Position Statement of the South African Institute of Drug Free Sport (SAIDS) on the use of supplements in sport in ADULTS

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Note: This document is currently being updated

What you need to know

Supplement availability and use by consumers across all walks of life are ever-increasing. Supplements, whether it be sport supplements, ergogenic aids, health supplements etc. all fall under the umbrella of dietary (or nutritional) supplements. The sporting population in particular offers a lucrative market for 'designer sports supplements' with a range of ingredients and alleged benefits. Aggressive marketing of these products at school, recreational and elite-level has led to large numbers of consumers willing to pay for and use these products in the hope of enhancing various aspects of human physiology, exercise capacity and ultimately sporting performance (1).

SAIDS define 'sports supplements' as sources of nutrients and/or other substances, marketed and sold as such in the field of amateur and/or professional sport, with claims of a nutritional or physiological effect whose purpose it is to supplement the normal diet, directly or indirectly alter body composition, support health status, enhance sporting performance, and/or assist with recovery following sporting activity.

Common misconceptions about supplements

The most common reasons for sport supplement use in athletes include the belief that it may offer a 'magic bullet' that will increase sporting performance either directly (e.g. improved power, sprint, endurance capacity) or indirectly (e.g. improve body composition, immune function etc.). Other common beliefs are that it cannot do any harm; that competitors are using it; believing advertisement 'hype', and that it cannot do any harm, especially products marketed as being 'natural' and 'safe'. These beliefs have been entrenched through aggressive advertising employed by the supplement manufacturers and retailers, often making use of unsubstantiated claims - a result of an unregulated, unlegislated market.

Common pitfalls surrounding supplements that consumers should be aware of:

- Supplements bought from or provided by a well-known store, pharmacy, website, supplement company or retailer (and their representatives) do not necessarily mean that it is effective, safe and legal.
- Even if the product label, website, sales representative or advertising say it has 'proven benefits', it does not necessarily mean that the product was indeed adequately tested; that the testing met scientific-grade standards, and/or that the results were conclusive of its *efficacy and safety* for the conditions, age-group, and purpose that it is marketed for.
- 'Tested' (and the various related logo's, verifications, certifications etc.) could have various meanings, which could be misleading and misinterpreted by consumers as evidence for efficacy and a safeguard against the full spectrum of safety risks related to supplement-use.
- Just because there are no harmful ingredients and/or banned substances listed on the label does not guarantee that it is indeed 'safe' (harmless to health and getting you banned from sport).
- Products promoted as 'natural' (or herbal) does not automatically translate into it being effective, harmless or safe.
- Be aware of clever marketing messages aimed at creating consumer misconceptions that results in selling more product e.g. though it is true that active sportspeople need more nutrients, it is not true that one cannot meet these performance demands through clever food

choices alone; or that you need 'something special' which you cannot get from food; or that nutrients form supplements are superior to those obtained from food, especially in terms of their ability to build muscle mass and strength, improve weight (fat) loss, enhance endurance capacity, aid recovery, boost immune function and so on.

The reality:

There is an alarming increase in the number of reported adverse health effects and positive tests (in SA and globally), resulting from the use of supplements. This is largely due to the following:

- Despite the large range of supplements and their alleged benefits (and availability through various sources), *the fact remains that the majority of supplements on the market have not been tested according to sound, scientific and objective standards, and as such their claims of superiority, efficacy and safety are not proven and cannot be guaranteed.*
- There is a lack of legislation and governance in the supplement industry resulting in the reality that products can be advertised and sold with misleading claims, incorrect labelling, and lack of scientific-grade efficacy and safety evidence. The lack of consumer awareness in this regard means that consumer demand for these products remains high, with little impetus for supplement companies to change the status quo.
- There are many on-going examples (locally and globally) of untested, harmful supplements being launched into the market that are only prohibited or banned from the market once a critical number of public reports of serious adverse side-effects / medical problems and/or fatalities were received.
- The same goes for the increasing number of failed drug tests in SA sportspeople (and globally) - most recently there are examples of Rugby team members using a product from a well-known sport supplement company, marketed as 'tested to be safe and effective'.
- There is also evidence that some of the apparently 'harmless' or legitimate dietary supplements may also be contaminated with ingredients that are not declared on the label but are prohibited by the doping regulations of the International Olympic Committee (IOC) and of the World Anti-Doping Agency (WADA) (2). **
- The above include products alleged to be 'natural', 'herbal' and therefor 'safe'. No product in a bottled pill, tablet, or powder form, that has undergone any form of processing, extraction, purification, dehydration (etc.) can be regarded as 'natural' anymore. Further, one cannot associate herbal with natural or safe, as there are many herbal components that have potent harmful side-effects, can lead to harmful interactions with other herbals or medications, and/or lead to a failed drug test (ephedra (ephedrine), pro-hormones). The dosages of these products are often also varied and it is not uncommon to reach toxic levels that could lead to serious organ damage and/or death (e.g. mahuang, kava-kava).
- Reliance on supplements shifts focus away from the more critical and proven methods of achieving optimum performance (and health). Sportspeople can easily get side-tracked from the true elements of success in search of the easy, unfounded short-cuts that the sport supplements promise (1). Optimising one's training, overall dietary intake, rest, recovery and sleep patterns can have a far bigger impact on physique, performance and health than any sport supplement tested to date can; nor can 'skimping out' on any of these aspects be replaced by the use supplements as is often claimed by the supplement advertising.

