Caffeine's Fat Reducing Effects: An Update

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If asked to name the most accepted and researched performance-enhancing substance in the world, most people would answer "creatine." Despite the impressive list of publications supporting the use of creatine, its support pales in comparison to another product that is automatically included in many product formulations and is consumed by more Americans than any other performance product.

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What is this wonder substance? And if it's so widely known and has such power, why doesn't it immediately register? The product is caffeine. Caffeine has become so accepted and so familiar that it's not given its due respect. Consider the number of people who consume caffeine daily, most making it part of their morning ritual in the form of coffee, tea or soda.1,2 It has integrated itself into beverages and tablets and capsules in such a devious manner, that it's rarely acknowledged as being present.

Numerous studies have shown positive ergogenic effects with caffeine use and it's considered safe to use.2,3,4 The same sports organizations that routinely ban any substance with performance-enhancing benefits allow caffeine to be used at doses that are in excess of common levels of consumption. Despite being highly effective at improving the performance of athletes and soldiers, caffeine has been most widely used in the formulation of fat-loss products.

Impressive Fat Burner

Caffeine has an impressive resume as a fat burner, with many published studies documenting its effectiveness at dropping pounds and reducing body fat.5,6,7 These studies have shown caffeine to be capable of increasing the release of stored fat, as well as the rate at which calories are burned. The net results are statistically significant, but in the real world are not sufficient for the fat loss desires of overweight couch potatoes or competitive bodybuilders. Caffeine is able to increase the resting metabolic rate only slightly; noticeable fat loss would require many months of constant use.

The effects of caffeine are best realized when used with certain other drugs or supplements. This fact is the basis for the inclusion of caffeine in combination with many different compounds. The most popular combination (and the most effective) has been the ephedrine/caffeine mix. Other ingredients have been combined with varying degrees of success, including green tea extract, yohimbine, synephrine, etc.

Recently, a paper was published that demonstrated the true effectiveness of caffeine and reviewed the many pathways by which caffeine accomplishes fat loss.5 Acheson, et al, investigated the effect of caffeine on lipolysis (release of stored fat from fat cells), oxidative lipid disposal (burning fat calories), non-oxidative lipid turnover (breaking down fat that is not burned for energy and then reforming it as stored fat) and energy expenditure (the total number of calories burned).

Caffeine promotes fat loss at two major sites- fat cells and muscle cells. The action of caffeine at the fat cell appears to be predominantly supportive to the fat loss signal generated by neurotransmitters and drugs that stimulate beta(B)-adrenergic receptors.8,9 These receptors are stimulated by adrenalin (the hormone that causes a rapid heart rate during periods of excitement) and similar chemicals. The level of adrenalin-like drugs, hormones and neurotransmitters released at any point in time is called the "sympathetic tone." The sympathetic tone may rise quite high during a "fight-or-flight" response or it may be low during periods of rest or sleep. Regardless, beta-adrenergic receptors are constantly being stimulated to some degree to maintain blood pressure, mental focus, energy (glucose and fat) levels, etc. At rest and without the addition of caffeine, there is not much fat release or increase in calorie burning because of the negating effect of a competing class of adrenergic receptors called A2-adrenergic receptors. While B-receptors promote fat loss and increase calorie burning, the A2-receptors do the opposite.10 Dan Duchaine had recommended the use of yohimbine to block A2 receptors while using fat loss products.

Caffeine is a fairly simple molecule, categorized as a trimethyl xanthine. One function of caffeine is to promote the cAMP signal generated by the B-adrenergic drugs or hormones. It does this by acting as an adenosine antagonist, meaning it counters or interferes with the signal that normally prevents cAMP production.10 Caffeine increases the release of stored fat by prolonging the fat breakdown signal generated by adrenalin, ephedrine, clenbuterol and similar drugs. This includes the B-receptor stimulation that exists from the normal sympathetic tone.

The newly released FFA (non-estrified free fatty acid) travels the bloodstream to enter active areas, such as the liver or exercising muscle, to be burned for energy (oxidative lipid disposal). If there is no need for additional energy (calories), then the FFA will return, through the bloodstream, to fat cells. The release of FFA from a fat cell, only to return to the fat cell to be stored is called non-oxidative lipid turnover or futile cycling.5 It reminds one of the old phrase "you're just running in circles," meaning a lot of activity that accomplishes nothing. Fat release without fat burning accomplishes nothing in regard to fat loss; the FFA just "runs in circles."

