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THE DO'S AND DONT'S OF
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DO'S AND DON'TS OF SUPPLEMENTS IN RUGBY

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Although there are thousands of supplements available, there are only a few that offer either practical or physiological benefits to rugby players. Before these can be used safely and effectively there are several factors which have to be considered. The first challenge is to identify the product(s) that may offer these advantages, as there is often a big gap between the suggested claims and product features compared to the proven benefits, dosages and applications. The second challenge is to understand players' specific needs and their individual responses, as this varies from player to player. The third challenge is to understand why players believe supplements will assist their specific needs. A fourth challenge is the concern about quality, safety and purity of the supplements.

In 1994, the Dietary Supplement Health and Education Act (DSHEA) essentially gave "free licence" to anyone to market and sell a variety of products as supplements. As a result there has been an exponential growth in the local dietary supplement industry, which contributes to sales estimated to be in excess of \$270 billion worldwide to the global economy⁽⁵⁶⁾. In 2007, an average total sales of R78.5 million was reported in South Africa⁽²⁴⁾. Simultaneously there has also been a global increase in the contamination of dietary supplements with "banned substances" such as testosterone, benzodiazepines, powerful diuretics and potent stimulants^(1, 31, 36).

Unlike drugs, supplements are not required to prove their efficacy before being marketed or sold and the industry, both internationally and locally, is poorly regulated. The intention of Good Manufacturing Practice (GMP) regulations which supplement companies may claim to adhere to, are in fact very general and open-ended and allow each manufacturer the flexibility to decide on how to implement controls. Although GMP standards may provide some assurance with regard to documentation of manufacturing processes, they do not guarantee that the product has been tested for banned substances.

In practice, this means there is only limited control on the production, labelling, importation, distribution, and marketing of supplements and there is also no system to ensure products are safe and effective before they are sold. There have been numerous cases of supplements either being incorrectly labelled, or containing negligible amounts of declared ingredients and may even contain undeclared ingredients with potential harmful side-effects. There have also been several cases of athletes testing positive by virtue of having taken supplements and, unfortunately, this has undermined the image of the whole industry^(12, 15, 16, 32).

WHAT IS A SUPPLEMENT?

The DSHEA defines a dietary supplement as “a product, other than tobacco, which is used in conjunction with a healthy diet and contains one or more of the following dietary ingredients: a vitamin, mineral, herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total daily intake, or a concentrate, metabolite, constituent, extract, or combinations of these ingredients and dietary supplements are products that are labelled as a dietary supplement and is not represented for use as a conventional food or as a sole item of a meal or the diet”⁽¹⁰⁾.

Typically, dietary supplements are available in the form of tablets, capsules, soft gels, liquids, powders and bars and may include vitamins, minerals, herbals, protein and carbohydrate powders, fat-cutting remedies, sports bars and drinks or powders, to more specialised products such as amino acids, creatine, HMB (beta-hydroxy-beta-methylbutyrate) and glutamine, either on their own or in combination with other ingredients.

SARU

SARU recognizes that the only way rugby players will be risk-free is to AVOID using supplements completely. This been said SARU also recognizes that some supplements do have proven performance enhancing and/or practical benefits, but since the industry is currently so poorly regulated it does not necessarily protect the player. However, players are always looking for a competitive advantage, and supplements allure to meet this need. Industry uses this desire to perform better when marketing and advertising their products often making false claims with regard to the potential performance benefits.

As a result of this SARU has made a commitment to help guide players on making informed choices through ongoing education and other initiatives.

This document provides a scientific, evidence-based and practical approach to supplementation and outlines all the criteria that rugby players need to consider when choosing a supplement. These guidelines will minimize the risk but players are always reminded about the **strict liability clause** which means that all supplements are still taken at their own risk. SARU cannot be held responsible for players testing positive as a result of using contaminated supplements.

