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FUELLING THE ATHLETE

This resource was created by Michael Naylor, Head of Performance Nutrition, UK Sports Institute in collaboration with the GetPRO Professional nutrition team

This resource is for use under professional supervision

WHERE DOES ENERGY COME FROM?

CARBOHYDRATE
4 kcal/g

PROTEIN
4 kcal/g

FATS
9 kcal/g

DID YOU KNOW?
Protein is primarily used by the body for building and repairing tissues, and not for movement!

WHERE DOES ENERGY COME FROM?

Carbohydrates tend to be the preferred energy source for athletes, because it is the only fuel source that can produce ATP without oxygen. This means, that any exercise above 60% VO2 max, carbohydrates are the predominate fuel source.

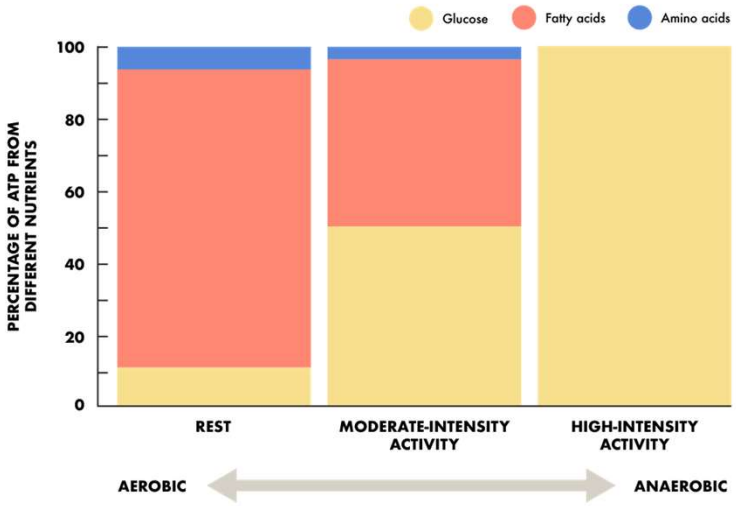

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Image from:
https://med.libretexts.org/Under_Construction/Purgatory/Book%3A_Human_Nutrition_1e_(University_of_Hawaii)/16%3A_Performance_Nutrition/16.04%3A_Fuel_Sources

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CARBOHYDRATE STORAGE

Carbohydrates are primarily stored in the body as glycogen; however stores are limited to around 500g. Glycogen serves as a reserve of energy and is a readily available source that can be mobilised quickly when needed. Think of it like a race car, when the driver puts their foot down on the accelerator, the car (glycogen) responds almost immediately!

DID YOU KNOW?

Even at rest, approximately 60% of glucose found in the blood is metabolised by the brain?

Glycogen storage location	Function	Storage Capacity
 Liver	Glycogen in the liver maintains blood glucose levels, particularly during fasting periods, such as sleeping or between meals. When blood glucose levels drop, glycogen stored in the liver is broken down into glucose and released into the blood stream to maintain energy.	100-120g
 Muscles	Muscles glycogen reserves are primarily used to provide energy for muscle contraction during physical activity. Muscle glycogen is not able to regulate blood glucose, but instead acts locally to provide energy for the working muscles.	300-400g

Murray B, Rosenbloom C. Nutr Rev. 2018 Apr 1;76(4):243-259

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Excess glucose is primarily stored in our muscles and liver in the form of glycogen, however our stores of glycogen are limited to around 100-120g in the liver, and 300-400g in the muscles. ike a race car, your body needs “fuel” in order to perform! Ever experienced hitting the wall? This is because your body has run out of glycogen stores and is relying on fatty acids as it’s predominate fuel source … meaning a decline in performance. Just like a car, you won’t get very far if you run out of fuel! As mentioned in the previous slide, fats are a sufficient fuel source at lower intensities, but not when you’re looking to exercise beyond around 60% of your VO2 max, or for long durations over around 80 minutes.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6019055/
Murray B, Rosenbloom C. Fundamentals of glycogen metabolism for coaches and athletes. Nutr Rev. 2018 Apr 1;76(4):243-259