A closer look at the RISKS involved with supplement use

- Short- and long-term health and/or being banned from sport.

Health risks may include allergic reactions, toxic effects from self-medicating, over-dosing or poisoning due to contaminants found in the products (3). Examples from the past include a number of reported deaths and medical problems resulting from the use of tryptophan supplements (4) and medical problems and deaths relating to products containing *Ephedra* and caffeine (5).

Apart from serious health risks, for elite-level athletes there is also the risk of testing positive for a banned substance that can ruin a sporting career and discredit their reputation and that of the sporting code and country they represent. The rise in the number positive drug tests stemming from alleged sport supplement use has raised concerns amongst several sporting bodies, locally and internationally (SAIDS, SARFU, Olympic Committee (IOC), IAAF).

The label does not guarantee safety
In one of the first investigations into the extent of the problem, the IOC commissioned a study where a total of 634 so-called 'non-hormonal' supplements were bought in 13 countries - the majority from retail shops (578) and the rest via the internet (52 products). Alarmingly, 94 products were contaminated with and tested positive for anabolic-androgenic steroid hormones (mainly pro-hormones) that were *not declared on the label* (6). Why and how these hormones ended up in these products remain unanswered.

Subsequent studies have also demonstrated that even seemingly 'harmless' nutritional supplements such as vitamin and mineral supplements may contain pro-hormones not declared on the label. In 2005 vitamin C, multivitamin and magnesium products sold in effervescent tablet form were confiscated as it contained high amounts of the anabolic-androgenic steroid hormones (stanozolol, methandienone, and small amounts of norandrostenedione and several other steroids (7). In fact, since 2002 there has been a growing number of apparently harmless nutritional supplements containing high amounts of 'classic' anabolic steroids detected on the supplement market (likely sourced from Chinese pharmaceutical companies which sell anabolic steroids in bulk) (8). New 'designer' steroids such as prostanozol, methasterone, androstatrienedione are also available in nutritional supplements and it is predicted that in the near future products cross-contaminated with these steroids are also expected (8). Apart from resulting in positive doping results, these substances have the potential to cause serious adverse health effects (7).

These studies demonstrate the extent of *insufficient surveillance in the manufacturing of dietary supplements available on the local and global market*.

Due to the substantial risks (known and yet unknown) related to supplement use, we support international consensus that sports supplements should not be used in persons <18 yrs of age (see the SAIDS position paper for YOUTH).

Lack of supplement manufacturing and marketing legislation: a local and global problem

The sport supplements available and used locally are a mixture of products imported, bought on internet and those locally produced (which may/may not contain ingredients imported from overseas manufacturers). The lack of legislation and laws governing local and global supplement manufacturing and marketing are major reasons for the lack of efficacy and safety standards of the products available on the market. Even in established and sophisticated countries such as the USA and UK the lack of supplement legislation, governance and enforcement are problematic and a source of concern.

Moreover, there is a lack of capacity (resources, funds) to 'police' and enforce appropriate supplement manufacturing and marketing policies and legislation. Even if we had sufficient policies, legislation and policing locally, these products remain freely available via the global market (e.g. via the internet) where lack of legislation remains problematic.

As a result, the products and claims of alleged beneficial effects are not subject to a rigorous process of scientific-grade testing to a) substantiate its purety, b) prove efficacy (including indications and contra-indications of use and effective dosage) and c) demonstrate safety (in terms of short- and long-term health, interactions with other supplements and pharmaceutical products and the risk of testing positive for banned substances).

Therefore, consumers should be aware that supplements can contain prohibited and harmful substances without it being indicated on the label - the label does not guarantee efficacy and safety, and that supplement use can pose a risk to health and being banned from participating in competitive sport.

Though some athletes are guilty of deliberate cheating, some positive tests may be the result of inadvertent ingestion of prohibited substances present in sports supplements without the knowledge of the athlete. However, the WADA's principle of strict liability applies in sport meaning that innocent ingestion of prohibited substances is not an acceptable excuse, and athletes testing positive are liable to be sanctioned.

How to minimise the risks

Choosing to use a supplement should be based on:

(a) Firstly optimising overall dietary intake - supplementation should be individualised to 'fill the gaps' if/where needed, appropriate to , training, rest and recovery (the evidence-based performance nutrition guidelines are provided on page 6 and Addendum A of this document);
(b) determining the needs and applicability of the supplement(s) for the *individual* and their nutritional, training and performance goals and,
(c) evaluating the supplement itself and whether it has sound scientific support with direct, well-controlled research showing its effectiveness and safety for the individual (9).

A registered dietitian with sports nutrition expertise can be a valuable resource to help make informed choices on the applicability and validity of supplement use in order to meet the individual's goals for training and performance. The section below will provide an overview of the dietary needs of active individuals to sustain and boost training and competitive performance, based on sound scientific evidence.

