Masterclass Certificate in Fencing Nutrition for Endurance

Macronutrient Timing for Endurance

Macronutrient timing for endurance athletes involves understanding how the body processes carbohydrate, protein and fat at different phases of training and competition, and how strategic intake can enhance performance, delay fatigue, and accelerate recovery. In fencing, especially in bouts that require repeated high-intensity actions over extended periods, the timing of these nutrients becomes a critical component of a successful nutritional strategy. The following key terms and vocabulary are essential for mastering this aspect of endurance nutrition.

Glycogen – The stored form of carbohydrate found in skeletal muscle and liver. Muscle glycogen is the immediate fuel for high-intensity efforts, while liver glycogen maintains blood glucose levels during prolonged activity. In a typical fencing match lasting 15-20 minutes, depletion of muscle glycogen can impair rapid footwork and explosive blade actions. Athletes aim to maximize glycogen stores before competition through a process known as carbohydrate loading.

Carbohydrate Loading – A dietary protocol that increases muscle glycogen stores by consuming a high-carbohydrate diet (≈70-80 % of total calories) for 3-4 days before competition, often combined with a taper in training intensity. For example, a fencer might consume 8–10 g of carbohydrate per kilogram of body weight per day, focusing on easily digestible sources such as rice, pasta, or fruit smoothies. The goal is to raise glycogen levels above typical baseline, providing a larger reserve for the energy-demanding bouts.

Glycemic Index (GI) – A ranking of carbohydrate foods based on how quickly they raise blood glucose after ingestion. High-GI foods (e.G., Glucose, white bread) cause a rapid spike in blood sugar and insulin, while low-GI foods (e.G., Oats, legumes) produce a slower, more sustained release. Selecting appropriate GI foods for pre-exercise meals can influence the rate of carbohydrate availability during a fencing match. A typical pre-match meal may combine a moderate-GI source (e.G., Whole-grain toast) with a small amount of high-GI fruit to provide both immediate and lasting energy.

Insulin – A hormone released by the pancreas in response to elevated blood glucose. Insulin facilitates cellular uptake of glucose and inhibits fat oxidation. During the pre-exercise period, a moderate insulin response can promote glycogen synthesis, but excessive insulin can reduce the availability of free fatty acids, potentially limiting endurance capacity. Understanding the balance of insulin response is key when planning pre-match nutrition.

Glucagon – The counter-regulatory hormone to insulin, released when blood glucose falls. Glucagon stimulates glycogenolysis (the breakdown of glycogen) and gluconeogenesis (the production of new glucose) in the liver. In the later stages of a fencing bout, glucagon helps maintain blood glucose when carbohydrate stores are being depleted.

Carbohydrate Oxidation – The process by which carbohydrate is broken down to produce ATP (energy) during aerobic metabolism. At moderate intensities, the body preferentially oxidizes carbohydrate because it yields more ATP per unit of oxygen consumed compared with fat. For a fencer maintaining a steady pace between bouts, carbohydrate oxidation can supply up to 60-70 % of the required energy.

Fat Oxidation – The metabolic pathway that converts fatty acids into ATP. Fat provides a virtually unlimited energy source but requires more oxygen per ATP generated, making it the dominant fuel during low-intensity, long-duration activity. In fencing training sessions lasting over an hour, encouraging fat oxidation through appropriate timing of carbohydrate intake can spare glycogen and delay fatigue.

Protein Synthesis – The building of new muscle proteins, which is essential for repair and adaptation after training. Consuming protein after a bout supports the repair of micro-tears in muscle fibers caused by rapid lunges and parries. An intake of 0.25-0.30 G of high-quality protein per kilogram of body weight within 30 minutes post-exercise is often recommended to optimize muscle protein synthesis.

Protein Oxidation – The utilization of amino acids for energy, which generally occurs only when carbohydrate availability is low. During prolonged fencing sessions where carbohydrate intake is insufficient, the body may increase protein oxidation, potentially compromising muscle repair. Proper timing of protein intake helps prevent this undesirable shift.