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CARBOHYDRATE RECOMMENDATIONS FOR DIFFERENT EVENTS

Type of Activity	Minutes per day	Carbohydrate	Potential sports
Light intensity training e.g., walking, light jog, yoga – can easily talk or sing	<60	3-5 g/kg/bw	Weightlifting, shooting, archery
Moderate intensity training **e.g.,** jogging or cycling – can talk but unable to sing	>60	5-7 g/kg/bw	Weightlifting, swimming, running, team sports
Moderate to high intensity training e.g., interval training, a football match, swimming at a modest effort – can only carry out brief conversations	60-180	6-10 g/kg/bw	Team sports, triathletes, running, cycling
Moderate to high intensity training e.g., very hard interval training, high intensity football/ rugby match, ice hockey, swimming (cannot speak during the effort)	>180	8-12 g/kg/bw	Running, triathletes, ultra endurance athletes, cycling

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Murray B, Rosenbloom C. Nutr Rev. 2018 Apr 1;76(4):243-259

As you can see, even on light training days, there is still an emphasis on consuming sufficient carbohydrates. It is important to focus on consuming complex carbohydrates from sources like wholegrains, fruit, vegetables and legumes, as they provide essential nutrients and fibre for overall health.

Moving up the scale, individuals needing 12g/kg/bw per day can often be difficult to achieve. For example, for a 70kg athlete, this equates to 840g carbohydrate … the equivalent to 2.5 loaves of bread! This is where working with a qualified nutritionist can be hugely beneficial in helping you achieve your goals, supporting your health and performance.

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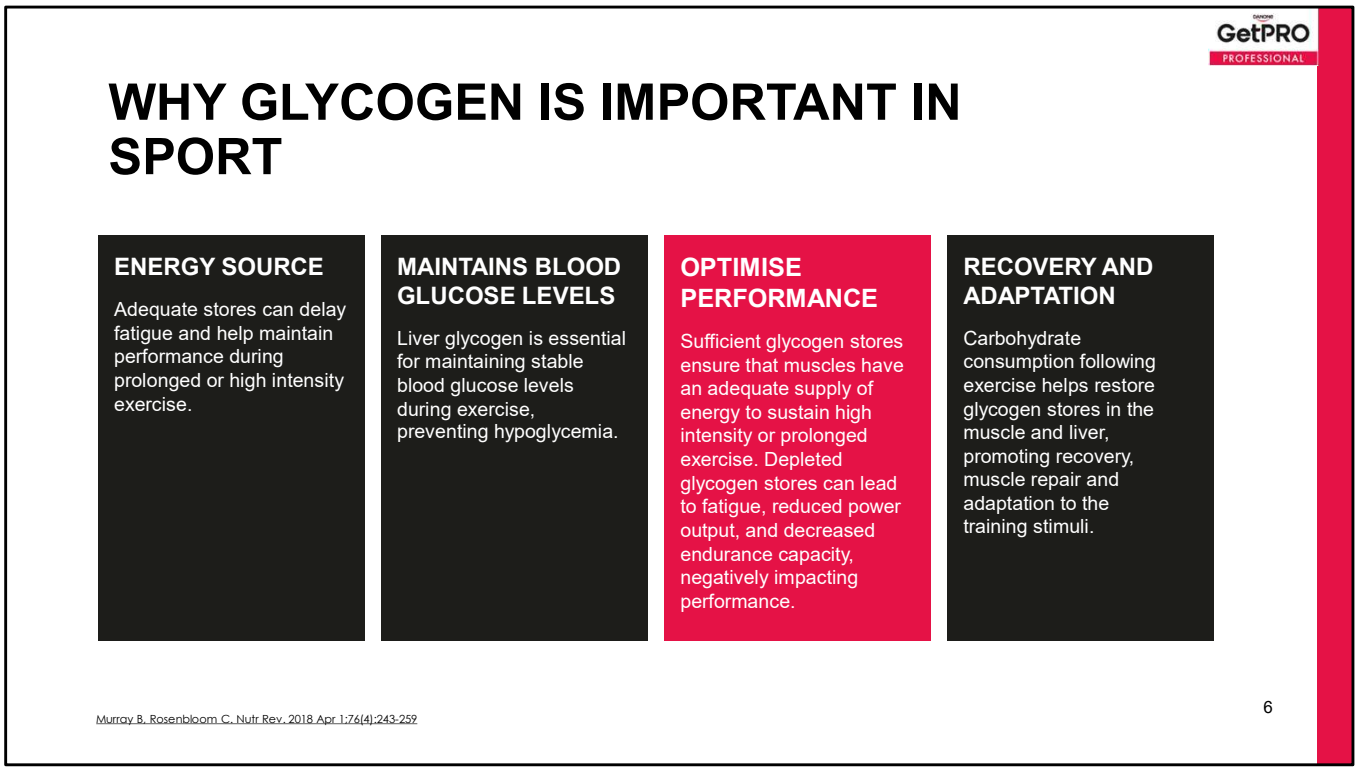

