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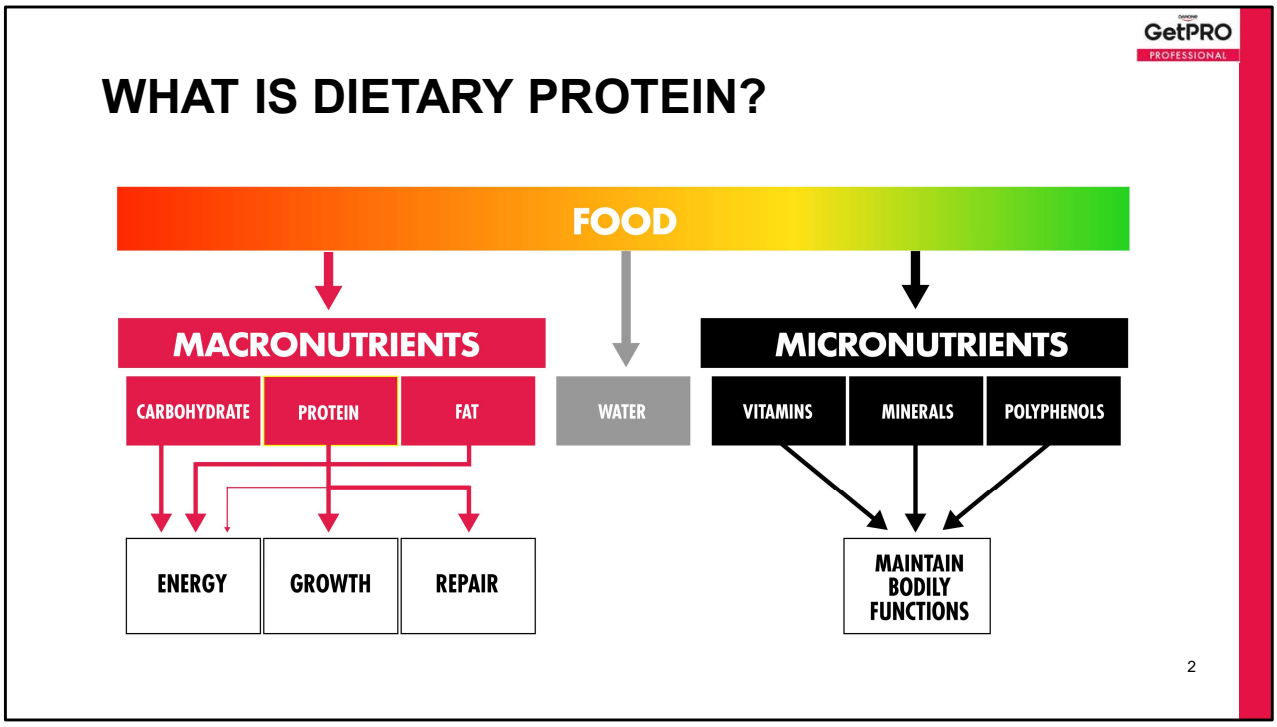
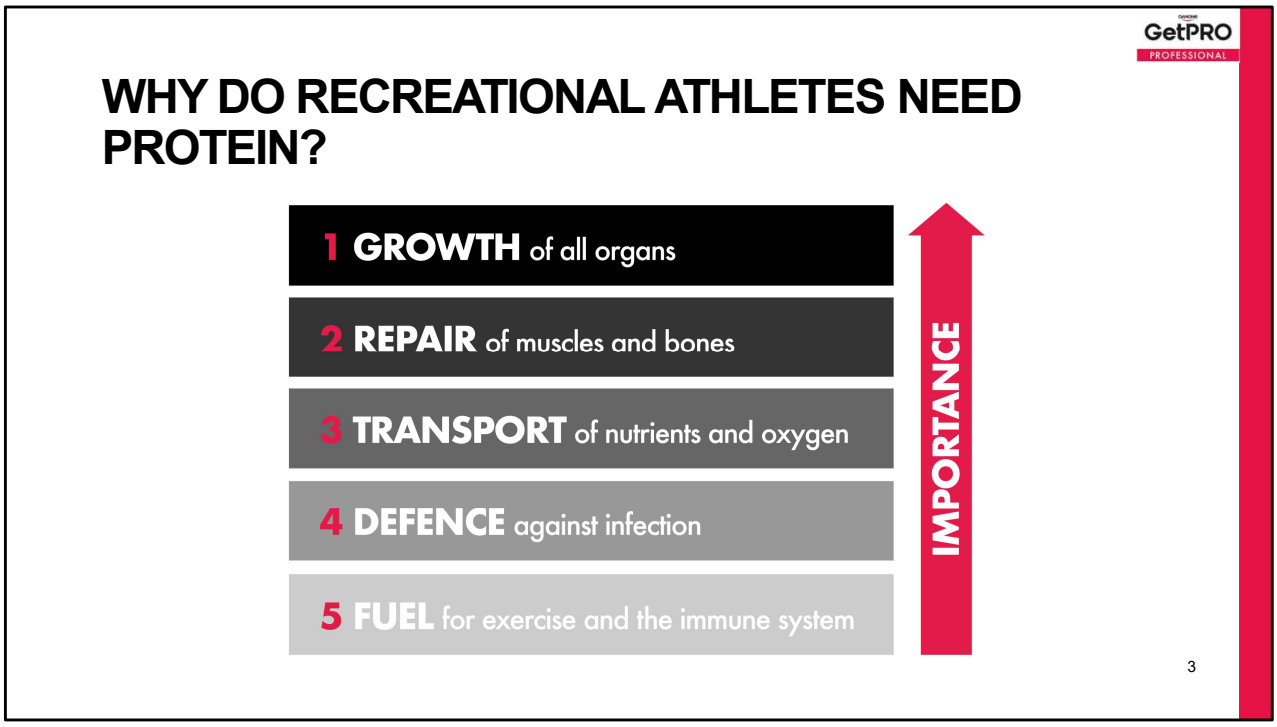
PROTEIN FUNDAMENTALS

