The Benefits of Caffeine and How to Use It

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WARNING:

Caffeine should not be taken by caffeine sensitive individuals.

THE PHARMACOLOGY OF BIOENERGETICS
- Enhancing Muscle Energy Systems

This section explores the various mechanisms through which caffeine can effect human energy systems. It outlines dosages and procedures for specific results in enhancing physical performance.

CAFFEINE

Scientific Name:	Methylxanthine
Type of Nutrient:	Stimulant drug of Central Nervous System
History:	Used for hundreds of years in form of tea and coffee beverages
How Supplied:	Powder, Tablet, Liquid, Suppository
Natural Sources:	Tea, Coffee, Guarana, Kola Nut
Used for:	Reducing bodyfat and perception of effort. Increasing workload capacity, muscle fibre recruitment, exercise intensity, endurance, alertness, concentration, and oxygen uptake, Glycogen sparing
Cost effectiveness:	Excellent
Safety:	Up to 600mg/day (7 cups of coffee) considered safe (Gilbert 1992)
Precautions:	Should not be taken by pregnant women (has been linked with reduced bodyweight of the newborn) or people with heart problems (excessive doses can cause extra beats of left ventricle). Can cause physical dependence at daily dosages of 350mg and above (about 4 cups of coffee). 5 grams and above can be a lethal dose (about 60 cups of coffee).

Some Personal Trainers will be horrified at the thought of encouraging clients to consume caffeine. However, its effects on physical performance and bodyfat reduction are too great and well documented to ignore. Used prudently, caffeine's benefits can be made to outweigh possible risks. The following are **caffeine benefits and effects**...

FAT REDUCTION

The most common beneficial finding of caffeine use is an increasing in burning of bodyfat as fuel (Costill et al 1978, IVY et al 1979). *For the use of Caffeine in fat reduction see Section III - Fat Loss.* Click here

INCREASED MAXIMUM OXYGEN UPTAKE (VO2 MAX) DURING ENDURANCE ACTIVITY

In two related studies (Costil et al 1978, Ivy et al 1979) nine competitive cyclists were exercised to exhaustion on a bicycle ergometer. After a dose of 330mg of caffeine, the cyclists improved their VO2 max by 19% over placebo. In the second study (Ivy et al 1979) the cyclists rode an adjusting ergometer. The resistance of the ergometer was constantly adjusted and an estimate of work determined. Each cyclist was given 250mg of caffeine and a further 250mg administered over several divided doses. The caffeine treatment resulted in a 7.4% increase in work production and a 7.3% increase in the maximum oxygen uptake.

INCREASED ENDURANCE AND INTENSITY OF PHYSICAL PERFORMANCE

One recent study (Flinn S et al Int J Sports Med 1990;11:188-193) done here in Australia by Dr Lars McNaughton and colleagues at the Tasmanian Institute of Technology tested cyclists against themselves as controls under double-blind conditions, pedalling a cycle ergometer to exhaustion under progressively increasing workload. Caffeine at 10mg/kg bodyweight, or a placebo, were given as a flavoured drink three hours prior to the test. That is a dose of 800mg for an 80kg man.

Results showed that the caffeine increased time to exhaustion by 18% and exercise intensity by 24%. Thus, it allowed them to ride both longer and harder. In addition, caffeine increased the use of free fatty acids for fuel thereby sparing glycogen. It also raised the lactate threshold in relation to workload, suggesting that there was less build-up of lactic acid. This is the level of benefit you could expect with correct caffeine usage.

INCREASED INTENSITY WITH REDUCED PERCEPTION OF EFFORT

Caffeine has direct effects on muscle contraction (Alles et al 1942). It acts on the skeletal muscle by increasing calcium permeability essential for muscle contraction (Foltz et al 1943).

Excessive amounts of caffeine are not required for effects. Researchers (Alles et al 1942) observed effects of caffeine on the muscle during exercise. Caffeine (50mg orally) given one hour before the experiment produced higher muscle tension at low frequencies of muscle stimulation, suggesting a direct effect on muscle contraction. This study showed that caffeine may be acting directly on the muscle in addition to the central nervous system in masking fatigue.