To support this initiative, SARU is also planning to implement and manage a supplement approval programme, with a listing of specific products that have undergone rigorous research and comply with standards and regulations. Similar programmes have been successful internationally and are seen to be the only way forward.

THE CASE FOR AND AGAINST SUPPLEMENTS

Rugby players generally take supplements to achieve specific goals such as increased strength, improved endurance and overcoming injury, as well as avoiding sickness. There is however supporting evidence for only a limited number of supplements that have any potential benefit for sport, including rugby. These benefits may be physiological, practical and even psychological but it remains important to carefully weigh up the cost of the benefits against the risks (refer to Figure 1).

Supplements should not be used where nutrient needs can be met by normal foods and they cannot compensate for poor dietary choices ⁽³²⁾. Good food choices, on the other hand, do not compensate for an absence of talent, motivation, or a lack of training, but will help players maximise their potential.

A good training programme can be optimised with a varied and well-planned diet that provides the correct amounts and timing of food intake, to meet energy and nutrient demands.

Used on a 'just-in-case' basis or inappropriately, supplements are likely to do more harm than good. For example, antioxidant supplements taken at high doses can become pro-oxidative and taking single doses of too much zinc can decrease HDL-cholesterol levels as well as the absorption of other important nutrients like iron and copper ⁽³⁷⁾. Besides short- and long-term harm to health, there may also be negative effects on performance and the possibility of a player testing positive when taking a substance which may have been inadvertently or deliberately contaminated with banned substances.

Supplements can do more harm than good if used inappropriately.

TESTING POSITIVE - HOW BIG IS THE RISK?

Since 2000, several well-conducted international studies have shown that up to 25% of nutritional supplements, including those from companies that do not sell steroids or pro-hormones, may contain undeclared steroids or pro-hormones and stimulants which are banned by the World Anti-Doping Agency (WADA, www.wada-ama.org) ^(22, 31). There have also been cases of contaminated vitamins, multivitamins and minerals ^(31, 35). Further research has identified many potential opportunities for contamination in the manufacturing process, including the source of the raw material, machinery (polishers, capsulating machines), as well as packaging plants ⁽²²⁾.

Locally available supplements have also been shown to be risky - 30 different nutritional supplements bought from various shops in Bloemfontein and analysed for testosterone and nandrolone pro-hormones, various ephedrines and caffeine showed that 40% of these contained pro-hormones and/or stimulants of which in 7% of the products tested, these substances were not listed on the label ⁽⁴⁹⁾.

It is also important to note that trace amounts of a contaminant (e.g. 0.00005% 19-norandrostenedione ⁽⁵¹⁾) can result in a positive test. Steroid metabolism may vary between individuals but some individuals may still test positive a few days after having consumed trace amounts of a steroid ⁽⁴⁹⁾.

The consequence of testing positive is a huge price to pay (i.e. banned from playing) especially when these small amounts are unlikely to have any beneficial impact on the player's performance.

WHAT ARE THE LIMITS OF DETECTION?

Anti-doping testing uses **parts per billion** i.e. nanograms per gram (ng/g) or nanograms per millilitre (ng/ml) for trace analysis whereas the food and pharmaceutical manufacturing industry generally only uses parts per million i.e. 1000 times less sensitive in the routine detection of contaminants such as lead, faeces, aflatoxins, mycotoxins, salmonella and even glass ⁽²²⁾. Testing of banned substances is thus highly specialised and there are relatively few laboratories around the world capable of testing according to these standards (ISO 170125 as in a WADA-accredited laboratory).

Each test needs to be specific with regards to the matrix (powder, bar, gel, liquid or capsule), with a relevant detection limit. Remember the contamination may be pill-specific and whatever is tested may not be representative of the sample. Liquids are likely to be more accurate.