Optimise Performance

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6019055/

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REAL FOOD EXAMPLES OF CARBOHYDRATE AMOUNTS

BAGELS
45.3g per bagel

BAKING POTATO
39.6g per 175g

FRUIT SMOOTHIE
13g per 100ml

GREEK 0% YOGHURT
3g per 100g

MEDIUM SLICED BREAD
16.8g per slice

ORANGE JUICE
9.3g per 100ml

OATS
24.2g per 40g oats

BASMATI RICE
59.9g per 75g dry

CLASSIC VEG MIX
5.2g per 100g

SEMI SKIMMED MILK
9.6g per 200ml

FUSILLI PASTA
57g per 80g dry

BANANA
19.3g per 100g (medium banana)

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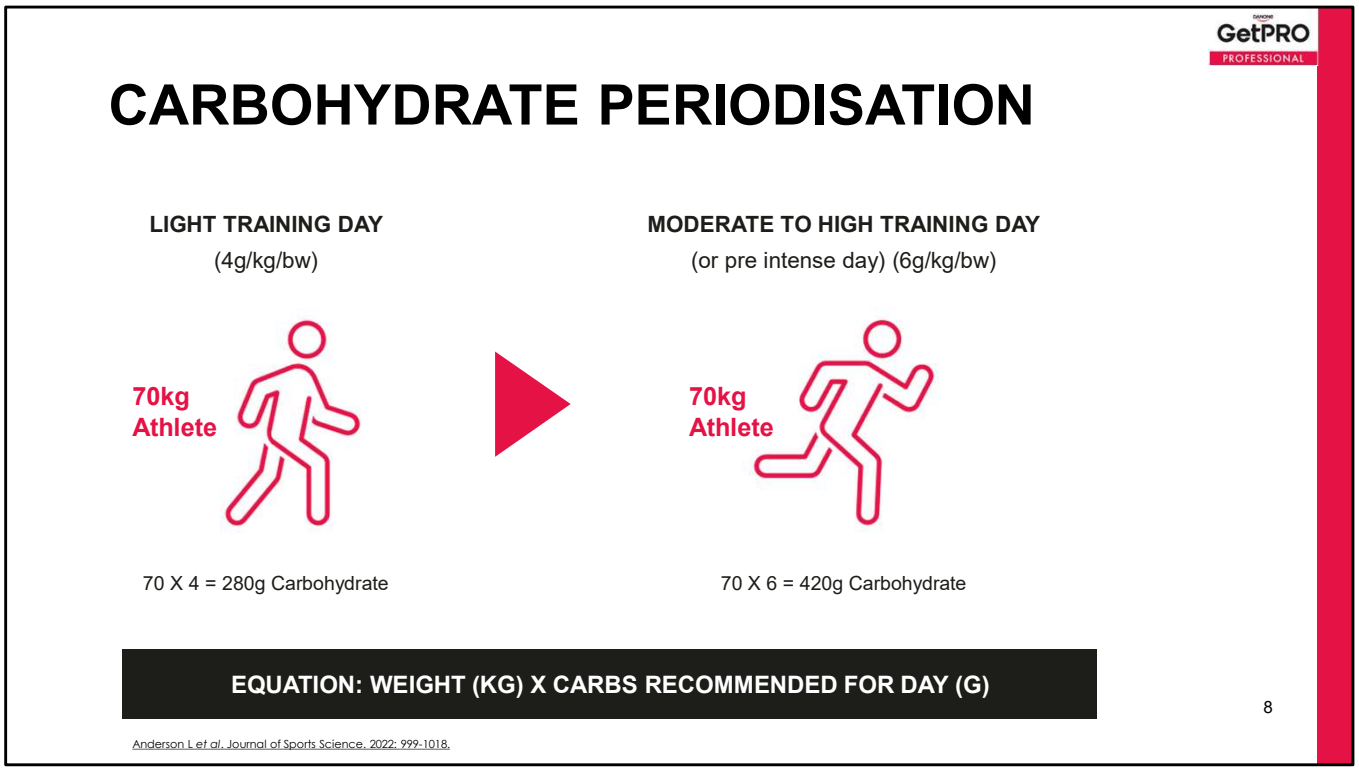
As you can see, the amount of carbohydrate in foods vary. Is anyone surprised by the carbohydrate in any of these foods?



