Linda Nebeling, PhD, MPH, RD
Chief, Health Promotion Research Branch
National Cancer Institute
Bethesda, Maryland

Phytochemicals
The Color of a Healthy Diet

Synopsis — During recent decades, studies examining the relationship between dietary patterns and health have found that eating a diet rich in fruits and vegetables has been associated with the prevention and/or treatment of at least four of the leading causes of death in the US. Phytochemicals, unique components found only in plants, are an important source of this protective effect.

Unfortunately, only one in five US children eats five or more servings of fruits and vegetables each day, with potato chips, condiments, and candy comprising a sizable portion of their total fruit and vegetable intake.

In order to reap the unique health benefits of phytochemicals, children need opportunities to socialize to a wide variety of fruits and vegetables during pleasant mealtime experiences. Choosing five or more colorful servings each day is a practical goal for families to strive for everyday.

During recent decades, many studies have examined the relationship between vegetables, fruits and health. While early studies on diet and cancer typically focused on dietary components thought to increase disease risk (saturated fats and fiber are two examples),[1,2] recent studies have focused on the protective benefits of fruits and vegetables.[3] For example, eating a diet rich in an abundance of fruits and vegetables has been associated with the prevention and/or treatment of at least four of the leading causes of death in the US (cancer, heart disease, diabetes, and high blood pressure).[4-7] Phytochemicals, unique components found only in plants, are an important source of this protective effect. Fruits and vegetables are also excellent sources of complex carbohydrates, dietary fiber, and several vitamins and minerals. As a result, nutrition and health professionals now stress the need for change in our dietary pattern, recommending a shift to one with less fat, saturated fat, and refined carbohydrates, and more complex carbohydrates, particularly from plant-based foods.

Unfortunately, the public's perception that fruits and vegetables provide significant health benefits does not correlate to increases in their intakes. In fact, the proportion of the adult population who has made it a habit to eat generous amounts of fruits and vegetables

The three most important factors for determining adult fruit and vegetable intakes are 1) the number of servings they thought they should have a day, 2) whether they liked the taste, and 3) whether they had been in the habit of eating lots of fruits and vegetables since childhood.

Families routinely sampling fruits and vegetables from each color group will benefit from a unique array of phytochemicals, as well as the essential vitamins, minerals and fiber that each group has to offer.

since childhood is declining. Only about a quarter of adults between 18 and 49 years of age eat five or more servings of vegetables a day, compared with 38% of adults between 50 and 64, and nearly half of adults age 65 and older.[8] The three most important factors for determining fruit and vegetable intakes were 1) the number of servings they thought they should have a day, 2) whether they liked the taste, and 3) whether they had been in the habit of eating lots of fruits and vegetables since childhood. This article explores the role of phytochemicals in the diet and stresses the importance of helping young children achieve the "5 A Day" habit right from the start.

What is a Phytochemical?

Phytochemicals impart health benefits to humans in addition to those provided by vitamins and minerals alone. Phytochemicals differ from vitamins and minerals in that they are not considered "essential" nutrients, i.e., those which are critical for normal metabolism and growth. With the exception of carotenoids, they are similar to vitamins and minerals in that they are not stored in the body for later use and must be consumed consistently over time.

Phytochemicals are part of a plant's natural systems of defense and repair. Our bodies utilize a small fraction of these components by incorporating them into various cellular and metabolic processes that enhance cellular growth, regeneration and repair. Some phytochemicals act as antioxidants, some protect and regenerate essential nutrients, still others work to deactivate cancer-causing substances.

Phytochemicals are also important to a plant's reproductive system, in that some of these components are responsible for the bright, beautiful colors that make plants appear more attractive to insects and animals, encouraging cross-pollination. The specific phytochemical content of fruits and vegetables tends to vary by the fruit or vegetable's color, with each component possessing unique functions. There are thousands of phytochemicals in plants, but not all have specific benefits to human health.

Perhaps the most well known phytochemicals are the antioxidant group, which protect cells from damage caused by the by-products (free radicals) of metabolism, as well as toxic substances in the environment and foods. At high levels, reactive species, such as reactive oxygen and nitrogen species, can be damaging to cells and may contribute to cellular dysfunction and disease. Antioxidants significantly decrease the adverse effects of reactive species by eliminating free radicals as they circulate throughout the body. Beta-carotene and the other carotenoids are not antioxidants, but influence the biochemical reactions involved in the oxidative process.[9] Other phytochemicals include: sulfides (allium), indoles, phytosterols, protease inhibitors, phenols, tannins and terpenes.[5,10,11]

The Nutrition Rainbow

The fruits and vegetables of plants contain the most concentrated sources of health-promoting phytochemicals, which is why it is important to eat a wide variety of colorful produce every day. In addition to the unique array of phytochemicals, families routinely sampling fruits and vegetables from each color group will benefit from the essential vitamins, minerals and fiber that each group has to offer.

