Protein is not protein. Here's why [Transcript with Source]

Protein is not protein.
For example, did you know that 30grams of protein from one food could build less muscle than 30 grams of protein from another food?
Or in a person who requires a minimum of 50 grams of protein a day for healthy body function, 50 grams of protein from this would not actually meet their protein needs.

This is important because the body requires protein for all kinds of things to stay healthy - anything from building bones to making hormones. And, data from NHANES suggests that 40% of Americans aren't even hitting their minimum protein requirements.[1]

OK So how can 30 grams of protein not be 30 grams of protein. Well we *absorb* and utilize certain proteins better than others. There's a scoring system called DIAAS recognized by the FAO that tells you the *quality* of a protein.[2]

Animal proteins like cows milk[114-Met+Cys], boiled eggs[113-His], beef and chicken breast[108-Try] are all considered **high** quality protein because they are very digestible and have high amounts of *all* the essential amino acids. Plant protein *powders* like soy or pea are of a lower rank but still **good** quality proteins. Another good rank protein is Baked chickpea[84-SAA] ...However *many* plant proteins, for example rice[59-Lys], lentils[54], rye[47], peanuts[43-Lys], almonds[40-Lys], and wheat[29-Lys] are all considered **poor** quality proteins.[2, 3, 4, 5, 6, 7, 8]

People often just assume 18 grams of protein from chicken is the same as 18 grams of protein from lentils or a peanut butter sandwich or some eggs.

Now, here's something you might find surprising. 50 grams of protein per day is the minimum protein requirement for adults*, and if you look here, most of these 103 countries get most of their protein from plants and they're hitting their 50grams a day just fine. But plant proteins aren't digested as well, so if you incorporate the digestibility of the proteins, far *more* countries are just *under* the 50g requirement. Now, if you account for the fact that many plant proteins don't

provide enough of one or more of the essential amino acids and therefore that protein can't be *fully* utilized, then it turns out that *none* of these 103 countries are hitting the 50g protein requirement.[9]
**In fact, the RDA is for high quality protein.*

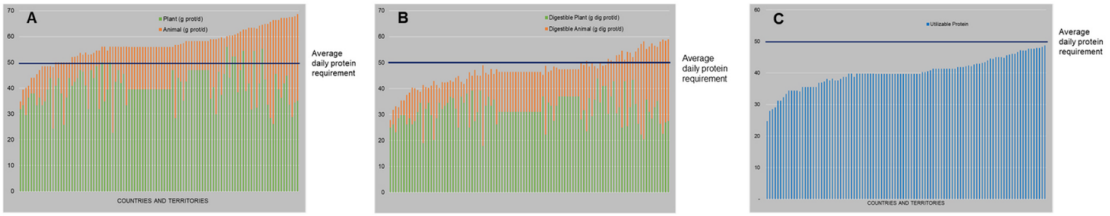


Fig. 2. Average daily per capita protein consumption relative to average daily protein requirement (grams protein/capita/day) for 103 countries either as in Fig. 1, gross protein, (A), corrected for protein digestibility (B), or corrected for protein utilizability (C).

Population protein intakes and food sustainability indices: The metrics matter

Now these countries could certainly hit the 50 grams of utilizable protein by simply eating a lot more plant protein. In developed countries we simply eat a bunch of protein in total so this is less of an issue.

But, research suggests that protein *quality* may still matter.

In a study looking at height of men in 105 countries, they found that in *developing* countries, the height of men correlated with protein *quantity*. Unsurprisingly, the challenge in developing countries is having access to *enough* protein. However, in developed countries where people eat plenty of protein, the *quality* of the protein they were eating is what mattered for height[10].

[Insert Deblasio clip]

Let's hope Mayor Deblasio at least adds an extra soy protein shake to lunches on Monday. Especially considering another March 2021 study looking at 187 Polish children found that children *not* eating meat, a high quality protein, were 3 centimeters shorter and had weaker bones.[11]

Protein quality comes down to amino acids. We don't just need protein, we need all the 9 essential amino acids that that protein source provides and they each have important functions. Just to name two, Leucine is a very important amino acid for muscle growth and tryptophan is a precursor for making the hormones melatonin and serotonin.[12, 13] So DIAAS scores are considering how much and how absorbable the essential amino acids in a food are.