Even though values for heart rate and oxygen consumption during one study were similar the caffeine made the work 'feel' easier. It is likely that a lessening of the subjective ratings of effort was due to the effect of caffeine on neuronal excitability, possibly through a lowering of the threshold for motor-unit recruitment and nerve transmission.

INCREASED CONCENTRATION AND ALERTNESS

Caffeine is reported to decrease drowziness and promote a more rapid and clearer thought process. Research reveals 85 to 250mg of caffeine increases the capacity for sustained intellectual effort and decreased reaction times.

Studies of changes in brain activity show that caffeine does have arousing effects. One way to measure this is to attach electrodes to a person's skull and record the patterns of electrical activity of his or her brain. It has been shown that caffeine in a few cups of coffee causes the patterns to change from those typical of an awake and sedentary person to those of an alert and active person.

CONFLICTING RESEARCH RESULTS

Not all research has been in total agreement of caffeine's performance enhancing effects.

Most of the work up till 1980 lacked the necessary controls to separate the effects of caffeine on sports performance from its effects in everyday life. The latest and best research shows they are quite different.

Numerous reviews lump together studies on sedentary people with studies on athletes and come to the conclusion that caffeine effects on performance are variable and inconclusive - and that a couple of cups of coffee before competition might help, or might not.

The first error of these reviews is assuming that a sedentary person coaxed into exercise reacts the same way to caffeine as an athlete - they don't (Bucci LR Nutritional Ergogenic Aids).

The second common error lies in confusing subjects who habitually use coffee, tea, cocoa, caffeinated soft drinks or chocolate with those who have a low daily intake of caffeine. Like giving an alcoholic a six-pack and expecting him to keel over! (Colgan). If your body has developed a tolerance to caffeine through prolonged use, then extra caffeine will not boost performance.

Two detrimental effects commonly cited by writers on sports nutrition about caffeine are that it is well established as a diuretic (makes you lose water) and that it is thermogenic (raises metabolic rate and body temperature) (Wager-Srdar SA et al Life Sci 1983;33:2431-2438).

Athletes are often warned that caffeine can make them dehydrate and overheat. But almost all the studies showing these effects were done with sedentary people. Recent research using athletes as subjects found no diuresis or thermogenesis. In fact caffeine ingestion has not been shown to alter fluid balance, sweat rate, total water loss, heart function, or blood electrolyte content during exercise (Can J Physiol Pharmacol 68:889, 1990; S Afr Med J 62:664,1982). Separate studies from Ohio State University confirm that caffeine ingestion does not alter body fluid/hydration and does not increase heart rate during exercise (Med Sci Sports Ex 26: Abstract 1146, 1994).

Sedentary people using caffeine would be advised to take a mineral supplement to safeguard against any deficiencies in iron, calcium, magnesium or sodium, and to drink plenty of water.

PRECAUTIONS

The IOC (International Olympic Committee) permits an upper level of 12 micrograms per millilitre of urine. This would be the equivalent of 12 milligrams per litre of water in the body of an athlete. A male athlete who weighs 70kg and whose body composition contains 60% water will have about 42 litres of water in his body, as 0.6 x 70kg = 42, and a kilogram of water is one litre.

If you multiply 12 milligrams by 42 litres, you will find that this athlete may consume about 500mg of caffeine to reach the legal limit. But to allow for individualities and to play it on the safe side, I would recommend not exceeding 5mg/kg of bodyweight. This would be a dose of 350mg.

Depending on the individual, a range of 100 to 300 milligrams is considered a therapeutic dose. 350mg could be considered a very therapeutic dose. Such doses meet the level for a stimulant effect and are still legal under IOC doping guidelines.

Excess caffeine can certainly mess you up. One study in the American Journal of Psychiatry reports anxiety, irritability, delirium and hallucinations, brought on by caffeine during exercise (Stillner V et al Am J Psychiatr 1978; 135:855).

Above a certain amount, more caffeine does not produce better effects, probably because its toxic side effects start to over-ride the benefits. So there is no reason to take so much it sends you crazy. 1000mg is over the top for most athletes, especially if they abstain from caffeine in everyday life.