RECOMMENDATIONS

There is no way for rugby players to know with 100% assurance what is in a supplement. Some manufacturers do have better quality controls and may to some extent be committed to having their products tested for banned substances. However, in many instances loopholes exist in the system (e.g. when only one specific flavour in a range has been tested, yet in the advertising this is not made clear; or the laboratory testing the products is not ISO 171025 accredited). Players still however need to question if using the supplement is necessary, and/or does the supplement have performance-enhancing benefits.

A systematic, safe and science-based approach to the use of supplements is therefore recommended (Figure 1).

Players need to **get the basics right first** (i.e. periodised diet and training) as this is where the biggest potential for performance enhancement lies, and **then only** to consider supplements if:

- there are gaps in the diet that cannot be resolved with food and drink
- there is a clinical or medical reason
- the player has optimised the basic diet and training and is still needing a competitive edge

Only supplements that fulfill **all four** of the following criteria should then be considered:

1. they are effective in offering practical and or physiological benefits, e.g. sports bars and gels are portable for travelling; caffeine may offer some players a small but significant advantage - see notes on caffeine;
2. they are legal (as many as 1 in 4 supplements may result in a positive test because of contamination with steroids, stimulants and other drugs). Quality assurance required for supplements is far more complex than a GMP statement from the manufacturer;
3. they do not adversely affect health, and
4. they are prescribed on a case-by-case basis by a registered dietitian with sports nutrition experience or a sports physician only once it has been determined that the habitual diet is unable to meet these additional nutrient requirements.

Supplements are generally not recommended for younger players (< 18 years) and should only be considered if medically indicated and monitored.

FIGURE 1: Supplement decision process and watch points.

Narrow down the choices to maximise the benefits and minimise the risks.

SUPPLEMENTS?

- ✓ Cross-check diet
- ✓ Is there a food/fluid solution?
- ✓ Supplements will not correct a bad diet
- ✓ Weigh up the cost of the benefits versus the risks



DO THEY WORK?

- ✓ What evidence is provided?
- ✓ Is the science valid and relevant? Is it a laboratory- or field-based study?
- ✓ Does the amount and form of the active ingredient claimed to be present in the supplement match that used in the study?
- ✓ Who are the subjects – athletes, rugby players or sedentary subjects?
- ✓ Is it a well-designed study with statistically significant results?
- ✓ If the study shows an effect, has the supplement been tested for contamination?
- ✓ Have the results been replicated?



ARE THERE ANY HARMFUL SIDE-EFFECTS?

- ✓ Is the product safe and will it compromise the health of an individual?
- ✓ Sport supplements are not any safer than vitamins and minerals.
- ✓ Supplements marketed as 'natural' are not necessarily healthy or less risky
- ✓ Herbals may have side effects.



ARE THEY LEGAL?

- ✓ Is the product illegal or banned?
- ✓ Does the manufacturer provide quality control (GMP) and certification programme details – is this batch-specific?
- ✓ What is the policy on sourcing raw materials to final product?
- ✓ Independent secure back-up batch for re-analysis
- ✓ Independent and not self-regulated
- ✓ Although some brands may be part of an international testing programme where they have been tested in a WADA ISO17025 accredited laboratory, certification is batch- and product-specific and does not mean that the entire range has been tested to this level and is safe to use.
- ✓ Muscle-gainers, fat-burners and herbal supplements are especially high risk from a drug-testing point of view.



HAVE YOU CONSULTED A REGISTERED DIETITIAN OR SPORTS PHYSICIAN?

- √ Supplements should only be prescribed on a case-by-case basis by a registered dietitian with sports nutrition experience or by a sports physician.

THREE (3) ESSENTIAL SUPPLEMENT RULES:

1. FOOD FIRST

Even when supplements are needed, this is only a short-term solution while dietary changes are being implemented.

2. IF THERE IS NO DIETARY SOLUTION

Limit the use as the more you take, the bigger the risk!

3. AVOID HAPHAZARD SUPPLEMENT USE OR SUPPLEMENT STACKING

Always follow the supplement decision process. (Figure 1)

WHAT ARE YOU LIKELY TO SCORE FROM TAKING SUPPLEMENTS?

