

Literature Review:

Whole Food Based Nutrition Vs.
Fragmented Vitamin and Mineral
Supplementation

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Abstract

Americans have become increasingly interested in nutrition. There are many reasons for this. Americans are living longer; healthcare has improved. A long life, however, is not necessarily a healthy life. People live longer, but eat more and exercise less. Many search for a quick fix, a magic bullet, a way out of their self-induced health problems. Often, instead of acting rationally, Americans act out of desperation. One of these desperate acts takes the form of an almost manic fascination with nutrition. Many of us find ourselves too fat but instead of eating normal portions and exercising, Americans eschew the discipline that such tactics demand, and opt for fad diets, or even liposuction.¹

This paper will address some of these issues, some ways that Americans are dealing with them and some solutions. In particular the controversy of whole food based supplementation versus fragmented vitamin and mineral supplementation.

Keywords: oxidants, antioxidants, nutrients, vitamins, minerals, fruit and vegetable supplementation, whole food supplementation, phytochemicals

Introduction

As hard as it is to admit, our mothers were right. "Eat your fruits and vegetables," they said. It seems however that some of today's mothers are not encouraging their children to eat their fruits and vegetables. Mothers not only meet the natural resistance that children put up, but the resistance fostered by countless McDonald's and Burger King commercials. Add to that, schools are stuffed with Coca Cola and vending machines. These mothers' warnings fall on deaf ears, ears itching for "excitement" of a Coke, and the visible Invisible Friend Ronald McDonald. It seems that many mothers have given up.

Americans are living into their 90s. Healthcare has improved. But, Americans are not eating recommended amounts of fruits and vegetables. Instead, they opt for quick and easy higher calorie, nutrient poor foods. Cells in our bodies are continually introduced to oxidizing agents. Those agents may be in air, food, water, or may be byproducts of cell metabolism. Balance must be kept between oxidants and antioxidants to maintain the body's optimum performance. A large number of oxidants lead to oxidative stress that can cause oxidative damage to

proteins, DNA and lipids. The result is an increased risk for cancer and cardiovascular disease.²

Since 1970, Americans have drastically changed how they eat, what they eat and where they eat. In the 1970s, Americans spent 23 percent of their food budget outside the home, much of it in fast-food restaurants. In the 1980s, that number climbed to 33 percent and is expected to reach 59 percent by 2020.³

In 1994, 57 percent of Americans ate at a fast food restaurant once a day. Therefore, their diet consisted of higher percentages of calories, fat, saturated fat, sodium, carbonated soft drinks, and significantly lower intake of vitamins A and C, fruits, vegetables, and milk.⁴

It is not completely the American consumer's fault. Another factor has aided and abetted in conspiring to make Americans live longer but fatter. New farming techniques have stolen many nutrients out of the earth. Minerals are depleted from the soil at twice the rate they were before. Farmers can get more crops out of their fields but in doing so, they are robbing those fields of minerals such as iron, copper, zinc and magnesium. In other words, we can no longer assume the mineral content of foods we eat. Plants do not make the minerals we need, they get the minerals from the soil.⁵

Any child that has watched a Popeye cartoon knows that there is iron in spinach and it makes you strong. However, spinach grown in iron-poor soil will have little or no iron to offer the body when consumed. Researchers are aware of this fact, and have recommended growing specially genetically modified seeds in nutrient-rich soils for exporting to a place where the soils are poor; the idea is that a seed that is already packed with minerals will produce a crop that is also packed with minerals.⁶

A *dietary supplement* is defined by the Dietary Supplement Health and Education Act of 1994 as "a product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, or a dietary substance for use by man to supplement the diet by increasing the total dietary intake, or a concentrate, metabolite, constituent, extract, or combination of the above ingredients."⁷

Americans' diets consist of high calorie, nutrient poor foods. It should come as no surprise that dietary supplement sales accounted for \$18.8 billion dollars in 2003.⁸ The question arises though as to which supplements are worth taking. Referring back to the issue of iron-poor soil, in the United States there are over 36 brands of iron

supplements alone. That is a small fraction of the total volume of supplements on the market.⁹

This paper aims to research and resolve one of the issues concerning nutrition today: whether whole food based nutrition supplementation is better than fragmented vitamin and mineral supplementation at delivering bioavailability of nutrients to the human body.

