RED MEAT IN NUTRITION AND HEALTH

Supplementary Chapter:
Red Meat and Sport

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Communicating current science about red meat as part of healthy diets for sportsmen and women

While we await more scientific evidence and consensus on the increasingly popular low carbohydrate, high fat diets, we continue to educate and disseminate a balanced approach to nutrition. As agreed by dietitians globally, a varied, balanced diet including a diversity of whole foods is recommended as part of a healthy, active lifestyle.

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Nutrition has been identified as the single factor that *may have more to offer the athlete than any other*.[1] Unfortunately, athletes often turn to supplements to improve performance, rather than to make use of a balanced, tailored diet consisting of natural foods to help them succeed. This chapter presents the role of whole foods (including red meat) and the matrix of nutrients they provide in the optimisation of sports performance and health. This chapter is not solely aimed at top athletes, but will also provide helpful insights for the countless young sportsmen and women who compete at school and university level, as well as individuals who use sport as a means of relaxation or for its health-promoting properties.

1 THE ROLE OF A BALANCED, TAILORED DIET

The connection between the food we eat and our physique, health and physical performance is undeniable. Although the relationship is complicated (and often downright confusing, given the constant stream of new scientific studies and media coverage of food and nutrition), you can be sure of one thing: whole foods have been around since the beginning of time, nourishing the diverse and variable physical and mental requirements of the human body.

The human diet over time – the role of whole foods for body and brain

Scientific interest in the evolution of human nutritional requirements has a long history, from gathering raw fruits, vegetables, nuts, tubers and roots, to evolving into hunters discovering and consuming animal source foods. Whole, nutritious foods such as red meat, fish, eggs, fruit and vegetables, dairy products, whole grains and healthy fats, have played an important role in the development of the human species.

Across all primate species, those with bigger brains eat richer foods. Humans are the extreme example of this correlation, boasting the largest relative brain size and the choicest diet. In general, primate diet quality (i.e. energy and nutrient density obtained through food) is inversely related to body size and total resting metabolic requirements (RMR). Humans, however, consume a diet of much higher quality than is expected for our size and metabolic needs. This energy-rich diet appears to reflect an adaptation to the high metabolic cost of our large brain.[14]

1.1 WHOLE FOODS VS SUPPLEMENTS

Athletes of all ages and levels of competence are constantly being enticed by dietary products or so-called "neutraceuticals, functional foods, ergogenic aids, food supplements, performance boosting supplements, speciality foods, potions, pills and powders..." that promise "prolonged endurance, faster recovery, increase in muscle mass and strength, loss of body fat and resistance

"Of primary concern is the health of the athlete. Performance issues are secondary and performance will only be helped if optimum health is maintained. The ergogenic effects of many supplements are controversial and good evidence for efficacy is rare"

~ Budgett, 2009,

Olympic Medical Institute, London

to fatigue, illness or infection".[1, 2] The sports supplement market is worth billions of dollars[4] and with aggressive marketing, expert testimonials and relentless advertising plus the urging of greedy coaches and gullible parents, athletes, especially adolescent sports stars, are constantly under attack to use 'Supplement X' or 'Product Y' to achieve what is usually a collective dream. ***It is probable that besides slimming, no other aspect of modern life is quite so plagued by the current version of 'snake oil salesmen products' than the sports supplement market.*** Walk through any supermarket or large chemist shop or gym and you will be overwhelmed by the number and variety of these products and the persuasive arguments of the eager, convincing sales staff.

The subject of supplements is however of crucial importance and there is a vital need for reliable, balanced and unbiased information for athletes and their support staff. Position statements on supplements have been published over the past 20 years by the International Olympic Committee (IOC), the British Olympic Association, UK Sport and others.[1]

In 2009 this situation had reached such ridiculous proportions that the British Journal of Sports Medicine published an extensive review entitled: "BJSM reviews: A-Z of supplements: dietary supplements, sports nutrition foods and ergogenic aids for health and performance". This list of supplements was so large that it had to be published in 48 parts from 2009 to 2013. The aim of the review was to inform professionals, athletes and their trainers about the efficacy, safety and risks associated with the use of these products. The review was published under the editorship of Louise Burke and Lindy Castell, leading authorities in the field of sports nutrition at the Australian Institute of Sport, Canberra and Green Templeton College, University of Oxford, UK, respectively.[2, 3] The 48 review papers make fascinating reading, but at the end of the day the conclusion of this series is that dietary supplements are poorly regulated in most parts of the world from the UK to the USA to South Africa. Consumers have no way of knowing what the supplements actually contain or how pure they are or how contaminated they may be with substances that can make the athletes ill or ruin their careers because of doping charges.

Watch this space: Dietary supplements database

The George Institute for Global Health is undertaking a collaborative project with the Food and Agriculture Organization to create a publicly available branded dietary supplement database. They have completed the pilot phase for the project which involved dietary supplement data for Australia and South Africa. However, this database only captures information which is reported on the supplement label (www.georgeinstitute.org.au).

1.1.1 Why sports supplements are so appealing

Supplements are consumed by athletes *inter alia* for the following reasons:

- *To prevent or treat a perceived nutritional deficiency*. Athletes who starve themselves or eat unbalanced diets may well suffer from deficiencies.
- *To have the benefit of a more convenient nutrient intake.* This approach is gaining popularity in the modern world where it is perceived as so much easier and less time consuming to

pop a pill than to buy, prepare and eat 'real' food. In the case of athletes, their desire to have convenient access to nutrients such as carbohydrates or proteins during and around practice sessions and events that last for longer than a few hours, is probably more justified than the dietary aberrations of our modern youth.

