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MUCH ADO ABOUT MILK

Second edition

Written for the American Council
on Science and Health
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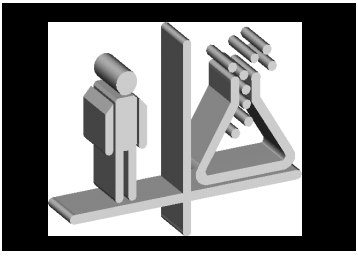
SPECIAL REPORT



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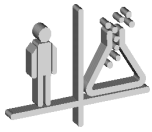

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EXECUTIVE SUMMARY

Except in cases of milk allergy (an uncommon problem), cows'milk and its products are acceptable, nutritious foods for persons one year of age and older.* Milk and dairy products are good sources of high-quality protein and several vitamins, and they are the best food source of the mineral calcium, a nutrient often not plentiful enough in the American diet. It is difficult to obtain an adequate supply of calcium from non-dairy sources, and it requires heavy reliance on foods not favored by most Americans.

It is not necessary to eliminate dairy products from the diet to reduce dietary fat intake or to solve the problem of lactose intolerance. Individuals who want to limit their fat intake can choose low-fat or fat-free dairy products. Those who need to limit their lactose intake should select hard cheeses (which are naturally low in lactose), yogurt (which is usually well tolerated), or lactose-reduced milk. Consuming small quantities of milk may help to increase tolerance of lactose.

Some preliminary reports have suggested a possible link between early exposure to cows'milk proteins and

* Unmodified cows'milk is not recommended for infants under the age of one year. Breast-feeding is the preferred method of infant feeding, and iron-fortified infant formula is the only acceptable alternative.

risk of Type 1 diabetes mellitus in individuals with a genetic predisposition to the disease. Further research has yielded conflicting results, but recommendations from the American Academy of Pediatrics recognize the possibility and encourage breast-feeding and the avoidance of unmodified cows' milk during the first year of life.

The fortification of milk with vitamin D has played an important role in the near-elimination of the dietary deficiency disease rickets in the U.S. Adequate intake of vitamin D is necessary for the proper absorption of calcium and the prevention of osteoporosis. Valid concerns have been raised in the past about several reports that milk sold in a specific locality in the U.S. contained excessive amounts of this vitamin due to careless dosing; however, improved monitoring measures are now in place.

Cows' milk and its products are healthful, exceptionally nutritious foods that play an important role in the American diet. They should not be eliminated from government guidelines or programs.

INTRODUCTION

The American public has long perceived milk as a wholesome, nutritious food, which is especially valuable for children. Nutrition experts agree with this view. Official recommendations, including the Dietary Guidelines for Americans[1] and the Food Guide Pyramid,[2] recognize milk and milk products as one of the five major food groups and call for two to three servings a day from this group.

However, many Americans have understandably been confused by statements from a non-profit organization called the Physicians Committee for Responsible Medicine (PCRM) announcing that "parents should be alerted to the potential risks to their children" from cows' milk and that "milk should not be required or recommended in government guidelines."[3] More recently, PCRM has claimed that "milk is useless against osteoporosis" and has again argued that milk should be removed from federal nutrition guidelines.[4] The organiza-

tion claims that cows'milk causes a wide variety of health problems, including anemia, allergies, and diabetes. PCRM also claims that contamination of milk with pesticides, drugs, and toxic amounts of vitamin D is a further reason why milk should be eliminated from the diets of Americans. In this special report, ACSH critically reviews the bases for these claims and discusses the role of cows'milk in the diets of infants, older children and adults.

THE MILK CONTROVERSY

A major controversy over the role of cows'milk in the diet first arose in September of 1992, when PCRM held a press conference to denounce the feeding of cows' milk to children. The organization charged that cows' milk can cause or contribute to a wide variety of health problems including iron-deficiency anemia, heart disease, allergies, digestive disorders, diabetes, and infant colic. In addition, PCRM said that milk is likely to be contaminated with harmful substances, and that its consumption is unnecessary for good nutrition. PCRM called for changes in government guidelines and programs to eliminate requirements and recommendations for cows' milk consumption. The organization also said that parents should be alerted to the potential risks that cows' milk poses to their children.

PCRM continues to reiterate these statements and to emphasize their anti-milk agenda. In February of 1999 PCRM held a press conference to denounce the role of milk in the prevention of osteoporosis.[5] The organization is also behind a campaign to downgrade milk as a nutritional requirement when the Dietary Guidelines are revised and to have the "milk, yogurt, and cheese" group removed from the Food Guide Pyramid.

This report evaluates PCRM's allegations against cows' milk. Before discussing those issues, however, it is essential to make some important distinctions between dietary recommendations for infants and those for children aged one year and older.

Infant Nutrition: Breast Is Best

The American Academy of Pediatrics and the American Dietetic Association, along with other health organizations, agree that breast-feeding is the preferred method of infant feeding. Ideally, an infant should be breast-fed exclusively for about the first six months of life and then receive an increasing variety of solid foods, along with continued breast-feeding, for the remainder of the first year.

