Module 3: World Football and Emerging Diets

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Unit 1: Nutrition for the World Game

Football is a global sport. Football is accessible to everyone regardless of age, religion, race, or culture. With the development of the internet, players from footballing countries all over the world are now more visible to professional clubs. In addition, players are also more mobile with travel made easier between countries or continents. Therefore, it is now common for a football club to consist of players from a diverse range of cultural and religious backgrounds. The sports nutritionist working in football should be aware of the diverse dietary requirements in world football and the potential challenges of meeting sports nutrition guidelines. Furthermore, cultural background will heavily influence the importance that players place on nutrition, as well as players' education surrounding foods. The internet is a valuable resource for nutrition education (Module 4); however, it can also be a source of misinformation surrounding foods. This unit discusses the diversity in world football and aims to provide the sports nutritionist with an insight into the needs of different players as well as different cultures. Unit 2 will discuss emergent diets which are popularly promoted on the internet or social media channels, and their relevance to football performance.

DID YOU KNOW

Jean-Marc Bosman was a professional footballer playing in the Belgian league who wanted to play for a French club. However, as this was not possible because of existing laws, he took his case to court. The subsequent court ruling banned restrictions on European players within national leagues. This meant that at the end of their contract players in the European Union were allowed to move to another club without need for a transfer fee. being paid.

Football Player Migration

In Europe, the migration of players between countries was facilitated by the "Bosman ruling" in 1995. Following the ruling, the number of players moving between the five major European leagues (England, France, Germany, Italy and Spain) more than doubled from 19% during the 1995/1996 season to 47% in the 2015/2016 season. There are differences in player migration reported across continents. The North American

Major League Soccer (MLS) and European leagues have the highest proportion (approximately 50%) of foreign players. The English Premier League has the highest number of foreign players (66%), with lower proportions reported in Asia (18%) and Latin America (14%) (Poli, Ravene, & Besson, 2016). In addition to the diverse players in elite teams, there is also great diversity among the supporting staff in football clubs. Background and nutritional education of key leaders, such as the manager, will have a big influence on the nutrition policies and culture at the club. From experience, the greater the emphasis that the manager puts on sports nutrition and player body composition, the greater the engagement from the players. Here, it is important to note that some managers may request that the nutrition advice comes from them. In this case, it is important for the sports nutritionist to provide the manager with easy to digest, up-to-date information, which is easily transferable. Any questions that the manager may have should be addressed in private and in confidence (Module 4).

Communication is vital between all staff and players. Often, different languages will be spoken on the pitch and in the locker room. For example, players from approximately 64 different countries play in the Premier League. In the Bundesliga, around 55 countries are represented, which is slightly more in comparison to Serie A, La Liga and Ligue 1 (approximately 50) (Entertainment and Sports Programming Network (ESPN), 2015). To this end, it is intuitive to recommend that sports nutritionists learn at least one other language. Learning an additional language will help facilitate conversations with players and open-up further opportunities to work for a football club in a different country. Understanding another language may also assist the sports nutritionist as they travel with the team to international tournaments, pre-season camps and friendly games. Communicating with international venue catering staff as well as being able to read food information are valuable skills (International Centre for Sports Studies (CIES), 2017).

Religious Beliefs and Associated Dietary Requirements

Islam is a major religion with approximately a quarter of the world's population being practicing Muslims. One of the most important periods for Muslims is Ramadan. The original objectives of this fasting period are physical and mental regeneration combined with intensified praying (Dvořák & Junge, 2014). During the month of Ramadan, a healthy adult Muslim will complete an intermittent fast by abstaining from the ingestion of fluid and food from dawn to sunset for 30 days. The Islamic calendar is different to the Gregorian calendar in that it is lunar based. Thus, Ramadan falls on different dates each year in the Gregorian calendar by which footballing seasons, tournaments and cups are based. For example, international football tournaments such as the FIFA (Fédération Internationale de Football Association) World Cup and European Championships have taken place during Ramadan in the past.

Ramadan is therefore an important consideration for players and can be a challenge for many elite football teams

DID YOU KNOW

The annual calendar commonly used worldwide is the Gregorian calendar. It is based on movements of the sun. It has 12 months and 365 days in the year.

In general, the studies investigating Ramadan fasting have primarily focused on acute exercise performance (Damit et al., 2014). The available evidence suggests that the physical performance of a player may be impaired during Ramadan. Many Muslim players will continue to train and compete during Ramadan, though each player must decide on how they approach the playing demands.