Deep Oranges and Bright Yellows

Sweet potatoes, carrots, pumpkins, cantaloupe, mangoes and peaches all contain beta-carotene, a common phytochemical within a group of over 600

Unfortunately, the fruits and vegetables contained in potato chips, condiments, and candy make up a sizable portion of the total fruit and vegetable intake for US children and adolescents.

called carotenoids. In the body, beta-carotene is converted to vitamin A, which has many vital functions, including the growth and repair of body tissues, the formation of bones and teeth, the resistance of the body to infection, and the development of healthy eye tissues. Only five or six carotenoids are currently recognized to have specific health benefits in the diet. The rest have functions, predominantly related to the color component of the plant.

Citrus fruits, such as oranges, grapefruits, and tangerines, contain the antioxidant vitamin C. They also contain bioflavonoids, a group of phytochemicals that work together with vitamin C to help reduce the risk of cancer, strengthen bones and teeth, help heal wounds, keep skin healthy, and lower the risk of heart attack.[12]

Deep Greens

Green leafy vegetables, such as spinach, Romaine lettuce, collard greens, kale and broccoli contain lutein, a powerful antioxidant that helps reduce the risk of cataracts and macular degeneration.[6,13] Green peas, honeydew melon, kiwifruit and avocado are also excellent sources of lutein.

Cruciferous vegetables, such as broccoli, cauliflower, cabbage, and Brussels sprouts all contain indoles, which help protect against breast cancer in women and prostate cancer in men. In a recent study, men who ate cruciferous vegetables at least three times a week had a 42% reduction in their risk of prostate cancer.[14]

Deep Reds and Bright Pinks

Watermelons, pink grapefruits, and tomatoes are all good sources of lycopene, one of the 600 carotenoids. Tomato-based products, such as tomato sauce, tomato soup, and tomato juice have the most concentrated source of lycopene.[15] Cooked tomato sauces are associated with greater health benefits, compared to uncooked, because the heating process makes lycopene more easily absorbed by the body. Lycopene is fat soluble, so it must be eaten with at least a small amount of fat.

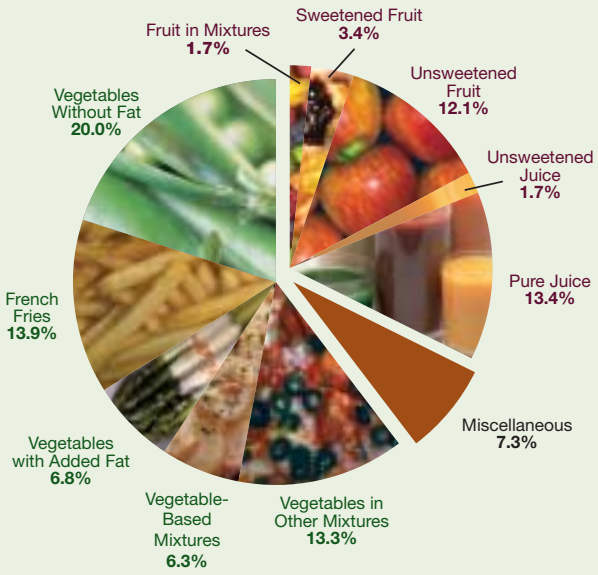
Blues and Purples

Blueberries, blackberries, grapes, plums, raisins and eggplant all contain the disease-fighting phytochemicals anthocyanine and polyphenols.[2,11] These powerful antioxidants help reduce the risk of several diseases including cancer, heart disease and Alzheimer's, and may even slow down the aging process. Research suggests that eating blueberries, in particular, may prevent some of the effects of aging by improving cell communication in the central nervous system.[12]

Whites

Garlic, onions and leeks may be lacking color, but they are bursting with powerful phytochemicals, including allicin, the most common phytochemical in this group.[12] Research has shown that eating allicin-containing garlic and onions every day lowers cholesterol and blood pressure and increases the body's ability to fight infections. Nutrition research also shows that eating vegetables from the onion family may speed recovery from colds, reduce the risk of heart attacks, and even stop the spread of certain cancers, particularly stomach and colon cancer. Adding garlic and onions to recipes is the same as eating a serving of vegetables.