Breast-feeding rates in the U.S. decreased between 1984 and 1989.[6] Between 1989 and 1995, the rate of in-hospital breast-feeding of newborns increased from 52.2 to 59.7% and the prevalence of breast-feeding at age six months increased from 18.1 to 21.6%.[7] This is encouraging, particularly because of the increase among population groups who historically have been less likely to breast-feed.[7]

For infants, the only acceptable alternative to breast milk is iron-fortified infant formula. The most commonly used formulas are based on cows' milk proteins, but the milk is extensively modified to support the nutrient needs of growing infants. Some special-purpose formulas are made with soy protein or extensively hydrolyzed proteins instead of cows' milk.

The current position of the American Academy of Pediatrics, adopted in 1992, is that cows' milk (whole, low-fat, or fat-free) and low-iron formulas should not be used during the first year of life.[8] Previously, the Academy had permitted the use of whole cows' milk during the second half of the first year as long as the infant was consuming substantial amounts of solid foods.

Unmodified cows'milk is inappropriate during the first six months of life because at this age, milk constitutes all or nearly all of the diet. This single food must therefore supply all necessary nutrients in appropriate amounts. As Table 1 indicates, in comparison with breast milk or formula, cows' milk contains too much of some nutrients and too little of others.

During the second six months of life, infants begin to consume a variety of foods. The exact nutrient contribu-

Table 1. COMPARISON OF BREAST MILK, INFANT FORMULA, AND COWS'MILK*

Nutrient	Breast Milk	Iron-Fortified Infant Formula	Whole Cows' Milk
Energy (kcal/oz)	21.6	20.0	20.0
Protein (g/l)	10.5	15.0	34.0
Fat (g/l)	39.0	36.0–38.0	37.0
Carbohydrate (g/l)	72.0	69.0–72.3	48.0
Calcium (mg/l)	280.0	400.0–510.0	1,291.0
Phosphorus (mg/l)	140.0	300.0–390.0	959.0
Sodium (mg/l)	179.0	161.0–230.0	506.0
Potassium (mg/l)	524.0	547.0–821.0	1,486.0
Chloride (mg/l)	419.0	390.0–497.0	959.0
Iron (mg/l)	0.3**	12.0–12.7	0.4

* Adapted from reference 9.

** The iron content of breast milk should not be directly compared with that of cows'milk or infant formula because the iron in breast milk is present in a different form which may be better absorbed from the gastrointestinal tract into the bloodstream.

tion of the milk component of the diet becomes less crucial during this period. Nevertheless, experts still recommend against the use of cows'milk. One important reason for this recommendation is that older infants who drink cows'milk may not get enough iron for normal health and development. The iron content of cows' milk is much lower than that of iron-fortified formula. Studies have shown that other foods commonly consumed by infants do not make up the difference.[8]

In some infants, unmodified cows' milk can also trigger the loss of small but significant amounts of blood from the intestinal tract. Nutritionally important quantities of iron can be lost in this way.[10] The component of cows' milk that causes this bleeding has not been identified. Tests have shown, however, that the intense heat treatment used to prepare infant formulas inactivates it. Ordinary pasteurization does not.

It has long been known that the feeding of unmodified cows'milk to infants can increase the risk of iron-

deficiency anemia. This conclusion has been strengthened by surveys showing that infants fed cows' milk in late infancy have inadequate iron intakes.[8] Persistent iron deficiency can result in impaired mental development in infants.[11] Also, several studies have suggested that iron deficiency in early childhood may be associated with long-term behavioral changes, although this remains controversial.[8]

Assuring Adequate Iron Intake in Older Children

Children over the age of one year continue to be at risk of iron deficiency, so it is important to include ample amounts of iron-rich foods in their diets. Some children tend to drink milk in excessive amounts, and this leaves little room in their diets for iron-rich foods. Parents who suspect that their child may have this problem should consult with the child's health care provider or a registered dietitian to see if they should limit their child's milk intake. It is not necessary or desirable to eliminate milk completely from the diet because this would correct one type of dietary imbalance by creating another.

Consumption of cows' milk does not appear to cause significant intestinal blood loss in older children. This problem occurs only in the very young.[12] Even individuals who were extremely sensitive to this effect of cows' milk in infancy can tolerate milk later in life without adverse effects.[13]

PCRM vs. the Medical Community

In the case of infants, PCRM's views agree with those of mainstream medicine. PCRM states, "Breast-feeding is the preferred method of infant feeding. As recommended by the American Academy of Pediatrics, whole cows' milk should not be given to infants under one year of age because of the risk of anemia."[14]

For children age one year and older, PCRM's views are diametrically opposed to those of medical authorities.

Although the organization does not state outright that no one should drink cows' milk under any circumstances, it clearly implies this. Individual spokespersons have made statements such as:

- "Milk is the number one health hazard facing young children and adults."[15]
- "I don't recommend milk for anyone."[16]
- "There is no reason to recommend cows'milk."[17]
- "There's no reason to drink cows'milk at any time in your life…[W]e should all stop drinking it today, this afternoon."[18]
- "I believe that no one needs milk. And, in general, people are better off not consuming it."[19]

In contrast, the scientific community endorses cows' milk and other dairy products as valuable foods that make important positive nutritional contributions to the diets of children and adults. Dr. Ronald Kleinman, a spokesperson for the American Academy of Pediatrics, responded to PCRM: "Milk and dairy products are safe and nutritious foods for growing children, and parents should make use of them unless there's some specific medical reason to avoid them."[20] He pointed out that "dairy products are not perfect foods, but they are concentrated with many of the forms of nutrients that children need to grow well." [21]

PCRM strongly supports vegetarianism. It advocates a four food group plan (vegetables, whole grains, fruit, and legumes), eliminating the meat and dairy groups that are included in the Food Guide Pyramid. The organization also opposes the use of animals in medical research and education. It is possible that these views may have influenced PCRM's judgment on the health effects of cows' milk and their allegations that milk is responsible for various diseases and health problems.

