

Why Alter Milk Composition?

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ABSTRACT

There are multiple reasons to alter milk composition. This paper delineates and discusses the processing, economic, regulatory, marketing, dietary, and future trends affecting alteration of milk composition. The ability to divide milk into various components creates a multitude of products that can be used as ingredients in both food and nonfood manufacturing. In almost every use, there are competing products from nonmilk sources. Economic and marketing factors will dictate the success of any product derived from milk for which the milk composition has been altered. In reviewing future trends, it is always dangerous to predict how markets could change and what the possible response of the dairy industry to such trends might be. A number of current trends, if they continue, may bring important changes both in the production and manufacturing sides of the industry.

INTRODUCTION

Why alter milk composition? The response is not difficult, for there are multiple reasons to alter milk composition. Yet altering composition is also complex, for many of the reasons are interrelated and can have both positive and negative ramifications.

Milk has been disassembled into its various components almost since the beginning of recorded history. Simple observation revealed that if milk was allowed to stand, the cream rose to the top. Early man learned to extract the milk fat by mechanical means and make butter or butter oil. Disassembly of the nonfat solids portion of milk was somewhat slower to develop. A higher degree of specific knowledge,

especially of milk chemistry, was required. The ability to divide milk into various components creates a multitude of products that can be used as ingredients in both food and nonfood manufacturing. In almost every use, there are competing products from nonmilk sources.

This paper will attempt to delineate and discuss the preservation, economic, processing, regulatory, marketing, convenience, lifestyle, nutritional, dietary, and future trend factors affecting the alteration of milk composition.

DISCUSSION

Preservation

Preservation is the oldest reason for altering milk composition: the manufacture of cheese and fermented products goes back to biblical times. In the mid-19th century, Gail Borden invented means of preserving milk via evaporation and sterilization. Of course, alteration by water removal through dehydration preserves milk solids.

The original dairy products of commerce were butter and cheese. Technical developments made fluid milk, cream, and canned milk marketable more than short distances from the farm over 100 years ago. Since then, the variety of dairy products for consumer and ingredient uses has multiplied several times. The availability of specific products in the market depends on technical developments, acceptability to buyers, and constraints or incentives provided by regulation or the market system.

Economics

Milk composition is economically important to milk producers and processors and nutritionally important to consumers. It has been known for years that variations in milk composition occur; however, the composition of milk marketed nationally has been rather constant over the last 15 yr, averaging 3.6% fat, 3.2% protein, and 4.7% lactose (36). This is probably partly because of the prominence of the Holstein

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breed and the pricing of milk based on its fat content (18). The introduction of milk pricing on a component basis and the perception by consumers that animal fats are unhealthy have created new interest in how milk components can be altered to accommodate these emerging markets.

Altering milk composition to manufacture products can improve economic returns. Examples include milk fat that is more easily spreadable at low temperatures, concentrated and dried milks, cultured products, dairy-based salad dressings, and reduced fat products that have the flavor and texture of the Standard of Identity product.

Although UHT milk can be stored without refrigeration, its retail price is higher because of special containers needed for long shelf life. More important, as a major product, UHT will not significantly reduce costs of handling supply and demand variability in the milk marketing system (20).

Each product made from milk, whether a consumer product or an ingredient, has an economic value of its own and sells in a somewhat separate market. The pricing system must determine that value in light of the many technical and economic factors that affect its supply and demand. In this task, the simple models of the economic textbooks, which assume away all the complications, are of only limited use. There are no simple either-or propositions. Because of the disassembly of the many components of milk and their potential for reassembly into dairy products or even more complex products and the multiple possible uses of each component, the costs are different for each product and each has multiple uses.

It is clear that some of the increase in soft drink consumption has come at the expense of milk. Though teen-age boys were still drinking more milk than soft drinks in 1977, for teenage girls the opposite was true, with 9.3 oz/d of soft drinks consumed compared to 8.6 oz/d of milk. Milk also has lagged in the growing dining-out market. Soft drink use by dining outlets more than doubled between 1969 and 1979, but milk use grew only 15% (28).