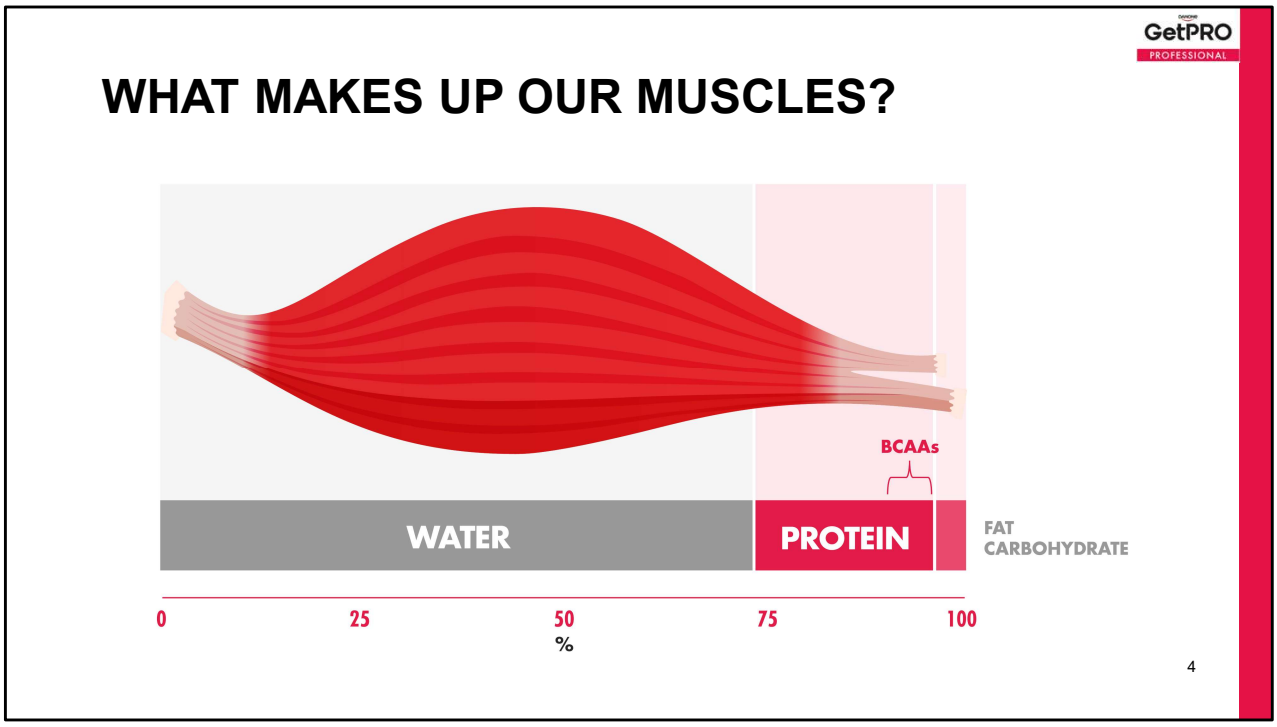
This resource was created by Oliver Witard, Senior Lecturer in Exercise Metabolism and Nutrition, Kings College London in collaboration with the GetPRO Professional nutrition team



