The stability of all milk clotting enzymes in whey depends on the acidity (pH). With the exception of the fungal enzyme from Endothia parasitica, the stability of all the commercial coagulants increases with decreasing pH. All other conditions being equal the coagulant from Mucor miehei is the most heat stable of the commercial milk clotting enzymes. Because of this we studied the effect of high-temperature-short-time pasteurization on the destruction of this enzyme in whey. Using a 24 second holding tube, it was found that all measurable activity could be destroyed at 74 C if the pH of the whey was 6.0 or higher. Some activity persisted if the whey was more acid.

The Mucor miehei enzyme in whey can be destroyed by reasonable HTST treatments provided the whey is processed before too much acid is developed. Fortunately conditions which favor destruction of the coagulating enzyme are the same conditions which favor production of food quality sweet whey viz. avoidance of excessive acidity prior to processing.
LITERATURE CITED


The following paper was presented by Mr. Hugh Osborn, Manager, Packaging Systems, Robert Reiser & Co., Inc., 253 Summer Street, Boston, Massachusetts 02210, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

**PROFIT IN VACUUM PACKAGING**

By Hugh Osborn

In addressing oneself to the subject of profit, it is most important that we identify two critical areas of concern:

1. The Importance of Add-On Cost

2. Factors that contribute to Profit.

I intend to demonstrate how vacuum packaging, and more importantly, the DixieVac 2400 answer the needs of both these critical areas.

**The Importance of Add-On Cost**

Italian Cheese Processors sometimes overlook the fact that by the time their products reach the packaging stage, their value has increased immensely. From the raw ingredients through molding and curing, a steady stream of costs are being added to your cheese products. Yields, time, labor, overhead, inspection, analysis, equipment write-offs and interest charges, etc. all have added on cost to the extent that NOW in the packaging room, your product is worth more than at any other point in the process.

It is here in the packaging room where the cheese processor is faced with his most important decision. It is here in the packaging room where mistakes cost the most money, where profits are lost. Here in the packaging room is where you need a DixieVac.

The DixieVac 2400 is designed with only one concept in mind: to reliably and consistently produce a high quality vacuum and/or gas flushed package which will afford the Italian Cheese Processor the insurance and marketability his valuable products deserve.

The wrong piece of packaging equipment can easily erase the one thing every Italian Cheese Processor is in business for - PROFIT.

**Factors that contribute to Profit**

Keeping in mind the value of your cheese products as they reach the packaging room, I would like to zero in on the key factors that contribute to profit. These are:

1. Capital Cost of Packaging Equipment
2. Useful Life of Packaging Equipment
3. Maintenance and Upkeep
4. Package Quality
5. Package Cost - Film Economy, Rejects, Returns
6. Operating Expense.
Capital Cost

As the Italian Cheese Industry looks at the remainder of this decade, it faces production increases in excess of 10% per year with no significant changes in the number of producing facilities. This added burden of production demands new equipment purchases. One of the traditional production bottlenecks has been packaging. The typical solution has been more people, with more bagging machines for more hours. However, this solution has not increased cheese processors' percentage of profit. In most cases, the profit percentage has slipped.

As production demands increase, capital expenditures by the Italian Cheese Processor must become more analytical. When purchasing a vacuum packaging machine, to satisfy present and future production requirements, the cheese processor must subordinate initial capital cost in favor of other considerations: package quality, package cost and operating expense.

The DixieVac is a new, proven vacuum packaging system. Constructed of Rugged Aluminum Castings, the DixieVac is 50% heavier than earlier generation machines manufactured from channel frames and simple plates. As can be seen from the attached drawing, the DixieVac is equipped with Easy Access Side Panels. Behind these panels are located the pneumatic and electrical components which have been so difficult to reach and replace on earlier vacuum machines.

Quality of construction and access to components cost money to build into a machine. They increase the initial capital cost. However, improved durability, longer production runs and improved serviceability, all translate into one thing: PROFIT for the Italian Cheese Processor.

Useful Equipment Life

Of vital importance to the Italian Cheese Processor is the question of useful equipment life. Your industry is painfully aware of equipment rendered useless by the extremely corrosive atmosphere of curing brines. It is not uncommon for packaging equipment to simply disappear almost as quickly as the salesman that sold the equipment.

Extreme corrosion, reduced useful equipment life and the perpetual maintenance inherent in earlier packaging systems have only served to amplify the devastating effect of capital cost on profit.

In addition to the obvious advantages of heavy, cast construction, the DixieVac 2400 offers a unique option to the Italian Cheese Processor. As you can see from this picture and the promotional material given to you, the DixieVac can be supplied with a complete, corrosion resistant, orange urethane coating over all cast aluminum surfaces. This coating has been successfully employed for years in the European, Italian Cheese market. The DixieVac is normally supplied with stainless steel product areas, teflon coated rollers and package guide rails, high slip plastic package supports, stainless steel film clips and heavy nickel-plated transport chains.
Again - Count These Corrosion Resistant Features

(1) Stainless Steel Product Areas
(2) Teflon Coated Rollers
Urethane +
(3) Teflon Coated Package Guide Rails
(4) Stainless Steel Film Clips
(5) Plastic Adjustable Package Supports
(6) Nickel-Plated Transport Chain.

If you add to this already impressive list a complete durable, corrosion resistant urethane finish throughout, the DixieVac is clearly the vacuum packaging machine of the future. Built today - so that you, the Italian Cheese Processor, will truly have a future in vacuum packaging. The extended useful life of the DixieVac is your key to future PROFIT.

Maintenance and Upkeep

All packaging machinery requires and deserves periodic and preventative maintenance. But when an industry more than doubles over ten years, without a corresponding increase in physical plant, the effect on equipment is horrendous. Cleanup and preventative maintenance suffer badly. Unless the Italian Cheese Processor purchases the right packaging equipment, he very often finds himself spending more time patching than packaging.

The DixieVac is designed to deliver packages, not problems.

Rugged cast construction, the intelligent use of stainless steel, teflon, plastic and, above all, urethane protection reduce the burden of maintenance and upkeep on the DixieVac. In addition, the unique positioning of all system components behind easy access side panels make maintenance easy and inexpensive.

Package Quality

As I discussed previously, add-on cost has greatly enhanced the value of your cheese product throughout the processing cycle. Now comes the final step - packaging. An inferior package renders your products valueless. Without good packaging the Italian Cheese Processor cannot make a profit.

The DixieVac is engineered to produce the highest quality vacuum and/or gas flushed package possible. Space age electronic controls hold sealing and forming temperatures precisely on set point. The DixieVac forms packages up to 6" in depth and 25" in length. Forming quality is achieved through the knowledgeable combination of temperature, time, pre-heated air and forming vacuum. Corner control is a key factor in large block packages.

In addition, the DixieVac allows you to set exactly the right sealing pressure and temperature for the given film and degree of seal-area contamination. Of particular interest is the fact that the DixieVac produces a high surface seal. High surface seals cool more quickly and set faster, thereby reducing the typical distortion during machine index which ultimately contributes to leakers.
Package Economy

As an industry, Italian cheese consumes enormous amounts of packaging materials. Even considering the high percentage of bulk packages, the Italian Cheese Industry accounts for packages numbering into the hundreds of millions. The very nature of the heavy sections being packaged precludes the use of expensive and rugged packaging films. Protection of your valuable products comes at a high cost.

The DixieVac is designed to eliminate excessive film usage. Our Posi-Grip stainless steel film clips and springs make oversized film tolerances unnecessary. On the DixieVac, the film stays in the clips, even when packaging heavy sections; therefore the number of broken and jammed packages is reduced considerably.

Operating Expense

As I have noted, the Italian Cheese Industry faces enormous growth in the coming years. The limitations of physical plant mean that more people for more hours is no longer a profitable solution to the packaging dilemma. The Italian Cheese Processor must have new, high production vacuum packaging equipment, capable of withstanding the corrosive atmosphere of the cheese plant. However, this equipment cannot be delicate or difficult to operate.

I have shown that the DixieVac is far from delicate in construction. What you should see for yourself is that a rugged, high production, corrosion resistant vacuum packaging machine can also be easy and inexpensive to operate. This is the DixieVac, the vacuum packaging machine of the future. The key to profit in vacuum packaging for the Italian Cheese Processor.
Measurements

<table>
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<tr>
<th>Measurements</th>
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<tr>
<td></td>
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<td>Bottom web</td>
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<td>Weight, depending on accessories</td>
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Sequence of operations

(a) Bottom web
(b) Forming chamber
(c) Loading area
(d) Top web
(e) Photo-electric eye
(f) DIXIE THERMO-PRINT
(g) Vacuum chamber
(h) Transverse cutting
(i) Longitudinal cutting
(k) Off-feed conveyor

Output speed according to DIXIE-NORM

with 400 mm (15 3/4") stroke
33 cycles/min.
with 650 mm (25 19/32") stroke 20 c./min.

Service connections

(l) Electrical 220/380 V, 50/60 cycles, 6 kW
(special voltage possible)
(m) Main vacuum connect. (2 3/8")
(n) Vacuum connection for forming (7/8")
(o) Water inflow 14 mm (9/16")
(p) (20 GPH)
(q) Water outlet 14 mm (9/16")
(r) Gas flushing 14 mm (9/16")
(s) Compress. air 19 mm (3/4")
(t) 85 PSI (25 cfm)

Capacity, distance between pump and packer, pipe dimensions, degree of vacuum, gas flushing and packaging material

Auxiliary equipment

- Hole punching device
- Zig-Zag cut for easy opening tear feature
- Labellers
- Code dater
- DIXIE-THERMO-PRINT for date, price and code
- Infeed conveyor
- Boil-in-bag version
- Gas flushing

1) detailed information on request
2) deeper on request
3) depending on product size, pump
4) depending on capacity and size of dies
The following paper was presented by Mr. William R. Mironchuk, President, Hallde Inc., 175 Fifth Avenue, Suite 1016, New York, New York 10010, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

HOW THE HALLDE SYSTEM CAN ENABLE THE SMALL OR LARGE CHEESE MANUFACTURER TO PROCESS CHEESE PROFITABLY

By William R. Mironchuk

The Hallde Mill is manufactured in Sweden by the AB Hallde Maskiner Company. It has been in use throughout Europe for more than twenty years. It was originally intended for use as a vegetable processing mill. In fact this is the main application in Europe. Hallde has been marketed in the U.S.A. through exclusive distributors for several years. In the interest of direct service to the end user, a subsidiary wholly owned by the parent company in Sweden was formed as of January 1976.

Hallde design philosophy stresses ease of operation and clean-up. Any model Hallde Mill can be completely broken down for a change over in mode of operation or clean-up in approximately 10 to 30 seconds. Hallde Mills can be mounted on mobile bases so that they can be wheeled from one completed operation such as mozzarella shredding to another staging area, perhaps for an entirely different operation such as onion slicing. This means there is no longer a need to use several different pieces of size reduction equipment that are only used a few hours a day or a few days per week. Hallde equipment is designed to accommodate growth in your operation. It can be used in a batch processing mode or in continuous production runs. As your volume of business increases, your Hallde Mill system can be expanded.

We have been involved in Hallde United States marketing projects for about four years. We note a sharp upward trend in processed cheese demand predicated on the consumer's growing awareness of the fact that cheese provides a high source of protein in the daily diet. With rising costs of meat protein, consumers are making ends meet by supplementing meals with cheese, especially since dollar for dollar, cheese protein value far outweighs meat protein value.

Another interesting trend is ethnic food applications for processed cheese. I think it is fitting that we start off with pizza applications such as Original Pizza of Delmarva. This is a wholesale frozen pizza manufacturer located in Philadelphia, Pennsylvania. We conducted a cost-free analysis for Original Pizza prior to taking their order in 1974. We were able to justify our RG3 Super Giant in this operation. This client has added our Pneumatic Whole Head Cheese Feeding Attachment which we are exhibiting at this seminar. Increased business required the addition of this accessory as of January of this year.

Another ethnic food application is that of the Corpus Christi Texas Independent School Board which uses the Hallde Mill
in its Type A lunch program. 18,000 student meals a day are served. Applications include: use of 1500 lbs. a week of cheddar-type cheese for Mexican dishes. This is shred coarsely for melting over hot dishes such as enchadadas or very fine for taco topping. Other Corpus Christi cheese applications include cheese cubes, rectangular and julienne cuts. It was found that the students prefer sized pieces over conventionally sliced cheese. By changing attachments and feeding heads, the same Hallde Mill is able to finely slice lettuce and dice tomatoes for tacos. Corpus Christi personnel are quite pleased with the extreme versatility and simplicity of the Hallde Mill, as opposed to competitive equipment which is no longer used.

We also have users, such as Calabro Cheese, who are using the Hallde Mill strictly for cheese processing. Calabro Cheese manufactures mozzarella cheese in Vermont and shreds the cheese (on our RG3 Super Giant) in its New Haven Connecticut Plant.

At this time, I would like to relate a story that demonstrates the importance of a working two-way relationship between our distributors and clients: When we were running tests at Original Pizza, we met Mr. Sal Maggio of Maggio’s Cheese in Philadelphia. Mr. Maggio felt we were on to a fine application for the Hallde Mill. We wrote an order calling for our RG3 Super Giant. After delivery, Mr. Maggio was pleased with the performance of the Hallde Mill. We then followed up by presenting our concept for a pneumatic attachment. Mr. Maggio gave us some suggestions that would speed up the processing operation as well as enable blending of different types of cheese. Based upon satisfactory test results of the prototype we produced, Mr. Maggio placed a firm order for our first production unit which he has had for about a year now. Most significant to this story is not that we were successful in our marketing, but that we were encouraged by Mr. Maggio to reach out to you, his friends and fellow associates. He suggested we do this by contacting Mr. Stan Ferris of Marschall Labs. On behalf of Hallde, I wish to thank both Stan Ferris and Sal Maggio for their assistance and encouragement, and of course, we thank you, our customers and our prospective customers for your cooperation and support.

It is our opinion that it is to our prospective Hallde customers' advantage to be able to conduct their own product tests at their own facilities. We believe that running a small quantity of samples at a testing facility is usually not in the prospective purchaser's best interest, since the test could not take into account all of the individual's environmental circumstances. We also have found that in many cases a demonstration of the equipment on the customer's premises is insufficient. We have therefore decided upon a "Test Rent" program for prospective customers who qualify. After analyzing the prospects needs, we write up a sales order with the following provisions:

1. A 25% deposit plus appropriate credit references are required.

2. The customer has seven consecutive
calendar days to use and test his Hallde equipment (counting from the day the equipment is received).