In one study, the physical performance of 55 Muslim players from two professional football teams in Algiers was assessed two weeks before, at the immediate end, and two weeks after Ramadan (Dvořák & Junge, 2014). It was reported that on the fourth week of Ramadan, performance was impaired in various physical assessments which included 20m sprint speed, dribbling speed, agility and endurance, compared to scores achieved two weeks after the end of the fasting period. Interestingly, approximately 70% of players self-reported that the quality of their training was poorer during Ramadan and approximately 75% of the players believed their match performance was also reduced during the fast (Dvořák & Junge, 2014). Common contributing factors to impaired performance from a nutritional perspective include a reduction in daily fluid intake, reduction in blood glucose concentrations, an alteration in the player's circadian rhythm, changes in sleep pattern and premature fatigue resulting in an increased incidence of non-contact injuries (Chamari, Haddad, Del Wong, Dellal, & Chaouachi, 2012; Eirale, Tol, Smiley, Farooq, & Chalabi, 2013; Guvenc, 2011; Leiper et al., 2008).

The available evidence indicates that elite players can maintain performance over Ramadan if training, sleep, food (energy) and fluid intake are well controlled (Maughan, Zerguini, Chalabi, & Dvořák, 2012). Football coaches and fasting Muslim players must take the appropriate steps and measures to promote these factors that impact upon performance during Ramadan (Damit et al., 2014). Where possible, training should be scheduled to allow the most appropriate nutrition support. When training is scheduled after sunset, players can benefit from food and fluid consumption before, during and after training (Drust, Ahmed, & Roky, 2012). There are also certain nutritional strategies that the sports nutritionist can facilitate to support the player's performance during Ramadan.

First, players may be advised to take advantage of the key meals. It is recommended that the meal before dawn (Suhour) should be ingested

as close to sunrise as possible. As a guide, this meal should be rich in carbohydrate (3 g/kg BM), protein (0.3 g/kg BM) and provide appropriate volumes of fluid (5-7 ml/kg BM). The first meal after sunset (Iftar) should aim to meet the player's recovery needs and be adjusted to meet the overall nutrition targets for the day (Burke & King, 2012). As a general guide, players should adjust their overall energy intake according to the demands of the day's training or match play. It is advised that fluid losses during the day are replaced by regular ingestion of fluids and electrolytes during the hours which the player is awake. Water and salt balance has been investigated by following young male football players in training during the month of Ramadan (Shirreffs & Maughan, 2008). In this study, fifty-five players were observed in the third week of Ramadan. Fluid and electrolyte balance, as described in previous courses, were measured at a 60-70 min training session performed in warm (25-28 °C) and moderately humid (50-53%) conditions. Mean sweat loss of fasting players was 1.41 litres and sweat sodium concentration was on average 20 mmol/L. This equated to a total salt loss of 1.7 g (Shirreffs & Maughan, 2008). Thus, good practice would be for players to weigh themselves in the morning upon waking and before the first meal after sunset to estimate fluid losses during the day. From this information, fluid and electrolyte replacement targets can be calculated.

Ideally, players should be individually monitored, and training loads prescribed accordingly, to reduce the risk of illness and injury, and limiting unnecessary excessive hypohydration (>3% morning body mass) (Chamari, Farooq, Tabanji, & Eirale, 2016).

Some possible interventions to reduce the potential negative effect of Ramadan on physical performance for players include:

- Adjusting the timing of training to early mornings, later in the evening, or at night. Training should be designed to match the competition needs in parallel with a Ramadan fasting plan. It is important to note that adjusting the times that matches kick off may not be possible.

- Adjusting the players' sleep pattern by allowing players to go to bed as early as possible after the evening meal and encourage a nap whenever possible during the day. Players should be encouraged to keep to the same routine.

- Attempt to maintain hydration status by avoiding unnecessary sweating prior to the training session or match. For example, ensure well air-conditioned travel and accommodation, and limit physical exertion (warm-up) before exercise.

- Educate players, coaches (and family members) about the physiological impact of Ramadan fasting, and provide

appropriate evidence-based recommendations to ensure optimal performance whilst still upholding religious beliefs (Farooq, Herrera, Zerguini, Almudahka, & Chamari, 2016).

