

## **Cairngorm Runners**

### **EZ Sports Nutrition Notes.**

#### **Macronutrients.**

**The 3 (or 4!) big guys – protein, carbohydrate, fat and water.**

#### **Protein.**

The word protein derives from the Greek meaning “of first importance”. Protein is needed to repair damage to all tissues in your body. All the soft tissues and structures of your body are comprised primarily of protein and water! Hair, nails, organs, skin, muscles...everything!

Protein needs vary dependent upon the lean body weight and the activity level of the individual in question, as well as differing slightly dependent upon training goals, metabolism etc. When insufficient amounts of protein are consumed you can expect to be lethargic, weak, depressed, uneasy or nervous, have a slowed rate of recovery from exercise and a lowered resistance to infections and disease.

Too much protein in the diet (to the extent that a large calorie surplus is created) will cause you to put on body fat, just as too much of any type of food will.

#### **Structure and Value of Proteins.**

Every protein is composed of amino acids, the so-called “building blocks” of protein. There are a total of 24 amino acids, of which 8 are essential in your diet. The remaining 16 aminos can be synthesised by your body from the essential ones.

However, this is an utterly sub-optimal way to obtain these amino acids.

It is far better to get all the aminos you need from your diet alone.

Different proteins can be rated according to how well they supply the essential amino acids to your body.

This is called the Protein Efficiency Ratio, or PER. Another similar rating is Biological Value, or BV, which is a measure of how closely a protein mimics the amino acid profile required to build human tissue.

The highest scoring proteins when either of these ratings is used are eggs, whey, milk, meats, poultry and fish. These should be everyone's primary sources of protein.

It is possible to combine many different foods in order to create a high PER or BV for a given meal. If you are vegetarian and hope to perform at your peak level this is worth bearing in mind, but for omnivores animal products should definitely supply the majority of your protein.

## **Carbohydrates.**

Carbohydrates are the primary source of energy for all prolonged physical activity. Therefore the majority of your calorie intake should come in the form of carbohydrates. Without adequate carbohydrates in your diet you will feel sluggish, tired, dizzy, unable to train and will suffer from cluttered thinking and a distinct lack of awareness of what is going on around you.

### **Structure and Types of Carbohydrates.**

There are several types of carbohydrates, with varying uses and varying value to you in your quest for health and fitness. The three main categories of carbs are:

Monosaccharides (one sugar molecule).

Disaccharides (two-sugar molecules).

Polysaccharides (three or more sugar molecules).

Mono and Di-saccharides are commonly called "simple sugars" whereas Polysaccharides are called "complex carbohydrates" or "glucose polymers".

All of these sugar types have some use to athletes, but it is the complex carbs that should make up the majority of your intake.

Examples of complex carbohydrates are starch, dextrin, cellulose, and glycogen all of which are

made up of chains of glucose (glucose polymers / maltodextrins) found in whole grains, vegetables, and legumes.

### **The Glycemic Index.**

The glycemic index (GI) is a comparative chart that shows how quickly a carbohydrate is absorbed by the body, relative to glucose, which is absorbed faster than all other sugars.

The carbohydrates that should make up the majority of your intake are those that have a LOW glycemic index.

These are typically polysaccharides or “complex carbs”.

The reason for the use of low GI carbs is that they are broken down slowly and provide a slow constant source of energy for your body.

These carbs do not greatly increase the levels of insulin (the hormone responsible for storing carbs) and this also lowers the likelihood of them being stored as fat. This small effect on insulin levels also helps to prevent peaks and troughs in energy levels. Insulin acts by shuttling carbohydrates from the blood stream in to the muscles and liver to be stored as Glycogen. When a lot of insulin is released it can lower the levels of sugar in the blood so dramatically that you will feel tired, listless and lacking in energy almost immediately.

This typically occurs when you consume a lot of simple sugars such as fizzy drinks, chocolate bars or biscuits or sweets. This is why we are all told to avoid such foods in our diet. They cause large increases in insulin, which means that blood sugar levels drop as our muscle and liver energy stores are filled up.

Once these stores are full any more blood sugar will be stored as fat, and at the same time we are left with low blood sugar levels which makes us feel hungry. So we eat more!

The following table shows the GI of some common foods. In certain instances a food will have a low Glycemic index despite being of little value in your diet. You have to bear in mind that if a food is high in fat it is typically broken down and absorbed slower than a low fat food, which in turn gives it a low Glycemic index rating. Needless to say that simply being low on the GI does not make a food a good choice, exercise your common sense. Ice cream for example has a low Glycemic index.....is ice cream health food? We all know the answer. For this reason I have split the GI table in to two sections, recommended and not recommended foods.