- *To achieve a direct ergogenic advantage and to enhance their performance*. They do not care if this endangers their health and might be life threatening. Athletes are known to be prepared to sacrifice all to win.
- *To fit in with their peers*. If it becomes known that other top athletes are using a root that grows in the Kgalagadi desert to increase their performance edge then every other athlete will want this product so as not to be left behind.[2]

1.1.2 What to take into account when considering the use of supplements

The cautionary and sensible approach that sports experts suggest for each athlete (and his or her team, parents, coaches, trainers, teachers, etc.) is to consider the issues of ***efficacy, safety and legality/ ethics*** when contemplating the use of sports supplements.[2] ***Advice: Beware of false claims or pseudoscience used in marketing material and on product labels.***

- **Efficacy:** Because of a lack of scientific studies, the efficacy of the majority of sports products has not been tested and no sports nutritionist who is responsible for the welfare of his or her sports star or team can ethically recommend the use of it.. According to Burke and Deakin (2002), the only three sports supplements that have proven efficacy are *creatine, caffeine* and *bicarbonate*. ***Advice: Red meat can be consumed as a natural source of creatine without having to resort to using sports supplements. Unfortunately, using whole food as a source of specific nutrients is a message that is seldom communicated to athletes.***
- **Safety:** Safety is often an issue because sportsmen and women, like most members of the public, are susceptible to the idea that "if a little is good, more is better".[2] Consequently, there have been fatalities due to overdoses of certain ergogenic aids. In the absence of good quality research, using untested products in physiological stressful situations such as sports events, is usually a dangerous undertaking.
- **Legality/ethics:** The purity of many illegal or unethical products which may be manufactured in less than ideal conditions without stringent hygiene and safety protocols, is also often lacking. Besides the danger of falling ill, athletes are always exposed to the risk of ingesting a banned substance which may inadvertently have contaminated a sport supplement manufactured under less than ideal conditions. Athletes also need to be aware of using products that can lead them to being banned from competing because of a doping contravention. Athletes and all who are involved with their safety, need to keep in mind that "very low levels of contamination (measured in parts per billion) can cause positive drug tests in an elite athlete at a level much lower than acceptable impurity levels (typically around 0,01%)". This concept of "Strict Liability" is indeed a sobering thought. [3]

Banned substances

The World Anti-Doping Code has published the 2014 Prohibited List for substances and methods prohibited in and out of competition. To view this International Standard, visit the World Anti-Doping Agency website at www.wada-ama.org.

Unfortunately, many supplements on the market may contain undeclared banned substances. In the concluding section of the BJSM reviews, the authors categorically state that a significant percentage (5-20%) of supplements contain prohibited substances, either by inadvertent contamination or deliberate adulteration during the production process.[2]

1.1.3 Protecting athletes against the risks associated with supplement use

To protect athletes against these risks of supplement use, the following steps that can be taken to avoid physical harm and being plunged into a doping scandal, are recommended:

- Athletes should not rely on the advice of their friends, peers, rivals, coaches or eager parents, but let themselves be evaluated by a qualified sports physician and/or sports dietitian/ nutritionist who is acquainted with sport and the anti-doping rules and regulations. In most cases such evaluations will reveal that the athlete does not need to use any supplements and that any nutrient deficiencies that may exist can be corrected by using standard foods such as red meat to provide haem iron, or dairy products to boost calcium intake.
- Products which make extravagant claims about enhancing performance, boosting muscle growth, burning fat, stimulating endurance, etc., should be avoided because they may well contain illegal substances even if these are not listed on the label.
- The fact that products are herbal or classified as 'natural and safe' in advertisements is no guarantee that they do not contain prohibited substances.
- Always make sure that the companies manufacturing and certifying any sports product are legitimate and not fly-by-nights.
- The World Anti-Doping Agency (WADA) never approves any product. Products that claim that they are "WADA approved" should be carefully evaluated.
- Products that contain multiple ingredients such as supposed ergogenic aids, plus vitamins and minerals, have a higher risk of contamination. Athletes with deficiencies can use vitamin and mineral supplements produced by reputable pharmaceutical companies but should never overdose on such products as an excess of certain nutrients can also be harmful.
- Ask your local branch of WADA for updates on contaminated and dangerous products in your country or region.

It is ironic that most dietary supplements contain similar quantities of nutrients to those that are available in standard foods. So rather than to run the risk of contamination, ill health and doping scandals, eat a balanced diet and consult a sports nutritionist or dietitian to fine-tune your diet to really enhance performance and recovery.[4]

A balanced diet should contain a variety of foods including fruits and vegetables, whole grains, red meat, chicken, fish, eggs, milk and dairy, and healthy fats. Training and building muscle tissue are processes that require a great deal of physical effort, a balanced sports diet tailored to your specific needs and genetic makeup, and time.

GENES + TRAINING + NUTRITION + TIME = OPTIMUM PERFORMANCE

Look out for these certification logos on sports supplements available on South African retailers' shelves:

The INFORMED-SPORT and INFORMED-CHOICE certification programmes have been established by an international sports anti-doping control laboratory, LGC in the United Kingdom, which tests products for banned substances.

INFORMED-SPORT is a certification programme which assures athletes that each batch of the products carrying the mark have been tested for substances considered prohibited in sport. Products bearing the INFORMED-CHOICE certification are tested randomly throughout the year. Products that have gone through either of these processes offer a high level of risk management.

2 NUTRIENTS FOR SPORT

2.1 ENERGY

The three main sources of energy are protein, carbohydrates and fat. Iron, an important micronutrient, is also involved with energy metabolism (together with some other essential nutrients). Energy is the fuel for all body processes, including physical activity. Energy is measured (or calculated) in kilojoules (kJ) or kilocalories (kcal). Although kilojoules are used in South Africa, package labels often use one of these two units, or both.

To convert kJ to kcal, divide by 4.2 (e.g. 1200 kJ/4.2 = 286 kcal)

To convert kcal to kJ, multiply by 4.2 (e.g. 200 kcal x 4.2 = 840 kJ)

2.1.1 Energy availability

Energy availability is a relatively new concept.[5] It is defined as the energy available to the human body after the energy used for physical activity has been deducted. It is thus the amount of energy which can be used for the body's daily needs, such as growth, repair and hormonal functions. When too little energy is consumed to meet the needs of an athlete for the amount of training he or she is doing, the ability of the athlete's body to undertake the processes required for optimum health and functioning will be compromised.