There is currently supporting evidence for only a limited number of supplements that have any potential benefit for rugby. These are outlined in alphabetical order below. Other supplements that have potential benefits in other sports will not be discussed.

Buffers

Sodium bicarbonate and sodium citrate may be effective ergogenic aids as blood buffers. Buffers play a role in acid-base balance and the prevention of fatigue but cause unpleasant side-effects such as diarrhoea^(29, 33). There is a reasonable theory with some preliminary evidence to support the use of beta-alanine (an amino acid usually found in “white meat” like chicken breast and fish) supplements which increases the intracellular buffer, muscle carnosine^(23,25). Studies have shown benefits with taking split doses of ~ 65mg/kg for 4-10 weeks, but until there is certainty about optimal doses for different situations (e.g. age, training status, diet - vegetarians may need more and the effect of combining intake with other nutrients like carbohydrate and creatine) and long-term safety, it is still too soon to make any definite recommendations^(6, 26, 42, 44).

Caffeine

Caffeine at a dose of 2-6mg/kg body weight taken one hour before exercise has been shown to enhance performance in several sporting activities, including rugby^(4, 21, 42). Note that a dose of 2-3 mg/kg body weight is well within the normal intake of the general population. Caffeine is found in a variety of foods and beverages – 1 cup coffee contains 60 – 100 mg; 340 ml can Coca Cola contains 49 mg; a can of Red Bull 80 mg; 1 cup tea 27 mg and 1 chocolate bar has up to 50 mg caffeine. The response to caffeine and its effects on performance varies from person to person and may also be dependent on the form (chewing gum, tablets and powder is more effective than coffee) and habitual intake^(19, 28). At high doses (> 6-9 mg/kg) caffeine can cause nausea, diarrhoea, trembling, headaches, insomnia, visual disturbances, anxiety and nervousness – and so may impair performance^(21, 42). There are several mechanisms by which caffeine seems to improve performance. The primary effect is that it alters perception of fatigue^(9, 14), but it also increases alertness, improves reaction time and may increase fat metabolism, thus sparing glycogen^(13, 38, 42).

Players should therefore experiment in training, starting off with lower doses. They need to be aware of all caffeine-containing foods and beverages as well as herbal sources of caffeine (coffee, tea, soft drinks, energy drinks, chocolate, cocoa, guarana, kola nut, metaine and supplements) and should take extra fluid to compensate for the diuretic effect of caffeine, when using tablets or powders. Habitual caffeine drinkers should not suddenly withdraw their intake before a competition.

Carbohydrate supplements

Carbohydrate has two important features - it is the most proven ergogenic aid and it is a macro-nutrient found in many foods such as cereals, grains, legumes, fruit, starchy vegetables, many dairy products and sugar-rich foods. Carbohydrate has profound effects on sports performance and is unique in that it has benefits before, during and after exercise. It is a primary source of fuel; when taken during exercise it delays depletion of carbohydrate stores and the onset of fatigue and taken after exercise promotes recovery and replenishes muscle glycogen stores. High-carbohydrate diets also support the immune system by lowering stress hormone levels⁽¹⁸⁾. Carbohydrate taken in combination with water (i.e. a sports drink) has an even greater performance enhancing benefit in comparison to water or carbohydrate taken alone⁽⁶⁾.

Total body carbohydrate stores are limited and it is therefore important to consume carbohydrate at every meal and snack. However, the ingested amounts of carbohydrate need to be adjusted in accordance with training demands to avoid unnecessary weight gain. Players should always give preference to nutrient-dense carbohydrate food choices, only using supplements to boost intake.

There are many situations when it may be challenging for players to achieve the required carbohydrate intake via food alone. Carbohydrate supplements (drinks, gels, powders, glucose polymers, low-fat sports bars) are a convenient option when training loads are high, there are demanding match schedules, when travelling and/or if players lack appetite. Many of these supplements can be manipulated to suit individual players' needs and taste preferences. For example, glucose polymer powders can be used to add carbohydrate without affecting the taste; sports drinks may offer additional taste and flavour and sports bars are portable.

