

Flavored Milk

in PERSPECTIVE

INTRODUCTION

Nutrient-rich flavored milk comes in a variety of flavors and offers the same unique nutrient package of nine essential nutrients as unflavored milk. Flavored milk is available in traditional flavors such as chocolate as well as innovative flavors including strawberry, vanilla, mocha and root beer. As the most popular milk choice in schools, flavored milk is a highly palatable, nourishing beverage that can help Americans, particularly children, meet current daily dairy food and calcium intake recommendations. Despite the important nutrient contributions flavored milk makes to the diet, concerns about the potential effects of the added sugar and flavorings in flavored milk have raised questions regarding the role of flavored milk in a healthy diet. This review highlights flavored milk's valuable contributions to nutrient intake and health, presents recommendations offered by health professional organizations and nutrition experts regarding flavored milk consumption, addresses questions about the consumption of this nutrient-rich beverage and provides data that demonstrates the importance of flavored milk in the school environment.



Flavored Milk's Nutrients and Health Benefits

The *2005 Dietary Guidelines for Americans* (DGA) recommends 2 cups of low-fat or fat-free milk or equivalents (i.e., cheese, yogurt) daily for children aged 2 to 8 years, and 3 cups or equivalents daily for people aged 9 years and older because of milk's important nutrient contributions to the diet (1). Flavored milk is a nutrient-rich beverage providing the same nine essential nutrients as unflavored milk,

including calcium, potassium, phosphorus, protein, vitamins A, D and B12, riboflavin, and niacin (niacin equivalents) (2). Milk, flavored and unflavored, whole, reduced-fat, low-fat or fat-free, provides three of the five nutrients that fall short in children's diets (i.e., calcium, potassium, and magnesium) and four of the seven nutrients limiting in adults' diets (i.e., vitamin A, calcium, magnesium, and potassium) (1). Each 8 ounce (1 cup) serving of flavored or unflavored milk provides 300 mg of calcium or 30% of the Daily Value (1000 mg) for calcium.

Milk's nutrients play an important role in bone development and maintenance and overall nutrient adequacy throughout childhood and adulthood (1). The *U.S. Surgeon General's Report on Bone Health and Osteoporosis* recognizes that milk's nutrients, including calcium, magnesium, phosphorus, potassium, protein, and vitamin D, work together to help build and strengthen bone and are important for both fracture and osteoporosis prevention (3). The 2005 DGA acknowledges milk and dairy foods' contribution to bone health and improvement of diet quality (1). In addition to improving bone health, milk and dairy foods, when consumed as part of a healthy diet, may help to reduce the risk of osteoporosis (3-5), hypertension (6-9), obesity (10-14), colon cancer (15-18) and metabolic syndrome (19-22), a cluster of conditions that can lead to heart disease and type 2 diabetes.



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Flavored Milk Helps Meet Nutrient Needs

Many Americans, both children and adults, are not consuming recommended daily servings of dairy foods (23). Approximately 60% to 80% of total dairy servings consumed by children and adolescents are consumed as milk, either as a beverage or as an ingredient in mixtures such as pudding or soup (24). As children enter adolescence, their milk consumption often decreases, while their intake of soft drinks increases (25-28).

Studies show that consuming low-fat or fat-free flavored milk can help children and adolescents meet the 2005 DGA recommendations for dairy foods and increase their intake of milk nutrients (29-31). In one study, children who drank flavored milk consumed more total milk and fewer soft drinks and fruit drinks compared with children who did not drink flavored milk, based on data from nearly 4,000 school-aged children and adolescents who participated in the 1994-96 and 1998 USDA Continuing Survey of Food Intakes by Individuals (29). In addition, flavored milk consumers had higher calcium



and phosphorus intakes, but a similar percent of energy from total fat and added sugars compared with children who did not consume flavored milk (29). A retrospective analysis of diets of more than 3,000 children ages 6 to 17 years found a positive effect on children’s overall diets when they chose flavored milks and yogurts instead of sodas and sweetened drinks (30). The researchers suggest that children and adolescents can enhance the quality of their diets by consuming milk such as flavored milk in moderation as an alternative to energy-dense, nutrient poor beverages (30). A more recent study found that children and adolescents who included flavored milk in their diets had significantly higher total milk intakes than those who exclusively consumed unflavored milk (31). Also, energy-adjusted intakes of vitamin A, calcium, phosphorus, magnesium, and potassium were significantly higher for children who drank flavored or unflavored milk than for non-milk drinkers (31). Among females

12-18 years of age, calcium intakes by flavored milk drinkers and exclusively white milk drinkers were nearly double the calcium intakes of non-milk drinkers. This study used data from 7,557 children and adolescents ages 2-18 years who participated in the 1999-2002 National Health and Nutrition Examination Surveys (31). Based on their findings, the researchers conclude that “limiting children and adolescents’ access to flavored milk due to its higher added sugars or energy content may only have the undesirable effect of further reducing intakes of many essential nutrients provided by milk” (31).

