Whey, Casein, Soy; Why Protein Sources are Different. Applications for Endurance Athletes.

The ISSN Florida Regional Conference.

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About the Speaker

- Douglas Kalman
  - PhD from Touro University Int. in Nutritional and Exercise Biochemistry.
  - M.S. in Nutrition; Hunter College - CUNY
  - RD since 1994
  - Certifications in Clinical Research, Personal Training

Background

- Clinical Nutrition (Oncology, HIV/AIDS)
- Sports Nutrition (ACSM, NSCA, Collegiate, Olympics)
- Teaching experience at Hunter College, NYU, LIU, FIU, etc.
- Active Member of ADA, ISSN, ACN (Fellow), NSCA, ACSM, APS and ACRP.
- Publications in Scientific and Non-Scientific arena (>100 combined).

Institutional Affiliations

- Director, Nutrition – Miami Research Associates: www.miamiresearch.com
- Adjunct Professor - Florida International University.
- Consultant, GTx Pharmaceuticals.
- Media Representative – American College of Sports Medicine, National Strength & Conditioning Association. www.acsm.org; www.nsca-lift.org
- Co-Founder ISSN www.theissn.org

Disclosures of Interest

- Work for a Contract Research Firm.
- Writer: Muscular Development, Fitness Rx for Her, Prosource.net, Labrada.com
- Per Diem Consultant: Metavantage Sciences, Inc. (consulting firm for Nutrex).
- Non-compensated board/advisor member of:
  - Javalution
  - Scivation

Overview

- The discussion of protein within the context of sports nutrition evokes many types of a response. Many view nutrition and “SN” as a religion and not a science.
- This session is fact-based, science based and intended to provide you with useful take home, applicable information for your clients in the here and now.

SPORTS DIET

- **Fuels muscles for top performance**
- **Nourishes the body**
- **Optimizes health**
- **Enhances recovery**

ENERGY NEEDS

- **Body composition**
- **Type of exercise**
- **Intensity**
- **Duration**
- **Frequency**

Ahlborg G. et al. Substrate turnover during prolonged exercise in man. *J. Clin. Invest.*, 53:1080,1974.

Factors Affecting Protein Metabolism

- **Type**
- **Frequency**
- **Duration**
- **Intensity**
- **Sex**
- **Age**
- **Protein and Calorie intake**

Grandjean, AC. Macronutrient intake of U.S. athletes compared with the general population and recommendations made for athletes. *Am J Clin Nutr*. 1989;49 (5): 1070-1076.

Why Protein?

- Contains EAA, conditionally EAA's and NEAA.
- Can be used as a source of energy.
- Cori-cycle; glucose-alanine cycle
- Gluconeogenesis.
- Transamination processes.
- Directly stimulates MPS.

Ref: D. Kalman. The Effects of Feeding Protein as Compared to Carbohydrate on Athletic Performance, Perceived Exertion and Biochemical Markers of Anabolism and Catabolism in Trained Athletes Under Glycogen Depleted Conditions. Dissertation. Touro University Intl. 7-2007.

Protein Sources

- Animal (dairy, red meat, fowl)
- Fish
- Dairy (foods, casein, whey, hydrolysates, isolates and concentrates)
- Soy (food, powder, RTD)
- Other vegetable sources

Medical Effects of Protein

- Increases plasma tryptophan.
- Tryptophan is the precursor of serotonin.
- Serotonin aids in relaxation and cognition.
- Nighttime feeding of protein enriched with α-lactalbumin ↑ early morning alertness.
- ↑ Trp: LNAA ratio and behavioral performance in poor sleepers.
- Source - whey protein.

Ref: *Amer J Clin Nutr* 2005;81:1026-33.

Protein lowers Cholesterol

- Milk protein, the whey fraction contains immunoglobulins.
- Hyperimmunized cows produce milk rich in bovine immunoglobin (BIg).
- Purified BIg is USDA approved.
- Six-week intervention trial (RDBCT) with 5gm BIg resulted in significant ↓ in TChol and LDL.

Ref: *Amer J Clin Nutr* 2005;81:792-8.