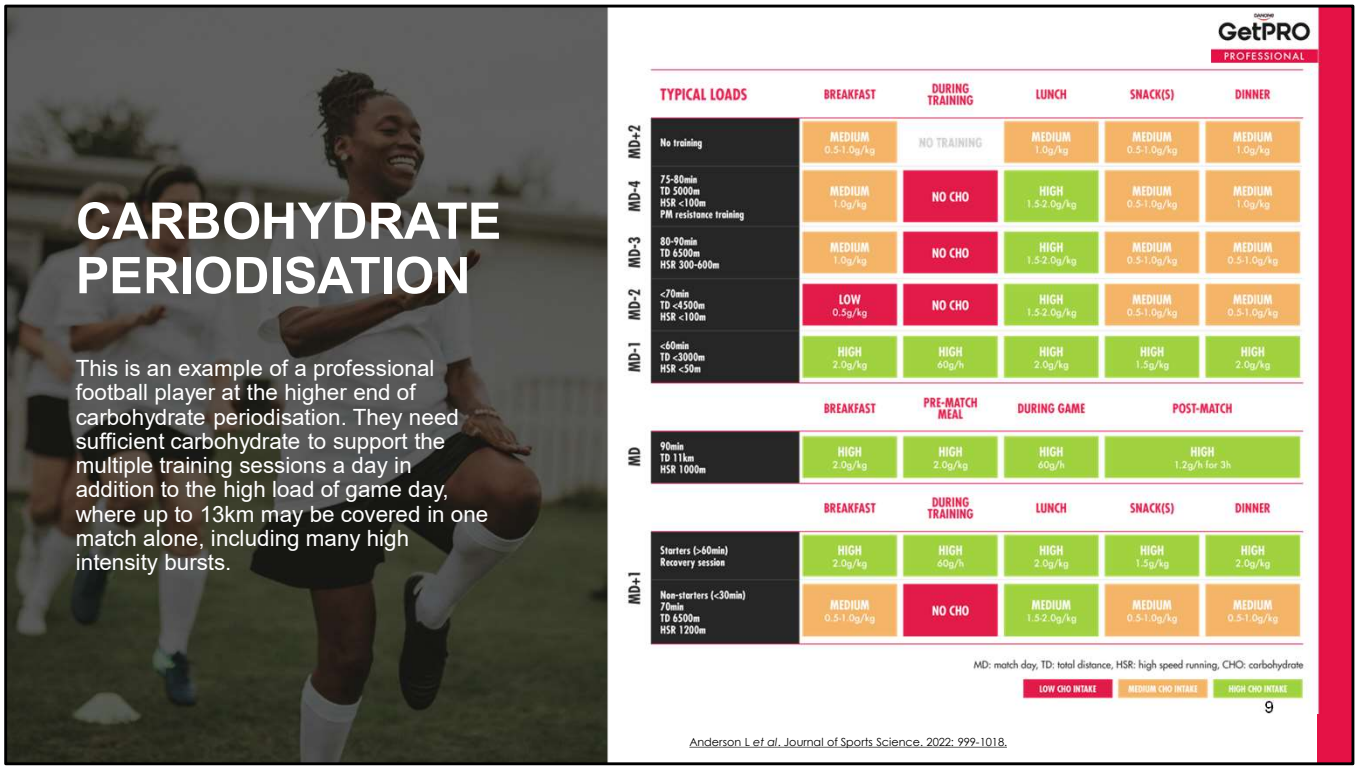
The amount of carbohydrate individuals need not only differs from person to person, but it will also differ day to day, depending not only on the individual's training, but also their individual goals. They might have goals around their training / competing demands, and so may need extra fuel to support this, or they may reduce their carbohydrate intake at certain times to support their body composition goals.

