Healthy Soil to Healthy Food: The How Matters

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The Issue Today

People are generally curious about their health. They are interested in seeking interventions to improve their lifestyle for increased longevity and wellbeing. Today chronic illness is standard occurrence and can be attributed to many lifestyle factors. Use of vitamins and supplements has increased in popularity because of the desire for improved health, but this tool has its limitations. Nutrient dense food is one intervention that can address these lifestyle factors by improving immune system function, mitigating stress, and increasing energy. The nutrient density of food depends on two things. First, how "nutrient density" is defined: if it includes macro and micronutrients, as well as phytochemicals that support human health, or if it is reduced to just protein, fat, and carbohydrates. And second, agricultural practices: how food is produced affects the level of macro and micronutrients, and phytochemicals present in the food (Montgomery, 2021).

Commercial-industrial agriculture operates on the premise that we can supply food crops with synthetic versions of fertility to produce food that will feed people. Since the early 1900's nutrient density of these foods as decreased while the use of vitamins and supplements in diet has increased. The foods that are feeding people increasingly resemble empty calories due to decades of selecting for high yield over nutritional value. Numerous studies have shown significant declines in vitamins and minerals, including calcium, iron, and vitamins C and A, since the 1930's, 50's and again since the 80's (Scientific American). Without shifts in convention to accommodate for our Earth's carrying capacity, the food we grow on an industrial scale requires more chemicals to produce less nutritious food. The "growth of the intensive livestock sector stresses many ecosystems and contributes to global environmental problems" (Alonso, 2012). We are witnessing consequences and effects on global health because of commercial industrial-scale farming pushing the agricultural industry to destroy critical habitats around the world to meet consumer demand. Below we explore the relationship between production practices and the nutrient content of food.

Mineral Depletion & Food Quality

Fortification of foods began as a method for improving the diets and health of populations that did not have access to enough nutritious foods. The FDA defines two categories for food fortification: mandatory and discretionary. Mandatory fortification must comply with the standards identified by the FDA, while discretionary fortification is based on the understanding that there is a need due to public health inadequacies but is not beholden to guidelines and there is little research on the effects of fortification (Datta, 2016). In domestic livestock specific mineral and micronutrient requirements for cattle are based on minimum requirements rather than for thriving (Alonso, 2012).

The basic building blocks of human nutrition are protein, carbohydrates, and fats. The rise in supplement use over the last century has benefited the overall health of the population, however, broad use of supplements outside of addressing specific needs has had deleterious effects due to consumption of nutrients above recommended and required levels causing imbalances with the body's own regulatory metabolic processes (CDC). For example, "vitamin B12 deficiency can be masked by excessive supplemental folic acid intake, and chronic excessive intake of supplemental zinc can reduce the absorption of copper and iron, leading to anemia, bone abnormalities and cognitive deficits" (Datta, 2016). Likewise, high heavy metals in livestock mineral supplements can lead to toxicities that affect productivity and overall wellbeing (Alonso, 2012) supporting the argument that agricultural practices that promote soil and plant health are also critical for improved forage and livestock health. An assessment of the changes in food composition for 43 garden crops from 1950 to 1999 showed "statistically reliable" decreases in levels of Ca, Fe, and P (Davis, 2004). Noting also that variability in data from other nutritional markers, including amino acids, could be attributed to soil type, "changes in storage and maturity at harvest", illuding to broader changes in how food is handled affecting the nutritional value.

Implications of Agriculture

A definition for sustainable agriculture that spans agricultural philosophies is ambiguous and hard to pin down. According to the USDA, "sustainable agriculture frequently encompasses a wide range of production practices, including conventional and organic". Ultimately producers and professionals agree that sustainable agriculture should improve the quality of life for communities, support ecologically sound practices and support viable local economies. We have seen a surge in the adoption of this approach in the last few decades. Today, the buzz is around "regenerative agriculture", a system of farming principles and practices that increases biodiversity, enriches soils, improves watersheds, and enhances ecosystem services. Practices such as this support the exchange of macro and micronutrients between plants and soil and an environment that allows plants to develop higher levels of phytochemicals. This facilitates resilience in the plant community and in the health of the people and animals that consume them.

By supporting the mineral density of feed and forage through addressing full spectrum soil and plant health excessive mineral supplementation can be mitigated. As well, operating in a less intensive, more regenerative system allows these minerals and nutrients to be recycled through the soil resulting in the added benefit of reducing supplementation needs over time. Because trace minerals in the soil are not always available to plants supporting the soil biology is necessary for the exchange of nutrients and minerals in the rhizosphere, as demonstrated by a recent study (Montgomery, 2022) comparing regenerative versus conventionally managed fields.

Comparison of nutrient content of individual crops over time is tough to measure due to the variability of analysis, soil conditions, growing practices, and different cultivars leading to

limitations in statistical significance, however significant changes have been seen when looking broadly at food groups (Marls, 2017). It has been documented that nitrogen fertilizers "reduce phytochemical production related to plant defense, like the phenolic compounds in foliage" (Montgomery, 2021). Through numerous studies it is now widely accepted that agricultural practices that promote soil and plant health without the use of synthetic inputs leads to healthier food (Mie, 2017) (Montgomery 2021, 2022) (Davis, 2004).

Parting Message

The way food is produced matters to the overall nutritional value. As with applying fertility in agriculture, food fortification and dietary supplementation is successful and positive when applied to specific conditions, whereas broad, non-specific application can have harmful effects to human health and the environment. Nutrient content of food has decreased overtime with conventional-industrial agriculture. Edaphix employs full spectrum fertilization strategies with the dual benefit of discouraging weeds and creating nutrient dense biomass and food. Growing awareness of the "importance of soil ecology and the diversity and abundance of soil life is reshaping agronomic thought to embrace enhancing and sustaining soil health as a fundamental agronomic goal" (Montgomery, 2021). While there is much variability across production studies show that using regenerative practices increases the amount of organic matter and builds topsoil in both small-scall vegetable farming and large-scale crop production. This increased organic matter facilitates greater nutrient cycling and plant-soil interactions resulting in higher mineral and nutrient content in food. In livestock production, regenerative practices mean higher quality forage, increased carbon cycling, and reduced use of antibiotics. These findings have implications for global health of people, communities, and the climate. With "the life-sustaining properties of trace minerals in foods consumed by humans and the associated possibilities for enhancing both functional and market value by changing methods of food production" (Alonso, 2012), we should strive for a system of farming principles and practices that increases biodiversity, enriches soils, improves watersheds, and enhances ecosystem services.

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