Pre-Exercise Meal – The meal consumed 3-4 hours before competition or a high-intensity training session. It should contain 1-4 g of carbohydrate per kilogram of body weight, a moderate amount of protein (≈0.2 G/kg), and low-fat content to ensure rapid gastric emptying. For example, a fencer weighing 70 kg might eat a bowl of oatmeal with banana and a small serving of Greek yogurt, providing both sustained carbohydrate release and a modest protein boost.

Pre-Exercise Snack – A smaller feed taken 30-60 minutes before the start of a bout, typically comprising 30-60 g of high-GI carbohydrate. This snack tops up blood glucose and primes the muscles for immediate energy use. Common choices include a sports drink, a piece of fruit, or a slice of white bread with honey. The snack is designed to be low in fiber to avoid gastrointestinal discomfort during rapid movements.

During-Exercise Nutrition – The ingestion of nutrients while training or competing. For endurance fencing events lasting longer than 60 minutes, athletes may benefit from consuming 30-60 g of carbohydrate per hour, usually in the form of a sports drink, gel, or carbohydrate-rich chewable. The goal is to maintain blood glucose, preserve muscle glycogen, and delay the onset of fatigue. The timing of ingestion (e.G., Every 15-20 minutes) can be adjusted based on individual tolerance and the intensity of the bout.

Post-Exercise Recovery Window – The period of approximately 30-120 minutes after training when the body is especially receptive to nutrient uptake. During this window, muscle cells are more insulin-sensitive, facilitating rapid glycogen replenishment and protein synthesis. A combined intake of carbohydrate (1.0-1.2 G/kg) and protein (0.3-0.4 G/kg) is recommended. For a 70-kg fencer, this could be a smoothie containing 70 g of carbohydrate (e.G., Fruit juice) and 25 g of whey protein.

Periodized Nutrition – The strategic planning of nutrient intake to align with training cycles (e.G., Base, build, peak phases). In the base phase, the focus may be on higher fat intake to enhance aerobic capacity, while the peak phase prioritizes carbohydrate loading to maximize glycogen stores for competition. Periodizing macronutrient ratios helps the athlete adapt metabolically and reduces the risk of over-training.

Glycogen Super-Compensation – The phenomenon where glycogen stores exceed normal baseline levels after a period of carbohydrate loading combined with reduced training volume. This state can improve endurance performance by providing a larger energy reserve. In fencing, achieving super-compensation before a championship can give a tactical advantage during extended bouts.

Gastrointestinal (GI) Comfort – The tolerance of the digestive system to the timing and composition of nutrients. High-fiber foods, excessive fat, or large meal volumes can cause bloating, cramping, or nausea, impairing performance. Athletes must test food choices during training to ensure GI comfort during competition. For instance, a fencer may discover that a low-fiber banana is better tolerated than a high-fiber granola bar before a match.

Carbohydrate-Electrolyte Beverage – A liquid containing both carbohydrate (typically 6-8 % solution) and electrolytes such as sodium and potassium. The carbohydrate provides a quick energy source, while electrolytes replace those lost through sweat, helping maintain fluid balance and preventing muscle cramps. In a 90-minute fencing tournament, sipping 150-250 ml of this beverage every 20 minutes can sustain performance.

Energy Density – The amount of energy (calories) per unit weight of food. High-energy-density foods (e.G., Nuts, dried fruit) provide many calories in a small volume, useful for athletes who need to increase caloric intake without feeling overly full. However, for pre-exercise meals, lower energy density is preferred to avoid gastrointestinal heaviness.

Metabolic Flexibility – The ability of the body to switch efficiently between carbohydrate and fat oxidation depending on intensity and availability. Training that includes both high-intensity intervals and long, low-intensity sessions can improve metabolic flexibility, allowing a fencer to preserve glycogen during moderate-intensity footwork while still tapping into fat stores for longer bouts.