Cyclists have been known to use 3000mg supporitories.

Symptoms of intoxication include insomnia, restlessness, sensory disturbance such as tinnitus (ringing in ears), and flashing of light. Large overdoses of caffeine can cause seizures. It can cause headache and involuntary muscle contractions.

Caffeine is capable of causing physical dependance in much the same way as other addictive drugs such as alcohol and nicotine.

However, caffeine withdrawal symptoms, though uncomfortable, are not life threatening.

To avoid physical dependence and minimize tolerance effects, caffeine dosages should be kept as low as possible and used intermittently; eg Don't use caffeine during every workout, and every fortnight have one week off. Also to maximise the benefits, avoid taking caffeine other than at training times. ie. Don't drink coffee, tea, coke or other food and drinks containing caffeine unless they are part of your program. The use of Grapefruit juice containing Naringin will also help stop the body from becoming de-sensitized to the effects of caffeine.

SLEEPING HINT

Some people may experience difficulty getting to sleep if they train late in the day.

A simple but powerful solution to this is to use a mental technique that relaxes the body and calms the mind, making sleep effortless and natural.

Lying flat on your back in bed, arms to your side and legs slightly apart, place your attention on your breathing.

Do not try to control it - just focus your attention on it. Be aware of each breath in and each breath out. Feel your lungs fill and then empty. Feel your chest rise and fall. Feel the air moving through your nose and then out. As thoughts enter your mind, just let them go and bring your attention back to your breathing. Do not try to do or think of anything - just be aware of your breathing.

After approximately 10 minutes, you will enter a profoundly relaxed state. Your brain wave frequency will slow down. Instead of producing predominantly Beta waves

(those which characterise an alert, awake state) your brain will start producing Alpha, Theta and Delta waves as you fall asleep.

STANDARD CAFFEINE CONTENT VALUES

Recognizing that there can be significant variability in caffeine content for a given source, it is nonetheless useful to have representative values for each of the major sources.

Coffee

Ground roasted	**85mg/150ml (5-oz cup)**
Instant	60mg/150ml (5-oz cup)
Decaffeinated	3mg/150ml (5-oz cup)

Tea

Leaf or bag	**40mg/150ml (5-oz cup)**
Instant	30mg/150ml (5-oz cup)
Cola (except caffeine-free)	18mg/180ml (6-oz glass)
Cocoa, hot chocolate	4mg/150ml (5-oz cup)
Chocolate milk	5mg/250ml (8-oz cup)
Caffeine 1g	1000mg

FOR MUSCLE BUILDING, PHYSIQUE ENHANCEMENT

Example:

SUBJECT:	**Male**
Lifestyle:	Active, trains 4 x week 2 years training
AGE:	25
Diet:	High Protein, High Carb, Low Fat
WEIGHT:	80kg
BODYFAT:	12%
NO CAFFEINE	

1/2 hr before training 250mg Caffeine

300ml Grapefruit juice

(FOR FAT LOSS, PHYSIQUE ENHANCEMENT - See Section III Fat Loss under Caffeine.)

Taken before a run, a bodybuilder could expect to run with less perceived effort, burn more body fat, have greater endurance and a greater VO2 max, than without it.

Taken before a workout, a bodybuilder could expect caffeine to help him to increase the intensity; reduce perceived effort, increase the workload and help him concentrate better than without it.

Taken before a contest a bodybuilder could expect caffeine to make him feel more alert, get a greater, more vascular pump, and appear more defined due to diuretic effect, than he otherwise would have.

SECTION 3
THE PHARMACOLOGY OF FAT LOSS

As the developed world as a whole gets fatter each year, certain athletes, (bodybuilders in particular), endeavour to obtain all-time lows in bodyfat percentages. Supplemental dietary techniques have been developed by these athletes almost to a level of a science and some of the major 'secrets' have been revealed in this section.

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FAT REDUCTION

The most common beneficial finding of caffeine use is an increasing in burning of bodyfat as fuel (Costill et al 1978, IVY et al 1979).