Figure 1:
Children's Fruit and Vegetable Consumption Patterns



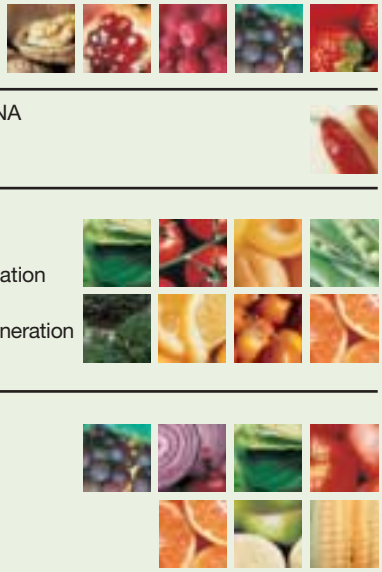
Ways fruits and vegetables are consumed by children shown as a proportion of **total** fruit and vegetable intakes.

Adapted from: Krebs-Smith SM et al: Fruit and vegetable intakes of children and adolescents in the United States. Arch Ped Adolesc Med 150:81-6, 1996.

French-fried potatoes alone constitute 23% of all vegetables consumed. Children of all ages have especially low intakes of citrus, melon, and berries and of dark green and/or deep yellow vegetables.

Table 1:
Phytochemicals: Functions and Presence in Fruits and Vegetables

Phytochemicals	Fruits	Vegetables	Function
Anthocyanine/ Polyphenols	◆	◆	Antioxidant
Capsaicin		◆	Antioxidant; prevents carcinogens from binding to DNA
Carotenoids			
Alpha Carotene		◆	Antioxidant; inhibits cell proliferation
Beta Carotene	◆	◆	Antioxidant; precursor to vitamin A; helps in differentiation of normal epithelial cells; inhibits cell proliferation
Lutein		◆	Antioxidant; protects against cataracte, macular degeneration
Lycopene	◆	◆	Antioxidant
Flavonoids			
Kaempferol	◆	◆	Antioxidant; may reduce cell proliferation; extends action of vitamin C; inhibits blood clot formation; antinflammatory action
Nobiletin	◆		
Rutin	◆		
Tangeretin	◆		
Quercetin	◆	◆	
Resveritrol	◆		Antioxidant; protects against heart disease
Glucosinolates/Indoles			
Dithiolthiones		◆	Increases activity of enzymes involved in detoxication of carcinogens and other foreign compounds
Glucosbrassicin		◆	Forms Indoles
Indoles		◆	Protects against estrogen-promoted cancers, induces protective enzymes
Isothiocyanates			
Sulphorophane		◆	Exceptionally potent inducer of detoxification enzyme
Phytoestrogens			
Biochanin A		◆	Antioxidant; inhibits growth of cancer cells; lowers blood cholesterol level and platelet aggregation
Genistein		◆	
Lignans	◆	◆	Antioxidant; may block or suppress cancerous changes
Phytosterols		◆	Protects against hormone-dependent cancers; slows colon cancer and growth
Protease Inhibitors		◆	Anticancer agent; suppresses enzyme action of cancer cells
Saponins		◆	Anticancer activity; possibly by preventing tumor cell division; binds bile acid and cholesterol to help reduce cholesterol level
Sulfides (Allium)			
Allyl methyl trisulfide		◆	Stimulates anticancer enzymes, detoxifies carcinogens; antibacterial activities may inhibit conversion of nitrate to nitrite, thereby reducing formation of nitrosamines which are thought to be carcinogenic
Diallyl sulfide		◆	
Tannins	◆	◆	Prevents carcinogens from binding to target sites
Terpenes			
D-Limonene	◆		Increases activity of glutathione transferase, a detoxification enzyme



Adapted from: VanDuyn MS, Pivonka E: Overview of the health benefits of fruit and vegetable consumption for the dietetics professional. Am Diet Assoc 100:1511-21, 2000.

Research shows that children's taste preferences account for only 9-13% of the variability in children's actual consumption patterns, suggesting that other factors are involved, including the likes and dislikes of others in their social environments, such as parents and their peers.

Children's Consumption Patterns

Unfortunately, the fruits and vegetables contained in potato chips, condiments, and candy make up a sizable portion of the total fruit and vegetable intake for US children and adolescents (Figure 1).[16] Fruits and fruit juices constitute about one third and vegetables about two thirds of total fruit and vegetable intakes by children. French-fried potatoes alone constitute 23% of all vegetables consumed. Children of all ages have especially low intakes of citrus, melon, and berries and of dark green and/or deep yellow vegetables.

