Folate-fortified eggs have niche

Nutritional organizations consider that the common table egg can be crafted into a good source of natural folate. The small investment to produce folate-enriched eggs presents an opportunity for egg producers to exploit a novel market.  

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F" first isolated from spinach in 1941, folate derived its name from the Latin word folium, which means leafy. Folate is the generic term that comprises naturally occurring folate derivatives and includes the synthetic folic acid found in fortified foods and supplements as well as in poultry and swine feeds. This vitamin functions in DNA synthesis and many one-carbon transfer reactions and is especially vital during rapid cell growth. Folate also takes part in a metabolic and hormonally-mediated 1-generational phenotypic expression (Zeisel, 2005; Ingrosso and Gouaille, 2005). In addition, an insufficiency is regarded as being pivotal in the risk of developing some cancers (Erdman, 1995).

The remethylation of homocysteine to methionine requires folate, and elevated plasma homocysteine can elevate arterial walls to platelet aggregation and clot formation, thus posing a risk for cardiovascular disease and stroke (Malinow, 1995).

Geriatric requirements

In elderly patients, high blood homocysteine is regarded as a reliable marker for the anemia caused by folate/vitamin B12 deficiency (Nilssson et al., 2001). In a three-year study with participants 50 years of age and older, twice the recommended daily allowance (RDA) of folate improved short-term memory, mental agility and verbal fluency (Durga et al., 2007). In other work, mental depression (Conper and Bolander-Gouaille, 2005) and Alzheimer’s disease (Corrada et al., 2006) were attributed to a folate deficiency. Generally, studies can associate some age-related mental debility with folate insufficiency. Folate is necessary for the synthesis of neurotransmitters, which play roles in mood disorders in elderly subjects (Brocker et al., 1986), presenting at least one route to couple folate with such disorders. According to recent U.S. Department of Human & Health Services data, the segment of the U.S. population 65 years and older will increase from 37.3 million people in 1993 to 71.5 million by 2030. Folate nutrition may become more prominent in this group.

Food fortification

Folate received a lot of attention when an inadequacy was closely related to an increased risk of neural tube defects in infants (Shaw et al., 1995). Compliance with higher dietary recommendations was woefully inadequate (Eichholzer and Zimmermann, 2006). As a result, mandatory folic acid fortification of cereal products in the U.S. and Canada was implemented in 1998 to target 100 µg of folic acid per day per person. This program is now credited with reducing spina bifida (De Wals et al., 2007) and possibly stroke (Yang et al., 2008). Prior to this fortification program, an estimated 26% of the U.S. population was folate deficient (Diez et al., 2005).

Most European countries disregard mandatory folic acid fortification due to the recognition that crystalline folic acid is far more stable and less tumorigenic risks. Although the threat of toxicity is low (Hathcock, 1997), folic acid in excess of 1 mg per day can obscure anemia caused by vitamin B12 deficiency. If permitted to continue, this anemia results in irreversible neurological damage (Dinkin, 1995).

In the absence of wide range of roles this vitamin plays, coupled with concerns for the use of synthetic folic acid, additional strategies are needed to ensure adequate folate intake for all segments of society.

Dietary folate equivalents

Folate or folic acid recommendations are expressed as dietary folate equivalents (DFE), and one DFE equals 1 µg of dietary folate or 0.546 µg of folic acid supplement. DFE assumes a 50% difference in bioavailability between fortified folic acid and folate from food sources — a notion that is not without controversy. Recommendations fall within the range of 150-600 µg per person per day, depending on age and country. For pregnant women, the RDA is 500-600 µg per day.

Egg fortification

Synthetic crystalline folic acid added to laying hen diets is deposited in the yolk (House et al., 2002). More than 80% of the folate in eggs is 5-methyltetrahydrofolate (5-MTF), a form of folate that is rapidly absorbed (McKillop et al., 2003). The active 5-MTF metabolite does not mask anemia caused by vitamin B12 deficiency. Relative to green leafy vegetables, folates in animal products are generally stable during cooking (McKillop et al., 2002).

Nutritional organizations consider hen eggs a poor source of folate. However, folic acid fortification of hen diets can increase folate in eggs by almost threefold and elevate eggs to an “excellent” source of folate. Furthermore, while the Institutes of Health places an upper limit on synthetic folic acid in fortified foods, it considers “nutritionally safe” for natural sources of folate.