Another potential nutrition strategy to maintain performance during exercise in the month of Ramadan is rinsing the mouth with carbohydrate solution and expectorating without ingestion (Rollo & Williams, 2011). This method has been reported to improve running performance in fasting subjects (Rollo, Cole, Miller, & Williams, 2010). The hypothesis is that carbohydrate can be detected by receptors in the mouth which trigger reward centres in the brain, resulting in improved self-selected exercise performance. After a prolonged fast, mouth rinsing and expectorating a 10% carbohydrate solution has been reported to be associated with significant improvements in intermittent running performance (Rollo, Homewood, Williams, Carter, & Goosey-Tolfrey, 2015). Specifically, a carbohydrate mouth rinse increased self-selected jogging speed. In addition, repeated 15 m sprint performance was also 86% "more likely" to benefit from routinely mouth rinsing a carbohydrate solution in comparison with a taste-matched placebo (Rollo et al., 2015). Although not specific to football, one study has investigated the effects of carbohydrate mouth rinsing during Ramadan fasting on running time to exhaustion (Bataineh et al., 2018). In this study, 18 sub-elite male runners who observed Ramadan mouth rinsed and expectorated a 25 mL bolus of either a 7.5% carbohydrate solution (sucrose), or a taste-matched placebo solution for 10 seconds or did no rinse prior to an incremental treadmill test to exhaustion. It was found that rinsing the mouth with carbohydrate improved running time to volitional fatigue and peak treadmill speed under Ramadan fasting conditions (Bataineh et al., 2018). To this end, rinsing the mouth with a carbohydrate beverage (6-10%) may be a practical nutrition strategy that the sports nutritionist can use with the player to preserve performance during training or matches. It is important to emphasize that this approach should be discussed with players. This is because some players may not permit fluid or carbohydrate to pass their lips during the fasting period, therefore, this strategy would not be appropriate. Further studies are needed to understand the impact of different nutrition interventions during Ramadan in well-trained Muslim football players (Damit et al., 2014).

Alcohol

The intake of alcohol varies significantly between countries and different cultures. Alcohol (ethanol) is an energy-supplying nutrient that is included in the diet of a large part of the world's population (Maughan, 2006). There is a long history of association between alcohol and football, which is reinforced by alcohol companies sponsoring football clubs (Westberg, Stavros, Smith, Munro, & Argus, 2018). In football, bottles of Champagne are synonymous with winning trophies and cups. It may be

the culture of some teams to celebrate routine victories by drinking alcohol. However, it is also important to note that drinking alcohol can also be used as a distraction from poor performances and the associated outcomes such as relegation.

Following the ingestion of alcohol (ethanol), it is absorbed rapidly from the gastrointestinal tract and circulated to all the tissues in the body. Alcohol is metabolized in the liver at a rate of approximately 100 mg per kilogram of body mass per hour (though individual variation will exist). However, as the metabolism of alcohol is slower than the rate at which it is absorbed, concentrations accumulate in the blood. Blood alcohol concentrations typically peak 40 minutes after ingestion (Maughan, 2006).

It is generally accepted that football physical and technical performance as well as decision making will be impaired if a player is intoxicated with alcohol. Therefore, it is obvious to advise that players abstain from alcohol intake prior to training and matches. It has been reported that 74% of sports science student football players drink alcohol, and 65% reported drinking alcohol the day before training or a match (O'Brien, Blackie, & Hunter, 2005). The extent to which this is representative of a professional football population is unknown, though for obvious reasons, it is impossible to complete alcohol studies in professional players. Studies have investigated the impact of drinking alcohol following a dehydrating exercise and have found that exercise induced hypohydration combined with alcohol intake post-exercise had the ability to influence the subjective effects of alcohol and increase the likelihood of risk-taking behaviours, i.e. drink-driving (Irwin, Goodwin, Leveritt, Davey, & Desbrow, 2012). Research from the same group also reported that alcohol ingestion post-exercise can result in impaired cognitive function in hypohydrated individuals (Irwin, Leveritt, Shum, & Desbrow, 2013). Beyond the potential for excessive energy intake, alcohol consumption post-exercise has also been shown to reduce myofibrillar protein synthesis, even when co-ingested with protein, which can potentially impair recovery (Parr et al., 2014). Thus, during the recovery period, players may be advised to avoid alcohol intake. Following alcohol intoxication, it is highly likely that a “hangover” will impede performance and interfere with players’ decision making. The hangover may also disrupt the players’ normal routine and result in poor dietary choices before a training session or a match (Burke et al., 2003).

Finally, alcoholism is a complex disorder which may affect any player independent of gender, country or culture. Alcoholism has been reported to have a strong genetic component that interacts with precipitating factors in the environment (Maughan, 2006). Alcoholics may be clever in disguising their condition. Some alcoholics may binge drink while others may consume alcohol in relatively moderate amounts on a regular basis. Players at risk of high alcohol intakes are usually injured players or

players no longer being selected for first team football. Alcohol intake may increase if players are unmotivated or seeking distraction from not being involved in the daily exercise routine of football (Tipton, 2010). The nutritionist should be aware of these different behaviour patterns and high-risk players, and should report any concerns to the team's sports medical department.

