STATEMENT OF SUE M. TAYLOR
LEPRINO FOODS COMPANY
at the
FEDERAL MILK MARKETING ORDER HEARING
Docket No AO-14-A77, et al; DA-07-02
Indianapolis, Indiana
April 2007

Introduction

I am Sue Taylor, Vice President of Dairy Policy and Procurement for Leprino Foods Company (Leprino), headquartered in Denver, Colorado. Our business address is 1830 West 38th Avenue, Denver, Colorado 80211. Leprino operates nine plants in the United States, manufacturing mozzarella cheese and whey products domestically and marketing our products both domestically and internationally. Six of the nine plants that Leprino operates in the United States receive milk pooled in the Federal Milk Marketing Orders. Therefore, Leprino has a strong interest in the decision by USDA ("Department") as a result of this hearing.

Expertise

In my role as Vice President of Dairy Policy and Procurement at Leprino Foods, I am responsible for developing the company's policy positions and advocating those positions in appropriate forums, such as this hearing. Additionally, I am responsible for market analysis and forecasting, and raw milk procurement among other things. I have represented the company at all Federal Milk Marketing Order and California Order hearings that have related to cheese milk pricing over the last twelve years.

In addition to my current responsibilities at Leprino, I chair the Legislative and Economic Policy Committee for National Cheese Institute, a constituent organization within International Dairy Foods Association ("IDFA"), and chair the Producer Relations

Committee for the Dairy Institute of California. Both committees formulate the respective organizations' positions as they relate to milk pricing policy.

My professional responsibilities have focused on dairy markets and policies since 1989, when I joined Sorrento Cheese as a dairy economist / production analyst. From 1992 through 1994, I was a principal in a dairy economics and management consulting business, Dairy Management Concepts, which provided consulting services to a broad spectrum of dairy companies, most of which operated plants. I have been at Leprino leading the dairy policy and procurement efforts since January 1995. My educational background includes both Bachelor and Masters degrees from Cornell University in agricultural education with a heavy emphasis on agricultural economics.

Position

This testimony is in support of adoption of proposal numbers 9 and 12. Proposal 9, submitted by IDFA, corrects the Class III protein formula to more accurately reflect the volume and value of whey cream that can be recovered from the production of cheddar cheese. Proposal 12, also submitted by IDFA, eliminates the three cents that is currently added to the 38% barrel cheese price before the calculation of the weighted average NASS cheese price that is currently used in the Class III formula.

I will testify regarding the balance of the proposals under consideration subsequent to hearing the testimony presented by the proponents of those proposals.

General Background on Cheddar Manufacturing

To understand the disposition and associated product yields of milk components through the cheddar manufacturing process, it is helpful to step back for a simplified overview of the cheddar manufacturing process. Other NCI witnesses with years of direct cheddar production experience can elaborate more specifically on the process; but I am generally familiar with it, and this explanation does provide a framework with which to understand the component losses that I will advocate must be considered in the Class III formula factors.

The cheddar manufacturing process starts with the pasteurization of milk and transmission of the pasteurized milk to the cheese making vats. The pasteurizer is a closed loop system with limited potential for loss with the exception of start-up and shutdown. During start-up and shutdown, milk components that are diluted with water (milk pushing water at start-up and water pushing milk at shutdown) are lost, generally to the floor drain where they are disposed of as waste.

Once in the vat, a series of steps occur that are critical to cheese making (e.g., introduction of starter culture, addition of coagulating enzymes such as rennet, and various setting, cooking, cutting and stirring cycles). Not to diminish the importance of these steps in overall production, I will jump to the end of the vat cycle. After the gel formed in the vat is cut and further cooked, the liquid whey is drained from the vat and the curds are pumped to another location (a table or conveyor, typically) for further draining. From this point, I will first describe the flow of the curds through cheese making and then will circle back to describe the flow of the liquid whey through further processing.

<u>Curd Stream</u>

Once the curds have been pumped from the vat to the next equipment, whether a draining table or belt, the whey that drains is recovered and it is typically combined with the whey that was drained from the vat.

The curds are then put through a cheddaring process during which the curds form a mat and acidity is developed to a targeted level. Whey is also expelled during the cheddaring process and is generally recovered and combined with the bulk whey that was drained from the vat. Once cheddaring is complete, the matted curd is milled into about ½ inch pieces.

The milled curd is then dry salted. This may be done on a table or in other equipment. Regardless of equipment, the osmotic pressure resulting from the salting of the curds will result in expulsion of additional whey from the curds. This whey is highly problematic because of its high salt content. This whey is collected but is typically not combined with the bulk whey from the vat or initial draining step. Most cheddar makers save the salt whey until the end of the production day and run it through the whey separator to recover as much fat as possible from it. However, the balance of the solids (which would include lactose, protein and the residual fat not separated) in the salt whey is not combined into the bulk whey stream because of their high salinity content. These solids represent a significant liability and may be disposed of through the waste systems or may be land applied if the cheese maker has a permit to do so. But they are not generally added back into the general whey stream and are lost in the waste stream.

After salting and stirring, the curds are ready to be transported into the block or barrel forms. During this final filling and pressing process, further whey is removed. Depending upon the equipment and forms, the whey extracted through this process may or may not be recovered in a manner that allows for further use. For example, the whey from the pressing of cheddar in wooden forms cannot be recovered for human use. Wooden forms are commonly used in the production of 640s (which are sometimes then cut down and marketed as 40s). The AMS Instructions for Dairy Plant Surveys (DA Instructions 918-PS found at http://www.ams.usda.gov/dairy/918-ps.htm) state the following on page W-12:

> 4. *Wooden Construction.*
>
> *These containers are usually knockdown type made of paraffined plywood panels and using painted iron angle-shaped frame and corners, held together and tensioned and clamped steel bands. Salty whey withdrawn by vacuum probing may be separated or desalted for human food use.* ***All salty whey***

recovered through subsequent pressing or draining operations shall be diverted to the floor or for uses other than human food. [emphasis added]

Whey Stream

The bulk liquid whey that has been collected that is acceptable for the production of human grade whey is passed first through a fines saver to collect any curd that made its way through the screens. It is then generally passed through a centrifugal clarifier that separates out smaller pieces of cheese sometimes referred to as "cheese dust". Most cheese makers add back to the cheese making process fines collected by the fine saver, but the fines collected at the clarifier are typically not approved for add-back and thus are lost . The AMS Instructions for Dairy Plant Surveys (DA Instructions 918-PS found at http://www.ams.usda.gov/dairy/918-ps.htm) state the following on page B-2:

> *Most modern high efficiency, automatic self cleaning clarifiers and separators are not designed or constructed to permit the collection and recycling of the sludge ("shoot") for human food. The areas of the machines that contact the sludge during the desludging operation are not designed or constructed as sanitary product contact surfaces. Some cream separators and centrifugal fine savers are designed to reclaim the heavy phase for use in human food.*

The clarified whey stream is then sent through a separator. The whey separation process generates three product streams. They are whey cream, skim whey, and sludge. Most separators automatically expel the sludge buildup on a regular schedule and this product typically becomes part of the waste stream. Other NCI members will elaborate further on the desludge process.