At a headline level, you can see from the example above, that on a light training day for a 70kg athlete, individuals might require 4g carbohydrate per kg body weight per day. So as you can see, if an athlete is 70kg, you times that by 4 and you get 280g carbohydrate.

If it was a more intense training day, or the day before an intense match or competition, the individual might want to increase their carbohydrate to 6g/kg/bw per day. The same formula is used, you times the body weight, in this case 70kg by 6, which equates to 420g carbohydrate for the day.

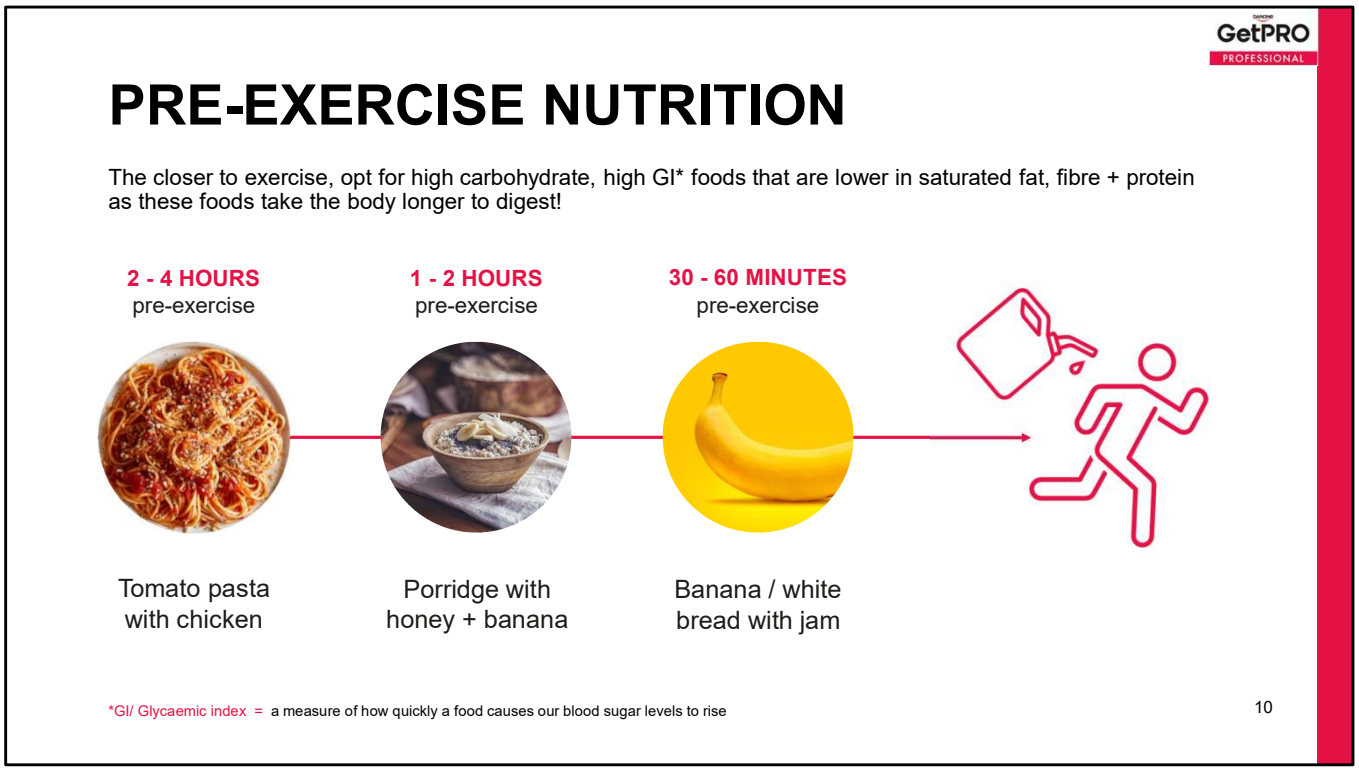
Anderson et al, 2022 - https://www.tandfonline.com/doi/epdf/10.1080/02640414.2022.2044135?needAccess=true