It should be emphasized that in the modern game, players are more aware of the detrimental effects of alcohol. The prevalence of social media also discourages players from becoming intoxicated in public places as their behaviour can be videoed easily and shared via internet channels. The sports nutritionist is encouraged to work with the coaching staff and medical team to devise a sensible drinking policy at the club. Alcohol may be enjoyed but in moderation. It is advised that alcohol is ingested outside of the competitive season.

Nutrition Knowledge

Nutrition knowledge is a modifiable determinant of dietary behaviour, and therefore, has the potential to have a significant impact on player performance (Trakman, Forsyth, Devlin, & Belski, 2016). The background education of the player or coach is highly likely to influence their nutrition knowledge. It is important that the sports nutritionist modifies the communication of nutritional strategies based on the literacy level of the target audience. It should not be taken for granted that all players have good literacy. For example, including pictures of foods and dietary goals can be more effective than word heavy documents or information.

The nutritional knowledge of a player may also be influenced by their playing level, whereby those playing at higher level tend to have better knowledge on nutrition than non-professional players (Trakman et al., 2016). This may be because professional players have greater access to sports nutrition expertise and resources. This is important for the sports nutritionist to consider especially when a new player arrives at a club from a different country or culture, or a non-professional league. These players may not have had the same exposure to nutrition compared to a player who has progressed through an academy system for example. Therefore, when first engaging with a player or coach, the sports nutritionist may use a nutrition knowledge questionnaire (Lohman, Carr, & Condo, 2018; Trakman, Forsyth, Hoye, & Belski, 2018). Nutrition questionnaires have been used to identify poor understanding of key nutrition topics such as energy balance, vitamins and minerals, and the role of protein in muscle recovery (Trakman et al., 2016). Thus, collecting baseline data on a player or coach's nutrition knowledge will allow more targeted nutrition education interventions. In addition, re-testing nutrition knowledge following an education intervention will allow the effectiveness of the strategy to be evaluated.

National Dishes

When working with a team that has players from different countries, it can be a challenge to cater to all the players' culinary tastes. The types of food and eating pattern of a player from Asia will differ to a South American player, for example. To this end, the sports nutritionist should be encouraged to understand the national dishes or home foods of players in their squad. The sports nutritionist may then work with the team's chef and catering staff to incorporate country specific meals into the daily menus or provide specific meals on one-off occasions. This strategy may promote an increase in energy intake among players and it may also improve the players' adherence to a sports nutrition plan. A national dish is one that is strongly associated with a country, which may also be part of a nation's identity and self-image. From experience, providing a national dish may also be appreciated by players when playing for their national team. This is because the availability of their home foods may be limited when playing in a foreign country. Table 1 provides some examples of the foods associated with different countries. Of course, it is important to note that world cuisine is now widely available. Just because a player is from one country, it does not mean that this corresponds to their favourite foods.

Table 1: Examples of the national food associated with different countries

Country	Example of Associated National Dish/Food
Algeria	Couscous
Austria	Wiener schnitzel: veal escalope, breaded and deep-fried
Brazil	Feijoada: kidney beans stewed with beef and pork
Denmark	Frikadeller: flat meat patties
England	Traditional roast dinner/Fish and chips
Greece	Moussaka
Hungary	Goulash: a spicy tomato-paprika-based stew of meat, noodles, and potatoes
India	Curry (various)
Italy	Pastas (various), Pizza
Japan	Sushi, noodles (various)
Mexico	Tacos
Spain	Paella
Sweden	Swedish meatballs

Source: Prepared by Author.

Summary

- A football team may consist of players from a variety of different countries and cultures.
- During Ramadan Muslim players may use overnight occasion as the opportunity to ingest foods and drinks to provide the nutrients required for performance, adaptation, and recovery from training and matches.
- Alcohol consumption may be part of football culture. The nutritionist should develop an appropriate drinking policy with the club's medical department and coaches.
- The nutrition knowledge among players will be, in general, determined by their educational background.
- Sports nutritionists are encouraged to have knowledge of international cuisines specific to the players at the club.