Prior to the final evaporation and drying of the skim whey, it is once again passed through a pasteurizer.

Cleaning Protocols

Proper cleaning and sanitation is critical to quality production of safe cheese and whey products. Cleaning of most equipment is done daily. Given the complexity of the manufacturing process already described and the wide array of equipment that comes into contact with the cheese and whey products at various stages of the process, it should be no surprise that milk components adhere to the equipment and are only removed through the aggressive use of chemicals during the daily clean in place ("CIP") cycles or through manual cleaning protocols.

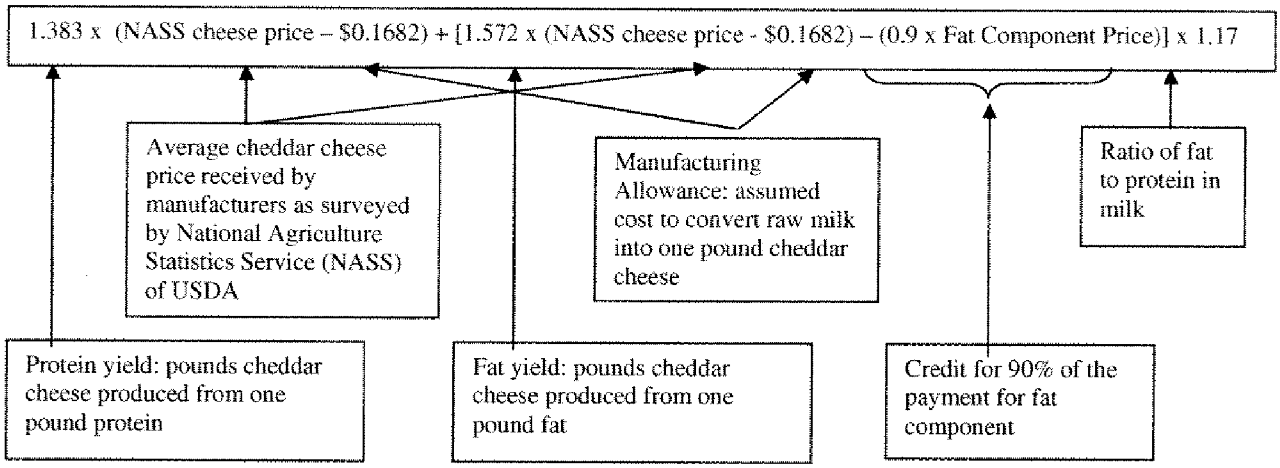
Product Losses

Additionally, given the high level of automation of most modern cheese plants and the open systems through the process, it is inevitable that from time to time some product will contact a surface that results in it being removed from the human grade production. This is particularly true if a piece of equipment malfunctions, causing the balance of the production system to stop while that equipment malfunction is addressed. While good manufacturing and preventative maintenance practices can minimize these instances of product losses, these events cannot be entirely eliminated. The magnitude of the component loss, of course, is significant when cheese curds that may be 32% fat and 24% casein become ineligible for human use. Unfortunately, milk cannot be transformed into finished cheddar and whey products in one closed system. Given that reality, component and product losses must be considered when establishing appropriate yields for the purpose of setting minimum regulated milk prices.

Proposal 9

Proposal 9 corrects an error in the existing Class III formulas regarding the volume and value of whey cream. Prior to focusing on the proposal, I'd like to review the assumptions embedded in the current formulas.

The current Class III protein component price formula is:



The existing Class III formula captures the cheese yield value of fat in the portion of the protein formula factor "1.572 x (NASS cheese price - $0.1682)". Specifically, the 1.572 is the assumed cheese yield of a pound of fat and is based upon a VanSlyke theoretical yield calculation in which the fat retention in the cheese is assumed to be 90% of the fat of the milk in the vat, the casein factor is zeroed out, and the moisture of the finished cheddar cheese is assumed to be 38%. The 1.572 yield factor reflects a combination of the fat captured in the finished cheese along with a prorated portion of the non-fat non-casein solids and the water that are in the finished cheddar cheese. A table dissecting the 1.572 fat yield factor is attached as Addendum A, Table 1.

Including the cheese value of fat in the protein component formula in addition to charging for the fat separately in the butterfat component formula would result in valuing the same fat twice. Therefore, the protein formula also gives credit for a portion of the price paid for the butterfat component. This is accomplished through the subtraction of "(0.9 x butterfat price)" in the protein equation. The "0.9" factor was adopted because the cheese yield factor of 1.572 assumes that 90% of the fat in the milk in the vat is captured in the cheese. By subtracting only 90% of the fat component price, the formula leaves 10% of the fat valued at the levels of the fat component price. That is to say, the formula leaves 10% of the fat (0.35 pounds at standard test) priced as if it was used to produce grade AA butter price.

This becomes obvious when the component price formulas related to the valuation of fat at the butter value are combined at the rates assumed in 3.5% standard milk. The following equations walk through that calculation.

<u>Credit in protein formula per cwt milk @ 3.5% standard fat:</u>

$$= -\left(0.9 \times \frac{\text{Class III butterfat price}}{\text{\# fat}}\right) \times \frac{1.17 \text{ \# fat}}{\text{\# protein}} \times 3.1 \frac{\text{\# protein}}{100 \text{ \# skim}} \times \frac{96.5 \text{ \# skim}}{\text{cwt milk}}$$

= - (0.9 x Class III butterfat price) x 3.5

= - 3.15 x Class III butterfat price

<u>Charge for fat component per cwt milk @ 3.5% standard fat:</u>

= 3.5 x Class III butterfat price

<u>Combined fat component charge and fat credit in protein price:</u>

= 3.50 x Class III butterfat price - 3.15 x Class III butterfat price

= 0.35 x Class III butterfat price

The 0.35 pounds of fat that is valued at the Class III butterfat price in the Class III formula is valued as if it produced 0.42 pounds of grade AA butter (0.35 pounds fat times the 1.2 yield of grade AA butter per pound fat in the Class III butterfat formula). Yet this fat was also assumed to have been delivered to the vat and been subjected to all of the fermentation and mechanical processes associated with cheddar cheese production. The assumption that butterfat, once subjected to the cheese making process, can be used to produce grade AA butter is inconsistent with USDA's own quality standards for grade AA butter.

