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The Milkfat Issue:
Production, Processing, and Marketing

Summary of a Cornell University Conference on Dairy Market and Product Research, held at the Syracuse Marriott Hotel, March 5, 1990

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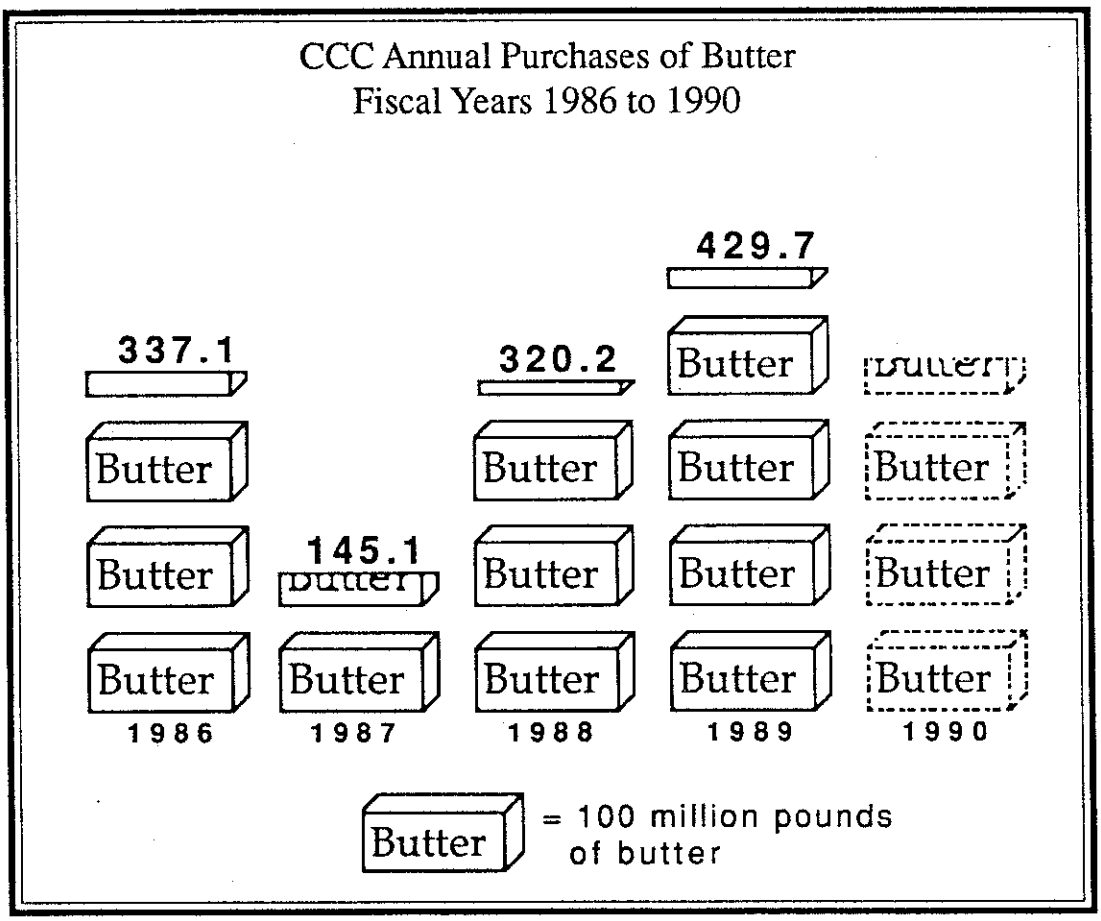

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Preface

Tom Cosgrove is currently a research specialist in the Department of Agricultural Economics at Cornell University. He began editing this proceedings as part of an independent study project while a senior majoring in communications at Cornell. Andrew Novakovic is the E.V. Baker Associate Professor of Dairy Marketing and Policy in Cornell's Department of Agricultural Economics. Assistance in preparing the manuscript was provided by Wendy Barrett.

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In 1988-89, the CCC purchased a record 429.7 million pounds of butter. The reason for these huge stocks of butter is that consumers are consuming less fat because of dietary concerns, leaving the dairy industry with a surplus of milkfat.

To examine the issues surrounding this surplus and the possible solutions for the dairy industry, Dr. David Barbano, Director of the Northeast Dairy Foods Research Center, and Dr. Andrew Novakovic, Director of the Cornell Program on Dairy Markets and Policy, co-sponsored a conference entitled, "The Milkfat Issue: Production, Processing and Marketing," held March 5, 1990, at the Syracuse Marriott Hotel.

Before exploring the solutions to the problem, the first morning session examined the research behind the dietary recommendations, how consumers are responding to them, and the regulation of nutrition labeling. The speakers in the second morning session looked for solutions on the farm through breeding and management.

The afternoon session opened with a review of the possibilities for new products and new production techniques. Finally, a broad range of issues in marketing, pricing and policy were covered in the final session.

Nutrition Issues Affecting the Sales and Use of Milkfat

The importance of the milkfat issue in the dairy industry stems from consumers' growing concerns about the health implications of fat and cholesterol in the diet. The morning session covered human nutrition issues in the areas of nutrition research, consumer education, and labeling regulations as a way of assessing the climate in the marketplace and society. The dairy industry must understand this environment in order to effectively deal with the declining demand for milkfat. At the source of these consumer concerns are recommendations from the National Academy of Sciences (NAS) and the Surgeon General based on research about how dietary fat and cholesterol and blood cholesterol levels contribute to coronary heart disease.

The morning presentations revealed flaws in the interpretation of nutrition research in this area, inconsistencies in consumer reaction to these recommendations and a void in the area of labeling regulation. Despite these flaws and misunderstandings, there is a clear consensus that Americans need to change their diets to reduce health risks.

In his discussion, Dr. Craig Hassel, Assistant Professor and Extension Nutritionist at the University of Minnesota, and chair of the Nutrition subcommittee of the American Heart Association—Minnesota Affiliate, attempted to look beyond the recommendations of the NAS and the Surgeon General and examine the underlying research data.

Hassel framed his discussion with the first two of the following three components of the diet-lipid hypothesis, which states that: 1) blood cholesterol level is associated with coronary heart disease; 2) dietary factors can influence blood cholesterol levels

and 3) diet plays a role in the development of heart disease. He noted that coronary heart disease is multifactorial in nature and that scientists still don't know what causes the condition, or what actually occurs at the molecular level. "Because we don't understand the causes, the actual causes, what we're attempting to do is treat...population-based statistics, hoping that what's true for the population is true for most individuals." Scientists have identified risk factors that can be divided into two categories: fixed factors, those which cannot be changed; and modifiable, those factors which can be changed.

If the risk factors for coronary heart disease are calculated by statistical (regression) analysis they reveal that 35% of heart disease risk is attributable to fixed factors such as family history, age, sex, etc. The breakdown of modifiable risk factors is as follows:

smoking	22%
high blood pressure	20%
high blood cholesterol	18%
obesity and inactivity	5%

According to Hassel, some sources will cite a compelling or an overwhelming amount of evidence which links blood cholesterol and coronary heart disease. "Although many of us have come to view this as a solid research base, in fact, a good deal of this data is flawed."

Though he does agree that intervention to manage blood cholesterol levels will have some impact on reducing the chances for coronary heart disease, he says that recommendations from various organizations over-emphasize the importance of high blood cholesterol as a contributing factor to coronary heart disease.

High blood cholesterol levels, as shown above, account for 18% of the risk of developing coronary heart disease. Dietary cholesterol (see appendix), however, is cholesterol found in certain foods (foods produced from or by animals, like dairy products) that we ingest. Dietary cholesterol raises blood cholesterol levels in some individuals and thereby increases their risk of coronary heart disease, however in other individuals dietary cholesterol has little or no effect on blood cholesterol levels.

Hassel examined the three most important dietary factors that affect blood cholesterol levels (see appendix). Intake of saturated fatty acids is the most significant cholesterol-raising component of a diet, and obesity is the second most important factor. Obese people tend to overproduce cholesterol to an extent not accounted for by their extra body weight. Dietary cholesterol is the third most important factor in terms of effect on raising blood cholesterol levels. Hassel says that the importance of this factor is minimal compared to the first two.