Despite the target health objective of five or more servings of fruits and vegetables each day, only one in five US children attains this goal consistently. Remarkably, one half of all children age 2 to 18 years consume less than one serving of fruit per day. The percentage of children consuming less than a serving of vegetables a day is not as high, but increases dramatically when fried vegetables (almost entirely French-fried potatoes) are excluded.

The research confirms that developing a habit of eating generous quantities of fruits and vegetables during early childhood is a significant positive predictor of fruit and vegetable intake among adults. Therefore, in addition to giving infants and young children a good start in life, beginning the "5 A Day" eating pattern early on has implications for long-term health.

Urbanization and Migration Studies

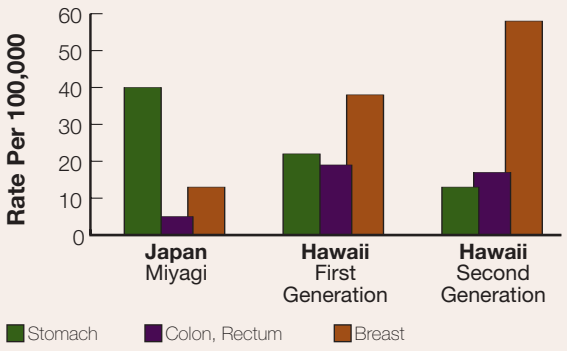
Epidemiologic data, especially from migrant studies, suggest that "childhood eating patterns are important determinants of adult risk of certain diet-related cancers."[16,17] Migrants share a common genetic background with their parents as well as their children. Therefore, changes in the patterns of cancer rates, for example, as people of the same genetic background move from one part of the world to another, is evidence of the extent to which changes in relevant environmental factors, including diet, influence risk.[17]

For example, cancer rates among women in successive generations of Japanese women who migrated to Hawaii are shown in Figure 2.[18] Stomach cancer rates dropped by almost a half in the first generation (the migrants themselves in Hawaii) and by over two-thirds in the second generation (the migrants' children). By sharp contrast, rates of breast cancer increased almost three times in the first generation and were between four and five times higher in the second generation. Cancer of the colon and rectum increased almost four times in the first generation, but did not increase further in the second generation.

A study of deaths from breast cancer among Italian migrants to Australia demonstrates just how quickly cancer rates change among migrants in a new country. In this study, breast cancer death rates among Italian

continued on page 8

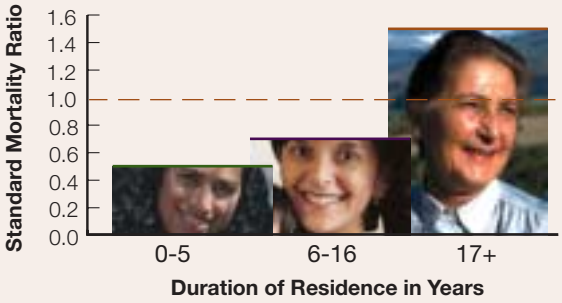
Figure 2:
Cancer Rates Among Successive Generations of Japanese Immigrant Women in Hawaii



Adjusted to the World Standard Population (From Kolonel et al, 1980)

Reference: Patterns of Cancer. In: Food, Nutrition and the Prevention of Cancer: A Global Perspective. American Institute for Cancer Research, Washington DC, 1997.

Figure 3:
Breast Cancer Death Rates Among Italian Immigrant Women in Australia



Adjusted to the World Standard Population. Australian-born = 1.0 (From McMichael and Giles, 1988)

Reference: Patterns of Cancer. In: Food, Nutrition and the Prevention of Cancer: A Global Perspective. American Institute for Cancer Research, Washington DC, 1997.

Putting Research Into Practice

with Dennis M. Bier, MD

Even before they experience their first taste of solid foods, infants are learning to appreciate the flavors of the foods from their family's table. Initially, the exposure is via the amniotic fluid, and later, during breastfeeding. One of the most unheralded advantages of breastfeeding may be how it familiarizes infants to a variety of flavors, facilitating the acceptance of complementary foods.

Breastfeeding also allows infants to choose their own portion sizes. Mothers typically nurse their babies until the child "says" he is satisfied. Since actual intake is difficult to discern, mother lets her baby guide the feeding. She doesn't inadvertently teach patterns of overconsumption by pressuring her child to finish the last ounce in a bottle.