Energy availability = energy intake – energy cost of training/competition

Warning: Many health and performance problems commonly observed in athletes are associated with energy imbalance. ***These include menstrual disturbances, poor hormonal function, compromised immunity and impaired bone density.*** A qualified dietitian or sports nutritionist can assist with determining adequate energy intake, taking body composition and degree of training into consideration.[5]

2.2 PROTEIN

2.2.1 How much protein do athletes need?

To answer this question it is important to remember what the prime functions of proteins are in the human body. Firstly proteins need to supply the correct amount of amino acids, particularly those we are not able to synthesize in our own bodies, to build new body protein and to repair damaged body protein. Proteins can be used for fuel purposes if there is a deficiency of carbohydrates in the diet, but most nutrition experts regard the use of protein for energy purposes as wasteful and counterproductive, because protein that has to be utilised to generate energy is not available for synthesis of muscle and other tissues in the body, leading to loss of lean body mass which is something no athlete can afford.

Sports nutritionists recommend those athletes and other individuals who are very physically active, may benefit from protein intakes varying between 1.2 and 1.7 gram per kg per day. In other words ***a 50 kg female athlete would require 60 - 85 g of protein daily, and a 70 kg male athlete would need 84 - 119 g of protein per day***, which is considerably more than the 0.8 g/kg/day suggested for sedentary adults.[6,7]

The lower values of the suggested protein intakes are intended for endurance athletes who do moderate intensity endurance exercise. However if an athlete is starting on intensive resistance training (e.g. body building), then he or she may need up to 1.7 g of protein/kg per day. It is important to note that once the intensive period of training has been completed, even body builders no longer need such high levels of protein intake and can reduce their intake down to 1.2 g/kg/day once more.

These recommendations for an increased protein intake are based on the premise that athletes have an increased need for protein for the following reasons:[7]

- Repair and replacement of proteins damaged by mechanical disruption (e.g. runners who pass blood in the urine after a strenuous race).
- Provision of the building material for increases in lean muscle mass.
- Support of the 'remodelling' process which ensures that the proteins in muscles, bones, tendons and ligaments are strong enough to withstand the stresses and strains associated with strenuous exercise.
- Maintenance of the function of all the metabolic pathways that use amino acids.
- Ensuring that the immune system functions optimally to counteract the reduction in immune function caused by the stress of exercise.
- Maintenance of plasma proteins which support optimal physiological functions.

While these are the physiological reasons why an increased protein intake is desirable for athletes, most athletes use proteins to increase their muscle mass and strength and to speed up recovery after exercise.

2.2.2 What determines muscle protein synthesis?

- **Dosage:** A dose of 8 g of the essential amino acids, has been found to produce maximum muscle protein synthesis.[7] Other researchers have recommended slightly higher doses of up to 9 g of amino acids for optimal recovery.[6] Translated into food intake this represents eating 20 g of high-quality protein (refer to Table 2 for examples of food portions containing 20 g of protein).
- **Type of Protein:** A study which was conducted to determine which types of protein maximise muscle protein synthesis at rest and after exercise in untrained and trained subjects, showed that 20 g of high-quality standard food proteins (obtained from skim milk, beef steak, boiled eggs and a liquid meal supplement) produced excellent results, with liquid forms of protein achieving the highest amino acid concentrations twice as fast as solid protein-rich foods. Results obtained with proteins of plant origin such as soy milk were lower than those obtained with steak, eggs and a liquid meal replacement product.[8] ***(Note: Liquid meal supplement in this study referred to a mixture of 1:1:1 whey, caseinate, and soy protein)***

According to the research team, "the pattern of AA (amino acid) delivery into the plasma after ingestion of a protein-rich food is dependent on its AA composition and the rate of digestion." It is possible to divide protein sources into "fast" or "slow" proteins and these researchers intend developing a protein criterion similar to the glycaemic index or GI which will measure postprandial AA response of the proteins we ingest for the purpose of fine-tuning athletic diets.[8]

- **Timing of intake:** In addition to ingesting 20 g of high-quality protein, the timing of the protein intake in relation to exercise, can have a significant influence on how efficient protein synthesis in the body of the athlete will be.[6,7] Research has indicated that eating the above mentioned foods that will deliver a dose of 8 g of essential amino acids to the body as soon as possible after a training session, produces the most positive results. This method of protein intake will not only enhance muscle protein synthesis, but also increase the percentage of lean tissue in the body and assist muscle repair.

Excessive protein intake

Excess protein intake is not desirable, because the surplus protein and amino acids which the body cannot use will be oxidised and thus increase urea levels, which can lead to many undesirable side effects such as gout. Athletes and recreational sportsmen and women are urged to adhere to the quantities per kg body weight per day defined by expert sports nutritionists.[7]

High-quality protein from red meat

Young athletes have an increased requirement for high-quality protein and amino acids derived from natural sources like red meat to provide for their normal growth as well as the added demands of training. As an important source of protein of the highest quality, 70 g to 90 g lean red meat can on average provide 20 g of protein containing ***all 9 essential amino acids, namely lysine, threonine, histidine, methionine, phenylalanine, tryptophan, leucine, isoleucine and valine***, to the diet. These amino acids are classified as 'essential' because they cannot be synthesized in the human body, and must be obtained from the diet.[15] These amino acids are key contributors to muscle growth and assist in the repair of damaged muscle tissue, which are of primary importance to sportsmen and women.