3. The customer agrees to pay a $250.00 "Test Rent" fee plus all freight, in addition to being responsible for the condition of the equipment.

4. If the customer decides to keep the equipment during the "Test Rent" period, the entire amount is credited towards the purchase price.

When processing cheese, we are able to regulate the width, length and height of a shred or dice.

By introducing anti-caking flow agents such as FMC Corporation's Avicel, we can eliminate matting of a processed product. In this area we encountered some dusting problems. When introducing Avicel, we solved the problem by meter feeding the Avicel through a Model SCR-20 Vibrating Screw Feeder manufactured by the Vibra Screw Corporation and distributed by us.

If any of you are using packaging equipment that turns out four to twelve ounce packages of processed cheese, we would be interested in working with you. We think we can eliminate some of the matting problems that are characteristic of this type of packaging.

As you can see, we have committed ourselves to research, development and application in the Cheese Processing Industry. If you or your clients have a size reduction problem involving cheese or related problems involving pizza toppings such as onions, mushrooms, green peppers, olives or sliced pepperoni, I hope you will contact Hallde.

In conclusion, I wish to thank you again for your support of our marketing as well as research and development efforts.
Before proceeding with a discussion of future culture programs for Italian Cheese we believe it is necessary to review our present culture programs and problems.

Today, as in the past, the manufacture of Italian type cheese in the USA is characterized by the need for proper control of lactic acid development in its manufacture. This is especially needed in the case of pasta filata types such as Mozzarella, Pizza and Provolone in order to give good stretchability to the curd, moisture control, influence salting times and absorption and to provide a good clean cheese flavor.

In the case of the stirred curd types such as Romano cheese, acid development has a great effect on proper piccante or lipolytic flavor development as well as the body and texture of the cheese.

We have learned that the yield of all these cheeses is influenced by how the starter performs in the early stages of manufacture, prior to drawing the whey.

The two principle ingredients in the successful production of Italian type cheese are the milk or milk substrate and the type of culture involved. Changing one or the other can cause a great variation in the body, texture and flavor of the finished cheese.

I will not cover the subject of milk quality as it relates to bacterial composition at this time but its importance in the production of good quality cheese should not be overlooked. Modern methods of procurement and storage of milk to meet efficient plant operating schedules dictates that this milk be stored for longer periods of time. Of course this places an extra burden on the culture to perform properly. Later I will discuss possible means of controlling this "aged" milk factor in cheese production.

The selection of the cultures to be used in the production of Italian cheese is very important. Unlike the early days of using seed cultures when one general purpose culture was used, today the cheese manufacturer must select specially developed cultures to fit his specific needs. This is especially true if he expects to get uniform day to day results in acid production and flavor.

Assuming one has chosen the best culture for the type of cheese produced, it is essential that it grows properly. Unfortunately, unlike many chemical reactions that proceed on an orderly basis, cultures are living cells which can be greatly influenced by the environment in which they are grown and used. There have been many factors reported that affect culture growth. However, if the correct, healthy culture is selected, the cheese milk is of normal composition, and the proper growth temperature and controls are used, then the two primary problems affecting culture growth are bacteriophage infections and inhibiting substances in the milk.
The problem of inhibiting substances in milk is primarily related to the use of antibiotics for the treatment of mastitis or to the massive growth of undesirable microorganisms in the milk, especially the psychrotrophic types. These problems can be controlled if the cheese manufacturer puts his mind to following recommended procedures by dairy technologists and government officials.

Unfortunately the control of bacteriophage is not so easy to master. The presence of bacteriophage in cheese plants as a cause of starter failures has been well documented in the literature. Mr. Harold Rasmussen of our Marschall staff, presented an excellent paper on this subject at our 1972 Marschall Italian Cheese Seminar under the title, "Bacteriophage in Italian Cheesemaking Today." In our work, bacteriophage has been detected in whey from most of the plants checked. The bacteriophage levels vary greatly as do the bacteriophage types present. Most starter failures in a plant can generally be traced to bacteriophage infection of the culture during various stages of culture propagation. Some failures can be traced to poor culture seed stock.

The following 10 slides were prepared by Professor George Reinbold, formerly of Iowa State University, using the electron microscope. They show actual bacteriophage from whey samples, obtained from Italian and Swiss cheese plants.

1) S. thermophilus phage -- empty head.
2) S. thermophilus phage -- full head.
3) S. thermophilus phage -- long tails.
4) S. thermophilus phage -- long and interlacing tails.
5) L. helveticus phage -- notice tail sheath.
6) L. helveticus phage -- one particle to show the details.
7) L. lactis phage -- slender and no tail sheath.
8) L. bulgaricus phage -- notice the tail sheath.
9) L. bulgaricus phage -- contracted and uncontracted tail sheath.
10) L. bulgaricus phage -- this is a different phage: notice this phage does not have the tail sheath.

Our work with Italian cheese manufacturers has shown that bacteriophage exists in raw milk as it comes from the farm and that it can survive the pasteurization or heat treatment generally used in the cheese manufacturing process. We have had experience with some bacteriophage types that withstand boiling temperatures for five minutes. It is possible therefore that some of the hardier strains of bacteriophage can survive the processing temperatures used in manufacturing non-fat dry milk and whey powders. The bacteriophage would undoubtedly be destroyed in the heat processing of bulk starter media. However, bacteriophage could be a source of contamination to the heat processed bulk starter media if the dust from the NFDM and whey powder is allowed to recontaminate the bulk starter media.

Tests run by our bacteriologists have verified that even under the best sanitary conditions of starter control, in special culture rooms, bacteriophage cannot be completely controlled and kept out of the bulk starter processing tank. When levels of bacteriophage in bulk starter tanks were over 100 particles per ml. of starter, the bacteriophage contamination of the initial milk in the vat for cheese making was followed by tremendous increases in bacteriophage numbers in the whey from each succeeding vat. The bacteriophage buildup due to cycling of bacteriophage through the whey separator, pasteurizer and vat lines greatly affected the severity of the infection, which has been shown to be as high as a 10 fold increase for each succeeding vat.
Therefore, it is our opinion that for a starter program to be successful one must overcome these problems. We refer specifically to the problems of controlling bacteriophage contaminations and the use of proven growth nutrients needed for healthy and active culture growth.

The prevention of contamination of the culture with bacteriophage has evolved primarily around three methods of control. One of these methods involves the protection of the mother and bulk starter culture from external contamination by the use of special equipment. Another, the selection of phage unrelated strains which are used in a specific rotation scheme. Both of these methods are laborious and many times not practical in large plants. Also, it has been demonstrated that even the most elaborate aseptic techniques cannot provide contamination protection for cultures that require transfers through the seed or bulk stage prior to their use in the cheese vat.

The third and most successful method has been the use of bacteriophage preventative media. Early in the 1960's a medium was developed by the Marschall Division of Miles Laboratories, Inc., that overcame the deficiencies of earlier attempts by other researchers. The medium controlled the infection of bacteriophage for lactic cultures normally used in the manufacture of cheddar cheese; it was relatively low priced as compared to NFDM powder; and most cultures grew better in it than in normal milk or re-constituted non-fat-dry-milk solids.

Since the development of the original Marstar® for cheddar, we have developed two other media specifically for use in Italian cheese and cheese types using coccus and rod cultures together or the coccus culture separately. These products are Thermostar®, a complete NFDM medium, to be used for the combination of coccus and rod cultures and 412-A, a whey and NFDM based medium, for the coccus culture only. The development and use of these media were discussed by your speaker at the 1974 Marschall Invintational Italian Cheese Seminar.

Since the development of Thermostar®, various bacteriophage inhibitory whey media have been investigated for acid production and bacteriophage control for coccus and rod cultures. Our first successful product was 412-A. This has been proven to support the growth of S. thermophilus and inhibit the growth of bacteriophage specific for these microorganisms. This media today is used in the majority of Swiss cheese producing plants in the USA.

A product called Stargard™ which is a complete bacteriophage inhibiting whey based medium for the growth of lactic cultures has been offered to those plants manufacturing cheddar cheese and associated types.

The Marschall Division of Miles Laboratories, Inc. has carefully studied the use and results of whey based media in the production of cheddar type cheeses. Based on reports of occasional erratic acid production during manufacture and flavor problems in aged cheeses, we have been slow to recommend their use.

We still feel today that whey based media present a risk factor that needs careful study by the cheese manufacturer when producing top quality cheddar and related cheeses. We also believe this condition prevails in cured, aged type Italian cheeses.

However, for those Italian cheese manufacturers producing Mozzarella type cheeses with little aging prior to use, whey based media can provide a low cost product capable of supporting good coccus and rod acid production.
About six months ago we began experiments with an improved, complete whey based medium for use with our CR-150 gallon bulk starters. After field trials and commercial use, I am pleased to announce the introduction of our new whey based coccus and rod starter medium which we have named "CR" Starter Medium.

Our Italian cheese sales staff will make announcements and begin marketing of "CR" Starter Medium as fast as time permits. Trials and demonstrations can be set-up upon request.

"CR" Starter Medium will be an economical product to use. The cost per lb. is low and the level of usage is relatively low, as compared to using regular reconstituted non-fat dry milk solids. Results to date indicate "CR" Starter Medium can be used successfully in the manufacture of Mozzarella and Pizza cheese. We do not as yet have evaluations completed for other varieties of Italian cheese. We suggest trials be conducted in Provolone, Romano and Parmesan, before proceeding to use this new starter media on a full time commercial scale in these cheeses.

We believe it is important to point out that the initial cost of any starter medium and the activity of the culture is not the only criteria that should be considered.

Recent publications by Dr. George Reinbold and Dr. Don Irvine have shown the importance of recovery of NFDM starter solids in the form of increased cheese yields. Assuming this is true, then a complete NFDM starter medium like Thermostar may mean a net lower use cost medium than a whey based product.

Preparation of both liquid and powdered whey based starter media must also be carefully handled with the thought in mind that liquid whey is a potential carrier of high levels of bacteriophage and by products from bacterial growth in the cheese vat, that could be inhibitory to desirable starter organisms.

We have found in our work that when one considers the variations in selecting various NFDM solids for starter media, the selection of whey solids for a whey based starter medium is especially important. Therefore, these points have been given careful attention when setting up our quality assurance specifications for our "CR" Starter Medium.

Our complete involvement in the culture business for cheese manufacturers, and specifically for Italian cheese producers, was further increased when it was found that phage resistant media only solved one part of the problem. Equally as important was the seed culture used and the difficulty involved in the transfer of these cultures. Generally, during the transfer of these highly specialized cultures, which are needed in today's "aged" milk, the culture could lose its activity and become unbalanced in all important ratio of the coccus and rod organisms.

It was for this reason that we originally developed the CR-150 gallon bulk set cultures for use only in Thermostar. These cultures are selected and grown to maintain a desirable ratio when grown in either Thermostar or "CR" Starter Medium. In the cheese vats, reliable, consistent results can be expected on a day to day use basis. They also help to prevent bacteriophage contaminations since they eliminate the transferring of cultures in the cheese plant.

Our CR-150 gallon bulk set cultures are grown in a special manner and have been adapted to grow in either Thermostar or "CR" Starter Medium. We do not advocate using CR-150 gallon bulk set cultures in any other milk or whey medium. We cannot
assume any responsibility for their activity or results when grown in any media other than Thermostar® or "CR" Starter Medium.

Too often we have found that when cultures and starters are working well, plant operators get careless and try to cut corners or forget about the necessity of following directions thoroughly and carefully every day. We do not recommend that you try to cut corners or shorten the daily procedures in starter preparation. We wish to remind you that a culture program is only as good as your continuing monitoring efforts to see that directions are followed in a precise manner each day. Your supervisory personnel should observe daily starter making procedures and see that careful records are kept on starter performance each day.

With this background of today's culture programs for Italian cheese manufacturers we foresee future culture developments in many areas that should help you maintain good product growth. As your milk supply changes, plants become larger and highly mechanized, power supplies become more costly, labor costs increase, and cheese quality increases to meet specialized needs, culture programs must also change to meet these needs.

Therefore some of the following culture developments will become increasingly more important.

I. Milk Supply

The changing bacterial flora of stored or "aged" milk has resulted in increased growth of psychrotrophic types. This has given rise to flavor problems in the finished cheese, coagulation problems which require increased use of coagulants and calcium chloride and certain body defects that result from the use of "aged" milk.

Recent work by Gilliland and Speck at the North Carolina State University has shown that lactic cultures can inhibit the growth of some of these organisms. It has been reasoned that by adding a lactic culture to the bulk tank milk when received, prior to pasteurization, the undesirable psychrotrophic growth could be reduced. During pasteurization of milk for cheesemaking the lactic culture would be destroyed so they would not affect culture growth during the cheese manufacturing process.

The addition of a regular lactic starter is not practical because of the large volume needed to inoculate the tank and because of the lactic acid added which could affect the milk solids on storage. It would necessitate carrying another culture and making additional starter. However, the recent development of highly concentrated cultures such as our direct-to-the-vat set Superstart® cultures now make this idea a very real possibility. One needs to add only a few ounces of culture to each storage tank.

We are presently conducting experiments to see if this program has economic as well as practical applications and will report on this at a future date. You may also want to discuss this further with your Marschall Italian Cheese technical sales representative.

A slight acid development by these lactic cultures could also be of benefit in very "sweet" milk especially during the winter months, by lowering the pH slightly prior to adding the coagulant. This could result in slightly lower coagulant usage, better setting of the milk, and more uniform cheese yields.
II. Bulk Starter Media Preparation

Present methods of preparing bulk starter media has passed through the stages of the initial method of using whey starters, skim milk, liquid whole milk, and reconstituted pre-tested NFDM, to specialized media such as Thermostar® and "CR" Starter Medium. These new methods now allow for selection of bulk starter media that gives consistent culture growth with proven seed cultures.

The heating, holding action, and cooling of the bulk medium requires considerable energy. Further there is then a large amount of cooling water added to the sewage from the plant. These factors now make the use of ultra-high-temperature-processes an economical investment. Future bulk starter tanks will be cleaned in place and steam sterilized. The medium will be pre-blended in a holding tank and then heat treated at ultra-high temperatures and cooled to the desired setting temperature. The medium can be pumped directly to the pre-sterilized bulk starter tank. Because the starter room can be kept dry, bacteriophage levels in the starter room will be reduced.