Both of these feeding principals – flavor variety and child-directed consumption patterns – should be carried over when solid foods are started. Offering a variety of flavors and textures during mealtimes varies the nutrients and phytochemical components of the diet and parallels recommendations to build to a variety of foods to ensure nutritional adequacy.

Similarly, infants eating complementary foods shouldn't be forced to use the bottom of the jar as the portion size. They should be allowed to determine just how much they want to eat. This is highly variable since in the beginning a "portion" may only add up to a teaspoon of food, and later a small fraction of an adult portion.

Infants' faces provide excellent feedback during mealtimes. A smile, smacking lips, or an eager mouth all may mean, "That tastes good." or "I want more." While pursed lips, turning the head away, or crying all may mean, "That tasted nasty!" or "Enough already!" Parents need to

be careful, however, not to interpret all of the funny faces that their infants make as a critical review of a food's taste. The infant may just be surprised or puzzled by a new taste. This initial reaction can be overcome by continuing to introduce the food over several days or even a couple weeks until the child becomes comfortable with it. Using "flavor bridges", such as pairing the new food on the spoon with a familiar favorite, can help.

Remember, vegetables that American children typically dislike are staple foods for millions of children around the world. It isn't that American children have an innate dislike for these vegetables, rather that children in countries like China and India have developed preferences for them because these foods are routinely served at the family table.

Just like adults, infants and children have foods that they just plain don't like — and may never like. Parents need to respect their child's personal preferences. Parents who use the colors of the rainbow as their guide for feeding will take comfort in knowing that a colorful variety of foods will allow their child to achieve adequate intake of essential nutrients. Thus, if a child is not happy with spinach, other deep green vegetables will provide similar nutrients. Or a child who doesn't like tomatoes can get lycopene from watermelon. Eating colorful meals everyday provides the full range of phytochemicals and nutrients that young children need.

Satisfying infants and young children's nutritional need for variety is easily accomplished in our modern, Western culture. The vast array of commercial baby food products gives parents year-round access to pure and well-ripened fruits and vegetables. Supermarkets routinely import fruits and vegetables from around the world, so a good variety of fresh produce is usually available, even during the winter months in northern climates. And local farmers' markets are famous for tomatoes that actually taste like tomatoes and for other delicious-tasting vine-ripened produce.

If an older infant is in the habit of eating a variety of fruits and vegetables, this habit should carry over into the toddler years, and track within the family and throughout the child's later life. Therefore, adopting the five-a-day habit for the whole family will provide life-long benefits for everyone. •

Dr. Dennis Bier is Professor of Pediatrics, Director of the USDA Children's Nutrition Research Center, and Program Director of the NIH General Clinical Research Center at Baylor College of Medicine. He is also a member of the Institute of Medicine of the National Academy of Sciences and Associate Editor of the Annual Review of Nutrition.

Given that repeated experiences dictate food preferences, it is not surprising that children's food preferences typically resemble those of their parents.

continued from page 6

migrants were shown to be half that of Australian-born women averaged over the first five years in the host country. After 17 years, the rates of death were the same as those of native Australians (Figure 3).[19]

Similar changes in cancer rate patterns have been noted during economic shifts in the developing world – with a very rapid transition away from urban-industrial diets and lifestyles within Africa, Latin America, and Asia being followed by rapid increases in chronic diseases that are common in Europe, North America and Australia. In the higher-income countries of Asia, cancer patterns in urban areas are now approximating those of established western economies. For example, incidences of cancers of the breast, colon, prostate and ovary approximately doubled in Singapore between the 1970s and the 1990s.[20]

Children Learn What They Live

Research shows that children's taste preferences account for only 9-13% of the variability in children's actual consumption patterns, suggesting that other factors are involved,[21] including the likes and dislikes of others in their social environments, such as parents and their peers.

Parents' influence on their children's food consumption is a complex issue[22] that involves parental modeling (whether parents eat and enjoy certain foods in front of their child[23,24]), parenting techniques (authoritative vs. permissive[25,26]) and social influences (such as various forms of encouragement[27-33]). Given that repeated experiences dictate food preferences, it is not surprising that children's food preferences typically resemble those of their parents.[34]

Despite the target health objective of five or more servings of fruits and vegetables each day, only one in five US children attains this goal consistently.

Children's peers also have an influence on one another's fruit, juice and vegetable consumption in the form of modeling and/or negative remarks about eating vegetables.[35,36] While in one another's company, children will show a preference for sweets, desserts and other snack foods as meal choices instead of fruit, despite liking many fruits.[36,37] Peer modeling can also induce children to reject an initially preferred food in favor of one that was not previously preferred if their friends choose the latter.