Carbohydrate Periodization – Adjusting carbohydrate intake based on training intensity and duration. On low-intensity days, a reduced carbohydrate intake (≈3-5 g/kg) may be sufficient, encouraging greater fat oxidation. On high-intensity or competition days, carbohydrate intake is increased (≈7-10 g/kg) to replenish glycogen. This approach optimizes body composition and performance.

Low-Glycemic Index (Low-GI) Carbohydrate – Foods that cause a gradual rise in blood glucose, such as sweet potatoes, quinoa, and berries. Consuming low-GI carbohydrates during the recovery phase can provide a steady supply of glucose for glycogen synthesis without causing large insulin spikes that might inhibit fat oxidation later in the day.

High-Glycemic Index (High-GI) Carbohydrate – Foods that rapidly elevate blood glucose, such as glucose tablets, white rice, or sports gels. These are typically used in the immediate pre-exercise or during-exercise windows to quickly restore blood glucose and delay the onset of fatigue.

Carbohydrate-Protein Ratio – The proportion of carbohydrate to protein in a post-exercise meal or snack. Ratios of 3:1 Or 4:1 (Carbohydrate:Protein) have been shown to maximize glycogen replenishment while supporting muscle repair. For a 70-kg fencer, a post-match snack might consist of a banana (≈30 g carbohydrate) mixed with a scoop of whey protein (≈20 g protein), achieving a ratio close to 1.5:1; Adding an extra carbohydrate source (e.G., A small cup of juice) can bring the ratio nearer to 3:1.

Slow-Digesting Protein – Protein sources such as casein that release amino acids gradually over several hours. Consuming slow-digesting protein before sleep can support overnight recovery, which is especially valuable during tournament weeks with multiple competition days. A 30-g casein shake before bed can provide a sustained supply of amino acids while the athlete rests.

Fast-Digesting Protein – Proteins like whey that are rapidly absorbed, leading to a quick rise in plasma amino acid levels. These are ideal for the immediate post-exercise window to stimulate muscle protein synthesis. A whey protein shake mixed with water or a carbohydrate-rich beverage can be consumed within 30 minutes after a bout.

Electrolyte Balance – The maintenance of optimal concentrations of sodium, potassium, calcium, and magnesium in the body. Electrolyte loss through sweat can impair nerve conduction and muscle contraction, leading to reduced coordination in fencing footwork. Replacing electrolytes via sports drinks, salted foods, or electrolyte tablets helps preserve performance.

Hydration Status – The level of body water relative to total body mass. Even a 2 % loss in body water can impair aerobic capacity and cognitive function, both essential for tactical decision-making in fencing. Monitoring urine color, body weight changes, and thirst can guide fluid intake strategies.

Fluid Replacement Rate – The recommended volume of fluid to consume per hour of exercise, typically 400-800 ml for endurance activities. This rate should be adjusted based on environmental temperature, humidity, and individual sweat rate. During a heated tournament, a fencer might aim for the higher end of this range.

Sweat Rate – The amount of fluid lost per hour of exercise, measured by weighing before and after a training session. Knowing personal sweat rate helps tailor fluid and electrolyte replacement. For example, a 70-kg fencer who loses 1.2 Kg after a 90-minute training session has a sweat rate of ≈0.8 L/h and should aim to replace at least 80 % of that loss.

Gastrointestinal Transit Time – The time required for food to move through the digestive tract. Foods with high fiber or fat content lengthen transit time, which can cause discomfort if consumed too close to competition. Selecting low-fiber, low-fat meals 2-3 hours before a bout minimizes the risk of delayed gastric emptying.

Thermal Regulation – The body’s ability to maintain core temperature during exercise. Carbohydrate ingestion can influence perceived exertion and thermoregulation, as glucose metabolism produces less heat than fat oxidation. In hot climates, careful timing of carbohydrate intake can help manage heat stress.

Metabolic Acidosis – The accumulation of hydrogen ions during high-intensity exercise, leading to a lower pH in muscle cells. This can impair muscle contractility and speed. Ingestion of carbohydrate during exercise can reduce reliance on anaerobic glycolysis, thereby limiting acid production and preserving performance.