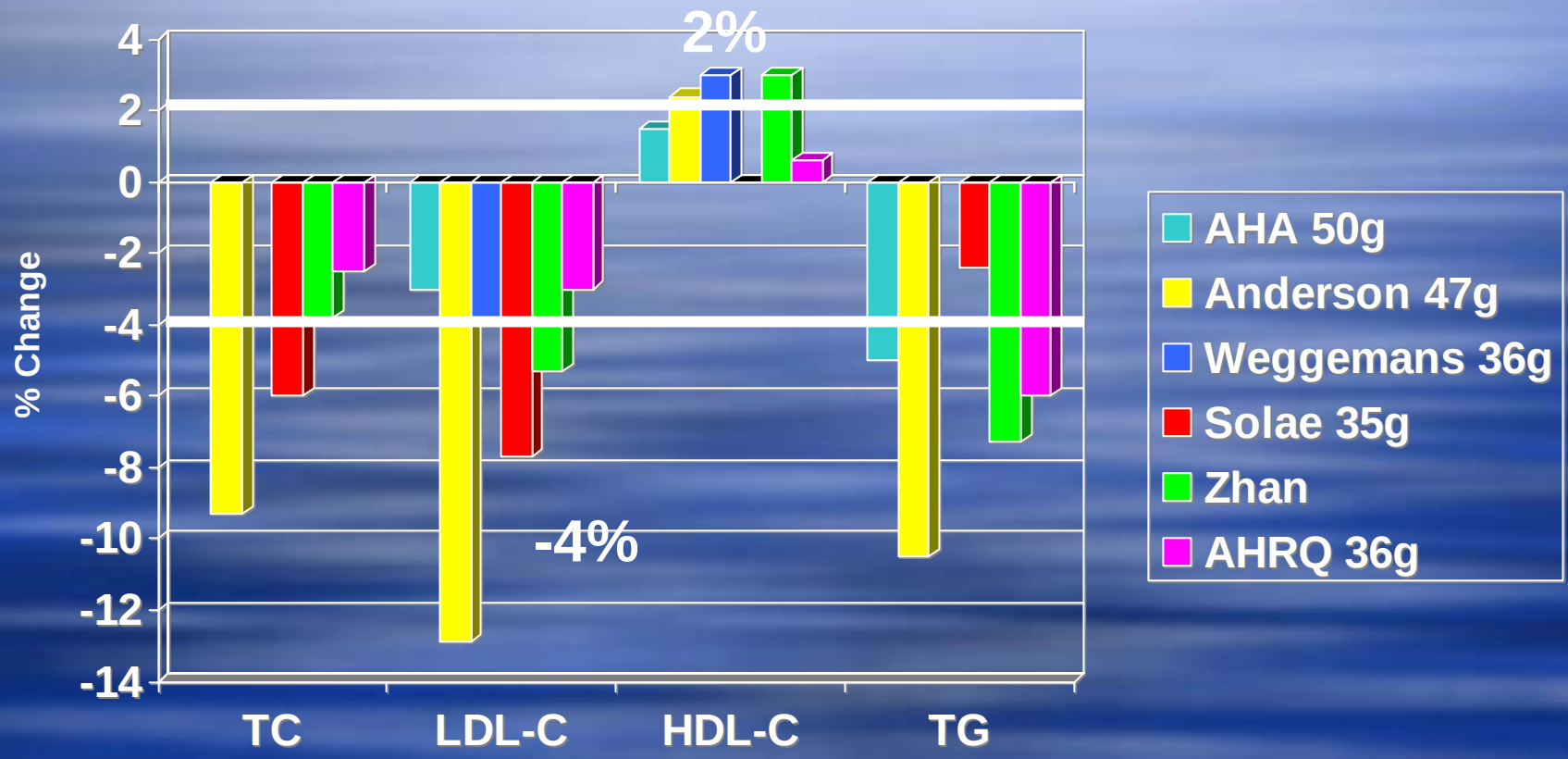
Meta-Analysis

A statistical approach designed to:

- determine the relationship between soy protein consumption and blood cholesterol reduction from a set of published studies
- generate conclusions from the analysis
- summarize the findings in an organized, analytical manner

Anderson *et al*, NEJM 1995;333:276-82.

Results from Meta-Analyses



Global Health Claims….
Soy Protein and Heart Health

Authorized

- Japan (1996)
- United States (1999)
- United Kingdom (2002)
- South Africa (2002)
- The Philippines (2004)
- Brazil (2005)
- Indonesia (2005)
- Korea (2005)
- Malaysia (2006)

Under Review

- France
- Canada

Milk Protein and OA

- Milk contains various protein fractions.
- These fractions include naturally occurring ACE-inhibitors, anti-inflammatory effects, pain reducing effects (opiods), etc.
- 31 adults with OA (1:1, placebo)
- 6-week intervention (12 oz. of NuVim® vs placebo beverage).
- Significant overall improvement in NuVim group vs placebo (WOMAN and KOOS; $P < 0.05$).
- Active ingredient made by Stolle Milk Biologics from “hyperimmunized cows”.

Ref: Nutrition. **2002 May;18(5):388-92**

Protein Source and Body Composition

- Aging is associated with ↓ in LBM, strength and QoL.
- Can type of protein plus RT induce an effect in men > 65 y.o.?
- Beef vs. Lacto-ova-vegetarian diet (12-week).
- "Protein supplementation" at 0.6 gm/kg (~1.03-1.17 gm/kg/d). The LOV group used soy (TVP).
- Both gps ↑ strength (14 - 38%) and muscle mass (vastus lateralis - ~4 - 6%).
- With adequate protein intake, no diff. in muscle size or strength in older men who RT.