What you need to know when evaluating the use of supplements

As noted before, literally only a handful of supplements (ingredients) have solid scientific backing behind it to support its claims of efficacy and safety, when used under specific conditions. These effects are typically also specific to a specific type of exercise / sport, and there often is a component of inter-individual variability in response (so it does not necessarily work for everyone, and in some, it may be detrimental to performance e.g. caffeine supplementation).

Supplement manufacturers and sales representatives may indeed present what they refer to as 'scientific evidence' and 'certification' of quality and efficacy; however, with closer inspection the 'evidence' is often insufficient, of poor standard or anecdotal; ignorant of evidence showing opposite results; or unrelated to the specific product at hand or the population it is promoted to. Scientific-grade efficacy and safety testing cost time and money which supplement companies typically have little incentive to invest in (despite them claiming the contrary) - especially seeing that there is limited / no legislative enforcement and, most importantly, that they can successfully sell their products to loyal consumers who do not question or demand substantial proof of their claims.

Following an 'evidence-based' approach

Sports supplements are typically designed as convenience supplements (e.g. energy bars, meal replacement powders, ready to drink supplements), and/or promoting weight gain, weight loss, boosting immune function, promoting cartilage/joint health and repair, and/or performance enhancement. Based on the degree of evidence available, supplements could be divided into the following categories:

- Category I. Apparently Effective - Supplements that help people meet general caloric and nutrient needs and/or the majority of research studies in relevant populations show it is effective under certain conditions and generally safe (e.g. carbohydrate drinks / gels; energy bars; meal replacements / protein for those with dietary insufficiencies). Note: very few supplements have been sufficiently tested to be included in this category.
- Category II. Possibly Effective - Supplements with initial studies supporting the theoretical rationale but requiring more research to determine how the supplement may affect training and/or performance.
- Category III. Too Early To Tell - Supplements with sensible theory but lacking sufficient research to support its current use.
- Category IV. Ineffective and/or Dangerous (cause serious adverse health effects).

- Category V. Supplements without sensible theory and without sufficient or any credible research to prove its claims of efficacy or safety. ***NOTE: The majority of supplements available on the local and global market fall into this category.***

A note of caution is warranted:

Even though *some* sports supplements or ingredients have been shown to have ergogenic potential and/or could be of value to complement a well-balanced diet, be aware of the risk of contaminated supplements with harmful and/or banned substances that may not be listed on the label.

Apart from considering the evidence on safety and efficacy, athletes should ensure optimal training, dietary and rest strategies, that the supplement and ingredients do not conflict with any existing or medical conditions (and predispositions), and consider 'low risk' sources of supplementation (16). A registered dietitian could assist in this process.

Further, there remains a lack of well-designed studies examining the safety and ergogenic (performance-enhancing) potential of the vast majority of supplements currently on the market - especially the effects in elite-level athletes and in real-life training / competition environments (16).

Strategies to lower the risk associated with using sport supplements:

The following strategies can be used to help reduce the risk of ingesting harmful and/or prohibited substances. Note: these can lower the risk but do not eliminate the risk.

- Limit / minimise the use of supplements;
- **Be extremely cautious** with regards to the following:
  - **?** Supplements advertising 'anabolic', 'extreme muscle building' and 'fat burner' effects - these are likely to contain banned substances such as anabolic steroids (or pro-hormones) or stimulants (NZ PS). Examples: 'DHEA'; Androstene-dione or -diol; '19' or '19-nor'; Mahuang; Ephedra (or ephedrine)
  - **?** Claims of 'anabolic' effects and/or 'boost testosterone' or 'growth hormone' levels (even it says it does so 'naturally' or that it is in 'herbal' form)
  - **?** Products of unknown origin and/or without a label.
- Products like creatine and caffeine are not banned substances, however, be careful when it is 'mixed' with other substances - it cannot be guaranteed not to be contaminated with banned / harmful substances.
- Carbohydrate supplements (drinks, gels, energy bars) are generally low risk, but be careful when mixed with other substances; choose reputable brands and evaluate the manufacturer track record / history (see below).
- Choose vitamin and mineral supplements from a reputable company. However, as mentioned before, there are reports of vitamin / mineral supplements found to be contaminated with banned substances.
- Investigate the manufacturing practices and history of the company, the range of products that it produces (e.g. company that does not produce other products containing banned substances); company follows responsible marketing and advertising practices;
- Request *certification that verifies the ingredients within the product as well as amounts (dosage), where these ingredients were sourced as well as manufacturing practice of the producer. However, be aware that there are issues with fraudulent certification, inaccurate or incomplete testing of the range of substances, or that it is out-dated. Further, certification and testing should be done for *each batch of product* that is produced, as well as testing for all individually known harmful and prohibited substances. The practicality and feasibility of doing this is, however, problematic (especially in SA).
- A registered dietitian can assist with identifying low-risk products.
- SAIDS cannot guarantee the safety of any supplements.