DOES MILK CAUSE HEART DISEASE?

One of the arguments for eliminating cows' milk from the diet is that the saturated fat content of whole milk

can contribute to elevated blood cholesterol levels and thus to increased risk of heart disease. It is not necessary, however, to eliminate dairy products from the diet in order to limit fat intake and reduce the risk of heart disease.

New regulations from the federal Food and Drug Administration (FDA) regarding milk labeling have made it easier for consumers to identify low-fat and fat-free milk. Milk previously labeled as "2% low-fat" is now labeled "reduced fat," 1% milk continues to be labeled "low-fat," and skim milk is now labeled "fat-free."[22]

Low-fat and fat-free milks provide most of the valuable nutrients found in whole milk but with much or all of the fat removed. Most fat-free and low-fat milks are fortified with vitamins A and D. For adults, fat-free milk is an excellent choice because it allows them to maintain an acceptable calcium intake without adding unnecessary fat.[23] Low-fat or fat-free yogurts and an increasing variety of reduced-fat or fat-free cheeses are also available.

Whole milk is recommended for children between the ages of one and two years because these very young children need the energy (calories) from fat for proper growth and for the development of the brain and nervous system.[11] Fat is a concentrated source of calories. Between the ages of one and two, some children may not get enough fat or energy in their diets due to the type of foods they typically eat.[24] Fat should not be restricted in the diets of children under the age of two years.

Authorities differ in their recommendations for older children. Parents should discuss the issue of when (or whether) to switch their child to low-fat milk with the child's health care provider or a registered dietitian.

LACTOSE INTOLERANCE

Allegations that milk should be avoided because it can cause digestive difficulties refer to lactose intolerance. Lactose intolerance is a problem experienced by some individuals who have an absence or relative deficiency of lactase, the enzyme necessary to digest lactose (milk sugar). If the activity of this enzyme is low, undigested

lactose reaches the large intestine, where gas-producing bacteria naturally residing in the intestine ferment it. The results are bloating, flatulence, cramps, nausea, and diarrhea. Individuals may have varying degrees of lactose intolerance.[25]

Some individuals produce lactase in ample quantities throughout life and have no difficulty digesting lactose. Others, however, produce the enzyme only during infancy and early childhood, and they lose the ability to produce it as they mature.

Lactose intolerance can be diagnosed by the use of medical tests. A lactose intolerance test measures blood glucose levels after an oral dose of lactose. An increase in plasma glucose of less than 20 mg/dl suggests lactase deficiency. The breath hydrogen test is the most accurate method of diagnosing lactose intolerance. In lactase deficiency, some of the unabsorbed lactose is metabolized by intestinal bacteria, producing hydrogen gas, which then can be absorbed into the blood. When the blood reaches the lungs, some of the hydrogen gas escapes in exhaled air and can be measured. Breath hydrogen levels are measured before and after an oral dose of lactose, and elevated breath hydrogen levels indicate that undigested lactose is reaching the large intestine—thus the person may have a deficiency of the lactose-digesting enzyme, lactase.[26]

About 25% of Americans are reported to be lactose maldigesters or to have low lactase levels.[27] An estimated 90% of Asian Americans and 75% of all African and Native Americans, Jews, and Hispanics in the U.S. may have lactase deficiency, to varying degrees. The condition is least common in those whose ancestors are from northern or western Europe.[25]

Federal agencies that promote nutrition guidelines encouraging milk consumption have been accused of racial bias because most lactose-intolerant individuals are not Caucasian.[4] However, lactose intolerance can be easily managed. Individuals with lactose maldigestion do not need to avoid dairy products completely. Instead, they should limit their intake of lactose-containing foods to a level that does not produce discomfort. The symptoms

that result from lactose maldigestion should not be a major impediment to the consumption of a diet that contains an ample amount of foods from the "milk, yogurt, and cheese" food group.[28]

Some individuals with mild intolerance can consume as much as 15 grams of lactose at a time (more than the amount in an 8-ounce serving of milk) without any symptoms. Others are more sensitive. Most people with lactose intolerance can easily consume up to two cups of milk per day, one in the morning and one in the evening. Consuming small amounts of milk on a regular basis with other foods or meals may help to improve tolerance to lactose over time, although this remains controversial.[29]

Table 2 shows the lactose content of various types of dairy products. As the table indicates, low-fat and fat-free milks are not lower in lactose than whole milk. A good