Measuring Fat Release

Acheson's group used a series of tests and measures to determine the amount of fat released normally and after taking caffeine.5 Through further measures, they evaluated the eventual fate of the released FFA. The results showed that under the influence of caffeine (10 milligrams per kilogram body fat), the amount of FFA released by fat cells more than doubled (130 percent increase). Simultaneously, the demand for calories increased, though only by 13 percent. For most people, that only translates to approximately 250 calories per day. As the amount of FFA released far exceeded the amount needed to meet the increased demand for calories, a great percentage of the released FFA was returned to the fat cell and re-stored as fat. The authors of the study referred to this as "futile cycling," as the fat was broken down, shuffled around and stored away again, resulting in no net fat loss for that percentage of the released fat.

Fortunately, there was a measurable increase in energy expenditure (the number of calories burned).5 The process by which caffeine increases calorie burning is more complex and less well understood than the process by which it increases fat release. In humans, an increase in energy expenditure is usually due to an increase in activity, as a result of the greater metabolic demand of skeletal muscle. When skeletal muscle contracts and relaxes, it uses ATP (the energy molecule) at a much greater rate. The ATP needs of exercising muscle are met through an increased rate of calorie burning. Most writers believe caffeine's effect on skeletal muscle is solely due to an amplification of the effect of adrenaline. This is because the most easily recognized side effect of caffeine excess is the jitters. Increasing the sympathetic tone of the skeletal muscle increases the twitching of muscle, which is an increase in activity requiring more ATP, thus the increase in energy expenditure.

However, there is another mechanism that may contribute to caffeine's effect on energy use. Caffeine, as well as its three major metabolites, increases the levels of free calcium ions in the muscle cell interior.5,11,12 Calcium ions are tightly regulated, as they are very potent triggers of biological reactions, including muscle contractions. When calcium interacts with the actin-myosin heads of muscle fibers, it causes the muscle to contract. Caffeine causes free calcium levels to increase in the muscle cell by interacting with another receptor called the ryanodine receptor. By increasing the amount of free calcium present in the muscle cell at rest, it makes the muscle more likely to contract and do so with greater force when stimulated.

One benefit of caffeine noted by Acheson was that the potent release of stored fat actually increased the proportion of fat (compared to carbohydrates) burned for calories.5,13,14 This is one reason why taking caffeine before early morning cardio (before eating breakfast) is so effective at reducing body fat.

One More Round

The researchers performed an additional round of tests, this time using

caffeine in the presence of propanolol. Propanolol is a drug that blocks the B-receptors, preventing any adrenalin-like responses in the body. This drug is used to prevent people with heart disease from becoming excited, but it is also effective as a research tool in blocking the effect of naturally produced adrenalin-like hormones and neurotransmitters, taking the sympathetic tone down to an absolute minimum.15

When propanolol was present, fat release was not increased by caffeine, meaning there was no additional fat loss. The increase in energy expenditure that had been previously recorded was also less, meaning fewer additional calories were burned. Thus, it would appear that the fat-releasing effect of caffeine is primarily dependent upon B-adrenergic stimulation. This stimulation may be the result of exercise, drugs (ephedrine, clenbuterol), cold weather (shivering), or an excited state. Regardless of the cause, without an increase in sympathetic tone, caffeine will have little effect on fat loss. Acheson did note that even under the influence of propanolol, caffeine was able to increase the energy expenditure slightly, possibly due to the entry of calcium into the muscle cell.5 However, the degree of increase is low and would only account for an additional 100 calories burned daily.

Summing Up

Caffeine is a popular, widely used drug with performance-enhancing benefits to athletes, soldiers and others who battle fatigue. Additionally, it has been shown to be effective as a fat-burning agent, particularly when used in conjunction with drugs or supplements that increase sympathetic tone by acting like the hormone adrenalin.8 Caffeine increases fat loss through a number of pathways. It increases the fat-releasing effect of ephedrine, clenbuterol and similar drugs by prolonging the cell signal, causing a greater amount of FFA to be released into the bloodstream. Caffeine again acts as a chemical companion to adrenalin-like hormones and drugs by increasing the activity of muscles, thereby increasing the number of calories burned. As a consequence of the high levels of FFA released, more fat calories are burned than would otherwise be available without the use of caffeine.

By itself, caffeine is has a minor role in fat loss. When used in conjunction with other fat loss methods, it increases fat loss dramatically. The prevalence of caffeine in the global diet and its enviable safety record4 make it a supplement to be considered for any fat loss program.

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