The ideal sports drink should contain 4-8% carbohydrate (and electrolytes), carbohydrate-rich bars should provide between 40-50g carbohydrate (with minimal fat and fibre) and gels, 25 g carbohydrate/sachet.

Note, these products may contain caffeine and/or other compounds that may not be safe or legal and some may cause gastro-intestinal problems (e.g. products containing Medium Chain Triglycerides – MCTs). Players should give preference to straightforward, uncomplicated options that taste good.

Chondroitin – see Glucosamine and Chondroitin

Creatine

There are still many unanswered questions about the exact mechanisms and long-term safety and side-effects of creatine^(39,47). Creatine increases lean muscle mass and strength, provides fuel, especially during intense exercise, buffers hydrogen ions (H⁺), aids recovery and enhances training adaptations. Studies also show that only 70% of creatine users will derive any benefits.

To rapid-load, the current guidelines recommend a total of 20-25 g creatine (approx 0.3 g/kg/day) divided into 4 doses for 3-5 days to be taken with 50 – 100 g high Glycemic Index (GI) carbohydrate, followed by a 2-5 g/day maintenance regime. To prevent rapid weight gain, slow loading with a dose of 2-5 g/day (approx 0.03g/kg/day) for 28 days with 50 – 100 g high GI carbohydrate and adequate fluid post-exercise is recommended. During the supplementation period, it may be advisable for players to take a 4-week break from using creatine every 4-6 weeks⁽³²⁾.

There is no evidence to support the different forms of creatine used⁽³⁰⁾. Moreover, it is premature to make recommendations on creatine in combination with beta-alanine.

Creatine should be avoided in players with renal impairment, elevated blood pressure levels, thermal stress and if taking non-steroidal anti-inflammatory medications. There have been anecdotal reports of nausea, gastric upset, headaches, muscle cramps and strains. The use of creatine supplements should be limited to players over the age of 18 or in well-developed players as there is no data documenting the safety of creatine in children and adolescents.

Glucosamine and Chondroitin

Many supplements are promoted as being good for joint health, including glucosamine and chondroitin, which have been reported in some studies to slow cartilage degeneration and reduce the degree of joint pain in active individuals. However, there is no evidence to support the view that these supplements will be preventative.

Melatonin

Melatonin (3-5 mg daily for 5 days) may be used in combination with other strategies to reduce the symptoms of jet-lag and travel fatigue. Although this can be purchased over the counter, it should only be used if prescribed by the team doctor and should not be used in combination with sleeping pills or warfarin or by players with a history of migraine or epilepsy. Melatonin may cause headaches and dizziness.

Omega-3 Fatty Acids

Omega-3 fatty acids supplements include alpha-linolenic (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), with the latter two being the preferred options as they are better absorbed. Although relatively few studies have examined omega-3 intake and the modulation of exercise-induced inflammation, there is some research that suggests that omega-3 intake may decrease inflammatory markers ⁽⁴¹⁾, being a potentially beneficial treatment intervention for athletes with exercise-induced broncho-constriction ⁽³⁴⁾ or with rheumatoid arthritis ⁽⁷⁾. Although there is no specific dose that can be prescribed to athletes based on the current body of literature, players who do not consume fatty fish twice a week, or foods fortified with significant amounts of omega-3, may need to consider supplements at levels recommended for heart health.

Probiotics

Probiotics are specific live micro-organisms in food or supplements that survive the passage through the gut. They improve microbial balance in the large bowel, are used to manage symptoms associated with lactose intolerance and other food allergies, and are also thought to have immune benefits. Probiotics are found in milk, yoghurt and other dairy products and are also marketed as capsules and tablets, as well as powders with varying combinations and concentrations. There are many different species, but lactobacillus acidophilis and bifidobacterium bifidum are the two main probiotics used commercially.