Manitoba research

University of Manitoba studies found that laying hens fed 4 µg of folic acid per kilogram of feed can produce eggs with about 40 µg of folate per egg on the basis of 5-MTF in the yolk (House et al., 2002; Dickson et al., 2005). This compares to 17 µg per egg with no added dietary folic acid. Higher egg folate levels were achieved, but the efficiency of deposition declined significantly as supplementation rates increased.

The Manitoba work tested two Hy-Line W36 strains: the W36 and W98 (Hebert et al., 2005). Increased folic acid significantly decreased plasma homocysteine in W98 birds but not in W36birds. Furthermore, Hy-Line W98 hens laid eggs as folic acid supplementation increased to 64 µg/kg, implying a higher folic acid requirement for early-matured and smaller birds. Elevated dietary folate was also associated with increased feed intake (House et al., 2004).

Of particular interest, the researchers found egg yolk folate bioavailability to be 100% compared to folate. Egg folate more effectively lowered plasma homocysteine than crystalline folic acid in bio-assay evaluations (House et al., 2002). Folate-fortified eggs stored for four weeks at 36°F (4°C) experienced no change in folate levels (House et al., 2002). These conditions correspond to typical storage of commercial eggs and indicate that storage losses are of little concern. Of the folic acid derivatives, 5-MTF is the most stable. Hence, two folate-fortified eggs provide about 20% of the U.S. RDA of 400 µg per day or 40% of the Canadian RDA of 200 µg per day.

U.K. study

A recent study investigated folate fortification of eggs with a slight twist (Hoey et al., 2008); Total folate was assayed in whole eggs as opposed to only analyzing egg yolks for 5-MTF.

Across several levels of dietary crystalline folic acid in hen diets, the maximum folate content was about 90 µg of folate per 60 g egg from hens fed 16 mg of folic acid per kilogram of feed (Hoey et al., 2008). This is about 1.5 times higher than reported by the Manitoba research, albeit with four times more folic acid. Hens fed 4 mg of folic acid per kilogram of diet attained a level of 5-MTF of 157.6 µg.

Regardless of the supplementation level of folic acid, the unfortified folic acid remained about 10% of total egg folate — too low to be of any worry to populations concerned with synthetic folic acid (Hoey et al., 2008).

The findings from the U.K. confirm that folate-fortified eggs could be a crucial source of folate. Two eggs can supply about 180 µg folic acid, which is equivalent to 45% of the U.S. RDA.

What about toxicity?

Folic acid is generally regarded as nontoxic by the National Research Council’s Subcommittee on Vitamin Tolerances (1987). No deleterious effects occurred in hens fed 128 mg of folic acid per kilogram of feed over a three-week period (Hebert et al., 2005), and that was a level 8-32 times more than needed for meaningful egg fortification.

Economies favorable

Enrichment of eggs plateaued within three weeks of supplementation (Hoey et al., 2008). Hence, it is a quick return on investment. At typical industry supplementation rates, which haven’t changed much over the years for laying hens (Wang and Doerksen, 2002), eggs to provide about 1% of vitamin costs, or about 2 cents per ton of feed at current prices.

To obtain two eggs that provide 45% of the U.S. RDA, the additional folic acid will cost about 30 cents per ton of feed. This equates to less than 0.05 cents/doz. eggs on the basis of typical egg production and feed costs. Two eggs to provide about 20% of the U.S. RDA entail about one-quarter of the cost (House et al., 2002).

Summary

Coupled with the high bioavailability of yolk folate, the common table egg can be crafted into an extraordinary source of natural folate. The investment to produce folate-enriched eggs is miniscule and permits considerable opportunity for egg producers to exploit a novel market.

References

The full list of references is available online at www.feestuffs.com or by e-mailing tlundeen@feedstuffs.com.

USDA offers poultry calendar

As part of its ongoing efforts to edu- caste backyard poultry owners on what they can do to protect their birds from infectious poultry dis- eases, the U.S. Department of Agri- culture announced that it is offering a free calendar for 2010.

The Backyard Biosecurity: Keeping Your Birds Healthy calendar features full-color photos of poultry and other birds each month.

The calendar contains useful in- formation on backyard poultry from disease and includes tips on what to do should poultry owners suspect that their birds are infected with a disease such as avian influ- enza.

The free calendar can be ordered online at http://healthybirds.aphis. usda.gov through the 2010 Backyard Biosecurity Calendar link.