Glycogen Repletion Rate – The speed at which glycogen stores are restored after depletion. Consuming carbohydrate at a rate of 1.0-1.2 G/kg per hour for the first 4 hours post-exercise accelerates glycogen synthesis. Adding protein (0.2-0.3 G/kg) to the carbohydrate source can further enhance the repletion rate by stimulating insulin release.

Meal Frequency – The number of eating occasions throughout the day. While traditional recommendations suggest three main meals, athletes may benefit from 4-6 smaller meals to distribute nutrient intake, maintain stable blood glucose, and support continuous recovery. For a fencer with multiple training blocks, a schedule of breakfast, mid-morning snack, lunch, afternoon snack, dinner, and pre-bed casein can be effective.

Macronutrient Ratio – The proportion of carbohydrate, protein, and fat in the overall diet. Endurance athletes often aim for a ratio of 55-65 % carbohydrate, 15-20 % protein, and 20-30 % fat, though individual needs may vary based on body composition goals and training demands.

Energy Availability – The amount of dietary energy remaining for physiological processes after accounting for exercise energy expenditure. Low energy availability (LEA) can impair hormonal balance, bone health, and immune function. For fencers who train multiple times per day, ensuring adequate caloric intake is essential to avoid LEA.

Relative Energy Deficiency in Sport (RED-S) – A condition resulting from chronic LEA, leading to metabolic, menstrual, and bone health disturbances. Monitoring body weight, menstrual status (for female athletes), and performance metrics helps identify early signs of RED-S.

Carbohydrate Periodic Fasting – A strategy where athletes cycle days of low carbohydrate intake with days of higher carbohydrate consumption, aiming to improve metabolic flexibility. While not universally applicable, some fencers may use this approach during off-season training to enhance fat oxidation capacity.

Supplementation Timing – The scheduling of specific ergogenic aids relative to training. For example, caffeine ingested 30-60 minutes before a bout can improve alertness and reaction time, while creatine loading is typically performed over several weeks before competition, with a maintenance dose taken daily.

Caffeine – A central nervous system stimulant that can increase perceived energy, reduce perceived exertion, and enhance muscular power. A dose of 3-6 mg per kilogram of body weight taken 30-60 minutes pre-competition is common. Athletes should test tolerance during training to avoid jitters or gastrointestinal upset.

Creatine Monohydrate – A compound that replenishes phosphocreatine stores, supporting short-duration, high-intensity actions such as lunges and ripostes. A loading phase of 20 g per day for 5-7 days followed by a maintenance dose of 3-5 g per day can increase muscular phosphocreatine, improving repeated sprint performance.

Beta-Alanine – An amino acid that buffers intracellular hydrogen ions by increasing muscle carnosine concentrations. This can delay fatigue during high-intensity intervals. A typical dose of 4-6 g per day, divided into smaller portions to avoid paresthesia, is taken over several weeks.

Electrolyte Supplement – Products that provide concentrated sources of sodium, potassium, magnesium, and calcium. Athletes may add these to water or carbohydrate drinks to fine-tune electrolyte intake, especially during hot competitions where sweat losses are high.

Training Adaptation – The physiological changes that occur in response to repeated training stimuli, such as increased mitochondrial density, capillary growth, and improved substrate utilization. Proper macronutrient timing can accelerate these adaptations by ensuring adequate fuel availability and recovery.

Recovery Nutrition – The specific intake of nutrients after a training session or competition designed to promote glycogen restoration, muscle repair, and rehydration. A typical recovery meal might consist of a carbohydrate source (e.G., Rice or fruit), a high-quality protein (e.G., Lean chicken or whey), and a serving of vegetables for micronutrients.

Micronutrients – Vitamins and minerals required in small amounts for metabolic processes. Iron, for instance, is crucial for oxygen transport; a deficiency can impair endurance performance. Fencers should ensure adequate intake of iron-rich foods (red meat, legumes) and consider vitamin C to enhance absorption.