The key is to get children exposed to and sample a variety of fruits and vegetables beyond apples, oranges, bananas, corn and potatoes during pleasant mealtime experiences. If mom and dad think that an iceberg lettuce salad is a vegetable, and that is the only vegetable that they serve with dinner, then it is very unlikely that as their children grow up they will experiment with broccoli rabi or various types of peas or string beans, or variations of corn (blue, yellow, white), or peppers (yellow, green, orange, red). Children need opportunities to socialize to a wide variety of fruits and vegetables in their diets.

The Rainbow Coalition

In an effort to convey this important message, recent public health education campaigns have focused on the plate of the consumer. A number of organizations, including the American Institute for Cancer Research, the American Cancer Society and the 5 A Day Program, promote themes such as: "What color is your diet?" and "Savor the Spectrum." These themes stress the value of adding concentrated sources of phytochemicals to the diet, such as those found in dark green, leafy vegetables, bright, red tomatoes, deep blue/purple blueberries and purple grapes, and bright yellow/orange squash and sweet potatoes, and the pure whites of onions and garlic.

These education campaigns have been successful largely because it is easier to educate the public about eating a healthy diet in terms of a colorful plate of fruits and vegetables, than it is with nutrient-based edicts, such as "Eat your indoles, flavonoids and carotenoids." Moreover, education messages that stress how many servings of fruits and vegetables to consume each day have a greater impact than those that stress why consuming fruits and vegetables is important. Families understand what is meant when they are encouraged to eat 5-9 servings of a colorful assortment of fruits and vegetables a day.[8] They understand that by sampling the colors of the spectrum (not just beige potatoes and light green iceberg lettuce), they are consuming a healthy diet.

Education messages that stress how many servings of fruits and vegetables to consume each day have a greater impact than those that stress why consuming fruits and vegetables is important. Families understand what is meant when they are encouraged to eat 5-9 servings of a colorful assortment of fruits and vegetables a day.

Conclusion

The health benefits of fruits and vegetables go beyond cancer prevention. A diet rich in fruits and vegetables is typically a healthier diet, with higher fiber intake, less fat intake. Overall, consuming such a diet may help reduce the risk of obesity or diabetes in children. In very young children, this type of diet provides optimal nutritional value for healthy cell growth and development, and helps keep children in more appropriate body weight ranges.

In addition, behavior research data indicates that children who are exposed to eating a wide variety of fruits and vegetables during their childhood will more likely continue to consume fruits and vegetables as adults.[8] The long-term effects of high consumption of fruits and vegetables during a lifetime continue to be explored. •

Linda Nebeling, PhD, MPH, RD, FADA is the Chief of the Health Promotion Research Branch, Behavioral Research Program, National Cancer Institute and a Fellow of the American Dietetic Association.

References

1 *Glanz K, Patterson RE, Kristal AR, et al: Stages of change in adopting healthy diets: fat, fiber, and correlates of nutrient intake. Health Education Quarterly 21:499-519, 1994.*

2 *Kohlmeier L, Simonsen N, Mottus K: Dietary modifiers of carcinogenesis. Environ Health Perspect 103:177-84, 1995.*

3 *Wise JA: Health benefits of fruits and vegetables: the protective role of phytonutrients. In: Vegetable, Fruit and Herbs in Health Promotion, pgs 147-76. RR Watson (ed), CRC Press, Boca Raton 2001.*

4 *World Cancer Research Fund in Association with American Institute for Cancer Research: Diet and the cancer process. In: Food, Nutrition and the Prevention of Cancer: A Global Perspective. American Institute for Cancer Research, Washington DC, 1997.*

5 *Knekt P, Jarvine R, Seppanen R, et al: Dietary flavonoids and the risk of lung cancer and other malignant neoplasms. Am J Epidemiol 146:223-30, 1997.*

6 *Steinmetz KA, Potter JD: Vegetables, fruits and cancer prevention: a review. J Am Diet Assoc 96:1927-39, 1996.*

7 *Ness AR, Powles JW: Fruits and vegetables and cardiovascular disease: a review. Int J Epidemiol 26:1-13, 1997.*

8 *Krebs-Smith SM, Heimendinger J, Patterson BH, Subar AF, Kessler R, Pivonka E: Psychosocial factors associated with fruit and vegetable consumption. Am J Helath Promot 10:98-104, 1995.*

9 *Food and Nutrition Board: Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids. Institute of Medicine, 2000.*