UNIT 2: Emerging Diets in Sports Nutrition

The purpose of this unit is to introduce the sports nutritionist to specific and emergent diets in sports nutrition. Some players may have specific dietary requirements or choose to omit specific food groups from their energy intake for personal or ethical reasons, for sustainability purposes, or for religious beliefs. The sports nutritionist should be aware of different diets, along with their implications for football performance, and how they can be catered for. In addition, players are constantly bombarded with nutrition information from family, friends and internet advertising. It is common for professional players to ask questions or to request to follow a diet that they have either been recommended or they have read about. For example, players' dietary habits may be influenced by health trends. Therefore, it is important for the sports nutritionist to have knowledge of the most common emergent diets in the sport and exercise arena. Diets such as FODMAP (explained below), vegetarianism and gluten-free are adopted by players for the perceived or potential health and performance benefits. It is important to emphasize that the purpose of this unit is not to promote the use of emerging diets in football, but instead, to ensure that the sports nutritionist understands the different diets which players and coaches may seek advice on. Tips and alternative food choices for the sports nutritionist to consider when working with players following specific diets are also discussed.

DID YOU KNOW

The players' diet can be considered as the foods and fluids they habitually consume, and when they consume them.

The FODMAP Diet

The acronym FODMAP stands for Fermentable Oligo-, Di- and Monosaccharides and Polyols (FODMAPs). The FODMAPs are short-chain carbohydrates that may be inconsistently absorbed in the small intestine. Football players will commonly ingest FODMAPs in their diet as they are present in many foods. FODMAPs include the monosaccharide (fructose), a disaccharide (lactose), oligosaccharides (long-chain fructose and long-chain of galactose sugars) and polyols. FODMAPs may be poorly digested, which increases the delivery of readily fermentable substrates and water to the distal small intestine and proximal colon. This may result in the player experiencing loose stools or diarrhoea. Consequently, the symptoms of gastrointestinal discomfort may increase at rest and become magnified during exercise (Gibson & Shepherd 2010; Lis, Stellingwerff, Kitic, Fell, & Ahuja, 2018).

Some football players may report an increase in gastrointestinal discomfort during training or matches (Jeukendrup, 2017). It has been suggested that reducing or removing sources of FODMAPs from the diet may improve gastrointestinal discomfort during exercise. For example,

specific case studies have been published detailing the impact of a short-term low-FODMAP diet on improving symptoms of gastrointestinal discomfort (Lis, Ahuja, Stellingwerff, Kitic, & Fell, 2016). However, it is important to note that current case studies and available literature has been completed in endurance or track athletes (Lis, Kings, & Larson-Meyer, 2019). There is no specific information on the impact of the diet among football players.

Table 2: Examples of high FODMAP foods and potential low-FODMAP alternatives to exchange in a player's daily energy intake

FODMAP Example	High FODMAP Foods	Low FODMAP Food alternative
High lactose	Dairy: Cow's milk, yoghurts	Lactose-free milk, soya milk (from soy protein)
Excess fructose	Figs, Watermelon, apples, cherries, honey, most fruit juices.	Banana, grapes, kiwi fruit, cantaloupe, strawberries, blueberries, raspberries, Oranges, berries, blended vegetable juice
Oligosaccharides	Dates, cashews/pistachio nuts, breads/bagels, onions.	Gluten-free, spelt, special sourdough spelt breads, rice cakes, corn tortillas, wheat and/or gluten-free energy bars
High polyols	Protein bars and powders, some electrolyte tablets, sugar-free gum/candies	Protein bars with alternative sweeteners, limit intake of sugar-free gum/candies/sports products.

Source: **Prepared by author**.

Table 1 also illustrates the diversity and prevalence of FODMAPs in common foods. Therefore, if considering this diet with a player, it is important not to omit complete food groups from a player's diet, but rather to seek alternatives. The sports nutritionist should work with the player to avoid unnecessary food restriction or complications with energy availability due to food avoidance.

To this end, if players are frequently experiencing or complaining of gastrointestinal discomfort the sports nutritionist may consider a FODMAP diet. It is advised that players begin by following a "low" rather than a strict "no" FODMAP diet. As a guide, lactose or fructose have been reported to be the most common triggers for gastrointestinal complaints. Therefore, reducing high lactose and fructose foods/beverages from a player's diet may be sufficient in improving symptoms. It is important to

note that this diet is a process; it should be regularly monitored and evaluated by both the player and sports nutritionist. Ideally a specific trigger for gastrointestinal distress can be identified. The trigger can then be removed from the day before and on match days, as well as training (Lis, 2019).

DID YOU KNOW

Polyols are used as “sugar-free” or “low-calorie” sweeteners. They are not actively absorbed in the small intestine so they pass to the large intestine for fermentation by bacteria.