Eleven studies done in the 1950s completely eliminated all or almost all dietary fat and cholesterol for 400 subjects and measured the effect of diet on blood cholesterol levels, which are measured in milligrams of cholesterol per deciliter of blood plasma (mg/dl). The average reduction for these studies was 60 mg/dl, or about 25%, for subjects whose beginning levels probably ranged from 240-250 mg/dl, according to Hassel. The current average blood cholesterol level is about 210 mg/dl— below 200 mg/dl is considered a desirable level. These studies could not be conducted today for ethical reasons related to the proper treatment of human subjects, but the 60 mg/dl represents a theoretical maximum achievable dietary reduction of blood cholesterol level. These results are consistent with the low blood cholesterol levels found in pure vegetarians.

Dietary cholesterol's effect on blood cholesterol has been measured in 68 studies. They show an average increase of 2.3 mg/dl for every 100 mg of dietary cholesterol consumed, however there is wide range of individual response. Using the high range of the data, the American Heart Association says that every 200 mg of dietary cholesterol will increase blood cholesterol levels 8-10 mg/dl. "If we look at what the American Heart Association says, they're pushing the limit of this data.... They're looking at 200 milligrams so that they can get this number as high as they possibly can and indicate that there is significance." The

AHA does acknowledge an indivdual variability of response. Hassel contended that dietary cholesterol plays only a minor role in increasing blood cholesterol levels.

Hassel summarized 40 studies that examined the effects of dietary fat. It has been found that dietary fat raised blood cholesterol levels 2.7 mg/dl per 1% of calories consumed as fat. The effects of the different fatty acids couldn't be concluded from the studies because the composition of fats in each was different. In general, however, they showed that saturated fatty acids raise blood cholesterol levels while polyunsaturated fatty acids lower blood cholesterol levels. He said that although monounsaturated fatty acids have little or no effect on blood cholesterol, they can have a lowering effect when substituted for saturated fatty acids. Butterfat is comprised of 66% saturated fat.

Hassel emphasized that there is a wide range of individual response, and that further, each fatty acid has different effects on blood cholesterol levels as determined from the research of Hegstead in 1965.

Hassel noted the importance of looking beyond whether fats are saturated, unsaturated or polyunsaturated. While it is true that most saturated fats raise blood cholesterol levels, different saturated fats have different effects on raising blood cholesterol levels. For this reason the fatty acid profile must be examined.

As shown below, a relative blood cholesterol index can be created for each fat if the known fatty acid composition is combined with the Hegstead index of the effect of each fatty acid on blood cholesterol. The numbers themselves have no relevance except for comparison among different fats and oils.

Calculated "Blood Cholesterol Index" of Various Food Fats and Oils

Fat or Oil	Score
Cholesterol Raising	
Nutmeg Butter	432
Coconut Oil	197
Palm Oil	143
Milkfat	123
Beef Tallow	91
Chicken Fat	34
Cholesterol Lowering	
Peanut Oil	-38
Corn Oil	-81
Soybean Oil	-82
Safflower Oil	-128

Hassel emphasized that the effect of a fat on blood cholesterol level and thus its implications for coronary heart disease risk is primarily the result of its fatty acid composition and not because it contains cholesterol (see appendix).

He concluded by reminding the audience that, "foods aren't good or bad, eating habits are," a comment echoed by other speakers.

Eating habits of Americans are changing due to these dietary recommendations, but not in consistent ways. Consumers' inconsistent behavior may result from their poor understanding of dietary issues involving fat and cholesterol.

Christina Stark, a nutrition specialist for Cornell Cooperative Extension in the Division of Nutritional Sciences at Cornell University, reviewed recent dietary recommendations for fat intake as the basis for her discussion of consumer response to the recommendations of "Nutrition and Your Health—Dietary Guidelines for Americans," from the USDA and the Department of Health and Human Services, and the previously mentioned reports from the NAS and the Surgeon General.

Stark observed that organizations that have recommended specific levels of dietary fat agree that fat should not comprise more than 30% of an individual's daily intake of calories and that saturated fats should not comprise more than 10% of the calories. Polyunsaturated fats, which historically have not been limited, should not make up more than 10% of the daily caloric intake either. Most recommendations also suggest that dietary cholesterol intake be limited to 300 mg per day.

Stark showed that consumers are responding to these recommendations by reducing consumption of certain higher fat foods. The decreased consumption of whole milk illustrates this trend—in 1987 lowfat milk sales surpassed whole milk sales for the first time. A decrease in red meat sales,

and increased sales of lowfat mayonnaise, nonfat yogurt and diet margarine reflect consumers' behavioral changes. However, Stark also pointed out consumer responses that conflict with the dietary recommendations. For example, cheese sales have doubled between 1972 and 1987, and sales of high-fat products like hot dogs, hamburgers and luncheon meats have also increased in recent years.

The replacement of certain high-fat products with other high-fat products was demonstrated in the Household Refuse Analysis Project, an ongoing project being conducted by the University of Arizona. One part of this study, completed between 1979 and 1985, analyzed household garbage to see what fat consumers were throwing away. It was suspected that some people understate their consumption of fat because of the stigma of a high-fat diet. It was found that from 1979 to 1982 the households in the study discarded 3-10% of separable fat from cuts of red meat, but in 1983, the percentage of discarded fat increased to 12-16%. In addition these households reduced fat intake by buying less red meat that contained separable fat— like chops, roasts, and steaks.

While cutting back on fat consumption from certain forms of red meat, the residents in the households either maintained or increased their purchases of red meats with hidden, nonseparable fat.

They bought more hamburger, luncheon meats, sausage and bacon. The two explanations for the purchase of these foods were that either the consumers desired the convenience of the substituted high-fat foods, or they lacked the knowledge that these products had comparable amounts of fat. The author of the study dubbed this phenomenon, "meat fat madness."

Stark has observed a similar situation of milkfat madness in the dairy industry today, and she attributes this behavior to either a lack of knowledge or motivation.

Consumers' lack of knowledge is evidenced by the many misconceptions about fat. One segment of a survey done by the USDA in 1988 measured consumer understanding of the dietary guidelines for fats. Overall, those interviewed have a poor understanding of the guidelines and in particular can't distinguish unsaturated fat from saturated fat, fat from cholesterol, or dietary cholesterol from blood cholesterol. The study found that the consumers also have difficulty translating dietary advice into food choices.

The study showed that the subjects didn't understand what fat does and what distinguishes saturated fats (see appendix). They assumed that saturated meant the fatty acids were saturated with more fat. Stark observed that, with these prevailing misconceptions, it is not surprising that people don't know how to decrease fat in the diet.

Most of the respondents believed that fat and cholesterol were the same thing. "Cholesterol is a difficult concept to define, you can see the fat on a piece of meat, but you can't see cholesterol. So how do you explain to consumers that they're different?" Stark questioned.

Stark cited similar findings from the 1988 FDA health and diet survey (see below). This telephone survey showed a low level of knowledge about fat and cholesterol, though knowledge about saturated fat was greater.

	Percent Responding Correctly
Cholesterol is not the same thing as fat.	41
Cholesterol is found in animal products like meat and dairy	33
Different fats have the same number of calories.	21
Saturated fats are more likely to raise blood cholesterol	56
Saturated fats are usually found in animal products like meat and dairy	62

Another component of the FDA phone survey polls people's opinions on what causes heart disease. Citing the 1983, 1986, and 1989 surveys, Stark said that fat and

cholesterol are the two most mentioned factors. A similar question is asked about risk factors for cancer, and the number who mention fat has increased from 12% to 25% between 1983 and 1988.

A review of the data from the Food Marketing Institute's annual *Trends* study showed that 96% of all shoppers rate nutrition as very or somewhat important, second only to taste (97%).

When asked to comment on the specific nutritional contents, cholesterol was rated as the item of highest concern in January 1989, followed by fat and then salt.

[Editors' note: Fat ranked first and cholesterol ranked second as consumers' top concerns in the 1990 Trends study, which was presented recently at FMI's annual convention.]

Stark has found that consumers' knowledge and attitudes about nutrition don't necessarily translate into eating habits, especially for young adults. A New York Times survey in November 1987 found that while the 18-29 age group endorsed nutrition, their eating habits didn't reflect this professed concern. This group was more likely to snack, choose sweets or salty snacks, eat red meat, and have french fries and drink soft drinks than older Americans.