Table 2. LACTOSE CONTENT OF VARIOUS DAIRY PRODUCTS*

Product	**Lactose** (grams)
Whole milk (1 cup)	11.0
2% lowfat milk (1 cup)	9.0–13.0
Skim milk (1 cup)	12.0–14.0
Chocolate milk (1 cup)	10.0–12.0
Evaporated milk (1 cup)	24.0
Lactose-reduced lowfat milk (1 cup)	3.3
Cultured buttermilk (1 cup)	9.0–11.0
Lowfat yogurt (8 oz)	11.0–15.0
Cheese (1 oz)	
Blue, cream, Parmesan, Colby	0.7–0.8
Camembert, Limburger	0.1
Cheddar, Gouda	0.4–0.6
Processed American	0.5
Processed Swiss	0.4–0.6
Cottage cheese, lowfat (1 cup)	7.0–8.0
Butter (2 pats, 10 grams)	0.1
Ice cream/ice milk (1 cup)	9.0–10.0
Sour cream (1 TBS)	<1.0

* Adapted from reference 30.

choice for lactose maldigesters is commercial lactose-reduced milk, prepared with the use of the enzyme lactase. This product is widely available in stores and supermarkets. It contains the same nutrients as untreated milk.[11] Consumers also can purchase lactase tablets or liquid enzyme preparations and use them to treat milk at home.

Whole milk and chocolate milk appear to be well tolerated by lactose-intolerant individuals.[31] Apparently, the higher fat content of these products slows the movement of food from the stomach to the intestine, thereby "spreading out" the effect of lactose and improving tolerance. Cheese is another good choice. Most types of cheese (except fresh cheeses such as cottage cheese) contain very little or no lactose. Yogurt contains as much lactose as does milk. Nevertheless, many lactose-intolerant people can eat substantial amounts of yogurt without discomfort. Apparently, the bacteria in yogurt (or the lactase enzymes that they have produced) digest some of the lactose during its passage through the digestive tract. Buttermilk is not well tolerated, however, presumably because it is produced with different strains of bacteria or because it has fewer beneficial bacteria of the types found in yogurt or kefir.

MILK ALLERGY

True allergy to cows' milk is less common than lactose intolerance, and it is primarily a problem for infants and young children rather than adults. It has been estimated that between 0.4 and 7.5% of the infant population is allergic to the proteins in cows' milk.[8] About 1 to 3% of formula-fed infants develop an allergy to the proteins in cows'milk.[11] These proteins are present in both unmodified cows'milk and in infant formulas based on cows' milk. Therefore, if symptoms of cows' milk allergy develop in formula-fed infants, milk-free formulas must then be fed.[32] Most children outgrow milk allergy.

Early exposure to foods that tend to provoke allergies (cows'milk, eggs, seafood, soybeans, wheat, peanuts and other nuts) may increase the risk that allergies will develop. Current infant feeding recommendations are designed

to minimize this problem. They call for breast-feeding if possible, no solid foods before the age of four to six months, and delayed introduction of foods likely to provoke allergies.*

Infants with a family history of allergies are at increased risk of developing allergies themselves. Breast-feeding is particularly urged for these infants, and parents should take special caution when introducing solid foods.

Decisions about infant feeding should be made with the consultation of the child's health care provider or a registered dietitian. Parents should consider visiting the health care provider before the baby is born to discuss initial infant feeding choices among other concerns.

Occasionally, it is argued that nursing mothers should avoid cows' milk and other foods likely to provoke allergy because it is possible that some proteins from these foods might be transferred intact into breast milk. In certain instances, where there is a strong family history of allergies, some physicians do indeed recommend this type of restriction. It would be unwise, however, to advise all nursing mothers to limit their food choices. Such advice could discourage large numbers of mothers from the desirable practice of breast-feeding while preventing only a very few cases of food allergy.

INFANT COLIC

Colic is an incompletely understood condition involving intermittent, unexplained excessive crying, usually occurring in the first four months of life. It occurs in both breast-fed and formula-fed infants. Some cases of severe colic are related to sensitivity to proteins in cows' milk. Thus, some formula-fed babies with colic will improve if switched to a milk-free formula. In breast-fed babies, some cases of colic may be related to the mother's diet. Maternal intake of cruciferous vegetables, cows' milk, onion, and chocolate has been associated with colic

* For additional information on feeding infants and young children, see the ACSH booklets *Feeding Baby Safely* and *Growing Healthy Kids.*

symptoms in breast-fed infants.[33]

Colic in breast-fed infants may improve if the mother avoids certain foods.[34] Dietary changes (for the infant or the nursing mother) are worth trying under the guidance of the infant's health care provider. However, it is certainly not necessary to eliminate dairy products from the diets of all nursing mothers or to recommend milk-free formulas for all formula-fed infants.

COWS' MILK AND DIABETES

Perhaps the most frightening charge against cows' milk is that it may cause diabetes. To understand the basis for this claim, it is necessary to review a few basic facts about the disease.

There are two distinctly different types of diabetes. Their characteristics are summarized in Table 3.

Both types of diabetes have a hereditary component. The type that is suggested to have some relation to cows' milk is Type 1 diabetes—the severe, insulin-dependent type of diabetes that usually begins in childhood or young adulthood. Type 1 diabetes affects about one million Americans. However, not all who are genetically susceptible to Type 1 diabetes actually develop the disease.