2.2.3 How to optimise protein intake

- Ingest more protein than the NRV (Nutrient Reference Value), thus 1.2 - 1.7 g of protein per kg per day spread throughout the day (i.e. at 3 meals and 2 snacks.)
- Concentrate on proteins derived from animal sources such as red meat, dairy products and eggs.
- Ensure an intake of high-quality protein which contains all 9 of the essential amino acids.
- Make sure to also consume 20 g of high-quality protein as soon as possible after exercise.
- Your carbohydrate intake must be adequate and contribute at least 50-60% of your energy, so that you don't need to use protein for fuel. This is particularly important for strength and power athletes, who tend to believe that only endurance athletes need carbohydrate. This is not the case and such athletes must also ensure that their carbohydrate intake is sufficient to compensate for fuel use during training sessions. It is important to keep in mind that adequate glycogen stores are 'protein sparing', making the protein available for muscle growth and repair.

Table 2: Cooked food portions that will provide 20 g protein[16]

Portions marked with an * provide all 9 essential amino acids

70 g to 90 g lean beef, lamb, pork or turkey*
70 g to 90 g chicken white meat, without skin*
80 g to 110 g chicken dark meat, without skin*
75 g to 110 g liver (beef, lamb or chicken)*
75 g to 110 g meatballs made with egg*
30 g biltong*
90 g beef tongue*
80 g drained, canned tuna*
100 g steamed hake or salmon*
110 g canned pilchards in tomato sauce*
150 g eggs* (3 large eggs)
190 g low-fat cottage cheese*
450 ml low-fat plain yoghurt*
3 to 4 glasses of skim or low-fat milk*
120 g cooked soybeans
220 g chickpeas, lentils or kidney beans
3 cups of cooked rice or pasta

2.2.4 Timing of protein meals

Timing of meals can have important effects on sport performance and endurance. In general sports nutritionists recommend the following:

a) **The Pre-Exercise Meal:** The pre-exercise meal about 1 to 4 hours before exercise should be high in carbohydrates with a moderate protein content, for example pasta with a moderate portion of lean mince. Athletes should determine which foods they tolerate best before exercise during trial runs and not on the day of competition.

b) **Protein intake after training:** To be able to refuel, rehydrate and repair damaged muscle tissue, athletes need to combine 20 g of high-quality protein with their carbohydrate intake as soon as possible after exercise. Lean red meat is a good choice to provide the essential amino acids required by athletes to repair damaged tissues. By combining the protein with carbohydrates, the release of the hormone insulin will be stimulated which will in turn stimulate the athlete's muscles to take up amino acids, and therefore to be able to build muscle.[4]

   As Beelen and coworkers (2010) have pointed out, "*The combined ingestion of carbohydrate and protein (amino acids) in the post-exercise phase can further stimulate net protein balance. Besides providing amino acids as precursors for protein synthesis, combined ingestion of carbohydrates and protein (amino acids) can elicit a strong insulinotropic response.*" This insulin response may not only stimulate protein production, but even prevent protein breakdown.[6]

c) **Protein before sleep:** A relatively new approach to boosting muscle protein synthesis rates has been suggested by van Loon (2013)[9], who recommends ingestion of dietary protein just before sleep to increase the adaptive response of muscles to training and to further improve training efficiency. This author points out that top athletes need more than their acute stage post-exercise protein intake to maximise overnight muscle conditioning. The finding that muscle protein synthesis is low during the night, has promoted research into delivering additional protein or amino acids to serious athletes by intake of liquid protein such as a milk drink prior to sleep.

Examples of snacks that can be used for 'Recovery' after strenuous exercise (that contain carbohydrates and protein)

- Sandwiches with lean meat, cheese, fish or peanut butter fillings
- Yoghurt or milk with muesli or other breakfast cereals
- Fruit and milk/yoghurt smoothies
- Flavoured milk drinks

WHAT ABOUT PROTEIN SHAKES?

You can meet your daily protein requirements by eating whole foods, drinking protein meal-replacement shakes, or a combination of the two. However, you will not get equal nutrition from both. Shakes contain fewer nutrients (depending on the product formulation), while whole foods offer bioactive compounds and a diversity of additional nutrients, including carbohydrates, fats, vitamins, minerals and fibre.

Advice: Pre-made shakes tend to contain large amounts of refined sugar and artificial ingredients, and even homemade shakes that feature ingredients such as protein powder fall short in offering the calcium or fibre those whole food alternatives such as yoghurt or black beans would respectively provide. Protein-rich whole foods are ***more nutritionally complex*** than shakes, so they offer a greater variety of vitamins and minerals. In addition, since you go through the process of chewing and take a longer period of time to consume whole foods, ***they also satisfy your hunger more effectively and keep you fuller for longer***.

2.2.5 Vegetarian athletes

Some people choose to eat vegetarian diets which vary from near-vegetarian eating (eating most foods except red meats and offal) to strict vegan or fruitarian diets which exclude every form of foods from animals, processed food and in the latter case all foods except fruits and nuts. The decision to follow a vegetarian lifestyle is motivated by many different considerations ranging from religious beliefs, animal activism to pursuit of the perceived health benefits.[10]

It has been estimated that between 1.9 - 8.2% of athletes follow some type of vegetarian diet, and up to 37% of these athletes specifically avoid red meat. Long distance runners and triathletes who eat very-high-carbohydrate diets are more inclined than most athletes to reduce their red meat intake, because they want to avoid high-fat and/or cholesterol intake. Female and adolescent athletes may use a vegetarian regimen to disguise their highly restrictive food intake so as to achieve the maximum reduction in their weight and/or body fat levels.[10]

To date, no distinct advantage has been found in using a strict vegetarian diet as part of an athletic regimen, except that such athletes may find it easier to ingest larger amounts of carbohydrate.