III. Culture Seed Stocks

Culture seed stocks currently being used are generally of the direct bulk-set type frozen in liquid nitrogen and distributed using dry ice. These cultures are then stored in special low temperature freezers.

Presently we have four CR-150 cultures and two 300 gallon bulk set concentrated coccus and rod cultures that are performing in an excellent manner in the field. In addition individual ST and LB culture strains are sold.

Efforts to obtain these cultures has entailed a great deal of work and study over the last several years. We see the need for more strains and hope to be able to add one or two more each year so that good rotation plans can be worked out as cheese plant sizes increase. We would like to have at least ten different strain combinations available.

Because of differences in the type of cheese made we also plan to have coccus and rod cultures that meet the production needs for many cheese varieties. These cultures would be selected based on the variation in cooking temperature, moisture desired in the cheese, final cheese pH, and salting requirements.

The new methods of culture preparation will allow for the development of improved quality assurance specifications. These specifications will include such meaningful information as cell count, strain ratios, activity in acid production, gas production, specific cheese usage, and flavor performances.

Presently cultures are stored mainly in low temperature freezers such as the small Kelvinator freezer operating at -55°F when placed in a cheese plant cooler. New and better freezers are being developed and freezers operating now at minus 100°F will be available at reasonable costs. These freezers are upright freezers with special compartments that allow for easy access to various strains.

A very useful tool in the work of selecting lactic cultures has been the development of a large number of bacteriophage strains that enable us to determine culture rotation plans for individual cheese plants. These can be computerized to give the cheese plant the best starter schemes possible for the strain of cultures he is using at the time or if a replacement strain is needed.
It has been more difficult to develop the same program for coccus and rod starters. However, we have prepared a small bacteriophage bank for the S. thermophilus strains and now can suggest culture rotation schemes on a technical basis. We look forward to enlargement of this program as more new coccus and rod starter strains are introduced.

IV. Superstarts for the Italian Cheese Manufacture

During the last 15 years Marschall has been the leader in developing new culture programs and culture techniques. The art of carrying and propagating cultures has been advanced from the dried seed cultures through the use of frozen cultures, lcc vials frozen in liquid nitrogen, to the present bulk-set culture.

One problem in cheese manufacturing still exists today -- the preparation of bulk starter. With the development of cheese plants that manufacture many varieties of cheese along with associated labor, equipment and milk problems, some means were needed for greater starter versatility, reliability and control.

Recently we have demonstrated, on a commercial scale, the technology of growing and concentrating cultures to much higher concentrations than previously believed possible.

These highly concentrated "Superstarts” lactic cultures allow the cheese plant to by-pass the bulk starter preparation step, inoculate milk in the cheese vat directly, and save up to four days of inoculation and incubation time when compared to the old culture seed process.

This program has been field tested in cheddar cheese plants for over two years, with great success. Presently there is great enthusiasm by the cheese manufacturer to incorporate this system as the newest and latest step to upgrade and improve the handling of cultures and starters while improving the quality of the cheese.

As with any new program there were, and are, many problems to overcome. These include the major problems of production, storage, and distribution to be built around a biological system. These are being solved so that starter room equipment cost can be eliminated in the preparation of bulk starter, at a comparatively low cost per pound of cheese produced. We believe the cost of production and distribution of direct-to-the-vat cultures can today compete with other methods of culture handling and do a better job.

Although present field testing and the majority of our direct-to-the-vat efforts have been done mainly with lactic cultures for cheddar cheese and associated types, we are committing a great deal of research to a similar program for coccus and rod cultures for Italian cheese.

It is possible that many of you may have seen the activity and construction of the new building at our present Culture Plant site. This new addition will allow us to produce "direct-to-the-vat" lactic cultures for cheddar types. This plant will come "on stream" during the Summer of 1976.

Later we hope to add additional equipment that will allow us to manufacture similar type coccus and rod cultures for Italian cheese manufacturers. We know from experience that coccus and rod cultures and starters are much more sensitive and difficult to concentrate and store as compared to regular lactic cultures used in cheddar. As soon as the production and distribution of Superstart for cheddar
are satisfactorily developed, we will then turn our efforts to the coccus and rod Superstarts®— hopefully in 1977. We hope it will be possible to make commercial plant trials in 1977 and can report on the progress of our efforts at the time of our 1978 Marschall Italian Cheese Seminar.

For those of you not familiar with how the Superstart® is used, we have developed a system based on the packaging of a 16 ounce aluminum pull-top can containing 11 ounces of concentrated culture flash frozen in liquid nitrogen. This amount of culture is standardized to inoculate approximately 5,000 pounds of milk which is equivalent to normal one, to one and half per cent inoculation, with regular bulk starter. The actual number of cans used per vat will vary in relation to ripening time and temperature, milling or salting acidities wanted and total make time desired. We believe these general parameters will apply to coccus and rod Superstart® cultures. It is very possible it will be necessary to make adjustments to fit manufacturing procedures used in the manufacture of some Italian varieties.

Several advantages can be cited for direct-to-the-vat cultures for Italian as well as cheddar types.

1) **Convenience**

No starter preparation of any kind is needed in the factory. Factories will be able to use these cultures to supplement their regular bulk starter program. For example, many cheesemakers may wish to use this on week-ends and holidays. It also lends itself to enable you to buy more milk when it is available on short notice and have the starter needed to handle the extra milk. Also, in instances when the bulk starter prepared for use is not performing satisfactorily the direct-to-the-vat cultures can be used as back-up starter.

2) **Culture reliability**

Since these cultures can be pre-tested for activity and composition, the cheesemaker can standardize his operations on a much more consistent day-to-day basis.

3) **Improved daily performance**

Use of pre-tested cultures should result in more uniform day to day cheese production by not having to rely on a new batch of bulk starter each day.

4) **Improved strain balance**

The strain balance of the coccus and rod blend can be maintained. Change of culture coccus and rod balance is a delicate process in today's culture transfer procedures and is cause for many cheese manufacturing problems.

5) **Greater flexibility**

The cheesemaker will be able to use different strains or types of cultures on the same day without preparing a variety of bulk starter. This is especially important to the modern day cheesemakers manufacturing different styles and types of cheese in the same plant on the same day.

6) **Better control of bacteriophage**

The cheesemaker will be able to cope more effectively with the build-up of bacteriophage in the cheesemaking area by being able to rotate different culture blends in alternate vats.
7) Possible improvements in cheese quality

Our experience with cheddar cheese has been where direct-to-the-vat cultures have been used, that the cheese quality has been improved in comparison to cheese made with regular bulk starter. In cases where acidities were lower or higher than desired at the time of finishing the cheese, the cheese did not develop the commonly related cheese defects on storage. Cheddar cheese made with these cultures has had an exceptionally close body and texture.

We believe this will also be true with Italian type cheeses. One of the basic reasons for this is that only the concentrated bacterial cells are added instead of the coagulated bulk starter media solids and associated lactic acid produced in the fermentation. The normal high heat treatment used in preparing bulk starter causes denaturation of the milk protein which can produce weak spots in the cheese curd, thus allowing for a shorter-bodied cheese.

8) Possible improvement in cheese yields

Commercial cheesemaking studies have shown an increase of 2 to 3 pounds of cheese per 1,000 pounds of milk, based on the pounds of milk in a vat. Supporting this is the fact that the whey contains a lower level of solids when Superstar cultures are used in cheddar cheese manufacture.

It has been reasoned by academic people that these improved yields may be due to the higher pH during ripening, renneting, and cooking of the cheese curd prior to drawing the whey. At the higher pH the calcium salts and associated products are more insoluble, resulting in less acid soluble material being drawn off with the whey.

In some cases depending on the type of cheese made the cheesemaker may experience a slightly greater coagulant usage especially with porcine pepsin blends. In these cases additional calcium chloride can be used to decrease set times. We have not experienced a great deal of differences in setting times when pure calf rennet or Marzyme microbial coagulant is used.

V. Direct-to-the-Vat Culture for Flavor Development

Studies of lactic organisms and their enzyme systems are being undertaken to determine their relationship to cheese production and flavor. These studies show that not only can organisms be chosen for their ability to produce acidity, but also for their ability to aid ripening and development of good cheese flavors for many cheese varieties, including Italian types.

We believe it is possible that concentrated dairy cultures similar to our Superstar cultures may be added to milk to aid in hastening the curing process of typical, aged soft and hard type cheeses.

The ability to develop and improve Italian cheese processing methods has been assisted greatly by the introduction of new cultures and culture methods. Not only have these developments improved the quality of the product, but they have also increased the reliability so that the cheese manufacturing process and be maintained on a predictable time schedule at a minimum of costs.

I appreciate your very kind attention and trust this information will aid you in future consideration of improvements in your cheese operations.
REFERENCES


The following paper was presented by Professor K.M. Nilson, Department of Animal Sciences, University of Vermont, Burlington, Vermont 05401 especially for the 13th Annual Marschall Invitational Italian Cheese Seminar, held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

STIRRED CURD MOZZARELLA CHEESE

By Professor K. M. Nilson and Mr. F. A. La Clair

INTRODUCTION

Historically stirred curd cheese preceded regular Cheddar cheese making. But it is gaining acceptance as an alternative solution to the cheddaring step in Cheddar cheese making. This same step is practiced in the making of Mozzarella cheese, however, on a limited basis.

The advantages of stirred curd Mozzarella would make cheese making simpler and shorter as well as helping to make the operation more mechanized.

Professor Kosikowski from Cornell University points out that stirred curd cheese is more susceptible to coliform gas formation if the milk quality is poor and also that the small cheese particles do not knit or bond well together. Using high quality milk, proper pasteurization, good sanitary practices, and higher mixer-stretcher water temperatures to help knit the curds together should make this method more practical.

A study was conducted at the University of Vermont Agricultural Experiment Station to determine the acceptability of stirred curd Mozzarella cheese. Two hundred seventy five pounds of pasteurized 2.0% fat milk was used in each trial to make the cheese. A 1.0% commercial Lactobacillus bulgaricus starter was used, along with a single strength rennet.

Three different stirred curd techniques were studied: 1) Dry stirred; 2) Whey stirred; and 3) Water stirred.

In all methods the milk was pasteurized to 161°F for 16 seconds, then cooled to 90°F, with 1.0% Lactobacillus bulgaricus starter added. After 1 hour rennet was added on the basis of 3 oz./1000 lbs. milk. The cheese was ready to cut in about 30 minutes. The cheese was cut using 3/8 inch knives and cooked at the rate of 3-4°F rise every 5 minutes until the cheese-whey mixture reached 112°F. In all three stirred curd methods the cheese was manufactured by the traditional Mozzarella technique up to the point of draining the whey. The following is an example of the manufacturing procedure with temperature, acids and times involved for each method studied.

DRY STIRRED CURD

Standardizing Milk 8:00 A.M.

Percent fat in milk used was 2.0%. Milk was pasteurized at 161°F for 16 seconds, then cooled to 90°F and pumped into cheese vat. Titratable acidity of milk was 0.18% with a pH of 6.6.
Starter Added 8:10 A.M.

A 1.0% *Lactobacillus bulgaricus* starter was added. The titratable acidity of the starter was 1.65 with a pH of 3.6.

Setting the Milk 9:10 A.M.

A single-strength rennet was added at the rate of 3 oz./1000 lbs. milk. The rennet was diluted 1:40 with cold tap water prior to adding to milk. The milk was agitated for 5 minutes after the rennet was added.

Cutting Curd 9:40 A.M.

The milk coagulated in 25-30 minutes after adding the rennet. Cheese was cut with 3/8 inch knives and remained undisturbed for 10 minutes.

Cooking Curds 9:50 A.M.

Curds were cooked to 110°F-112°F using vat jacketed steam. At start of cooking the titratable acidity was 0.12% with pH of 6.6.

Draining the Whey 10:15 A.M.

Acidity at draining was 0.16% with pH of 6.3.

Acid Ripening 10:30 A.M.

Curds were agitated intermittently every 3-5 minutes to avoid matting and to keep temperature of curds at near 112°F as possible. Titratable acidity was 0.60% and pH of 5.5.

Hot Water Processing 12:30 A.M.

The mixer-stretcher water was heated in the vat to 170°F, and the cheese was mixed and stretched manually for about 20 minutes. When ideal stretch was obtained, the cheese was molded into 5 lb. loaves and submerged in cold water.

Cold Water 1:00 P.M.

Cold 45°F-50°F water was used to cool the cheese. A cheese temperature of at least 75°F-80°F was attained before it was removed from the molds and placed into the salt brine.

Salt Brine 3:30 P.M.

The cheese was submerged in an 80°F Salometer salt brine solution overnight at 40°F.

Packaging 7:30 A.M. (next morning)

All cheese was vacuum packaged using plastic shrink bags. The pH of the cheese at packaging was 5.35.
WHEY STIRRED CURD

The steps from 8:00 A.M. through cooking curds at 9:50 are the same as dry stirred curd procedure.

Partial Draining the Whey (Acid Ripening) 10:15 A.M.

Whey was drained off until the curds appeared. Titratable acidity at beginning of stirring was 0.16% with a pH of 6.35.

Complete Draining of Whey 11:45 A.M.

The whey was completely drained after reaching a titratable acidity of 0.65% with a pH of 5.4

Hot Water Processing 12:00 P.M.

Same as in dry stirred curd.

Cold Water 12:30 P.M.

Same as in dry stirred curd.

Salt Brine 3:00 P.M.

Same as in dry stirred curd.

Packaging 7:00 A.M. (next morning)

Same as dry stirred curd except pH of cheese was 4.9.

WATER STIRRED CURD

The steps from 8:00 A.M. through cooking curds at 9:50 are the same as the dry stirred curd procedure.

Draining the Whey 10:15 A.M.

Acidity at draining was 0.16% with a pH of 6.35.

Water Added (Acid Ripening) 10:20 A.M.

The curds were flooded with warm 112°F water and stirred. When a curd pH of 5.55-5.60 was attained the water was drained.

Hot Water Processing 11:30 A.M.

Same as in dry stirred curd.

Cold Water 12:00 P.M.

Same as in dry stirred curd.
Salt Brine 2:30 P.M.

Same as in dry stirred curd.

Packaging 6:30 A.M. (next morning)

Same as dry stirred curd except pH of cheese was 5.15.