After being quizzed about their eating habits, they were asked what they had eaten the day before. Those who said they watch their cholesterol intake at every meal also reported eating meals the previous day heavy in red meat and eggs. *The New York Times* study found little difference in the eating habits of those who said they had changed their eating habits and those who said they didn't. "People also appear to be very selective in which improvements they make; for example, they [might] decrease their intake of fat by eating a smaller amount of a nutrient-rich food such as meat, only to substitute [it] for a salad with five or six tablespoons of dressing.".

Stark is concerned that people may cut out whole food groups as a way of adhering to the dietary guidelines for fat. If people cut out dairy products in order to reduce fat intake, they may become deficient in the nutrients that dairy foods provide. Most American women don't receive the Recommended Dietary Allowance of 800-1200 mg of calcium per day, and eliminating dairy products from the diet would only add to that problem.

In her advice for the dairy industry, Stark said that the industry must continue to offer alternatives to consumers who continue to send mixed messages with their buying decisions. She calls this the "self-indulgence paradox"—health conscious individuals demand lowfat alternatives but want to reward themselves with high-fat products.

The industry has already provided a large variety of lowfat dairy products. Stark said she would like to see the industry continue to offer this variety, in addition to creating new products. Makers of lowfat and nonfat frozen desserts may have more possibilities in lieu of the FDA's approval of Simplesse™ and cellulose gel for use in certain lowfat or nonfat products.

According to Stark, the wide range of fat substitutes and nonfat, lowfat, reduced fat, "lite," or "light" versions of dairy products necessitate better standards of identity and labeling to help consumers make their decisions.

The final morning presentation focused on the current lack of nutrition labeling regulations and the likely direction of policy in that area. Sarah Taylor, an attorney with the Washington-based firm Covington & Burling, specializes in the area of food and drug law and is the author of "Health Claims for Foods: Present Law, Future Policy."

Taylor discussed how the recent dietary recommendations have spurred great interest in the area of food labeling. A report from the NAS concerning nutrition labeling is expected in the fall of 1990. In addition, FDA has undertaken a reevaluation of food labeling, and 84 bills pending in Congress deal with some aspect of food labeling. Consumers, public health officials, and the food industry seem to want more nutrition information to appear on the food label but disagree on specific proposals. "Consumers are interested in diet and health information. In addition, many public health experts see the food label as an important

point of purchase educational tool—a means by which to harness the private sector to the task of nutrition education. The food industry increasingly sees food labeling as a means to market the health benefits of their food products."

These new goals for food labeling divert from the original purpose of the descriptive food label which was to guard against consumer deception. The FDA does have standards of identity for some foods and regulations concerning the labeling of nutritionally inferior foods as imitation, but Taylor questioned whether consumers appreciate that the term imitation refers to the nutritional value of the product. FDA doesn't yet regulate the use of terms with nutritional implications like, "light" or "reduced fat."

Currently, products must carry the nutrient information only if the food is fortified or if a claim is made concerning the nutritional quality of the food. Therefore most labeling done today is voluntary.

Taylor also noted that regulations for health claims on food labels—claims that extend beyond the nutritional information to convey a health message—are also being debated. These messages had historically not appeared on food labels because any health claim would cause the product to be regulated as a drug. All drugs must be considered safe and effective for the intended purpose and must not have false and misleading claims. Any food with a health claim would usually fail this standard as the relationship between diet and health is so poorly understood.

Kellogg's broke this tradition in 1984 with their campaign for All-Bran which included a bold health claim of reducing the risk of cancer, backed by a recommendation from the National Cancer Institute. Many other food manufacturers followed Kellogg's lead by printing health claims, prompting the FDA to propose regulations to permit health claims in 1987.

This regulation has been criticized for being too permissive of misleading claims, and in February, 1990 the FDA withdrew the 1987 proposal and issued a more restrictive one. The new proposal is part of a larger reevaluation of nutrition labeling in general.

Taylor reported that in addition to the new proposal by FDA, several nutrition labeling bills were introduced into Congress, and hearings were held.

Some of the specific areas of interest to the dairy industry concern the descriptive and nutritional labeling requirements, and fat may be a likely item included on the food label. Taylor listed some new directions for regulation: definitions of terms like "low-fat", and "lite"; mandatory fat content labeling; widening of current definitions of food standards and imitation labeling to encourage greater development of lowfat foods; and requiring more foods to have mandatory nutrition labeling.

Taylor reviewed some of the current regulations along with the provisions of four bills that have been introduced into Congress that would expand nutrition labeling and make it mandatory for certain FDA regulated products.

Nutrition labeling is currently voluntary unless a product is fortified or enriched, or a nutrition claim is made—and then a variety of nutrients must be listed on the food label along with serving size, calories, protein, carbohydrate, and sodium. Fatty acids and cholesterol must be listed only if a claim concerns these constituents.

In addition to these requirements, the bills sponsored by Representative Waxman and Senator Metzenbaum would require all products to use "realistic" serving sizes and include a listing of total fat, saturated fat, unsaturated fat, and cholesterol. Bills from Senator Hatch and Representative Rangel would also require fat labeling on all products. Except for Rangel's bill, which deals exclusively with fat labeling, these bills would also ban all health claims on food labels except for those approved by the FDA.

"Because all three of...these bills give FDA substantial authority to define what is an acceptable health message, FDA's 1990 rule proposal takes on some special significance." The rule has proposed a new category of nutrition claims that would be permitted if they met the following criteria:

1. They are truthful and not misleading.
2. They describe the value of the dietary component as part of the total dietary

pattern, claim only to lower the risk of a particular chronic disease, and reflect the totality of scientific evidence.
3. They are consistent with generally recognized medical principles.
4. They are consistent with the conclusions made in a scientific summary and consumer health message summary accepted by the FDA.
5. The label must refer to the consumer health message summary which provides fuller information for the consumer.

The FDA will base acceptable health claims on the Surgeon General's report and that of the National Academy of Sciences. A public service committee will be appointed to create model health claims in six disease areas. Three of these areas will be of special importance to the dairy industry. They concern calcium and osteoporosis, lipids and heart disease, and lipids and cancer. The 1990 proposal will guide the FDA while the rule is pending.

Taylor said she expects that FDA's policy will require messages to be balanced. For example, a calcium claim made for a food that is high in both calcium and fat may be required to disclose the high fat content. Overall Taylor predicted, "the food industry [will have] greater opportunity to market the health benefits of their products, and likely give consumers more nutritional information on the food label."

Opportunities for Dealing with Milkfat at the Producer Level

In searching for solutions to the milkfat problem, the first place to look is at the source of the milkfat. The discussions on dairy cattle genetics and management explored the possibility of reducing or altering milkfat at the producer level. Dr. Robert Everett, Professor of Animal Science at Cornell University, explained that a cow's phenotype, or observed performance, results from a combination of her genetics and her environment. He explained the strong genetic correlation between milk production and fat production. This relationship prohibits the reduction of fat production without a loss of milk production through the breeding program.

A plausible way of reducing fat production or altering fat composition, without loss of milk production, through feeding and management was discussed by Dr. Dale Bauman, the Liberty Hyde Bailey Professor of Animal Science at Cornell. Bauman pointed out that the approval of such methods would require more research and that there will be little research in the area of milkfat depression—reduction of fat percentage—until there is economic incentive to reduce fat production.

Everett began the segment by reviewing how producers get paid. Using recent values at the time, he observed that they receive $1.13 for every pound of fat and $.094 for every pound of skim milk. Although there is much more skim milk than fat in farm milk, 38% of the price of milk has come from fat. Everett commented it is no wonder that the producer has maximized the pounds of fat produced. He observed that the only way to discourage the production of fat is to lower the price farmers receive for the fat component of milk.

The dairy manager selects for different traits to change the genetic merit of cows to suit the economic situation. Genetics has accounted for one-third of the increase of production per cow between 1960 and 1988 which has risen from 13,500 to 21,000 for two-year olds on a mature equivalent basis.

Fat production has risen at a similar rate during this period. Everett emphasized protein production also rose in a similar fashion, even though it wasn't being selected.

The reason for the similar increases in milk, fat, and protein production is the strong phenotypic correlation between the three traits. As dairy farmers change their management strategies, they observe a high positive relationship between these production traits.

Phenotypic Correlations

	Milk	Fat	Protein
Milk	1.00	.83	.76
Fat		1.00	.70
Protein			1.00

Everett pointed out that the phenotypic correlation represents the relationship between the observed traits, which are influenced by both genetics and environment. Looking at solely the genetic component, there is a similar high positive correlation between the three traits.