Specifically, the fat that is not captured in the cheddar cheese curd is drained from the cheese vat as part of the whey stream. After being passed through a fines saver and clarifier, the whey stream is passed through a separator. Upon separation from the skim whey, the whey fat is contained in a product referred to as whey cream. USDA's quality standards prohibit whey cream from being used to produce USDA Grade AA butter; rather, it can only be used to produce Grade B butter.

The Department's Agricultural Marketing Service Dairy Division publication, "United States Standards for Grades of Butter" (Addendum B to my written testimony), describes the specifications for the USDA Grade AA butter on page 2 as follows:

> *(a) U.S. Grade AA. U.S. Grade AA butter conforms to the following: Possesses a fine and highly pleasing butter flavor. May possess a slight feed and a definite cooked flavor... For detailed specifications and classification of flavor characteristics see Table I, and for body, color, and salt characteristics and disratings see Table II.*

The same page goes on to describe U.S. Grade B butter as follows:

> *(c) U.S. Grade B. U.S. Grade B butter conforms to the following: Possesses a fairly pleasing butter flavor. May possess any of the following flavors to a slight degree: Malty, musty, neutralizer, scorched, utensil, weed, and whey... For detailed specifications and classification of flavor characteristics see Table I, and for body, color, and salt characteristics and disratings see Table II.*

The table referred to in these definitions, Table I on page 3 of the same USDA publication, specifically assigns butter with a whey flavor to Grade B status. Whey flavor is inherent to whey cream. Therefore, butter produced from whey cream would be assigned a Grade B rating.

Whey Cream Value

Although whey cream is sometimes recycled back into the cheese making process, many cheese makers do not recycle the whey cream. Agrimark has testified at this hearing that it does not do so. Kraft, the largest retail marketer of cheese in the US, has testified at this hearing that it does not allow its suppliers to do so, with respect to over 85% of the cheddar cheese it purchases.

The recycling of whey cream in cheddar production is limited by quality concerns. Additionally, the risk of a buildup of bacteriophage is greatly increased with the recycling of whey cream. Bacteriophage are viruses that attack the bacteria cultures that are used to set the cheese curds. The buildup of bacteriophage can lead to poor vat sets and production of off-grade cheese which commands a considerably lower price than is reflected by the NASS survey.

For all of these reasons, many cheddar makers sell whey cream in bulk truckloads. Very few buyers of whey cream exist in the market today. With the acquisition of West Point Dairy Products by Grassland in 2005, one less independent market is available than was available at the time of the May 2000 hearing. After canvassing cheese makers from throughout the country, I have been able to identify only five companies that represent a total of seven plant locations that purchase whey cream in the country. These five buyers are Agrimark (West Springfield, MA), Beaver Meadows (DuBois, PA), Grassland (Greenwood, WI; West Point, NE; Hyrum, UT), DFA (Winthrop, MN), and Madison Farms Butter (St. Louis, MO). In addition to the reduced competition due to the limited number of players, the lack of local outlets drives up the cost of transporting the whey cream to market. The cost of transport is either borne by the seller explicitly or indirectly through a lower purchase price.

The testimony that I expect will be entered into the hearing record by cheddar makers will show that the sales price for committed whey cream supplies is 94.4% of the grade AA butter price in the Pacific Northwest and the flat (100.2%) grade AA butter price in the Northeast. Pricing on spot loads is typically considerably less. The pricing in a whey cream transaction is applied only to the pounds of fat in the whey cream; the skim portion of the whey cream is not valued. Ignoring the fact that the cheese maker does not receive payment for the protein and other solids in the whey cream for the moment, even a flat grade AA market revenue stream falls short of the cheese maker's cost based upon the regulated Class III fat price.

Specifically, the revenue received by processors on the fat component of the whey cream at the 100.2% and 94.4% grade AA multipliers generate a 12.5 cent and a 20.4-cent per pound shortfall per pound, based upon the fat component cost established by the existing Class III formula. In other words, the regulated minimum price under the current formula is based upon the assumption that processors are receiving in the marketplace 12.5 cents (Northeast) 20.4 cents (Pacific Northwest) more than they really are, with respect to the fat component of the whey cream. The following table, using a five-year average grade AA butter price, shows the details behind the conclusion.

	Northeast	Pacific Northwest
Average Grade AA butter price (02 - 06)	$1.3592	$1.3592
Multiplier	100.2%	94.4%
Return per pound whey fat	$1.3619	$1.2831
Cost per pound fat (current formula)	$1.4868	$1.4868
Revenue less cost per pound fat	($0.1249)	($0.2037)

In addition, as already noted, this 20.4 cent shortfall does not even reflect that the protein and other solids in the whey cream are not generating any explicit revenue whatsoever, given that the price paid for whey cream is based entirely upon its fat content. Yet the protein and other solids in the whey cream are being priced under the Class III formula. .

The discounted values of whey cream and grade B butter have long been recognized in regulation and in the marketplace. The California Class 4b price formula, which covers milk used to produce cheese in the state of California, has contained a whey cream factor since a unique cheese milk formula was first developed in August 1989. The formula originally used the CME grade B butter price for the purpose of valuing whey cream. When the CME discontinued grade B butter trading in May 1998, the California Department of Food and Agriculture (CDFA) used the CME grade AA butter price, **discounted by $0.10**. The $0.10 discount to the grade B butter price is based upon a 1998 hearing record that focused on the historic price relationship between the grade AA and B butter markets at the CME. Addendum A Table 2 to this written testimony summarizes the grade AA and B butter prices for the 24 months immediately prior to the CME's discontinuation of trading. The grade B price over that period was 9.78 cents below the average grade AA butter price.

Whether viewed from the perspective of the value of whey cream or the value of grade B butter, it is clear that the whey fat recovered as whey cream is overvalued in the current Class III price formulas, which falsely value that fat as if it had the same value as the fat in Grade AA butter. Therefore, there must be an adjustment in the protein formula to reflect that lower value. I will discuss a specific approach after I first discuss whey cream volume.

<u>Whey Cream Volume</u>

In addition to overvaluing the whey fat that is recovered in the form of whey cream, the existing Class III formula overstates the volume of fat that can be recovered as whey cream from cheddar production. The 0.35 pound assumption in the current formula ignores both the fat that is captured in dry whey rather than in whey cream, and the fat that is lost in the salt whey, sludge and cleaning solutions, which I have already discussed.