10 *Lampe JW, Gustafson DR, Hutchins AM, et al: Urinary isoflavonoid and lignan excretion on a Western diet: relation to soy, vegetable, and fruit intake. Cancer Epi Biomarkers Prevent 8:699-707, 1999.*

11 *Waladkhani AR, Clemens MR: Effect of dietary phytochemicals on cancer development. Int J Mol Med April 1(4): 747-53, 1998.*

12 *O'Neill KL, Standage SW, Hughes BG, Murray BK: Fruits and vegetables and the prevention of oxidative DNA damage. In: Vegetable, Fruit and Herbs in Health Promotion, pgs 147-76. RR Watson (ed), CRC Press, Boca Raton 2001.*

13 *Beecher CWW: Cancer prevention properties of varieties of brassica oleracea: a review. Am J Clinc Nutr 59(suppl 1166S-1170S), 1994.*

14 *Kolonel LN, Hankin JH, Whittemore AS, Wu AH, et al: Vegetables, fruits, legumes and prostate cancer: a multiethnic case-control study. Cancer Epi Biomarkers Prevent 9:795-804, 2000.*

15 *Sengupta A, Das S: The anti-carcinogenic role of lycopene, abundantly present in tomato. Europ J Cancer Prevent 8:325-30, 1990.*

16 *Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, Kahle LL: Fruit and vegetable intakes of children and adolescents in the United States. Arch Ped Adolesc Med 150:81-6, 1996.*

17 *World Cancer Research Fund in Association with American Institute for Cancer Research: Patterns of Cancer. In: Food, Nutrition and the Prevention of Cancer: A Global Perspective. American Institute for Cancer Research, Washington DC, 1997.*

18 *Kolonel LN, Hinds MW, Hankin JN: Cancer patterns among migrant and native-born Japanese in Hawaii in relation to smoking, drinking, and dietary habits In: Genetic and Environmental Factors in Experimental and Human Cancer, pgs 327-40. HV Gelboin et al (eds), Sci Soc Press, Tokyo, Japan, 1980.*

19 *McMichael AJ, Giles GG: Cancer in migrants to Australia: extending the descriptive epidemiological data. Cancer Res 48:751-6, 1988.*

20 *Parkins DM, Muir CS, Whelan SL, Gao YT, Ferlay J. Powell J (eds) Cancer Incidence in Five Continents VI IARC Sci Publ 120 Lyon:International Agency for Research on Cancer, 1992.*

21 *Domel SB, Baranowski T, Thompson WO, Davis HC, Leonard SB, Baranowski J: Psychosocial predictors of fruit and vegetable consumption among elementary school children. Health Educ Res 11:299-308, 1996.*

22 *Baranowski T: Families and health action. IN Handbook of Health Behavior Research I: Personal and Social Determinants, pgs 179-205. DA Gochman (ed), Plenum Press, New York, 1997.1997*

23 *Birch LL: The relationship between children's food preferences and those of their parents. J Nutr Ed 12:14-18, 1980.*

24 *Birch LL, Fisher JO: Development of eating behaviors among children and adolescents. Pediatrics 101:539-49, 1998.*

25 *Johnson SL, Birch LL: Parents' and children's adiposity and eating style. Pediatrics 94:653-61, 1994.*

26 *Birch LL, Fischer JA: Appetite and eating behavior in children In: The Pediatric Clinics of North America: Pediatric Nutrition, pgs 931-53. GE Gaull (ed), Saunders, Philadelphia, PA, 1995.*

27 *Hertzler AA, Vaughan CE: The relationship of family structure and interaction to nutrition. J Am Diet Assoc 74:23-7, 1979.*

28 *Birch LL: Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. Child Dev 51:489-96, 1980.*

29 *Hertzler AA: Children's food patterns—a review: II. Family and group behavior. J Am Diet Assoc 83:555-60, 1983.*

30 *Seagren JS Terry RD: WIC female parents' behavior and attitudes toward their children's food intake—relationship to their children's relative weight. J Nutr Educ 23:223-30, 1991.*

31 *Cousins JH, Power TG, Olvera-Ezzell N: Mexican-American motehrs' socialization strategies: effects of education, acculturation and health locus of control. J Exp Child Psychol 55:258-76, 1993.*

32 *Ioanotti RJ, O'Brien RW, Spillman DM: Parental and peer influences on food consumption of African-American children. Perceptual and Motor Skills 79:747-52, 1994.*

33 *Wardle J: Parental influences on children's diets. Proceedings of the Nutrition Society 54:747-58, 1995.*