Processing

Milk is widely considered nature's most perfect food because of its balanced availability of

protein, fat, carbohydrates, vitamins, and minerals and its high content of essential nutrients such as calcium, essential amino acids, and essential fatty acids. Concentrating these nutrients through processing further enhances the nutritional value of milk and its by-products.

For instance, the cheese-making process concentrates protein and fat, reduces water, and eliminates the carbohydrate component. The whey derived from cheese making can be further processed through UF to concentrate the α -lactalbumin and β -lactoglobulin, proteins of high nutritional value (24).

Without a doubt, protein is the single most important component in milk for manufacturing purposes. Higher average protein levels would benefit a number of important products, and this benefit would be greater if the casein concentration in milk was selectively increased (32). Changes in either fat level or composition would have different and contradictory effects on individual products and would need to be undertaken with considerable forethought.

Seasonal changes in the protein and milk fat composition effect cheese yield (22). Although there is a correlation between fat plus protein and cheese yield, these changes are not always consistent. Failure of cheese yield to always reflect changes in the fat plus protein content of the milk can be related to factors such as seasonal variation of casein as a percentage of total protein and in the efficiency of recovery of milk fat and protein from milks of different composition.

Ultrafiltration is a high pressure microfiltration process that selectively segregates components of various molecular weights. Ultrafiltration, an efficient means of significantly altering milk composition, has multiple applications in the dairy industry. Examples include the concentration of whey proteins, the manufacture of cheese base for processing, and the concentration of total milk proteins and fat for the manufacture of all cheese varieties.

The application of heat during milk or product processing can be helpful or harmful. On one hand, heating reduces microbial loads and eliminates pathogens; it also denatures milk proteins to create specific properties, such as the melting of components in cheese processing to create a homogeneous mass. On the other hand, heating destroys, through protein denaturation, valuable components such as immuno-

globulins, enzymes such as lactoperoxidase, and vitamin activity (12).

The cholesterol content of dairy products has become a public nutritional issue. The concentration of cholesterol in bovine milk ranges between 10 and 15 mg/100 ml, or .2 to .4% of total milk lipid (2). Milk cholesterol is 95% unesterified; the balance is esterified to long-chain, usually saturated, fatty acids. Seventy-five percent of milk cholesterol is dissolved in milk fat, 10% is in the fat globule membrane, and 15% is in the skim milk (14). The effects of commercial processing on the concentrations and distribution of milk cholesterol are poorly defined, but this information is needed so that technologies can be applied to decrease the cholesterol content of milk.

A cholesterol reductase from *Eubacterium* species might have use in converting milk cholesterol into coprostanol species and cholesterol, which are poorly (or not at all) absorbed by humans (3, 17). Supercritical carbon dioxide extraction also holds promise for reducing the level of cholesterol in milk. However, it will be necessary to penetrate the milk fat globules, which contain most of the cholesterol, without destroying the globules themselves (12). In general, supercritical fluid extraction works by penetrating the structure of a material to be separated, dissolving soluble components, and carrying them away.

Lactose is the primary carbohydrate in milk. Many dairy products (for example, sour cream) are manufactured via fermentative processes that eliminate or reduce lactose and can therefore be consumed even by those who cannot tolerate lactose. As is known, a segment of the population is lactose intolerant. In these cases, the fermentative process converts the lactose to lactic acid, an element digestible by almost everyone. In addition, yogurt has been shown to contain an inactive form of lactase (the enzyme that breaks down lactose), which is activated in the neutral pH environment of the small intestine (13).

Conventional milk, rich in lactose, can be enzymatically treated with the enzyme lactase to hydrolyze about 80% of the lactose. This process, which substantially reduces the intolerance, creates a milk product that is nutritionally unaffected (21). This product is available under the trade name Lactaid®. Also available are packets of the enzyme lactase, which the consumer can add to conventional milk.

The minerals in milk can have profound effects on the stability of products, which are sterilized either in cans or by the UHT process. In general, a lowering of the citrate and soluble calcium concentrations would offer a significant advantage to the milk processor (25).