Genotypic Correlations

	Milk	Fat	Protein
Milk	1.00	.81	.87
Fat		1.00	.72
Protein			1.00

The effects of these high correlations are illustrated by the scenario where producers select solely to increase milk production, yet fat and protein production increase as well because of the genetic link between the traits.

He then described how the genetic response might be altered if a price structure existed that discriminated against the production of butterfat. Everett concluded that even when the producer was taxed for producing butterfat—in this scenario $.90 per pound—the genetic response of fat production would still cause an increase of 4.52 pounds per year. "Because the milk is worth so much to him, regardless of whether we charge him for the fat or not, the genes are causing an automatic response."

	Milk	Fat	Protein
Economic weights ($/lb.)	.1243	-.90	1.20
Genetic response (lbs./year)	198	4.52	4.54

Even with economic incentive to select against fat production, there would still be a positive response due to the underlying biology of the cow which causes a high correlation between milk and fat production. Everett explained that the limit of breeding programs is to slow down the rate of increase in fat production.

He finished by stating that feeding and management programs are the only way to limit fat production on the farm and that he believes the pricing structure is the cause of the milkfat problem because producers have received 38% of their income from the sale of fat.

Bauman then began to discuss how management could change milkfat production. He outlined his talk and discussed milkfat synthesis, changing the environment to change milkfat production, and changing milk fatty acid composition.

Bauman reviewed that milkfat is composed of triglycerides of short, medium and long chain fatty acids, the composition of which varies by species. The production of milk in a heavily lactating cow consumes 72% of the cow's total energy, and the cow's maintenance requires 28%. Half of the energy used to produce the milk is needed for making fat, so that making milkfat consumes 33% of the cow's energy intake. Reducing milkfat production could save energy and increase production efficiency.

Then Bauman looked at the two sources of fatty acids. De novo, or new, synthesis is the source of short and medium chain fatty acids, and uptake of preformed fatty acids from the blood is the source of all the long chain fatty acids. The fatty acids in the blood come from diet and body fat reserves.

Bauman then considered what could be done about milkfat percentage. He noted that with modern management practices striving to increase fat test, milkfat depression is not difficult to achieve and that research has long attempted to overcome the tendency toward milkfat depression. Bauman himself performed trials where a cow's milkfat percentage was doubled or cut in half through diet alone. In cases of milkfat depression, the ratio of acetate-producing bacteria to propionate-producing bacteria in the rumen is one to one—where it is normally three to one. A greater percentage of propionate-producing bacteria in the rumen is associated with milkfat depression. Bauman concluded that anything that

causes rumen fermentation to shift to high-propionate producing bacteria will cause milkfat depression.

He listed three factors which could cause this shift: high grain diets, like those commonly fed today; finer chopped roughages; and ionophores. Ionophores selectively inhibit the bacteria that produce acetate making those that produce propionate more competitive in the rumen.

Ionophores are not approved for use in lactating dairy cows. Bauman said he suspects that ionophores would be safe in lactating dairy cows, as they are currently used in young dairy animals. "You're certainly not going to expect differences between a growing animal and a lactating animal for this particular compound, it's just [that] it was never dealt with in dairy cows because there was no economic incentive to decrease the amount of milkfat."

Bauman then examined the issue of maintaining milkfat depression over a lactation without causing problems with the cow. He emphasized that no studies have been done that have maintained milkfat depression throughout the lactation. The potential danger lies in that high grain diets and finely chopped roughages without the buffering effect of bicarbonates would lower the pH in the cow's rumen; increased acidity is what favors the propionate-producing bacteria which are linked to milkfat depression. Maintaining this condition over a whole lactation could cause digestive disturbances and ulcers in the cow. A modest decrease in fat production could be maintained safely with careful management, according to Bauman.

Ionophores are a second way to favor the propionate bacteria in the rumen and maintain milkfat depression without lowering the pH in the rumen. "The reason why ionophores are approved for growing animals, and in fact economically valuable to use, is [that] when you shift the rumen fermentation to a higher propionate production, . . . you get a pattern of nutrients that can be used more efficiently by the animal."

Using ionophores in lactating animals would have the dual benefit of lowering the amount of energy used for fat in addition to creating a more energy efficient pattern of nutrients coming from the rumen.

Learning the biological mechanism of milkfat depression is another possible way to maintain it. Again, no research has been done in this area, but Bauman stated that if the biochemical pathways are uncovered, fat could be uncoupled from the other milk components.

Another approach to the milkfat problem is to find ways of altering milk fatty acid composition. In all other species, fatty acid composition in the body can be altered through the fatty acid composition of the dietary fat. Bauman explained this is not the case in ruminant animals like dairy cattle, because the bacteria in the rumen change the composition of the dietary fat. Bacteria in the rumen change unsaturated fatty acids to saturated fatty acids.

Bauman mentioned that a mechanism to protect fat so that it could bypass the rumen was developed some fifteen years ago, but there was little interest in it at the time. These studies focused on increasing the polyunsaturated fat content of milk. Although this was proven to be possible, milk high in polyunsaturates proved to be highly susceptible to rancidity problems. With this mechanism it would be possible to the amount of unsaturated fatty acids by feeding the protected fat. He observed that changing the fatty acid composition of the milk could change many of the manufacturing characteristics.

He concluded by emphasizing that with the proper economic incentive in the marketplace, milkfat percentage and fatty acid composition can be altered, not through genetics, but through feeding and management strategies.

Opportunities for Dealing with Milkfat through Dairy Product Formulation and Processing

The first afternoon session addressed the milkfat issue from the stance that, given the amount of butterfat in the milk supply, what are the options for the industry in

formulating new products and finding new processing methods for existing products.

Dr. David Hettinga, Vice President for Research, Technology and Engineering, and Agricultural Research and Technology of Land O'Lakes, covered the marketing and formulation of lowfat products, removal of cholesterol from dairy products, and non-food uses for fat.

Dr. David Barbano, an associate professor in Cornell University's Department of Food Science completed this topic by covering processing uses of fat substitutes and the alteration of milkfat composition.

Hettinga reviewed the decreases in consumption of high-fat products like butter and whole milk. He emphasized consumers' concern for fat and calories in addition to their desire for convenience. He noted the increase in "light" products introduced in 1989 and the gaining share of lowfat dairy products.

Hettinga discussed the market for butter and its substitutes. The current standards require at least 80% milkfat for a product to be classified as butter, and over 80% non-dairy fat for a product to be considered margarine. Any product that falls below these levels are termed spreads. He noted a great increase in the number of spreads with a wide range of fat content percentages and many spreads that do contain some percentage of milkfat.

Butter consumption has declined despite the efforts of the National Dairy Board and others to promote butter. In explaining this trend Hettinga cited a 1984 survey from the International Dairy Federation which found that the top three reasons why spreads have displaced butter are price, health and spreadability.

The dairy industry and state governments have protested the marketing of spreads that have butter in the name in order to protect butter's identity standard. According to Hettinga, the FDA has been reluctant to rule on this issue because the standards for butter were originally set in an act of Congress and would therefore be outside of FDA's jurisdiction. He said that the FDA wants the Butter Act to be repealed so that it can issue its own standard of identity, but many industry leaders don't feel that the FDA is best suited to handle this issue. The industry, through the American Butter Institute, has proposed the creation of a light butter standard with a minimum level of 52% butterfat that allows for the inclusion of other ingredients in the product.

Hettinga explained that 52% has been the proposed minimum because at that level the calories are reduced by one-third and the product still has comparable performance to butter.

The introduction of light versions of sour cream and cheese have also increased. Hettinga predicted that the number of reduced fat cheeses will increase in the next decade. He said that as technology develops, reduced fat cheeses will improve in texture and flavor, and gain in consumer acceptance.

Continuing with new product trends, Hettinga discussed the increase in lowfat versions of yogurt, cottage cheese and ice cream. He mentioned that reduced fat, ice cream substitutes have led to the development of the ice milk standard of identity to inform the consumer that lowfat products are available. A conflict has developed over a nonfat product labeled as ice cream which has been banned in New York and Maine because of failure to meet identity standards. Light ice cream standards are being considered, according to Hettinga.