The effects are strain-specific and more information on the dose and duration of treatment for these various strains is needed before making specific recommendations. Indications for use include travel, as a preventative measure for traveller's diarrhea and when using antibiotics.

Protein and Amino Acids

Rugby players have higher protein requirements (in the range of 2-3g/kg body weight, depending on factors such as phase and level of training) than the recommended daily allowance (RDA) for the general population (0.8g/kg body weight). With a well-planned diet the increased protein requirements can be achieved and there may be no further advantage to using protein or amino acid supplements ^(37,46).

To optimise the benefits that protein offers, rugby players need to focus on the *quantity* of protein as well as the *quality* of protein and *timing* of intake. They also need to ensure adequate carbohydrate intake, the latter always being present in the greater percentage.

Protein is essential for growth and development, to build and maintain muscle, repair muscle damage and together with carbohydrate aids recovery and may decrease muscle soreness^(11, 45, 54). Many of these benefits, specifically the increase in protein synthesis and the reduction in the rate of protein degradation, have been linked to leucine, one of the branched-chain-amino-acids (BCAA's)^(2,5, 40).

Protein supplements help rugby players achieve their desired protein intake goals without an unacceptable increase in fat intake. Protein also offers a practical solution when appetite may be limited in the recovery period. By adding small amounts of protein to carbohydrate in the recovery period, players can consume smaller volumes of food, while still achieving their recovery goals.

Depending on the situation, there are different types of protein supplements with specific characteristics that may be beneficial:

- Whey protein is more rapidly digested than soy protein and contains virtually no lactose. Whey isolates, concentrates and hydrolysates are a more concentrated source of essential amino acids, including leucine, which together are needed to manufacture new muscle. Whey protein may also be added to products like higher-protein sports bars and drinks.
- Casein hydrolysate, like whey protein, is also rapidly absorbed and provides all the essential amino acids. There are casein hydrolysate products that can be easily mixed into different fluids and sports drinks and are relatively low in bitterness and are suitable for individuals allergic and/or intolerant to dairy products.
- Milk-based protein shakes, meal replacements and milkshakes. Many of these ready-to-drink products are fortified with vitamins and minerals and differ in the amount of carbohydrate, protein, and or fat they contain. Players need to use their discretion if products contain additional ingredients such as herbals as they are often marketed to promote weight-gain, enhance weight-loss, and to improve performance. Depending on individual product features, these convenient meal-replacements and shakes can offer players a concentrated and nutrient-dense snack and players can also use them to help control energy (kilojoule) intake when trying to gain or lose weight. There is some evidence to suggest that higher-calcium dairy-based diets may have a positive role on weight/fat loss, but the exact mechanisms are unknown⁽⁵⁵⁾.
- Soy-based meal replacements and bars may be useful for players allergic or intolerant to dairy produce.

When protein is consumed at very high intakes, compromising carbohydrate requirements, performance will be negatively impacted. There is also the potential for unwanted weight gain. Individual amino acids are not recommended as they can be toxic and the acute benefits that have been shown in limited studies are small and short-lived⁽³²⁾.

Vitamins and Minerals

The use of vitamin and mineral supplements will not improve performance in players whose diets are nutritionally adequate^(30,51). However, in situations where dietary intakes may be sub-optimal (for example if energy intake and food choices are restricted to help reduce body fat or to prevent weight gain or if players have limited food choices when travelling), a broad-spectrum, low-dose multi-vitamin and mineral supplement may help ensure that essential nutrient needs are met.

Single nutrient supplements (e.g. iron) can do more harm than good, if use is random and uncontrolled, and should therefore only be prescribed by a sports physician or dietitian. As a general rule, vitamin and mineral supplements should only be used when a deficiency has been confirmed, which may include blood analysis, and then only as a short-term solution while dietary changes are being implemented

⁽³²⁾.

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