Flavored Milk’s Nutrients are Important for Bone Health

The nutrients in unflavored and flavored milk including calcium, magnesium, phosphorus, potassium, protein, and vitamin D, are necessary for developing strong bones and teeth as well as for overall health (3, 5, 32-33). Childhood, particularly adolescence, is the most critical time to build bone mass (5). Studies have shown that consuming an adequate intake of milk and other dairy foods during childhood benefits adolescents’ bone health (34) and that low intake of milk during childhood and adolescence is associated with low bone mass and increased risk of fractures in adulthood (33).

In addition to the 2005 DGA “nutrients of concern” that dairy provides including calcium, potassium and magnesium, recent studies suggest that vitamin D is also lacking in the diets of children (35). Recognizing the importance of adequate vitamin D for bone and the prevalence of vitamin D deficiency among children and adolescents, the American Academy of Pediatrics (AAP) issued a clinical report calling for doubling the amount of vitamin D they recommend (i.e., from 200 I.U. per day to 400 I.U. per day) (36). The report recognizes the importance of vitamin D-fortified milk as a source of vitamin D for children and adolescents. Nearly all fluid milk, flavored and unflavored, marketed in the U.S. is fortified with vitamin D to obtain the standard amount of 400 I.U. per quart (100 I.U. per cup) (37). Therefore, consuming vitamin D-fortified flavored milk may help improve children’s and adolescents’ vitamin D status, especially for those who drink little or no unflavored milk. A recent study showed that drinking vitamin D-fortified milk improved the vitamin D status in adults (38).



HEALTH PROFESSIONAL RECOMMENDATIONS

In addition to the 2005 DGA recommendations of 2 cups or equivalents of low-fat or fat-free milk daily for children aged 2 to 8 years and 3 cups for those aged 9 years and older, the DGA has also highlighted low-fat and fat-free milk and milk products as one of the “Food Groups to Encourage” since most Americans are not consuming enough of these foods and

the nutrients they provide (1). The AAP recommends children consume 3 servings of dairy foods and adolescents consume 4 servings daily (5) to meet calcium intake recommendations. Additionally, the American Academy of Family Physicians (AAFP), the American Dietetic Association (ADA), the National Medical Association (NMA), the National Hispanic Medical Association (NHMA) and the School Nutrition Association (SNA) all support and promote 3 daily servings of dairy foods among their members and the public. To help meet recommendations, many health professional organizations and nutrition experts recognize the importance of consuming flavored milk in helping children and adolescents meet their recommended daily intakes of dairy foods and dairy food nutrients such as calcium. The ADA states that “by increasing the palatability of nutrient-dense foods/beverages,

The American Dietetic Association states that “by increasing the palatability of nutrient-dense foods/beverages, sweeteners can promote diet healthfulness” (39). This concept is also supported by the 2005 *Dietary Guidelines for Americans* which states that enhancing the palatability of nutrient-dense foods, such as milk, may improve nutrient intake (1).

sweeteners can promote diet healthfulness” (39). This concept is also supported by the 2005 DGA which states that enhancing the palatability of nutrient-dense foods, such as milk, may improve nutrient intake (1). The AAP, in a policy statement discouraging soft drinks in schools (27) and in its report on optimizing children’s and adolescents’ bone health and calcium intakes (5), encourages consumption of nutritious beverages including low-fat or fat-free flavored milks. The Institute of Medicine (IOM) recognizes the nutritional value of flavored milk with modest amounts of sugar for school children (40).

Lastly, the American Heart Association (AHA) supports a positive role for added sugars to help increase intakes of nutrient-rich foods including dairy foods. Specifically, in their scientific statement on *Dietary Sugar Intake and Cardiovascular Health*, the AHA states, “when sugars are added to otherwise nutrient-rich foods, such as sugar-sweetened dairy products like flavored milk and yogurt and sugar-sweetened cereals, the quality of children’s

and adolescents' diet improves, and in the case of flavored milks, no adverse effects on weight status were found”(41).