Antioxidant Capacity – The body's ability to neutralize reactive oxygen species generated during intense exercise. While excessive antioxidant supplementation may blunt training adaptations, consuming natural sources (berries, leafy greens) as part of regular meals supports recovery without interfering with adaptation.

Gut Microbiota – The community of microorganisms residing in the gastrointestinal tract. Emerging evidence suggests a healthy gut microbiome can influence nutrient absorption, immune function, and even mental resilience. Including fermented foods (yogurt, kefir, kimchi) can promote a diverse microbiota, potentially benefiting overall performance.

Training Periodization – The systematic planning of training phases (pre-competition, competition, transition) to peak at the right time. Nutrition must be aligned with each phase: Base phases emphasize fat oxidation, build phases increase carbohydrate intake, and peak phases focus on glycogen super-compensation.

Acute Nutrient Timing – The immediate manipulation of nutrient intake surrounding a single training session or competition. This includes pre-exercise meals, intra-exercise fueling, and post-exercise recovery meals, each with specific goals and recommended macronutrient amounts.

Chronic Nutrient Timing – The long-term pattern of nutrient intake across weeks and months. Consistency in meeting energy and macronutrient needs supports sustained training adaptations, while periodic adjustments (e.G., Carbohydrate periodization) fine-tune performance for specific events.

Fuel Utilization – The proportion of energy derived from carbohydrate, fat, and protein during exercise. This proportion shifts with intensity: Low-intensity activities rely more on fat, while high-intensity actions depend heavily on carbohydrate. Understanding fuel utilization helps athletes schedule nutrient intake to match the metabolic demands of each fencing bout.

Metabolic Rate – The amount of energy expended at rest (resting metabolic rate) and during activity (total daily energy expenditure). Accurate estimation of metabolic rate informs caloric needs, ensuring that energy intake matches expenditure to avoid deficits that could impair performance.

Body Composition – The proportion of lean mass to fat mass. While endurance performance benefits from a lean physique, excessive leanness can decrease glycogen storage capacity. Optimal body composition balances power, speed, and energy reserves, and macronutrient timing plays a role in preserving lean mass during training.

Glycogen Sparing – Strategies that preserve muscle glycogen for later stages of competition. This can be achieved by training in a fasted state, using low-GI carbohydrates during early training sessions, or enhancing fat oxidation through periodized nutrition. Glycogen sparing helps maintain high-intensity output when bouts become decisive.

Fuel Availability – The accessibility of substrates (carbohydrate, fat) for energy production. Adequate fuel availability reduces reliance on anaerobic pathways, decreasing lactate accumulation and preserving technique quality throughout a match.

Training Load – The cumulative amount of stress placed on an athlete during a training cycle, often quantified by volume (duration, distance) and intensity (heart rate, power output). Matching nutrient intake to training load ensures that the athlete can meet the energetic demands of each session.

Recovery Index – A metric that evaluates how quickly an athlete restores physiological markers (e.G., Heart rate variability, perceived soreness) after training. Proper timing of carbohydrate and protein can improve the recovery index, allowing for higher training frequencies.

Performance Nutrition – The application of nutritional science to optimize sport-specific performance outcomes. In fencing, performance nutrition integrates macronutrient timing, hydration, and supplementation to support rapid footwork, precise blade work, and sustained mental focus.

Energy Substrate Cycling – The alternating use of carbohydrate and fat as primary fuels during different phases of a bout. Skilled fencers often begin with high-intensity bursts relying on carbohydrate, then transition to lower-intensity footwork where fat oxidation predominates. Nutrient timing should facilitate this cycling.

Training Adaptation Lag – The delay between a training stimulus and observable performance improvements. Adequate post-exercise nutrition can shorten this lag by accelerating recovery and supporting the physiological processes necessary for adaptation.

Hydration Strategy – A plan that outlines fluid and electrolyte intake before, during, and after training. A typical strategy includes a pre-exercise drink containing 200-300 ml of fluid with 5-10 mmol/L sodium, regular sipping during bouts, and post-exercise rehydration aimed at restoring 150 % of fluid loss.