Here's an easy example, say you're trying to gain muscle in the gym - Both leucine and essential amino acids are important for that. Soy and Pea protein powders do have a decent amount of well digested amino acids, but still to match the Leucine content and Essential Amino Acid content of 25 grams of Whey protein, you'd need 40 grams of soy protein or 38 grams of pea protein.[14]

This protein quality issue may be why this study found that women not eating meat have less muscle mass than women who *do* eat meat, even though they ate the same total grams of protein.[15]

[Clip from Game Changers]*

Of course plant foods have various benefits other than just protein, but the recent very popular film The Game Changers backed by big names like Arnold Schwarzenegger and James Cameron makes it sound like you can get the protein and the essential amino acids you need from *only* plant-based foods without much effort at all.

[Clip from Game Changers: "For example, one cup of cooked lentils or a peanut butter sandwich has about as much protein as 3 ounces of beef or 3 large eggs"]

**Note: Game changers assume appropriate daily protein intake to be 0.8g/kg.(S)*

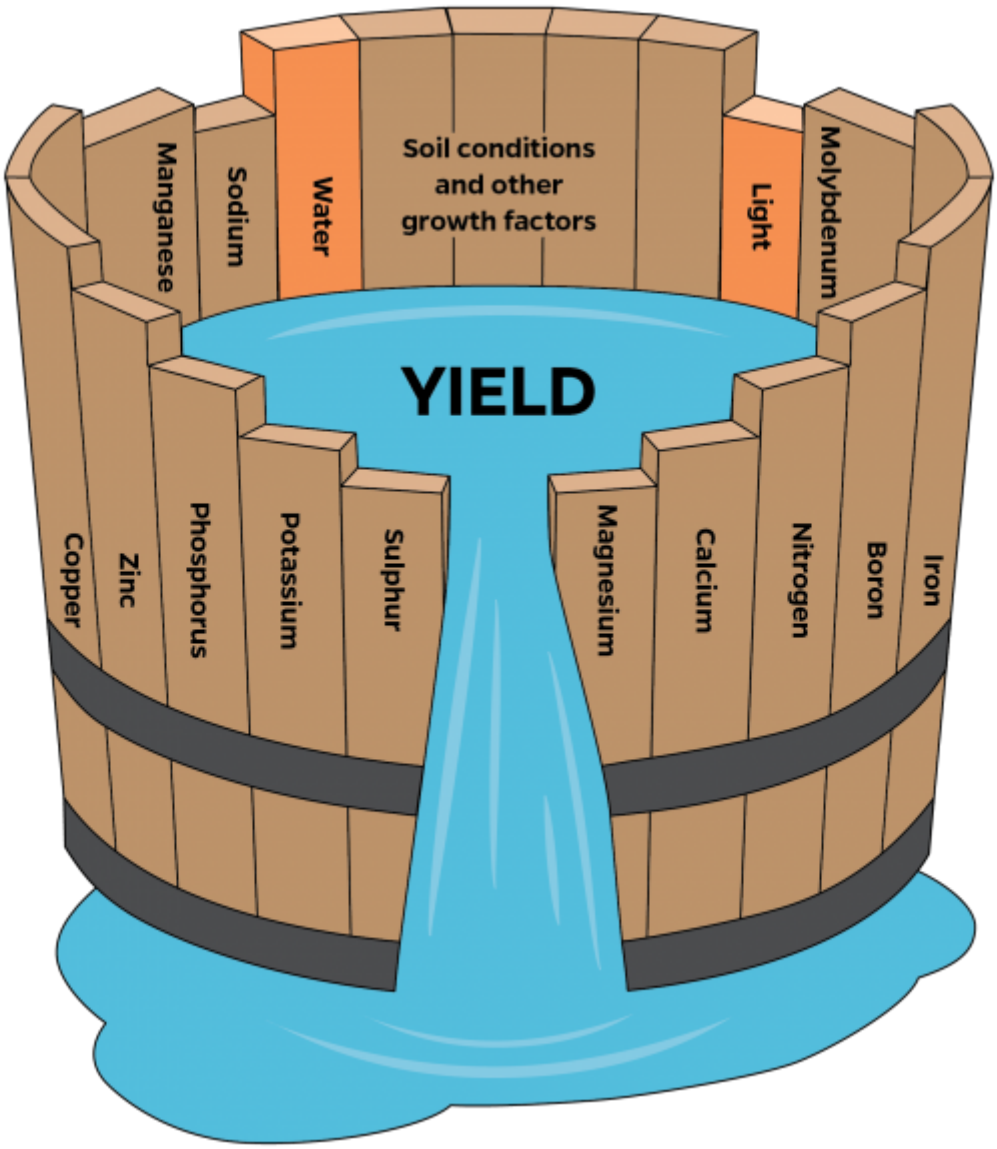
But this film doesn't talk much about protein quality.

