“Failure to Thrive” as a Vegan – Could Supplemental Carninutrients Help?

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Abstract

Flesh foods are rich in certain physiologically essential, nutritionally non-essential metabolic cofactors – dubbed “carninutrients” – which, when employed as supplements, have shown efficacy for treating certain health disorders and for promoting optimal physical and mental performance. Carnitine, taurine, creatine, and carnosine are prominent carninutrients; long-chain omega-3 fats, although not cofactors, might also be considered carninutrients. Although these compounds are synthesized endogenously, they are also absorbed from the diet, and their tissue levels tend to be lower in vegetarians than in omnivores. About a third of former vegetarians report that they abandoned vegetarianism owing to their impression that they failed to experience robust health while vegetarian. B12 or iron deficiency, which are readily correctible, may account for some of these cases. The down-regulation of IGF-I activity associated with vegan diets – of key importance to the cancer-preventive properties of such diets – conceivably could be a factor in other cases; a higher protein intake would remedy this. But consideration should be given to the possibility that comprehensive carninutrient supplementation could be symptomatically beneficial in some vegetarians; this could be assessed in double-blind studies. Vegetarians who develop clinical syndromes reported to respond to carninutrient supplementation would likely be prime candidates for such supplementation.

Carninutrients Can Promote Health and Optimal Performance

Flesh foods are a rich source of certain physiologically essential, but nutritionally non-essential metabolic cofactors which are not provided by plant-derived foods, notably carnitine, taurine, creatine, and carnosine; these have been described as “carninutrients”.[1] These agents play key metabolic roles in skeletal muscle, heart, and the brain. Dairy products and eggs, staples of many vegetarian diets, provide only trace amounts of these compounds. Although vegans can synthesize these within their bodies from precursors provided by vegan diets, these agents are reasonably well absorbed when ingested in foods or supplements. Hence, body stores of these carninutrients can be boosted to some extent by oral administration. For each of these carninutrients, rodent studies, and to a more limited extent clinical studies, have demonstrated that supplementation can provide benefits to health or physical capacities, at least under certain circumstances.[2-25] The clinical utility of carnitine or carnitine esters is well established in early age-related cognitive dysfunction, diabetes, and intermittent claudication; in patients who have sustained a previous myocardial infarction, supplemental carnitine lessens mortality and reduces risk for arrhythmias and angina.[2-4, 7] Although taurine has received limited clinical evaluation – primarily in congestive heart failure, where it has proved efficacious - it exerts anti-atherosclerotic, anti-hypertensive, and platelet-stabilizing activities potentially beneficial for cardiovascular health.[1, 8-13] The greater aggregability of platelets in vegetarians as opposed to omnivores may reflect sub-optimal taurine status.[1] Supplemental creatine can improve muscle performance in exercises involving rapid repeated contractions and improve the effectiveness of resistance training; it also may favorably impact cognitive performance in some circumstances, and is reported to improve memory, specifically in vegetarians.[14-17]

However, supplemental creatine does not appear to improve cardiac function in heart failure.[26, 27] Boosting muscle carnosine levels via supplementation with its precursor beta-alanine aids performance in vigorous anaerobic exercise; this agent may also have potential for cardioprotection.[21, 24, 28]

These findings evidently reflect the fact that body stores of these agents are often functionally sub-saturating; in regard to carnitine and creatine, this appears to be true among many of the elderly.[17, 29, 30] It is logical to expect that this this sub-saturation may be most common or significant in vegans, as they do not ingest these agents in their diets and are wholly dependent on endogenous synthesis. Indeed, for each of these carninutrients, there is evidence that plasma levels or tissue stores are lower in vegans and vegetarians than in omnivores.[1, 31-42]

Why Do Some Vegans Report "Failure to Thrive"?

Advocates of vegan or vegetarian diets often hear from people who claim that they made an earnest effort to eat a plant-based diet, but that they simply did not experience robust health when they did so – resulting in their return to their former omnivore ways. An informal survey by CBS News in 2005 found that 3 times as many people described themselves as ex-vegetarians as current vegetarians – implying that only a minority of self-described vegetarians stick with their diet in the long term. An internet survey of former vegetarians found that 35% blamed chronic poor health for their return to an omnivore diet.[43] What could be the basis for such a perception?