Potential nutritional problem areas for such athletes centre around ***protein, iron, calcium, zinc, vitamin B12 and riboflavin which may require monitoring and supplementation***. From a practical point of view, it is useful to clarify why an athlete uses a near-vegetarian, vegetarian, vegan or macrobiotic diet, so that individuals using these diets to mask eating disorders can be identified and assisted to address their problems. Other reasons for following such diets (religious, cultural, moral or environmental) and avoiding red meat must be respected and these athletes should be counselled by dietitians on how to compensate for the absence of the above mentioned nutrients in their diets so that no deficiencies develop which may hamper performance.[10] In particular, the tendency for female athletes who follow a vegetarian diet to develop amenorrhoea (up to 5 times more frequently than those that eat a mixed diet), should also be addressed.[1]

2.3 CARBOHYDRATES

Carbohydrates are considered as the major source of energy for everyone, including athletes. As a general rule, dietitians and nutritionists recommend that carbohydrates, such as whole grain foods, provide more than half of your daily energy. Recently, carbohydrates have been placed under the spotlight and many athletes and trainers are limiting carbohydrate consumption. However, some important functions of carbohydrates for athletes should not be ignored:

- Carbohydrates are stored as glycogen, which is the major source of energy for muscles during exercise.
- During recovery, the release of the hormone insulin will be stimulated if carbohydrates are consumed post-exercise, which will in turn stimulate uptake of amino acids from protein ingested into muscle tissue, enabling recovery and growth.[4]

The exact amount of carbohydrate required, depends on your body composition and level of training (Table 3). The body can only store a limited amount of glycogen, so it is essential to eat carbohydrates throughout the day, spread into 20 g portions (depending on your requirements). Table 4 provides examples of foods portions containing 20 g of carbohydrates.

Table 3: Recommended amounts of carbohydrate for athletes[4]

Training load	Exercise intensity	Carbohydrate (g) per kg bodyweight per day
Light	Low intensity or skills-based activities	3-5 g
Moderate	Moderate exercise programme (1 hour/day)	5-7 g
High	Endurance programme (1-3 hours/day of moderate/high intensity)	6-10 g
Very high	Extreme commitment (4+ hours/day of moderate/ high intensity)	8-12 g

Table 4: Food portions containing 20 g of carbohydrates[4]

2 thin slices of bread	1 cup cooked pumpkin
2 plain crackers	1 medium banana, large apple of orange
1 cup cooked porridge	150 ml fruit yoghurt
½ cup cooked pasta or rice	1 tbsp jam/honey/sugar
1 medium potato	

Glycaemic Index

The Glycaemic Index (GI) ranks foods based on their ability to influence blood glucose levels. Eating moderate to high GI carbohydrates after exercise raises blood glucose levels quickly and enhances recovery of glycogen stores and promotes uptake of amino acids from protein foods. Low GI foods (55 or lower) in a pre-exercise meal can be useful when a sustained release of glucose for energy is needed during the exercise.

Advice: If training for longer than 90 minutes an additional 30 g - 60 g high GI foods per hour may be useful.

Table 5: Examples of high, intermediate and low GI foods[17]

Low GI foods (55 or lower)	Intermediate GI foods (56 - 69)	High GI foods (70 or above)
Low GI breads	Pita bread	White and brown bread
Instant oats natural flavour	Couscous	Maize meal porridge warm
Provita	Risotto rice	Rice cakes
Pronutro Wholewheat	Ripe banana	Weetbix
Low GI Muesli	Raisins	Cornflakes
Maize meal porridge cooled	Dates	Pronutro Regular
Chickpeas / Hummus	Sultanas	Jasmine rice
Milk		Sports drinks and gels
Yoghurt		Jellybeans and gummies

2.4 FAT

Fat is an essential component of our bodies. It insulates the body from cold and helps with the absorption and transport of the fat soluble vitamins (A, D, E and K). Fat is also important for hormone production and fat from our food is a rich source of energy, providing 37 kJ per gram of fat, compared to roughly 17 kJ per gram of carbohydrate or protein.

2.4.1 The animal fat conundrum

Animal source foods such as red meat also contain fats. This is a contentious issue with athletes, particularly female athletes, who are committed to keeping their weight as low as possible. In addition, the fact that animal fats contain saturated and *trans*-fatty acids, may turn athletes away from using foods from animal origin. Recently, with the rebirth of the Banting Diet, numerous athletes are opting for fattier meals to make up for energy deficits as a result of excluding carbohydrates. However, too much fat (like too much of anything) can contribute to health problems, including weight gain and heart disease. Foods containing mono- and polyunsaturated fatty acids should be chosen whenever possible, for example lean red meat, oily fish and nuts.

Red meat is lower in total fat than you might think

The fat content of South African red meat has decreased dramatically over time thanks to purposeful selection of lean breeds and trimming of meat at retail outlets and at home. If you purchase lean meat and remove all the visible fat and make sure that you are adding ***limited*** quantities of fat or oil during cooking, then an average lamb chop which in the untrimmed state contains 21% fat can be reduced to a fat content of less than 8%. This results in a reduction of more than 60% in the total fat content of the meat by the time it is consumed.[18] What this also means, is that lean red meat, trimmed of visible fat, compares favourably with other lean animal source foods such as roast chicken without the skin.

Comparison of the total fat content of trimmed (lean) and untrimmed South African animal products.[16,19,22]

Food (100 g, cooked)	Fat (g)
Trimmed	
Lamb, leg, roasted, lean	7.7
Lamb, loin, roasted, lean	7.8
Lamb, shoulder, braised, lean	9.9
Mutton, leg, roasted, lean	7.2
Mutton, loin, roasted, lean	9.8
Mutton, shoulder, braised, lean	8.7
Chicken, dark meat, roasted, without skin	9.8
Chicken, dark meat, boiled, without skin	9.7
Chicken, white meat, roasted, without skin	3.6
Chicken, white meat, boiled, without skin	4.1
Pork, loin, braised, lean	8.3
Untrimmed	
Lamb, leg, roasted, untrimmed	11.7
Lamb, loin, roasted, untrimmed	20.9
Lamb, shoulder, braised, untrimmed	15.8
Mutton, leg, roasted, untrimmed	10.1
Mutton, loin, roasted, untrimmed	25.4
Mutton, shoulder, braised, untrimmed	11.3
Beef, rump, roasted, untrimmed	14.4
Beef, prime rib, roasted, untrimmed	18.0
Beef, shoulder, braised, untrimmed	8.2
Chicken, meat and skin, boiled	12.6
Chicken, meat and skin, roasted	13.0
Pork, thick rib/breast, braised, untrimmed	25.4
Pork, loin, grilled, untrimmed	13.9