Now recent research says the old 50g of protein a day recommendation is way too low and that a 62 kilogram (135 pound) person needs at least 75 to 100 grams of high quality protein per day.[16] So if you eat 75 grams of protein from animal foods, then you've met your protein requirements because most animal proteins have a DIAAS score of 100 or higher. However since Lentils for example have a DIAAS score of only 54, 75 grams of protein from lentils would only cover a little over half of your protein requirement.[2]

**Page 21 of FAO's Dietary Protein Quality Evaluation in Human nutrition: "DIAAS can be used as a means of defining protein equivalent intake (protein adequacy), when it is multiplied by the actual protein content or intake (i.e. measured protein intake times DIAAS)."*

But nobody eats *just* lentils... and you can combine foods to make up for the essential amino acids other foods lack[17, 18] so it's good that people typically eat

a variety of proteins in the same day, because if you're not getting enough of one amino acid, you can't properly utilize the other amino acids. ~~Kind of like this barrel - the barrel is only as good as the most limiting amino acid.~~



Also, eating lentils with your millet will improve the protein quality of the millet.[17] Corn flakes cereal has a very poor DIAAS score of 19 and it is very lacking in the amino acid Lysine[19]. However, Milk has a very high DIAAS score of 114[4] and has plenty of extra Lysine, so if you eat your corn flakes cereal with milk, then the DIAAS of your breakfast is actually 89.*[21]

Appendix A

Table A1. DIAAS calculation table for mixed diet: Example.

	Wt	**Pro**	**Lys**	**SAA**	**Thr**	**Trp**	**Lys**	**SAA**	**Thr**	**Trp**	**Protein Content**	**Lys**	**SAA**	**Thr**	**Trp**	
	(g)	(g/100g)	(g/100g)				Ileal Digestibility				(g)	Digestible mg IAA				
	A	B	C	D	E	F	G	H	I	J	AxB/100	(AxB) X CxG	(AxB) X DxH	(AxB) X ExI	(AxB) X FxJ	
Milk	100	3.4	0.312	0.136	0.177	0.055	0.91	0.93	0.92	0.93	3.4	283.92	126.48	162.84	51.15	
Cereal (corn)	50	7.5	0.07	0.24	0.2	0.04	0.66	0.76	0.69	0.42	3.75	23.1	91.2	69	8.4	
Total	150										7.15	307	217.7	231.8	59.6	
			Amino Acids mg/g (total for each AA/total protein)									42.9	30.4	32.4	8.3	
							Reference Pattern (mg/g)					Digestible IAA Reference Ratio				DIAAS for mixture
							Lys	SAA	Thr	Trp		Lys	SAA	Thr	Trp	**89% (Lys)**
		Older Children/Adults					48	23	25	6.6		**0.89**	1.32	1.3	1.26	

The above table is adapted from: "Dietary protein quality evaluation in human nutrition." FAO/WHO 2013. (see ref. [24]).