Nutritional needs of active individuals

Based on a wealth of evidence the overall consensus is that the cornerstone of optimal performance is eating an energy balanced and nutrient dense diet, proper timing of nutrient intake, training intelligently and allowing for optimal rest and recovery (9). These factors have a far bigger impact on performance than any supplement tested to date and should therefore be the main areas of continuous focus and effort for active individuals seeking to optimise their performance.

Energy and macronutrient requirements of active individuals

The first component to optimize training and performance through nutrition is to ensure a sufficient calorie intake (9) - the harder / more intense the training, the higher the caloric (energy) needs of the individual. To get your sufficient quota of calories, you need to ingest appropriate amounts of carbohydrate, protein and fat, and in the right proportions (Table 1).

Table 1: *Consensus from the International Society of Sports Nutrition (ISSN) (9) is as follows:*

Training Level	**Energy**	**Carbohydrate**	**Protein**	**Fat**
		(contributing towards meeting daily energy requirements)		
General, moderate-intensity recreational activity e.g. 30 - 40 min per session, ~3 x per week.	Can typically meet energy needs by following a 'normal' diet of 25 - 35 kcals/ kg/day (e.g. 1,800 - 2,400 kcals/day for a 50 - 80 kg individual)	3-5 g CHO / kg BW / day Tip: with low volume and intensity, and with weight loss as a goal opt for the lower end of the range, and vice versa.	0.8 - 1.0 g protein / kg BW / day, and older individuals may benefit from ingesting: 1.0 - 1.2 g protein / kg BW / day	0.5 - 1.5 g fat / kg BW / day, based on: - level of training (trained people are better able to burn fat during exercise, albeit still limited vs. untrained) - energy needs and body composition goals of the person (to lower body fat aim for the lower end of the range and vice versa) Focus on mono- and poly-unsaturated ('healthier') types of fat (canola / olive oil; avocado pear, olives, nuts and seeds), fatty fish (pilchards, tuna, herring, mackerel, salmon). Limit saturated and trans fats (e.g. animal fat, chicken skin, cream, hard-brick margarine etc.). High-fat diets are not recommended (10).
Moderate levels of more intense training e.g. 2-3 hrs of intense exercise, 5-6 times / week)	50 - 80 kcals/ kg BW / day (e.g. 2,500 - 8,000 kcals/day for a 50 - 100 kg athlete) = depending on the volume and intensity of different training phases (the harder the training, aim for the higher end of the range)	5-8 g CHO / kg BW / day to sustain energy levels, promote recovery and optimise training and performance.	1 - 1.5 g protein / kg BW / day is recommended for most, including endurance sports to maintain muscle mass, support training adaptations and recovery. 1.4 - 1.7 g protein / kg BW / day is recommended for intermittent (team)-type sports.	
High volume intense training e.g. 3-6 hrs / day of intense training in 1-2 workouts, 5-6 days / week		High-level athletes doing high-volume intense training: increase to ~8-10 g CHO / kg BW / day	1.5 - 2.0 g protein / kg BW / day if doing high-volume, intense endurance training OR when doing *strength training* aiming to increase muscle mass	
		Incorporate recommendations for CHO and Protein intake before, during, after training		

There is ample scientific evidence to show that by not ingesting sufficient amounts of calories and/or not enough carbohydrate, protein, and fat may hamper training and performance. It may lead to loss of muscle mass and strength, increased susceptibility to illness, and increased incidence of overreaching and/or over-training (9). Good dietary practices can therefore help optimize training adaptations and optimise performance.

It may be difficult for some athletes to eat enough food in order to meet caloric needs (e.g. smaller built athletes, those in weight category and aesthetic sports such as runners, cyclists, swimmers, triathletes, wrestlers, boxers, gymnasts, dancers) (9). Furthermore, intense training can suppresses appetite; some athletes may not like exercising within hours of eating a meal; and travel and training schedules may limit food availability (9). These challenges can be overcome with careful planning of energy-dense food and beverage availability and timing of meals / snacks around training and lifestyle schedules (9). For some, individually planned and carefully selected 'low risk' supplementation could be considered. **Addendum A** provides practical advice and examples of energy-dense, nutritious foods to support health and performance needs.

Carbohydrate (CHO) requirements for active individuals

Second to overall energy intake, CHO is a well-proven dietary component for optimising training and performance, in fact, sufficient dietary intake of CHO can have substantial direct and indirect performance benefits and as such is the best-proven dietary ergogenic aid/strategy to date (9-14).

There is a strong body of evidence and consensus on the ergogenic benefits of maximising CHO intake and availability before, during, and after training sessions / competition to enhance the training adaptation and performance (13). The type of CHO ingested before, during and after exercise is important as it determines the rate of availability of CHO energy to the muscle for energy (oxidation), recovery (release of anabolic hormones e.g. insulin; glycogenesis etc.) (9).

The majority of dietary CHO should come from 'wholesome' CHO with a low to moderate glycemic index (GI) (e.g., whole-grains, vegetables, fruit, etc.) (9). However, for those doing intense training with high CHO-energy needs, the proportion of the high-fibre and generally more filling CHO foods could be lowered and more of the energy-dense CHO with higher GI be consumed (e.g. fruit juice, CHO energy drinks or colddrinks, or other high-CHO easily digestible foods, see Addendum A). The latter recommendation is not for the recreational-type individual who engages in general fitness training (30-60 min, 3-4 times / week).