Thermal Load – The heat stress experienced during training or competition. In hot environments, carbohydrate intake can affect thermogenesis; therefore, adjusting macronutrient timing to limit excess heat production may improve comfort and performance.

Acute Fatigue – Short-term decline in performance due to metabolic depletion, dehydration, or psychological factors. Immediate carbohydrate ingestion can mitigate acute fatigue by replenishing blood glucose and sustaining muscle glycogen usage.

Chronic Fatigue – Long-term performance decrement often linked to inadequate nutrition, insufficient recovery, or overtraining. Addressing macronutrient timing, ensuring adequate caloric intake, and incorporating rest days are essential to prevent chronic fatigue.

Individual Variability – Differences among athletes in metabolism, gastrointestinal tolerance, and response to nutrients. Personalized nutrition plans, often based on trial testing during training, account for this variability and improve effectiveness.

Trial Testing – The process of experimenting with different foods, timing protocols, and supplement dosages during training to identify what works best for the individual. For example, a fencer might test a 30-g carbohydrate gel versus a banana during high-intensity interval sessions to determine which causes less GI distress.

Recovery Nutrition Window – The timeframe immediately after exercise when muscle cells are primed for nutrient uptake. Consuming nutrients within this window maximizes glycogen synthesis and protein repair processes, leading to faster adaptation.

Carbohydrate Threshold – The point at which the body's carbohydrate stores become depleted enough to impair performance. In endurance fencing, reaching this threshold typically occurs after 60-90 minutes of continuous activity without carbohydrate replenishment.

Fat Adaptation – The physiological adjustments that increase the body's ability to oxidize fat as a primary fuel. Fat adaptation can be enhanced through training in a low-carbohydrate state, but it requires careful management to avoid performance decrements during high-intensity periods.

Metabolic Acidosis Buffering – The use of nutrients (e.G., Beta-alanine) to increase intracellular buffering capacity, reducing the impact of acid accumulation during intense bouts. Effective buffering can sustain power output during repeated lunges and rapid changes in direction.

Energy Substrate Preference – The tendency of an athlete to rely more heavily on one fuel source over another. Training, diet, and genetic factors shape this preference. By manipulating macronutrient timing, a fencer can shift substrate preference to better suit the demands of competition.

Glycogen Resynthesis – The process of rebuilding glycogen stores after they have been depleted. This process is accelerated by consuming high-glycemic carbohydrates combined with protein within the first hour post-exercise, followed by continued carbohydrate intake over the next several hours.

Macro-Cycling – Alternating periods of high and low intake of specific macronutrients to align with training phases. For instance, a fencer might follow a high-carbohydrate week during competition, then a lower-carbohydrate week during recovery to promote fat oxidation.

Energy Density Management – Adjusting the caloric content of foods to meet energy needs without excessive volume. During travel or tournament days, athletes may rely on energy-dense foods (e.G., Nut butter, dried fruit) to ensure sufficient intake despite limited meal opportunities.

Protein Timing – The strategic placement of protein intake throughout the day to maximize muscle protein synthesis. Consuming protein every 3-4 hours, with a focus on the immediate post-exercise window, supports continuous repair and adaptation.

Carbohydrate Timing – Aligning carbohydrate intake with periods of high energy demand (pre-exercise, during exercise, and post-exercise) to optimize glycogen availability and blood glucose stability. Precise timing helps prevent both hypoglycemia and hyperglycemia, which can impair focus.

Hydration Monitoring – Techniques such as body weight changes, urine specific gravity, and thirst perception used to assess fluid status. Regular monitoring allows athletes to adjust fluid intake proactively, reducing the risk of dehydration-related performance loss.

Heat Acclimatization – The process of adapting to hot environments through gradual exposure, which improves sweating efficiency and cardiovascular stability. Nutrition strategies during heat acclimatization include increased sodium intake and careful carbohydrate timing to avoid heat-related GI distress.

