WEIGHT GAIN SUPPLEMENTS

Since the times of Charles Atlas man has been striving to develop the perfect physique. Inspired by the pictures of the early muscle magazines many boys rushed to the local gym in hopes of developing the then perceived "massive musculature" that all the girls wanted. Those early muscle men, although inspiring in their day, pale in comparison to the behemoths found in today's bodybuilding magazines. It is not hard to notice the substantial differences between the body building pioneers of yesterday and the one's that grace today's newsstands. The naïve might attribute it to the new technology and innovation of training equipment. The wiser would recognize the major difference to be one that can probably be found in the medicine cabinets of the latter.

Steroids are extremely common and used by men women and teens alike. They have proven results as evidenced by most bodybuilding and strength competitions but are not the only way to develop muscle mass. For someone looking to add muscle mass without drugs there is always hard work, dedication and an industry aimed at selling the same dream as the one had by the boys looking at the early muscle mags. The nutritional supplement industry has found huge success with individuals looking to gain muscle, lose weight, add energy, increase sex drive….. the list goes on for hours. This article will review some of the more popular supplements advertised at enhancing human muscle mass.

Everywhere you look is an ad making astounding claims of products aimed at increasing the size of muscle. Weight gain supplements can be purchased at retail stores, through mail order catalogs, out of magazines and even at your local supermarket. This rise in popularity coincides with the male perception that large muscles are more aesthetically pleasing to females. This concept has lead to a race to find the elixir that can make good on its claim as a muscle builder. Some of the current candidates include chromium, beta-hydroxy-beta-methyl butyrate (HMB), creatine, vanadyl sulfate, boron, protein isolates, and amino acids.

Chromium saw early popularity as a proposed weight loss tool. It was believed that taking chromium supplements increased the rate of fat metabolism. The premise stemmed from the basic function chromium has on insulin action. Upon further review, it seemed to make more sense that the trace minerals role on insulin was better served as a muscle mass supplement. This concept was based on the fact that if chromium indeed increased insulin activity, and insulin increases the uptake of glucose and amino acids by the cell, then the cell would have more amino acids leading to an increased synthesis of protein and ergo more muscle mass. In theory, maybe, but based on research, probably not.

The data collected on animals suggests that the chromium supplements do increase muscle mass (Stoecker,1996), but for humans the same results were not so supportive. One complication is that the US Food and Nutrition Board does not have a defined RDA value, but a recommended range (ESADDI) of 50-200 μg. The first report of possible efficacy came from a study (Evans 1989) using a group of trained and untrained college students. The subjects were given 200 μg of chromium picolinate (picolinic acid is thought to enhance the

effect) or a placebo for 40-42 days while participating in a resistance training program. The author concluded that the test group showed greater gains in lean mass than the placebo group based on estimates of lean mass using circumference measurements. The choice of measurement and changes measured make the conclusion somewhat questionable.

Surprisingly these results were not supported by subsequent trials. A similar study (Hastens 1992) showed that students participating in resistance training programs while consuming 200 µg of chromium picolinate. Only small amounts of weight gain were seen in both the placebo and test group. Interestingly, females made considerable gains in body weight while taking the supplement. Lean mass was never assessed so the actual weight gain could be from compartments other than added muscle mass. The author made several speculations regarding the weight gain in the female test group.

1. **Females may have a chromium deficient diet.**
2. **The dose per body weight was higher**
3. **Females may be less insulin resistant than males**
4. **The relatively large gain found for untrained subjects just beginning a strength training program may mask any effect of the supplement for males**

Two additional studies, (Clancy 1994, Lukaski 1996) examined the effects of chromium picolinate on muscle mass enhancement. In the 1994 study, Clancy and colleagues gave football players either chromium or placebo during a 9 week strength program. Assessment of body composition was determined using underwater weighing and anthropometric measurements while caloric intake was tracked using food diaries. There was no difference found between groups in either body composition or lean mass, although urinary chromium excretion was elevated in the chromium supplement group.

These results were duplicated in the study by Lukaski and colleagues in 1996. In a well-controlled study, untrained men started on a resistance training program while taking either chromium picolinate, chromium chloride, or placebo. Again the supplement had no effect on body composition, but similarly with the study by Clancy, found an increase in urinary excretion of the mineral. This suggests that males seem to have adequate levels of chromium, and additional supplementation is simply excreted.