CHO intake before exercise / competition:
A CHO beverage before exercise has been proven to enhance performance (10). It should provide sufficient fluid to maintain hydration, be relatively low in fat and fibre to facilitate stomach comfort and relatively low in protein, and contain familiar foods that are well tolerated by the individual (10).

Amount CHO and timing	Type	Practical tips & examples
~200 to 300 g of CHO for meals consumed 3–4 h before exercise (10) - the more time one has available before the event, the bigger the meal and vice versa to ensure sufficient time for digestion and stomach comfort	Glycemic index (GI): Bulk of scientific evidence show that whether your pre-exercise CHO meal is high or low in GI has little / no effect on performance (10). Choose the type of CHO that you feel most comfortable with. It also does not matter whether the meal is in solid or liquid form, as long as it is high in CHO. Individual stomach comfort is most important.	Some individuals are comfortable with a more substantial meal (e.g. bowl of cereal or toast, scrambled egg and juice) 2 - 4 hrs before exercise / competition, whereas others may prefer a liquid meal or beverage (10).

The type of pre-exercise CHO beverage should be chosen based on individual experience and preference, stomach comfort, and type of exercise or event. For long-duration (>90 min) exercise with sufficient opportunities for repeated CHO replenishment the pre-event CHO meal size and GI of CHO meal are less important; but with long-duration exercise with limited opportunity for CHO intake during the event, a more substantial pre-exercise CHO beverage could be beneficial.

CHO intake during exercise / competition:
The ergogenic value of CHO intake during exercise (from intermittent to endurance-type sports) is unequivocally proven - particular in exercise lasting >60-90 min (10).

Amount CHO and timing	Type	Practical tips & examples
0.7 g CHO / kg BW / hour during exercise, ideally in a 6-8% solution (i.e. 6-8 g CHO per 100 ml of fluid), but can be as high as 10% solution; CHO intake should start shortly after the onset of exercise, and should be repeated every 15- to 20-min throughout exercise (best results in terms of stomach comfort, energy delivery and ergogenic effect)	Easily digestible (predominantly high GI) CHO yielding primarily glucose, although mixtures of glucose and sucrose, other simple sugars, fructose and maltodextrins also seem effective (14). It can be liquid or solid form, depending on stomach comfort and as long as sufficient amounts of CHO and fluid are ingested.	Practically this equates to ~30-70 g CHO / hour (~30g for smaller sized and/or slower athletes and vice versa). Ingesting more than this amount does not seem to have any further performance benefits. A CHO energy drink is convenient and can meet both CHO and fluid needs simultaneously

(9;10;12).

CHO ingestion during exercise is of particular importance when the athlete did not carboload, those who follow a low-CHO diet or restrict energy intake for weight loss, or if no pre-exercise meal was ingested (10). Caution should be taken with the ingestion of large amounts of slowly digested CHO sources such as fructose and other low GI sources, as these may cause stomach discomfort and diarrhoea (9;10).

CHO intake post-exercise:
The timing of CHO intake post-exercise has a key impact on the rate of recovery in terms of glycogen replenishment (refuelling energy stores), eliciting an anabolic stimulus via the release of insulin and energy availability (12;15). Effective recovery can improve sporting performance (10).

Timing of post-exercise CHO intake is of particular importance when there is a limited time to recover (e.g. training / competing twice in a 24 hr period or strenuous training / competition day-to-day) (10).

Amount CHO and timing	Type	Practical tips & examples
To maximise recovery in these situations 1.0 - 1.5 g CHO / kg BW ingested at 2 hr intervals up to 6 hrs post exercise is recommended (10).	Easily digestible, fast-releasing (high GI) CHO yields a faster rate of glycogen recovery compared to slow-release (low GI) foods.	When recovery time is limited, high GI CHO beverages should predominantly be chosen in the first 6 hrs post-exercise (thereafter the type of CHO is of less importance.

(10;15).

Adding protein to carbs in the post-exercise beverage may promote recovery process - see protein section for further details. However, when CHO intake is sufficient (i.e. >1g / kg BW), the bulk of studies show no significant further benefit of adding protein to enhance glycogen recovery (10).

Protein requirements for active individuals

There is evidence that regular exercise improves the efficiency at which the body utilises and retains protein, thereby arguing against increased protein needs for active individuals (15). However, current consensus is that exercising individuals, particularly those doing hard, intense training, can benefit from increased protein intake (9). See Table 1.

Though a sufficient level of dietary protein intake is important to support the muscle building process, the correct type, volume and intensity of training is an over-riding factor in providing the stimulus for muscle to 'grow', and factors such as genetics, gender, and age will further determine the rate and net amount of muscle that could be gained (15).

It is also important to note that a high protein intake may be harmful in individuals with underlying medical conditions such as diabetes, metabolic syndrome, people with kidney and/or liver ailments (9;16).