With the dry stirred curd method, the whey was completely drained after the cooking period. The curd was agitated continually to prevent matting of the curd. The whey stirred curd technique was the same as the dry method up to whey draining. At this point the whey was drained down until the curd began to appear. The curd was continuously agitated to prevent matting. The water stirred curd was manufactured the same as the above two methods up to whey draining. At this point the whey was completely drained from the curd. The curd was then flooded with water at 112°F. Stirring was continued throughout the entire process to prevent matting of the curd.

RESULTS AND DISCUSSION

Dry Stirred

In the dry stirred process it required $4\frac{1}{2}$-5 hours from the time the milk was added to the vat until the cheese was molded. There was only a slight decrease in pH from the time the cheese was molded to the time the cheese was packaged (Table 1).

Table 1. Cheese Composition Dry Stirred Curd

<table>
<thead>
<tr>
<th>Moisture %</th>
<th>Fat %</th>
<th>Fat-DM*</th>
<th>pH</th>
<th>Yield %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>47.9</td>
<td>17.5</td>
<td>34.4</td>
<td>5.35</td>
</tr>
<tr>
<td>Range</td>
<td>47.6-48.0</td>
<td>17.2-1.80</td>
<td>33-35</td>
<td>5.30-5.40</td>
</tr>
</tbody>
</table>

*DM - Dry Matter

The moisture and fat was within the ranges expected. However, the pH of the cheese when packaged was slightly high at 5.3.

In this method the cheese knitted together well when the stretching-mixing water temperature was 170°F. There was also good stretchability. However, once the cheese was salt brined it became very hard. An analysis of the finished cheese (Table 1) showed a moisture content of 47.9%, fat 17.5%, pH 5.35 with a yield range of 8.4-9.4 averaging 8.9%.

Whey Stirred

As the whey was partially drained, the curd was agitated continuously to avoid matting. It took only 1 hour for the pH to develop from 6.35 to the desired pH of 5.30. The whey was completely drained, and the curd was processed through the stretcher-mixer process at a temperature of 170°F. The curd was then molded into 5 lb. loaves. Again the cheese knit and stretched well when molded. However, the pH of the cheese
was more difficult to control, leaving the cheese with a definite acid flavor.

In order for this method to be acceptable, great care must be followed to control the pH through the final manufacturing process. Analysis of the finished cheese (Table 2) revealed a moisture content of 51.2%, fat 15.5%, pH 4.86 and a yield of 9.5 to 10.5, averaging 9.9%.

Table 2. Cheese Composition Whey Stirred Curd

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Fat</th>
<th>Fat-DM*</th>
<th>pH</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>51.2</td>
<td>15.5</td>
<td>31.8</td>
<td>4.86</td>
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<tr>
<td>Range</td>
<td>49.53</td>
<td>15-16</td>
<td>31-33</td>
<td>4.70-5.00</td>
</tr>
</tbody>
</table>

*DM - Dry Matter

Water Stirred

In the water stirred curd method there was less problems with pH control compared with the whey stirred curd method. The average moisture content (Table 3) of the finished cheese was 48.4, with a fat content of 19.8%. The fat content on a dry weight basis was 38.4%. Final pH was 5.13 with a yield range of 9.9 to 10.5 averaging 10.1%.

Of the three methods studied, the water method was the best. In the dry method, moisture was low causing the yield to be low. One of the disadvantages of the water stirred curd method is the disposal of the water after its use. It is probably feasible to re-use the water for the next vat. While this was not done in this study it is something that needs further study. Acid control during the final stages of manufacturing was a problem with the whey stirred method.

Table 3. Cheese Composition Water Stirred Curd

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Fat</th>
<th>Fat-DM*</th>
<th>pH</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>48.4</td>
<td>19.8</td>
<td>38.4</td>
<td>5.13</td>
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<tr>
<td>Range</td>
<td>47.6-49.6</td>
<td>19.0-20.4</td>
<td>36-40</td>
<td>5.10-5.15</td>
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</tbody>
</table>

*DM - Dry Matter

In Table 4 is the data on the composition of the whey and mixer-stretcher water. The fat loss in the whey was 0.32%, 0.38% and 0.28% respectively, for dry stirred curd method, whey stirred curd method, and water stirred curd method. The total solids was 6.53% for dry method, 6.61% for whey method and 6.50% for the water
method. It was noted that in the mixer-stretcher water the fat loss was greatest in the dry curd method with 0.77% loss next in the water method at 0.51% and least in the whey method at 0.44%. Total solids loss was least in the water method, 1.01, next in dry at 1.27 and greatest in whey method at 1.50%.

Table 4. Whey and Mixer-Stretcher Water Analysis

<table>
<thead>
<tr>
<th>Product</th>
<th>T.A. %</th>
<th>pH</th>
<th>Fat %</th>
<th>T.S. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Stirred</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Whey</td>
<td>0.12</td>
<td>6.48</td>
<td>0.32</td>
<td>6.53</td>
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<tr>
<td>Curd</td>
<td></td>
<td></td>
<td>0.77</td>
<td>1.27</td>
</tr>
<tr>
<td>Mixer-Stretcher</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whey</td>
<td>0.13</td>
<td>6.52</td>
<td>0.38</td>
<td>6.61</td>
</tr>
<tr>
<td>Curd</td>
<td></td>
<td></td>
<td>0.44</td>
<td>1.50</td>
</tr>
<tr>
<td>Mixer-Stretcher</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Stirred</td>
<td>0.13</td>
<td>6.40</td>
<td>0.28</td>
<td>6.50</td>
</tr>
<tr>
<td>Curd</td>
<td></td>
<td></td>
<td>0.51</td>
<td>1.01</td>
</tr>
<tr>
<td>Mixer-Stretcher</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Water</td>
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</tbody>
</table>

CONCLUSIONS

All methods showed promise as an alternative to the cheddaring step in the manufacture of Mozzarella cheese. All of the cheese met FDA regulations for low moisture part-skim cheese. The dry stirred curd cheese showed the lowest yield at 8.9%. The moisture was also lower than the cheese from the other two methods.

Both the whey stirred and water stirred curd cheese showed good yields at 9.9 and 10.1% respectively. The moisture was the highest on the water stirred at 51.2%, but still within FDA limitations.

It should again be pointed out that in the whey stirred curd the pH was more difficult to control and that the cheese contained an acid flavor. While the water stirred curd method proved to be the best method under this particular study, there is the water disposal problem. This problem could be minimized if the water was re-used.

Fat loss in the whey was greatest in the whey method and least in water method. Total solids in the whey was greatest in whey method and least in the water method. Total solids loss in mixer-stretcher water was least in water method and greatest in whey method.
The Italian type cheese business is the end product of milk, geography, government regulations, economics, dairy technology, and marketing requirements.

The obvious fact is that Italy was the wellspring and source of the industry. It was the Italian who emigrated to other places and brought Italian cheese and its commerce to the new worlds with him. The source was Italy, the offshoots were Argentina, the United States, Canada, and Australia.

In Italy, cheeses evolved following the geography and terrain, sheep's milk cheeses from the poor rocky hills that could sustain only sheep, mozzarella from the marshes where the water buffalo thrived, and the northern hills and valleys where cows grazed giving milk for use in parmesan, grana and table cheeses. From Sicily to the borders of Switzerland, the local climates, eating habits, and economic conditions worked to create different varieties and types of cheeses. Today, the originals would achieve little recognition or identification by any panel of cheese experts. Cheese is a product that has evolved and been adapted to the requirements of progress. Since the time when milk was cooked in kettles over an open fire and the curd was cut with a wooden instrument, until today, the original cheese has been transformed.

Changes in manufacturing techniques have progressed as have changes in milk production, dairy technology, marketing needs, and all of the components evolving as the end product, cheese.

As the years passed, what has emerged has been a product of marked transformation from the original cheese in Italy to what is called by the same name today. Consider the Italian cheesemaker who left Compana Romana, Italy, and went to Argentina. In Italy, he made pecorino romano from sheep's milk, and by certain cheesemaking techniques. He found himself 7,000 miles away, outside of Buenos Aires in a small shed with crude equipment and a supply of cow's milk. Small wonder the end product was a cheese that may have been called romano, but was different and an adaptation.

Years later, another Italian cheesemaker came to Wisconsin and found himself in a modern factory with all kinds of different equipment, pasteurizers, standardizers, large vats, automatic curd cutters, and new cheesemaking devices. This, too, was a way to make an Italian cheese, and this cheese was called romano.
The Italian cheese business is a young business in the United States. Historically, the Italian cheese business began in the small dairy store (the latteria fresca) where fresh cheeses were made in back of the store, and sold over the counter. From these beginnings grew the fresh Italian cheese business in the Eastern part of the U.S.

In the late 1930's, Ramon Tolibia and some Italian associates pioneered the manufacture of Italian type semi-hard and hard cheeses in Wisconsin. With the coming of the Ethiopian and World War II, and a lack of imports from Italy, several firms came into the business to fill the void left by a lack of imports from Italy. Firms like STELLA, S & R, CONCORD CHEESE, TONY PECE, GRANDE, FRIGO, STEWART CHEESE, PASSINI and others began to produce Italian type cheeses. The impetus given by the huge demand for cheese products during the years between 1941 and 1945 allowed the infant Italian cheese industry to develop. The early production ranged from poor quality to excellent, and there were good imitations and bad imitations, some with only a shape to suggest the identity - but it started the Italian cheese business in the United States.

The hard cheese business in Argentina was developing in its own way. A naturally favorable climate and an abundance of milk with a favorable economy gave impetus to the production of grating cheeses. It supplied a large immigrant Italian population who were teaching Argentines to enjoy the Italian cuisine and expanding the market for Italian type cheese.

The production of reggianito, sbrinz and reggiano was a well-developed industry by 1920. Firms like Luis Magnasco had started producing cheese as far back as 1842. They prospered. They worked with their own land, cows and milk, factories, and eventually sold in their own retail shops. They were followed by many other firms, and the production of hard cheese increased to over 110 million pounds for a relatively small population of 14 million inhabitants. This production became a natural source of supply for us during the war years 1941 to 1945. The United States needed product, it was available in Argentina, it was relatively cheap, and they had been shipping hard cheese to the United States since the 1920's, so the market was extended. Large quantities of Argentine cheese were imported into our country during that period and helped to sustain and supply the market.

When World War II ended, a new situation developed. Italy began to recover and produce cheese again, and Argentina had plenty of cheese to offer. Wisconsin Italian-style cheese producers were geared to produce with more milk available. Customers were more discriminating, demanding, and had alternative supplies available. By 1949, the Italian cheese market was tough and competitive. The buyers were flexing their muscles, and cheese had to be something they wanted. The Italian type and total cheese production was normal, and the cheesemaker could not hope for sales unless customers came back. Deficiencies in product quality began to magnify and it became important to raise the quality level if you wanted to compete and sell.
The United States, having a high level of dairy education, a technical edge, and capital availability, was able to make strides in production which Italy and Argentina did not then emulate. The use of a scientific and technical know-how accomplished the improvements needed to satisfy the American market dictates. While it is true many of the techniques produced a product which was not really the original flavor, texture or body consistency, they were legal, market conforming products that met a need.

U.S. government regulations have been a significant factor in the development of the Italian cheese business in the United States. The governmental regulations that have most shaped and formed the business in the past 30 years are: Standards of Identity for Cheese, U.S. Import Controls, Customs' laws, price supports, and Food and Drug Standards for sanitation, pesticides and bacteria. Consider that the standards of identity for cheese were primarily evolved from our U.S. domestic practice, and one can understand that Italians and Argentines had to adjust their own cheese creations to fit standards which were not necessarily representative or typical of their own cheese and production. They had to adapt their product to fit our standards for their shipments to the U.S.

But the laws which strongly influenced the business and were of great importance in the development of the Italian-style cheese business were the quantitative restrictions and import controls, limiting quantities of cow's milk Italian type cheeses which may be imported. Without discussing the merits of the controls, the fact remains that for 25 years there has been a quantitative limit on the imports of cow's milk grating cheeses and provolone, and there has been a growing consumer market to satisfy. The American producer has the knowledge that, collectively, no more than 12,500,000 pounds of provolone and/or grating or grated cheese made from cow's milk can be imported. This gave the industry the opportunity to develop programs for the United States, and assured that imports were of limited importance. As the quantities produced here grew, these Italian varieties came to be recognized and identified by many in the image of the United States' production. Because of adjustments made to meet the requirements of an evolving market for packaging, processing, slicing or grating, it is understandable that the cheese called by its Italian original name is often not recognizable to Italians or Argentines.

In 1974, the world production of hard grating cheeses was --

- Italy ... 417,800,000 lbs.
- Argentina ... 115,000,000 lbs.
- United States ... 76,675,000 lbs.
- Total ... 609,475,000 lbs.

This was an increase in production over 1973 by about 10%, but the statistics are deceptive and bear analysis.
Taking the total world growth of the Italian type cheese business including soft, semi-hard and hard cheeses, the hard cheese production is not growing as fast as the entire Italian type cheese production and less of the total production of all cheese goes into hard cheeses.

Italy imports five times the quantity of cheese they export. Italian cheese prices are at all-time high levels, and still, Italy is basically underproduced on hard cheese. Italy's imports consist mostly of non-Italian type semi-hard and soft cheeses, and their exports are primarily hard cheese and semi-hard cheese, but the net result is that Italy's hard cheese production is not keeping overall pace with the demand in the home and export market, and less of the total hard cheese production is being exported. Most of Italy's cow's milk hard cheese production is consumed in Italy, and exports to the United States are less than one million pounds.

Pecorino cheese requires some extra explanation. Less than 1.57% of the milk in Italy is sheep's milk, but the yield of cheese from sheep's milk is approximately double that of cow's milk. Pecorino romano sheep's milk cheese amounts to more than 25% of the total of Italy's hard cheese export, and over 90% of the U.S. hard cheese imports from Italy. There is little alternative use for sheep's milk, so the utilization holds steady for cheese, but high land values are forcing flocks and sheep herding to more remote areas of Italy. Decreasing sheep numbers are evident on the mainland, and it seems doubtful that the overall production of sheep's milk cheeses for grating can maintain in Italy. Little has been done to breed ewes selectively or improve milk yields per animal to compensate for shrinking numbers of sheep.

In Italy as in the United States, more of the production of cheese is moving from small individual producers to cooperatives, and larger industrialists. While 150 million pounds of the classical typical parmesan is still being made much as it has been for 700 years, during natural pasture periods, in small dairies, in the traditional way, the production of other types and varieties is following the inevitable movement to larger factories receiving more milk and with a larger production and better controls.