Ref: *Amer J Clin Nutr* 2002;76:511-517.

Hormonal Response to Protein

- Does feeding protein directly affect MPS?
- Does acute feeding reflect net 24-hr protein balance?
- 7 subjects rest vs. rest + RT + EAA.
- 24-hr FSR > for RT-EAA
- 3 hr. data mirrors 24-hr data
- Acute anabolic response to EAA + RT reflects 24-hr response.

Ref: *Am J Physiol Endocrinol Metab* 2003;E76-E89.

Protein Intake and Plasma Protein

- Does meal timing and exercise affect circulating amino acids?
- High versus normal protein intake (1 vs. 2.5 gm/kg).
- Physical exercise = 90 min of exercise at 46% maximal O_2 uptake. 14 subjects.
- 10 meals fed fed over a 9-hr period.
- Normal protein intake resulted in greater fasting plasma AA than the high-protein group, with exercise slightly increasing this effect.
- Perhaps higher protein intake preserves or protects against muscular AA oxidation?

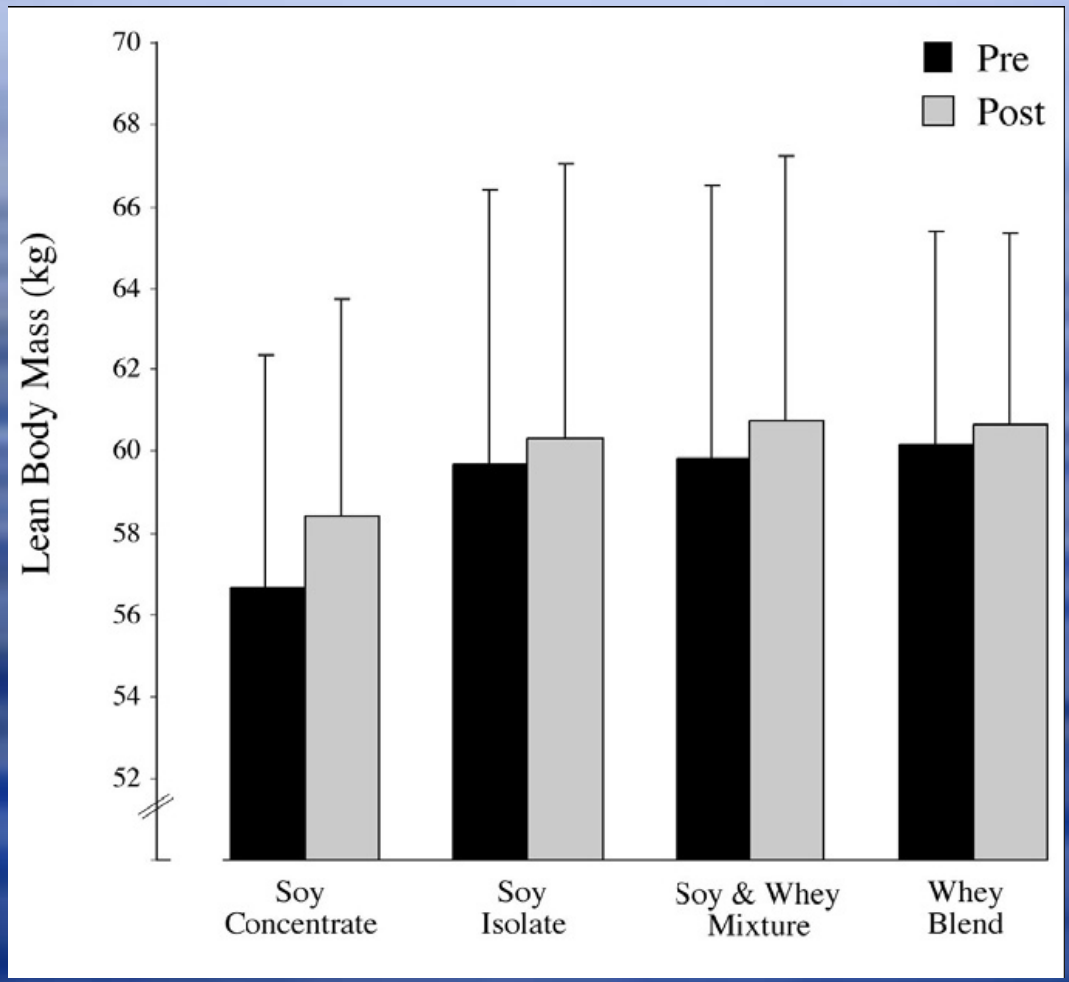
Ref: *Am J Physiol Endocrinol Metab* 2000;278:E857-67.