Based on a preponderance of the data the supplement does not show to be effective at increasing lean mass or reducing body composition. Chromium should be consumed as part of a normal healthy diet but fails to demonstrate any additional effects beyond its role in normal metabolism.

Creatine has become one of the most popular supplements due to its muscle building properties. The substance found in meat and fish or synthesized in the body from the amino acids glycine and arginine, combines with phosphate to form creatine phosphate in skeletal muscle. This marriage provides a source of energy when used in conjunction with adenosine diphosphate.

Several studies (Green et al l996, Jacobs et al 1997, Volek et al 1997, and Prevost et al 1997) have found that creatine supplementation in doses of 20-30 g/d, (the amount found in roughly 12 lbs. of raw steak) for 5 days has a significant effect on weight gain (1-3 kg). The mechanism for the weight

gain is still unclear but seems to be an increase in muscle creatine. It is thought that the creatine acts as an osmotic agent within the skeletal muscle which would cause the cells to increase water retention. In some subjects urine volume decreased which helps explain the water retention theory (Volek & Kraemer, 1996).
Creatine does seem to have an effect on protein synthesis within cells (Zeigenfuss et al 1997; Flisinska,1996). The actual weight gain due to protein synthesis is still unknown and the majority of weight gained is still primarily attributed to fluid within the cell.

The safety of creatine supplementation has been questioned due to the lack of long-term research studies. Some unfounded claims suggest the possibility of liver damage and renal stress. Additionally, creatine has been believed to be responsible for cramps, spasms and strains based on anecdotal information. If taken within the recommended dosage, a loading phase of 20g for five days and 3-5g each day after that, no short term effects have been encountered except for the occasional stomach irritation and loose stool. Higher dosages do not offer additional benefits and should be avoided.

Another trace mineral that has been sold as a possible ergogenic aid is vanadium. Unlike chromium vanadium does not have any established criteria or recommendations for consumption by the RDA or the ESADDI. The inorganic compound has not been classified as essential for human life. Interest in vanadium came from animal studies that showed that deficiencies can have harmful effects and reduce life span. This deficiency problem has not been observed in humans.

The role of vanadium is not yet known but one proposed function is that is has a role in promoting the transport of protein into the cell. This concept coincides with the thought that increased cellular uptake of amino acids equates to increased lean muscle mass, hence the marketing of vanadium as a muscle building supplement in the form of vanadyl sulfate. This idea that vanadium has an anabolic effect comes from the animal studies and the analysis of cells (Nielson, 1996).

To this day there has not been any data that has proven that vanadium as an anabolic compound. One study evaluated vanadyl sulfate supplementation in a 12 week clinical trial which compared weight training results of subjects ingesting the supplement to those ingesting a placebo. The results showed no beneficial effects on body composition as assessed by arthropometric measures or DEXA scan (Fawcett et al 1996).

Vanadium does not appear to show any efficacy as a muscle promoting agent. It does though look like consumption of quantities around 10 mg for periods as long as 16 months are not toxic. But larger doses do appear to be harmful and since there is no apparent reason for using vanadyl sulfate, it does not make any sense to consume additional amounts outside of that found in a normal diet.

Boron is yet another hopeful on the list of potential muscle builders. The essential element for plant growth does not appear to be an essential nutrient for humans. There is no RDA or ESADDI for the element and it does not appear in any database as a measurement within food. It is not known how boron is transported within the body but it does become concentrated in areas such as the teeth, fingernails and hair. (Neilsen, 1996) The exact function of boron is unclear but it does appear to have a function based on animal studies. It is proposed that boron affects the metabolism of calcium and magnesium (Chrisley, 1997). It is thought to increase testosterone which leads to an

increase in protein synthesis. One study found that boron (3 mg/d) increased serum estrogen and testosterone in postmenopausal women in addition to reducing calcium loss when ingested with a low magnesium diet. Other studies showed no increase in anabolic hormone concentration and the one study that did look at the effects of boron on muscle mass in males came up with no evidence of boron having any effect. Based on these findings there is no evidence that would suggest that boron will increase muscle mass.

Beta-hydroxy-beta-methylbutyrate is the long way of describing an amino acid metabolite, specifically leucine. HMB is not only formed in the body but can also be found in citrus fruits and catfish. The role of HMB is not fully understood but it has been determined that it is not essential to the body.

HMB does seem to hold promise as an anabolic agent. It is proposed to act as an anti-catabolic in that it may prevent or reduce the breakdown of protein that is seen with intense training and may also enhance the repair of tissue (Nissen et al, 1996). Nissen performed two studies that showed evidence to support the idea that HMB can increase muscle mass when combined with a strength training program.