Two members of the AAP's Committee on Nutrition, in an article on clearing up confusion on the role of dairy products in children's diets, state “given the importance of calcium, vitamin D and other key ingredients in the diet of children and adolescents, flavored milks could be a nice alternative [to unflavored milk] since the contribution of added sugars to the overall diet of young children is minimal” (42). Researchers at Pennsylvania State University, recognizing the low dairy and calcium intakes of children ages 4 to 18 years, recommend that nutrition guidance be focused on increasing children's intake of low-fat dairy products “with special emphasis on increasing calcium intake in school-age children and adolescents through flavored low-fat milk products” (43). Similarly, researchers at the University of Saskatchewan, Canada, recommend adding chocolate milk to school vending machines as a strategy to increase children's and adolescents' milk intake (44). The American Academy of Pediatric Dentistry states that “chocolate milk is OK for your teeth,” is a highly nutritious beverage, is preferable to many popular snacks that provide calories but few nutrients, and because children like flavored milk, they drink more of it (45).



SWEETENERS IN FLAVORED MILK

Flavored milk – whole, reduced-fat, low-fat or fat-free - provides the nutrients calcium, potassium, phosphorus, protein, vitamins A, D and B12, riboflavin and niacin (niacin equivalents). Flavored milk contains both natural sugar (12 gm of lactose per 8 ounce serving) and added sweeteners. Sweeteners can be nutritive (caloric) such as sucrose, commonly known as table sugar, or high fructose corn syrup (HFCS), or non-nutritive, depending on the brand. Because each manufacturer has a unique formula, including the amount and type of added sweetener(s), added sugar content may vary among flavored milk products. On average, an 8 ounce serving of low-fat chocolate milk contains about 4 teaspoons of added sugar, while an equivalent amount of soft drink contains 7 teaspoons. An 8 ounce serving of low-fat (1%) chocolate milk provides 158 calories, whereas its unflavored counterpart provides 102 calories (2).

HFCS is a type of nutritive sweetener that can be added to flavored milk. The composition of HFCS is very similar to the sweetener sucrose. Sucrose molecules are composed of one molecule of glucose and one of fructose, thus sucrose contains 50% glucose and 50% fructose, while HFCS is composed of 55% glucose and 45% fructose with these two sugar molecules existing separately. The similar content may explain the lack of metabolic differences between the two sweeteners (46). Based on a review of

the scientific literature, the American Medical Association concluded that, because the composition of HFCS and sucrose is so similar, particularly with regard to absorption by the body, it is unlikely that HFCS contributes more to obesity or other conditions than sucrose (47). Therefore, despite some studies linking fructose consumption with obesity, overall, the scientific evidence indicates that HFCS does not appear to contribute more to obesity or other chronic diseases than other nutritive (caloric) sweeteners (47-48).

Studies found that flavored milk drinkers had higher calcium and nutrient intakes compared to nondrinkers but did not have higher added sugar or total fat intakes.



Body weight

The key to maintaining a healthy body weight is to balance calories consumed from foods and beverages with calories expended by physical activities (1). Added sugar, when used in moderation and with concern for overall caloric balance, can increase the appeal of nutrient-rich beverages such as flavored milk and provide additional choices for children and adolescents, thus improving nutrient intake without contributing excessive calories (1). Although flavored milk contains some added calories from sugar, there is no evidence that milk, flavored or unflavored, adversely affects body mass index (BMI) in youth. A study by Murphy et al. found that the BMI of milk drinkers was comparable to or lower than that of non-milk drinkers, in children 2-5 years and 6-11 years, and in males 12-18 years, respectively (31). There was no difference in total intake of added sugars between flavored milk drinkers and non-milk drinkers. Similarly, an earlier study found that flavored milk drinkers had higher calcium and nutrient intakes compared to nondrinkers but did not have higher added sugar or total fat intakes, both important considerations for weight control (29).

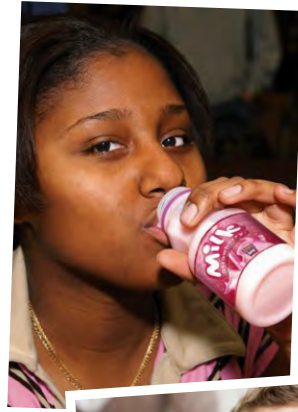
Dental Caries

It is known that sugar consumption can contribute to tooth decay, however experts agree that flavored milk is a good choice for healthy teeth. Studies have demonstrated that several components in chocolate milk such as calcium, phosphorus, protein, and cocoa may protect teeth from decay (32). Because flavored milk is a liquid, it may be less likely to cause cavities than other foods such as raisins or candies that adhere to tooth surfaces. A briefing paper on milk, flavored milk products, and

dental caries concluded that the cariogenicity (cavity-forming potential) of flavored milks is “negligible to low” and, when consumed in moderation, flavored milks are a preferable alternative to similarly sweetened soft drinks (49). The American Academy of Pediatric Dentistry states that “chocolate milk is OK for your teeth” (45).