Table 3. CHARACTERISTICS OF THE TWO TYPES OF DIABETES

	Type 1	Type 2
Percentage of all U.S. diabetics	5-10%	90-95%
Age of onset	Usually before 25 years	Usually over 40 years
Type of onset	Rapid	Gradual
Insulin production by the pancreas	Totally absent	Insulin produced, amount depends on stage of disease
Insulin needed for treatment	Yes	Not always
Associated with obesity?	No	Yes, very strongly

For example, if one member of a pair of identical twins becomes diabetic, the other must be susceptible since identical twins have exactly the same genetic inheritance. Yet in more than half of all cases, the second twin does not develop diabetes.

These observations imply that environmental factors trigger the onset of Type 1 diabetes in genetically susceptible persons. It has been suspected that exposure to cows' milk proteins early in life may be one such triggering agent. It is not the only possible trigger, however. Other agents, including viruses, are also suspected, and cases of Type 1 diabetes have been reported in children who have never consumed cows' milk in any form.[35] Scientists also know that only a small proportion of susceptible individuals actually develop diabetes, even in countries such as the U.S., where the vast majority of babies receive at least an occasional bottle of cows' milk–based formula.

Nevertheless, some evidence suggests a link between cows' milk proteins and diabetes. In animal models of Type 1 diabetes, the risk of the disease drops substantially if researchers exclude cows' milk from the animals'diet in the early stages of life.[36] Some epidemiological studies of human populations have found longer duration of breast-feeding or delayed exposure to cows'milk to be associated with a lower risk of Type 1 diabetes, but others have not shown this relationship.[37]

A Finnish study of cows'milk and diabetes published in July 1992 received much attention in the news media. This study showed that newly diagnosed patients with Type 1 diabetes had high levels of antibodies to a protein found in cows' milk while normal subjects had much lower levels.[38] This finding was difficult to interpret. The high antibody levels may have been a result rather than a cause of metabolic derangement that occurs with the onset of diabetes.

The American Academy of Pediatrics was prompted to review the body of research on this subject. In 1994 the organization issued a policy statement which acknowledged a possible association between the early introduction of cows'milk and the development of Type 1 dia-

betes in susceptible individuals. The policy statement strongly endorses breast-feeding and recommends the avoidance of unmodified cows' milk during the first year of life,[39] the same recommendations made in previous policy statements on the use of cows'milk in infancy and the promotion of breast-feeding.

Research on the possible link between cows' milk and Type 1 diabetes continues, and results are conflicting. Some new findings refute the previous observations and suggest that avoidance of cows' milk may not be effective in the prevention of Type 1 diabetes.[40] Animal studies suggest that the proposed relationship between Type 1 diabetes and cows'milk actually represents a problem with impaired or immature mucosal (intestinal) immunity in susceptible individuals. One benefit of breast-feeding is that breast milk contains factors that stimulate the maturation of the baby's gastrointestinal tract. Thus, the problem may be more one of lack of such factors in individuals who are genetically predisposed to diabetes, rather than a specific problem with cows' milk protein or any other protein.[41]

According to Jill M. Norris, Ph.D., a diabetes researcher in the Department of Preventive Medicine and Biometrics at the University of Colorado Health Sciences Center, "Unfortunately, we still do not have a clear-cut answer."[42] Progress is also being made in identifying and understanding the genetic basis for this disease. At the present time, compliance with the American Academy of Pediatrics'recommendations for breast-feeding and the avoidance of unmodified cows' milk during the first year of life is prudent. No reputable authorities, however, have recommended that children over age one avoid milk and dairy products.

CONTAMINANTS IN MILK

Anti-milk advocates allege that milk should be avoided since it may contain harmful levels of contaminants including pesticides and residues of drugs used to treat dairy cows.

For example, in the book, *Milk—The Deadly Poison*, author Robert Cohen claims that genetically-engineered bovine somatotropin (bST), a hormone sometimes given to cows to increase milk production, is hazardous to human health.[43] However, there is ample information supporting the safety of bST. The FDA, the National Institutes of Health, the World Health Organization, and the Office of the Inspector General of the Department of Health and Human Services have all performed independent reviews of the studies and agree that milk from bST-supplemented cows is safe.[44] According to C. Everett Koop, M.D., former Surgeon General of the United States, "Milk from cows given supplemental bovine somatotropin is the same as any other milk."[45]

Pesticide residues in milk are not a significant health threat. As is the case with other food commodities, the minute quantities of pesticides occasionally found in milk are well below the tolerances set by the government and do not pose a health hazard.