IDFA's proposal 9 calls for the protein formula to be adjusted to reflect the volume of whey cream that is actually recovered in cheddar production. Based upon the evidence that I am aware of now, the following table summarizes the approach that I believe identifies that fat that is available for whey cream recovery:

			Fat Pounds
1	Standard Milk Composition		3.5000
2	less: farm to plant volume loss (0.25%)		(0.0088)
3	Less fat lost on surfaces prior to receipt in plant		(0.0150)
4	volume delivered to plant (lines 1 + 2 + 3)		3.4763
5	Calculation of fat in finished cheddar		
6	volume delivered to plant (line 4)	3.4763	
7	vat fat retention	90.00%	
8	Fat captured in cheddar (line 6 * 7)		3.1286
9	Calculation of fat in dry whey		
10	Dry whey per cwt	5.8643	
11	Fat composition of dry whey	1.25%	
12	Fat in dry whey (line 10 * 11)		0.0733
13	Calculation of fat left in skimmed salt whey (disposed of as waste)		
14	Nonfat solids in salt whey	0.2172	
15	Fat in proportion to SNF in dry whey	1.30%	
16	Fat associated with skimmed salt whey (disposed of as waste) (line 14 * 15)		0.0029
17	Residual fat marketable as whey cream (line 4-8-12-16)		0.2715
18	divided by original farm fat	3.5	
19			
20	Percent of fat recoverable as whey cream		7.8%

As the table shows, farm fat pounds are first reduced by farm to plant losses, which are already captured in the current Class III formula. They are then reduced by the fat captured in the cheddar, which is also already captured in the current Class III formula. They are then reduced by the fat that is incorporated in dry whey, which is 1.25% of the dry whey volume. This is not captured in the current Class III formula. They are then reduced by the fat associated with the skim portion of the salt whey that is disposed of due to the salinity issues. This is not captured in the current Class III formula.

As the Table shows, even without considering the loss of fats on the stainless piping and equipment from pasteurizer through the vat, draining, cheddaring, milling, and pressing, or the losses related to product losses, the maximum residual fat available for whey cream is 0.2715 pounds of the original 3.5 pounds. This equates to 7.8% of the original fat.

<u>Correcting The Protein Formula</u>

IDFA's proposal 9 calls for the correction of the whey cream factor to account for both the true volume of the fat recovered in the whey cream and the true value of whey cream. Based upon the above analysis, the maximum recoverable whey fat at a 90% vat capture rate in cheddar cheese is 7.8% of the original fat. Therefore, in this example, the 0.9 factor should be replaced by a factor of 0.922 or greater in the protein equation, leaving a maximum of 7.8% of the fat to be valued as whey cream. The effect of moving the 0.9 factor to 0.922 at the average fat component price of the last five years (restated to the February 2007 make allowances) of 1.4868 is a reduction of 11.45 cents per hundredweight milk.

While the adjustment above will correct the formula to account for the proper amount of recoverable whey cream, a further adjustment must be made to account for the true value of whey cream. The protein formula should include a factor for the difference between whey cream values and the Class III fat price. This should be done with a flat adjustment, similar to the Agrimark methodology in Proposal 10, but the adjustment should be reflective of the difference in value between the whey cream and the grade AA butter value.

The analysis and discussion under the heading of whey cream value above indicates that the whey fat component that is recovered is overvalued by 12.5 in the Northeast and 20.4 cents per pound in the Pacific Northwest. Since the minimum regulated milk price is just that, an adjustment must be made to the protein component formula to accommodate the market values and, since we have uniform Class III pricing across the country, the targeted adjustment should be to accommodate the 20.4 shortfall in the Northwest. This 20.4 cents per pound on the remaining .2715 pounds (7.8% of original fat) that we have determined is recoverable as whey cream (at a maximum) equates to a reduction of 5.5 cents per hundredweight. For consistency, this adjustment should be effectuated in the fat value correction portion of the protein formula. Since there are 2.9915 pounds protein assumed in a hundredweight of milk and the fat correction portion of the formula is multiplied by 1.17 (effectively grossing up the fat adjustment to 3.5 pounds of fat), the appropriate adjustment to the fat portion of the protein formula is 1.6 cents. The $0.016 multiplied by 1.17 and 2.9915 equates to the 5.5 cents per hundredweight that needs to be adjusted.

Given this evidence, I propose that the protein formula become:

1.383 x (NASS cheese price – $0.1682) + [1.572 x (NASS cheese price - $0.1682) – (0.922 x Fat Component Price) - $0.016] x 1.17

I will note again that this is a conservative change, The proposed change does not account for the fat lost on the stainless piping and equipment from pasteurizer through the vat, draining, cheddaring, milling, and pressing, or the losses related to product losses. In other words, the formula will still require processors to pay for milk as if they had not suffered these losses, but were instead able to extract revenues from the marketplace for this fat.

The combined effect of the correction for volume and value of whey cream is a reduction in the Class III hundredweight price of 16.9 cents per hundredweight over the last five years.

Proposal 12

USDA should also adopt IDFA's proposal to eliminate the 3 cents that is currently added to the barrel price before calculating the weighted average NASS cheese price used in the Class III formula. This 3 cents addition is wholly without merit.

At the time the current three cent adjustment was adopted as part of the Final Rule under Federal Order Reform, it was stated that: "Since the make allowance of $0.1702 is for block cheese, the barrel cheese price must be adjusted to account for the difference in cost for making block versus barrel cheese. The three cents that is added to the barrel cheese price is generally considered to be the industry standard cost difference between processing barrel cheese and processing block cheese." Fed. Reg. Vol. 64 No. 63 Page 16098.

Subsequent to the adoption of this three-cent adjustment, two significant facts have arisen. First, the cost data presented by Dr. Mark Stephenson of Cornell University at the September 2006 hearing, which was used to set the make allowances that went into effect February 1, 2007, included both blocks and barrels. While CDFA cost data was also used to set the current federal order make allowances, Dr. Stephenson's cost data covered 78% of the total production volume and given that relative weight in establishing the make allowances. Therefore, the current make allowances already reflect any processing cost difference that may exist between 40 pound blocks and 500 pound barrels. To make an additional three cent adjustment to reflect the purported processing cost difference is double counting.

Second, the three-cent addition was not based upon a study of actual cost differences between blocks and barrels. . Rather, it was based upon what was "generally considered to be the industry standard cost difference between processing barrel cheese and processing block cheese" as noted above. And the three-cent rule of thumb was accepted by the industry as the cost difference because it had been manifested in the marketplace as the long-term difference in prices between 40# blocks and 500# barrels at 39% moisture.

However, subsequent to the implementation under Federal Order Reform, USDA adopted in the Tentative Rule implemented January 2001 a change in the pricing reference used for barrel cheese from the 39% moisture price that set the framework for the three cent adjustment to a 38% moisture adjusted price. This change in the moisture level at which barrel prices are quoted has increased the barrel cheese price by 2.2 cents per pound during the last five years. Thus, the three-cent adjustment and the adjustment of the barrel price to a 38% price reference both capture the same facet of the relationship between blocks and barrels, and are duplicative and double counting.