Unfortified milks and formulas are poor sources of iron. However, the percentage of iron absorbed by infants varies widely with the source. About 50% of the iron in breast milk is absorbed compared with 10 to 12% for cow's milk or formula (8). Fortification of cow's milk with iron sulfate or iron gluconate increases the total iron assimilated. Prolonged breast-feeding protects against iron deficiency; fortified cow's milk or infant formulas are also effective. The total amount of iron absorbed from fortified cow's milk can be four times that absorbed from breast milk (12).

Calcium is secreted by the Golgi apparatus. Average levels of calcium in milk are 30 mmol/L, but vary slightly with breed of dairy cattle and stage of lactation. Levels decline with mastitis. The nutrition of dairy cattle has little effect on the calcium content (16).

Milk is a particularly good source of calcium. Its absorption and utilization by humans is facilitated by the presence of vitamin D, obtained from sunlight or fortified into the milk itself (12). Milk can be further fortified by the addition of extra calcium. Most milk products, especially cheese, are rich sources of bioavailable calcium.

Studies have focused on the compositional factors responsible for the seasonal instability and technological solution to heat stability and mineral interaction problems. For example, Sweetsur and Muir (30) found a highly significant relation between heat stability of concentrated skim milk and the citrate and soluble calcium concentrations. In milk, citrate and soluble calcium are highly correlated.

These arguments notwithstanding, the modern milk processor can readily adjust milk composition by technological means. Fat content is easily adjusted by separation of cream and protein; lactose values and mineral composition can be manipulated by UF diafiltration, electro-dialysis, and ion-exchange. In view of the specific needs of individual products, it may be wisest to concentrate dietary treatments on the production of cheap milk and to leave the manipulation of milk composition for each manufactured product to the milk technologist.

Regulations

The US and state government regulations can affect alteration of milk composition. For instance, in order to manufacture Standard of Identity Cheddar cheese, milk fat content must be standardized to meet minimum fat requirements in the Cheddar cheese.

Kraft has introduced a line of reduced fat cheeses to more fanfare than the company may have wanted. Last year, Wisconsin officials withheld shipments of the company's new Light Natural cheeses from retail stores, claiming that the products, as labeled, defy US Food and Drug Administration standards for natural cheese (35).

For years, the cheese industry has balked at the restrictive harness that federal standards place on cheese production and marketing. Minimum requirements for fat and moisture in the Standards of Identity for cheese do not allow labels to state "reduced-fat Cheddar cheese". The Kraft situation highlights the problems. Regulations do not allow US manufacturers to produce what the consumer wants — with a familiar name.

Other companies, most notably Dorman Roth Foods, have avoided confronting the standards by choosing other names and descriptions for their products. Dorman Roth, which has been selling "light" cheeses for several years, tiptoed around the issue by giving its products carefully chosen names like "Chedda Delite" and "Slim Jack".

Food labels and standards have been a matter of controversy for nearly a century. The USDA personnel review every meat and poultry product label before it can be used and require an ingredient statement even if the product is covered by a Standard of Identity. In 1985, 143,000 labels were approved and 19,000 were disapproved (23). The FDA does not review labels, nor does it require ingredient statements for standardized foods.

Dietary cholesterol is present only in animal products. It is now widely accepted that a number of Americans should probably reduce their cholesterol intake. However, current FDA regulations are restrictive as to the inclusion of cholesterol information on product labels. The new proposed rules would "encourage the voluntary declaration of cholesterol and fatty acid contents on labeling to assist individuals in lowering their intake of these substances should

they so desire, as well as to assist those individuals who have been medically directed to modify their intake".

Again, developing processing techniques for cholesterol removal would affect dairy products labeling and standards, and of course, consumer attitudes. Proper market signals and information are just as important to consumers as they are to producers. Information on the label or as conveyed by Standards of Identity is a basic starting point for consumers wishing to exercise informed choice in the marketplace.

Marketing

There have been dramatic changes in the marketplace over time that have significantly affected milk composition for manufacture of products available to the consumer.