34 *Logue AW, Logue CM, Uzzo RG, McCarty MJ, Smith ME: Food preferences in families. Appetite 10:169-80, 1988.*

35 *Cullen KW, Baranowski T, Nwachokor A, Baranowski J, Hajek RA, Lones LA: 5 A Day achievement badge for urban boy scouts: formative evaluation results. J Cancer Educ 13:162-8, 1998.*

36 *Cullen KW, Rittenberry L, Olvera N, Baranowski T: Environmental influences on children's diets: results from focus groups with African-, Euro- and Mexican-American children and their parents. Health Educ Res 15:581-90, 2000.*

37 *Cullen KW, Baranowski T, Rittenberry L, Cosart C, Hebert D, de Moor C: Child-reported family and peer influences on fruit, juice and vegetable consumption: reliability and validity of measures. Health Educ Res 16:187-200, 2001.*

CHILDREN UNDER TWO NEED

Five A Day

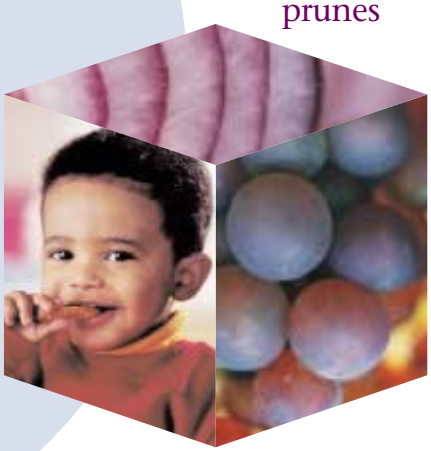
squash
star fruit
corn
bananas
pineapples
mangoes

peas
beans
spinach
avocados
kiwis
broccoli
zucchini
pears
greens

oranges
peaches
cantaloupe
carrots
apricots
sweet potatoes
pumpkin
papaya

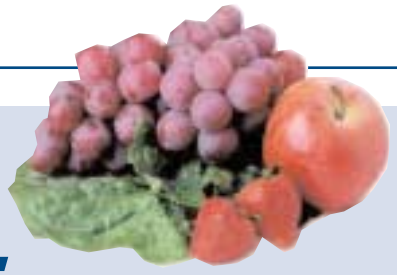
As your baby makes the transition from an all-milk diet to one that includes a variety of fruits and vegetables, she'll need your help – five times each day.

grapes
raspberries
plums
eggplant
blueberries
prunes



apples
red peppers
strawberries
tomatoes
watermelon
cherries

For a complimentary supply of this wall poster, call 1-800-595-0324



5 SERVINGS — EQUAL — 2½ JARS

Nutrition experts recommend five or more servings of fruits and vegetables a day — even for toddlers.

But how many slices of fruit or tablespoons of greens equal a serving? Gerber makes it easy. Just remember 2½ jars of our fruits and vegetables meet that daily recommendation. Just two and a half jars – the measure of a healthy infant and toddler diet.

"Don't 'trick' your kids into eating fruits and vegetables. Help them learn to enjoy them by offering them a wide-variety of good tasting choices … Cultivate an attitude of curiosity and anticipation …"

Secrets of Feeding a Healthy Family
Ellyn Satter, Kelcy Press, 1999

5 TIPS FOR REACHING THE FIVE-A-DAY GOAL

1. Introduce the traditional favorites first (applesauce, bananas, carrots, sweet potatoes).
2. Later, offer new flavors along with familiar favorites. It may take several tries before your baby learns to like some fruits and vegetables.
3. Respect your child's personal preferences. No one fruit or vegetable is going to make or break your child's diet.
4. Convenience is key. Baby food in a jar is easy, safe, portable, nutritious and comes in appropriate portion sizes.
5. Let the colors of the rainbow be your guide each day. The more variety, the better!

DOES YOUR FAMILY…

	Yes	No
Drink 100% fruit or vegetable juice at least once a day?	❑	❑
Eat a green salad with other vegetables several times each week?	❑	❑
Limit French fries to 2 or 3 times per week or less?	❑	❑
Eat vegetables other than potatoes and salad every day?	❑	❑
Eat whole fruits (in addition to juices) every day?	❑	❑
Eat a colorful assortment of foods throughout the day?	❑	❑
Like to try new and interesting foods?	❑	❑
Would you like to know more about eating 5 A Day?	❑	❑

If you have answered "yes" to 5 or more of these questions, you're family is well on their way to eating five a day!

For more information, visit http://www.5aday.gov.

Adapted from: National Institutes of Health – Fruit and Vegetable Screener.