Hettinga suggested the dairy industry change how it prices lowfat products. "I think we made a mistake when we took the price of no-fat or lowfat milk down when we took the fat out. We should have raised the price." He also commented that brand names of fluid milk should be featured on the label instead of the generic product name milk. He illustrated this point with retail gasoline sales where brands like Amoco and Mobil are highlighted instead of the product name, gasoline.

In introducing the cholesterol issue, Hettinga agreed with the conclusions drawn in the morning presentation that the importance of cholesterol in the diet has been overstated. However, he says that because the dairy products have been singled out

and lost market share for containing cholesterol, the removal of cholesterol could provide a market opportunity. Removing it would allow dairy products to make reduced cholesterol or cholesterol free claims that take advantage of the concerns about cholesterol in the diet. Vegetable oils have used these claims even though they never contained cholesterol.

Before Hettinga described six processes of cholesterol removal he pointed out the removal would be more viable for some products, noting that it is very important to the flavor of butter, but is less critical to the composition of cheese or ice cream.

The first of these methods is supercritical fluid extraction, which in Hettinga's opinion is not effective because of the high costs. Short path distillation is another method that has been performed on a pilot scale, but proved inefficient when the process was scaled up.

Steam distillation is the best option in Hettinga's opinion because of its relatively low operating and equipment installation costs, and because it is a well understood process that has been used to deodorize vegetable oils. Some organizations have had promising initial results.

The adsorption process requires the addition of another ingredient which must later be separated from the butterfat. High levels of regular butterfat will also be carried away with the cholesterol. All solvent extraction methods have a risk of product contamination from the solvent.

Finally, he briefly described an enzymatic process which would use bacterial enzymes to remove cholesterol from butterfat, but this process is at the early stages of development.

Dr. Hettinga concluded with a discussion of non-food uses for milkfat. He observed that the fundamental barrier for nonfood uses is that fat is still too highly priced. Hettinga reported that the consensus of the economists of the National Milk Producers Federation is that the CCC butter price will fall within a range of $0.76 and $0. 87 per pound in 1992 or 1993 and at that time there may be some relief from the surplus because U.S butter will be competitive on the world market.

Barbano began by citing the Bridge Report: "There will always be a need or major market for traditional dairy products and the growing health conscious market...should be viewed as an opportunity for market expansion."

The second point made in the report is that the movement away from high-fat products is more than a fad, but a long-term trend that requires commitment on the part of the dairy industry. Barbano said he believes that the industry has already responded to this trend by making available a wide variety of lowfat products.

Barbano stressed that "the dairy industry has an obligation and needs to help consumers take a sensible look at their total diet, and I think the emphasis on total diet is very important, and the role of dairy products in providng fat and other nutrients." Most dietary recommendations state that fat intake should represent no more than 30% of total calories and be composed of an equal balance of saturated, monounsaturated and polyunsaturated fats. He suggested one way of translating these recommendations is to look at the number of grams of fat that would account for thirty percent of daily calories. Then the consumer could see what their daily allotment for fat was, and give them a total diet perspective when they choose individual foods.

To put the milkfat problem in perspective, Barbano pointed out that the majority of milkfat is consumed in fluid milk and cheese, and these are the products with the biggest amount of milkfat sales to be lost.

In turning to the processing possibilities Barbano said he believes that in addition to reduced and nonfat versions of traditional dairy foods, new uses of milkfat must be explored.

One way of exploring the different uses of fat is to break the fat down into its fatty acid components, which can be sorted by their characteristics through fat fractionation. There are three primary methods to fractionate fat: dry crystallization, solvent crystallization and supercritical extraction. These processes sort the fatty acids into groups of fatty acids that are better suited to specific uses than milkfat as a whole. Some fractions of fat are of specific interest to

confectioners, but researchers are still challenged to find other uses for the unwanted saturated fat fractions.

The impact of fat substitutes must also be explored by the dairy industry. Barbano explained that fat substitutes add the "smooth and creamy mouth-feel" of fat to a product, and are usually composed of protein or carbohydrates. He reported that Simplesse, made from egg or whey protein has been Generally Recognized as Safe (GRAS) by the FDA. It will soon be released by Nutrasweet in a frozen dessert called Simple Pleasures. With the great number of lowfat products on the market, Barbano said he is unsure of the potential impact of fat substitutes, but added that it will depend on the quality of the products made with fat substitutes.

Another area of opportunity in processing that Barbano examined is the alteration of milkfat composition. This task could be accomplished by altering the milkfat as it comes from the cow through management or by blending milkfat with other fats—although it would then no longer be milkfat. Separating the fatty acids through milkfat fractionation is a third alternative.

Barbano mentioned that there is a wide range of possibilities available to change the composition of milkfat, but the economics of doing so must be investigated. Barbano said that the question of the functionality of the fat once it is altered must be considered.

A new composition of milkfat could be formulated if found to be cost effective. Barbano observed that the amount of total milkfat in fluid sales, the largest usage of milkfat, has been rapidly declining. He posed the question of whether milkfat could be made more desirable through reformulation in order to slow this trend.

If altering the fat is feasible, Barbano questioned what would be the desirable target blend of saturated, monounsaturated, and polyunsaturated fats that could be achieved. In trials where the amount of polyunsaturated fats has been increased, the milk's performance has decreased tremendously. Off-flavors from oxidation, and changes in the melting point that alter the characteristics of manufactured products have resulted from raising the level of polyunsaturated fats in milk.

Barbano pointed out that the level of monounsaturated fats has never been altered. He suspected that there would be less of a change in the melting point, flavor and texture of the milk.

Feeding protected lipids could increase the level of unsaturated fats 60% without too much difficulty. Barbano said he thinks that this change wouldn't greatly alter the flavor of milk because the largest change would come from the amount of oleic acid, a monounsaturate, which is a very stable component of milkfat.

Barbano concluded by emphasizing the need for continued development of new lowfat and nonfat alternatives. He warned that "The lowfat dairy products need to be of high quality. I think that's one thing we could get ourselves into problems with in the rush to get products out there. I think we have the obligation to maintain a quality image of dairy products and to truly deliver high-quality, good-flavored, lowfat products."

He said he hopes to see the alteration of milkfat to enhance its nutritional value if economically feasible and investigation of the nonfood uses of milkfat and its fractions in order to effectively prepare for the impact of the continuing trend away from fat consumption.

Opportunities for Dealing with Milkfat through Marketing, Pricing, and Government Policy

In the final session, four industry executives and a university economist took a proactive viewpoint of how industry and government might change the ways they are currently dealing with the milkfat issue.

In discussing what direction to take in marketing dairy products, the industry speakers agreed in calling for continued development of new products and lowfat and nonfat alternatives to existing foods. Different views were offered by the industry and university economists about the feasibility of dealing with the milkfat issue at the supply level through policy measures.

George Muck, Vice President for Research and Development for Dean Foods predicted that consumers will continue to reduce their consumption of fat over the long-term, but that the decline will level off when the average percentage of calories from fat is 30%. "If you get too much below thirty, the body's going to reject that and going to react to that...you're going to, for lack of other terms, 'crave' fat-type products."

He emphasized that the demand for more lower fat products has made processing more complicated. He gave the example of a fluid milk plant that produces several types of lowfat products, requiring the use of more tanks and causing a loss of efficiency from complex scheduling, need for more storage tanks, and more frequent flush outs. If lowfat cheeses become more popular, Muck pointed out that many cheese plants could require the additional capital costs of adding separators. Getting by without a separator by adding purchased skim milk would also add to production costs.

Muck projected a continued drop in the butter price that will continue to hurt plants that sell excess cream and urged the development for new uses of excess cream.

He said he hopes to see continued development of lowfat alternatives, but insists that the quality of the product must be retained even though the fat is being taken out. Lowfat products that achieve this level of quality will have a good market potential, in his opinion.

Muck tied the development of new products to the issue of problems with standards of identities. Creative alternative products are needed, but they should fit within better defined identities for products.

He questioned whether consumers are demanding reduced cholesterol, or reduced fat products, and said he wonders if they understand the difference between the two concepts. He said he believes that improved standards in nutrition labeling could help clear confusion in this area.

He concluded by stressing that manufacturers consider how the continued trend toward lowfat products will fit into their processing scheme.

Thomas Perry, President of Perry's Ice Cream, continued the marketing segment by giving a regional ice cream manufacturer's perspective on the milkfat issue.