The earliest fluid milk products were fluid whole milk and light and heavy cream. Pasteurization became common in the 1920s, homogenization in the 1940s, addition to vitamin D in the 1950s. Half-and-half was developed due to World War II regulations. Some skim milk has been sold for many years, but low fat milks (1 or 2% milk fat) were a postwar development. Buttermilk is an old product, as is chocolate milk.

Desire for healthier foods has had a significant impact on the dairy industry over the past 25 yr. Between 1962 and 1986, per capita consumption of whole milk and butter has been halved while per capita consumption of low fat milk has increased from 4.7 to 119 lb and yogurt consumption has increased from .3 to 3.3 lb (31). Not since the Depression has consumption of whole milk and butter made up a smaller percentage of American diets.

There is much less milk fat in fluid milk products now than there was 25 yr ago, mostly because low fat milk has replaced whole milk in many households. In addition, the milk fat content of whole milk is down and cream makes up a smaller share of fluid products (4, 5).

Concern about fat and cholesterol has fueled the consumption of low fat dairy products. Per capita consumption of cream and half-and-half is a fraction of what it was 30 yr ago; the major portion of the market is now accounted for by coffee whiteners and whipped toppings whose only dairy ingredient is imported casein. In the

last 4 yr, both cream and half-and-half have made a comeback (4, 5).

Popularity of low fat products has increased in all major dairy categories to varying degrees, based on relevance of low fat benefit and taste/texture delivery. Low fat products now account for 58% of the yogurt market, 34% of the cottage cheese market, and 10% of the cream cheese market. Low fat products of natural cheeses and sour cream account for smaller market shares in these product categories, but inroads into these product categories have occurred (27). The variety of perishable products with significant markets has grown substantially in the postwar period. Many were made earlier but they had not been generally available. For some, improved processing techniques were responsible. More general availability of refrigeration in distribution also helped. Rising income levels and changes in consumer tastes no doubt were major contributors. There was a major growth for low fat "cream cheese", low fat cottage cheese, "sour cream" products, yogurt, frozen yogurt, and ice milk, both hard and soft.

Evaporated milk was once a major dairy product. It is no longer, replaced by powdered coffee whiteners, nonfat dry milk, and to a major extent, by ingredients in manufactured foods.

A word about casein. The most important food usage of casein is in substitute dairy products, including cheese analogs, whiteners, whipped toppings, and similar products. Cheese analogs, which were unknown 25 yr ago, are by far the most important use.

Lifestyle

Although the heated debates regarding proper food patterns have persisted for decades, Americans have continued to pass the potatoes, bake pies, prepare turkey on holidays, and socialize over a good meal. In the process, food patterns have changed. In fact, the American diet has changed more radically and quickly since the beginning of the 20th century than at any other time in human history. In addition, the food supply of the 1980s mirrors the complex relationship between technology, economics, and social changes.

Today more than ever, consumers are conscious of nutritional value and calories. They

also desire high quality, premium products and eating enjoyment. Sometimes, nutritional and caloric concerns seem to be in direct conflict with the demand for premium products. For example low fat and skim milk sales were up about 7% in 1986. Super premium ice creams – containing more milk fat than regular ice creams – are expected to grow from a \$2 billion market in 1985 to \$3.4 billion by 1990 (31). Thus, consumers want less fat in their milk, yet more fat in their ice cream. Indeed, consumers want their cake and eat it, too.

Life in the 1980s is more affluent than at the beginning of the century. People eat out more often, snack frequently, and choose more "finished" convenience foods. Some basic American customs have changed, too. The composition of the American family is shifting, with more women in the work force, more single-parent families, and a larger proportion of single-person households. No behavior, except perhaps religion, more closely reflects a society's character than its eating habits. It is no wonder, with these changes in the American lifestyle, that nutritional and dietary trends have undergone such profound changes in the past 80 yr (11).