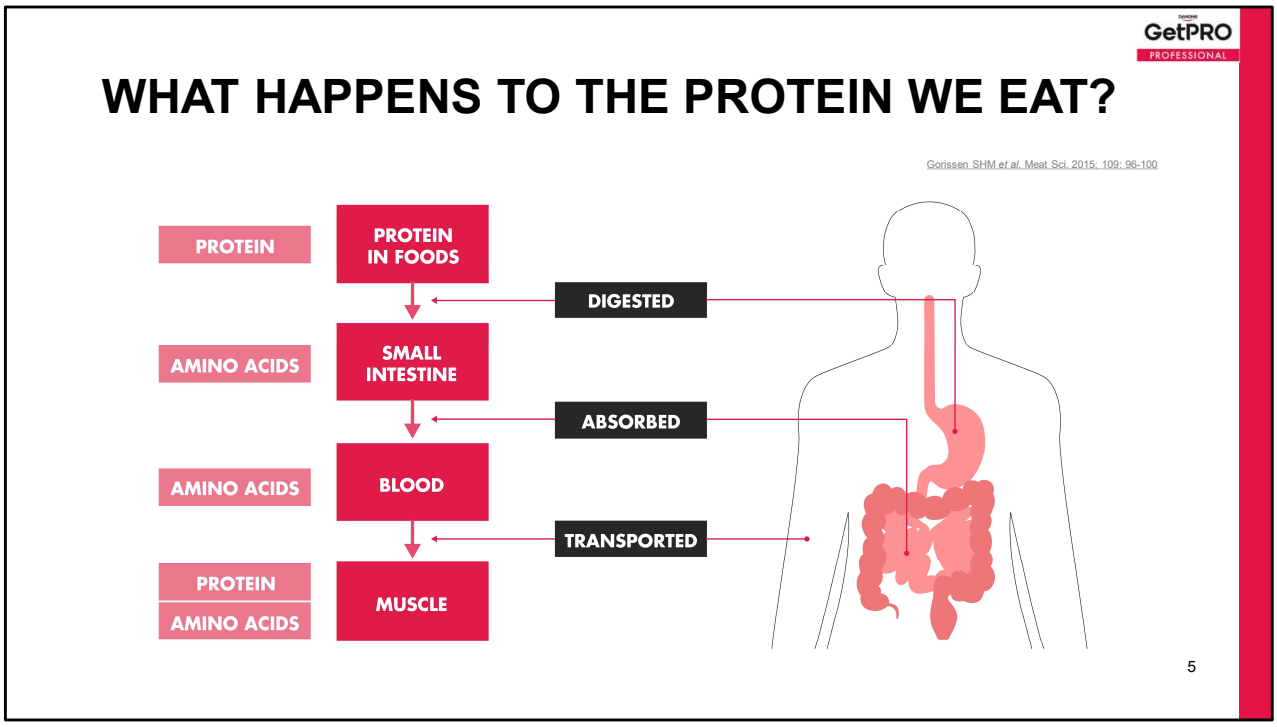
- So, what is dietary protein?
- Protein is a nutrient found in food.
- The body uses nutrients for energy (engine), growth (muscle), repair (bone injury) and maintenance of bodily functions (immune).
- Nutrients can be split into macronutrients and micronutrients.
- We have two classes of micronutrients called vitamins and minerals.
- Protein is one of the 3 macronutrients. The other two are carbohydrate and fat.
- Carbohydrate and fats are primarily responsible for supplying energy for the body.
- Protein is key for growth and repair, as well as maintaining various bodily functions, including (see next slide) …



- Why do exercisers need protein as part of their diet?
- In order of importance …
- Dietary protein is needed …
- … for the growth and formation of all of our organs, including muscle
- … for repairing our tissues including muscles and bones
- … for the transport of nutrients such as glucose and carrying oxygen by haemoglobin
- … for fuelling our immune system. Alongside glucose, one of the amino acids called glutamine is a key fuel for immune cells
- … for energy production when carbohydrate availability is low.