Hyperactivity

Hyperactivity is defined as a cluster of symptoms including excitability, learning difficulties, and short attention span. Claims that sugar consumption can lead to hyperactivity or interfere with academic performance in children were popular during the 1990s but several reviews on the subject state that this notion is scientifically unsubstantiated (39, 50). For example, a meta-analysis of 23 studies performed over a 12-year period concluded that sugar intake does not affect children's behavior (51).



OTHER QUESTIONS ABOUT FLAVORED MILK

Caffeine in Chocolate Milk

Chocolate milk contains a small amount of caffeine per serving compared to many other caffeinated beverages (52). The 2 to 7 mg of caffeine in an 8 ounce serving of chocolate milk is similar to that in one cup of decaffeinated coffee and 5 times less than an equal amount of iced tea or some regular soft drinks (52). The amount of caffeine in a serving of chocolate milk is relatively small compared to the average total daily caffeine intake by children of 14-22 mg or about 0.8 - 0.85 mg/kg body weight (52-53).

Caffeine's effects on behavior depend on an individual's usual intake and tolerance or sensitivity to caffeine (53). At lower doses, caffeine is associated with positive subjective effects such as mild stimulation, whereas at higher intakes, negative effects are reported such as a delay of sleep onset (53). A meta-analysis of double blind, placebo-controlled studies of dietary caffeine and/or supplementary caffeine treatment and behavior in children and adolescents led to the conclusion that caffeine has no adverse cognitive or behavioral effects in children (54). However, very high caffeine intakes (>3mg/kg) in children whose usual caffeine intake is low led to negative subjective reports of nervousness, stomach aches, and nausea (54). While possible adverse behavioral effects of caffeine have been cited as a reason for restricting or eliminating chocolate milk from children's diets, there is no persuasive scientific evidence to justify this concern (52, 54). Consuming the recommended amount of daily servings of low-fat or fat-free dairy foods, including flavored milk, can help children meet nutrient needs without contributing to excessive caffeine intake.

Calcium Absorption

Chocolate milk contains a small amount of oxalic acid (0.5-0.6%), a compound occurring naturally in cocoa beans and other plants. In some instances, oxalic acid can combine with calcium in the intestine to form calcium oxalate, which is fairly insoluble. Scientific evidence indicates that the oxalic acid in chocolate milk does not impair calcium absorption, and calcium absorption from chocolate milk has been found to be similar to that from unflavored milk and other calcium-containing foods (55-56).

Lactose Intolerance

People with lactose maldigestion may tolerate chocolate milk more easily than unflavored milk (57-58). Lactose maldigestion is the limited ability to digest lactose, the main carbohydrate in milk, due to insufficient levels of the intestinal enzyme lactase. Lactose maldigestion may manifest into gastrointestinal symptoms, known as lactose intolerance, with excess lactose intake. Most individuals with lactose maldigestion can comfortably drink 2 cups of any type of milk a day when consumed in small servings with foods at separate meals (e.g., breakfast and dinner) (59-60). Because most individuals drink flavored milk such as chocolate milk with meals (61), this beverage is likely to be well tolerated by lactose maldigesters. Also, the cocoa in chocolate milk may slow gastric emptying (58-59). In one study of 16 individuals with lactose maldigestion who consumed chocolate and other milks, chocolate milk significantly reduced breath hydrogen production compared to fat-free unflavored milk (58).



FLAVORED MILK IN SCHOOLS

Flavored milk is an important part of school nutrition programs and its inclusion can help children meet nutrient needs to support bone development during peak bone building years. Flavored milk is the most popular milk choice among school children and

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accounts for 66% of all milk sold in schools according to a recent report based on the U.S. Department of Agriculture's *School Nutrition Dietary Assessment Studies I and III* (28, 62). A study among northern Texas elementary school students aged 6 to 11 years found that milk's flavor was the most important factor influencing children's milk drinking, with the majority of children choosing chocolate milk at school (63). A credit to its popularity, the study reported that children's typical advice to new students included "get chocolate milk" (63).

Capitalizing on flavored milk's popularity and encouraging availability of flavored milk in schools is an important way to help children meet daily calcium and other essential nutrient recommendations at a time when milk intake typically declines. The percentage of students consuming milk (flavored and unflavored) at lunch progressively decreases from elementary school to middle school to high school (28). As milk intake decreases, particularly between the ages of 10 to 18 years which overlaps with the peak bone building years, intake of

carbonated beverages dramatically rises with total daily consumption more than three times higher than total daily milk consumption by age 18 (64). The consequences of not consuming adequate amounts of milk or milk products can be detrimental to bone development and overall health (5, 32).