Protein Plus RT = ?

- Is there differential effects of soy versus whey protein in males who engage in RT over a 12-week period?
- Comparative trial of SPI, SPC, soy-whey blend and Whey.
- ACSM hypertrophy program used.
- Irrespective of group, all gained significant LBM (DEXA, ~ 0.5 to 0.9 kg).
- No negative effects on T, Free-T with actual improvements in the T:E ratio.
- Serving size, 25 gm within 1 hr of exercise and 25 gm another time of the day.

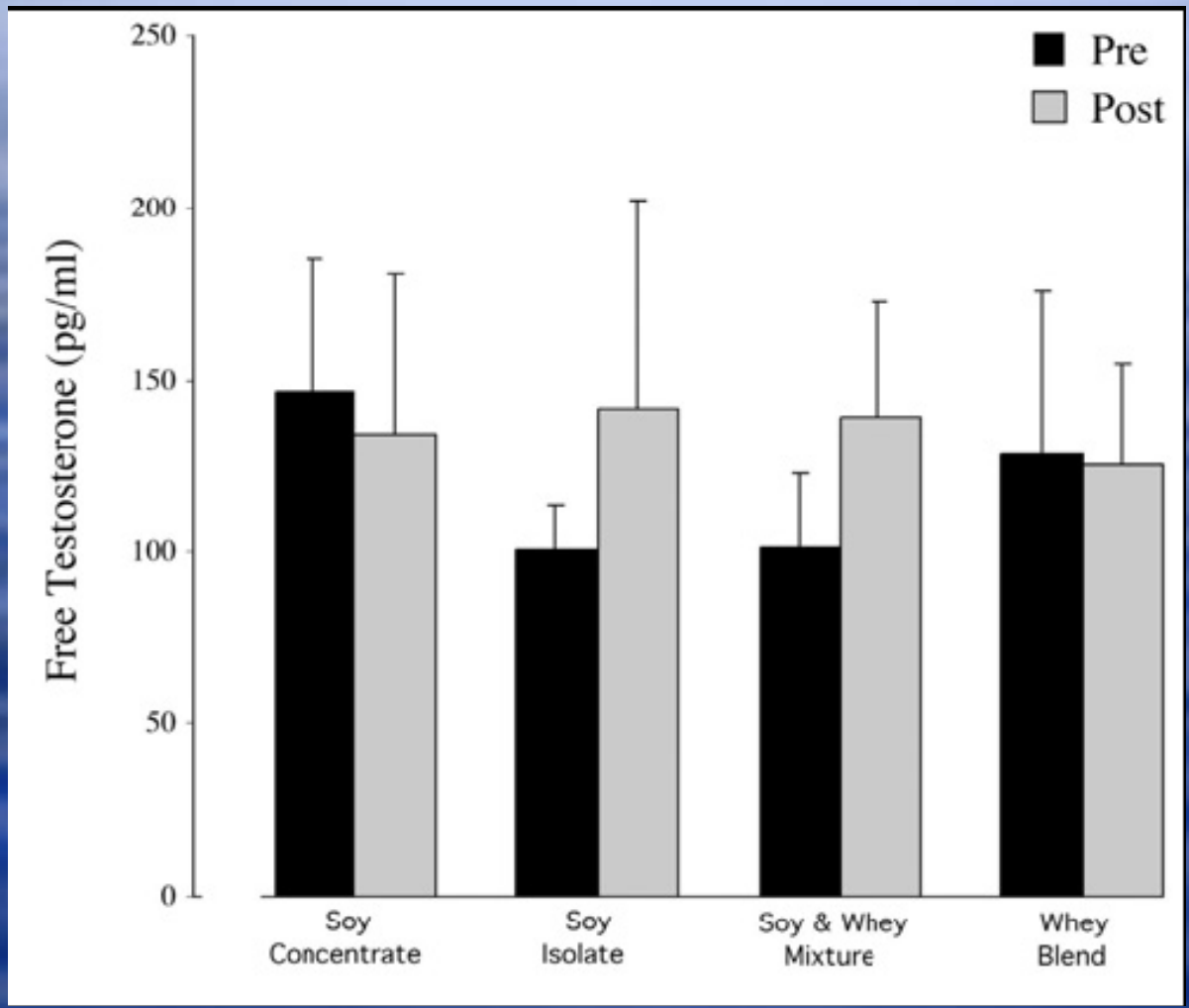
Ref: *J Int Soc Sports Nutr*. 2007 Jul 23;4(1):4. *FASEBJ*. 2005 Experimental Biology Conference, Late Breaking Abstracts #LB250.