- Why is protein so important for muscle?
- Because other than water, protein is the major biochemical constituent of skeletal muscle tissue (75% water, 20% protein, 5% divided between fat and glycogen).
- Interestingly, the branched chain amino acids, valine, leucine and isoleucine, make up one-third of muscle protein.
- So, protein nutrition is often heavily linked with muscle reconditioning following exercise



- What happens to the protein we eat?
- After ingesting protein, the stomach and pancreas make a series of digestive enzymes which are known as pepsins.
- These enzymes break down the chain of amino acids into single amino acids.
- Digestion continues as protein is moved to the small intestine.
- Once in the small intestine, the amino acids drip into the blood.
- This is where the amino acids are transported to various tissues including muscle. If we exercise, the process happens more quickly because blood flow is increased.
- The amino acids then appear in the muscle and switch on a process called muscle protein synthesis.
- This is where the amino acid building blocks fit together to form new muscle protein.

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WHAT ARE AMINO ACIDS?

OBTAINED IN DIET		
Leucine	Phenylalanine	Histidine
Isoleucine	Threonine	Methionine
Valine	Tryptophan	Lysine

NOT OBTAINED IN DIET			
Alanine	Aspartic acid	Glutamine	Serine
Arginine	Cysteine	Glycine	Tyrosine
Asparagine	Glutamic acid	Proline	

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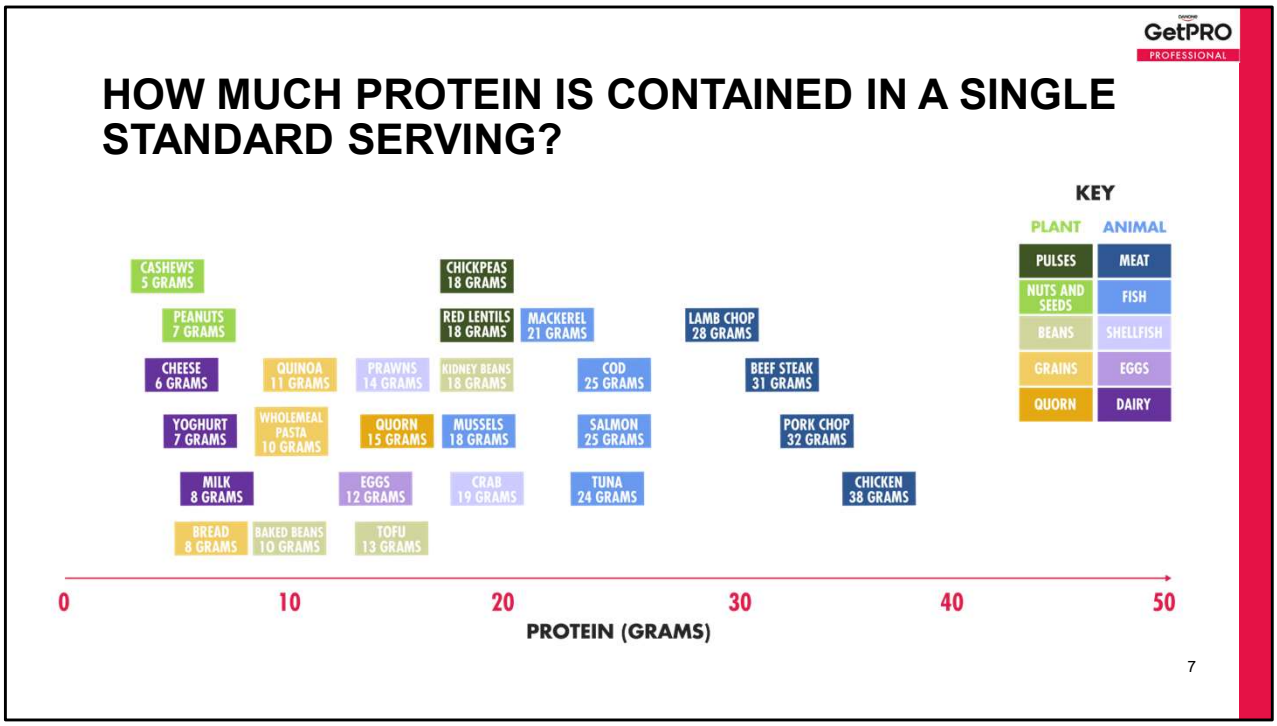
- So, in their physical form, proteins are chains of amino acids joined by peptide bonds.