Both the cow's digestive system and the milk secretion process provide a measure of screening which protects the consumer of milk from many potentially harmful substances. For example, milk contains far lower concentrations of arsenic, cadmium and mercury than are found in the cows'feed or in most other foods consumed by humans.[46]

As with pesticides, drug residues are not a major problem. It is true that there have been instances in the past in which dairy farmers have violated regulations and allowed milk containing antibiotics to be sold. (The milk is supposed to be discarded until drug treatment ends and the cow stops secreting the drug in her milk.) Such incidents have always been rare, however, and they are now being prevented by better enforcement efforts. A nationwide milk quality program is in place that prevents milk containing illegal antibiotic residues from entering the marketplace. All loads of milk are tested for these residues, and any load that contains them is rejected and cannot be sold.[47]

VITAMIN D OVERFORTIFICATION

Vitamin D, which prevents the dietary deficiency disease rickets and is needed for the proper absorption of calcium, is routinely added to milk in the U.S. As with many other nutrients, excess intake can be toxic. It is important to ensure that fortified milk contains the correct quantity of the vitamin. If the amount is too low, some segments of the population might not receive the required level of protection. If the amount is too high, there could be problems with vitamin D toxicity.*

In 1992, there were two reports in the U.S. of instances in which milk was fortified with incorrect amounts of vitamin D.[48,49] One of these reports described an incident involving a Massachusetts dairy, in which eight cases of vitamin D intoxication were traced to milk that contained extraordinarily high amounts of vitamin D.[48] The other report, a survey of milk products purchased in supermarkets in five eastern states, showed that some samples were overfortified with the vitamin while others were underfortified.[49]

The FDA now requires that the vitamin D content of milk be monitored on a daily basis at all dairy plants. Periodic testing is performed in each state by laboratories that are credentialed in that state to perform vitamin assays.[45] The fortification of milk with vitamin D is now more reliable and should continue to be so.

Sunlight-stimulated conversion of vitamin D in the skin cannot provide enough vitamin D reliably on a year-round basis, particularly in northern latitudes. Elderly people may not get much sun exposure, and their skin is less efficient in using the sun to make vitamin D. Dark-skinned Americans may also have difficulty getting enough vitamin D from sunlight-induced synthesis. Americans need a reliable dietary source of vitamin D. Vitamin D-fortified milk has played this role for decades and should continue to do so.

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* *The tolerable upper intake level (UL) of vitamin D for adults is 2000 IU/day. (The UL is the highest amount of a nutrient that is known to be safe; higher intakes may be toxic.) The UL for vitamin D is five times the Daily Value of 400 IU/day.*

MICROBIOLOGICAL SAFETY

Before the widespread introduction of pasteurization about 70 years ago, milk was a vehicle by which infectious diseases were frequently transmitted. Pasteurization and improved sanitation have virtually eliminated this problem.[50]

Unpasteurized milk (also called "raw" milk) is still sold in some parts of the U.S. This product is sometimes promoted as being more healthful than pasteurized milk. In fact, the exact opposite is true. Unpasteurized milk can be contaminated with disease-causing microorganisms. About 2 to 10% of all samples of raw milk contain harmful bacteria such as *Salmonella*, *Listeria*, *Campylobacter*, and *Escherichia coli* 0157:H7.[44] The safest course of action is never to drink it.

THE ROLE OF MILK IN THE DIET

It has been claimed that cows' milk is nutritionally unnecessary. In the strictest sense, this argument is valid. No single food is absolutely essential for good nutrition. However, milk provides many nutrients, especially calcium, high-quality protein, riboflavin and vitamin B_{12} (and vitamins A and D, if the milk is fortified). It is much easier to meet the recommended allowances for these nutrients with dairy products in the diet.

Milk is particularly important as a source of calcium, a mineral that can be in short supply in the diets of some segments of the population, such as growing children and post-menopausal women. Dairy products are the main source of dietary calcium and account for 76.8% of the calcium in the U.S. food supply.[51]

Calcium is essential for the formation of bones and the maintenance of bone strength. Low calcium intake is one of several factors associated with the development of osteoporosis, a condition in which bone mass is lost, leading to increased susceptibility to fractures. Osteoporosis is common in older Americans, especially women of European or Asian heritage. The exact rela-

tionship between dietary calcium intake and osteoporosis is not fully understood. There is good reason to believe that ample calcium intake during the years when bone mass is increasing to its peak (adolescence and young adulthood) may delay the onset of osteoporosis-related fractures in later life. Adequate calcium intake is also important in older adults for the maintenance of bone mass.

Because of concern over the adequacy of the 1989 Recommended Dietary Allowance (RDA) for calcium, the National Institutes of Health (NIH) sponsored a consensus conference in 1994 to examine the issue of optimal calcium intake. The NIH panel of experts concluded that for people over the age of eight years, the amount of calcium needed to reduce the risk of osteoporosis was greater than the 1989 RDAs, and they proposed new guidelines. The panel recommended, as the United States Department of Agriculture had previously, that calcium be obtained primarily from dairy foods because of their high content of calcium and other valuable nutrients.[52]

The Institute of Medicine established new Dietary Reference Intakes (DRIs) for calcium in 1997. The new proposal increased the recommended intakes of calcium modestly for all individuals age 9 and older. Recommendations for people aged 51 and over were substantially increased from 800 to 1200 mg per day. Table 4 shows the current DRIs for calcium. *Healthy People 2000*, the U.S. Public Health Service's report on health promotion objectives for the nation, also calls for an increase in dietary calcium intake.[35]

Allegations exist that milk does not protect against osteoporosis. The study often cited as evidence against milk's role in the prevention of osteoporosis was an observational study that did not control for other factors that may have influenced the results.[54] However, numerous well-controlled scientific studies have shown a positive effect of dietary and/or supplemental calcium on bone growth, on the reduction of bone loss, and on the reduction of the risk of fracture in the elderly.[55]

