



Amino acid need from the World Health Organization⁴, food composition from the USDA nutrient database^{4,1}.

Analysis is for each individual food all supplying calorie needs (closest to the "low active" category for a 5'11" 181lb, 25BMI male, as per the FDA).³

So when we compare the *actual requirements* to what plant foods *actually contain*, we find that basic plant foods aren't incomplete at all. They have every essential amino acid, in excess of what we need. It might not surprise you that beans are a complete protein by themselves, but even carrots are a complete protein. Tomatoes are a complete protein. Celery is a complete protein. Even *iceberg lettuce* is a complete protein.

(Those who would object that we can't eat enough lettuce to satisfy our protein needs are wildly missing the point. The point of using a day's worth of calories for a single food is simply to show how the food measures up, not to suggest that anyone could or should eat only a single food. These plant foods are complete no matter how much or how little of them you eat. That is, if only 1% of your diet is lettuce, then lettuce supplies *more* than 1% of your protein and amino acid requirements.)

A 2015 study analyzed the dietary intake and blood amino acid levels of various groups, and found that vegan met met the RDA for each and every amino acid. ([Jack Norris](#))

Interestingly, the amounts for "Need" in the table are twice what they were until recently. The original recommendations in the WHO's 1973 and 1985 reports were based on William Rose's pioneering work in the 1950's, and were considerably lower.⁶ Rose determined the levels needed by his subjects by intentionally feeding them diets with a synthetic mixture of declining levels of amino acids until they became deficient. After finding the *highest* amount needed by any subject, he then *doubled* that figure to arrive at his recommendation.⁷ And the current WHO recommendations have doubled their earlier figures *again*. And even with all these increases, individual plants *still* measure up as fully complete.

Experts confirm that plant proteins are complete

Besides the American Dietetic Association, other medical and nutrition professionals who have actually looked at the science have come to the same conclusion that there is no need to carefully combine proteins. For example:

Dennis Gordon, M.Ed, R.D.:

[C]omplementing proteins is not necessary with vegetable proteins. The myth that vegetable source proteins need to be complemented is similar to the myths that persist about sugar making one's blood glucose go up faster than starch does. These myths have great staying power despite their being no evidence to support them and plenty to refute them.⁸

Jeff Novick, M.S., R.D.:

Recently, I was teaching a nutrition class and describing the adequacy of plant-based diets to meet human nutritional needs. A woman raised her hand and stated, "I've read that because plant foods don't contain all the essential amino acids that humans need, to be healthy we must either eat animal protein or combine certain plant foods with others in order to ensure that we get complete proteins."

I was a little surprised to hear this, since this is one of the oldest myths related to vegetarianism and was disproved long ago. When I pointed this out, the woman identified herself as a medical resident and stated that her current textbook in human physiology states this and that in her classes, her professors have emphasized this point.

I was shocked. If myths like this not only abound in the general population, but also in the medical community, how can anyone ever learn how to eat healthfully? It is important to correct this misinformation because many people are afraid to follow healthful, plant-based, and/or total vegetarian (vegan) diets because they worry about "incomplete proteins" from plant sources. ...if you calculate the amount of each essential amino acid provided by unprocessed plant foods ... you will find that any single one, or combination, of these whole natural plant foods provides all of the essential amino acids. ...

Modern researchers know that it is virtually impossible to design a calorie-sufficient diet based on unprocessed whole natural plant foods that is deficient in any of the amino acids. (The only possible exception could be a diet based solely on fruit.)⁹

John A. McDougall, M.D.:

Many people believe that animal foods contain protein that is superior in quality to the protein found in plants. This is a misconception dating back to 1914, when Osborn and Mendel studied the protein requirements of laboratory rats.[11]... Based on these early rat experiments the amino acid pattern found in animal products was declared to be the standard by which to compare the amino acid pattern of vegetable foods. According to this concept, wheat and rice were declared deficient in lysine, and corn was deficient in tryptophan. It has since been shown that the initial premise that animal products supplied the most ideal protein pattern for humans, as it did for rats, was incorrect.... From the chart, it is clear that even single vegetable foods contain more than enough of all amino acids essential for humans.... Furthermore, many investigators have found no

improvement by mixing plant foods or supplementing them with amino acid mixtures to make the combined amino acid pattern look more like that of flesh, milk, or eggs.[35-44] ... People have actually lived for long periods of time in excellent health by satisfying their entire nutritional needs with potatoes and water alone.[33] ... Nature has designed vegetable foods to be complete. If people living before the age of modern dietetics had had to worry about achieving the correct protein combinations in their diets, our species would not have survived for these millions of years.¹⁰

Andrew Weil, M.D.:

You may have heard that vegetable sources of protein are "incomplete" and become "complete" only when correctly combined. Research has discredited that notion so you don't have to worry that you won't get enough usable protein if you don't put together some magical combination of foods at each meal.^{10,5}

Charles Attwood, M.D.:

Beans, however, are rich sources of all essential amino acids. The old ideas about the necessity of carefully combining vegetables at every meal to ensure the supply of essential amino acids has been totally refuted.¹¹