Type and timing of protein intake

The importance of consuming CHO before, during and post-exercise remains paramount, however, the potential for protein to contribute to the training adaptation and recovery process has emerged as a viable component of nutrition protocols (ACSM news flash, Nancy Rodriguez).

Protein intake before exercise

The optimal CHO and protein content of a pre-exercise meal is dependent upon a number of factors such as exercise duration and fitness level (12). There is indication that a *small* amount of protein, 0.15 – 0.25 g protein / kg BW added to a pre-exercise CHO meal / beverage (and ingested ~3 hrs prior) may decrease muscle protein breakdown (and potentially enhance recovery post-exercise) (12). However, data on exercise performance are inconclusive (10) and there is potential detrimental effects caused by the addition of protein such as decrease stomach emptying, stomach discomfort / upset, and even toxic effects if large amounts of amino-acids are taken (15).

Protein intake during exercise

Protein ingestion during prolonged exercise (in a CHO:Protein ratio of 4:1) may attenuate whole-body protein breakdown and reduce markers of muscle damage which could enhance muscle recovery and promote training-induced adaptations (12;13).

Strength (muscle building) exercise: Ingesting CHO alone or in combination with protein (in the ratio mentioned above) during strength exercise may increase muscle glycogenesis, offset muscle damage, and facilitate greater training adaptations after either acute or prolonged periods of strength training (12).

However. collectively taken, the evidence is inconclusive regarding the addition of protein to CHO beverages during exercise on actual performance (10).

Protein intake post-exercise:

There is evidence that a relatively small amount of protein ~0.2 - 0.5 g protein / kg BW (to a maximum amount of 25 g protein, or 10 g essential amino acids) ingested immediately up to 3 hours post exercise may promote *muscle protein synthesis* after strenuous exercise (12;13), while the addition of CHO may stimulate even greater levels of protein synthesis. Combining small amounts of protein with ample CHO could therefore be an effective recovery nutrition strategy. However, evidence suggest that when sufficient amounts of CHO (>1 g CHO/ kg BW) are ingested post-exercise, the addition of protein does not enhance *muscle glycogen synthesis or* improve subsequent exercise *performance* (13).

Though there is evidence for enhanced protein synthesis with protein (and CHO) ingestion post-exercise, there is limited and conflicting information about how this effects 24 hr whole-body protein balance (and beyond) and ultimately training-induced gains in skeletal muscle hypertrophy, lean mass, and strength over time (13).

Supplement manufacturers typically over-emphasise the importance of protein whether it be to build muscle, aid recovery or to boost performance and promote levels of intake several-fold higher than the scientific-based recommendations (boosting product sales and income). However, levels above 2 g protein/ kg BW /

day are currently unjustified as it does not necessarily translate into infinite gains in muscle or other benefits (15).

A further down-side to the over-emphasis of protein intake (and popularity of protein supplement use) is that it detracts focus from other key dietary components and their well-proven benefits. Protein at the expense of CHO may in fact impair performance in various ways. CHO intake, for example, has a powerful protein-sparing effect, has a powerful anabolic potential (e.g. via the release of insulin) and combined with its function as primary fuel source during all types of exercise, CHO plays a critical role in muscle building and recovery, providing energy to sustain high-intensity exercise and support sporting performance and health (9;10;12).

In addition, there is no evidence to substantiate the notion that the protein and amino acids from supplements is 'superior' to that obtained from dietary sources, nor that it is difficult / impossible to meet requirement through diet alone. In fact, the composition, type and combination of proteins and amino acids, combination with other key nutrients and factors (known and yet unknown) in food yield many advantages which cannot be replicated in pill or powder form.

As such, there's been growing scientific evidence to support the use of low-fat dairy (e.g. milk) as an exercise beverage, especially during recovery from strength training and endurance sports. Post-exercise milk consumption combined with resistance training (12 weeks minimum) has been shown to result in greater increases in muscle hypertrophy and lean mass (17). Research also suggests that milk may be an effective post-exercise beverage for endurance-type exercise. A recent study tested the effects of 3 recovery drinks - chocolate milk, a CHO replacement drink, or fluid replacement drink - on endurance performance (18). Each drink was ingested at 0 and 2 hrs during the 4 hour recovery period, after which the trained athletes performed a cycle test to exhaustion. Performance was significantly better after ingesting the chocolate milk compared to the other recovery drinks.

Hence, milk (low-fat and fat free) has been shown to be as effective, if not more effective, than commercially available sports drinks at promoting rehydration and recovery from strength and endurance-type sports (17). It is an excellent source of essential amino acids to support muscle protein synthesis, it is a more nutrient dense beverage (with CHO and key vitamins/minerals) compared to traditional sports drinks, it is safe (except for those who are lactose intolerant) and effective (17). Further work is required to better understand the physiological mechanisms by which milk exerts its actions following exercise and training (17).

Fat requirements for active individuals

Dietary fat is a source of energy, fat-soluble vitamins, and essential fatty acids which are important for health and performance. Though dietary fat and stored body fat are dense and abundant sources of energy, its capacity to be used as fuel during exercise *per se* is limited (ref).