Argentina exports some 5 to 10% of the hard cheese production but the production has been changing significantly. Argentine hard cheese production is lower today than it was 30 years ago. Even more significantly, the relative production of hard cheese has fallen to less than 25% of their total cheese production, while it was the major part of the total in the 1930's and 1940's. Less of the total milk goes into hard cheese than ever before, and the production of milk has been increasing in Argentina. With the movement of production to larger factories, the use of trained dairy technicians, management controls, and noting the very high interest costs on money in Argentina, hard grating cheese production is decreasing and less attractive than
soft cheese. This trend probably will continue and even accelerate with the continued closing of many smaller cheese factories who can not vary their production and make only hard cheese.

Actually, were it not for the difficult economic conditions and inflation in Argentina, there would not be enough hard cheese produced over estimated home market needs. The total production of hard cheeses has been inadequate for export demand several times during the last 15 years.

Certain conditions present in the Italian type cheese business have a relationship in the world industry.

The production of hard cheese is not growing in world total and is a declining percentage of the entire Italian type cheese industry and even a greater percentage decline appears in relation to the increasing world cheese production.

It appears that production is falling behind demand created for hard cheese, and the reserves of hard cheese curing have been reducing.

Lowering standards in deliveries of cheese and the usage of substitutes have obscured some of the real shortfall in production. The situation is becoming more evident because hard cheese quantities being cured are estimated to be at their lowest levels, and the time requirements for curing have been reduced substantially and almost to the feasible minimum for cheese to grate.

Yields returned on capital investment in the hard cheese business have not been high enough to attract increased production or even enough additional capital to finance normal production at the higher prevailing prices.

Unfortunately, brand identification of hard cheese is easily lost in bulk form, so that marketing of parmesan, romano, any hard grating cheese, and provolone in bulk form makes production and marketing investment less attractive. Since product identification is hard to establish, and other cheese products are easier to identify, there tends to be less investment interest.

The sale of a large percentage of the hard cheese production has been to manufacturers and processors, who have set rigid requirements and standards for their production standards. Too often, the marketplace dictates a price which doesn't reflect the basic production value of the product. This has made it less profitable to produce hard cheese compared to other items in the cheese line sold to consumers.

Too little consumer identification of hard grating cheeses has meant that the relative value of the cheese to the consumer does not easily command the required price. Many consumers actually think that a canister or jar of grated cheese is the only way parmesan cheese is available, or is the cheese itself. Few consumers know the difference between romano and parmesan, or if it's made from sheep's milk or cow's
milk, and many are unaware of the uses or nature of these products. In fact, many dairy and cheese buyers are unaware of the differences. If you have an uneducated market, you can't obtain or justify prices. If the cheeses don't get a fair and normal markup, production dollars will not go into producing hard cheese. If the total market continues to be underproduced, the hard cheese industry will lose ground, and the market will substitute other cheeses or imitations. Foods now using parmesan or romano will no longer be programmed to use them. Too often, we forget that a grating cheese is used as a condiment and really isn't the basic part of the food or of its cost. Compared to spices and extracts, grating cheeses are cheap, and the price needed can be secured.

If it weren't for Italy and Argentina shipping 20 million pounds of grating cheeses to the United States, the U.S. market would be undersupplied and underdeveloped.

There is little doubt that the Italian culinary habit, the growing consumer market, increased purchasing power, the growth of commercially made Italian style products have all been developing a market for grating cheeses, and that market, due to the specialized conditions and nature of the business, is less attractive to the cheese producer. It's easier for producers to turn over money making soft cheese, and the market is easier to forecast for 30 days rather than in 5 or 10 months. Warehouse space and curing rooms turning over quickly ease money problems and reduce quality problems. Still the simple fact is that there is a worldwide growing market for 615 to 700 million pounds of grating cheeses, and less hard cheese is being made today.

If the industry collectively examined the situation, production would adjust more easily. Production is spread through many firms and factories in several countries, and, most cheese producers can utilize their milk in many different ways, so individually little can be done to adjust the situation. But if production is not adjusted to correct the declining trend in hard cheeses, the total market will diminish and become increasingly less important.

There is an inconsistency in a world dairy production where powdered milk is a glut on the market, and a market with a developed milk usage of 9 billion pounds of milk and potentially more is being allowed to deteriorate.

Perhaps it would alleviate the situation if the cheese standards of identity were relaxed as far as curing time and a couple of additional points of moisture were permitted.

Perhaps it would help if the import quotas were increased for these hard varieties of cheese to be imported to the United States, so that larger markets develop and producers here and in supplying countries would be encouraged to increase production.
Solutions are required and there is a need for hard grating cheese products. Perhaps a method of financing curing time through government assured long term loans at favorable bank interest rates could be considered. A method should be studied and devised for delayed payment terms of milk bills on milk used in this specialized type of cheese production.

The growing need for hard cheeses developed in spite of relatively little being done to promote these cheeses. The potential for development of the Italian type cheese business is one of the attractive areas open to those who desire to capitalize on an underdeveloped and underproduced market. If a market is underproduced, it becomes easy enough for the sales prices to justify production costs, and eventually production will follow proper returns on investment.

If you further develop the hard cheese business, your whole Italian line of cheeses benefit. The push on parmesan and romano will help pull along almost all of the cheeses in the Italian line: mozzarella, ricotta, and provolone, since they all benefit from good development of the Italian food consumption. Today - Italian type food is a part of the American diet. It's important that the cheese industry keep its share of that diet and that you help promote its growth.
The following paper was presented by Dr. C. A. Ernstrom, Department Head, Nutrition and Food Sciences, UMC 87, Utah State University, Logan, Utah 84322, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

ENERGY ALLOCATION IN THE FOOD SYSTEM:
A MICROSCALE VIEW

by S. J. Brown, J. C. Batty, S. L. Folkman and C. A. Ernstrom

INTRODUCTION

America's food system attracted a special kind of attention after the advent of the energy crisis (Refs. 12, 13, 14, 19, 20, 23, 25). Realization that our food supplies are directly dependent on our energy supplies became widespread. Simultaneously, agriculture was criticized for being particularly inefficient in terms of fossil fuel energy inputs per unit of food energy produced. Subsequent proposals for reducing on-farm energy inputs included reducing or eliminating the use of manufactured fertilizers.

The study reported here was devised to determine the areas in the food chain requiring the greatest input of energy. We chose a micro rather than a macroscale point of view with the intent of examining two specific food products rather than the industry as a whole. The two products selected were canned whole kernel corn and Cheddar cheese.

We tracked the energy inputs into a single #303, 1-lb can of whole kernel corn, having a digestible energy content of 269 Kcal, from production to consumption. Corn was selected because its production energy inputs are already well documented and it is a worldwide staple as well as being familiar to the typical consumer.

Cheddar cheese was selected because it represented an animal product which is frequently criticized as being wasteful of energy when compared to direct consumption of plant products by human beings.

Unfortunately our study of energy inputs into Cheddar cheese has not been completed. Therefore, we are able to give only rough estimates which we are using as a basis for collecting more exact data. We also hope these estimates will provide a stimulus to the cheese industry to provide information needed to complete the study.

Our findings with regard to canned whole kernel corn are summarized in Table 1. The study assumptions and sources of data are further clarified in Table 2. Energy uses in each sector of the food system are discussed in the following sections.
<table>
<thead>
<tr>
<th>Process</th>
<th>Energy (Kcal/can)</th>
<th>Process</th>
<th>Energy (Kcal/can)</th>
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<tr>
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<td>pumped irrigation</td>
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</tr>
<tr>
<td>Transportation</td>
<td></td>
<td>Transportation</td>
<td></td>
</tr>
<tr>
<td>441 mile haul</td>
<td>231</td>
<td>1000 mile haul</td>
<td>477</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing</td>
<td>340</td>
<td>Marketing</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shopping</td>
<td></td>
<td>Shopping</td>
<td></td>
</tr>
<tr>
<td>2½ mile round trip</td>
<td>654</td>
<td>5 mile round trip</td>
<td>982</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Preparation</td>
<td></td>
<td>Home Preparation</td>
<td></td>
</tr>
<tr>
<td>1 dishwasher cycle per day</td>
<td>430</td>
<td>2 dishwasher cycles per day</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3865</td>
<td><strong>Total</strong></td>
<td>5384</td>
</tr>
</tbody>
</table>

**Table 1.** Summary of Energy Inputs (Kcal) to a 1-lb can of whole kernel corn. The left column shows energy inputs based on rather conservative assumptions. The right column shows how these energy inputs can vary depending on the assumptions made. See Table 2 for more detail. The digestible food energy of the corn is 269 Kcal. (Ref. 27)
Table II. Development of Energy Inputs to Can of Corn

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>Energy Inputs Ecal/can</th>
<th>EXPLANATION AND ASSUMPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural Production</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seed production</td>
<td>16.4</td>
<td>Production energy inputs on a per acre basis were obtained from Ref(7). The average yield of canning corn was taken as 5.0 tons of husked corn per acre in California, and 32 cases of 24 #303 cans per ton, Ref(1). Includes energy for manufacture and maintenance of equipment calculated as 8% of fuel inputs, Ref(26). Electrical energy inputs converted to fossil fuel equivalents by multiplying by 3.05. Irrigation includes only energy inputs to pumping. Does not include energy required to manufacture pipe, etc., see Ref (2).</td>
</tr>
<tr>
<td>crop establishment</td>
<td>82.8</td>
<td></td>
</tr>
<tr>
<td>cultural practices</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td>harvesting</td>
<td>30.5</td>
<td></td>
</tr>
<tr>
<td>fertilizer</td>
<td>257.5</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>41.6</td>
<td></td>
</tr>
<tr>
<td>irrigation</td>
<td></td>
<td>Based on Ref(7). Does not include energy to manufacture processing plant or equipment or energy to transport workers to and from job, etc.</td>
</tr>
<tr>
<td>non-pumped</td>
<td>725.0</td>
<td></td>
</tr>
<tr>
<td>pumped</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Processing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>remove from cob, washing, retorting, etc.</td>
<td>655</td>
<td></td>
</tr>
<tr>
<td><strong>Packaging</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>can manufacture</td>
<td>997</td>
<td>Includes only direct inputs. Does not include energy to manufacture plant or equipment to manufacture can or box. Assumes 24 cans per box.</td>
</tr>
<tr>
<td>box manufacture</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>farm to processor</td>
<td>37</td>
<td>Average shipping distance for canned fruits and vegetables in US is 441 miles Ref(6). An average of 52 ton-miles of cargo per gallon of diesel fuel is assumed (Ref (21)).</td>
</tr>
<tr>
<td>processor to retailer 441 miles</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>processor to retailer 1000 miles</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td><strong>Marketing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wholesaler</td>
<td>18</td>
<td>Based on .5% of gross sales allocated for utilities and costs of electricity and natural gas of $.0206/kwh and $1.025/MPC respectively, Ref(18). Also, assumes one paper bag provided per national average purchase of $6.42, Refs(11,22). Can of corn was priced at $.34/can, Refs(11,17). Bag energy inputs per can computed as the product of ($ .34/$6.42) x (Energy to manufacture bag), Ref(4).</td>
</tr>
<tr>
<td>retailer</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td><strong>Shopping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>automobile</td>
<td></td>
<td>Average distance traveled to supermarket is 2.5 miles, Refs (10,15,21,22). This figure accounts for shopping for non-grocery items and refers only to that mileage chargeable to grocery shopping. Fuel use computed on basis of national average, Ref(24), with allowance for engine warmup, Ref(8). Energy for automobile manufacture and maintenance computed as 8% of fuel energy, Ref(26). Energy per can calculated as the product of (.34/6.42) x (energy per trip).</td>
</tr>
<tr>
<td>2.5 mile round trip</td>
<td>654</td>
<td></td>
</tr>
<tr>
<td>5 mile round trip</td>
<td>982</td>
<td></td>
</tr>
<tr>
<td><strong>Home preparation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cooking on electric range</td>
<td>201</td>
<td>Assumes corn is placed on 1257 watt heating element operating at 2/3 capacity for 5 minutes. Includes estimate for manufacturing of stove and dishwasher. Assumes gas hot water heater at 64% efficiency, Ref(16), 10.6 gal/cycle of 160° water, heated from 60°, per cycle. Assumes a family of 4 consumes 8000 Kcal of food per day. Energy content of can of corn is 269 Kcal. Energy per can calculated as the product of (269/8000) x (energy per cycle). Disposal based on data from Ref(4).</td>
</tr>
<tr>
<td>dishwashing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>one cycle per day</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td>two cycles per day</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td>disposal of can and box</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
AGRICULTURAL SECTOR

When pumped irrigation is necessary to corn production, irrigation energy requirements far overshadow all other on-farm energy inputs combined (Table 2). Only about 5% of the nation's farmland is presently irrigated (Batty et al., 1975), however, with the bulk of U.S. sweet corn being produced under non-irrigated conditions (The Almanac, 1971). It is therefore reasonable, for comparisons made in this study to consider the non-irrigated production unit as typical. Among the other on-farm energy inputs (Table 2), those involved in manufacturing fertilizer are by far the largest. It's obvious, therefore, why some individuals are urging a reduced use of manufactured fertilizers.

PROCESSING AND PACKAGING SECTOR

At a processing plant the corn is husked, removed from the cob, washed, placed into cans, and cooked. These operations typically require 655 Kcal per can or about 145% of the agricultural energy inputs. The energy required to manufacture the steel can in which the corn is packaged amounts to 997 Kcal per can. The case-lot box into which the cans are placed costs an additional 108 Kcal per can to make. Altogether, processing and packaging account for about four times more than the agricultural energy inputs and about seven times more than the energy required for fertilizer production. In many instances, similar conclusion might be extended to other food products (Table 3).

Unfortunately, proving that packaging food often requires a far greater use of energy resources than does the growing of that food, doesn't automatically lead to practical alternatives for preservation. Freezing rather than canning food is one option that warrants analysis. The energy requirements to maintain a 1-lb package of frozen corn are about 45 Kcal per day whether at a supermarket, (Berry et al., 1974), or in the at-home deep freeze (Statistical Abstract of the U.S.). We did not calculate the energy required to freeze the corn initially, to manufacture the frozen corn container (plastic bag or paper carton), and to produce the freezer. But we did assume that the freezer operates on electricity. Under those conditions, corn maintained longer than about 22 days in a frozen state would be more energy consumptive than if it had been placed in a steel can. Keeping a 1-lb package of corn frozen for a year would consume 17 times more than the energy required to manufacture a can to put it in.