Anderson L et al. Physical loading in professional soccer players: Implications for contemporary guidelines to encompass carbohydrate periodisation. Journal of Sports Science. 2022: 999-1018.



Here is an example of how professional football players periodise their carbohydrate intake based on their energy needs for the day or the following day. A traffic light system has been used, with green being high carbohydrate consumption days, averaging 2g/kg/bw per meal, medium meals ranging from 0.5 - 1 g/kg/bw carbohydrate and red blocks containing low carbohydrate of 0.5g/kg/bw or no carbohydrate. As you can see, on heavier training days the carbohydrate content increases to support the demands of that day. On high days, fruit juices such as smoothies or orange juice, are a great way to top up carbohydrate content, without leaving you too full.

Anderson et al, 2022 - https://www.tandfonline.com/doi/epdf/10.1080/02640414.2022.2044135



A lot of the time for health, low GI, high fibre meals are recommended, however these foods take the body longer to process and so may lead to gastrointestinal issues if consumed too close to exercise. Everyone's gut sensitivity is different, and the intensity of your workout will also impact the incidence of gastro issues. As a rule of thumb, consuming a meal high in carbohydrate, with moderate protein, fat and fibre 2-4 hours before your moderate to low intensity training, should limit the incidence of gastrointestinal issues.

Any exercise 1-2 hours before exercise means less time for digestion, and so options lower in fat and fibre but high in carbohydrate should be prioritised. This is because when we exercise, our bloodstream is diverted away from the gut and to the working muscles', meaning the digestion of food is slowed.

30-60 minutes before exercise. Here digestibility is key as no one wants to be running around while food is only just beginning to be digested. If eating close to exercise, prioritise foods higher in carbohydrate and lower in fibre and fat. Faster releasing carbs (high GI) are of benefit due to them being absorbed into the bloodstream more quickly therefore providing you more efficient energy once exercise begins. See them as your 'superfuel' at a garage!

DURING EVENT NUTRITION

High Gi foods first when practically possible

Gels / Carb drinks when food less practical

How much Fuel?

Duration	Carbohydrate per hour (g)
Up to an hour	Mouth rinse or nothing
1-2 hrs	30g carbohydrate
2hrs +	60g per hour
2.5hrs +	90g per hour