### Glycemic Index of Various Foods.

<b>Not Recommended Foods</b>	<b>Glycemic Index</b>
Glucose	100
Honey	87
Parsnips	98
Carrots	90
White Potatoes	70
Mashed Potatoes	80
Broad Beans	75
Bananas	65
Raisins	68
Dried Fruits	65 - 70
White Flour Spaghetti	56
Cornflakes	85
White Rice	70
White Flour Pancakes	66
White Bread	76
Fructose	20
<b>Recommended Foods</b>	<b>Glycemic Index</b>
Soybeans	15
Kidney Beans	29
Lentils	25
Sweet Potatoes	48
Yams	45
Apples	36
Oranges	40
Northern Fruits	30 - 40
Whole-wheat Spaghetti	40
Oats	48
Brown Rice	60
Whole-wheat Pancakes	45
Whole-wheat bread	64

## **Carbohydrate Storage and Use in the Body.**

As with all foods, excess carbohydrates will be stored as body fat.

Your body breaks down and stores carbohydrates as Glycogen in the liver and in the muscles, but if these stores are full and you continue to eat more carbs the excess will be stored as fat.

This process is outlined below.

Our bodies can only absorb monosaccharides (glucose, galactose, or fructose),

the single units of sugars and starches. Our digestive processes break down more complex sugars into these single units. Once absorbed through the small intestines our bodies can put glucose to work in three ways:

It can burn the glucose immediately for energy if blood glucose levels are not at a stable level.

If it is not needed for energy immediately, then it is converted into glycogen in the liver or muscles.

Glycogen is the body's main energy store. The liver has the capacity to store around 100 grams of glycogen.

The muscles have the capacity to store between 250-400 grams of glycogen, depending on muscle mass and physical condition.

Fitter people can store more glycogen. People with larger muscle mass can store more glycogen.

Liver glycogen supplies energy for the entire body.

Muscle glycogen only supplies energy to muscles.

If the body has an excess of glucose, and all of the glycogen stores are full, the surplus glucose is converted to fat by the liver and stored as body fat around the body. If needed, fatty acids can be burned as fuel (BUT the fat cannot be converted back to glucose).

As discussed above, low glycemic index foods are less likely to be stored as body fat because they are released slowly into the blood stream, steadily topping up glycogen stores as opposed to flooding them with fuel.

## **Carbohydrate Conclusions.**

All the above data can be encapsulated in a few simple rules for carbohydrate consumption.

1. Try to consume foods that are low on the glycemic index, typically whole grains, beans etc instead of high GI simple sugar foods most of the time (there are exceptions such as post training when simple carbs are appropriate).
2. Moderate carb intake to reflect energy needs – view carbs as being “just fuel” and you will be on the right track. When you DO a lot, you USE a lot, so EAT a lot. Otherwise – DON'T!!!!

## **Fats.**

Contrary to popular belief fats are not the enemy of health: far from it. Without sufficient fats in your diet you will be unable to produce hormones, sterols, globular enzymes and many other chemicals in your body that are necessary for your survival.

The problem with fats is that they are extremely calorie dense, containing 9 Kcals per gram, so over consumption of them makes it extremely easy to create a surplus of calories. This leads to body weight gain, usually in the form of body fat. In essence, you need fats to live, but as with all foods too much fat in your diet will lead to body fat gain.

### **Structure and types of Fats.**

There are several different types of fats, some of which deserve special emphasis in your diet and some that should be avoided like the plague. All fats are found as a combination of saturated and unsaturated fatty acids.

Saturated fats are typically those from animal sources like meat, milk and butter and they are usually solid at room temperature.

Unsaturated fats are usually liquid at room temperature and generally come from plant sources. Unsaturated fats are further divided in to two categories: monounsaturated fats (olive, peanut and avocado oils) and polyunsaturated fats (corn, sesame and safflower oils).

To further complicate the issue we foolhardy humans have invented a process called hydrogenation that makes less saturated fats more saturated. This is done to improve their shelf life, and these hydrogenated fats are just as bad (some would say worse) for you as saturated fats.

Hydrogenated fats include most margarines and shortening and most fats used in pre-packed or heavily processed foods.

The fats that we need to emphasise are those that provide high levels of Essential Fatty Acids (EFA's). EFA's are those fats that our body cannot itself produce, so they have to be provided by your diet.

## **Cholesterol.**

Cholesterol is a fatty acid usually found in foods higher in saturated fats like meats, milk, butter and cheeses.