Maintenance of an optimal level of body fat (and muscle mass) is key to optimal performance - excess body fat is a dead weight that may reduce power to weight ratio that may impact on speed, power, endurance, agility etc. (10). Too low a body fat on the other hand (typically <14 % in females and <4 % in males) may be detrimental to health (and performance) (ref). A note of caution is to steer away from an over-fixation on a specific weight (kg) on a scale typically seen in weight category sports (rowing, boxing, judo etc.) or where weight is seen as an important selection criterion in power sports (e.g. rugby) - especially where the actual body composition (lean body mass vs. fat mass) *per se* is unknown. Other factors such as genetic ability to build or lose body fat / muscle mass should be considered, as well as talent, dedication, trainability of the individual etc.

Micronutrient requirements – Vitamins and minerals

Vitamins and minerals are important for many metabolic processes in the body and as such are important in supporting optimal growth and repair, development, immune function, exercise and performance (19).

There is still much debate over the micronutrient needs of active individuals - some researchers believe athletes have an increased need, whereas others do not report increased requirements amongst athletes (19).

The micronutrients found to be of particular significance in athletes' diets are calcium, B vitamins, iron, zinc, magnesium, and antioxidants such as vitamins C and E, beta-carotene, and selenium (10). Generally, athletes consuming a diet adequate in energy and including a variety of foods from the various food groups are likely to also ingest an adequate amount of micro-nutrients (19). However, those who severely restrict energy intake (e.g. for weight loss), eliminate one or more food groups from their diet long-term (e.g. vegans), or who consume unbalanced and low micronutrient-dense diets, are at greatest risk for poor

micronutrient status (10). These individuals may benefit from a daily multivitamin / mineral supplement that ideally do not contain mega-doses of select nutrients. However, use of vitamin and mineral supplements do not improve performance in individuals consuming nutritionally adequate diets (10;20).

Bear in mind that the ingestion of nutrients above levels naturally occurring in foods can be toxic and harmful. It is very difficult to reach toxicity levels from diet alone, but easy to do when taking supplements. Furthermore, supplementation could in itself result in other vitamin / mineral imbalances. Some vitamins / minerals can block the absorption and/or function of other nutrients and create a deficiency, or it can promote the absorption / storage which can lead to toxicity. This is of particular concern when single vitamins / mineral supplements are used, or a range of supplements (and/or nutrient 'enriched' or 'fortified' products) are used. Toxic effects can harm immune function, health and performance.

If nutritional insufficiency is a concern, it is advised not to take *single* vitamins or minerals, especially in large dosages. It is generally better to take a multi-vitamin and mineral supplement that provides nutrients in dosages that ideally do not exceed 1.5 x Recommended Daily Allowance (RDA) or Dietary Reference Intake (DRI) level. Where a specific nutrient deficiency is diagnosed, the cause of the problem should first be addressed, appropriate dietary optimisation should be done, and short-term 'low-risk' supplementation should be considered.

In conclusion

Consumers should be aware of the risks involved with supplement use, both in terms of health and risk of being banned form sport. This Position Stand aims to create awareness and provide education on sports supplement use, highlight more effective alternatives such as proven nutritional strategies to optimise adaptations to training, enhance training capacity, recovery, sporting performance and sustain long- and short-term health. Ultimately this should assist active individuals in making informed, evidence-based decisions on supplement use.

Athletes (and all consumers alike) should take special care in making choices on supplement use. Athletes are encouraged to seek advice from qualified professionals such as a registered dietitian with sports nutrition expertise who is uniquely qualified to provide guidance on sport supplement use, on an individualised needs-based approach, help reduce the risks involved and provide effective nutritional strategies to maximise training and performance goals of the individual.
Lastly, it is our hope that the information contained in this document will help minimise the number of adverse health effects (long-and short-term), as well as the number of positive doping tests related to the use of sports supplements.

ADDENDUM A: Practical dietary advice

Use this advice along with the energy, carbohydrate, protein and fat recommendations provided in Table 1.

CHO portion planner: CHO sources providing ~30g CHO (choose 'low in' or no fat) **1 Cup = 250ml*	
Grains 2 slices of whole-wheat, rye or brown bread (slices) 1 bread roll or bagel or pita bread 6 Provitas 4 Ryvitas, snackbreads or rice cakes 2 Weetbix 1 Cup* of breakfast cereal (e.g. Corn flakes or All bran flakes) 1 Cup of cooked porridge (e.g. cooked oats, Maltabella, 'mieliepap') ½-⅔ Cup of low-fat muesli or ProNutro 1 Cup of cooked rice, pasta, couscous or barley	**Fruit** 2-3 medium (size of tennis ball) fruit (e.g. apples, peaches, pears, oranges, naartjies) 3-4 small (size of golf ball) fruit (e.g. quavas, apricots, plums, granadillas) 1 big banana or mango 2 Cups or paw paw 1-1½ Cup of mixed fruit salad or melon 2 Large slices of watermelon 2 Tbsp raisins 6-8 dried prunes or dates ⅔ Cup canned/tinned fruit (unsweetened) ⅓ Cup of dried fruit 1 Cup of fresh fruit juice
Vegetables and legumes 2 medium (100g) potatoes ½-⅔ sweet potato (160g) 1 big mealie cob (200g) ⅔ Cup sweet corn 1 Cup of mashed potato (skim, low-fat milk) 12-16 low-fat oven-baked potato chips 2 Cups of peas, beetroot or mixed vegetables 2 Cups of carrots, butternut or pumpkin (no butter / sugar) ½ - ⅔ Cup of baked beans 1-½ Cup of cooked beans, lentils, split peas or chickpeas 1½-2 Cups of thick vegetable soup	**Low-fat snacks** 1 Jungle oats bar or Safari fruit bar 4 Cups of low-fat popcorn ½-⅔ Cup of low-fat or fat free rice crackers 1 small packet (35-40g) of low-fat pretzels 1 small raisin or hot-cross bun 2 small (size of doorknob) or 1 med. banana or bran muffin 4 small crumpets or flapjacks 2 medium (17cm diameter) pancakes 4 Marie biscuits or Boudoir biscuits 300 ml low-fat flavoured milk 250 ml low-fat drinking yoghurt 1 Cup of low-fat yoghurt (unsweetened)