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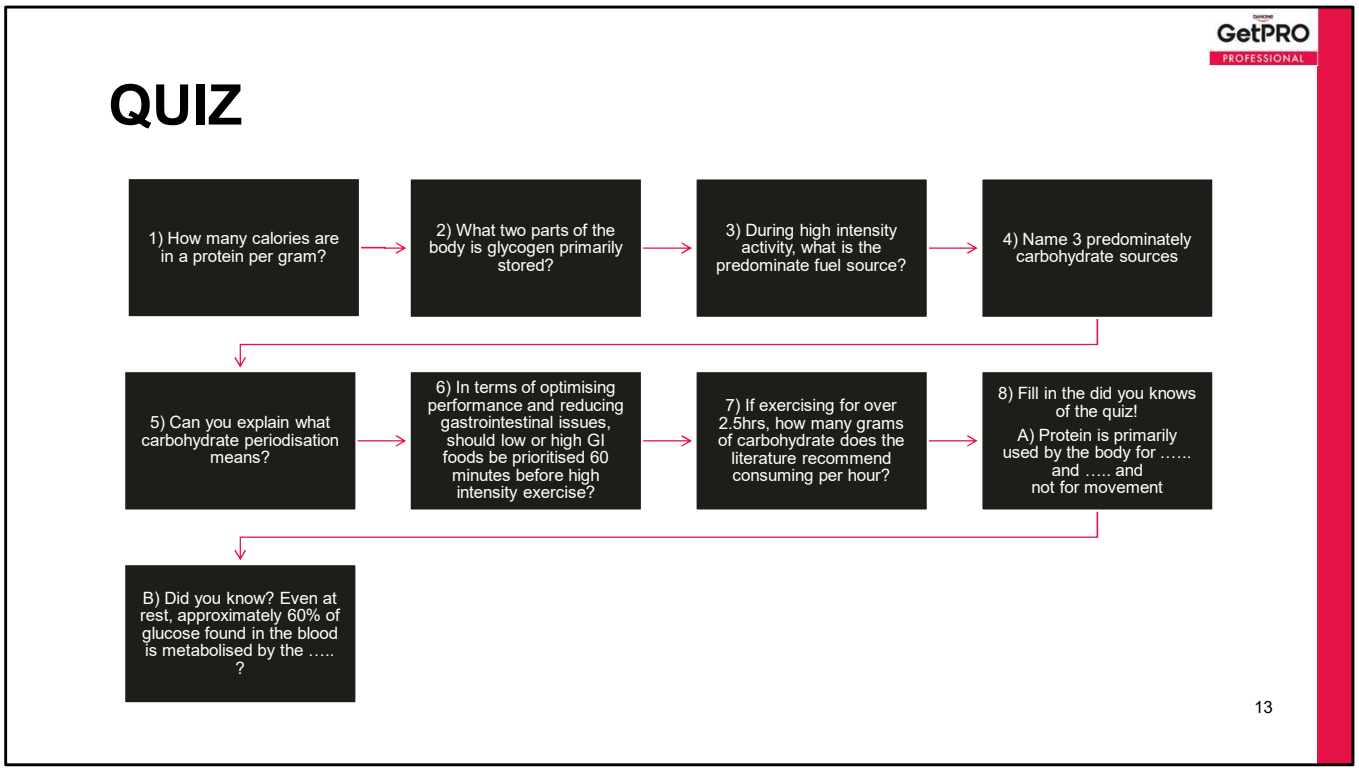
During exercise, high GI foods are recommended as they provide a quick source of readily available energy, helping replenish glycogen stores and provide glucose for fuel. A food first approach where practical is recommended, opting for foods such as bananas, soreen, banana bread or fruit juice.

During day to day life, energy gels and drinks are often not required. However, during high intensity or extremely long activities such as a 4hr cycle ride, where it may be difficult to consume food based carbohydrate, it may be beneficial to consume a carbohydrate drink and / or energy gel due to their high GI content, providing a quick release of energy and therefore helping support performance.

SUMMARY

- Energy comes from the carbohydrates, fats and protein in our diet.
- Sufficient carbohydrates are essential when it comes to performance.
- Glycogen stores are limited (~500g) highlighting the importance of topping up stores if exercising at high intensities or for long durations (>80mins) , when the aim is to maximise performance.
- Periodising carbohydrate doesn't mean no carbohydrate! The amount you need is dependent upon your individual goals and activity levels.
- The closer you are to exercising, opts for foods higher in GI and lower in fibre, fat and protein to limit gastrointestinal issues.
- Glycogen is king when it comes to performance!



Answers

1. 4 calories
2. Liver + muscles
3. Glucose
4. Bread, rice, pasta, veg, or others!
5. Altering your carbohydrate intake, based on your individual goal and energy expenditure for that day or the following day.
6. High
7. 90g per hour
8. A) building and repairing B) Brain

REFERENCES

1. Murray B, Rosenbloom C. Fundamentals of glycogen metabolism for coaches and athletes. Nutr Rev. 2018 Apr 1;76(4):243-259.
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About the author: Michael Naylor is a leading health & performance nutritionist with over 15 years' experience in elite sport. In his role as Head of Nutrition for the English Institute of Sport he provides expertise to 25 of Team GB's Olympic and Paralympic sports.

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THANK YOU