To help meet the recommendations for calcium intake for Americans (as well as to provide important

Table 4. CRITERIAAND DIETARY REFERENCE INTAKE VALUES FOR CALCIUM BY LIFE-STAGE GROUP*

Life-Stage Group**	Criterion	AI*** (mg/day)
0 to 6 months	Human milk content	210
6 to 12 months	Human milk + solid food	270
1 through 3 years	Extrapolation of maximal calcium retention from 4 through 8 years	500
4 through 8 years	Maximal calcium retention	800
9 through 13 years	Maximal calcium retention	1,300
14 through 18 years	Maximal calcium retention	1,300
19 through 30 years	Maximal calcium retention	1,000
31 through 50 years	Calcium balance	1,000
51 through 70 years	Maximal calcium retention	1,200
> 70 years	Extrapolation of maximal calcium retention from 51 through 70 years	1,200
Pregnancy		
< 19 years	Bone mineral mass	1,300
19 through 50 years	Bone mineral mass	1,000
Lactation		
< 19 years	Bone mineral mass	1,300
19 through 50 years	Bone mineral mass	1,000

* From reference 53.

** All groups except *Pregnancy* and *Lactation* include both males and females.

*** AI: Adequate intake

amounts of other nutrients), the federal government's Food Guide Pyramid calls for two to three daily servings from the "milk, yogurt & cheese" group. The USDA's Human Nutrition Research Center at Tufts University's suggested food pyramid for the elderly recommends three servings per day.[56] Many foods, such as orange juice, bread, and cereals, are now being fortified with calcium in an effort to increase the calcium intake of Americans.

Table 5 lists the calcium content of a variety of foods from the five major food groups. As the table indicates, all foods in the "milk, yogurt & cheese" group provide substantial amounts of calcium. Typical servings of these

foods (except for cottage cheese) provide about 200 to 300 mg of this mineral. According to the USDA's 1994-96 *Continuing Survey of Food Intakes by Individuals*, the average number of servings consumed from the "milk, yogurt & cheese" group is only 1.5 servings per day.[57]

In the other food groups, however, most foods are not calcium-rich. Only a few of the many possible choices provide substantial amounts of calcium, and most of the calci-

Table 5. CALCIUM CONTENT OF FOODS FROM THE FIVE MAJOR FOOD GROUPS

Food Group and Item	**Calcium** (mg)
Bread, Cereal, Rice, & Pasta	
Bread, whole wheat (1 slice)	25
Bread, enriched white (1 slice)	21
Corn flakes (1 cup)	4
Oatmeal (1 cup)	22
Raisin bran (1 cup)	28
Rice, enriched white (1 cup)	21
Rice, brown (1 cup)	23
Macaroni, enriched (1 cup)	8
Vegetables	
Broccoli (1 cup)	178
Carrots (2 medium)	38
Cauliflower (1 cup)	34
Celery (1 cup)	54
Collards (1 cup)	148
Corn, sweet (1 ear)	2
Kale (1 cup)	94
Lettuce, iceberg (1/4 head)	23
Lettuce, Romaine (1 cup)	20
Onion (1 raw)	30
Potato (1 baked)	20
Snap beans, green (1 cup)	63
*Spinach, cooked, drained (1 cup)	245
Sweet potato (1 cup)	70
Tomato (1 raw)	24

* The bioavailability of calcium from spinach is low due to its high oxalate content.

Table 5. CALCIUM CONTENT OF FOODS FROM THE FIVE MAJOR FOOD GROUPS *(continued)*

Food Group and Item	**Calcium** (mg)
Fruits	
Apples (1 raw)	8
Bananas (1 medium)	10
Cantaloupe (1/4 medium)	14
Dates (pitted, 1 cup)	105
Figs (10 dried)	269
Grapes (1 cup)	15
Orange juice (1 cup)	25
Orange juice,calcium-fortified (1 cup)	300
Peaches (1 raw)	9
Pears (1 medium)	19
Raisins (2/3 cup)	53
Strawberries (1 cup)	31
Milk, Yogurt, & Cheese	
Milk whole (1 cup)	288
Milk, 2% reduced fat, solids added(1 cup)	352
Milk, skim (1 cup)	296
Cheese, Cheddar (1 oz)	213
Cheese, Swiss (1 oz)	262
Cheese, processed American (1 oz)	198
Cheese, cottage, creamed (1/2 cup)	115
Yogurt, lowfat (1 cup)	294
Meats, Poultry, Fish, Dry Beans, Eggs, & Nuts	
Beef, lean ground, broiled (3 oz)	10
Chicken, broiled (3 oz)	8
Pork, roasted (3 oz)	9
Lamb, roasted (3 oz)	9
Salmon, canned (with bones; 3 oz)	167
Tuna, canned (3 oz)	7
Sardines, canned (with bones; 3 oz)	372
Shrimp, canned (3 oz)	98
Chickpeas (1 cup)	78
Kidney beans (1 cup)	50
Navy beans (1 cup)	128
Soybeans (1 cup)	175
Tofu (processed with calcium sulfate; 1/2 cup)	258
White beans (1 cup)	161
Egg (1 large)	27
Peanut butter (1 tbsp)	9

um-rich choices are not eaten frequently or in substantial amounts by most Americans. For example, some choices in the "meat, poultry, fish, dry beans, eggs, and nuts" group—specifically, fish with edible bones and some legumes—are high in calcium. However, the foods most commonly chosen in the U.S. from this group—beef, chicken and pork—provide little calcium.