Americans today are eating less than their ancestors and gaining more weight. The shift from physical labor to office jobs has resulted in a reduced calorie expenditure, which offsets the moderate decrease in energy intake. Protein intake has remained constant but the type of protein has changed. Earlier in the century, plant protein made a major contribution to total protein intake. Today, meals revolve around meat, poultry, fish, or eggs. Meat is eaten once or twice a day by 83% of Americans (11). The large proportion of high fat animal proteins, accompanied by an increased use of margarine and oils, has contributed to a sharp increase in fat consumption.

An in-depth look at consumption of milk and related products has shown that they will differ in significance in individual diets, with consumption in many cases determined by the popularity of other foods or drink, and likely to vary according to social group, lifestyle, age, sex, and season (9).

Lifestyle changes were also the main force behind the phenomenal growth of two other categories of dairy products: cheese and yogurt. A recent survey found that 53% of the respon-

TABLE 1. Cholesterol content in dairy products and eggs.¹

Product	Amount /100 g	Amount common usage
Butter	219 mg	11 mg/5 g (pat)
Cheddar	105 mg	30 mg/oz (28 g)
Low fat cottage cheese	8	9 mg/4 oz
Yogurt	13	14/4 oz (113 g)
Vanilla ice cream	45	59 mg/133 g (cup)
Super-premium ice cream	59	88 mg/133 g (cup)
Whole milk	14	35/244 g
Egg (1)	548	274 mg/1 egg (50 g)

¹Reference: USDA (34).

dents consumed low fat milk for diet or caloric reasons, 26% for health or fat reasons, 15% for taste, and only 7% because of price. Consumption of all types of cheeses, except cottage cheese, almost tripled between 1950 and 1984, from 7.7 to 21.7 lb per person. One can attribute the growth to increasing affluence of consumers; the versatility of cheese, with its use in many dishes (especially pizza); and lifestyle trends that made wine-and-cheese parties a substitute for cocktails and chips. Increased advertising budgets – some \$66.2 million in 1983 (28) by leading national manufacturers – have also helped.

With the proliferation of new dairy products, there is a crunch in finding space with grocers either giving dairy more space or expanding existing dairy cases. There has been a rapid increase in the number of new dairy products introduced. In 1987, 1132 new dairy products were introduced, up 33% versus the total for all of 1986 (27). Products such as light cream cheese and low fat items, calcium-added juices, and oversized containers of blended juices and yogurts are among those that appeal to consumers and are one that retailers need to stock. A number of specialty products are also gaining a market, such as specialty cheeses, sweet acidophilus milk that aids in lactose digestion, and six-pack packaging of yogurts and puddings for convenience. Cheeses accounted for 19% of supermarket dairy sales in 1986 and juices and drinks 8.7% (26).

Nutrition

Divergent health concerns and consumer attitudes continue to foster the "love-hate" rela-

tionship between the American public and dairy products. In the recent past, the high calorie and cholesterol contents of many dairy foods caused health conscious individuals to decrease consumption of whole milk, cheese, and other fat-rich products. Now calcium, dubbed by some "the nutrient of the '80s" is keeping dairy foods in the nutritional spotlight for more positive reasons. Increased consumer awareness of calcium's alleged role in combating osteoporosis and hypertension have helped renew public interest in dairy products.

Many experts point to consumers' concerns about heart disease and other health risks from too much fat and cholesterol in their diets as the biggest reason for the swing away from dairy products and eggs (15). American consumers increasingly appreciate the need to cut back or moderate consumption of total fats, animal fats, saturated fats, and cholesterol.

Since the 1960s, the American Heart Association has been urging Americans to eat less fat and cholesterol to reduce their risk of heart disease, and other health groups have echoed those recommendations. And in 1984, a panel of experts convened by the National Institutes of Health (NIH) concluded that the blood cholesterol level of most Americans is too high, in large part because of high intake of calories, saturated fat, and cholesterol. The panel advised a daily intake of no more than 250 to 300 mg of cholesterol (a single egg yolk contains 270 mg (19)). Table 1 provides a comparison of the content of cholesterol in the egg and various dairy products in 100 g and in common usage levels (34).

Such recommendations have hit home. The USDA found in its 1980 survey that reducing cholesterol was the primary reason for cutting

back on eggs, cheese, and butter and for substituting margarine for butter (most brands of margarine contain no cholesterol). Those concerned about cholesterol also reported less frequent use of whole milk and greater use of low fat milk compared with those persons in other households (28).