Changes in LBM



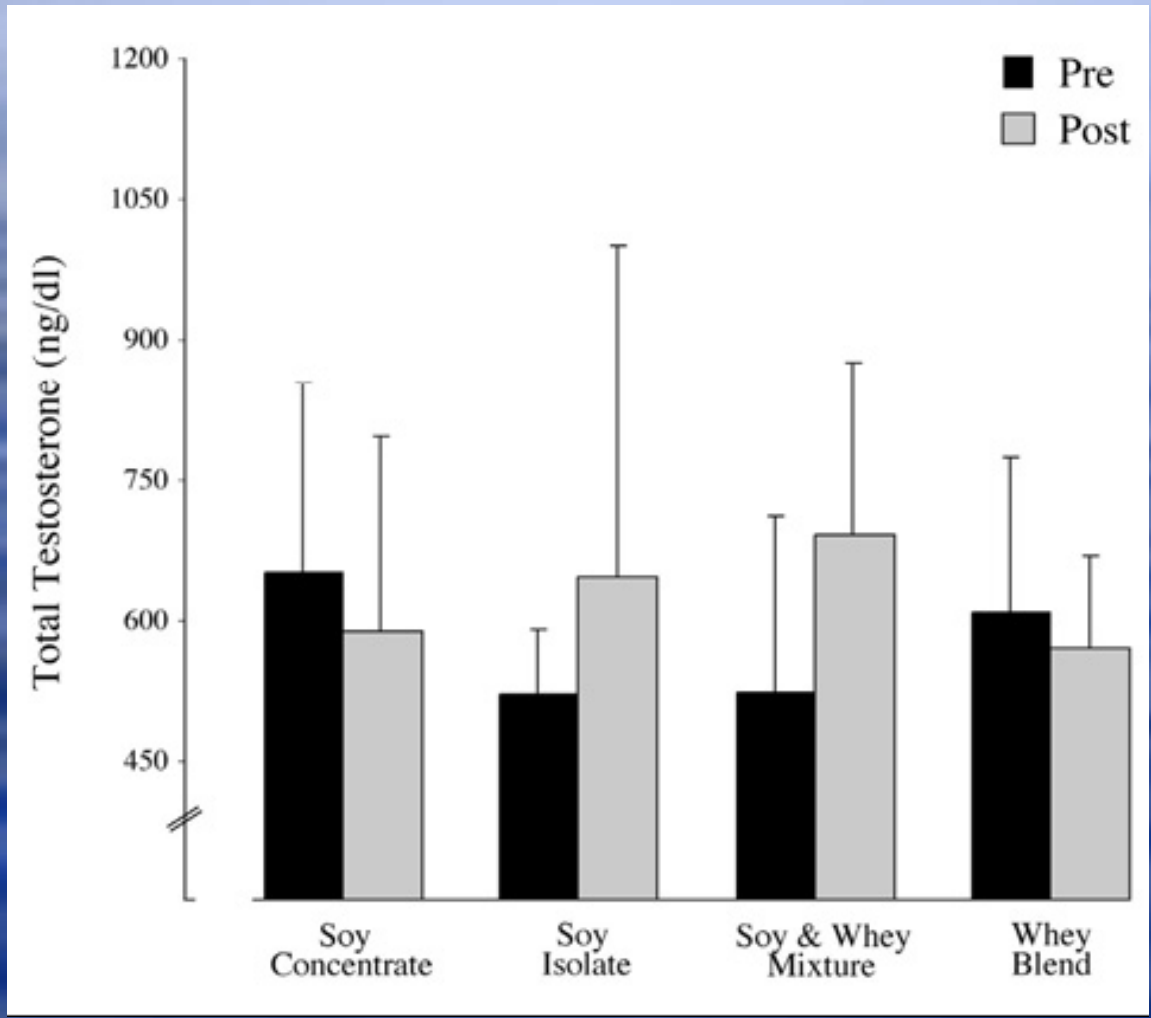
Kalman et al. Effect of protein source and resistance training on body composition and sex hormones. J Int Soc Sports Nutr, 2007.