Informed vegans are aware that their diets lack vitamin B12, and therefore supplement with this nutrient. However, a high proportion of citations under the key word "vegan" in PubMed pertain to vegans who have developed symptomatic B12 deficiency. Some former vegetarians who report malaise while following a primarily vegan vegetarian diet may in fact have become B12 deficient.[44]

In young women, an exacerbation of latent iron deficiency may sometimes be responsible for their malaise; heme iron from flesh foods is more efficiently and reliably absorbed than non-heme iron, and body iron stores tend to be notably lower in vegans/vegetarians than in omnivores.[45, 46] When this is the problem, it can be readily diagnosed and corrected with supplemental iron.

Some lapsed vegans complain that they experienced excessive weight loss on a vegan diet. The tendency for whole-food vegan diets to promote healthful weight loss is in fact one key reason why many people become vegan in the first place.[47, 48] However, certain restricted versions of vegan diets – such as raw food vegan diets, devoid of grains, beans, or tubers – may often be unduly low in total calories, leading to a degree of weight loss perceived as cosmetically undesirable. The solution here is to include unrestricted amount of grains, beans, and tubers in one's diet.

It is also conceivable that the down-regulation of systemic IGF-I and possibly mTORC1 activities, consequent to a vegan diet rather low in certain essential amino acids (most notably methionine and lysine), may have adverse symptomatic consequences in some people. This down-regulation is thought to be largely responsible for the much lower risk for "Western" cancers enjoyed by certain quasi-vegan non-Western cultures, and also has potential for slowing the aging process.[49-54] If a reduction in IGF-I activity does contribute to the "failure to thrive" phenomenon reported by some lapsed vegans, high-quality protein from dairy foods or eggs, or a higher intake of plant proteins (high soy intakes increase IGF-I in vegans[50, 55]) would be expected to remedy the problem.

In some instances, a person may develop a temporary illness, unrelated to diet, while eating a vegetarian diet. If the person suspects his diet as the cause, goes back to omnivore eating, and his illness then resolves (which it would have anyway), he may falsely attribute his illness to his former vegetarian diet.

Carninutrient Supplementation for Vegetarians

But consideration should also be given to the possibility that supplemental intakes of carninutrients could be symptomatically beneficial in many vegans who report that they simply don't feel as good – or who experience specific symptoms – since they adopted a vegan diet. If a sufficient cohort of such people could be gathered together for a clinical study – or perhaps recruited via the internet – it should be possible to do a placebo-controlled test of this hypothesis. If this hypothesis were sustained, an avenue would be available for maximizing the number of people who could stick with a vegan diet. Such a diet is clearly very beneficial in numerous ways for health, the environment, and our fellow animals.[56] There does not appear to be any reason to suspect that increased intakes of carnitine, taurine, creatine, and carnosine are in any way responsible for the health risks associated with flesh-rich diets; saturated fat, high-quality protein, heme iron, bioavailable phosphate, and mutagens produced by high-temperature cooking of flesh foods (e.g. heterocyclic amines) may be key mediators of these. In contrast, moderate elevations of carninutrient stores emerge as health protective in the research literature, and supplemental intakes of these compounds, at least in non-massive doses in subjects with adequate renal function, do not produce side effects. (An exception in regard to the carnosine precursor beta-alanine is noted below.)

Carnosine – the dipeptide beta-alanyl-L-histidine - is found primarily in muscle, heart, and neurons, where it functions to buffer changes in pH during rapid muscular or neuronal activity; it also has versatile antioxidant activity.[57, 58] Beta-alanine availability, but not that of histidine, is rate-limiting for carnosine synthesis in muscle and likely other tissues as well, which is why supplemental beta-alanine is employed to boost tissue carnosine stores. Moreover, in most humans, carnosine in plasma is degraded so rapidly by carnosinase that the functional consequences of joint ingestion of beta-alanine and histidine are little different than those of ingesting intact carnosine.[59] Supplemental beta-alanine has the drawback that a bolus intake of beta-alanine in excess of 800 mg tends to produce transitory "pins and needles" paresthesias during the peak of plasma concentrations; these can be avoided by administering the daily beta-alanine in divided doses, or using a time-release preparation.[60] This also should aid tissue retention of beta-alanine. Supplemental orotate can also boost beta-alanine availability, as it is converted to beta-alanine within the liver.[61, 62] This may play a role in the reported utility of magnesium orotate administration in cardiac disorders.[63-65]