Perry noted the declining sales of ice cream nationwide—a 12% decline in sales the third quarter of 1989, and a 20% decline in the Northeast. Sales of lowfat ice cream compensated for a small portion of the decline.

He reviewed the current standards and urged the improvement of standards of identity for ice cream "to keep [manufacturers] on a level playing field and be able to develop products that do have a standard between different manufacturers."

Product	Standard fat content
Ice cream	10%
Ice milk	2-7%
Nonfat frozen dessert	none

He reported that the International Ice Cream Association (IICA) has proposed new standards of identity to the FDA.

Product	Proposed fat content
Ice cream	10%
Reduced fat or "light"	2-7%
Lowfat	.5-2%
Nonfat	less than .5%

One problem with this proposal is that FDA wants "light" to mean one-half of the fat and one-third of the calories, which wouldn't match with the IICA's proposed range for "light".

Identity hasn't been as much of a problem with yogurt, a newer product in the industry. To be successful, frozen yogurt

should taste like ice cream, according to Perry. He said he is proud of his company's yogurt product, but also pointed out that introducing live cultures into their plant for the first time provided for some interesting quality control experiences. Standards of identity for frozen yogurt have also been proposed.

Yogurt Product	Proposed fat content
Regular	3.5%
Lowfat	2%
No fat	less than .5%
.3% acidity for all three	

The technology is available to make better quality products at a lower fat content. These other products are gaining back a percentage of the lost market by the full fat products, but people expect them to taste like the full fat products.

Putting the milkfat issue in perspective in his closing remarks, Perry called for the industry to, "Build on the positive aspects of milk and milk products.... Milk products are still a very, very good food, as we all know. We just have to find ways of getting milk and milk products to the consumer."

Dealing with the milkfat issue by replacing the fat in dairy foods was the subject of a presentation by Matthew Benner, a Senior Manager for Corporate Development with Kraft General Foods. He discussed KGF's Fat Replacement Project in which KGF has introduced eight fat-free products into the market as line extensions, not as substitutes.

He said that food manufacturers who want to use fat replacements are caught between the consumers who demand these products, the regulatory community, farmers and health officials.

Consumers are demanding fat-free products because of health concerns, but problems have arisen with regulatory bodies, mainly with KGF's fat-free ice cream. Some states have not allowed it to be sold as ice cream because it doesn't meet the standards of identity. Though changes in the standards are being proposed, three states are waiting until those standards are changed.

Benner observed a split among dairy farmers in their opinion of lowfat and fat free products. Some want to see these products developed to regain market share while others oppose them for fear they will reduce milk product purchases.

Health and nutrition specialists applaud the introduction of these products provided "that the methods for replacing the fat are safe and that the fat-free products are not seen by the consumer as a license to overindulge."

In response to consumers, KGF is using different fat replacement methods to achieve products with quality and taste that they will accept. "There's no single magic silver bullet that can be used across all of our categories. There's no single way to replace all the fat in these categories, whether it be dairy or non-dairy."

The science of fat replacement must be understood and accepted by the consumers, because some food technologies like saccharin and cyclamates have been viewed with skepticism in the past.

Focusing in on the regulatory scheme for ice cream, Benner said that KGF supports the IICA's proposed standards because they will provide a uniform standard and parallel the standards for reduced fat and fat-free products in categories like cottage cheese, yogurt and milk . "Above all, the industry needs uniformity, not a fragmented approach. It's not in our best interest to confuse consumers, and we need the efficiency that a uniform approach can bring."

Benner said he would like to see swifter response on the part of the regulatory system in changing the standards of identity to accommodate fat-free alternatives. He recognized that they cannot move so fast as to violate the public trust, but said they have the responsibility to "move fast enough so as not to destroy the private sector initiative and give the advantage to those companies that wait."

Benner said he foresees an increase in dairy purchases because of the development of these products. With these products, the right nomenclature is needed "to clearly distinguish dairy-based fat-free products from lower cost non-dairy imitations." He concluded by urging the dairy industry to support reduced fat and fat-free products so that dairy doesn't lose its market share to cheaper non-dairy substitutes.

Paul Christ, Vice President for Dairy Planning and Analysis with Land O'Lakes, examined solutions to the milkfat issue by comparing supply side solutions with demand side solutions.

"On the demand side we're going to offer more and more and better and better lowfat products which means the excess butterfat problem is going to get bigger and bigger, so we [must] find ways to address the problem," In discussing the supply side, he cited a University of Minnesota study that had comparable findings to the study discussed by Dr. Bauman where milkfat percentage was reduced by changing the ratio of concentrates to forages in the diet.

Concentrate to Alfalfa Ratio

Item	40/60	50/50	60/40
Milk, lb./day	61.8	63.4	66.4
Milk Composition			
Fat %	3.52	3.46	3.25
Protein%	3.19	3.25	3.23
Yield, lb./day			
Fat Yield	2.18	2.19	2.16
Protein Yield	1.97	2.06	2.15

Although the milkfat percentage was reduced, the percentage of protein remained about the same and the pounds of milk increased. Christ pointed out that total yield of butterfat declined slightly and total yield of protein increased slightly.

He analyzed this scenario from an economic perspective by comparing the variable costs of different feeding programs and the variable returns based on different butterfat differentials ranging from $.00 to $.15.

Value of Milk ($/day)

Butterfat Differential	Concentrate to Alfalfa Ratio 40/60	50/50	60/40
@ $ .15	$8.05	$8.20	$8.38
@ .10	8.05	8.22	8.47
@ .05	8.04	8.23	**8.55**
@ .00	8.03	8.24	**8.63**
Feed Cost ($/day)	$2.70	$2.94	$3.18

Where the proportion of concentrates was increased—the 50/50 and 60/40 diets—Christ showed that there were only two cases (highlighted in bold) where the increased income from milk compensated for the increased cost of the feed. Because the current butterfat differential exceeds $.10, Christ concluded that it is not economically feasible for producers to change the ratio of concentrates to alfalfa as a way to lower the butterfat percentage in milk.

Christ next delved into the area of genetics to examine if the milkfat situation could be improved through breeding programs. He summarized a 1971 study done by a group of Northeast and Southeast Agricultural Experiment Stations that investigated the response of a wide range of production traits, when one trait was selected for. The results are the expected response that will be seen in one generation.

Christ illustrated the potential for dealing with milkfat through breeding by demonstrating four breeding strategies that might be used, and the economic consequences of each, with the butterfat differential as a variable.

The only breeding strategy where the producer receives more money for the milk than the starting point at every butterfat differential is when milk yield is the trait selected for.

Like Dr. Everett, Christ concluded that producers will always maximize milk yield. Even if the butterfat differential is zero, selecting for milk yield will make them the most money, unless they are fined or taxed for their butterfat, which is unlikely to happen in Christ's opinion.

Direct and Correlated Response from Single Trait Selection

Selection Trait	Yields: Milk	Yields: Fat	Yields: Protein	Percentages: Fat	Percentages: Protein	Protein/Fat Ratio
Yields						
Milk	607	23.3	13.7	-.036	-.018	.001
Fat	443	34.7	14.1	.058	.010	-.011
Protein	428	23.2	14.3	.014	.014	.001
Percentages						
Fat	-287	24.1	3.4	.190	.051	-.025
Protein	-231	7.2	5.9	.084	.075	.002
Ratio						
Protein/Fat	37	-20.3	1.6	-.113	.006	.025

[For example, if a manager selects solely for milk yield, the expected response in the next generation is an increase of 607 lbs. of milk, an increase of 23.3 lbs. of fat yield, etc.]

falls far enough, it may become a substitute for other products like margarine. In his opinion lowering prices is the only policy that will reduce the milkfat surplus.

A policy perspective was also delivered in the final presentation by Dr. Andrew Novakovic, the E.V. Baker Associate Professor of Dairy Marketing and Policy in Cornell University's Department of Agricultural Economics. In contrast to Christ's view, Novakovic began by contending that some progress toward solving the milkfat issue can be made at the farm level.

Returning to the demand side, Christ predicted that the fat surplus will end when the U.S. butter price falls low enough so that it can compete on the world market. He also noted that world butter stocks are much lower than they have been recently.