The Gluten-Free Diet

The general name for protein found in foods such as wheat, rye and barley is gluten. Gluten is a plant storage protein which gives food its shape, acting as an adhesive to hold the structure together. Gluten-containing foods are commonly blamed for gastrointestinal discomfort at rest and during exercise. However, a gluten-free diet is only necessary in those players with a diagnosed clinical condition. Clinical conditions requiring a player to avoid gluten containing foods in their diet include celiac disease, wheat allergy, gluten ataxia and non-celiac gluten sensitivity (Newberry, McKnight, Sarav, & Pickett-Blakely, 2017).

Celiac disease is an autoimmune disorder that occurs in genetically predisposed individuals (Evans & Cecere, 2019). Individuals with celiac disease are unable to digest the gluten protein. If players with celiac disease eat gluten, their body will respond by initiating an immune response that attacks the small intestine. The damage caused by the immune response on the villi results in nutrients not being absorbed properly into the body. Celiac disease is hereditary; people with a relative with celiac disease (parent, child, sibling) have a 10% risk of developing celiac disease (Celiac Disease Foundation, 2019). This risk can be determined during a dietary consultation/interview with the player when symptoms occur. However, it is more efficient to screen for potential celiac implications in health questionnaires when players first sign for the club or engage with the nutritionist (Module 4). Although celiac disease is estimated to affect 1 in 100 people worldwide, it is difficult to diagnose correctly. Players may be screened for certain antibodies in their blood, via a blood test. However, the only way to confirm a celiac disease diagnosis is to have an intestinal biopsy (Celiac Disease Foundation, 2019).

There is also a condition recognized as non-celiac gluten/wheat sensitivity (Lis, 2019). Non-celiac gluten/wheat sensitivity is characterized by symptoms which are similar to celiac disease, but may also overlap with other issues such as fatigue, bloating and diarrhoea. However, there are a lack of diagnostic biomarkers for non-celiac

gluten/wheat sensitivity, so when players present these symptoms it is common to attribute them to gluten ingestion.

DID YOU KNOW
The villi are finger-like projections that line the small intestine that absorb and transport nutrients from the intestine into the body.

Gluten can be found in many types of foods, even ones that would not be expected. Table 2 displays common foods that contain gluten, along with alternatives for the sports nutritionist to consider when either reducing or eliminating gluten from a player's diet (depending on clinical diagnosis).

Table 3: Gluten containing foods and alternatives

Gluten containing foods	Most breads and baked goods (pastries), pasta, cereals, sauces, salad dressings, barley, malted barley flour, malted milk and milkshakes, malt extract, malt syrup, malt flavouring, malt vinegar, food colouring, beer, brewer's yeast, rye bread.
Gluten alternatives	Corn, rice, millet, quinoa based grain products, gluten-free oats, gluten-free energy bars

Source: **Prepared by author.**

High-Fat Diets

A high-fat diet may be classified/achieved by ingesting greater than 60% of energy intake from fat sources or less than 25% of energy intake from carbohydrate sources (Burke, 2015). The short-term ingestion of a diet which is low in carbohydrate and high in fat has been reported to reduce exercise capacity (Jeukendrup, 2002). This is because low carbohydrate availability reduces the concentrations of liver and muscle glycogen, which are vital for sustained high-intensity performance. Nevertheless, diets are emerging to suggest that the long-term adherence to a low-carbohydrate, high-fat (LCHF) dietary regimen may result in adaptations to increase the breakdown, transport and oxidation of fat in skeletal muscle (Yeo, Carey, Burke, Spriet, & Hawley, 2011). An increase in fat utilisation may "spare" the limited stores of glycogen and would therefore sound appealing to support a football player's performance (Phinney, Bistrian, Evans, Gervino, & Blackburn, 1983). The main dietary approaches to achieve this include ketogenic and non-ketogenic high-fat diets.

A ketogenic diet is one where carbohydrate is restricted for prolonged periods of time, causing an increase in circulating ketone bodies which promote a state of ketosis. During periods of reduced carbohydrate availability, Ketone bodies (acetoacetate, acetone and beta-hydroxybutyrate) are produced in the liver. The increase in fat lipolysis

elevates the circulating concentrations of free fatty acids, which serve as the primary substrate for ketone production in the liver (Evans, Cogan, & Egan, 2017). Ketones can function as an alternative fuel source for organs including the brain, heart and skeletal muscle (Evans et al., 2017).

A non-ketogenic diet promotes the intake of a high-fat diet, but ketosis is absent. Ingesting a LCHF diet without ketosis may induce rapid (approximately 5 days) adaptation in the muscle, including an increase in intramuscular triglyceride stores and increased mobilization of free fatty acids (via hormone sensitive lipase) (Yeo et al., 2011). These adaptations enhance the capacity of aerobically trained muscle to metabolize endogenous and exogenous fat stores during moderate intensity exercise. It has been reported that the rate of fat metabolism can be doubled by following specific fat-adaptation strategies (Yeo et al., 2011). These adaptations persist in the short-term, even when carbohydrate is restored in the diet.

