

Iron deficiency is the most prevalent nutritional disorder in the world, affecting one out of four people. In developing countries the rate is drastically higher, topping 50% amongst pregnant women and young children.¹ Although iron deficiency is less common in Western nations, it remains a significant health concern for vulnerable individuals and groups. In the United States alone, 2.4 million children are affected by iron deficiency along with 15-25% of pregnant women.²

Because iron is not synthesized by the body, it must be obtained via diet or supplementation. Although certain foods such as red meat, poultry, beans, and pork are naturally iron-rich, regional scarcity and economic barriers to accessing these food sources leaves billions around the world with inadequate iron intake, which can cause serious damage to physical, cognitive, and behavioral health. Indeed, the World Health Organization considers iron deficiency as “being among the world’s most serious health risk factors.”³ As such, iron fortification of food products like breads, cereals, dairy, and infant formulas is critical to increasing the availability of dietary iron and addressing iron deficiency as a public health concern.

In the United States, fortification began in the 1930s and is now standard within many food manufacturing practices, particularly as increasingly health-conscious consumers seek to optimize nutritional intake.⁴ In the developing countries without the food security and lengthy history of food enhancement enjoyed in the United States, iron fortification is increasingly vital and offers a “sustainable and low-cost effective approach” to combatting iron deficiency.⁵ The extraordinary efficacy of fortification has led several countries with high deficiency rates to implement mandatory fortification laws and international public health experts regard iron fortification as a critical measure in many regions. As demand for iron-fortified foods grows throughout the world and becomes ever-more vital to public health strategies, spectrophotometers can play a central role in the formulation and production of these innovative food products.

Color Change in Fortified Foods

One of the primary challenges to the iron fortification process is introducing fortificants without disturbing [the sensory characteristics of the food](#). As noted in *Cereal Chemistry*, “One of the initial hurdles to overcome in any fortification program is consumer acceptance stemming from sensory effects. For a fortification program to be successful, it is important that the combination of the fortificant and the vehicle are acceptable to the target population.”⁶ Unwanted color change as the result of fortification is a significant problem for food manufacturers and can impede consumer acceptance of fortified products, hindering commercial success and compromising the efficacy of public health efforts. Iron compounds are particularly prone to producing undesirable and unpredictable color shifts as the result of their interactions with raw ingredients, response to processing methods, and reaction to oxidation; common types of discoloration include “a green or bluish coloration in cereals, a greying of chocolate and cocoa, and darkening of salt to yellow or red/brown.”⁷ Formulating appealing food products that balance enhanced iron bioavailability with minimal color change depends on thoughtful selection of fortificants, raw ingredients, and processing methods to ensure consumer satisfaction.

Using Spectral Analysis to Measure Color Change and Perfect Fortification

Spectral analysis expands your ability to produce fortified foods that replicate their non-fortified counterparts as closely as possible by providing a precise, objective method of identifying and assessing color change caused by iron compounds. Through spectral measurement, you can quickly quantify and compare the impact of fortificants, correlate ingredient and processing variables to degree of color change, and evaluate color stability in response to stressors to refine formulation. Once a recipe is in production, in-line, non-contact spectrophotometers can continuously monitor color to ensure consistent and accurate coloration by providing ongoing spectral feedback and instantly alert operators to color variations that fall outside your specifications. The remarkable versatility, accuracy, and flexibility of spectrophotometers allow for highly accurate chromatic evaluation of all types of food products — solid or liquid, [opaque or transparent](#), [smooth or textured](#)—and optimizes the success of individual food products while enhancing the potential of fortification programs as a whole.

Full article with photos available here:

<https://www.hunterlab.com/blog/color-food-industry/utilizing-spectrophotometers-to-measure-color-change-in-ironfortified-food-products/>