Cholesterol has garnered its reputation as a killer because high levels of this substance in the blood lead to Arteriosclerosis, or plaque build-up in the arteries. This in turn can restrict blood flow and cause heart attacks and strokes. Thankfully however, it is not all bad news.

There are two types of cholesterol, HDL cholesterol and LDL cholesterol. HDL stands for High Density Lipoprotein and LDL for Low Density Lipoprotein. Lipoprotein simply means a combination of protein and lipids (fats). Of the two, HDL cholesterol is often referred to as “good” cholesterol.

This is because HDL attaches to cholesterol deposits and transports them to the liver to be broken down or reprocessed. LDL, or “bad” cholesterol, on the other hand carries cholesterol through the blood to be deposited.

It is excesses of these deposits that make up the arterial plaque that causes health problems. So, ideally we want to maximise the presence of HDL and minimise the action of LDL cholesterol. This ratio of good : bad is what really matter for long term health, almost irrespective of the total cholesterol amount.

Thankfully there is a very simple way to do this.

Hydrogenated oils tend to stimulate the production of LDL cholesterol (the bad stuff).

Polyunsaturated and monounsaturated fats reduce the production of LDL cholesterol and increase the production of HDL cholesterol (the good stuff!).

So, by cutting down on hydrogenated margarines etc and increasing your consumption of polyunsaturated and monounsaturated fats (olive oil, avocados, peanut oil, corn oil, sesame oil, safflower oil etc) you can positively effect your cholesterol profile.

Further LDL lowering substances include fatty acids found in fish oils and flax seed oil. Any increase in monounsaturated oils should be met with an increase in omega 3 fatty acids.

## **Fats Conclusions.**

You need fats in your diet in order to manufacture chemicals needed for your survival. However, too much fat in the diet can lead to obesity through a large surplus of calories, and too much saturated and hydrogenated fat can cause cholesterol problems. So, you must intake fats, but you should get most of your fats from unsaturated sources and emphasise those sources that provide high levels of Essential Fatty Acids like fatty fish (salmon, trout, mackerel), fresh vegetables, nuts and Olive or Flaxseed oil.

BTW – the majority of fats in beef are monounsaturated, with the breakdown being approx 2.8g monounsaturated fats and 2.6g saturated per 85g serving. Beef has a good naturally occurring balance of fatty acids along with tons of other nutritional benefits, it should NOT be avoided!

Other note: Grass fed low yield reared beef has MUCH more omega 3 than intensively reared grain fed beef. It is intensive rearing of beef and other animals that has changed their fatty acid balance and made them less “good” for us. Eat meat – but good meat!

## **Application to short, middle and long distance sports.**

Carbs.

Overview applicable to all...

Eat a high carbohydrate diet in the days and hours before your events.

Use carbohydrate supplements during events.

Use the immediate recovery interval to begin rebuilding carbohydrate stores ASAP after training / competing.

{NOTE: Although any increase in glycogen stores WILL increase the DURATION of exercise to fatigue, they WILL NOT increase MAXIMUM PERFORMANCE (VO<sub>2</sub>max)}

Maximizing carbohydrate replacement while competing is important for events of more than 2 hours.

At least 1 to 2 grams of carbohydrate per minute can be absorbed and metabolised to supplement pre event body glycogen stores.

This additional carbohydrate fuel will prolong the time to depletion so TAKE on BOARD during the RUN! 2G / minute = 400g + of carbs during a marathon, thats another 1600 calories of fuel to burn before you BONK!

Finally, take advantage of the **glycogen repletion window** that is open in the 4 hours immediately following vigorous exercise.

During this time, any carbohydrates you eat will be converted into muscle glycogen at 3 times the normal rate.

This is primarily due to an increase in glycogen synthase levels as glycogen falls. This ALWAYS occurs post training if the training has depleted glycogen levels at all.

Glycogen synthase is an important enzyme involved in the re-building of blood glucose into longer glycogen polymers and it's storage as glycogen in the muscle and liver.

Cool Note: In addition, some muscle types, particularly fast twitch glycolytic muscle, iare capable of forming glycogen from non-glucose sources, such as lactic acid. That horrible burny stuff is actually a fuel source your fast twitch "sprinting" muscles can use!!!

It may require up to 48 hours for complete muscle glycogen replacement, but 90% is compelte within 24 hours.

How much glucose is enough during this 4 hour interval?

3 grams of carbohydrate per kg of body weight during this 4 hours and up to 10 grams per kg over the post exercise 24 hours.