Of great relevance to football performance is that, although fat metabolism is increased at rest and during exercise, it comes at the expense of down-regulating carbohydrate metabolism. Specifically, there is a down-regulation of the enzymes that complete the metabolism of carbohydrate. Thus, the ingestion of a short-term, high-fat diet decreases the players' metabolic "flexibility", i.e. the capacity for players to utilize both fat and carbohydrate as a fuel.

The implications of high fat diets on football performance are unknown. This is due to the absence of a rationale for these types of diet to be followed and studied in a sport which is carbohydrate dependent for performance. Short term implications reported by other athletic groups that have followed a high fat low carbohydrate diet include a reduction in training capacity and increase in perceived effort and heart rate, particularly in relation to high-intensity training (Burke & Hawley, 2002). On the basis that high-intensity efforts are of paramount importance in football and that fat adaptation strategies reduce, rather than enhance, metabolic flexibility, players would not be advised to adopt a high-fat diet (Burke, 2015).

Vegetarian Diets

Players, coaches and support staff in football may follow vegetarian diets for several reasons including:

- Perceived health benefits
- Environmental and sustainability principles
- Ethical reasons, animal welfare
- Religious/spiritual beliefs
- Aesthetic reasons, perception of superior body composition
- Dislike of meat products

Vegetarian diets are well accepted in the public health arena. However, in general, vegetarianism is less prevalent in football environments. As a result, some coaches may express concern that vegetarian players are not receiving the appropriate nutrition required for optimal training and performance. This is a misguided view, and in fact, vegetarian players, at all levels of the game, can meet their energy and nutrient requirements while following a vegetarian diet. There are various types of vegetarian diets, with specific dietary expectations listed in Table 4.

Table 4: Type of vegetarian diet and associated dietary regime

Type of vegetarian diet	Dietary requirement/consideration
Vegan (strict vegetarian)	Exclusion of all animal products including dairy and eggs; may exclude honey
Vegetarian	Avoids all flesh foods; may or may not consume eggs or dairy products
Lacto-vegetarian	Includes milk or other dairy products, but not eggs or other animal foods
Ovo-vegetarian	Includes eggs, but not dairy products
Lacto-ovo-vegetarian	Includes eggs and dairy products
Other	Individual preference and dietary combinations

Source: prepared by author.

As with all players, vegetarian players may benefit from sports nutrition support and education concerning food choices to optimize their health and performance (Melina, Craig, & Levin, 2016). Little is known about the prevalence of vegetarianism among football players. In North America, surveys suggest that approximately 3% of adults are vegetarian and just under half of vegetarians are classified as vegans (The Vegetarian Resource Group, 2016). The same survey reported that the prevalence of vegetarianism was greater (6%) in adults aged 18 to 34 years (the typical age of professional football players). In a poll of international athletes, 8% reported maintaining vegetarian diets, with 1% being vegan (Pelly & Burkhart, 2014).

Vegetarian diets may have health advantages over the typical western based diets. This is because vegetarian and vegan diets are associated with a reduced risk of a variety of chronic diseases, including obesity, hypertension, cardiovascular disease, type 2 diabetes and overall cancer mortality (Melina et al., 2016). However, little information is available regarding the impact that vegetarian diets have on enhanced training or football performance (Craddock, Probst, & Peoples, 2016). Players who choose a vegetarian diet can achieve their energy intake, and macro- and micronutrient requirements. However, additional planning may be

required for players because good dietary vegetarian options may not be readily available. In general, the player should be encouraged to consume a diet that contains a variety of different plant-based foods, such as whole and enriched grain products, fruits, vegetables, protein-rich plant foods, and (if appropriate) dairy products and eggs. The sports nutritionist should make efforts to understand the player's reasons for being a vegetarian and be sensitive to their individual needs. The player should be educated on sources of both dietary macro- and micronutrients that align with their personal beliefs and values.

DID YOU KNOW

Visiting local vegetarian or vegan restaurants (with or without the player) provides inspiration for vegetarian or vegan recipes and meal suggestions.

Regarding macronutrients, carbohydrates requirements can be met through the ingestion of grain products, fruits, juices, starchy vegetables, sports beverages, gels, sports bars, and added sugars. Good sources of dietary protein to meet requirements include soy products, beans, lentils, tofu, nuts, seeds, milk, yogurt, Greek yogurt, cottage cheese, eggs and most grains (e.g. quinoa). Daily fat intake can be achieved by eating foods such as nuts and seeds, avocados, olives and olive oil, and sesame oil.