From: ***A Comparison of Dietary Protein Digestibility, Based on DIAAS Scoring, in Vegetarian and Non-Vegetarian Athletes***

**Bailey and Stein provide a similar example, but mix milk with a Wheat based cereal.[20]*

Figure 2. The calculated digestible indispensable amino acid score (DIAAS) value of a mixed meal of 60% milk and 40% wheat based breakfast cereal is 107, demonstrating the ability of milk to complement wheat resulting in a balanced meal that provides 100% of human AA requirements.

Unfortunately, as this 2021 paper shows, as the percentage of plant protein in the diet goes up, the overall protein quality of the diet goes down.[9]

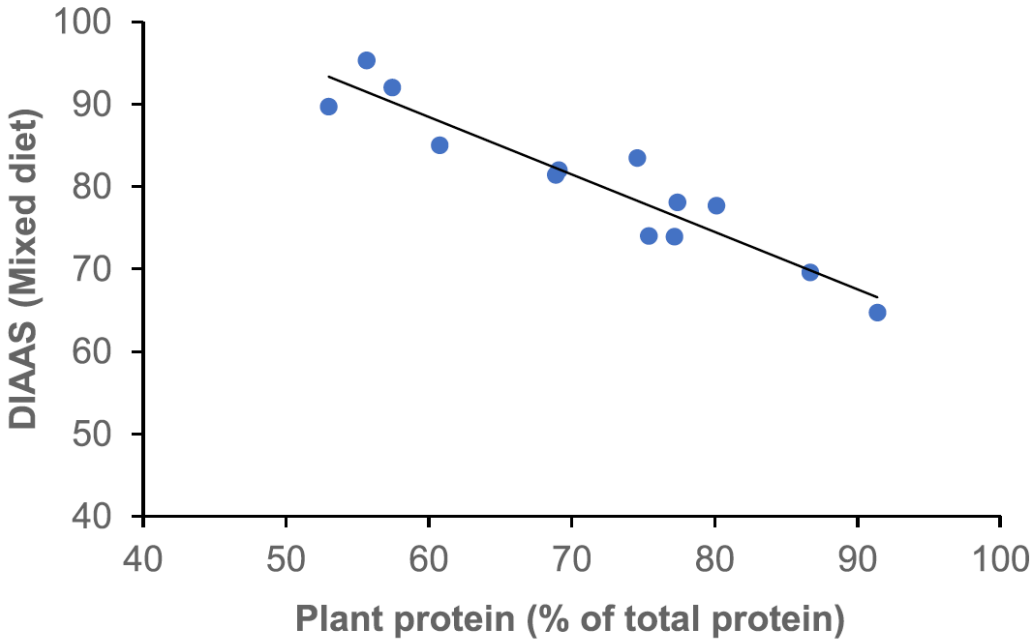


Fig. 4. Plot of calculated DIAAS values versus the proportion of dietary protein supplied by plant protein for the dietary patterns analysed here.

Population protein intakes and food sustainability indices: The metrics matter

In this study, even *athletes* who were following a vegetarian diet, didn't end up getting the minimum recommended amount of protein.[21]

The vegetarian athletes were getting enough protein in terms of total protein, but they only utilized 89% of the protein they ate, so they missed the lower end of their protein target by 10 grams and the upper end of the target by 22grams of utilizable protein. Now 89% is actually not bad, but as vegetarians they would be eating high quality proteins like dairy or eggs, so if they were vegan, we would expect their overall protein to be a lot lower than 89% utilizable.
~~This study looking at the overall protein quality of various vegetarian dishes served at restaurants found that the only the dishes that contained dairy received a **high** quality protein score.[22]~~

The solution for these athletes is quite simple really, they could just add another scoop of soy protein powder a day.... but it was surprising to me that even these

athletes who I imagine would be very calculated with their protein... could be missing their recommended protein intake.

With the right knowledge and diligence, yes you can meet your protein requirements on a vegetarian or vegan diet but you need to make sure and pick the right proteins.