Discussion

If there is a difference between the effectiveness of whole food based nutritional supplementation and fragmented vitamin and mineral supplementation, it will be in the bioavailability of the nutrients. The nutrients to which I am continually referring are technically called "micronutrients" - those nutrients that are required in minute quantities for continued healthy living. In addition to minerals, they include vitamins and secondary products such as polyphenols, flavonoids, isoflavones, terpenes, and glucosinates.¹⁰

According to Jackson, bioavailability is the fraction of the ingested nutrient that is utilized by the human body for normal physiological functions or storage.¹¹ This means that there are some forms of nutrients that the body finds

easier to absorb than others. This ability of a nutrient to be absorbed into the body is known as bioavailability. Several things affect the bioavailability of a nutrient. Beyond the chemical structure of the nutrient itself are other factors likely to influence the amount of nutrient absorbed from any source. It does not matter whether the nutrient is derived from whole food or synthetic supplementation. Factors that also come into play in tracking a nutrient's bioavailability are: the efficiency of digestion, the previous intake of the nutrient, the body "status" of the nutrient, gut transmit time, the presence of gastro-intestinal disorder or disease, other products with which the food is consumed, and prior treatment of the product such as cooking or processing.¹²

It has been shown that efficiency of digestion can be different for each individual. Some people digest better, faster, or slower than others, and also build up tolerances to certain nutrients. For instance, if a person takes massive doses of nutrients due to a deficiency, and then suddenly stops, the amount of the body's nutrient will sometimes fall below the level that prompted the need for the supplement in the first place. The body "status" of the nutrient refers to the fact that some nutrients are necessary in small amounts, but large doses would not

necessarily provide added benefit. "Gut transmit time" relates to the time a nutrient spends inside the digestive tract before it is excreted. The lesser the transmit time, the more likely the nutrient will pass through the body without providing benefit. If a person has a gastric disorder that inhibits proper absorption of food, then they will obviously have a deficiency of nutrients.¹³

If supplements and food/drink are consumed at the same time, the bioavailability of the supplement can be affected - sometimes for good, sometimes for bad. For instance, Vitamin C can hinder the body's ability to absorb iron; and Vitamin D increases the body's ability to absorb calcium. Grapefruit increases the potency of some supplements and medicines, especially those that are involved in channel blocking, such as medication for hypertension.¹⁴

Beta carotene has been made more bioavailable by first pureeing then cooking carrots. Oddly enough, it has been shown that beta carotene is more bioavailable after cooking, as compared to its bioavailability in the raw, unprocessed version of the vegetable.¹⁵ Castenmiller and West had similar findings in that pureed and cooked carrot meal made beta-carotene dramatically more available to research subject's bodies than did raw carrot meal.¹⁶

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pointed out that Vitamin C is taken as a dietary supplement because of its antioxidant activity, although a high dose (500 mg) may act as a pro-oxidant in the body. One hundred grams of fresh apples have antioxidant activity equivalent to 1,500 mg of vitamin C. Natural antioxidants from fresh fruit could be more effective than a dietary supplement. Cell proliferation of colon and liver cancer cells was inhibited after exposure to whole apple extract concentrations.

This relationship between supplements, whole foods and their effects on the human body can be examined in an even more microscopic way. There are things called phytochemicals. Phytochemicals are "bioactive non-nutrient plant compounds in fruit, vegetables, grains, and other plant foods."¹⁷

Some scientists think that it is because of phytochemicals that often an isolated nutrient may have a harmful effect on the body, whereas when consumed as a part of a whole food it has a beneficial effect. More than 5000 phytochemicals have been identified but there are still many that are still unknown.¹⁸ Phytochemicals in fruits, such as apples, dramatically enhance antioxidant properties and their ability to inhibit proliferation of tumor cells

in vitro.¹⁹ Antioxidant effects of whole foods and the synergy between compounds like phytochemicals in foods may have added benefit.²⁰

Studies have shown that the phytochemicals in fruits and vegetables act as scavengers of free radicals, boost the immune system, control gene expression in cell proliferation and apoptosis, metabolize hormones and have antibacterial and antiviral effects. They have been shown to have roles in the reduction of platelet aggregation, modulation of cholesterol synthesis and absorption, and reduction of blood pressure.

Recently, C-reactive protein, a marker for systemic inflammation, has been reported to be a stronger predictor of cardiovascular disease than LDL cholesterol, suggesting that inflammation is a critical factor in cardiovascular disease. "Inflammation not only promotes and initiates the progression of atherosclerosis but also causes acute thrombotic complications of atherosclerosis. Therefore, the anti-inflammatory activity of phytochemicals may play an important role in the prevention of cardiovascular disease."²¹

Because studies have shown that consumption of whole foods reduces the risk of chronic diseases, some scientists have tried to fragment and isolate bioactive compounds in

those foods as a "magic bullet" aimed at these chronic diseases. Clinical trials have not been able to prove that fragmented antioxidants fail to prevent disease, or have any effect whatsoever. "The isolated pure compound either loses its bioactivity or may not behave the same way as the compound in whole foods." There is no Recommended Daily Allowance for phytochemicals and it is probably not wise to take large doses before evidence shows that it is safe.