Vegetarian players can also get omega-3 fats in their diet by ingesting foods such as walnuts, flax, chia, hemp seeds, and canola, walnut, flax and hemp oils (Larson-Meyer, 2018).

For micronutrients, the sports nutritionist should emphasise the inclusion of foods rich in iron, zinc, calcium, vitamin B-12. While it is encouraged that players obtain these micronutrients through the ingestion of natural or fortified foods, it is noted that players may occasionally require dietary supplementation (Melina et al., 2016). Examples of key micronutrients and dietary sources are listed in Table 5.

Table 5: Food examples of micronutrients sources in the vegetarian diet

Micronutrient	Vegetarian Dietary Source
Iron	Broccoli, kale, potatoes, beans, peas, lentils, edamame, nuts, seeds, most vegetables, whole & fortified grains including breads, rice, quinoa, breakfast cereal. The absorption of iron is enhanced with the co-ingestion of vitamin C: citrus fruits, berries, melon, peppers, tomatoes,
Zinc	Peas, lentils, beans, edamame, nuts, seeds, most vegetables, whole & fortified grains including breads, rice, quinoa, breakfast cereal, hard cheeses.
Calcium	Good bioavailability (> 50%): Chinese/Napa cabbage, kale, okra, turnip greens, texturized vegetable proteins, blackstrap molasses. Moderate bioavailability (~30%): Milk, yogurt, cheese, calcium-set tofu, fortified orange juice (with calcium citrate malate). Low bioavailability: fortified soymilk, most nuts, seeds legumes, fortified orange juice.
Vitamin D	Eggs (yolk), fatty fish vitamin D-fortified breakfast cereals. Exposure of the arms, torso and legs, two to three times a week, at close to solar noon for 25 - 50% of the time it would take to develop a mild sunburn.
Iodine	Iodized salt, fish, seafood, seaweed, dairy products and some commercial breads. The iodine content of most foods is low and affected by soil content, irrigation and fertilizers.

Source: adapted from Larson-Meyer, 2018

Other Diets and Definitions

Finally, it is important to recognize less prevalent dietary choices that the player may request, listed below:

- Pescetarianism is a diet choice which includes the ingestion of fish and other seafood, but not the meat of other animals. Vegetarian and dairy options offer good dietary choices for this group.

- The raw food diet (raw foodism) involves the ingestion of non-processed foods and beverages. Usually, these foods are plant based and typically organic.

- Intermittent fasting is a dietary approach which requires periods of food abstinence between days of energy intake. There are various methods of intermittent fasting. Although this method has become popular, it is not recommended for football players, especially during the competitive season where performance and recovery are the primary objectives.

- The paleo diet (caveman diet) advises individuals to only ingest foods that are representative of human's hunter-gatherer ancestors, i.e. only food that would have been hunted (such as meat and seafood) or gathered (such as eggs, nuts, seeds, fruits, vegetables, herbs and spices). Definitive definitions of a paleo diet are difficult to establish but generally consist of low carbohydrate (less than 25% of energy intake) and high protein. To date, there are no studies to advocate the use of the paleo diet in supporting football-specific performance.

- The alkaline diet is based on the idea that modern diets cause our body to produce too much acid. However, the acid-base balance of the human body is tightly regulated. To date, there is no evidence to support an alkaline diet for football specific performance.

- The "fussy" eater. Although not technically a diet, when working in football the sports nutritionist is highly likely to encounter players who are "fussy" eaters. These are players who refuse to eat a variety of different foods and instead limit their energy intake to a select few food groups (that are not usually nutrient dense). In this instance, it is advised that the sports nutritionist engage with the club's sports psychologist (if available). The aim will be to build a long-term plan to understand the source of the player's self-imposed dietary restrictions (ensuring no underlying eating disorders), and gradually introduce new foods into their overall energy intake.

Summary

- Players, coaches and staff will have diverse dietary preferences.

- A low FODMAP diet may be considered for players who commonly report exercise-induced gastrointestinal symptoms.

- A clinical diagnosis is required to determine if a player requires a gluten-free diet.

- High-fat, low-carbohydrate diets are not recommended for football performance.

- Vegetarian diets are selected by players for a variety of reasons, including health, environmental, and ethical principles.

- All players will benefit from education about appropriate food choices to optimize their health and performance, regardless of their chosen diet.

Disclaimer: Ian Rollo is an employee of the Gatorade Sports Science Institute, a division of PepsiCo, Inc. The views expressed in this course are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.

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