Compared with controls up to 100% more bodyfat is burned by the subjects using caffeine.

Caffeine is a powerful lipolytic agent, promoting the breakdown of stored fats. This leads to a dumping of fats (non-esterified fatty acids, NEFA's) into the blood where they can then be taken up by skeletal muscle to be oxidized.

Caffeine increases lipolysis by increasing blood adrenaline levels, and adrenaline is a potent internal lipolytic hormone (J. Appl Physiol 72:1297, 1992). Adrenaline can activate lipolysis not only from fat cells but also from within fat cells (muscle triglycerides).

When ingested with a meal, caffeine increases the rate at which the food is to be converted into usable energy.

When caffeine is taken between meals, it causes fats to be transferred from deposits in the cells to the bloodstream. Here, as free fatty acids they can be used as energy by most of the organs of the body. (Gilbert 1992).

A high protein, low carbohydrate, low fat diet works best with caffeine for maximum fat burning. A high carbohydrate diet negates the fat-burning effects of caffeine (Weir J et al Med Sci Sports Exerc. 1987; 19:100-106)

Caffeine also raises the activity levels of the body, which can mean that the energy derived from food is used up in exercise rather than be stored as fat. In addition, caffeine stimulates the temperature-regulating centres of the body, which in turn produces an increase in body temperature. To sustain this change, energy that might have otherwise been deposited as fat is used. Thus, even when the body is at rest, a greater amount of food is burned. (Caffeine: The most popular stimulant, Gilbert 1992).

Although caffeine achieves peak blood levels about an hour following oral ingestion, the fat burning response does not begin until 3-4 hours after ingestion. (Weir J et al Med Sci Sports Exer 1987; 19:100-105 Belect S et al Metabolism 1968; 17:702-707).

Most of the drug is removed from the body within 12 hours. However, smoking causes the body to metabolize caffeine 50% faster, whereas other substances can substantially extend caffeine's life. Oral contraceptives can more than triple the half-life of caffeine. I remember laughing lots of times when being told that eating grapefruits with coffee for breakfast would reduce fat. But now we know it's true. The bitter compound which is contained in the grapefruit, known as Naringin, will extend caffeine's life in your body, slowing the breakdown of the Xanthines in the liver (British Journal of Clinical Pharmacology).

This enables a lower dose of caffeine to remain active and give the same effects as a higher dose whose duration of effect has not been extended.

While we're on the subject of increasing the effects of caffeine, are there any other substances that can be 'stacked' with caffeine? Yes, there are. Another legal one is Aspirin. Like caffeine, aspirin is a methylzanthine. Bodybuilders combine Caffeine, Aspirin and Ephedrine in a thermogenic cocktail. Ephedrine is not legal without a prescription in Australia, nor is its herbal precursor Ma Huang or Ephedra herb which are classed S4 drugs. They are on the International Olympic Committees list of banned substances.

On its own, 1/2 an aspirin per day with one of your meals will help prevent the formation of gallstones which some people develop when dieting for weight loss (Dr David Powell 1997).

The thermogenic cocktail of the three drugs promotes fat burning, increasing lean body mass while decreasing muscle breakdown (Dulloo Ag, Nutrition Review 1989; 5(1):7-9). Aspirin taken under these conditions can also have a positive effect on workload capacity and anabolic drive. Methylzanthines potentiate the ephedrine activity by increasing release of the hormone nor-epinephrine (Falk B et al Can. J Physcol Pharmacol 1990; 68:889-892).

The ratio of caffeine to ephedrine is 10:1 (Int J Obesity 17: Suppl 1, 51-578, 1993) in combination with 300mg Aspirin. (This combination is actually patented). Prolonged daily use of Aspirin can blow ulcer holes in your gut. Agents that work like Aspirin (prostaglandin blockade) may exert the same synergistic effect without the risk of finding blood in your stools. Several plant derived compounds share aspirin's actions, like curcumin from the spice tumeric and gingerols from ginger root.