And finally, I expect evidence to be presented at this hearing that will show that the difference between block and barrel production costs in a plant that has comparable capacity in both forms with capital investments to both lines made in a comparable timeframe to show no difference in cost between the production of cheddar blocks and barrels.

For all of these reasons, the three cent adjustment should be eliminated from the formula. At the average barrel representation in the NASS cheese survey over the last 5 years of 56.15%, the elimination of the 3 cent barrel adjustment equates to a reduction of $0.1624 per hundredweight.

Addendum A

Table 1. Dissection of fat yield in cheddar calculation embodied in current Class III formula.

		Volume in Finished Cheddar
Beginning farm fat	3.5000	
less: farm to plant volume loss (0.25%)	(0.0088)	
less fat lost on surfaces prior to receipt in plant	(0.0150)	
volume delivered to plant	3.4763	
fat to vat (assuming no pre-vat plant loss)	3.4763	
fat retention rate in finished cheddar	90.00%	
fat captured in finished cheddar		3.1286
other non-fat non-casein solids captured in curd (9% of fat capture)		0.2816
Fat and non-fat non-casein solids captured in curd matrix		3.4102
casein in true protein		
assumed finished product moisture	38.0%	
water in finished cheddar		2.0901
cheddar yield of 3.5# farm fat		5.5003
Yield per pound farm fat		1.572

Addendum A

Table 2. Comparison of CME Grade AA and Grade B butter prices for the 24 months preceding discontinuation of trading.

Month	CME Grade AA Butter	CME Grade B Butter	Grade B less Grade AA Butter
May-1996	$ 0.9490	$ 0.8865	$(0.0625)
Jun-1996	$ 1.3663	$ 1.3063	$(0.0600)
Jul-1996	$ 1.5194	$ 1.4487	$(0.0707)
Aug-1996	$ 1.5300	$ 1.4500	$(0.0800)
Sep-1996	$ 1.5300	$ 1.4500	$(0.0800)
Oct-1996	$ 1.4035	$ 1.2626	$(0.1409)
Nov-1996	$ 0.8248	$ 0.6870	$(0.1378)
Dec-1996	$ 0.8142	$ 0.7102	$(0.1040)
Jan-1997	$ 0.9039	$ 0.8074	$(0.0965)
Feb-1997	$ 1.0734	$ 0.9693	$(0.1041)
Mar-1997	$ 1.1581	$ 1.0461	$(0.1120)
Apr-1997	$ 1.0233	$ 0.9027	$(0.1206)
May-1997	$ 0.9652	$ 0.8584	$(0.1068)
Jun-1997	$ 1.1294	$ 1.0500	$(0.0794)
Jul-1997	$ 1.0995	$ 1.0116	$(0.0879)
Aug-1997	$ 1.0932	$ 1.0045	$(0.0887)
Sep-1997	$ 1.1103	$ 1.0310	$(0.0793)
Oct-1997	$ 1.4650	$ 1.3735	$(0.0915)
Nov-1997	$ 1.5892	$ 1.4842	$(0.1050)
Dec-1997	$ 1.3021	$ 1.1608	$(0.1413)
Jan-1998	$ 1.1932	$ 1.0987	$(0.0945)
Feb-1998	$ 1.3918	$ 1.2914	$(0.1004)
Mar-1998	$ 1.3452	$ 1.2477	$(0.0975)
Apr-1998	$ 1.3788	$ 1.2727	$(0.1061)
May 96 - April 98 avg	$ 1.2150	$ 1.1171	$(0.0978)

United States
Department of
Agriculture

Agricultural
Marketing
Service

Dairy
Division

United States Standards for Grades of Butter

Effective August 31, 1989

United States Standards for Butter[1]

Definitions

§ 58.2621 Butter.

For the purpose of this subpart P "butter" means the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80 percent by weight of milkfat, all tolerance having been allowed for.

§ 58.2622 Cream.

The term "cream" when used in this subpart P means cream separated from milk produced by healthy cows. The cream shall be pasteurized at a temperature of not less than 165°F. and held continuously in a vat at such temperature for not less than 30 minutes; or pasteurized at a temperature of not less than 185°F. for not less than 15 seconds; or it shall be pasteurized by other approved methods giving equivalent results.

U.S. Grades

§ 58.2625 Nomenclature of U.S. grades.

The nomenclature of U.S. grades is as follows:

(a) U.S. Grade AA.

(b) U.S. Grade A.

(c) U.S. Grade B.

§ 58.2626 Basis for determination of U.S. grade.

The U.S. grade of butter is determined on the basis of classifying first the flavor characteristics and then the characteristics in body, color, and salt. Flavor is the basic quality factor in grading butter and is determined organoleptically by taste and smell. The flavor characteristic is identified and together with its relative intensity is rated according to the

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[1]Compliance with these standards does not excuse failure to comply with provisions of the Federal Food, Drug and Cosmetic Act.

applicable classification. When more than one flavor characteristic is discernible in a sample of butter, the flavor classification of the sample shall be established on the basis of the flavor that carries the lowest rating (see Table I). Body, color, and salt characteristics are then noted and any defects are disrated in accordance with the established classification (see Table II). The final U.S. grade for the sample is then established in accordance with the flavor classification, subject to disratings for body, color, and salt; when the disratings for body, color, and salt exceed the permitted amount for any flavor classification the final U.S. grade shall be lowered accordingly (see Table III and IV).

§ 58.2627 Specifications for U.S. grades of butter.

The specifications for the U.S. grades of butter are as follows:

(a) *U.S. Grade AA.* U.S. Grade AA butter conforms to the following: Possesses a fine and highly pleasing butter flavor. May possess a slight feed and a definite cooked flavor. It is made from sweet cream of low natural acid to which a culture (starter) may or may not have been added. The permitted total disratings in body, color, and salt characteristics are limited to one-half (½). For detailed specifications and classification of flavor characteristics see Table I, and for body, color, and salt characteristics and disratings see Table II.

(b) *U.S. Grade A.* U.S. Grade A butter conforms to the following: Possesses a pleasing and desirable butter flavor. May possess any of the following flavors to a slight degree: Acid, aged, bitter, coarse, flat, smothered, and storage. May possess feed flavor to a definite degree. The permitted total disratings in body, color, and salt characteristics are limited to one-half (½), except, when the flavor classification is AA, a disrating total of one (1) is permitted. For detailed specifications and classification of flavor characteristics see Table I, and for body, color, and salt characteristics and disratings see Table II.