Strongly linked to the concern over cholesterol is a worry about too much fat in the diet, especially saturated fat, a strong contributor to raising blood cholesterol. Among the major sources of saturated fat in the American diet, whole milk ranks second (behind ground beef), cheese third, eggs seventh, and butter ninth. A National Institutes of Health panel that urged Americans to reduce cholesterol intake also recommended that total fat intake be cut from its current level of about 40% of calories to 30% with saturated fat no more than 10% (28). Fat in the diet also has been linked to certain forms of cancer, prompting the American Cancer Society in 1984 to say that Americans might reduce their risk of cancer by eating less fat. The federal government's "Dietary Guidelines for Americans" also urges the public to "avoid too much fat, saturated fat, and cholesterol" (28).

Cheese may also be benefiting from its "health food" image among some consumers. But, although cheese is relatively high in riboflavin, phosphorus, calcium, and protein, it has its nutritional drawbacks. Many cheeses contain over 50% fat and are high in saturated fats, cholesterol, and sodium – all components that do not stack up well against diet and health recommendations.

Consumption of cottage cheese, however, has been relatively flat. Its image as the diet food of the 1950s and 1960s spurred a jump in consumption from 3.1 lb per person in 1950 to 5.3 lb by 1970 (28). Then it began to decline, replaced among trend-following weight watchers by the diet food of the 1970s and 1980s: yogurt.

Thanks to its diet and health food image and heavy advertising, yogurt was surpassed only by low fat milk in increased consumption over the past 20 yr. From .33 lb per person in 1965, Americans are now gulping down more than 3 lb (28). Yogurt was initially a curious, small volume product basically restricted to ethnic enclaves. Then along came popularized fruit and modified and sweetened flavors.

The dairy industry has been particularly responsive to consumer health needs and preferences. Table 2 gives the nutrient composition of many traditional dairy products, as well as some of the modified versions of these products (34). Milk and milk products are the main sources of calcium in the food supply and provide substantial amounts of high quality protein, zinc, riboflavin, magnesium, and fortified vitamin D.

In modifying milk, an important market is infant formula. A mature human infant obtains from mother's milk within a few days of birth sufficient balanced nutrients to grow at a rate determined by its genetic potential and the quantity and quality of the mother's milk. Rarely, the intake of unmodified human milk can be harmful, as in infants with inherited metabolic defects such as galactosemia and phenylketonuria (7). That human infants grow and develop when given a wide variety of modified and synthetic diets has been demonstrated not only in children requiring specialized diets for inherited metabolic defects, but in a majority of infants who were given modified cow's milk formula.

When we consider the number of older Americans, it is amazing that we have such limited knowledge of their nutrition. Most nutrient allowances recommended for people over 65 are projected from the needs of young adults. Fortunately, many groups are now studying how aging affects the way in which our bodies use different nutrients.

Bone Loss. Aging causes a tendency for the alveolar bone (from the upper and lower jaw) to become loose. This process of periodontal bone loss has been estimated to affect 80% of the adult population in the US. As a result, 50% of the population over 60 have lost their teeth. In addition, the disease osteoporosis is particularly acute in older women (29).

Sense of Taste. Another problem is a decrease in the sense of taste as we age. Salty and sweet taste sensations can decline markedly with age. As a result, older people often prefer richly seasoned foods. Unfortunately this may result in a high use of salt, an element that, in most cases, should be restricted.

Gastric Acid. A decrease in the secretion of gastric acid (hydrochloric acid) also occurs with aging. This may seem surprising, since so many older people complain of heartburn.

TABLE 2. Nutritional composition of selected milk and milk products in a 100-g edible portion (34).