Let's go back to this example from the Game Changers:

[Clip from Game Changers: "For example, one cup of cooked lentils or a peanut butter sandwich has about as much protein as 3 ounces of beef or 3 large eggs"]

So yea, technically you get the same grams of crude protein from a peanut butter sandwich, a cup of lentils, or 3 eggs or a 3 ounce steak but you would get even more protein from the steak if it were leaner. But let's look a little closer.

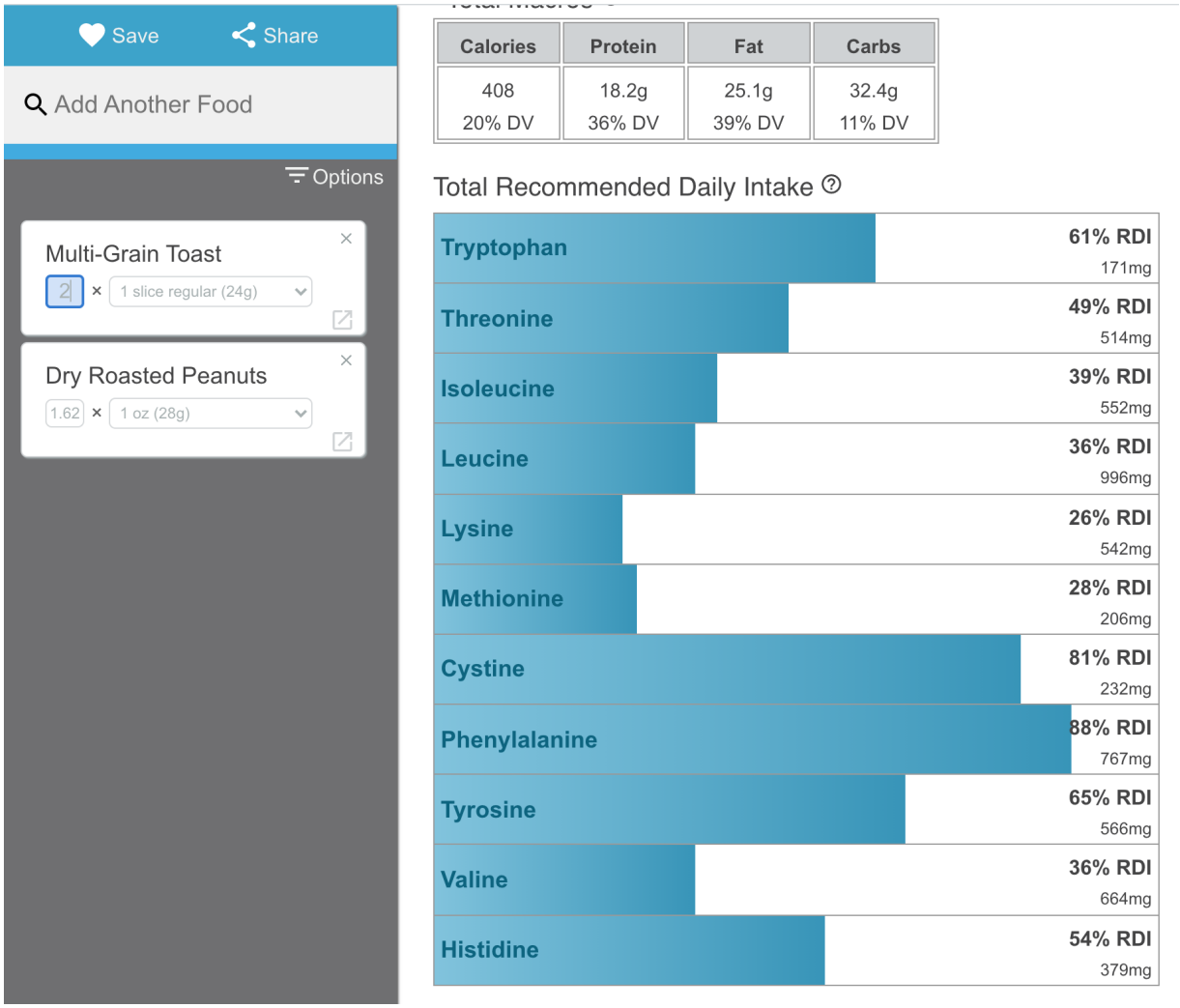
Here are the DIAAS scores of these foods:

Boiled eggs are **high** quality 113
So is Beef at 112
Lentils are **poor** quality at 54
So are Roasted peanuts at 43
And so is Wheat bread at 29

See the 4th paragraph of this document for sources for these values.