(c) *U.S. Grade B.* U.S. Grade B butter conforms to the following: Possesses a fairly pleasing butter flavor. May possess any of the following flavors to a slight degree: Malty, musty, neutralizer, scorched, utensil, weed, and whey. May possess any of the following flavors to a definite degree: Acid, aged, bitter, smothered, storage, and old cream; feed flavor to a pronounced degree. The permitted total disratings in body, color, and salt characteristics are limited to one-half (½), except, when the flavor classification is AA, a disrating total of one and one-half (1½) is permitted and when the flavor classification is A, a disrating total on one (1) is permitted. For detailed specifications and classification of flavor characteristics see Table I, and for body, color, and salt characteristics and disratings see Table II.

(d) *General.* Butter of all U.S. grades shall be free of foreign materials and visible mold. Butter possessing a flavor rating of AA and workmanship disratings in excess of one and one-half (1½) shall be given a flavor rating only; butter possessing a flavor rating of A and workmanship disratings in excess of one (1) shall be given a flavor rating only; and butter possessing a flavor rating of B and workmanship disratings in excess of one-half (½) shall be given a flavor rating only.

Table I.--Classification of Flavor Characteristics

Identified flavors[1]	**Flavor classification**		
	AA	**A**	**B**
Feed	S	D	P
Cooked	D	------	------
Acid	------	S	D
Aged	------	S	D
Bitter	------	S	D
Coarse	------	S	------
Flat	------	S	------
Smothered	------	S	D
Storage	------	S	D
Malty	------	------	S
Musty	------	------	S
Neutralizer	------	------	S
Scorched	------	------	S
Utensil	------	------	S
Weed	------	------	S
Whey	------	------	S
Old cream	------	------	D

S--Slight; D--Definite; P--Pronounced.

[1]When more than 1 flavor is discernible in a sample of butter, the flavor classification of the sample shall be established on the basis of the flavor that carries the lowest classification.

Table II.--Characteristics and Disratings in Body, Color, and Salt

Characteristics	Disratings		
	S	D	P
Body:			
Short	------	½	1
Crumbly	½	1	------
Gummy	½	1	------
Leaky	½	1	2
Mealy or grainy	½	1	------
Weak	½	1	------
Sticky	½	1	------
Ragged boring	1	2	------
Color:			
Wavy	½	1	------
Mottled	1	2	------
Streaked	1	2	------
Color specks	1	2	------
Salt:			
Sharp	½	1	------
Gritty	1	2	------

S--Slight; D--Definite; P--Pronounced.

§ 58.2628 Relation of U.S. grade of butter to the flavor classification as affected by disratings in body, color and salt characteristics.

(a) The flavor classification and total disratings in body, color, and salt characteristics permitted in each grade are as follows:

Table III

Flavor classification	Total disratings	U.S. grade
AA	½	AA
AA	1	A
AA	1½	B
A	1	B
B	½	B

(b) Examples of the relation of U.S. grades to flavor classification and total disratings in body, color, and salt characteristics:

Table IV

Example No.	Flavor classification	Disrating Body	Disrating Color	Disrating Salt	Total disrating	Permitted total disratings	Disratings in excess of total permitted	U. S. grade
1.	AA	½	0	0	½	½	0	AA
2.	AA	½	½	0	1	½	½	A
3.	AA	0	1	0	1	½	½	A
4.	AA	½	1	0	1½	½	1	B
5.	A	½	0	0	½	½	0	A
6.	A	0	½	½	1	½	½	B
7.	A	0	1	0	1	½	½	B
8.	B	½	0	0	½	½	0	B

§ U. S. Grade not assignable.

(a) Butter which fails to meet the requirements for U. S. Grade shall not be given a U. S. grade.

(b) Butter, when tested, which does not comply with the provisions of the Federal Food, Drug, and Cosmetic Act, including minimum milkfat requirements of 80.0 percent, shall not be assigned a U. S. grade.

(c) Butter produced in a plant found on inspection to be using unsatisfactory manufacturing practices, equipment or facilities, or to be operating under unsanitary plant conditions shall not be assigned a U. S. grade.

(d) When the butter has been produced in a plant which has not been surveyed and approved for inspection or grading service.

§ 58.2635 Explanation of terms.

(a) *With respect to flavor intensity and characteristics*--(1) *Slight.* An attribute which is barely identifiable and present only to a small degree.

(2) *Definite.* An attribute which is readily identifiable and present to a substantial degree.

(3) *Pronounced.* An attribute which is markedly identifiable and present to a large degree.

(4) *Aged.* Characterized by lack of freshness.

(5) *Bitter.* Astringent, similar to taste of quinine and produces a puckery sensation.

(6) *Acid.* Lacks a delicate flavor or aroma and is associated with an acid condition but there is no indication of sourness.

(7) *Cooked.* Smooth, nutty-like character resembling a custard flavor.

(8) *Cooked (coarse).* Lacks a fine, delicate, smooth flavor.

(9) *Feed.* Aromatic flavor characteristic of the feeds eaten by cows.

(10) *Flat.* Lacks natural butter flavor.

(11) *Malty.* A distinctive, harsh flavor suggestive of malt.

(12) *Musty.* Suggestive of the aroma of a damp vegetable cellar.

(13) *Neutralizer.* Suggestive of a bicarbonate of soda flavor or the flavor of similar compounds.

(14) *Old Cream.* Aged cream characterized by lack of freshness and imparts a rough aftertaste on the tongue.

(15) *Scorched.* A more intensified flavor than coarse and imparts a harsh aftertaste suggestive of excessive heating.

(16) *Smothered.* Suggestive of improperly cooled cream.

(17) *Storage.* Characterized by a lack of freshness and more intensified than "aged" flavor.

(18) *Utensil.* A flavor suggestive of unclean cans, utensils and equipment.

(19) *Weed.* Aromatic flavor characteristic of the weeds eaten by cows.
(20) *Whey.* A flavor and aroma characteristic of cheese whey.

(b) *With respect to body*--(1) *Crumbly.* When a "crumbly" body is present the particles lack cohesion. The intensity is described as "slight" when the trier plug tends to break and the butter lacks plasticity; and "definite" when the butter breaks roughly or crumbles.

(2) *Gummy.* Gummy-bodied-butter does not melt readily and is inclined to stick to the roof of the mouth. The intensity is described as "slight" when the butter tends to become chewy and "definite" when it imparts a gum-like impression in the mouth.

(3) *Leaky.* A "leaky" body is present when on visual examination there are beads of moisture on the surface of the trier plug and on the back of the trier or when slight pressure is applied to the butter on the trier plug. The intensity is described as "slight" when the droplets or beads of moisture are barely visible and about the size of a pinhead; "definite" when the moisture drops are somewhat larger or the droplets are more numerous and tend to run together; and "pronounced" when the leaky condition is so evident that drops of water drip from the trier plug.