Product	Calories (kcal)	Protein	Carbo- hydrate	Total fat (g)	Stearic acid(C _{18:0})PUFA ¹		Cholesterol	Calcium (mg)	Sodium
Milk									
3.7% Fat	64	3.28	4.65	3.66	.44	.14	14	119	49
Skim	35	3.41	4.85	.18	.023	.01	2	123	52
Milk products									
Cheese									
American, pasteurized	375	22.15	1.60	31.25	3.80	.99	94	616	1430
Cheddar	403	24.90	1.28	33.14	4.01	.94	105	721	620
Cottage (1% fat)	72	12.39	2.72	1.02	.12	.03	4	61	406
Mozzarella	281	19.42	2.22	21.60	2.44	.76	78	517	373
Swiss	376	28.43	3.38	27.445	3.25	.97	92	961	260
Ice cream									
16% fat	236	2.79	21.59	16.00	1.94	.59	59	102	73
10% fat	202	3.61	23.85	10.77	1.30	.40	45	132	87
Ice milk, 4% fat	140	3.94	22.11	4.30	.52	.16	14	134	80
Yogurt									
Plain, skim milk	56	5.74	7.68	.18	.02	.01	2	199	76

¹Polyunsaturated fatty acids.

However, heartburn is often caused by other factors, such as gas production, rather than by increased acidity.

Peristalsis. The reduced ability of the intestine to move its contents through the digestive tract sometimes results in digestive difficulties with certain foods. Some older people may suffer from cramps and diarrhea after eating dairy foods. This occurs because the activity of the intestinal enzyme lactase is reduced.

Nutrient Absorption. Changes in the gastrointestinal tract that occur with aging result in reduced intestinal absorption of some nutrients, including proteins, carbohydrates, fats, and some vitamins and minerals.

Energy Consumption. There is good evidence as well as good theoretical grounds for recommending that older people consume fewer calories. Older people are generally less active, and hence, expend less energy. This is particularly important when an individual leaves a relatively active job for the more sedentary life of retirement. Second, there are changes in the body's metabolism that cause it to require less energy. Third, older individuals tend to lose lean body mass, mostly due to some wasting of muscle. This results in an increase in the ratio of fat tissue to lean tissue, or a relative obesity, another good reason for consuming fewer calories.

Drug Therapy. The interaction between drugs and nutrients has received increasing attention during the last decade. The use of drugs in our society for the treatment of specific and perceived ailments has reached unprecedented levels. Because of their high consumption of medications, the elderly are particularly at risk for drug-induced nutrient deficiencies.

In relation to nutritional aspects of milk and milk products and altering composition, the dairy and foods industry has been aggressive in developing "nutritionally enhanced" new lines of dairy products. These products cut across all lines of traditional categories and include calcium-fortified low fat milks and yogurt, reduced fat cheeses, and lactose-reduced milks and processed cheeses (23).

Americans' pursuit of good health, trim bodies, and long lives is turning the nation into a nutritional battlefield. Old dogmas and new theories are under attack. Doctors, consumers, politicians, and food marketers are all vying for control of the diet. The disputes are sparked by new studies with surprising findings – that eating some fats may reduce the risk of heart disease, that salt does not appear to affect blood pressure in most people, that many people can eat all the cholesterol-rich eggs they want without clogging their arteries.

Once relegated to the fringe of medicine, the new science of nutrition has now entered the academic mainstream. It is turning up tantalizing clues that certain foods can prevent – or cause – diseases.

Most important, the war over diet affects what ends up on Americans' dinner plates and in their bodies – and feeds a multimillion dollar industry of weight loss clinics and diet products along with a \$3 billion vitamin and mineral trade. People want advice, but scientists who want to be thorough are reluctant to give it, and that leaves a gap for those who are less scrupulous to rush in (33).

Diet

I have split the reasons for altering composition into two categories that are related but can be quite different in motivation. The first, nutritional considerations, which are primarily health motivated, have been covered. The other one is diet and the desire to lose weight, motivational factors here include appearance but could include health. The gap between what we would like to be and what we are is widening. American advertising and the mass media portray a relentless urge for fitness. But the truth is that we are not a nation of joggers, iron-pumpers, and whisper-thin fashion models. Rather, we are, increasingly, a nation of broad bottoms and bulging middles.