- Amino acids when combined make up protein. Multiple amino acids (20>1000) make up a polypeptide chain.

- The combination of amino acids in peptide chain determines the function of a protein …



- So, how much protein is contained in a standard serving of various commonly consumed protein rich foods?
- Virtually all food we consume, both plant sources (on the left in green font) and animal sources (on the right in blue), contains some protein.
- But some foods are considered as protein-rich foods which means they contain a relatively high protein content.
- The main examples are various meats, fish, and dairy products,
- As well as beans, pulses cereals and nuts.
- Of course, the importance of any food as a source of any nutrient also depends on the amount of that food that is eaten, so foods we eat a lot of are important sources of protein.

Beef steak - 105 g – 31 g protein

Chicken - 130 g – 39 g protein

Cod - 1 fillet 120 g – 25 g protein

Mackerel, grilled - 1 fillet/150 g – 31 g protein

Tuna, canned in brine - 1 small tin (100 g) – 24 g protein

Cheese, cheddar - 1 slice (25 g) – 6 g protein

Milk - 1 glass (250 ml) – 8 g protein

Low fat yoghurt, plain - 1 carton (125 g) – 7 g protein

Eggs – 2 – 12 g protein

Peanuts, roasted and salted - 1 handful (25 g) – 7 g protein

Cashew nuts, roasted and salted - 1 handful (25 g) – 5 g protein

Baked beans - 1 small tin (205 g) – 10 g protein

Red lentils, boiled 4 tbsp (200 g) – 18 g protein

Kidney beans – boiled - 4 tbsp (200 g) – 18 g protein

Chickpeas, boiled - 4 tbsp (200 g) – 18 g protein

Tofu - Half a pack (100 g) – 13 g protein

Quorn mince - 4 tbsp (100 g) – 15 g protein

Wholemeal bread – 8 grams

Wholemeal pasta, boiled - 5 heaped tbsp (250 g) – 10 g protein

Quinoa, cooked - 5 heaped tbsp (250 g) – 11 g protein

HOW MUCH PROTEIN SHOULD YOU CONSUME EACH DAY?

Morton RW *et al.* Br J Sports Med. 2018; 52(6): 376-384

Witard OC et al. Int J Sport Nutr Exerc Metab. 2019; 29(2): 165-174

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- The current recommendation for daily protein intakes for exercisers is 1.5 grams of protein per kilogram body mass per day.
- By finding your body weight on the horizontal axis you can work out roughly how much protein you should target when including exercise in your daily routine.
- So, an average 70kg adult would require around 100 g of protein per day.
- If you have the goal of weight loss, the guidelines increase.
- So, an average 70kg adult would require around 150 g of protein per day in order to maintain muscle mass and encourage fat mass loss during a period of dieting.

EXAMPLE MEAL PLAN FOR 80KG TEAM SPORT AND EXERCISE ENTHUSIAST

	Time	Meal	Foods providing ~30g protein in highlighted meals during the day
	8:00	Breakfast	250g oatmeal porridge and 200ml of low-fat milk
	11:00	Snack	300g Greek yogurt with granola
	12:30	Lunch	Omelette of 2 eggs and toast/salad
	16:00	Dinner	120g chicken with rice and vegetables
	17:00-19:30	Team sport training	Water and/or sports drink
	19:30	Recovery snack	200 g high protein yoghurt. '
	22:00	Pre sleep snack	3 slices of wholewheat bread with ham, cheese, peanut butter and 200ml low fat milk