Click here to buy pure caffeine

For more information and facts on the other performance boosting effects of caffeine, click here

NARINGIN

Scientific Name:	**Naringin**
Type of Nutrient:	Food
How Supplied:	Grapefruit powder (with peel)
Natural Source:	Grapefruits (including peel)
NOTE:	Not Grape Juice (usually red) but Grapefruit Juice (green)
Used for:	Thermogenic enhancer
	Xanthine extender
Legal status:	OTC
Availability:	Limited
Cost effectiveness:	* * * *
Safety:	Excellent

As mentioned earlier, the bitter compound which is contained in the grapefruit will extend caffeine's life in your body, slowing the breakdown of the xanthines in the liver (British Journal of Clinical Pharmacology).

This enables a lower dose of caffeine to remain active and give the same effects as a higher dose whose duration of effect has not been extended.

One of caffeine's most beneficial effects is its ability to increase lipolysis (fat burning) by increasing blood adrenaline levels, because adrenaline is a potent internal lipolytic hormone (J Appl Physiol 72:1297, 1992).

Naringin is a flavonoid and may have anti ulcer effects. Grapefruit juice contains 500 - 800 mg/litre naringin.

HOW TO TAKE

200-300 ml Grapefruit juice (100-150 mg naringin) with 200-350mg caffeine. Drink two more glasses of grapefruit juice over the day 4 hours apart.

Caffeine dose will vary according to Bodyweight/Tolerance/Reason for use and Individual differences.

The total calories and carbohydrates of grapefruit juice drinks must be taken into account when planning a fat loss program. Using dried grapefruit peel can supply high concentrations of Naringin without many carbs or calories.

PUTTING IT ALL TOGETHER
FOR FAT LOSS, PHYSIQUE ENHANCEMENT

Example	PRESENT REGIME	
SUBJECT:	Female	
Lifestyle:	Sedentary - just started exercising	
AGE:	25	4 coffees per day (320mg caff)
WEIGHT:	80kg	2500 calories per day
BODYFAT:	30%	Typical High Fat, High Carb diet

NEW REGIME

First week: Total abstinance of caffeine containing foods.

Reduced calorie, low fat, low carb, high protein diet.

Week Two:	**Upon awakening 250-350mg caffeine**	
Drink 2 litres water	1 multi mineral 200ml Grapefruit juice	
throughout day	4 hrs later	200ml Grapefruit juice
	4 hrs later	200ml Grapefruit juice
	1 hr before weight training	250mg caffeine
	or 3 hrs before Aerobic training	

Reduced calorie, low fat, low carb, high protein diet

Daily total not to exceed 500mg caffeine.

TIP: TOLERANCE EFFECT

If you have ingested caffeine containing foods and beverages in high amounts for a long time, your body may have developed a tolerance to the effects of caffeine.