(4) *Mealy or grainy.* A "mealy" or "grainy" condition imparts a granular consistency when the butter is melted on the tongue. The intensity is described as "slight" when the mealiness or graininess is barely detectable on the tongue and "definite" when the mealiness or graininess is readily detectable.

(5) *Ragged boring.* A "ragged boring" body, in contrast to solid boring, is when a sticky-crumbly condition is present to such a degree that a full trier of butter cannot be drawn. The intensity is described as "slight" when there is a considerable adherence of butter to the back of the trier and "definite" when it is practically impossible to draw a full plug of butter.

(6) *Short.* The texture is short-grained, lacks plasticity and tends toward brittleness. The intensity is described as "slight" when the butter lacks pliability and tends to be brittle; "definite" when sharp and distinct breaks form as pressure is applied against the butter plug; and "pronounced" when sharp and distinct breaks form in the butter surface when the trier is inserted, or when segments of the butter plug separate along fracture lines.

(7) *Sticky.* When a "sticky" condition is present, the butter adheres to the trier as a smear and possesses excessive adhesion. The intensity is described as "slight" when the smear is present only on a portion of the back of the trier and "definite" when the trier becomes smeary throughout its length.

(8) *Weak.* A "weak" body lacks firmness and tends to be spongy. The intensity is described as "slight" when the plug of butter, under slight pressure, tends to depress easily and definitely lacks firmness and compactness.

(c) *With respect to color*--(1) *Mottled.* "Mottles" appear as a dappled condition with spots of lighter and deeper shades of yellow. The intensity is described as "slight" when the small spots of different shades of yellow, irregular in shape, are barely discernible on the plug of butter and "definite" when the mottles are readily discernible on the plug of butter.

(2) *Specks.* "Specks" usually appear in butter as small white or dark yellow particles; they

may be of variable size. The intensity is described as "slight" when the particles are few in number and "definite" when they are noticeable in large numbers.

(3) *Streaked.* "Streaked" color appears as light colored portions surrounded by more highly colored portions. The intensity is described as "slight" when only a few are present and "definite" when they are more numerous on the trier plug.

(4) *Wavy.* "Wavy" color in butter is an unevenness in the color that appears as waves of different shades of yellow. The intensity is described as "slight" when the waves are barely discernible and "definite" when they are readily noticeable on the trier plug.

(d) *With respect to salt*--(1) *Sharp.* "Sharp" salt is characterized by taste sensations suggestive of salt. The intensity is described as "slight" when the salt taste predominates in flavor; and "definite" when the salt taste distinctly predominates in flavor.

(2) *Gritty.* A "gritty" salt condition is detected by the sandlike feel of grains of undissolved salt on the tongue or between the teeth when the butter is chewed. The intensity is described as "slight" when only a few grains of undissolved salt are detected and "definite" when the condition is more readily noticeable.

Determining the Flavor of Butter and the Probable Causes of Certain Characteristics in Butter

General - Basically the quality of the finished butter can be no higher than the quality of the raw milk and cream from which it is made. Careful grading and segregation of the milk and cream received is very important. Also, poor workmanship can result in disratings that can cause the butter to be down-graded and detract from the flavor and stability of the finished product. Therefore, it is important that close attention be given to the workmanship factors, especially to those conditions which influence spreadability and product stability. Plants should carefully examine each churning of butter after the butter has been properly chilled for 48 hours.

Determining the Flavor of Butter - The flavor (taste and odor) of butter is determined primarily by the senses of taste and smell.

The proper procedure in grading butter is first to use the sense of smell to determine aroma, and then the sense of taste to confirm and establish the character, probable origin, and degree of development of each flavor present. By carefully discerning the taste, odor and aroma characteristics of the sample, the grader is able to properly identify and classify the flavor.

The taste buds of the tongue vary in their response to the four basic tastes (sweet, sour, salt and bitter). The sweet taste may be generally noted at the tip of the tongue, sour along the sides, salt along the side and tip, and bitter at the base.

The centers for determining odor are in the uppermost regions of the nasal cavity. For this reason, to get the maximum benefit of the odor part of butter flavor, note its odor by inhaling slowly and deeply after you warm the sample in your mouth.

The temperature of the butter at the time of grading is important in determining the true characteristics of the butter. The temperature of the butter should preferably range from 45° F to 55° F. A temperature of about 70° F should be provided in the grading room; it should not be below 60° F. The room should also be free of off-odors.

Probable Causes of Certain Characteristics in Butter

Flavor Characteristics -

(1) *Acid* - Associated with moderate acid development in the milk or cream, or excessive ripening of the cream.

(2) *Aged* - Associated with short or extended holding periods of butter. The holding temperature will affect the rate of development of this flavor. May also occur if high quality raw material is not properly handled and promptly processed so that the flavor loses its freshness.

(3) *Bitter* - Attributable to the action of certain microorganisms or enzymes in the cream before churning, certain types of feeds and late lactation.

(4) *Cooked* - Associated with using high temperatures in pasteurization of sweet cream.

(5) *Coarse* - Associated with using high temperatures in pasteurization of cream with slight acid development.

(6) *Feed* - Attributable to feed eaten by cows and the flavors being absorbed in the milk and carried through into the butter. Most dry feeds (like hay or concentrates), silage, green alfalfa, and various grasses produce feed flavors in butter. Silage flavor may vary in degree and character depending on the time of feeding, extent of fermentation and kind of silage.

(7) *Flat* - Attributable to excessive washing of the butter or to a low percentage of fats or volatile acids and other volatile products that help to produce a pleasing butter flavor.

(8) *Malty* - Attributable to the growth of the organism Streptococcus lactic var. maltigenes in milk or cream. It is often traced to improperly washed and sanitized utensils in which this organism has developed.

(9) *Musty* - Attributable to cream from cows grazing on slough grass, eating musty or moldy feed (hay and silage) or drinking stagnant water.

(10) *Neutralizer* - Attributable to excessive or improper use of alkaline products to reduce the acidity of the cream before pasteurization.

(11) *Old Cream* - Attributable to aged cream, or inadequate or improper cooling of the cream. This flavor may be accentuated by unclean utensils and processing equipment.

(12) *Scorched* - Associated with using excessively high temperatures in pasteurization of cream with developed acidity, prolonged holding times in forewarming vats or when using vat pasteurization. Also associated with vat pasteurization without adequate agitation.

(13) *Smothered* - Attributable generally to improper handling and delayed cooling of the cream.

(14) *Storage* - Associated with extended holding periods of butter for several months or

longer.

(15) *Utensil* - Attributable to handling or storing milk or cream in equipment which is in poor condition or improperly sanitized.

(16) *Weed* - Attributable to milk or cream from cows which have been fed on weed-infested pastures or weedy hay.

(17) *Whey* - Attributable to the use of whey cream or the blending of cream and whey cream for buttermaking.