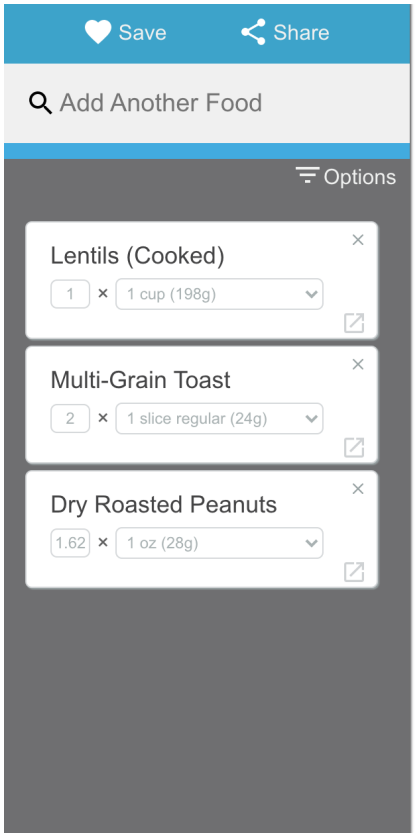
Wheat and peanuts are both limiting in Lysine so even if you combine them, their DIAAS score couldn't be higher than 43.[23]

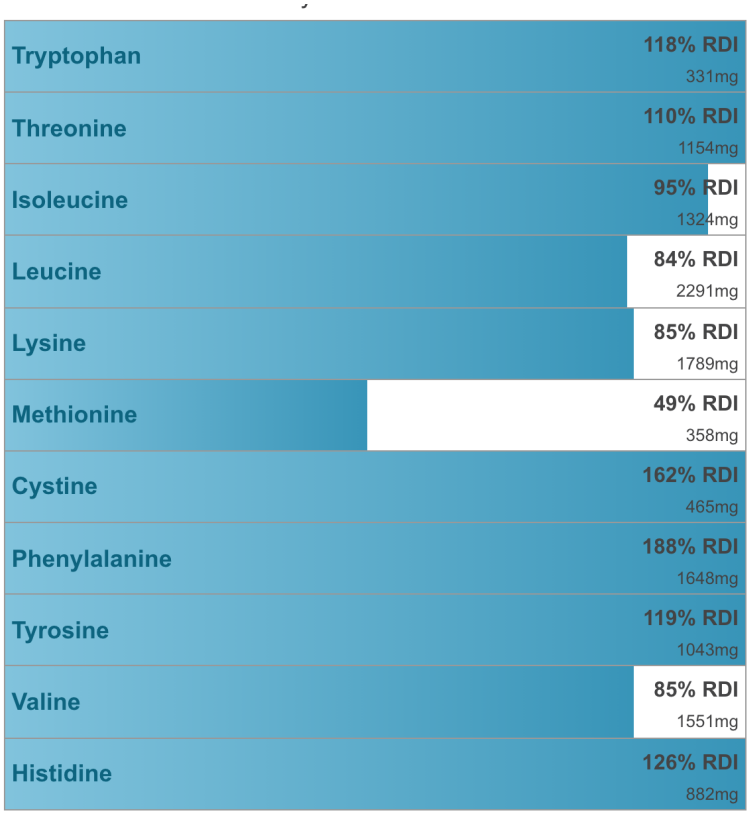
So let's say you start off with a peanut butter sandwich, here's the amino acids you're getting.
The below amino acid data for foods comes from https://tools.myfooddata.com/protein-calculator/ which pulls data from https://fdc.nal.usda.gov/