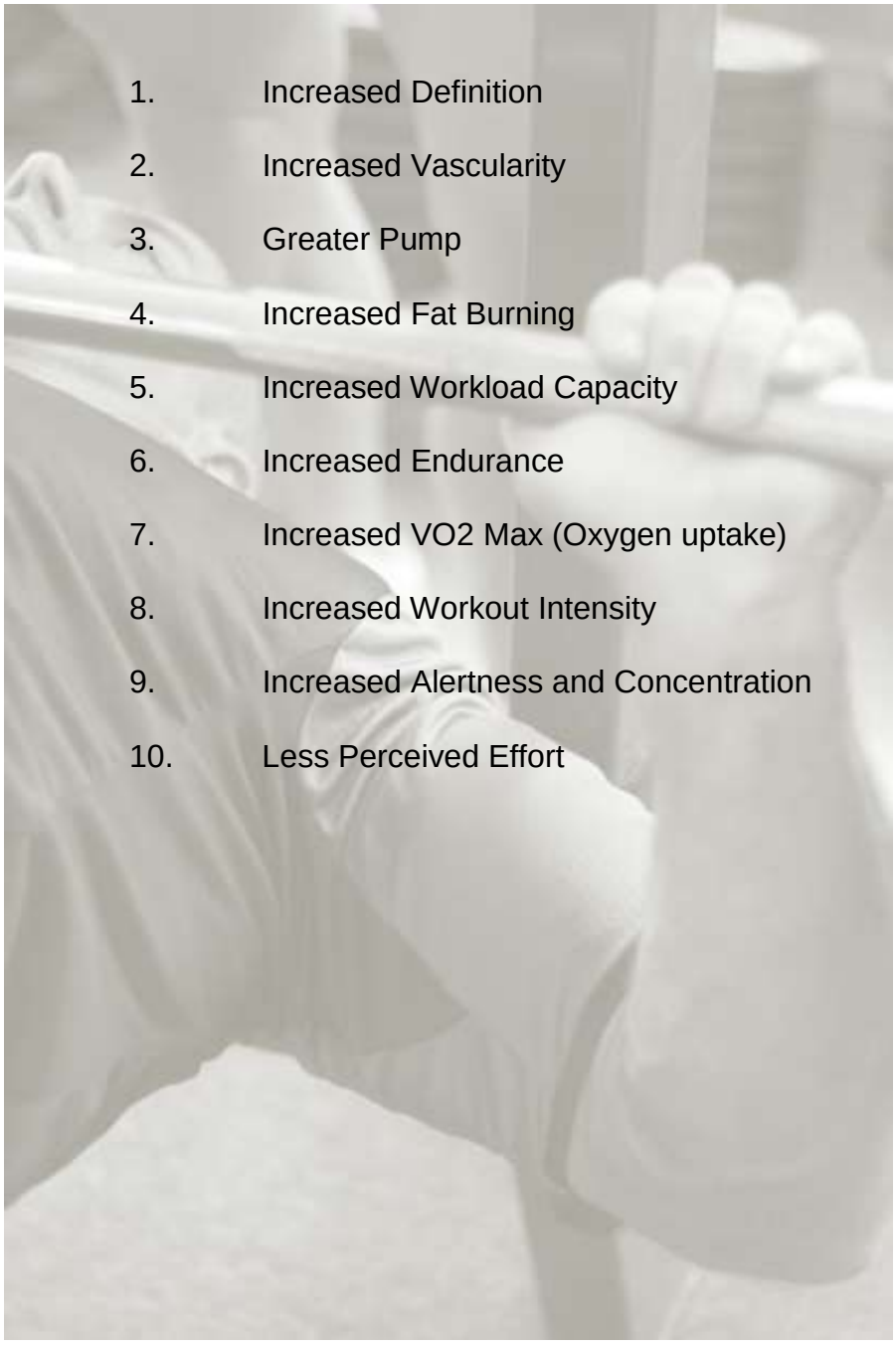
If this is the case then slightly higher dosages may need to be taken.

Alternatively, and probably better, is to have a complete break from caffeine for a few weeks prior to its use. This allows the body time to clear itself of the drug so that when it is taken in the future, a small amount has a greater effect.

To avoid or minimise the effects of tolerance, dosages should be kept as low as possible and used intermittently.

ie. don't use caffeine every day and every fortnight of use should be followed by one week off.

Top 10 Benefits of Caffeine for Bodybuilders



1. Increased Definition
2. Increased Vascularity
3. Greater Pump
4. Increased Fat Burning
5. Increased Workload Capacity
6. Increased Endurance
7. Increased VO2 Max (Oxygen uptake)
8. Increased Workout Intensity
9. Increased Alertness and Concentration
10. Less Perceived Effort

FOR ATHLETIC PERFORMANCE, INCREASED ENDURANCE

Example:

SUBJECT:	**Male**	
AGE:	30	
WEIGHT:	70kg	
BODYFAT:	10%	
Lifestyle:	Active, trains 2 x week weight	3 x week runs 10 km
Diet:	High Carb, Mod Protein, Low Fat	
NO CAFFEINE		

Event: 10 kilometre + race

3 hours before 700mg * Caffeine

300ml Grapefruit juice

5 minutes before 300ml Grapefruit juice

*__WARNING__: *This dosage (10mg/kg) has the potential to exceed the IOC's legal limit.*

Caffeine is known as an analeptic drug, or a substance that can restore strength, awake and invigorate.