Histidine and Long-Chain Omega-3 as Supplements for Vegetarians

Even though supplemental histidine does not increase carnosine synthesis, histidine itself has metal-chelating, antioxidant, and anti-inflammatory properties that are potentially beneficial, as rodent and clinical studies are starting to reveal.[66-70] Flesh-rich diets tend to be especially rich in histidine, owing to their high carnosine contents; hence, histidine supplementation, with or without beta-alanine, might be more likely to benefit vegans than omnivores.

Also pertinent is the fact that vegan diets – and indeed any diets devoid of fish or brain tissue – tend to be low in the long-chain omega-3 fatty acids that play a key structural role in the brain and retina, and that diminish risk for cardiac sudden death.[71] Ample intakes of these special fats also can have useful anti-inflammatory and anti-carcinogenic activities, especially in the context of diets relatively low in omega-6 fats.[72-75] And some epidemiology suggests that a lifetime of ample omega-3 status may provide a measure of protection from age-related cognitive dysfunction, macular degeneration, and clinical depression.[76-82] Vegan diets with meaningful levels of terrestrial alpha-linolenic acid enable a certain limited endogenous synthesis of long-chain omega-3s, but fish or fish oil ingestion is associated with notably higher tissue levels of these fats. Hence, long-chain omega-3s, although they do not function as cofactors, might be considered carninutrients. Vegan admirers of the China Study, which provided important evidence for the protective merits of plant-based diets, should be aware that this study also correlated increased fish consumption with improved health outcomes, likely reflecting a protective role of long-chain omega-3s.[83]

Vegans can now obtain DHA supplements manufactured from certain algae, but these are greatly more expensive than fish oil per unit omega-3.[84] Flaxseed genetically modified to produce stearidonic acid - more efficiently converted to long-chain omega-3s than is alpha-linolenic acid[85] – could represent a more cost-effective way for vegans to achieve superior omega-3 status, but unfortunately such a product is not yet commercially available.[86] It is clear that declining fish stocks will ultimately prove inadequate as a growing portion of the world's population wishes to ingest fish oil; stearidonic acid from bioengineered plants may represent a practical and cost-effective solution to this problem.

Concluding Comments

A peculiarity of the flesh-derived nutrients discussed here is that, although they each play a key role in muscle function (not surprising, as they are richly supplied by flesh foods), they are also important constituents of neurons and the brain. It's not inconceivable that subtle impairments of brain function reflecting suboptimal levels of carninutrients might contribute to the malaise reported by some ex-vegetarians.[7, 17, 87-92]

Whether or not dietary deprivation of carninutrients plays a role in the "failure to thrive" phenomenon reported by some ex-vegetarians, clinicians should be aware that tissue stores of these cofactors are likely to be somewhat decreased in long-term vegetarians. Hence, such people may be prime candidates for carninutrient supplementation when they present with ailments that are reported to respond to such supplementation. In particular, vegetarians who develop heart disorders might benefit from supplementation with carnitine, taurine, precursors of carnosine, and omega-3 oils.

In closing, it is crucial to note that there is *no evidence* that the net impact of transitioning from an omnivore to a vegan diet is a reduction in perceived health. A great many people who become vegans report robust or improved health, and are often delighted with the spontaneous weight loss and marked improvements in risk factors that this transition typically entails. And, in the long term, whole-food vegan diets can be expected to reduce risk for a wide range of common health disorders, including coronary disease, diabetes, and many types of cancer. However, no diet is perfect in every particular for every individual. If some individuals genuinely feel subpar on a vegan diet, it is important to find ways to correct this – precisely because such diets have such valuable long-term impacts on health, the ecology, and animal welfare.

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