Again, If you don't get enough of one essential amino acid, then all the other essential amino acids can't be fully used for protein synthesis and the excess are just oxidized.[24, 25, 26]

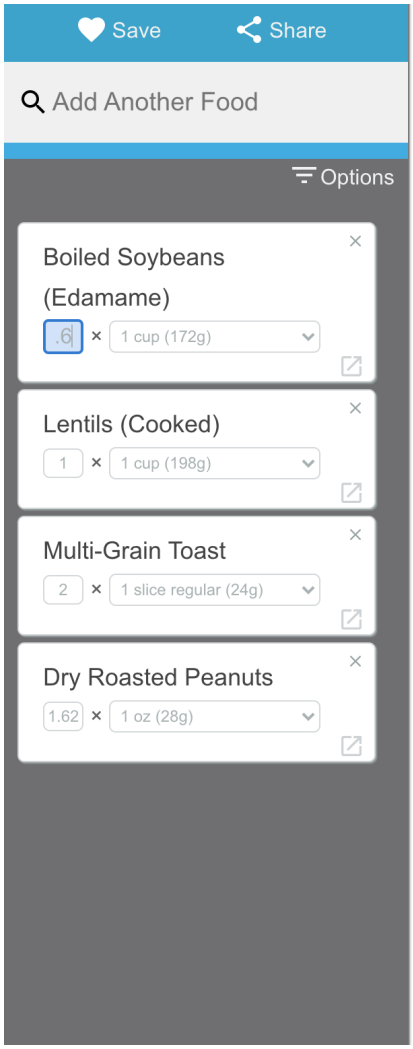
So, we'll want to make up for the poor Lysine content of the PBJ. So you can add some Lentils which have plenty of lysine and this will have increased the overall protein quality of the meal... but now you're still quite low in Methionine.





So then you add some edamame, boiled Soybeans, because they're one of the best plant sources of methionine, but even then you're not getting much methionine relative to all the other amino acids.

Note: Tofu's DIAAS score is 52 and it is limiting in Methionine and Cysteine

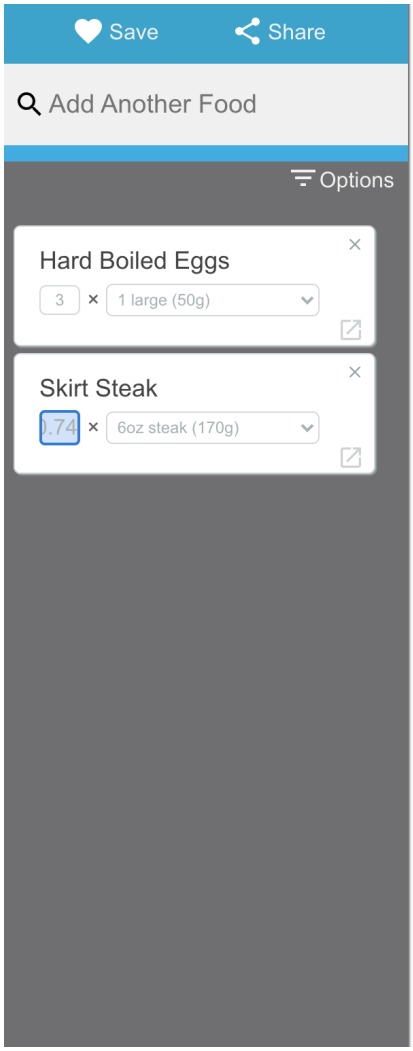


Calories	Protein	Fat	Carbs
815 41% DV	54.8g 110% DV	35.1g 54% DV	80.9g 27% DV

Total Recommended Daily Intake

Tryptophan	207% RDI 581mg
Threonine	181% RDI 1900mg
Isoleucine	154% RDI 2157mg
Leucine	135% RDI 3689mg
Lysine	140% RDI 2933mg
Methionine	81% RDI 590mg
Cystine	258% RDI 742mg
Phenylalanine	291% RDI 2545mg
Tyrosine	194% RDI 1693mg
Valine	132% RDI 2409mg
Histidine	192% RDI 1345mg

So that's the amino acids you're getting from 54 grams of protein from these plant foods. Now compare this to what you get from just eating 3 eggs and a 4 and a half ounce skirt steak.