A School Milk Pilot Test, co-sponsored by SNA and National Dairy Council (NDC), found that children drank more milk when schools offered ice-cold milk in various flavors (strawberry, chocolate, etc.) and in plastic, re-sealable containers, in different sizes and different merchandising locations (e.g., vending machines, a la carte cafeteria, school stores) (65). Participating schools consisted of 47 elementary and 99 secondary schools in eight states across the country including school districts in Utah, California, Florida Virginia, Pennsylvania, Massachusetts, New York and West Virginia. This pilot study demonstrated that simple improvements to school milk, including offering a variety of flavors served cold and in plastic containers, not only increased milk consumption in primary and secondary schools by an average of 37%, but also increased average daily school lunch participation at the secondary level by 5% (65).



Since 90% of flavored milks sold were low-fat or fat-free its inclusion in the school nutrition programs is likely encouraging the consumption of low-fat and fat-free milk (61), a component of the *Dietary Guidelines for Americans* “Food Groups to Encourage.”

Offering flavored milk in schools as part of the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) can increase milk and nutrient intake and can help children and adolescents meet the DGA recommendations for milk and dairy foods (66-68). Children who participate in the NSLP are more likely than non-participants to consume more total milk (75% vs. 19%) and more flavored milk (50% vs. 9%) at lunch. Moreover, this trend has been shown to persist over 24 hours (28). When approximately 400 elementary school children in Pennsylvania were provided with an option of having chocolate milk included in school meals, more milk was consumed and intake of nutrients such as calcium and riboflavin increased (66). Likewise, when 6th grade students in an elementary school in New York City were provided with low-fat (1%) chocolate milk as part of the NSLP, children’s milk and nutrient (e.g., calcium, riboflavin, phosphorus) intakes increased (68).

The inclusion of flavored milk in school meal programs may help students consume more low-fat or fat-free milk. A report on the U.S. Department of Agriculture’s *School Nutrition Dietary Assessment Studies I and III* found a significant shift in milk consumption from the early 1990s when approximately three-quarters of students chose whole-fat or reduced-fat (2%) milk in school to the 2004/2005 school year when more than three-quarters of students chose low-

fat (1%) or fat-free (62). Since 90% of flavored milks sold were low-fat or fat-free (62) and flavored milk was the most popular choice among students (28), its inclusion in the school nutrition programs is likely encouraging the consumption of low-fat and fat-free milk (62), a component of the DGA “Food Groups to Encourage.” The AAP and the IOM Committee on Nutrition Standards for Foods in Schools acknowledge key nutrient contributions that milk, including low-fat and fat-free flavored milk, makes to children’s diets (27, 40).

FLAVORED MILK IN SCHOOL NUTRITION POLICY

Increasing rates of childhood and adult obesity have resulted in greater efforts to address the epidemic by changing the school environment. Excess intake of macronutrients such as sugar and fat can lead to increased caloric intake and weight gain. Some groups have called for a reduction of added sugars in sweetened foods and beverages, including flavored milk, particularly within the school environment (40, 69-70). Currently there is no consensus on national school nutrition standards for foods and beverages, including sugar and caloric content of flavored milks. However, Congress is expected to address national school nutrition standards in 2009 when it reauthorizes the 2004 Child Nutrition Act. The SNA has called for the adoption of a uniform national, science-based nutrition standard for all foods served in schools, including no more than 28 grams of sugar per 8 ounce serving of milk and offering only low-fat or fat-free milk (70).

The Alliance for a Healthier Generation recommends that low-fat and fat-free flavored milks contain no more than 150 calories per 8 ounce serving (69). The IOM’s report, *Nutrition Standards for Foods in Schools*, recommended that low-fat and fat-free flavored milks contain up to 22 grams of total sugar (naturally occurring and added) per 8 ounce serving (40). The IOM beverage guidelines recommend that only milk, water and 100% fruit juice be available in schools, and that non-nutritive sweeteners only be allowed in beverages sold in high schools, outside of the school day hours. In debating nutrition policy, some lawmakers have also proposed specific nutrient parameters. For example, U.S. Senator Tom Harkin, chairman of the Senate Committee on Agriculture, Nutrition & Forestry, proposed legislation in the 2008 session of Congress that would mandate national school nutrition standards, including a cap on flavored milk at 170 calories per 8 ounce serving.

The AAP, in their policy statement on soft drinks in schools, recommends reducing intake of sweetened beverages such as soft drinks, and replacing them with healthful offerings such as real fruit and vegetable juices, water, and low-fat white or flavored milk (27).

To help children meet Milk Group recommendations, the acceptability and availability of nutrient-rich flavored milk in schools is critical. When used in moderation and with consideration of overall caloric balance, sugars can increase the appeal of nutrient-dense foods and beverages, thereby providing



additional choices to meet nutritional needs in the context of a healthful diet (1). Flavored milk is the most popular milk choice in schools and may even help children choose low-fat or fat-free milk options more often since 90% of flavored milks consumed are low-fat or fat-free (62). For a product to be acceptable, it must also taste good since no one wins when children throw away their nutrient-rich milk because they don't enjoy the taste.