Turning to the export statistics, Christ observed that the USSR now imports over half of the total butter exports by the major dairy producing countries. This represents the most important export market for the U.S., though increased production in Eastern Europe could satisfy that demand. Christ emphasized that if the price of butter falls low enough, it may become a substitute for other products like margarine. In his opinion lowering prices is the only policy that will reduce the milkfat surplus.

World Butter Stocks
(1,000 metric tons)

	EC-12	Other countries (including U.S.)
1985	1,282	452
1986	1,583	495
1987	1,172	353
1988	545	361
1989	428	390
1990 forecast	391	312

Strategy #1: Decrease fat yield
#2: Decrease fat percentage
#3: Increase protein/fat ratio
#4: Increase milk yield

Expected Production and Total Value of Milk after one Generation with each Breeding Strategy

	Start	#1	#2	#3	#4
Milk Yield	15,594	15,151	15,881	15,631	**16,201**
Butterfat Yield	583.0	548.3	558.9	562.7	**606.3**
Protein Yield	499.0	484.9	495.6	500.6	**512.7**
Butterfat %	3.70	3.64	3.51	3.59	**3.66**
Protein %	3.11	3.10	3.06	3.12	**3.09**
Protein/Fat Ratio	0.84	0.85	0.87	0.87	**0.84**
Total Value of milk at alternative butterfat differentials					
@ $.15 diff.	$2,074.00	$2,001.90	$2,066.91	$2,052.43	**$2,145.98**
@ .10 diff.	2,058.41	1,991.14	2,066.12	2,045.62	**2,132.69**
@ .05 diff.	2,042.81	1,980.39	2,065.32	2,038.83	**2,119.41**
@ .00 diff.	2,027.22	1,969.63	2,064.53	2,032.03	**2,106.13**

Addressing the idea of changing the butter price, he emphasized the importance of how the butter price changes relative to the price of nonfat dry milk (NDM)—the skim milk component—because butter and NDM are joint products. There are two ways of looking at changing the butter price, "Are we talking about leaving milk values relatively con-

stant and just changing whether we put more or less of that value on butterfat versus the skim milk part, or are we talking about lowering the price of milk and butter."

A key part of this discussion is recognizing that the NDM or skim component of milk can "carry" a certain part of the value that the fat component can't carry anymore. Novakovic pointed out a strengthening of the market for NDM which illustrates the value of the nonfat components of milk.

In looking at how much value NDM can carry, Novakovic used a table to show what the price of NDM had to be, relative to changes in butter price, at a given milk price.

He pointed out that when the price of butter is lowered, the gap between the value of higher fat and lower fat milk narrows. Reducing the economic incentive to produce high-fat milk could help move the industry toward less fat production, but there is a limit to how much value nonfat dry milk can carry. He suggested that nonfat dry milk represents the lowest value use of skim milk and that the value of those same components in other products like cheese can be much higher.

Another component of the milkfat problem is the mechanism for changing the support price. "Since 1985 we've been changing the support price according to a formula that says, 'lets make an estimate of how much dairy products the federal government is going to purchase [and] let's express that on a milk equivalent basis.' [I]f that number looks too big then let's cut the support price." The milk equivalent calculates how much milk was needed to make the product in storage based on the amount of fat in each product. He observed that many people in the dairy industry want to change this traditional accounting method because butter has been the main product purchased for the last two years, inflating the milk equivalent. Purchases in 1989 were 9.1 billion pounds on a milkfat basis, but would have been 0.4 billion if calculated on a skim-solids basis.

There's a wide range of support for establishing a different system of milk accounting to more accurately determine the amount of government removals. He reported that the National Milk Producer's Federation, the Milk Industry Foundation and the International Ice Cream Association agree that the removals should be calculated using both butterfat and solids not fat.

In looking at supply side solutions, Novakovic argued that continuing to reduce the butterfat differential will help the milkfat situation, but that doing so implies lowering the price of butter.

Novakovic said he considers multiple component pricing as a policy tool for reducing the milkfat surplus, but not a solution in itself. California uses this system, but it assigns fat the same value as is used nationally and, therefore does nothing to reduce the incentive to produce milkfat. He argued that the pricing system is less important than the value assigned to milkfat under the system. However Novakovic added that multiple component pricing does have the added benefit of explicitly expressing the value of skim solids, drawing the attention of the producer and processor to what the price of each component is. Today, component pricing allows price to express as a "carrot" the value of skim sol-

Implications of Changing Butter Prices

Butter Price	1.10	0.90	0.70	0.90
M-W Milk Price @				
4.5%	12.27	12.04	11.80	11.04
3.7%	11.25	11.21	11.16	10.21
3.5%	*11.00*	*11.00*	*11.00*	*10.00*
3.0%	10.38	10.52	10.60	9.52
0.0%	6.57	7.38	8.19	6.38
Implied Value of NDM* ($/lb.)	0.95	1.05	1.16	0.90

* This a wholesale value based assumed milk prices, standard product yields, and a joint processing cost for butter and nonfat dry milk equal to $1.40 per cwt. of milk.

ids in addition to the "stick" of lower milkfat values.

Looking at the national supply and demand numbers, Novakovic unveiled some rough estimates that might depict the situation now.

Novakovic suggested that the magnitude of adjustments needed to alleviate the milkfat surplus are low enough that the industry should not give up on the possibility of reductions in milkfat test in farm milk, given the information in Bauman's talk about the potential for lowering fat test. A reduction in the fat content of farm milk from 3.7% to 3.3% would more than eliminate the record amounts of surplus butter produced in 1989. A reduction of 0.4% is not a trivial amount, but it is not so large as to require the industry to abandon farm level changes as part of a practical solution.

How Big is the Milkfat Surplus?
(billion pounds)

	M.E.	Milkfat
Farm Marketings	145	5.3
Net Removals	10	0.5
Commercial Disappearance	138	4.6

Assume farm milk is 3.7%
Butter surplus is eliminated if fat test = 3.3%

A final policy proposal discussed by Novakovic is one from the NMPF where a surplus of one component of milk (milkfat) would trigger a quota system to set in where each farmer would have to produce within a milkfat quota and be assessed for milkfat produced over that amount. Legislators will decide whether or not to use such a system. Novakovic noted that, like multiple component pricing, whether or not such a system would work to reduce the fat content of the nation's milk supply depends on how strictly the system is designed.

Moving from supply to the demand side, Novakovic considered selling on the world market as a potential way of reducing the surplus of fat. Novakovic agreed with Christ that large volumes of butter could be moved in world markets but emphasized that to do so the U.S. price would have to drop much further, by about one third. He observed that increased exports of butter may be the most practical way to reduce the milkfat surplus, but at the levels of butter prices that implies it seems quite possible that a production response could occur as well.

He finished with his opinion on the impact of products like light butter on total milkfat use. "The implication would be that you're going to be selling less milkfat as that product is introduced, but . . . some of these new products that scavenge from the main product initially [may] make a positive contribution as the conversion to lower fat diets proceeds over the next five to ten years." If the long run alternative is no dairy fat, then lowfat options could mean better dairy sales.

Appendix

A Primer on Fats, Fatty Acids and Cholesterol

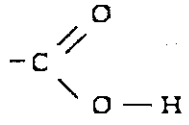
Fats are a major nutritive component of both animal and plant derived foods. If the fat is solid at room temperature, it is probably referred to as "fat." The name "oil" is usually used for fats that are liquid at room temperature. In either case, fats and oils have the same caloric content and are made from the same basic parts. The building blocks of fats, which give each fat its own unique character, are called fatty acids. Cholesterol is not fat, nor is it a fatty acid. Cholesterol can exist freely or independent of fat, as in egg yolks; however it is usually combined with fats in animal tissue.

This appendix offers a brief description of some of the terminology used to describe fats, the major categories of fatty acids, the fatty acid profile of milkfat, and the differences between fat and cholesterol.

What are Fats and Fatty Acids?

As stated above, fatty acids are the building blocks of fats. Thus, we can speak of milk fat, beef tallow, palm oil, or corn oil as types of fats, each having their own specific characteristics. Though there are many different fatty acids, usually 5 - 10 fatty acids make up the bulk of each fat. To understand the properties of different fats, it is helpful to know some of the chemistry of fatty acids.

Fatty acids are composed of hydrogen atoms attached to a chain of carbon atoms, at one end of which is the distinctive carboxyl group, making it an organic acid:



The fatty acids which make up natural fats have 4 to 24 carbons and, with minor exceptions, have an even number of carbons.