Nutrition Periodization Model – A framework that integrates macronutrient timing, calorie cycling, and supplementation across training phases. The model guides athletes through base (fat-focused), build (balanced), and peak (carbohydrate-focused) phases, ensuring that nutritional intake supports the physiological goals of each phase.

Energy Balance – The relationship between calories consumed and calories expended. Maintaining a neutral or slight positive energy balance during training prevents loss of lean mass and supports optimal performance.

Metabolic Stress – The physiological strain placed on the body during high-intensity activity, characterized by elevated lactate, reduced pH, and depleted glycogen. Managing metabolic stress through appropriate carbohydrate timing can sustain performance and reduce injury risk.

A rate of 5-6 % of muscle glycogen per hour can be achieved with carbohydrate intake of 1.2 G/kg/h combined with protein, especially when insulin sensitivity is high post-exercise.

Oxidative Capacity – The ability of mitochondria to use oxygen for ATP production, primarily from fat substrates. Training that enhances oxidative capacity, paired with nutrition that supports fat oxidation, improves endurance and delays glycogen depletion.

Fuel Loading – The practice of increasing the intake of a specific substrate (usually carbohydrate) before an event to maximize its availability. Fuel loading is often employed the night before a major competition to ensure maximal glycogen stores.

Gastrointestinal Permeability – The integrity of the gut lining, which can be compromised by intense exercise, leading to “leaky gut” and potential inflammation. Consuming easily digestible, low-fiber foods around competition helps maintain gut barrier function.

Pre-Competition Ritual – A repeatable sequence of nutritional actions performed before a bout (e.G., A specific snack, hydration protocol). Consistency in the ritual reduces anxiety and ensures the athlete's physiological state is predictable.

Recovery Protocol – The combination of nutrition, hydration, sleep, and active recovery activities designed to restore the athlete's systems after training. A typical protocol may include a carbohydrate-protein shake, electrolyte-rich fluid, a light stretching session, and 8-9 hours of sleep.

Carbohydrate Periodic Loading – Short bursts of high carbohydrate intake interspersed within a lower-carbohydrate diet to induce glycogen super-compensation. This approach can be useful during taper weeks leading up to a tournament.

Macro-Nutrient Distribution – The specific allocation of calories among carbohydrate, protein, and fat throughout the day. For endurance fencing, a distribution of 55 % carbohydrate, 20 % protein, and 25 % fat is common, but adjustments are made based on training intensity and personal tolerance.

Hydration Strategies for Travel – Maintaining fluid balance during travel days, when access to familiar foods and drinks may be limited. Carrying electrolyte packets and bottled water, as well as limiting alcohol and caffeine, helps preserve hydration status.

Nutrition Education – The process of teaching athletes the principles of macronutrient timing, portion sizes, and food selection. Empowered athletes can make informed choices, leading to consistent implementation of nutrition plans.

Performance Monitoring – Tracking metrics such as time to exhaustion, heart rate variability, and perceived exertion to assess the effectiveness of nutrition strategies. Adjustments to macronutrient timing are made based on observed performance trends.

Intra-Bout Nutrition – Small, rapid sources of carbohydrate taken during short rest periods between bouts. A 15-gram gel or a few bites of a low-fiber fruit can be consumed quickly, providing a glucose boost without causing GI upset.

Post-Bout Rehydration – Replacing fluids lost during a bout, typically at a ratio of 1.5 L of fluid for every kilogram of body weight lost. Including sodium (≈30–50 mmol/L) in the rehydration fluid enhances fluid retention.

Carbohydrate Threshold Test – An assessment where an athlete performs incremental exercise until blood glucose drops below a set level, indicating the point at which carbohydrate supplementation becomes necessary. This test helps tailor individualized carbohydrate timing protocols.

Nutrition Periodization Tools – Software or spreadsheets used to plan daily macronutrient targets, track intake, and align nutrition with training calendars. These tools facilitate adherence and allow quick adjustments based on training load changes.

Energy Substrate Utilization Shift – The gradual transition from fat to carbohydrate reliance as exercise intensity rises. Understanding this shift guides the timing of carbohydrate ingestion to match the point where glycogen becomes the dominant fuel.