Free Testosterone



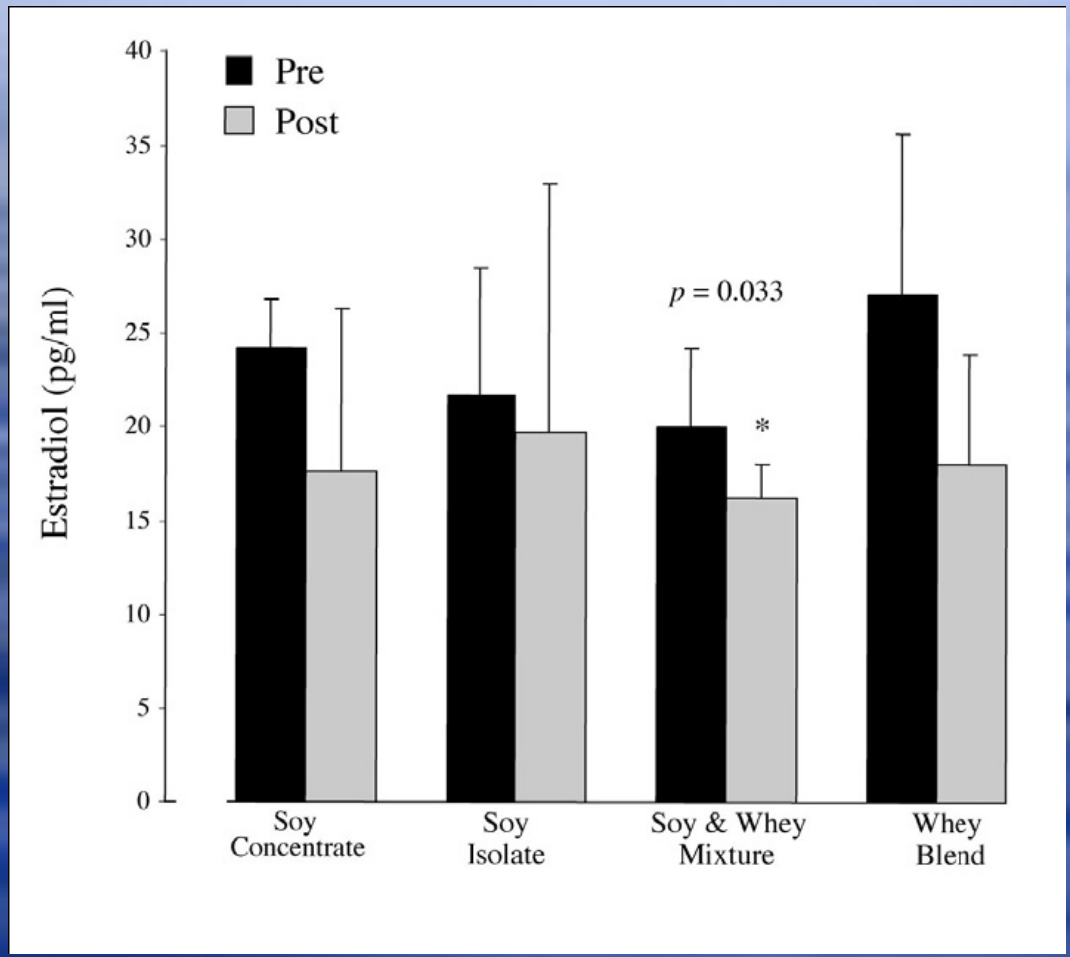
Kalman et al. Effect of protein source and resistance training on body composition and sex hormones. J Int Soc Sports Nutr, 2007.

Change in Total T



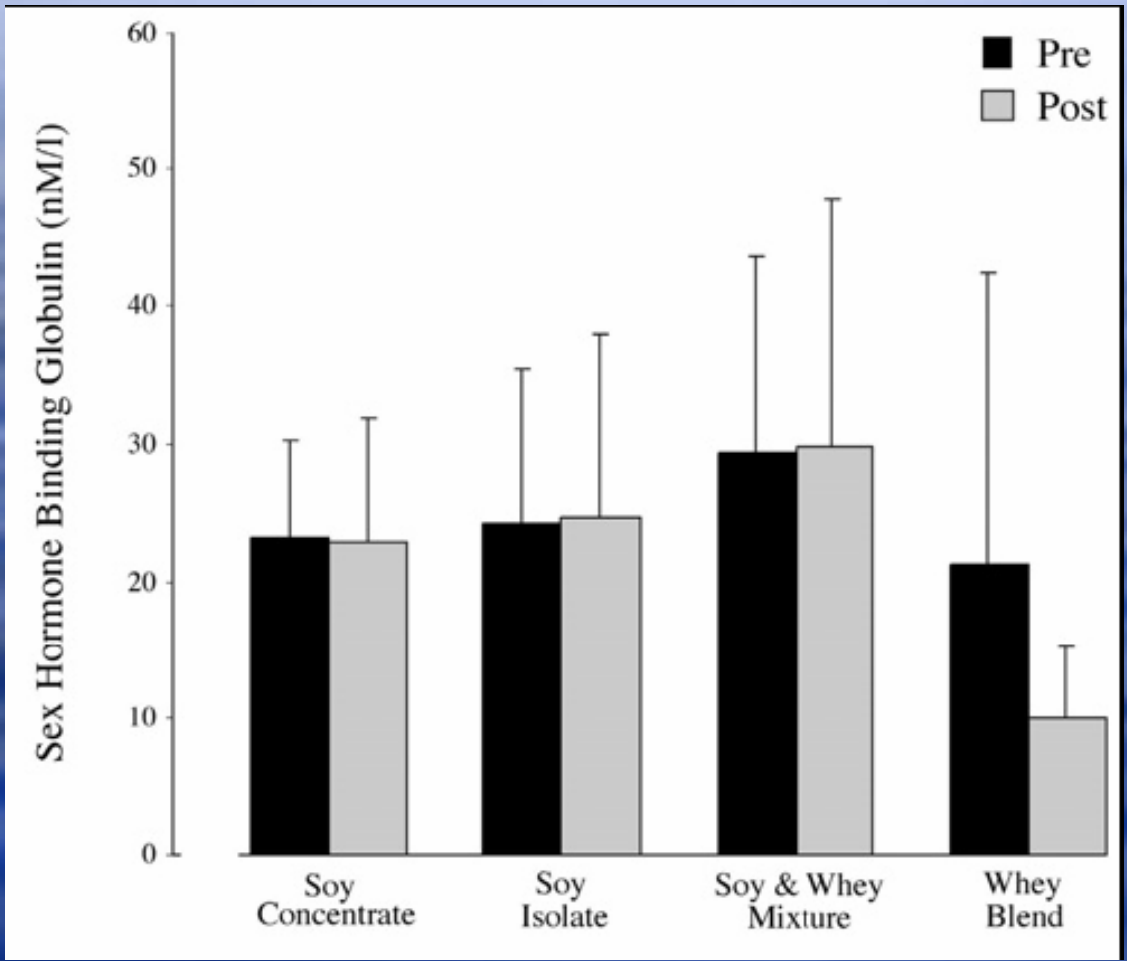
Kalman et al. Effect of protein source and resistance training on body composition and sex hormones. J Int Soc Sports Nutr, 2007.