On another front, some research suggests that carotenoids and retinoids are instrumental in preventing lung cancer in cardiovascular disorders - two major causes of death in this country. In one study, 30 mg of beta carotene and 25,000 IU of retinol were given to 18,314 smokers, former smokers, and workers exposed to asbestos. After four years, the study found "no benefit and may have had an adverse effect on the incidence of lung cancer and on the risk of death from lung cancer, cardiovascular disease, and any cause in smokers and workers exposed to asbestos." Interestingly enough, the study's authors still recommended the dietary intake of fruits and vegetables.²² A 1994 study also concluded, "[fragmented] supplements may actually have harmful as well as beneficial effects."²³

Another study weighs in on this supplement versus whole food controversy. Hoppe reports that a synthetic

source of lycopene (commonly found in tomatoes and associated with numerous healthful benefits) is just as effective as the natural source at delivering lycopene to the body. This study affirms the complexity of the relationship between supplements, whole food and the human body. For some nutrients at least, it appears irrelevant whether the source is synthetic or natural.²⁴

In a study that seems to contradict Hoppe's study, lycopene is better absorbed when administered as part of a reduced calorie diet.²⁵ While lycopene may have a powerful effect itself, the effect is enhanced when it is from a natural source. In their study of rats with prostate cancer, 80 percent died who received no lycopene, 72 percent died who received pure lycopene, but only 62 percent died who received their lycopene in the form of powdered tomato. This study seems to say that whole food is more effective than supplementation.

Phenolic compounds are subjects of study for their potential antioxidant and anticarcinogenic effects. Karakaya discovered that phenolic compounds, with some caviats, derived from natural sources have almost always been more bioavailable than those from synthetic sources.²⁶

Further, the Tufts University Health & Nutrition Letter reports on a study in the Lancet which claims that

large doses of antioxidants actually tend to reduce ones lifespan, not enhance it, and recommends sticking to natural sources for these valuable nutrients.²⁷

An article in Current Therapeutic Research advocates natural sources of nutrients. The authors performed a quasi-experimental design in which the nutrient levels in subjects' blood serum was measured periodically while taking a commercial fruit and vegetable derived supplement. The study uncovered a powerful effect, in which some nutrients showed a fivefold increase in subjects' blood serum. However, this study established no control group. Therefore, there was no group to receive no supplement; no subject set to receive a synthetically derived supplement, and the sample size was only 15.²⁸ It would seem difficult to justify applying the results of this study to a general population. Advocates of this fruit and vegetable derived supplement frequently cite this paper as a demonstration of the product's efficacy.²⁹

The research does have an assigned "P" value which is a statistical analysis measuring the validity of the research. In other words, if the study was conducted again under the same circumstances, there is a probability of getting the same results. In essence, a P value is a reliability of the data. The P value assigned to this

study is $P < 0.05$ so there is 95% reliability. If repeated 100 times, only 5 would give different results.³⁰

A study in the Journal of the American College of Cardiology describes a *double blind*, placebo-controlled, crossover experiment. In this experiment, the researchers studied three groups of human subjects: group one was given a placebo, group two was given a fruit and vegetable derived supplement (whole food supplement) in the form of a pill, and group three was given the same whole food supplement along with a berry derived supplement (whole food supplement).

Eating high fat meals create a constriction of blood vessels of about 50 percent within about 20 minutes and this constriction lasts approximately 2-6 hours. A constriction of this magnitude would certainly put a strain on the heart as it continues to try and pump against a strong resistance. This, in turn, would certainly affect blood pressure, the potential for strokes and other cardiovascular diseases, as well as the kidney, lung, etc. because of the "domino" affect created throughout the body.

A group of participants were taken to McDonalds and fed an Egg McMuffin, a Sausage McMuffin and hash browns. They were then taken to a lab and the entire group

experienced an average arterial constriction of 40-50 percent. Three groups were then created; a placebo group, a group on fruit and vegetable supplement alone and a group taking fruit and vegetable supplement and berry supplement. None of the participants knew which of the products they were consuming. After 28 days, these groups were taken again to McDonalds and given the same high fat meal. The placebo group continued to have 40-50 percent constriction of their arteries. The group taking fruit and vegetable supplementation had about a 64 percent improvement on this arterial constriction. The group on fruit and vegetable supplementation and berry supplementation had no constriction at all. The groups were then allowed to have their blood baseline values of these nutrients return to normal. The groups were switched around and the test was repeated. Again, the results were the same.³¹

The University of Sydney conducted a study on 32 men using a mixed fruit and vegetable concentrate to test levels of homocysteine in men. Results showed that the whole food supplement lowered the risk of heart disease by lowering the concentration of plasma homocysteine.³²

Conclusion

Based on this project's research it would not be fair or possible to declare one point of view superior at this stage to the other. In some cases, synthetic alternatives to whole food derived nutrients are as good as, and possibly better than, their whole food counterparts. This may be because they are formulated to exclude antinutrients. In other cases, the data seems to demand that we come to the opposite conclusion that whole foods are always superior to any artificial nutrients. Nevertheless, as research continues in this exciting area of study, these opposing views may come to be seen as not so contradictory as possibly complementary to one another. As research continues, we may become more aware of the synergies that make some whole food bioavailable. After doing this research, it is my judgment that products that do provide whole food nutrients may be generally as effective and do no harm. On the other hand, there is no basis to the claim that such supplementation is actually superior to supplements derived from synthetic sources, or those that may be from whole food sources but are in fragmented forms.

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