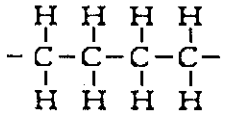
The particular structure of the fatty acid chain affects its physical characteristics and its performance as a food or food ingredient. Therefore, it is the relative amounts of each fatty acid in a particular fat that influence the physical and dietary properties of a fat.

Saturated and Unsaturated Fatty Acids

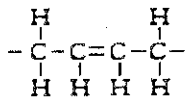
Although references are often made to saturated or unsaturated fats, in fact, it is fatty acids that are classified this way. Moreover, consumer surveys indicate that there is a lot of confusion about what these terms connote. One conclusion that seems to be drawn is that saturated fats are somehow "fatter" as well as "more fattening" than unsaturated fats. The actual story, in a nutshell, is as follows.

Fatty acids may be classified in one of three groups: "saturated," "monounsaturated," and "polyunsaturated"—all fats are made up of a combination of these three fatty acids types.

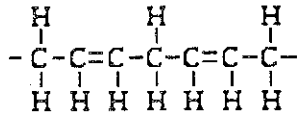
What these terms refer to is the number of hydrogen atoms relative to carbon atoms in the fatty acid molecular chain. Differences in the relative amounts of hydrogen result from the physical nature of the bonding between the carbon atoms. In a saturated fat, all the carbons are linked by single bonds and each carbon atom carries as many hydrogen atoms as possible. It is said to be *saturated* with hydrogen.



In a monounsaturated fatty acid, the carbon chain has one double bond in it, and two less hydrogen atoms as a result.



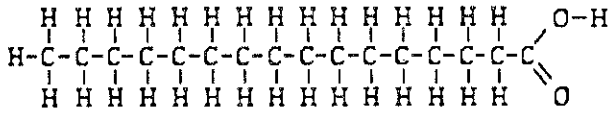
Two or more double bonds in the carbon chain and a corresponding reduction in hydrogen atoms are the characteristics of polyunsaturated fatty acids.



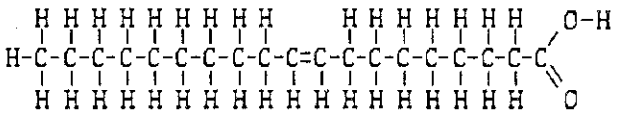
Fatty acids are identified by a name and can also be described numerically by indicating the number of carbon atoms in the fatty acid molecule and the number of double bonds within the carbon chain. For example palmitic acid is a 16 carbon saturated fatty acid; it can also be described as 16:0, indicating there are 16 carbon atoms with no double bonds between them. Oleic acid is an 18 carbon monounsaturated fatty acid. It is designated as 18:1, indicating its composition of 18 carbon atoms with one double bond in the chain.

Saturated fatty acids are found in highest proportions in fats of animal origin, such as dairy products, red meat and poultry. This does not mean that all milkfat and animal fat is made of only saturated fatty acids. Similarly, it does not mean that plant fats do not contain saturated fatty acids. Certain plant fats, often referred to as tropical oils, contain a higher proportion of saturated fatty acids than milk or animal fats. These would include palm kernel and coconut oils. The saturated fatty acid, lauric acid (12:0), is the major component of coconut oil.

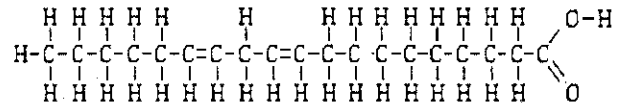
The molecular structure of palmitic acid (16:0), the most common saturated fatty acid found in animal tissues, including human adipose tissue, is illustrated as follows.



The molecular structure of oleic acid (18:1), a monounsaturated fatty acid found in relatively large amounts in milk, is illustrated below. Oleic acid is the major component of olive, peanut, and canola oils; it is also the second major component of corn, soybean, and safflower oils.



Linoleic acid (18:2) is a polyunsaturated fatty acid that is present in small amounts in milk. Linoleic acid is the major fatty acid in corn, soybean and safflower oil. Its chemical structure is illustrated below.



This chemical structure affects the physical characteristics of the fatty acid. Saturated fatty acids tend to be solid at room temperature, in fact some saturated fatty acids have the consistency of candle wax. Polyunsaturated fatty acids tend to be liquid at room temperature. In some food uses, it may be more desirable to have a solid or semi-solid ingredient, in others a liquid consistency may be preferable. Along with the obvious differences in physical structure, the more solid fats tend to be more stable and less subject to oxidation which can cause rancidity.

Physical conformation is the reason highly polyunsaturated fats that are favored for cooking come in the form of oils , e.g. corn oil or safflower oil. Some food products, like margarines, shortenings, non-dairy whipped toppings, and so on, are made from plant fats, but the liquid characteristic is undesirable. Plant oils can be modified to have a more solid physical structure through a process called "hydrogenation." As the name connotes, hydrogenation is a chemical process that changes oils (high in polyunsaturated fatty acids) to a more solid consistency by actually adding hydrogen to

the unsaturated fatty acids. This process imparts the desired physical property and improves the shelf life of the product, but it may also increase the proportion of saturated fatty acids. Many processed food products contain hydrogenated or partially hydrogenated vegetable oils. Many consumers may not appreciate that plant oils may lose some of their desirable dietary characteristics when they are hydrogenated.

The Fatty Acid Profile of Milk

As shown in the table below (taken from the *Fundamentals of Dairy Chemistry*, Second Edition), there are eleven fatty acids that are the major components of milkfat. Seasonal dietary changes account for the range for each fatty acid. Saturated fatty acids, mostly palmitic, account for about 60% of the total; 35% of the total are monounsaturated fatty acids, mostly oleic acid. Polyunsaturated fatty acids, mostly linoleic acid, represent about 5% of the total.

Fatty Acid Composition of Milkfat

Fatty acid		Percent Composition
saturated fatty acids		
Butyric	4:0	3.0-3.7
Caproic	6:0	1.4-2.0
Caprylic	8:0	.0.5-1.5
Capric	10:0	1.9-2.7
Lauric	12:0	1.9-3.7
Myristic	14:0	7.9-12.1
Palmitic	16:0	25.3-29.0
Stearic	18:0	9.2-12.7
Others		1.2-2.4
monounsaturated fatty acids		
Palmitoleic	16:1	3.4-4.6
Oleic	18:1	26.7-34.0
Others		0.9-2.3
polyunsaturated fatty acids		
Linoleic	18:2	3.6-3.7
Others		0.3-1.7

What is Cholesterol?

Physically, cholesterol is a soft, waxy substance found in the body cells of humans and animals. Although plants produce similar sterols, they do not produce cholesterol. Chemically, cholesterol is a steroid alcohol, and not an organic acid. It can exist freely, but it is often associated with fatty acids. Thus, foods that are high in fat are often high in cholesterol, but this need not be the case. Eggs are low in fat but very high in cholesterol. Vegetable oils are fats, but they contain no cholesterol.

Cholesterol is needed to form hormones, cell membranes, and perform other physiological functions in the body. The body is able to make all the cholesterol it needs; it is not necessary to consume cholesterol. Cholesterol that is manufactured in the liver or absorbed from digested food is carried in the blood for use by all parts of the body. This type of cholesterol is referred to as blood or serum cholesterol. Cholesterol in the food you eat is called dietary cholesterol.

Research has shown some correlation between high levels of serum cholesterol and heart disease and atherosclerosis. Eating foods high in cholesterol, i. e. dietary cholesterol, may or may not be associated with high levels of serum cholesterol. One may have high levels of serum cholesterol despite eating a low cholesterol diet; or one may have low or moderate levels of serum cholesterol even with a diet relatively high in cholesterol. It is more a matter of common sense than established cause and effect that people are encouraged not to consume foods high in cholesterol, particularly if they already have high serum cholesterol levels.

Research has more clearly demonstrated a link between the effects of dietary fats and serum cholesterol levels. Saturated fatty acids are associated with increasing levels of serum cholesterol. Consumption of polyunsaturated fatty acids seems to lower serum cholesterol levels. Neither an increasing or decreasing effect is associated with the consumption of monounsaturated fatty acids; however, recent research indicates that monounsaturated fatty acids may lower serum cholesterol levels because of a substitution effect. In any case, decreasing total fat as well as switching from saturated fatty acids to monounsaturated fatty acids would be viewed as a step in the right direction for most people.

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