Because refrigeration is so exceptionally energy consumptive, food scientists are attempting to develop alternatives. For example, they've discovered that if fresh milk is totally sterilized at ultra high temperatures and sealed in a container, refrigeration may no longer be required. Carefully designed, light-weight plastic pouches may offer considerable energy savings over the steel can for many products. Another alternative, of course, is for consumers to eat more fresh produce and less processed produce. From 1960-1973, consumption of fresh corn dropped by 7%, while consumption of canned corn increased by 19% and frozen corn increased by 136% ("1974 Handbook of Agricultural Charts"). The most energy efficient means of preservation that is readily available is the solar drying of fruits, vegetables, and meats. Done on a large scale, this could be a practicable food processing method in an energy-short world.

TRANSPORTATION SECTOR

Corn is commonly trucked from farm to processor and then from processor to distributor. Surprisingly, using average values, the energy inputs into this sector are smaller than those of any other sector. Of course, the product may be hauled farther than the average 441 miles and the energy required would then increase accordingly. A 600-mile haul would require an energy input slightly higher than the fertilizer input. For 1000 miles, the transportation inputs would exceed the total on-farm inputs.
Within the U.S., the development of low cost transportation dramatically influenced our food system. The world had never before seen an economically workable system that could feed Idaho hay to California dairy cows and then transport the California milk to Utah to be processed into cheese that is ultimately marketed back in California. While we had access to plentiful supplies of incredibly cheap fossil fuel energy, we fattened enormous numbers of cattle in feed lots hundreds or even thousands of miles away from where they originated and their feed was produced. Feed lot manure became a solid waste problem while fertilizers were manufactured from fossil fuels and transported to feed production centers. Exotic fruits such as bananas and pineapples, which are 3/4 water by weight, have been routinely transported half way around the world to be sold at a price the average consumer can readily afford. Today, the entire system is in trouble.

WHOLESALE AND RETAIL MARKETING

Spacious, comfortably heated or air-conditioned, and convenience oriented supermarkets, open 24 hours per day with long rows of open refrigerated display cases are designed to tempt and entertain the buyer rather than efficiently distribute food. As an energy use awareness increases, consumers may develop a resentment for energy wasteful gimmickry in the supermarkets. Redesigning the marketplace for energy conservation seems an appropriate concern.

SHOPPING

Incredible as it may seem, the data indicate that consumers spend more energy getting some food items from the supermarket to their kitchens than the farmer uses to produce it.

Most shoppers are not at all reluctant to drive around town looking for superior bargains or quality (Dixon et al. 1971). Although most consumers made concessions to the "Energy Crisis", by January of 1975 average consumer concern about fuel shortages and costs was waning. While the number of weekly trips to the grocery store had dropped very slightly from 2.28 in 1974 to 2.26, 41% of the consumers sampled did shop from store to store for specials, and only 12% were willing to make a major decrease in the number of shopping trips per week, (Dietrich, 1974).

Much of our food is eaten in restaurants, with patrons often driving considerable distances to reach a favorite eating spot. It is not unusual for people to burn 200,000 Kcal in the form of gasoline in order to consume a 2000 Kcal meal. As a ratio of fossil fuel energy input to the food system to digestible food energy produced, this amounts to 100 to 1.

The average American household makes 2050 trips of 2 miles or less per year. If bicycle and pedestrian travel were substituted for just two-thirds of these jaunts, only an additional 130 Kcal of human energy would be expended per person, while 8.8 million Kcal would be saved in fuel energy (Rice, 1972). Perhaps other consumer alternatives such as monthly deliveries from warehouse to doorstep or a return to neighborhood markets located within household walking distance should be examined. Certainly factors other than simple energy flows must be considered.

HOME PREPARATION

In general, we expend about as much energy to cook our corn and wash our dishes as the farmer invested in growing the corn(Table 1). On a national basis, the energy used in residences for cooking, water heating, and refrigeration (Ref. 16, 1972), amounts to almost 2 1/2 times the total energy consumed by U.S. Agriculture (Heichel, 1976).
Table III. Comparison of the ratio of energy required in manufacturing the container to the digestible food energy for a number of products. (Berry et al., 1974 and Watt et al., 1973)

<table>
<thead>
<tr>
<th>Product</th>
<th>Container Energy</th>
<th>Food Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk in returnable glass (½ gallon, regular)</td>
<td></td>
<td>.5</td>
</tr>
<tr>
<td>Milk in plastic pouch (½ gallon, regular)</td>
<td></td>
<td>.9</td>
</tr>
<tr>
<td>Milk in paper carton (½ gallon, regular)</td>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td>Milk in non-returnable plastic bottle (½ gallon, regular)</td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>Milk in non-returnable glass bottle (½ gallon, regular)</td>
<td></td>
<td>3.8</td>
</tr>
<tr>
<td>Corn in steel can (16 oz.)</td>
<td></td>
<td>3.7</td>
</tr>
<tr>
<td>Cola in non-returnable glass (16 oz.)</td>
<td></td>
<td>8.3</td>
</tr>
<tr>
<td>Cola in (12 oz.) aluminum can</td>
<td></td>
<td>12.4</td>
</tr>
<tr>
<td>Tomatoes in steel can</td>
<td></td>
<td>16.5</td>
</tr>
<tr>
<td>Diet cola in aluminum (12 oz.)</td>
<td>app. 1000</td>
<td></td>
</tr>
</tbody>
</table>
Preliminary estimates of energy requirements for making one pound of Cheddar cheese are summarized in table 4. In this instance the majority of the energy appears to be expended on the farm in the production of the milk. This includes energy requirements for fertilizer manufacture and power for the production, harvesting, and feeding hay, grain and corn silage and for operation of milking equipment, lights and refrigeration. The estimate also suggests utilization of one percent of the energy for transporting the milk 35 miles to the cheese factory. Ten percent is utilized in making the cheese, 16% in processing and drying the whey and 11% in distributing and marketing the cheese. No amount has yet been assigned to transporting and marketing the dried whey.

While one pound of canned whole kernel corn contains 269 Kcal of digestible food energy, one pound of Cheddar cheese contains 1808 Kcal of food energy.
Table 4

Preliminary Estimates of Energy Inputs into the Manufacture of One Pound of Cheddar Cheese.

<table>
<thead>
<tr>
<th>Function</th>
<th>Energy (K cal/lb. cheese)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On farm milk production</td>
<td>11,890</td>
<td>62</td>
</tr>
<tr>
<td>Milk transportation to plant</td>
<td>1,900</td>
<td>10</td>
</tr>
<tr>
<td>(70 miles round trip)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese manufacture</td>
<td>1,900</td>
<td>10</td>
</tr>
<tr>
<td>Whey processing and drying</td>
<td>2,980</td>
<td>16</td>
</tr>
<tr>
<td>Distribution and marketing</td>
<td>2,169</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td><strong>19,129</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
CONCLUSIONS

The fossil fuel energy invested in producing a can of corn amounts to 14 times the digestible food energy of the corn, while the energy invested in producing a pound of cheese appears to be only 10.5 times the food energy in the cheese. Such simple energy input-output ratios, however, do not take into account the social utility of the various forms of energy involved. Putting 2 Kcal of natural gas into fertilizer to increase energy output in the form of corn by only 1 Kcal is not necessarily a bad bargain. A million Kcal of energy in the form of natural gas has a market value of about $5, while a million Kcal in the form of canned corn has a market value of about $1250. In the United States, the cost of mechanical energy produced by a tractor is about $200 per million Kcal while the cost of human muscle energy is on the order of $35,000 per million Kcal, (Batty et al., 1976). Agriculture has therefore become heavily dependent upon fossil fuels and machines, but scarcely more so than other segments of the food system.

As energy costs sharply increase, the food industry will have little incentive to transport raw, unprocessed agricultural products containing high fractions of water over long distances. Consequently, more products will be processed locally. Simultaneously, economic pressures will favor reduced energy inputs to processing and packaging. Since cheese is a highly concentrated food it can no doubt still be shipped more economically than corn.

While it may not be realistic to expect the affluent suburbanized housewife to begin to shop by bicycle, consumer behavior probably will respond to sharp energy price increases that are reflected in higher food and gasoline prices. Demands for cheaper food prices may become less relevant than demands for more efficient transportation.

Obviously, conclusions drawn from tracking energy inputs to a particular commodity cannot in general be extended to all food products. However, an important result of this study and the technique used is the creation of increased awareness concerning actual energy expenditures throughout the food system.

We conclude that even if on-farm energy conservation efforts effectively reduce on-farm energy requirements, savings may be pointless unless accompanied by a significant change in the energy costs of processing, packaging, distribution, and home preparation. Steps taken to conserve on-farm energy such as reducing the use of chemical fertilizer, may not only fail to noticeable affect the national energy budget, it may lower productivity.
REFERENCES


17. Personal Communication with store managers of Albertson's (Highland Drive, Salt Lake City, Utah), Warshaw's (Holladay, Utah), and Macey's (Logan, Utah) on May 15, 1975 and June 27, 1975.

18. Personal Communications with Haven Simmons, Manager, Smith's Food King (Logan, Utah) on March 17, 1976.


The following paper was presented by Dr. Robert R. Zall, Associate Professor, Department of Food Science, Cornell University, Ithaca, New York 14853, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3-4, 1976.

THE PROBLEMS OF CLEANING RESIDUALS: CAUSE AND EFFECT

by Robert R. Zall

If you believe that good starter growth also depends on the quality of its culturing medium, then you should agree that an environment hostile to microorganisms probably affects cultured products (3). Obviously, milk used for cheesemaking and other fermented products ought to be free from antibiotics. Not so obvious, however, is the fact that milk should also be free from cleaning and sanitizing residues. This is not always the case as shown in an ongoing Cornell study looking at milking center clean-in-place (CIP) methods for ways to conserve energy, chemicals, and water. We are finding design flaws in some CIP systems.

Milk Harvesting Problems

Automated cleaning systems in milking parlors can, and do, cause situations where detergents and sanitizers are commingled with milk supplies. In our enthusiasm to automate milking and cleaning, we have apparently overlooked the problems of separating cleaning fluids from milk itself. There appears to be more than just a casual mixing of detergents-sanitizers with milk on some farm operations, and these additives can affect flavor, bacterial numbers, and some milk fermentation characteristics.

Two surveys of packaged milk made in New York State during 1975 showed a high incidence of undefined inhibitory substances to be present in milk. Analyses were made by the Sarcina lutea cylinder antibiotic method\(^1\). These results raise the question that the inhibitory substances are cleaning chemicals, and they are occurring in high enough levels to be picked up by the S. lutea test.

Cause

An automated milking center on a modern farm is not the simple or nostalgic "milkmaid" and cow relationship system. Instead, we find glass lines, stainless steel tubing, plastic and rubber hoses, milking claws, and all sorts of other gadgetry peculiarly interconnected one to the other with different joining mechanisms. Milk, air, cleaners, sanitizers, and acids are often mixed in different solutions of varied temperatures, and then pumped through common lines which, when examined closely, do not always drain free.

How Much Cleaning Material Are We Talking About?

This problem was examined in detail on farms to see how New York State dairymen used different CIP systems. We looked at different kinds of equipment made by many manufacturers.

\(^1\) Test is currently being used by both FDA and USDA for powdered milk survey analysis and is about 12 times more sensitive than the B. subtilis assay method.
As you know, CIP methods generally clean by using a prerinsing cycle, followed by multiple recirculating washes, and then by flushing equipment with rinse water to rid the system of cleaning compounds. Cleaning effectiveness was monitored with a fluorescent dye and blacklight test which made it easy to trace fluid flow patterns circulating in glass lines or weigh jars. The test technique showed interesting results in samples collected from final rinse waters leaving the system at one-minute intervals.

The final burst of rinse water from almost all systems was not water alone, but contained substantial amounts of chemicals. This means that the systems under examination were not ridding themselves of cleaning substances.

Figures 1, 2, and 3 show cleaner concentrations left in a sampling of different systems during final rinse cycles as a percentage of chemical amounts added for CIP cleaning. The data do not show how much material was left behind as retained liquids because the volume varied with line size, line pitch, coiled hoses, number of weigh jars, number of milking units, and other hardware. In some cases we noted that rinse fluids fail to start out as water alone, but in fact, begin rinsing as a dilute mixture of water and cleaners. Based upon actual farm observations, we know that as much as two to three gallons of wash solution were being pumped into some bulk tanks at each milking. These amounts when translated into a milk contaminant mean that about two to three cubic centimeters of cleaners, sanitizers, or acid washes may be incorporated into each quart of milk. (A quart contains about 947 cc.)

In order to learn more about the effects of cleaning materials in milk, we followed up central New York farm visits by examining milk harvested from Cornell's 350-cow herd milked in its new double-ten milking parlor system. We wanted to know:

(a) Did cow's milk, before a parlor system, contain enough inhibitory substances to be detected by the *Sarcina lutea* test which was developed for antibiotics?

(b) Did an automated milking system contribute inhibitory substances? If so, where?

(c) If milking methods introduced inhibitory material to milk, would fluid passing through such a system wash inhibitory substances free from the equipment?

Noncontaminated milk from pretested cows was sampled before milking and then again at different stations in the system as the liquid flowed through the double-ten milking equipment. Figure 4 shows that the system itself introduced inhibitory material into the milk as it flowed to a bulk tank.

In another experiment as shown in Table 1, we admitted uncontaminated water through a sanitized ready-to-milk system as one would begin to milk cows. Again, the water, like the milk experiments, picked up inhibitory material as analyzed by the *Sarcina lutea* test method. Of special interest is that milk appears to be a better solvent in this system than water as shown in Figure 4.

Elsewhere, we looked at potential contamination from teat dipping with iodine and chlorine. Overall, our results indicate that iodine does not appear to be detectable with the *Sarcina* test, but 5% solutions of chlorine when used as a teat dip may be troublesome. At this time about 10% of the farms in New York State treat cows with chlorine bleach as a mastitis preventative.
Fig. 1. Ability of DeLaval Single-Stage Milking Systems to Rid Equipment of Chemicals When CIP Cleaned. Spring 1975.

* 0-point signifies sink filled with rinse water
Final Rinse Water in One-Minute Intervals

* 0-point signifies sink filled with rinse water.

