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Folate & Folic Acid- Healthy Moms Mean Healthy Babies

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Before they may even know they are pregnant; women's bodies and their level of folate play a critical role in preventing certain birth defects, specifically neural tube defects (NTDs). NTDs are birth defects in the brain, spinal cord, or spine. Considered 'one of the most important public health discoveries of this century' is that daily supplemental folic acid taken before becoming pregnant significantly reduces the risk of NTDs (1). In 1998, the United States made sweeping efforts that fortified cereal grains with folic acid to ensure all Americans consume adequate amounts of this vitamin. So what exactly is folate? What are the functions of this vitamin? What foods have high levels of folate and what is the recommended daily intake? This article will answer these questions and will go on to explain folic acid fortification and the impact fortification has had on the incidence of NTDs in Arizona.

What is Folate?

Folate is a water-soluble vitamin of the B-complex group (vitamin B-9). Food folate is how naturally-occurring folate is described. Folate is best known by the name 'folic acid', which describes the synthetic form of the vitamin widely found in multivitamin pills and fortified foods. In this article we use the name "folate" to represent both food folate and man-made folic acid.

Functions of Folate

- Proper cell reproduction
- Required to make DNA
- Neural tube defect prevention when at least 400 micrograms (mcg) of folic acid are taken daily
- Helps prevent anemia

Am I getting enough folate?

As a water-soluble vitamin, excess amounts of folate are excreted in the urine and not stored in the body, which means adequate intake should occur daily. Folic acid is more easily absorbed than food folate, but as most people consume both types of this B vitamin, the daily recommendations are set as 'dietary folate equivalents' (DFE). In order to reduce the risk of NTDs, an additional recommendation for women capable of becoming pregnant is to consume 400 mcg of folic acid a day from fortified foods and/or supplements, in addition to folate from foods consumed from a varied diet (2).

Food Folate

Folate occurring naturally in foods is referred to as food folate, and can be easily found in a variety of plant- and animal-based foods. (See Table 1).

Folate Deficiency

Folate deficiency is most commonly caused by insufficient dietary intake of the vitamin. However, heavy alcohol consumption as well as smoking have both been associated with lower folate status (4,5). Situations in which the body has a higher demand for folate, such as pregnancy or inflammation, may lead to a folate deficiency if intake doesn't increase to meet the demand. Additionally, decreased ability to absorb nutrients from the diet, such as with inflammatory bowel diseases, may cause a folate deficiency.

Due to folate's role in cell division, the impact of folate deficiency is most quickly observed in conditions related to rapidly dividing cells, such as in blood cells. A result of folate insufficiency is megaloblastic anemia, a condition where the number of red blood cells decreases, eventually impairing oxygen transport. Symptoms include fatigue and shortness of breath. Importantly, a deficiency in vitamin B-12 also leads to megaloblastic anemia, whereby a diagnosis by a medical practitioner is necessary (2).

Can I have too much folate?

Naturally occurring food folate is safe to consume at any level. However, consuming large amounts of folic acid can mask the symptoms of a vitamin B-12 deficiency. In some people, high intakes of folic acid can increase the risk of colorectal cancer and possibly other cancers. Therefore, an upper limit for adults of 1000 mcg/day has been set for folic acid (2). Table 2 lists dietary recommendations for folate as well as the upper limit for folic acid, for all age groups.

Table 1: Food Folate Sources

Food	Mcg DFE/ serving	Percent Daily Value (%DV) /serving
Beef liver, braised, 3 ounces	215	54
Spinach, boiled, ½ cup	131	33
Black-eyed peas (cowpeas), boiled, ½ cup	105	26
Asparagus, boiled, 4 spears	89	22
Brussels sprouts, frozen, boiled, ½ cup	78	20
Lettuce, romaine, shredded, 1 cup	64	16
Avocado, raw, sliced, ½ cup	59	15
Spinach, raw, 1 cup	58	15
Broccoli, chopped, frozen, cooked, ½ cup	52	13
Green peas, frozen, boiled, ½ cup	47	12
Kidney beans, canned, ½ cup	46	12
Peanuts, dry roasted, 1 ounce	41	10
Tomato juice, canned, ¾ cup	36	9
Orange juice, ¾ cup	35	9
Orange, fresh, 1 small	29	7
Papaya, raw, cubed, ½ cup	27	7
Banana, 1 medium	24	6
Egg, whole, hard-boiled, 1 large	22	6
Milk, 1% fat, 1 cup	12	3
Ground beef, 85% lean, cooked, 3 ounces	7	2
Chicken breast, roasted, ½ breast	3	1

* Foods providing 20% or more of the DV are considered to be high sources of a nutrient. Source: National Institutes of Medicine, Office of Dietary Supplements, 2016 (3)

Table 2: Recommended Dietary Allowances (RDAs) for Folate

Age	Male	Female	Upper Limit
Birth to 6 months (AI)*	65 mcg DFE	65 mcg DFE	Not established
7-12 months (AI)*	80 mcg DFE	80 mcg DFE	Not established
1-3 years	150 mcg DFE	150 mcg DFE	300 mcg folic acid
4-8 years	200 mcg DFE	200 mcg DFE	400 mcg folic acid
9-13 years	300 mcg DFE	300 mcg DFE	600 mcg folic acid
14 - 18 years	400 mcg DFE	400 mcg DFE	800 mcg folic acid
Adults	400 mcg DFE	400 mcg DFE	1000 mcg folic acid
Pregnant		600 mcg DFE	1000 mcg folic acid
Lactating		500 mcg DFE	1000 mcg DFE

*Adequate Intake Source: Institute of Medicine, 1998 (2)

Folic Acid Fortification

The *Dietary Guidelines for Americans* (11) recommends people get most of their nutrients from foods. However, due to the proven protective effect folate has against certain birth defects, encouraging the consumption of supplemental folic acid is part of the many countries' public health programs. Since many pregnancies are unplanned, the United States and over 50 other countries have adopted folic acid fortification policies to ensure higher overall folic acid intakes. The United States implemented the mandatory addition of folic acid to enriched cereal-grains in 1998 (7). In 2016, the U.S. Food and Drug Administration authorized folic acid fortification of corn masa flour (8).

Decreased Incidence of Neural Tube Defects

It is estimated that up to 70% of neural tube defects can be prevented with folic acid supplementation (9). In the U.S., folic acid fortification has resulted in increased intake across all age groups; and a 19 - 32% decrease in the incidence of neural tube defects (10). In Arizona, the average incidence of NTDs decreased 31% after fortification (11).

However, disparities remain in the prevalence of NTDs. The Arizona Birth Defects Monitoring Program reports that the incidence of NTDs is higher amongst Hispanics than Non-Hispanic White Arizonans (11), a trend that is also observed nationally. Other at-risk groups include younger women of reproductive age, women with less formal education, and low-income women (12). The recent approval of folic acid fortification in corn masa flour (8) should result in increased intake among Latina women, since there is a higher consumption of corn masa flour among the overall Latino population. This is expected to prevent many new cases of NTDs for this at-risk population. Still, it is important that efforts are maintained to educate all at-risk groups of women, as well as those in the healthcare field, about the benefits of consuming folic acid from fortified foods and supplements.

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