Calories	Protein	Fat	Carbs
570 28% DV	54.9g 110% DV	37.4g 58% DV	1.7g 1% DV

Total Recommended Daily Intake

Tryptophan	250% RDI 700mg
Threonine	277% RDI 2913mg
Isoleucine	215% RDI 3017mg
Leucine	195% RDI 5317mg
Lysine	263% RDI 5514mg
Methionine	237% RDI 1726mg
Cystine	304% RDI 872mg
Phenylalanine	309% RDI 2702mg
Tyrosine	272% RDI 2378mg
Valine	178% RDI 3248mg
Histidine	296% RDI 2074mg

Well at first glance you can see that with the plant based meal, you have to eat 245 *more* calories to get *less* essential amino acids... and you get a better *balance* of amino acids from the animal proteins.

So, if you're not eating meat, you'll need to get a variety of plant proteins every day.

This is important because again, we need amino acids so the body can synthesize proteins to make things like enzymes, hormones, and amino acids act as the building blocks of bones, cartilage, skin, and so on...

Dr. Layne Norton did his PhD Dissertation on the critical role of the essential amino acid Leucine in building muscle.[27] He discussed in this video here how despite the Game Changers being all about athletes and performance, it glossed over this important topic

So with 54 grams of protein from steak and eggs you're getting 5.3 grams of leucine, but only 3.7 grams from the plant based meal, meaning you'd have to eat

almost 1200 calories of these plant foods to match the Leucine content of the steak and eggs meal which is only 570 calories.

[Clip of Layne saying you can get enough protein on a vegan diet, but you need to eat much more of it]

[Clip of Peter saying 59% of children globally don't get meat or seafood, yet the WHO says those are the best foods for them.]

I had a chat with forage agronomist and animal nutritionist Dr. Peter Ballerstedt who has been a key voice on this protein quality topic. In fact, his detailed presentation on youtube called "When is protein not protein?" is what got me interested in this topic. In that presentation he gets into a lot of important nuances, for example processing plant foods can lower the protein quality of that plant food - for example we don't just eat wheat, we process that wheat into bread and that processing actually worsens the protein quality.[20]

[Clip of Peter] "*Because the processing inactivates the lysine which is already the limiting nutrient."(S*)

Interestingly, *human* nutritionists don't fuss about protein *quality* or specific amino acids so much, but for an *animal* nutritionist like Dr. Ballerstedt, paying attention to protein quality is just common sense. After all animal nutritionists have been balancing the rations given to pigs based not on just protein, but amino acids for almost forty years now.(S)

In fact the FAO has suggested that maybe we should be putting individual amino acids on food nutrient labels.

This protein quality discussion is important not just because of the recent popularity of plant-based diets, but also as Dr. Ballerstedt points out, more than 60% of our current global protein supply is *already* plant-based.(S, data from FAOSTAT)

Now developed countries certainly eat much more animal sourced foods, so you might be thinking protein quality is an issue for *developing* countries. Well, as mentioned earlier, data from 2015 says 40% of Americans are not getting the minimum recommended amount of protein. And that is based on the old low recommendation of 0.8 grams of protein per kilogram bodyweight[1] ...but as we discussed, researchers are recently saying we need to get at least 1.2g to 1.6

grams of protein per kilogram. *And*, that data from 2015 is only looking at *total* protein - it's not accounting for the fact that some proteins are of lower quality than others. So, we'd expect that more than 40% of Americans are not hitting their minimum protein requirements.

But *why* would normal people not doing bodybuilding or competitive sports we need that much protein? This is an important question and it deserves a thorough answer. I'll be talking about this in another video, so make sure to subscribe and you can catch me on twitter, instagram or Patreon.

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