Fig. 2. Ability of Around-the-Barn Milking Systems to Rid Equipment of Chemicals When CIP Cleaned. Spring 1975.
Fig. 3. Ability of Two Types of Milking Systems to Rid Equipment of Chemicals When CIP Cleaned. Spring 1975.

*0-point signifies sink filled with rinse water
* 8.0 is taken to mean no inhibition.
** After milk of five cows rinsed system.

Fig. 4. Inhibitory Zones in Samples of Milk, Water, and Sanitizing Detergent Rinses from One Side of a Double-Ten Milking System at Cornell University. Measured by the Sarcina lutea Cylinder Method.
Table 1. Inhibitory Zones in Water Passed Through a Milking System (Measured by Sarcina lutea Cylinder Test)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Zone of inhibition * (millimeters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water from tap</td>
<td>8.2</td>
</tr>
<tr>
<td>Pre-sanitizing water flush</td>
<td>9.3</td>
</tr>
<tr>
<td>Post-sanitizing water flush</td>
<td>9.0</td>
</tr>
<tr>
<td>Post-detergent water flush</td>
<td>9.3</td>
</tr>
</tbody>
</table>

*A zone of 9.0 mm or greater (cylinder diameter +3 standard deviations) is considered to be a positive inhibition result.

Having presented you with this kind of information, we might ponder about the implications of these data. We have reason to suspect that untested CIP systems may contribute additional contamination at the reload station and again at milk processing plants themselves. Our research definitely shows that normal fermentations are being threatened by the residues left in some new milking and transport systems.

Effects of Inhibitory Materials in Cultured Products

Milk was collected from one half of the double-ten parlor previously discussed through which 159 cows were milked. Samples were taken after five cows' milk flushed the system, at midpoint, and then at the end of the operation. The milk was made into [1] buttermilk with the traditional starter of mixed Streptococci organisms and [2] yogurt with the 50-50 mix of streps and Lactobacillae. Table 2 shows buttermilk culturing taking a normal course when measured by pH, acidity, or coagulum. However, flavor defects were apparent in some samples. First milk and last milk produced unacceptable products that would surely cause sales problems. The mid-milk product, while still marketable, fell short of being an ideal commodity while the control was normal. One might expect the last milk to be best, except this portion of the milk picks up all drainage materials from different dead-end areas in the milking system. The experiment apparently shows that while buttermilk organisms are somewhat resistant to inhibitory material, they are selectively impaired in their ability to produce desirable flavors and aromatics.

Table 2. Milk from One Side of Double-Ten Herringbone Parlor Cultured for Buttermilk*

<table>
<thead>
<tr>
<th>Sample **</th>
<th>Pre-incubation</th>
<th>Post incubation</th>
<th>Flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH</td>
<td>Acidity</td>
<td>pH</td>
</tr>
<tr>
<td>After 5 cows</td>
<td>6.4</td>
<td>.18</td>
<td>4.45</td>
</tr>
<tr>
<td>After 70 cows</td>
<td>6.4</td>
<td>.18</td>
<td>4.25</td>
</tr>
<tr>
<td>After 159 cows</td>
<td>6.4</td>
<td>.18</td>
<td>4.40</td>
</tr>
</tbody>
</table>

* Milks heated to 85°C for 30 min and cooled; inoculated with 1% Flav-O-Lac #1 culture; incubated 16 hrs at 24°C and refrigerated.

** Sampled before entering bulk tank.
Figure 5 shows how a yogurt culture reacts with inhibitory materials. Not only do we see a growth-time difference between the control and the milk from beginning, midpoint, and at end of cycle, but we noted serious flavor defects in the test samples. This information tells us that the yogurt starter was both growth and flavor sensitive to residuals picked up on the farm milking system.

The experiment also suggests still another factor—we may want to use the culturing technique to screen farm milk coming into plants with a yogurt starter activity test. It's fast, it's simple, and needs very little in the way of equipment.

To prove the point, just prior to this meeting, my laboratory staff ran such an analysis along with the Sarcina lutea test on fresh milk samples from 40 producers near the college. Milk from 11 producers or about 25% of the 40 sampled failed to coagulate with an active yogurt culture in 4 hours. The milk was heated to 185°F (85°C) for 30 minutes and treated the same way as making yogurt. These results seem more significant as only two samples, or 5% of the sampling, were positive for inhibitory material with the Sarcina lutea cylinder test method.

It seems to me that this kind of information ought to be extremely valuable to cultured products processors. We tend, I fear, to equate starter slow up with phage problems or poor culture. Sometimes this may be just that, and then again not. The information being collected by researchers in my laboratory suggests that the real problem in some cases may well be cleaning compounds. We know that cleaners do affect culture activity, and they may also affect cheese yields by a solubility action on proteins which are then lost in whey.

Conclusions

While we are doing a lot of work with chemicals in milk, much still needs to be done. My presentation deals with inhibitory material: its cause and effect. The paper would be more meaningful if ended on a positive note by using the word "solution".

We believe that the cultured products industry at large will benefit by instituting three action programs:

1. Screen milk going to cultured products by using the yogurt culture activity test previously described. Some of you already do this sort of thing by segregating tank loads of milk and checking it with cultures for antibiotic problems.

2. Send fieldmen to farms where milk shows slow culture activity. The Zall dye test can be used to pinpoint problems (4).

3. Initiate action programs to rid milk of chemical residues at farm, reload and/or plant. You may want to use "the critical control areas" information supplied in this paper in your own quality assurance program (Figure 6).

As I see it, the opportunities for residues to contaminate milk may increase with more automated cleaning. Unless chemical contamination checks are made on a regular basis, your cultured products may suffer from chemo-intoxication. From this effect, the prognosis of products would be a poor flavor and foreign aromas.
Fig. 5. Yogurt Fermentation in Different Milk Portions Collected During Milking from One Side of a Double-Ten Parlor at Cornell University.
Data from two recent surveys of packaged milk made in New York State during a mid 1975 period looking for antibiotics show extremely high incidence of undefined inhibitory substances are present in milk when it is tested by the Sarcina lutea antibiotic method /1. These results raise the question that perhaps the inhibitory substances are cleaning chemicals in milk, and they are occurring in high enough levels to be picked up by the Sarcina lutea antibiotic test. Researchers are currently looking at different analytical methods of identifying these foreign materials in order to pinpoint the areas of origin.

In the meantime, farmers can begin a positive action program to rid milk of chemicals. Six areas have been identified as being important to prevent milk from being adulterated. These are:

**CRITICAL CONTROL AREAS**

1. **Look for dead ends.**
2. **Use level to check lines for pitch.**
3. **Drain system fully.**
4. **Avoid looped hoses.**
5. **Install automatic check drains.**
6. **Inspect all CIP systems for their ability to rid themselves of cleaning and sanitizing solutions.**

/1 Test is currently being used by both FDA and USDA for powdered milk survey analysis and is about 12 times more sensitive than the Bacillus subtilis disc assay method.

Selected information from a paper entitled, Detergents and Sanitizers as Possible Contaminants in Milk, by R. R. Zall and D. P. Brown, presented at the 62nd Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Toronto, Ontario, Canada, August 1975.
REFERENCES


The following paper was presented by Professor Norman F. Olson, Department of Food Science, University of Wisconsin, Madison, Wisconsin 53706, especially for the 13th Annual Marschall Invitational Italian Cheese Seminar held at the Dane County Exposition Center, Madison, Wisconsin, on May 3 and 4, 1976.

OBSERVATIONS MADE DURING MY THREE MONTHS TRIP TO ITALY IN 1975

By Norman F. Olson

I was privileged to spend three months (July to October, 1975) at the Catholic University of the Sacred Heart in Piacenza, Italy. The principle purpose of this leave was to carry out research on immobilized milk-clotting enzymes and continuous lactic fermentation of milk but I was also able to visit several dairy processing plants in Italy.

Catholic University. The Catholic University is composed of a number of departments and institutes which cover most of the biological and agricultural sciences. There are three buildings on the campus: one is used for undergraduate instruction, a main building houses faculty offices and research laboratories and a third building is used for animal housing and feed storage. The University is well-equipped considering its size. Included were the usual laboratory equipment such as spectrophotometers and chromatographic systems plus more specialized items such as scanning and transmission electron microscopes and a mass spectrometer.

The University holds two formal class sessions during the autumn, winter and spring. No classes are held during the summer allowing full-time research programs for those faculty members with research support.

Institute of Microbiology. Faculty members of the Institute of Microbiology of Milk and Cheese are Professors Bottazzi (Director), Bottistotti and Dellaglio. Professor Corradini is a member of the Institute of Chemistry but works very closely with the members of the Microbiology Institute. Activities of the Institute were very similar to those of Dairy and Food Science Departments in the United States. Faculty members devoted most of their time to research and extension or public service. Their teaching duties seemed lighter than those of faculty in the United States. The number of graduate students was also much lower than in most departments in the United States. However, there were seven full-time technicians in the institute. The entire staff was very intelligent, dynamic and extremely industrious.

Research at Institute. Most research projects were closely tied to problems or technological developments associated with the Italian dairy industry. Orientation of research of the faculty was: dairy microbiology and technology, Bottazzi and Bottistotti; dairy microbiology-Dellaglio; and dairy chemistry-Corradini.

An extensive study, funded by an industry group, was completed recently on use of refrigerated milk for the production of Grana cheese. Use of refrigerated storage is an attempt by the cheese industry to eliminate processing of milk immediately after each milking. Studies made at the Institute indicated that refrigerated storage had little effect on the cheese making process except for reducing the "creaming" capacity of milk. The creaming process is described in the section on cheese manufacture. Bottazzi and co-workers determined optimum milk storage conditions, and developed procedures for mixing refrigerated and non-refrigerated milk and techniques for heating milk to restore creaming activity. Details about the research were given in a paper by Bottazzi at the 1974 Italian Cheese Seminar.
Considerable research is being done at the Institute on microbiology of cheese. One study indicated pediococci may help to prevent the blowing defect (excessive gas production) in grana cheese. A system for continuous fermentation of milk with lactic bacteria for production of pasta filata types of cheese has been developed. The process was described in the 1974 Marschall Italian Cheese Seminar. The process was used also for other soft cheese varieties such as Crescenza.

Fundamental research is underway on identification and classification of the high temperature lactic bacteria. This work had practical application of the identification of lactic strains found in natural whey starters used routinely in the manufacture of grana cheese.

Research applicable to the fluid milk industry includes selection of strains of lactic bacteria for production of yogurt and a study of changes in chemical and physical properties during processing and storage of sterilized milk. Studies are underway to determine the role of heat-stable proteolytic enzymes in milk on formation of a gel or precipitate during storage of sterilized milk.

Milk production and processing. Piacenza is located in the Po River Valley which is an intensive agricultural area. The farms appear to be fairly large and the farming process appears to be fairly well mechanized. Farm buildings are usually arranged around a central courtyard. Although my observations were cursory, I did not see very many new farm buildings in the Piacenza area.

I had the opportunity to visit a large and modern fluid milk processing plant. A wide variety of fluid milk products, cultured milks, flavored yogurt and sterilized milk was produced in this plant. The yogurt was prepared culturing milk in closed vats. The coagulated milk was mixed with fruit and packaged. Lactic cultures used by this firm had been selected by the staff of the Institute of Microbiology for suitability in yogurt, especially for increasing viscosity. The firm packaged large quantities of ultra-high temperature processed milk in tetra-bricks or tetra-paks.

Cheese production. Visits were made to one small and one large plant producing grana cheese. Both plants received milk in cans; some milk was shipped in bulk trucks to the large plant. Cheese was made upon receipt of morning and night's milk which necessitated a split shift in the smaller plant. Adjustment of the fat content of milk was accomplished by natural creaming. The milk was held for several hours in shallow trays to allow fat globules to agglutinate and rise. The lower-fat portion was then drawn from the bottom of the vats for cheese making.

Cheese was made in the traditional cone-shaped vats in both plants. The curd was cut with a mechanical harp, cooked and allowed to settle upon reaching the desired firmness. The curd was scooped from the bottom of the vat with a coarse cloth similar to techniques used for Swiss Cheese. The mass of curd was flipped in the cloth by two men to obtain a smooth surface on the ball of curd. These men were real "artisans" in both plants and appeared to be extremely careful in obtaining the smooth surface. The ball of curd was hung in the cloth below the surface of the whey, presumably to allow additional knitting of the curd and production of acid. The curd was cut in half, the pieces pressed in hoops and then brine-salted.

Another visit was made to an extremely modern plant producing Gorgongola and Mozzarella cheese. Both cheeses were produced in one large room; the Mozzarella was also packaged in this room. The quality control personnel of the firm were extremely careful about sanitation of equipment because of the common processing facility.
Both varieties were made in a dual vat system composed of cooking vats and draining vats. Vats used for Gorgonzola were manufactured by Sordi Inc., Lodi, Italy. The cooking vats were deep horizontal vats with two revolving gangs of blades for cutting and stirring. The cooking vats could be raised to allow the flow of curd and whey by gravity to the draining vat. The inlet gate on the draining vat was unique since it was movable to allow curd and whey to flow onto the surface of the curd and whey in the draining vat. This was claimed to result in less shattering of the large, fragile Gorgonzola curd. Whey was drained and the curd was mechanically dispensed into draining and forming hoops.

Steinecker cooking vats were used for Mozzarella cheese. The curd was matted and pressed mechanically in a draining vat. It was mechanically dispensed from the vat and conveyed to mixing and molding machines. Although a number of different sizes of cheese were made, a popular type was a ball weighing a few ounces. Two balls were usually packed in dilute salt brine in plastic pouches or plastic cups. Mozzarella was considered to be acceptable when a milky serum could be squeezed from a freshly cut curd surface. There were 12-15 packaging machines for Mozzarella cheese in this plant.

Living in Italy. The graciousness and understanding of the wonderful people in Piacenza was sorely tested when a Scandinavian from Midwestern USA descended upon them. The magnitude of this can be appreciated when one considers that the Midwesterner knew virtually no Italian upon arrival. Through careful coaching and molto pazienza, the Scandinavian learned important phrases such as Buon giorno, signorina; grazie; ho fame; non capisco; and arrivederci.
The following paper was presented by Dr. Dino Sabato, Manager, Dairy Sales, Miles Italiana, S. p. A., Via F. L. Miles N. 10, 20040 Cavenago Brianza (Milan) Italy especially for the 13th Annual Marschall Invitational Italian Cheese Seminar, held at the Dane County Exposition Center, in Madison, Wisconsin on May 4, 1976.