Hydration-Electrolyte Ratio – The proportion of sodium to total fluid volume in a sports drink, typically 20-30 mmol/L. Matching this ratio to sweat loss helps prevent hyponatremia and maintain nerve function.

Macronutrient Timing Principles – Core guidelines that include: (1) Consume carbohydrate 3-4 hours before competition for glycogen loading; (2) ingest a high-GI carbohydrate snack 30-60 minutes pre-bout for rapid glucose availability; (3) sip carbohydrate-electrolyte fluid every 15-20 minutes during prolonged bouts; (4) prioritize carbohydrate-protein intake within 30 minutes post-exercise for glycogen restoration and muscle repair; (5) maintain steady protein distribution every 3-4 hours throughout the day.

Practical Application Example – A 68-kg fencer preparing for a 2-day tournament might follow this schedule: Day 1 (morning) – 2 h before first bout, a bowl of oatmeal with honey (≈80 g carbohydrate) and a boiled egg (≈6 g protein). 30 Minutes pre-bout, a banana (≈30 g carbohydrate). During the bout, sip 200 ml of a 6 % carbohydrate-electrolyte drink every 20 minutes. Immediately after the bout, a recovery shake containing 40 g whey protein and 60 g maltodextrin, plus 500 ml water with added sodium. Between bouts, a small snack of rice cakes with almond butter (≈20 g carbohydrate, 8 g protein, 5 g fat) to sustain energy. At night, a casein-rich cottage cheese serving (≈15 g protein) before sleep. Day 2 follows a similar pattern, with a slight increase in carbohydrate intake (≈10 % more) to account for any remaining glycogen depletion.

Common Challenges – (1) Gastrointestinal upset from high-fiber or high-fat meals close to competition. (2) Inconsistent carbohydrate intake leading to variable glycogen stores. (3) Over-reliance on supplements without adequate whole-food nutrition. (4) Difficulty maintaining hydration in hot environments. (5) Individual differences in insulin sensitivity causing unpredictable blood glucose responses. Addressing these challenges requires systematic trial testing, gradual adjustments, and close monitoring of performance indicators.

Adjustment Strategies – If an athlete experiences GI distress, reduce fiber and fat in pre-exercise meals, and opt for low-volume, high-glycemic carbohydrate sources. For inconsistent glycogen levels, implement a structured carbohydrate loading protocol three days before competition, ensuring a taper in training volume. When hydration is problematic, increase sodium content in fluids and schedule regular sipping intervals rather than large, infrequent drinks.

Monitoring Tools – Blood glucose meters for checking pre- and post-exercise glucose levels, body weight scales for assessing fluid loss, heart rate monitors for tracking intensity, and food diaries for recording macronutrient intake. Combining these tools provides a comprehensive picture of how timing strategies affect performance.

Integration with Skill Training – Nutrition timing should complement technical and tactical drills. For example, high-intensity footwork drills performed after a carbohydrate-protein recovery meal can improve both physical output and skill retention, as the brain benefits from stable glucose levels.

Psychological Considerations – Confidence in nutrition plans can enhance focus and reduce anxiety.

Establishing a reliable pre-competition routine, including familiar foods and timing, contributes to mental preparedness, which is crucial for the split-second decisions required in fencing.

Nutrition Periodization Checklist – (1) Identify training phase and corresponding macronutrient goals. (2) Plan pre-, intra-, and post-exercise meals and snacks. (3) Choose appropriate carbohydrate GI for each timing window. (4) Determine protein source and timing to support muscle repair. (5) Set fluid and electrolyte targets based on sweat rate and environmental conditions. (6) Conduct trial testing during training sessions. (7) Adjust based on performance feedback and physiological markers. (8) Document daily intake and outcomes for continuous improvement.

Key Takeaway – Mastering the terminology of macronutrient timing equips endurance fencers with the language needed to design, implement, and refine nutrition strategies that align with the specific demands of their sport.