Red meat contains good fats

As mentioned above, lean, trimmed red meat contains 8 g of fat per 100 g of lean meat, of which more than half consists of healthy mono- and polyunsaturated fatty acids. In addition South African lamb and mutton are natural sources of conjugated linoleic acid (CLA). CLA intake has been scientifically linked to a reduction in heart disease, cancer and cholesterol levels.[18]

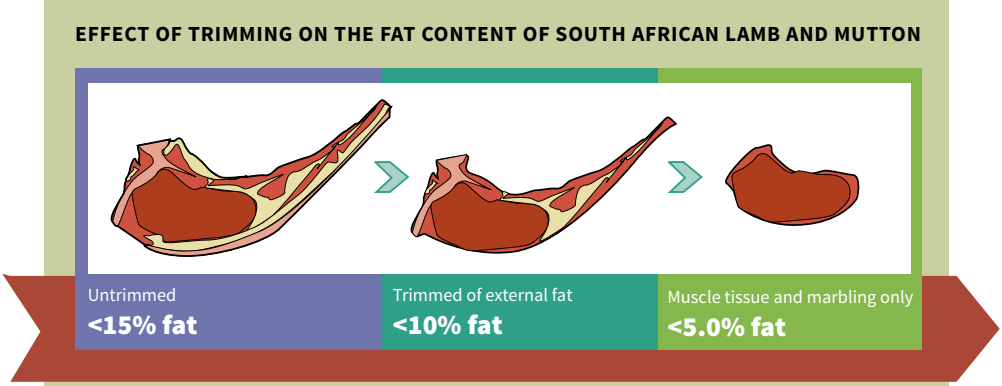
Fatty acid content of South African red meat (untrimmed) in relation to effect on plasma-cholesterol level.[19,20,21]

Fatty Acids	Content (g/100 g)		
	Lamb	Mutton	Beef
LDL-cholesterol raising	4.2	3.62	3.64
Lauric acid C12:0	0.08	0.01	ND
Myristic acid C14:0	0.85	0.34	0.37
Palmitic acid C16:0	3.27	3.27	3.27
Cholesterol neutral	1.91	3.01	2.99
Stearic acid C18:0	1.91	3.01	2.99
LDL-cholesterol lowering	5.22	5.40	5.4
Oleic acid C18:1	4.79	4.95	5.12
Linoleic acid (Omega 6) C18:2	0.36	0.29	0.24
Alpha-linolenic acid (Omega 3) C18:3	0.07	0.14	ND
Arachidonic acid C20:4	0.00	0.02	0.04

(ND = Not detected)

Trimming makes a difference

EFFECT OF TRIMMING ON THE FAT CONTENT OF SOUTH AFRICAN LAMB AND MUTTON



2.5 IRON

Because iron forms an integral part of the haemoglobin molecule that transports oxygen to all the cells of the body, it is understandable that anyone who exercises (and serious sportsmen and women in particular) must ensure that their iron intake is completely adequate for their increased demands.

Red meat is a good source of readily available iron, which is referred to as haem iron, that the human body can easily absorb and use. Haem iron is only found in foods derived from animals and our bodies are able to absorb 25% of this type of iron from food. When an individual has low body stores of iron, he or she may be able to absorb even more. Conversely non-haem iron which is found both in plants (spinach, wholegrains, etc.) and animal products (beef, lamb, mutton, chicken, etc.) is poorly absorbed and on average our bodies are only able to extract 5% of the non-haem iron for absorption.[4]

Nutrient Reference Values for Iron

In South Africa the NRV for iron is 18 mg/day for individuals older than 4 years of age, which is similar to the Australian RDA (Recommended Dietary Intake) of 18 mg/day for women. The Australian RDI for men is much lower at 8 mg/day.[4,11]

2.5.1 Consequences of iron-deficiency

A deficiency of iron in the diet or increased loss of iron (usually via blood losses during menstruation in girls and women and due to tissue damage incurred during intense workouts), can cause iron-deficiency anaemia which has been classified as one of two extremely common and most widespread nutritional disorders in the world.[11]

Iron-deficiency in the diet is common in the general population and is well documented in athletes. Sports nutritionists are aware of the fact that iron depletion can easily deteriorate into iron-deficiency anaemia which will have a negative effect on athletic performance.

Iron-deficiency not only causes anaemia, but has also been linked to ***increased incidence of stress fractures*** in female combatants in the Israeli army who participate in intense physical training. The study conducted with Israeli soldiers found that up to 19% of the subjects were anaemic and approximately 60% of the subjects suffered from iron-deficiency. During 4 months of basic army training, 14 of the female subjects who had a significantly higher prevalence of anaemia and iron-deficiency, suffered stress fractures. The authors of this study have suggested that eating kosher meat may be linked to this high prevalence of iron-deficiency among young Israeli recruits.[12]

2.5.2 Common causes of iron-deficiency

The highest prevalence of iron-deficiency anaemia in athletes is found in endurance sports, female athletes and adolescent athletes. In men, runners particularly distance runners, are more prone to depletion of iron stores due to breakdown of red blood cells caused by mechanical and capillary trauma during running.