Similarly, some vegetables (especially leafy green vegetables) and a few fruits do provide substantial amounts of calcium. However, these are not the fruits and vegetables most commonly eaten in the U.S. In fact, among the ten most popular vegetables and ten most popular fruits,* none is rich in calcium.

To meet the RDA for calcium without eating dairy products, Americans would have to make substantial changes in their choices from practically every food group. It is very doubtful that most people would or could do this successfully. In practice, when people in this country exclude dairy products from their diets, the replacement food choices are seldom rich in calcium. As *Healthy People 2000* points out, "With current food selection practices in the United States, use of dairy products constitutes the difference between inadequate and adequate intakes of calcium."[35]

The calcium in foods derived from plant sources is less available to the body than the calcium in dairy products because plants contain substances, such as fiber, phytate, and oxalate, which reduce the absorbability of calcium from the digestive tract.[58] Oxalates, found in foods such as spinach, sweet potatoes, and beans, are particularly strong inhibitors of calcium absorption. The body absorbs about a tenth as much calcium from spinach as it does from milk.[59] Calcium from beans is absorbed only about half as well as calcium from milk.[31]

It is not easy to plan milk-free diets that provide adequate calcium. Two of the sample menus provided by PCRM[14] rely on artificially fortified products to provide

* According to data from the U.S. Department of Agriculture, the ten vegetables consumed in greatest quantities in the U.S. are potatoes, tomatoes, lettuce, onions, sweet corn, cucumbers/pickles, carrots, cabbage, celery, and snap beans. The ten top fruits are oranges, bananas, apples, melons, peaches, grapefruit, grapes, pears, strawberries and lemons.

calcium. A third menu provides only 801 mg—which is substantially less than the amounts recommended for everyone age nine years and older.

Some scientific evidence suggests that calcium needs increase as protein intake increases and that different types of proteins may have different effects on calcium nutriture.[60] Other studies suggest that bone mineralization is affected more by calcium intake than by the source of the protein. However, the current protein intake of Americans should not be of concern for bone health if adequate calcium is consumed.[31] Virtually all nutrition experts agree that Americans should make an effort to meet the current recommended intake for calcium.

Anti-milk literature frequently states that people in some non-Western cultures maintain good bone health despite calcium intakes of only 200 to 500 mg/day and a total absence of dairy products from their diets. However, there is serious question about the adequacy of such low calcium intakes, particularly in societies with high intakes of protein, such as in the U.S. The people who appear to do well on low calcium intakes generally consume near-vegetarian diets with relatively low protein content. They also do not smoke or consume much alcohol, and they are physically active. Most Americans have a very different dietary pattern and lifestyle

Calcium is not the only nutrient needed for proper bone formation. Other nutrients such as protein, phosphorous, vitamin D, and some trace elements such as copper, zinc, and manganese, are also necessary. Dairy foods are good sources of all of these nutrients. In fact, calcium intake from dairy foods may increase bone density more than calcium intake from supplements.[61]

OTHER BENEFITS OF DAIRY PRODUCTS

Dairy foods also appear to play a part in the prevention and treatment of high blood pressure. Accumulating scientific evidence indicates that an adequate intake of calcium, potassium, and magnesium — minerals found in dairy foods — may help to prevent and treat high blood pressure. The Dietary Approaches to Stop Hypertension

(DASH) study showed that a diet rich in fruits, vegetables, and lowfat dairy foods (3 servings per day) can help to lower blood pressure.[62] Consuming calcium-rich foods may pose fewer problems with compliance than would salt-restricted diets for the management of high blood pressure.[31]

Preliminary scientific evidence suggests that certain components of milk and other dairy foods may reduce the risk of cancers of the breast and colon.[63] These components include calcium, vitamin D, bacterial cultures, and a type of fatty acid known as CLA (conjugated linoleic acid).[31]

CONCLUSIONS

Calls for the exclusion or near-exclusion of cows' milk and dairy products from the American diet are not justified. These foods continue to be a valuable, nutritious part of the diets of Americans over the age of one year. They are particularly important as a source of calcium, and they also provide important amounts of other essential nutrients.

Breast-feeding is the preferred method of infant feeding. Unmodified cows' milk should be avoided in the first year of life. Concerns about dietary fat intake and problems with lactose intolerance can be alleviated by careful selection of dairy products. The only situation that calls for exclusion of cows'milk from the diet is cows' milk allergy.

Some preliminary scientific evidence has suggested a possible link between early exposure to cows' milk proteins and increased risk of Type 1 diabetes in susceptible individuals, but further studies have produced conflicting results. No reputable authorities have recommended that children over age one avoid milk and dairy products.

Cows' milk and its products are safe, healthful, and exceptionally nutritious foods that play an important role in the American diet. Certain components of milk may even be helpful in the prevention or management of many disease states. Cows'milk and its products should not be eliminated from government guidelines or programs.

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