NDC recognized that having acceptable and palatable flavored milk formulations containing reduced levels of added sugar to offer in schools is a priority in the school environment. The dairy industry conducted research among children aged 8 to 17 years to determine the palatability of new lower sugar formulations for flavored milk. This research suggests that flavored milk of 150 to 170 calorie range per 8 ounces — depending on brand — meets children's taste approval (71). However, while these flavored milks may be acceptable, palatable and meet lower-calorie and sugar recommendations, these formulations have limited availability and can cost more to produce. Higher costs may further reduce availability for cost-conscious schools. Limited product availability of the most popular milk choice in school may reduce consumption of milk and the nutrients it contains during the peak bone-building years.

Flavored milk remains an important component of school meals, and all types can help school-aged children meet intake recommendations for the calcium, potassium and other nutrients they need for proper growth and development. The dairy industry is working to continue to expand and diversify milk choices including a range of reduced sugar formulations to help meet the varied needs (including taste, nutrition and overall acceptability) of today's schools and their milk drinkers.

ATTITUDES TOWARD FLAVORED MILK

Parents and health professionals both support offering flavored milk to children. A review of qualitative consumer research conducted in 2005 by NDC suggests both health professionals and parents would encourage their child to drink flavored milk when away from home because the overall goodness of milk simply outweighs any concerns with sugar (72). A quantitative survey of more than 4,000 moms found that 92% are comfortable with their child drinking chocolate or flavored milk with their school lunch (73). Within the same survey, 83% of moms would prefer for their children to drink flavored milk as opposed to soft drinks at school and 84% knew that flavored milk and unflavored milk have approximately the same nutritional value (73). A more recent survey also found that a majority of moms do not feel that the sugar in chocolate milk is excessive (74). In a survey of more than 400 family practitioners, dietitians and pediatricians, a majority thought it was important that children drink more milk, regardless of whether it was flavored or unflavored (75). The positive attitudes of both parents and health professionals toward flavored milk and encouragement of its consumption can be conducive to helping children meet dairy food intake recommendations.

SUMMARY AND CONCLUSIONS

Flavored milks are well liked and health professionals support intake of this beverage. The availability of flavored milk can increase overall milk and nutrient intake in schools. Research indicates that health and behavior concerns about flavored milk and weight gain or hyperactivity are unfounded. This review addresses various nutritional and health topics related to flavored milk and indicates the following:

- The 2005 DGA encourages the consumption of 3 servings of low-fat or fat-free dairy foods each day for those age 9 and older, and flavored milk is a nutrient-rich and appealing beverage choice for children that can help them meet nutrient recommendations.
- Flavored milks – whole, reduced-fat, low-fat or fat-free – contain the same essential nutrients as unflavored milks. Chocolate milk, for example, provides calcium, potassium, phosphorus, protein, vitamin A, D and B12, riboflavin and niacin (as niacin equivalents) and contains 2 to 4 teaspoons of added sugar that accounts for about 60 more calories per serving than unflavored milk.
- When used in moderation and with concern for overall caloric balance, sugars can increase the appeal of nutrient-rich foods and provide additional choices for children to meet nutritional needs in the context of a healthful diet.
- Research shows that children who drink flavored milk can increase milk and nutrient intake without increasing added sugar or total fat intake and without adversely affecting BMI, a measure of weight status.
- Intake of sugar may contribute to dental caries, but it is unlikely that flavored milks cause this condition. Components in flavored milk including calcium, phosphorus, and cocoa in chocolate milk may protect teeth from decay.
- Flavored milk is a healthful, nutrient-rich product for schools and wellness policies and is the most popular milk choice among school children. Since most of the flavored milk consumed in schools is low-fat or fat-free, its presence in schools may be helping children transition to consuming lower fat milk.
- A variety of reduced sugar formulations may help meet the varied needs of schools, including taste, nutrition, and overall acceptability.