Change in Estradiol



Kalman et al. Effect of protein source and resistance training on body composition and sex hormones. J Int Soc Sports Nutr, 2007.

Change in SHBG



Kalman et al. Effect of protein source and resistance training on body composition and sex hormones. J Int Soc Sports Nutr, 2007.

Milk, Soy - Can they get along?

- Fat Free Milk vs isonitrogenous soy protein.
- 56 heatlhy men, trained 5x/wk x 12wk.
- Consume ~ 500 ml milk or soy (or nothing-control group) w 17.5 gmPro/svg pre-exercise and 1-hr post-training.
- Results: No b/w gp differences for strength or for Δ Type II muscle fiber area (size).
- Type I muscle fiber ↑ significantly in the Milk & Soy groups ($p<0.05$).
- DXA measured FFM ↑ in all groups with the milk having the greatest increase ($p<0.05$).
- Interesting, but not perfect in design.

AJCN 2007;86(2):373-381.

Does Age Matter?

- Are rates of MPS different in the young vs. elderly?
- ~34 y.o vs. 67 y.o. (n = 6, 7 respectively)
- Oral bolus of 15gm EAA. Synthetic?
- In elderly, EAA resulted in prolonged elevation of Phe, along with greater IC values.
- In both groups MPS rose by about 0.04% per hour.
- Therefore, only time-course kinetics different, but PRO supplementation ↑ acute MPS.

Ref: *Am J Physiol Endocrinol Metab* 2004;286:E321-28.

Macronutrient + Exercise = ?

- Both what you eat and how you exercise can affect macronutrient oxidation.
- 2.5 gm/kg PRO + 90 min of 45-50% max O_2 BID vs. 1.0 gm/kg PRO + same exercise intensity.
- 24-hr energy expenditure measured.
- Higher protein feeding resulted in a 12% greater energy turnover and a positive protein balance.

Ref: *Am J Physiol Endocrinol Metab* 1999;276:E964-76.

Protein, Leucine Plus CHO

- Post-exercise meal and nutrient timing can have profound effects on athletic recovery and MPS.
- Does CHO have any effect on MPS?
- CHO vs. CHO + PRO vs. CHO + PRO + Leu.
- 45 min RT, drink assigned drink, crossover trial (n = 8). Product included casein hydrolysate-PeptoPro®.
- CHO/PRO & CHO/PRO/Leu resulted in ↑ MPS and whole body PRO oxidation.
- FSR rates > in CHO/PRO/Leu; CHO alone little effect.
- Drink CHO/PRO/Leu or CHO/PRO post RT, not CHO alone.

Ref: *Am J Physiol Endocrinol Metab* 2005;288:E645-53.

Hepatic Protein and Diet

- If you eat the ~RDI for protein versus a higher intake, does it affect hepatic protein synthesis?
- Hepatic proteins used as transporters, in lipid metabolism, clotting, etc.
- 12 healthy young men ate a progressive ↓ amount of protein, 1.13 to 0.75 gm/kg. Mixed protein sources.
- Over time (~10d) hepatic turnover of transport proteins slowed to meet metabolic needs.

Ref: *Am J Physiol Endocrinol Metab* 2004;287:E327-30.