The following three causes have been identified as contributing to iron-deficiency anaemia in athletes:[1,12]

- *Decreased dietary intake* particularly in athletes who avoid red meat, those who follow vegetarian diets due to religious and other convictions, lack of iron even in red meat consumed by Jewish athletes due to kosher preparation practices and individuals who are trying to reduce weight and have reduced their energy intake to such an extent that their diet is dangerously unbalanced.
- *Increased losses of iron* due to sweating, gastrointestinal bleeding and intravascular haemolysis causing losses of haemoglobin in the urine.
- *Recurrent episodes of acute inflammation* caused by intensity exercise and repeated use of anti-inflammatory drugs, may also decrease iron absorption and utilisation.

2.5.3 Symptoms of iron-deficiency

The symptoms of iron-deficiency are counterproductive to efficient physical performance and can seriously disadvantage an athlete's success. The symptoms of iron-deficiency anaemia include:

- Inability to do aerobic activity (due to lack of haemoglobin).
- Fatigue, weakness, breathlessness and reduced brain activity (due to oxygen deficiency).
- Disturbances in muscle metabolism and temperature control, as well as lowered immunity, mood changes, and lack of appetite.[1]

2.5.4 Diets that promote iron-deficiency

Sportsmen and women, particularly female and adolescent athletes, may use a variety of diets that limit adequate iron intake and may increase chances of iron-deficiency.[1,4] These include:

- ***Low-energy diets.*** Energy restricted diets are often used in an attempt to keep body weight as low as possible for specific sports and activities (gymnastics, ballet, high and long jump), with energy contents of less than 8300 kJ per day.
- ***Vegetarian diets.*** Non-haem iron in plant foods is usually not well absorbed due to the presence of chelating compounds like phytates, tannins and oxalates that form insoluble complexes with the iron and prevent its efficient absorption. Even lacto-ovo-vegetarians run the risk of iron-deficiency as milk and dairy products are poor sources of iron and their high calcium content inhibits iron absorption from other sources when eaten together.
- ***Very-high-carbohydrate diets*** tend to also contain iron that is not highly bioavailable and thus cause deficiencies.
- ***Fad diets*** which are particularly popular among athletes who are obsessed with weight control, are generally lacking in foods rich in haem iron such as red meat.
- ***Ergogenic aids and sports shakes*** which are also popular among athletes are often inadequate sources of iron and when used for long periods can cause iron-deficiency.
- ***Dietary inhibitors.*** Certain foods such as soy beans and products that contain soy beans (e.g. sports shakes, energy bars, etc.) contain inhibitors like phytate and peptides that can inhibit iron uptake.
- ***Inadequate dietary intake.*** The combination of inadequate dietary intake coupled with the increased demands of growth especially in children, adolescent and young adults can also cause iron-deficiency.

It stands to reason that athletes of both sexes and all ages need to ensure an adequate intake of absorbable iron from their diets. Foods like beef and lamb are two of the richest sources of haem iron and can counteract iron-deficiency anaemia and the other symptoms of iron depletion that athletes tend to suffer from.[4] ***Advice: Food sources of haem iron are superior to iron supplements, which should always only be taken under medical supervision because repeated use of iron supplements may reduce the absorption of other minerals and trace elements (zinc, copper and calcium), thus causing additional deficiencies.*** Eating a well-balanced diet that includes a serving of iron-rich meat regularly is the safest way of ensuring peak performance and health.

2.6 SODIUM

Table salt is made up of two minerals, namely sodium (40%) and chloride (60%). Sodium plays a vital role in maintaining the so-called electrolyte balance of the body, i.e. keeping body fluids, including blood and sweat, in balance. Too much sodium can result in high blood pressure and lower the body's calcium levels, while an adequate amount of salt is not only required to regulate the body's water balance, but also to transmit nerve impulses that allow muscles to move and contract.[4]

When salt and water are lost from the body during sweating this can cause a decrease in blood volume. Decreased blood volume can lead to decreased blood pressure. If blood pressure gets too low, the blood cannot transport essential nutrients and oxygen to vital organs, including the heart, brain and kidneys. Lowered blood pressure also causes fatigue. When competing in endurance sports, adequate salt intake is, therefore, important to replace losses of sodium during sweating.

As a general principle: 1 g salt = 0.4 g sodium; 1 g sodium = 2.5 g salt

Recommended daily intake (World Health Organization): 5 g salt / day[13]

2.7 FIBRE

Fibre is important for intestinal health and maintenance of bowel movements, as well as helping to reduce cholesterol levels. Sources of fibre include vegetables, fruit, wholegrain cereals, beans and pulses. Foods high in fibre also assist in satiety, which assits with weight control.[4]

Advice: Too much fibre can cause gut discomfort for some athletes. In selected cases, it may be advisable to lower fibre intake prior to exercise, e.g. choose white bread and peeled fruit and vegetables.

THE ROLE OF RED MEAT IN THE DIET OF ATHLETES

Red meat contains various nutrients, together with certain beneficial bioactive compounds, antioxidants and creatine (which athletes often buy as ergogenic aids in the form of supplements). Considering these facts, eating red meat appears to be a natural choice for athletes, particularly those who are trying to build muscle tissue or those who suffer from anaemia (iron-deficiency).

Major Nutrient Contributions[15]

- Protein with a high biological value which contains all nine of the essential amino acids. Amino acids are the building blocks of proteins which in turn are used in the body to build and repair muscle and organ tissues, as well as to manufacture blood and hormones.
- B-vitamins, especially vitamin B_{12}, prevents the development of megaloblastic anaemia, niacin, thiamine (B_1) and riboflavin (B_2), which are involved in numerous metabolic processes in the body.
- Minerals, particularly haem iron which is highly biologically available and vital in the prevention of iron-deficiency anaemia, zinc which also acts as a catalyst in countless metabolic reactions and boosts immunity and phosphorus that plays a role in energy and bone metabolism.
- Long-chain omega-3 polyunsaturated fatty acids namely DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid), which are linked to reduced risk of chronic diseases, but are increasingly deficient in western diets.
- Biogenic substances, including taurine, carnitine, carnosine, ubiquinone, glutathione and creatine. Red meat is a natural source of these compounds which are often added to sports supplements to improve performance or promote an increase in lean muscle mass.