REFERENCES

1. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *Dietary Guidelines for Americans, 2005*. Washington, DC: US Government Printing Office, 2005.
2. U.S. Department of Agriculture, Agricultural Research Service. *National Nutrient Database for Standard Reference, Release 21*, 2008.
3. U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, 2004.
4. Heaney RP. *J Am Coll Nutr.* 19(suppl): 83s, 2000.
5. Greer FR, Krebs NF, and the Committee on Nutrition. *Pediatrics.* 117: 578, 2006.
6. Appel LJ, Moore TJ, Obarzanek E, et al. *N Engl J Med.* 336: 1117, 1997.
7. Chobanian AV, Bakris GL, Black HR, et al. *J Am Med Assoc.* 289: 2363, 2003.
8. Alonso A, Beunza JJ, Delgado-Rodriguez M, et al. *Am J Clin Nutr.* 82: 972, 2005.
9. Djousse L, Pankow JS, Hunt SC, et al. *Hypertension.* 48: 335, 2006.
10. Pereira MA, Jacobs DR, Van Horn L, et al. *J Am Med Assoc.* 287: 2081, 2002.
11. Zemel MB, Thompson W, Milstead A. et al. *Obes Res.* 12: 582, 2004.
12. Zemel MB, Richards J, Russell A, et al. *Int J Obesity* 29: 341, 2005.
13. Mirmiran P, Esmailzadeh A, Azizi F. *Int J Obes.* 29: 115, 2005.
14. Heaney RP and Rafferty K. *Nutr Rev.* 67: 32, 2009.
15. Holt, PR, EO Atillasoy, J. Gilman, et al. *J Am Med Assoc.* 280: 1074, 1998.
16. Huncharek M, Muscat J, Kupelnick B. *Nutr Cancer.* 61:47, 2009.
17. Larsson SC, Bergkvist L, Rutegard J, et al. *Am J Clin Nutr.* 83: 667, 2006.
18. Park S, Murphy SP, Wilkens, et al. *Am J Epidemiol.* 165: 784, 2007.
19. Azadbakht L, Mirmiran P, Esmailzadeh A, et al. *Am. J Clin Nutr.* 82: 523, 2005.
20. Choi HK, Willett WC, Stampfer MJ, et al. *Arch Intern Med.* 165: 997, 2005.
21. Liu S, Choi HK, Ford E, et al. *Diabetes Care.* 29: 1579, 2006.
22. Elwood PC, Pickering JE and Fehily AM. *J Epidemiol Community Health.* 61: 695, 2007.
23. Wells HF and Buzby JC. *Dietary Assessment of Major Trends in U.S. Food Consumption, 1970-2005*. Economic Information Bulletin No. (EIB-33). U.S. Department of Agriculture, Economic Research Service, March 2008.
24. Cook AJ and Friday JE. U.S. Department of Agriculture, Community Nutrition Research Group. *Pyramid Servings Intakes in the United States 1999-2002, 1 Day*, CNRG Table Set 3.0.
25. Striegel-Moore RH, Thompson D, Affenito SG, et al. *J Pediatr.* 148: 183, 2006.
26. Nielsen SJ and Popkin BM. *Am J Preventative Med.* 27: 205, 2004.
27. American Academy of Pediatrics, Committee on School Health. *Pediatrics.* 113: 152, 2004.

REFERENCES

28. U.S. Department of Agriculture, Food and Nutrition Service. *School Nutrition Dietary Assessment Study — III*. Alexandria, VA: Food and Nutrition Service, USDA, November 2007.
29. Johnson RK, Frary C, and Wang MQ. *J Am Diet Assoc.* 102: 853, 2002.
30. Frary, CD, Johnson RK, and Wang MQ. *J Adol Health.* 34: 56, 2004.
31. Murphy MM, Douglass JS, Johnson RK, et al. *J Am Diet Assoc.* 108: 631, 2008.
32. Miller, G.D., J.K. Jarvis, and L.D. McBean. *Handbook of Dairy Foods and Nutrition*. Boca Raton, FL: CRC Press, 2007.
33. Kalkwarf, HJ, Khoury JC and Lanphear BP. *Am J Clin Nutr.* 77: 257, 2003.
34. Moore LL, Bradlee ML, Gao D, et al. *J Pediatr.* 153: 667, 2008.
35. U.S. Department of Agriculture, Agriculture Research Service. Usual Nutrient Intakes from Food and Water Compared to 1997 Dietary Reference Intakes for Vitamin D, Calcium, Phosphorus, and Magnesium. *What We Eat in America*. NHANES 2005-2006, 2009.
36. Wagner CL, Greer FR, and the Section on Breastfeeding and Committee on Nutrition. *Pediatrics* 122: 1142, 2008.
37. Food and Drug Administration. *Fed. Register* 61(225): 58991-59002,1996.
38. O'Donnell S, Cranney A, Horsley T, et al. *Am J Clin Nutr.* 88: 1528, 2008.
39. American Dietetic Association. *J Am Diet Assoc.* 104: 255, 2004.
40. Institute of Medicine. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: National Academy Press, 2007.
41. Johnson RK, Lawrence JA Brands AM, et al. Dietary Sugars Intake and Cardiovascular Health: A Scientific Statement from the American Heart Association. *Circulation.* 2009, 120:1011-1020.)
42. Bhatia, J.J.S., and F.R. Greer. *AAP News* 28 (June), 2007. www.aapnews.org. Accessed July 9, 2009.
43. Kranz S, Lin P-J and Wagstaff DA. *J Pediatr.* 151: 642, 2007.
44. Vatanparast H, Lo E, Henry CJ, et al. *Nutr Res.* 26: 325, 2006.
45. American Academy of Pediatric Dentistry. *AAPD Fast Facts. Diet and Dental Health*, 2008. www.aapd.org/media/fastfacts08.pdf. Accessed July 9, 2009.
46. Fulgoni V. *Am J Clin Nutr.* 88: 1715S, 2008.
47. American Medical Association, Council on Science and Public Health. *The Health Effects of High Fructose Syrup*. Report 3 of the Council on Science and Public Health (A-08), 2008.
48. International Food Information Council Foundation. *What Science Says About Fructose*. Food Insight. July/August, 2008.
49. Levine RS. *Br Dent J.* 191: 20, 2001.
50. White JW and Wolraich M. *Am J Clin Nutr.* 62(suppl): 242, 1995.
51. Wolraich ML, Wilson DB and White JD. *J Am Med Assoc.* 274: 1617, 1995.
52. International Food Information Council Foundation. *Caffeine and health: clarifying the controversies*. *IFIC Review*. March 2008.