A PREVIEW OF OUR ITINERARY FOR CHEESE VISITS IN ITALY IN 1977

By Dino Sabato

I have been given by our chairman, Mr. Ferris, the special assignment of speaking about our itinerary for cheese visits in Italy on the occasion of the "Field Trip to Italy in 1977" which I understand will be your 14th Annual Marschall Invitational Italian Cheese Seminar.

I am grateful to Stan for this assignment since it has given me the opportunity of visiting the United States to appear as a speaker on this program, as well as an opportunity to meet many of you in person. It is my further hope that time will permit me an opportunity to visit some of your American-Italian Cheese plants before it is necessary to return to Italy.

My first visit to America is very interesting, especially since we work in the same field ---- Italian cheese ---- but in different ways and with different results.

Statistics indicate that in the United States the Italian Cheese Industry is continuously expanding year by year but in order to maintain the yearly increase you are recording at present, I think everybody agrees with me on the necessity of new ideas. Then I would say that the general aim of the trip to Italy in 1977 is an exchange of information which can contribute positively toward a further expansion of the Italian Cheese Industry in America.

We hope further, that your trip to Italy in 1977 will be a step towards fostering better international relations between cheesemakers and cheese people in Italy and the United States. We hope someday it will be possible for a group of cheese people from Italy to come to the United States and visit different cheese factories here, so we Italians can learn more about the American-Italian cheese business to perhaps contribute to new products and new ideas for Italian cheese people in Italy. It is our hope that your trip to Italy in 1977 will be the beginning of such exchanges, that will increase and grow in the years ahead.

The Marschall Divisione, Miles Italiana, S. p. A., Cavenago Brianza, Italy, is happy to work cooperatively with our American associates in an effort to make this possible.

My associate in Marschall-Miles Italiana, Dr. Adalberto Villa, appeared as a guest speaker at your 1974 Marschall Invitational Italian Cheese Seminar. He presented a paper giving details of cheese production in Italy, according to the latest information available at that time. I will not repeat this information since it is possible for you to review his paper to give you an overview of total cheese production in Italy. I hope it will be possible for everyone coming to Italy in 1977 to review the information in Dr. Villa's 1974 presentation so you will be better acquainted with cheese production in Italy, as compared to cheese production in the United States.

It is my further understanding that the Marschall Division of Miles Laboratories, Inc. here in Madison, Wisconsin, plans to mail out the newest and latest information about cheese production in Italy prior to the time you leave for your trip to Italy. It is hoped this late information will help to give you an up to date picture of cheese production in Italy at that time. We also understand the people going on this trip will also have some other surprises in store to make it a more educational and rewarding trip.
At this point I would like to say that we anticipate problems in the transportation, feeding and touring of approximately 150 to 175 people interested in visiting cheese factories. Cheese factories in Italy are not planned to entertain visiting tourists and it might be that you will be inconvenienced or delayed slightly due to the problems involved in handling such a large number of visitors.

Perhaps you can understand this if you were to imagine 150 people coming to visit your plant at one time. This certainly would cause problems for you, we are sure. However, we plan to do our best to make your trip to Italy interesting. Because of the large number of people involved, we are sure you can understand movement will be slow. As a result, the number of visits we can plan, in the short time you will have available, is limited by the time factor. All our plans are subject to change until our final itinerary has been determined late next Fall.

It would be unfair to discuss your itinerary for the trip to Italy next year without saying a few words about the formal program being planned for your benefit in the Hotel in Milan on Monday, May 16, 1977. Plans are not final and will remain subject to change for several weeks, but we plan to have a number of our leading Italian cheese manufacturers present at this meeting to give you an opportunity to meet some of our principal executives.

We are arranging for instantaneous translations of all speeches in Italian so you will be able to understand all speakers. We will have a variety of subjects that we think will be of interest to American-Italian cheese manufacturers. The development of the program is now being determined. We will eventually supply a final program with the names and addresses of all speakers' as well as the subject they will talk about. It is my understanding you will have the people from the cheese industry in Italy as your guests for lunch on Monday, May 16, 1977. Following the completion of the formal program, we are making plans to have a "Cheese and Wine Tasting" social period to give everyone present an opportunity to taste different varieties of cheese made in Italy, as well as an opportunity to taste some of our excellent Italian wines.

During this social period, following the conclusion of the formal program, you will have an opportunity to meet and visit with different executives from the cheese industry in Italy, as well as the speakers who appears on the program. We think this will be a most interesting and informative period. If you are interested in buying or selling Italian cheese, you will have your opportunity during this meeting. It should be an opportunity for you to taste several varieties of quality cheese as it is made in Italy.

On the four days following the Italian Cheese Seminar in Milan, we plan to visit a number of selected cheese factories, two research institutions, one equipment manufacturer and a large, modern Grana cheese warehouse.

The cheese industry in Italy may be divided into three groups according to daily capacity ---- small, medium and large. We plan to visit different size factories, to give you an idea of our different productions. It is on this basis that our program is being worked out. Let us start with the cheese factories.

CASEIFICIO MOLINARI
Lodi, Italy area

One of the first cheese factories we will visit is CASEIFICIO MOLINARI, located in the Milan area, near Lodi, Italy. This is a medium size plant mainly producing Parmesan and Mascarpone, Ricotta and Mozzarella. It also produces butter. Its daily capacity
is about 45,000 – 50,000 lbs. of milk daily. The milk is supplied by local farmers and transformed daily into cheese and butter. The cheese factory is owned by a family and managed by the owner. This plant was rebuilt in 1975 and are now working on a five year plan during which they plan to double the present production.

One of the peculiarities of Italian cheese factories is the variety of cheeses produced in the same plant. You will have an opportunity to see this when we visit CASEIFICIO MOLINARI. This plant produces 4 or 5 different varieties of cheese, covering in this way different requests of the customers.

LATTERIA SORESINESE SOC. COOPERATIVA

Soresina (Cremona) Italy.

This well managed dairy plant is one of the largest and oldest producing cooperative societies in Italy. It is located in the Cremona area which is traditionally rich in farms and milk. Year after year it has now reached a daily capacity of 450,000 lbs. of milk. Their main products are Parmesan, Provolone, Sweet Provolone, Melted Cheese, Butter, Milk for human nutrition, whey powder and lactose.

The general manager of this large plant will be one of our speakers on the program on Monday, May 16, at the Hotel in Milan.

Products from this plant are marketed through a wide organization of wholesalers and resalers throughout Italy and abroad. This company ships large quantities of their bulk and packaged cheeses to the United States. We will have an opportunity to observe manufacture of Parmesan and Giant Provolone, as well as to visit their cheese packaging operation. The visit to this plant will be one of the highlights of your trip to Italy.

Milk for the LATTERIA SORESINESE plant is supplied by member farmers who are paid according to financial results at the end of the financial year.

GALBANI, S. p. A.

Corteolona (Pavia) Italy.

GALBANI S. p. A., together with Messrs. LOCATELLI and INVERNIZZI, represents the best of our cheese industry and also the customer that all of Marschall's competitors would like to acquire. The Corteolona plant we will visit has a daily capacity of 650,000 – 680,000 lbs. and this is only one of GALBANI'S plants. Four more GALBANI plants are located in Northern and Central Italy. Their Corteolona plant is probably the oldest one, but it is being rebuilt and renewed. They also maintain a large pig farm several blocks from the plant, where the whey from the cheese factory is used for animal feeding. Main production of this large plant is Mozzarella, Gorgonzola and Yogurt. You will see a very large, well maintained, clean, automated cheese factory, including a very modern packaging operation.

GALBANI produces in all their factories a large variety of Italian cheese such as Parmesan, Provolone, Sweet Provolone, Bel Paese, Yogurt, Butter, Processed Cheese, etc., for a total of 30 different products. The main office of GALBANI is located in Milan where you will see the name GALBANI atop their centrally located office building and headquarters of their operations in Italy. GALBANI products are marketed through a network of warehouses located throughout Italy. You may very well pass their trucks on the highways any place in Italy.
A marketing management, advertising in magazines, on television and radio and all mass-media spread around the idea "GALBANI means trust," thus making cheese a product of wide consumption. Investments in advertising are very substantial and this is quite in line with the position acquired by this company on the market. A constant research of new products lets the company maintain its leading position in the field.

Milk for GALBANI plants is supplied by local producers and also imported, mainly from Germany. Plants are provided with large storage tanks so as to program different productions according to requests coming from the market. The GALBANI plant in Cortolona employs 300 workers. Total manpower of the whole GALBANI company is around 2,500 people.

BANCO SAN GIMIGNANO

Reggio Nell'Emilia, Italy

Enroute from Milan to Florence, it is our hope to visit the large warehouse which is used to cure Parmigiano Reggiano (Parmesan) cheese. Perhaps a word of explanation is in order to explain the unusual fact that a large Italian bank owns a cheese warehouse and the cheese being cured inside.

In Italy most of the Parmesan cheese is made by relatively small factories who do not have the financial power to cure their cheese for 18 months while still paying for the milk and supplies ordinarily used in cheese manufacture. It is not uncommon, therefore, in Italy, to have a bank own the cheese warehouse and operate it as a service to help the small cheese factories. The bank buys the cheese from the cheese factory and pays them at once according to the weight and quality of the cheese. The bank then assumes ownership of the cheese and holds it until it is properly cured. The bank then sells their cheese when the market is favorable and hope to sell at a profit to compensate them for the cost of curing and maturation, plus the original cost of the cheese.

Thus, in Italy, you will have an opportunity to visit one of the large warehouses owned and operated by a bank. We think you will find this warehouse to be very interesting. If time permits and if circumstances work out, we will have tentative plans to visit one of the large Parmigiano-Reggiano factories in the Reggio Nell'Emilia area of Italy.

M. SORDI COMPANY

Lodi, Italy

Another interesting place on your trip to Italy will be a visit to the M. Sordi Company, Lodi, Italy. Certainly some of you are already familiar with this name since this company took part in the 1974 Italian Cheese Seminar here in Madison, Wisconsin. They were unable at that time to ship their equipment and display it for your benefit.

Your hosts and hostess for your visit to the M. Sordi Company will be Mr. and Mrs. Mario Sordi, assisted by their director of sales, Dr. Augusto Balducci. Many of you had the pleasure of meeting and visiting with the Sordi people in 1974, here in this building. We understand Mrs. Sordi was the first lady speaker to ever appear on the program at your Annual Marschall Italian Cheese Seminar, in 1974.

The M. Sordi company has become the principal supplier of specialized and automated equipment used in the manufacture of Italian cheese in Italy. Today they are the
only company manufacturing entirely Italian dairy equipment and the results in Italy, as well as abroad in Spain, Australia, United Kingdom and Eastern Europe show an undoubted success on the part of the M. Sordi Company. Further, you will see much of their newest and latest automated equipment in some of the visits we plan to cheese factories.

Mr. and Mrs. Mario Sordi, ably assisted by Dr. Augusto Balducci, will be pleased to have you as their guests to make a complete tour of their manufacturing facilities from the drawing boards up to the completed machinery especially manufactured for Italian cheesemaking. They will be pleased to answer any questions you may have, through interpreters.

INSTITUTE OF MICROBIOLOGY
CATHOLIC UNIVERSITY OF THE SACRED HEART
COLLEGE OF AGRICULTURE
Piacenza, Italy

Included in your tour will be a visit to the Catholic University of the Sacred Heart, Piacenza, Italy. Professor Vittorio Bottazzi, head of the Institute of Microbiology, will welcome you to a visit and tour of their facilities in Piacenza. He will be assisted by members of his staff. Through interpreters, Prof. Bottazzi and his staff members, will be pleased to try and answer any questions you might have about the production of cheese in Italy. You will be able to visit their laboratories and there you will have an idea of how they work, the goals they are aiming at and the results they hope to obtain.

Many of you will recall that Professor Bottazzi came to the United States and appeared as a guest speaker at the 1974 Marschall Italian Cheese Seminar. Two of his able assistants, Prof. Bruno Battistotti and Prof. Cesare Corradini, will be present as hosts also. Both of these men have indicated they would be glad to do consulting work for Italian cheese people in the United States providing their expenses are fully paid and a reasonable fee is made available to them to cover their outside expenses while in the United States. Both men are widely experienced in the manufacture of most varieties of Italian cheese made in Italy and are capable, practical men who could help start the manufacture of specialty cheese in America as it is made in Italy. You will have an opportunity to meet and visit with both men, through interpreters.

LATTERIA-CASEARIO
INSTITUTE OF EXPERIMENTAL CHEESEMAKING

Via C. Besana, 8
20075 Lodi, Italy

Dr. Julius Caesar Emaldi is the Associate Director of the Institute of Experimental Cheesemaking. This organization performs cheese experiments of all kinds, including hard and soft varieties. A visit to this laboratory and any opportunity to have Dr. Emaldi explain their programs in cheesemaking would be very beneficial to every cheesemaker. Dr. Emaldi spent one year at Cornell University in Ithaca, New York, working with Prof. Frank Kosikowski. He is currently doing research work at the Institute of Experimental Cheesemaking in Lodi, Italy. We believe a visit to this laboratory will be well worth your time.
CHEESE FACTORY VISITS

Rome Area

Now, a few lines about three cheese factories we will visit in the Rome area, i.e., ANSELMI, BRUSCINO, AND CINQUE, whose daily capacity is respectively about 10,000; 18,000 and 22,000 lbs. of milk daily. Thus, they are small cheese plants. In fact, their market area is only Rome and its suburbs.

ANSELMI is located in the Northern area of Rome where there is still a certain production of Sheeps milk and therefore its main production is Romano. BUSCINO and CINQUE are located in the Southern area of Rome and their production is mainly Mozzarella, Provolone, Caciotta and Ricotta cheese.

Distribution of the products from these three plants is usually carried out by wholesalers and salesmen who practically act on their own account and in this chain, the weakest link is the producers who has also to take back the unsold products.

This is a very common situation among the small cheese industries in Italy. An old system which has to be forgotten and overcome by the many like it was by the few.

SUMMARY

Due to the limitations of time, we plan to show you those cheese factories and cheese institutions that we believe will give you a certain perspective of the cheese industry in Italy, yet prove to be educational and informative to help your business here in America. If we had more time, we could undoubtedly show you much more of our cheese industry in Italy, but with the problem of handling such a large crowd, we must not plan too much in too short a time.

I do hope that, in spite of my English, what I have said has given you a general view of what you will be able to see during your trip to Italy in 1977.

Thank you for your kind attention.