Witard OC *et al.* Int J Sport Nutr Exerc Metab. 2019; 29(2): 165-174

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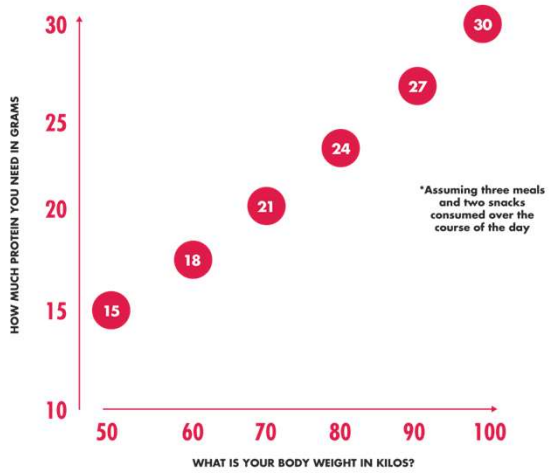
HOW MUCH PROTEIN SHOULD YOU CONSUME IN EACH MEAL?



Moore DR *et al.* J Gerontol A Biol Sci Med Sci. 2015; 70(1): 57-62

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- What about target amounts of protein in each meal of the day?
- The guidelines is 0.3 grams per kilogram body mass per meal or serving.
- By finding your body weight on the horizontal axis you can work out roughly how much protein you should target each meal.
- So, an average 70kg adult would require around 20 g of protein in each meal, an 80 kg person 25 grams, and a 100 kg person more like 30 grams.

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EXAMPLE PROTEIN FOODS FOR 80-100KG EXERCISER QUALITY?

WHAT DOES ~30G OF PROTEIN LOOK LIKE?

RAW SALMON
1 medium fillet (150g) = 31g protein

LEAN BEEF STEAK
1 medium fillet (150g raw) = 35g protein

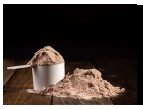
PORK TENDERLOIN
2 thin slices (150g) = 31g protein

CANNED IN WATER TUNA (DRAINED)
1 can (130g) = 31g protein

COOKED BEANS (LENTILS/CHICKPEAS)
2 cups (360g) = 26g protein

LARGE EGGS
3 pieces = 25g protein

EMMENTAL CHEESE
5 slices (110g) = 33g protein



WHEY PROTEIN
1 average serving/scoop (30g) = 27g protein

COOKED CHICKEN BREAST
1 small fillet (100g) = 31g protein

GREEK YOGURT 0% FAT OR COTTAGE CHEESE
1 cup (250g) = 26g protein

LOW FAT CHOCOLATE MILK
500ml = 17.3g protein

PEANUT BUTTER
7 heaped teaspoons (98g) = 26g protein

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So, what might a protein based meal plan look like for these individuals?

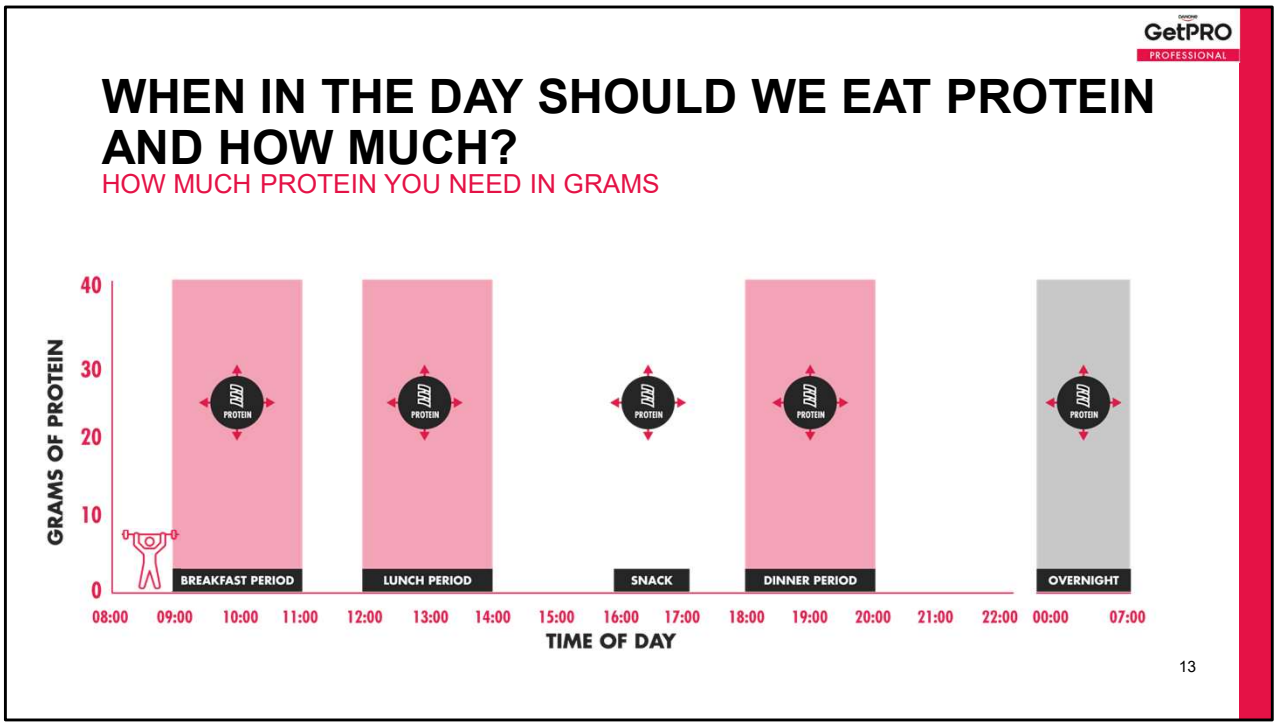
WHAT DOES A HIGH PROTEIN PLANT-BASED MEAL LOOK LIKE?