REFERENCES

53. Fredholm BB, Battig K, Holmen J, et al. *Pharmacol Rev.* 51: 83, 1999.
54. Stein, MA, Krasowski M, Leventhal BL, et al. *Arch Pediatr Adol Med.* 150: 284, 1996.
55. Recker RR, Bammi A, Barger-Lux MJ, et al. *Am J Clin Nutr.* 47: 93, 1988.
56. Heaney RP, and Weaver CM. *Am J Clin Nutr.* 50: 830, 1989.
57. Lee CM and Hardy CM. *Am J Clin Nutr.* 49: 840, 1989.
58. Dehkordi N, Rao DR, Warren AP, and Chawan CB. *J Am Diet Assoc.* 95: 484, 1995.
59. Suarez FL, Savaiano D, Arbisi P, et al. *Am J Clin Nutr.* 65: 1502, 1997.
60. Suarez FL, Adshead J, Furne JK, et al. *Am J Clin Nutr.* 68: 1118, 1998.
61. Attitude and Usage Trend Study (AUTS). *Chocolate Milk. Beverage Usage & Attitudes Among Consumers.* May 2001.
62. ENVIRON International Corporation. *School Milk: Fat Content Has Declined Dramatically since the Early 1990s,* 2008.
63. Conners P, Bednar C, and Klammer S. *J Nutr Educ.* 33: 31, 2001.
64. Rampersaud GC, Bailey LB and Kauwell GP. *J Am Diet Assoc.* 103: 97, 2003.
65. National Dairy Council and School Nutrition Association. *The School Milk Pilot Test.* Beverage Marketing Corporation for National Dairy Council and School Nutrition Association. 2002.
66. Guthrie HA. *J. Am. Diet. Assoc.* 71: 35-40, 1997.
67. Kimbrough JR., Shanklin CW and Gench BE. *School Food Service Research Rev.* 14: 24, 1990.
68. Garey JG, Chan MM and Parlia SR. *J Am Diet Assoc.* 90: 719, 1990.
69. Alliance for Healthier Generation. *Alliance School Beverage Guidelines.* www.healthiergeneration.org/schools.aspx?id=108. Accessed July 9, 2009.
70. School Nutrition Association. *National Nutrition Standards Recommendations, 2008.*
71. Dairy Management Inc. *New Lower-Calorie Flavored Milk Formulations Address Nutrition Issues and Win Kids' Approval,* 2008. www.innovatewithdairy.com. Accessed July 9, 2009.
72. Teri Gacek Associates (TGA): *Flavored Milk & Sugar — Is It An Issue For Moms, Dietitians and Pediatricians?* A Qualitative Exploration for Dairy Management Inc. (DMI), November 2005.
73. National Dairy Council. *Online Survey of More Than 4,000 Moms Who Subscribe to the 3aday.org E-Newsletter on Behalf of the National Dairy Council/3-A-Day of Dairy,* November 2005.
74. GfK Custom Research North America. *Attitudes About Milk and Other Dairy Products: 2008 Kids Milk Tracking Study,* Prepared for Dairy Management Inc., 2009.
75. GfK Custom Research North America. *2008 Health Professionals Dairy Nutrition Tracking Study,* Prepared for Dairy Management Inc., 2009. ba/bhnrc/ndl.