Is the type of carbohydrate important?

Glucose, dextrose, sucrose etc are of equal value when used in isolation, ideal is a blend of glucose and longer chain polymers, and some fructose as fructose preferentially replaces liver glycogen.

In repeated bouts with 24 between them, the addition of protein to the carbohydrate blend does NOT increase glycogen compensation but DOES promote protein synthesis and have a positive effect on performance in the 2<sup>nd</sup> bout of exercise.

## **Summary.**

Pre-load as much as possible for events longer than 2 hours.

Take on up to 2g / minute during the event.

Take in 3 to 4 gm carbohydrate/kg BW in the 4 hours post ride - start immediately

If you will be Training again within 24 hours, consider a protein-CHO combination for replacement

You don't need to push beyond 1.5 grams CHO per kg body wt per hour which appears to be an upper limit to muscle glycogen replacement.

Aim for a total of 8 to 10 grams of CHO per kg body weight over the next 24 hours to maximize repletion of muscle and liver glycogen.

## **Fluid Intake.**

Total body fluid losses during exercise lead to a diminished plasma volume (the fluid actually circulating within the blood vessels) as well as a lowered muscle water content.

Unreplaced water loss equal to 2% of base line body weight will impact heat regulation.

3% loss there is a measurable effect on muscle cell contraction times.

4% loss of body weight there is a measurable 5% to 10% drop in performance.

**So make it a point to weigh yourself both before and after the event** - most of your weight loss will be fluid.

Use weight loss as guide to fluid replenishment and remember your electrolytes etc as well – water does not replace sweat – sweat replaces sweat!!!

## **Phosphate Loading.**

Phosphate as a buffer to acidosis?

Old school thinking has it that basic phosphates (baking soda etc) can prevent the acidity of the blood increasing as lactate acid builds up....one word...

NOOOOOOOOOOOOOOOOOO !

NEUROMOTOR FATIGUE

Acidosis is a weak contributor to muscle fatigue at high intensities, the real culprit is depolarization of the muscle cells resulting from a shift in calcium-potassium balance.

Muscle contractions are stimulated by electrical currents that flow throughout the body via minerals including sodium and potassium.

Each muscle cell contraction involves a lightning-fast exchange in which potassium molecules inside the muscle cell and sodium molecules outside the muscle cell switch places.

These exchanges are most efficient when there is a high degree of polarization (a difference in the strength of the electrical charge) between the spaces inside and outside the cells.

At the beginning of high-intensity exercise, the inside of the muscle cell has a much stronger positive charge than the area outside the muscle cell. This difference in charge strength makes it easy for sodium and potassium to cross the cell membrane.

During sustained high-intensity activity, potassium is released from the muscle cells faster than it can be taken up outside the muscle cells. The resulting buildup of potassium outside the muscle cells causes a progressive lessening of the difference in charge strength between the intracellular and intercellular spaces, hence weaker and less efficient muscle contractions (i.e., fatigue).

Picture the nerve signals that cause muscle contractions as little marbles rolling down a sand hill. Each grain of sand is a potassium molecule.

The top of the hill is the inside of the muscle cell, and the bottom of the hill is the outside of the muscle cell. Each time a marble (nerve signal) rolls down the hill, a small avalanche of sand (potassium molecules) follows it.

Consequently, as marble after marble rolls down the hill, the hill becomes less and less steep as sand shifts from the top to the bottom.

So the marbles roll down slower and slower until eventually they don't roll at all.

That's neuromotor fatigue.

The build up of lactic acid is co-incident BUT NOT THE CAUSE!

**BONUS!!!**

Training increases potassium storage within muscle cells and the density and efficiency of the so-called calcium-potassium pumps that are responsible for those lightning-fast calcium-potassium exchanges.

### **What phosphates ARE useful???**

Regeneration of ATP.

Adenosine Tri-Phosphate – energy currency of the body



PI = free phosphate. More free phosphate = faster ATP regeneration and more power output, CREATINE is best phosphate donor.

**Superhydration – Really carrying it with you :)**

**Creatine is hydrophilic, pulls water with it.**

**Glycerol is also hydrophilic.**

**Carbs are hydrophilic.**

**6% carb solution + 40ml Glycerol / litre + 5g creatine / litre = superhydration between 250 and 600ml retained for up to 8 hours.**

Anyone do ultra-distance events?

Fat loading is possible across 2-3 days and during events. MCT's are preferable as they are less likely to be stored as bodyfat. Coconut milk very high in natural MCT's and usually well tolerated.