QUINOA, RED KIDNEY BEAN AND GREEN BEAN BOWL

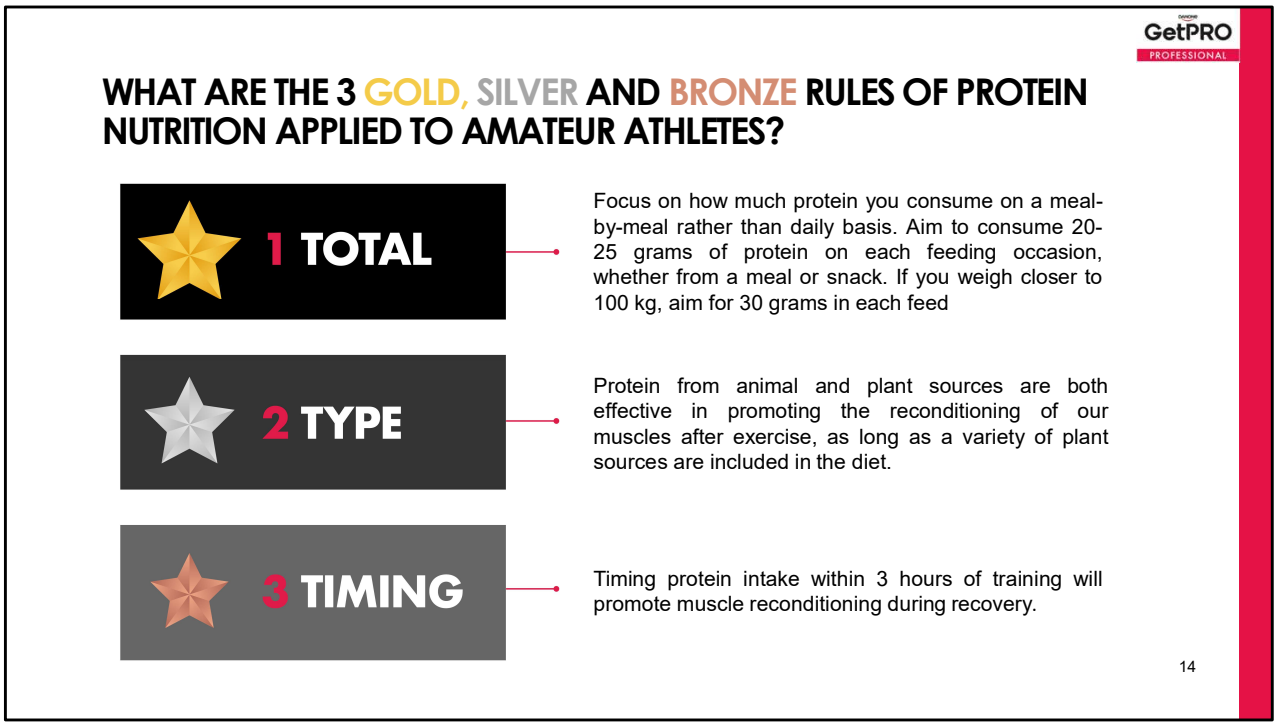
- Red kidney beans, cooked (150g / 1 cup)
- White and red quinoa, cooked (100 g / ½ cup)
- Spinach, sautéed (100 g / ¼ cup)
- Peas, boiled (80 g / 1 tablespoon)
- Watercress (20 g / ½ cup)