A 100 g portion of lean red meat such as lamb, provides more than 30% of the Nutrient Reference Value (NRV) of protein, niacin, vitamin B_{12} and zinc, and more than 10% of the NRV of phosphorus, iron, thiamine and riboflavin.[22]

TIPS: COMPETITION NUTRITION[4]

Pre-competition nutrition:

- Low GI carbohydrate foods before an event are ideal. Ensure that you have practised with these foods in training before competition day.
- A pre-competition meal is especially important if you are involved in events lasting longer than 90 minutes.
- Aim to eat 1 to 4 hours prior to the event depending on the size of the meal, time of the event and type of activity.
- To reduce stomach upsets, choose a pre-competition meal low in fibre and low in fat, such as white bread with no butter.
- If you are involved in sports of long duration (over 90 minutes) and are interested in carbo-loading, see a Sports Nutritionist or Dietitian.
- Ensure hydration before an event.
- Talk to a Sports Nutritionist or Dietitian if your sport involves gaining muscle weight.

Nutrition during the competition:

- Be familiar with foods consumed on competition day.
- In high intensity and long duration events such as tournaments, consume carbohydrate and fluid at regular intervals (every 20 minutes if practical) throughout the event.

Post-competition nutrition:

- Water is a good option for rehydration if training for less than an hour at low intensity.
- Avoid drinks containing caffeine and alcohol after competing – these encourage dehydration and can delay recovery from injuries.
- Consume foods containing 20 g protein and all 9 of the essential amino acids.
- Include some carbohydrates in the recovery meal to help replenish muscle glycogen stores.
- Carbohydrates can be consumed as solids, fluids or both. Moderate to high GI competition nutrition carbohydrates are ideal.
- Sports drinks and salty foods can replace salt lost by sweating.
- A sports drink with 4-8% (4-8 g/100 ml) carbohydrate and 500-700 mg/L sodium is generally recommended. Drinks with high levels of carbohydrate (8-10%) can increase dehydration as they reduce fluid absorption.

NOTE: Fruit juices and cordials can be diluted if they are to be consumed before and during exercise, but keep in mind that such drinks do not contain any sodium to replace losses caused by sweating

SAMPLE EATING PLAN[4]

Here is a sample eating plan with sufficient carbohydrate and protein portions suitable for either a 55 kg long distance runner training 1 to 2 hours per day, or a 68 kg soccer player training at least an hour per day, or an 85 kg person who walks an hour a day. Please note that eating plans for optimum performance need to be personalised and tailor-made for each individual athlete's unique requirements.

BREAKFAST 7 AM (6 carbohydrate portions and 1 protein portion)
- 2 slices toast/bread with 2 Tbsp jam, honey or peanut butter
- 1 cup cereal with ½ cup milk, small pot of yoghurt and a banana
- 1 glass fruit juice
- 1 glass water

MID-MORNING 10.30 AM (3 carbohydrate portions)
- 1 scone thinly spread with margarine and jam
- 1 apple
- 1 glass water

LUNCH 12 NOON (5 carbohydrate portions and 2 protein portions)
- 2 pita breads with lettuce, tomato and cold meat
- 1 apple
- 1 large cereal bar
- 200 ml flavoured milk
- 1 glass water

MID-AFTERNOON 3 PM (Pre-training meal) (3 carbohydrate portions)
- 1 sandwich with jam
- 1 glass water

BEFORE TRAINING
- 1 glass water

TRAINING 5 PM
- Water

AFTER TRAINING (Post-training snack) (3 carbohydrate portions)
- 1 banana
- 1 cereal bar
- 300 ml sports drink

DINNER 7.30 PM (Post-training meal) (5 carbohydrate portions and 3 protein portions)
- 125 g lean red meat
- 1½ cups cooked rice
- Stir-fried vegetables
- 2 Tbsp raisins
- ¼ cup cashew nuts
- 1 glass water

SNACK 10 PM (1 carbohydrate portion)
- 1 cup hot chocolate

NOTE: Each athlete must determine a balance between thirst and excessive water intake which can lead to 'water intoxication' and death. Consult a Dietitian/ Nutritionist to help you calculate how much liquid you should drink on a daily basis. This is particularly important for young athletes.[23]

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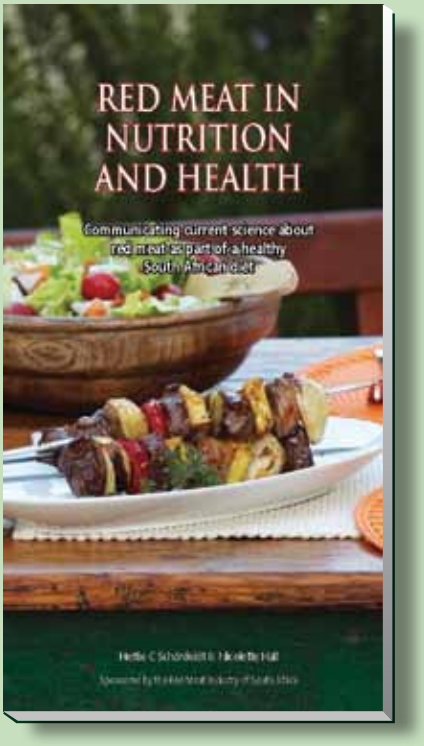
MORE ON RED MEAT IN NUTRITION AND HEALTH



TOPICS DISCUSSED INCLUDE:

- Nutrient content of red meat
- The nutritional status of South Africans
- The South African food-based dietary guidelines and red meat intake
- Bioavailability of nutrients - focus on protein, iron and vitamin A
- The role of red meat in weight management
- Red meat and cancer
- Red meat and fat
- Red meat in hypertension
- Red meat in a green environment

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