Protein portion planner: each provide ~7g protein (choose low or no fat)

**30g = size of a matchbox*

- 1 large egg (boiled, poached, scrambled)
- 2 commercial slices of lean ham
- 4 slices of shaved lean ham or chicken
- 30g smoked chicken
- ½ x small chicken breast (without skin)
- 30g* meat (all fat removed) or lean mince
- 20g lean biltong
- ½ - ⅔ Cup cooked beans, lentils, split peas or chickpeas
- ½ Cup grilled calamari
- 30g low-fat yellow cheese
- 60g ricotta or low-fat cottage cheese

Fat portions: each providing 5 g of fat

- 1 level teaspoon (tsp) margarine or butter
- 1 ½ tsp low-fat/lite margarine
- 2 tsp extra lite margarine or peanut butter
- 1 tablespoon (Tbsp.) low-fat cream cheese
- 1 Tbsp reduced fat mayonnaise
- 1 tsp oil (any type)
- ¼ medium avo
- 1 rasher of bacon

Timing of intake - Pre-, during and post-exercise / competition:

Pre-exercise meal / snack / beverage suggestions (providing ~100g CHO)

Endurance-type exercise (~100g CHO + 8-10g protein)

4 slices brown or white bread/toast with thin margarine or peanut butter (optional)
+ 2 heaped Tbsp jam, honey or syrup
+ 1 Cup of coffee/tea with low-fat milk and 1-2 tsp sugar
or
2 slices of brown or white bread/toast with a thin scraping of margarine
+ 1 heaped Tbsp jam, honey or syrup
+ 1 medium banana
+ 1 Cup of CHO energy drink (e.g. *Energade, *Powerade, *Game)
or
1 Cup cooked porridge (e.g. oats, 'Mieliepap') with 1-2 tsp sugar
+ 2 slices of brown or white bread/toast with a thin scraping of margarine
+ 1 heaped Tbsp jam, honey or syrup
+ ½ Cup of fruit juice diluted with water

Strength exercise (~100g CHO + 15-20g pure protein)

2 Cups cooked porridge or cereal (e.g. Corn Flakes) with 1-2 tsp sugar
+ 1 Cup of low-fat/fat free milk
+ 1 Cup of fruit juice
or
1-1½ Cup of ProNutro or low-fat muesli with 1-2 tsp sugar
+ 1 Cup of low-fat/fat free milk or low-fat/fat free yoghurt
+ 1 medium banana
+ 1 Cup of coffee/tea with low-fat milk and 1-2 tsp sugar
or
4 slices of brown or white bread/toast +thin margarine or peanut butter
+ 1 heaped Tbsp jam, honey or syrup
+ 1 scrambled egg
+ 1 Cup of fruit juice

During-exercise meal / snack / beverage suggestions (providing ~30g CHO each)

- 350-500 ml of 6-8% CHO energy drink (e.g. *Energade, *Powerade, *Game)
- 300 ml Coke
- 1 *Jungle Oats Energy Bar
- 6 Jelly Babies/Super C's
- 8 Super C's or Liquorice All Sorts
- 5 mini nougats
- 3 bite size bar ones
- 3 baby potatoes
- 1 sandwich (2 slices bread)
- 2 medium bananas

Post-exercise meal / snack / beverage suggestions (each option providing ~50g CHO + ~20 g Protein)

- 250ml *Nestle Nutren Activ (with low-fat or fat free milk) + 1 Cup of fruit juice or energy drink
- 1 Cup of cooked porridge or breakfast cereal with 1 tsp sugar and a few nuts
  + 1 Cup of low-fat/fat free milk
  + 1 Cup of fruit juice
- 500ml CHO Energy drink + 50g lean biltong
- 350ml low-fat drinking yoghurt + 1 Cup of fruit juice or energy drink
- 2 slices of bread with a slice of lean ham and cheese + 175ml Yoghurt + 1 medium banana
- 2 slices of toast with a scrambled egg + 175ml Yoghurt + 1 Cup of fruit juice

(* Lower-risk supplement)

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