Body Characteristics -

General - Butterfat in butter is a mixture of various triglycerides of different melting points and appears in the form of fat globules and free fat. In both of these forms, part of the fat is crystalline and part liquid. Some fats are solid at temperatures up to 100° F or even higher, others are still liquid at temperatures far below the freezing point. Butter, at the temperature at which it is usually handled, is always a mixture of crystallized and liquid fat. The variations in the composition of milkfat thus have a great influence upon the body and spreadability of butter. In the summer when milkfat contains more liquid or soft fat, butter tends to be weak and leaky. In the winter when the milkfat contains more solid fat, butter tends to be hard and brittle, resulting in unsatisfactory spreadability. The ratio between the crystalline and liquid fat particles depends upon the composition of the milkfat (varying with the season of the year), manufacturing methods, and the temperature of the butter. Close attention needs to be given to tempering the cream, temperature of churning, washing and working of the butter as the seasons of the year change. This is important in maintaining a uniform firm waxy body possessing food spreadability.

Butter with a firm waxy body has an attractive appearance, has granules that are close knit, cuts clean when sliced, and has good spreadability. The trier sample from such butter will show this clean cut, smooth, waxy appearance.

The temperature of the butter at the time of grading is important in determining the true characteristics of body and should be between 45° F and 55° F.

Body in butter is considered from the standpoint of its characteristics or defects. Defects in body are disrated according to degree of intensity.

(1) *Crumbly (Lacks cohesion)* - Attributable to a high proportion of fat crystals in the free fat. Such a condition is associated with higher melting point fats resulting from feeding certain dry feeds like cottonseed meal, and also is associated with cows in late lactation. Cooling cream rapidly helps to form small globules or particles. If enough liquid fat is available, the butter will not crumble. It will crumble if crystals are large and there is no liquid fat. Cooling cream to too low a temperature for a long period during fall and winter months also may cause crumbliness. Lower wash water temperature (10° F to 20° F below the temperature of the buttermilk) will help to correct crumbliness.

Butter with a normal body may appear crumbly at a low temperature, while a crumbly butter may appear to have a normal body at a higher temperature.

(2) *Gummy (Sticky mouth feel)* - Attributable to the presence of a high percentage of high-melting-point fats. Feeding cottonseed meal or whole cottonseed in quantities large enough to

supply the bulk of the protein in a ration will result in a high proportion of high-melting-point fats and a hard-bodied butter. Such cream requires slower cooling, higher churning temperatures, higher temperature wash water, and longer working time.

(3) *Leaky (Free moisture on the butter surface)* - Attributable generally to insufficient working, resulting in incomplete incorporation of the water. The water droplets are not reduced sufficiently in size to be well distributed throughout the mass of the butter. When the fat is soft and the granules are not sufficiently firm at the start of the working process, they mass together too quickly and do not offer enough resistance to break up the water in the butter. An uneven salt distribution may also cause migration of moisture in the butter.

(4) *Mealy or grainy (A grainy feel on the tongue similar to cornmeal)* - Attributable to oiling-off of the milkfat at some stage of the buttermaking process, improper melting of frozen cream, or improper neutralization of sour cream. The oiled-off fat, upon being cooled, crystallizes into small particles which cannot be worked into a smooth texture.

(5) *Ragged boring (Unable to draw a smooth full trier of butter)* - Attributable to certain types of dry feeds, especially when such feeds are not offset by succulent feeds. It is caused by a combination of the factors that are generally associated with crumbliness and stickiness, particularly when the melting point of the continuous (non-globular) fat phase of butter is unusually high. Although this condition is related to crumbliness and stickiness, it differs in appearance as the butter tends to roll on the trier. It may be minimized by procedures which permit the fat in the cream to crystallize at relatively high temperatures and by rapid chilling of the fat after the butter granules have formed.

(6) *Short (Lacks plasticity and tends towards brittleness)* - Attributable to predominance of high-melting-point fats with relatively small fat globules; and comparatively low curd content of the butter. Certain types of manufacturing processes where partial or total melting of the fat takes place and normal granules are not produced, usually result in a short and brittle bodied butter. Too rapid cooling to too low a temperature may also be a factor.

(7) *Sticky (Butter adheres to the trier as a smear)* - Associated with dry feeds and late lactation period and predominance of high-melting-point fats. This defect may result from not having the correct proportion of liquid and solid fat in the butter as well as the proper proportion of large and small crystals of fat. The condition may be accentuated by too rapid cooling, cooling of the cream to too low a temperature or overworking the butter.

(8) *Weak (Lacks firmness)* - Attributable to churning cream which has not been cooled to a low enough temperature or not held long enough at a low temperature following pasteurization to properly firm the granules. May also be caused by churning at too high a temperature, incorporating too much air into the butter during churning and working, or overworking.

Color characteristics -

General - The natural color of butter varies according to seasonal and regional conditions. The color of butter is considered defective when it is uneven or lacks uniformity within the same churning or package.

(1) *Mottled (Spots of lighter and deeper shades of yellow)* - Attributable to insufficient

working of the butter, resulting in an uneven distribution of salt and moisture. Diffusion of the moisture towards the undissolved salt or areas of high salt concentration causes the irregular color spots. Churning at too high a temperature resulting in soft granules that do not have sufficient resistance to stand the necessary amount of working may also cause a mottled condition.

(2) *Specks (Small white or dark yellow particles)* - Attributable to small particles of coloring or coagulated casein. White specks present may be small particles of curd formed during heating of improperly neutralized sour cream or from partial coagulation caused by sweet-curdling organisms during pasteurization. The addition of a coarse-bodied starter may also be a contributing factor. Yellow specks may result from the use of butter color which has precipitated because of age or freezing.

(3) *Streaks (Light color surrounded by more highly colored portions)* - Attributable to insufficient working of the butter, faulty mechanical condition of the churn causing uneven working of butter, and addition of butter or butter remnants from previous churnings.

(4) *Wavy (Unevenness of color)* - Attributable to insufficient working, resulting in an uneven distribution of the water and salt in the butter. May also be caused by faulty mechanical condition of the churn and addition of butter or butter remnants from previous churnings.

Salt characteristics -

General - In grading butter, the factor of salt is considered from the standpoint of the degree of salt taste (sharpness) and whether it is completely dissolved (gritty). A range in the salt content or salty taste of butter is permitted without considering it a defect. This range provides for the various market preferences for salt taste in butter. Uniformity of salt content between churnings from the same factory is desirable.

(1) *Sharp salt* - Attributable to the use of too much salt or lack of sufficient working to obtain thorough distribution of salt and water.

(2) *Gritty* - Attributable to the use of too much salt or undissolved salt due to insufficient working of the butter.