Generally, people don't think of themselves as fat. Your friends say, "I've got to lose a few pounds" and put Sweet'n Low in the coffee. Then they pig out on dessert. There is a big difference between what they are and what they think they are.

The statistics are right. Federal fat watchers at the National Center of Health Statistics confirm that the total population has gotten plumper over the last 20 yr. By 1980 the girth of the nation had expanded to the point where the average adult was 6 lb heavier than in the 1960s (1).

Things have almost certainly gotten worse since those statistics were compiled: just as the country embarked on a high calorie, convenience, and fast food frenzy that made Whoppers, Haagen-Daz ice cream and Mrs. Field's Cookies household names. We don't have to hunt food anymore; it hunts us. Indeed, studies have shown that consumption and sales of ice

cream has increased significantly, with sales of Haagen-Daz, Fruzen Gladje, and Dove Bars among the most popular belt-busters.

Why is this phenomenon of weight gain occurring? Gluttony is not the only villain. Technology now enables us all to perform even common household tasks with less exertion, which means we burn fewer calories. We are bombarded with advertisements for food. Today the average child sees about 10,000 food commercials a year (1). Our feeding frenzy shows, too, in our appetite for literature. No self-respecting best seller list these days is without its new and different, sure-fire diet book. There is increased availability of a larger variety of foods. Just stroll through one of the new jumbo supermarkets. And finally, there is generally more discretionary income to spend on variety and value-added foods.

Future Trends

Having reviewed the role of milk and related products in light of current trends in eating habits and health guidelines, the following conclusions can be drawn: various milk products, and hence, milk constituents, differ in significance in individual diets. Cheeseman (6) stated that although consumption is mainly determined by the popularity of other food and drink and likely to vary according to social group, lifestyle, age, sex, and season, dairy products such as milk, cheese, and yogurt can make significant contributions to intakes of protein, calcium, riboflavin, and other B vitamins. Although it has proved technologically feasible to produce milk and milk products with reduced fat content, this is not the only form in which they can play a useful role in the diet. It is always possible to reduce the intake of a food constituent by eating less of the foods concerned. It is rarely necessary, for reasons other than lack of will power, to avoid particular foods altogether. When it is known that there are no good and bad foods, simply good and bad diets, consumers must not be led to believe that the path to good nutrition is obstructed by foods they must avoid at all costs and littered with others that initiate a feeling of guilt whenever they are encountered. They should be encouraged to evaluate their diet as a whole and to view foods in terms of the frequency with which they are eaten and the size of portion

served. It is surely sensible to present dietary modifications in terms likely to be considered and then, hopefully, adopted rather than confront individuals with oversimplifications of the "truth", which, as knowledge increases, may need revision and which experience shows is likely to be misinterpreted or rejected. With our ever-increasing awareness of the sociological factors affecting food choice and our desire to help consumers to help themselves, will long-term interests be best served by messages that suggest little or no place in the diet for full-fat milk products?

It is always dangerous to predict how markets could change in the future and what the possible response by the dairy industry to such trends might be. Predictions are, of course subject to considerable influence by political forces that, for social or national consideration, may wish to stop or alter the direction of the trends brought about by market forces. There are, nevertheless, a number of current trends that might, if they continue in their present direction, bring about important changes both in the production and manufacturing sides of the dairy industry.

Cheese. Continued increase in cheese consumption is likely with the availability of new "lifestyle" varieties and an increasing share of reduced fat varieties.

Butter. Per capita butter consumption should stabilize with introduction of technology driven new line extensions to eliminate perceived nutritional negatives.

Milk. Liquid whole milk consumption will likely continue to decrease, but with an increasing proportion of low fat milks consumed.

Component Solids. Consumption of milk solids in a variety of nondairy foods should increase as new methods are developed for modifying milk constituents.

Fermented Products. Increased consumption of fermented or flavored dairy products is likely, in part due to the introduction of new varieties, but also to improvements in consistency, flavor and texture.

Value-Added Products. Emphasis by dairy and food companies on value-added products will provide for maintaining consumption levels of high calorie, good tasting premium products such as ice cream.

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