The first study examined the effects of ingesting 1.5g, 3g and placebo on males performing supervised strength training 3d/week for 3 weeks. The results showed an increase in strength and mass in the supplement groups over the placebo group with the greatest results occurring in the higher dose group. It should be noted that the supplement group had a decrease in muscle protein breakdown and less evidence of muscle damage.

The second study showed similar results. This study used 3g HMB/d for 7 weeks with an increased training intensity. Again gains in strength and mass were found. Even with this evidence there needs to be more research that replicate these results and identify the mechanism of action, as well as any long term effects with its use.

It is well known that protein is the building block for tissue. Based on this it is probably safe to assume that additional protein should help in the building of more muscle mass. Several studies looked at the need for additional protein for individuals that perform heavy resistance training exercise or strength athletes. Several studies (Chesly et al., 1992; Marable et al., 1979; Yarasheski et al., 1997) found resistance training increased protein synthesis and caused a negative nitrogen balance. This suggests that resistance training athletes require additional protein, above the 0.8g/kg BW necessary for sedentary adults. Other studies reported that, if protein was consumed at 2.0g/kg BW per day in conjunction with heavy resistance training a positive nitrogen balance could be maintained by a strength athlete (Celejowa et al., 1970; Laritchevia et al., 1978). In attempts to find the optimal amount of protein necessary for the growth of muscle (Fern et al 1991) had strength athletes consume 2.0 g/kg BW in addition to the 1.3 g they were already eating. At 3.3g/kg BW/day the athletes had notable increased in protein synthesis and added lean body mass. But they also experienced amino acid oxidation which suggests that the additional protein was excessive and exceeded the maximum requirements for muscle growth. In a study (Tarnopolsky et al 1992) that compared 1.4 g/kg to 2.4 g/kg BW found that the additional protein did not increase protein synthesis but did increase amino acid oxidation. The excess protein is used for energy.

The protein ingestion for strength athletes should be between 1.4-1.8 g/kg BW/day

(Lemon 1995). Lemon (1992) also suggests that protein needs are decreased with training experience and that the lower end of the recommended range be used with an experienced athlete. There is no positive proof that a diet consisting of more than 2.0 g/kg BW/day of protein will increase lean mass. It should also be noted that complete dietary protein is adequate to meet the needs of the body and there is not enough information to conclude that designer proteins are any different than those found in real foods except for the cost per gram.

Amino acids, in particular arginine, ornithine, histidine, lysine, methionine, and phenylalanine has been purported to have a positive effect on muscle mass hypertrophy. In two studies comparing the effects of consuming ornithine and arginine and placebo while strength training (Elam, 1988; Elam, 1989) found that a significant increase in lean mass and reduction of body fat occurred. The premise behind the gain in lean mass is that the amino acids stimulate the release of growth hormone and insulin (Jacobson, 1990; Kreider et al., 1993). In two studies (Bucci 1990;1992) comparing different doses of ornithine found that subjects that consumed 170 mg/kg BW increased their growth hormone but did not effect serum insulin levels.

Other studies contradict the findings. Folgelholm (1993) found a combination of L-arginine, L-ornithine, and L-lysine did not increase serum GH or insulin. Lambert (1993) and Fry et al. (1993) both concluded that the amino acids showed no effect on the hormone levels in short period testing. Although some studies had seemingly positive results the doses are far too costly and can hold negative health consequences if consumed for a long period of time. Additionally there is not enough data to suggest that amino acid supplementation will enhance muscle growth.

The aforementioned supplements are all marketed and sold to consumers looking to enhance their physique with an increase in muscle mass. As seen in the studies few hold any merits and are simply a waste of money. Vanadyl sulfate, Boron and chromium do not promote additional muscle growth when used in conjunction with a resistance training program. Amino acids also failed to show any benefit for increasing muscle mass with resistance training. Creatine does contribute to gains in muscle mass, but the weight gain is likely to be attributed to increased muscle cell fluid volume. Long- term effects may include protein synthesis but more studies are necessary. HMB also showed some efficacy in the one study that used human males. It too may aid in enhancing muscle growth but more research is required before a definitive conclusion can be made. Protein continues to be a necessary component to adding muscle mass with resistance training. The current recommendations are to consume 1.4-1.8 g/kg of body weight per day. It is important not to consume more than 2.0 g/kg BW because of the affect it can have on renal function.

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