Energy = 414 kcal
Carbohydrate = 52 g
Fat = 5 g
Protein = 25 g
Leucine = 3 g
All 9 essential amino acids
Fibre = 26 g

- What about vegetarians? Can they also achieve this target protein intake in a meal?
- Here we have an example of a plant-based protein meal that, by combining different foods, covers all bases in terms of containing all 9 essential amino acids in sufficient amount
- In reality, of course, people do not usually consume only a single source of protein.
- So, a relative shortage of one amino acid in one food is made good by a relative excess of that amino acid in another food.
- This bean and quinoa bowl provides an example meal plan to meet protein recommendations from a single vegetarian dish.



- What about protein timing?
- This idea that we must ingest protein within a 1 hour window following our workout is a myth. We can ingest 1, 2 or 3 hours after exercise if more convenient.
- The most important recommendation is to evenly space the timing of protein throughout the day.
- So, rather than consuming all of the day's protein in a single meal, typically the evening meal, try to hit that target per meal protein intake every 3-4 hours of the waking day.
- So, 3 square meals plus a snack.
- You may also want to consume protein just prior to bedtime to support the overnight period. 40 grams is likely best in this case.



Total: Focus on how much protein you are consuming on a meal-by-meal rather than daily basis.

Aim to consume 20-25 grams of protein on each feeding occasion whether that be a meal or snack. If you are closer to 100kg in body weight, aim for 30 grams in each serving.

Protein from animal and plant sources are both effective in promoting the reconditioning of our muscles after exercise, as long as a variety of plant sources are included in the diet.

Timing protein intake within 3 hours of training will promote muscle reconditioning during recovery.

QUICK-FIRE QUIZ – QUESTIONS

Protein is one of the:

A) MACRONUTRIENTS	B) MICRONUTRIENTS	C) BOTH

The building blocks of protein are:

A) GLUCOSE	B) FATTY ACIDS	C) AMINO ACIDS

Protein serves as a fuel for muscles when exercise is:

A) SHORT DURATION AND INTENSE	B) MODERATE DURATION AND MODERATELY INTENSE	C) PROLONGED DURATION AND CARBOHYDRATE AND FAT STORES HAVE RUN OUT

Protein is contained in:

A) ANIMAL SOURCES ONLY	B) PLANT SOURCES ONLY	C) BOTH PLANT AND ANIMAL SOURCES

The highest quality protein recorded to date is derived from:

A) MEAT	B) DAIRY	C) PULSES

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QUICK-FIRE QUIZ – ANSWERS

Protein is one of the:

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The highest quality protein recorded to date is derived from:

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QUICK-FIRE QUIZ – QUESTIONS

The most important factor when determining protein recommendations relates to the:

A) TOTAL PROTEIN INTAKE	B) TYPE OF PROTEIN INTAKE	C) TIMING OF PROTEIN INTAKE POST WORKOUT

Protein recommendations during a period of weight loss (compared with no weight loss) are:

A) INCREASED	B) DECREASED	C) STAY THE SAME

The importance of consuming protein as soon as possible post workout is most relevant to:

A) ELITE ATHLETES	B) AMATEUR ATHLETES	C) NEW EXERCISERS

Regarding protein recommendations during a period of weight loss (compared with no weight loss), the optimal dose of protein to consume on a per meal basis is typically somewhere between:

A) 20-30 GRAMS	B) 40-50 GRAMS	C) 50-60 GRAMS

QUICK-FIRE QUIZ – ANSWERS

The most important factor when determining protein recommendations relates to the:

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2. Morton RW *et al*. A systematic review, meta-analysis and meta-regression of the effect of protein supplementation on resistance training-induced gains in muscle mass and strength in healthy adults. Br J sports Med. 2018; 52(6): 376-384
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About the author: Dr Oliver Witard worked in collaboration with the GetPRO Professional team to produce this presentation. He is a Senior Lecturer in Nutrition and Exercise Metabolism at King's College London. His academic research interests are in the response of muscle protein metabolism to exercise and nutrition with application to athletic and clinical populations.

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