CHO + PRO for Ultra-Exercise

- Does what you eat help protect against muscle breakdown (catabolism)?
- 8 endurance athletes cycled/ran/cycled at ~50% max O_2 for 6 hours. CHO vs. CHO/PRO ingested every 30 minutes during exercise and 4 hr recovery. Tested versus rest alone. Dairy sourced protein.
- CHO alone had no effect on protein balance, CHO/PRO positive effect.

Ref: *Am J Physiol Endocrinol Metab* 2004;287:E712-20.

Casein vs. Whey

- Protein is the most satiating macronutrient.
- Protein, but not CHO affects MPS.
- Positive MPS important to those who exercise.
- Does protein type matter?
- 48gm whey preload prior to a meal resulted in ↓ food intake but ↑ a 28% greater plasma AA than the same dosed casein preload.
- Whey also ↑ CCK, GLP-1, GIP & satiety.
- Gastric emptying rates differed. Whey...better!

Ref: *Brit J Nutr* 2003;89:239-248.

Leucine, the key Regulator

- AA availability controls protein synthesis.
- Protein synthesis not only important to muscle (signaling molecules).
- Leucine directly stimulates MPS.
- Initiates mRNA translation which -phosphorylation of translational repression factor SE-BP1, 4E-BP1 & ribosomal protein S6 kinase-1.
- Also targets the muscle rapamycin independent pathway (mTOR).
- Leucine is the only AA that directly has these effects. Should one choose protein based on it's leucine content?

Ref: *J Nutr* 2001;131:856s-860s. *Curr Opin Clin Nutr Metab Care* 2002;5:63-7..

Whey Different

- Varied proteins have varied affects on protein accretion and anabolism.
- Whey isolate vs casein over a 10-wk period with supervised RT in rec lifters (n=13).
- Protein supplementation 1.5 gm/kg/d
- Strength assessed by 1-RM in 3 lifts.
- After 10 weeks the WI group gained more muscle than the casein ($p<0.01$; ~ 4.2 kg difference)
- WI group achieved significant ↑ in strength & fat loss (-1.5±0.5kg) relative to casein group.

Ref: *IJSNEM* 2006; 16(5):494-509.

Soy, Whey - Does it Matter?

- Soy vs. whey protein bar (33gm) + RT in college aged males over a 9 week period.
- Control group (training alone).
- University weight training class, n = 9 per group.
- Both groups, but not the control group gained LBM.

Ref: *Nutr J* 2004,3:22 doi 10.1186/1475-2891-3-22. *J Amer Coll Nutr* 2005;24(2):134s-139s.

Add PRO to CHO, Get....

- CHO supplementation during exercise ↑ pl Glu & insulin = glycogen sparing.
- Add PRO (dairy sourced) and the insulin response is amplified.
- CHO vs. CHO/PRO in 9 trained cyclists.
- 3 hr cycling at 45 to 75%VO_{2max} & 85% until fatigue.
- 200 ml supplemental drink q 20 min.
- Result: adding PRO to CHO ↑ aerobic performance by ~7 min beyond CHO alone.
- No real difference in plasma glucose & insulin.

Ref: *Int J Sport Nutr Exer Metab* 2003;13:388-401.

Milk, Great for Muscles

- CHO, milk-based CHO/PRO vs. Placebo.
- Untrained males, glycogen depletion exercise, rest. Exercise test = 100 reps eccentric leg extensions at 120% 1-RM.
- Assigned drink ingested immediate and 2-hrs post-exercise.
- Results: Serum insulin > for CHO/PRO, CPK changed the least in the CHO/PRO group, no effect on glycogen repletion, markers of inflammation of function up to 72-hr post-exercise.

Int J Sport Nutr Exer Metab 2001;11:406-419.

Net Muscle Protein Synthesis and Protein Intake

- MPS is the balance between synthesis and breakdown.
- This remains negative post-exercise if there is not nutrition intake within a reasonable time period.
- Whey PRO, AA and CHO vs. CHO alone in RT adults.
- 77.4 gm CHO, 17.5 gm PRO & 4.9 gm AA.
- ↑ in MPS immediate and 90 min. later only in WAAC drink group.

Int J Sport Nutr Exer Metab 2004;14:249-265.

CHO and Net MPS

- Resistance training induces a negative effect on MPS in the immediate post-exercise period.
- 6 gm of EAA ↑ net MPS. Pure AA, identify of origin unknown.
- N=16, 10 sets of 8 reps at 80% 1-RM.
- 100 gm CHO fed vs. PLA (1-hr. post-exercise).
- 4-hr. net MPS rates monitored.
- Result: minor effects on net MPS, less than observed with EAA.

Ref: *J Appl Physiol* 2004;96:674-678.

Survey says: Add Protein!

- CHO/PRO appears to be more effective than CHO alone at enhancing post-exercise glycogen repletion.
- After 2.5 hr of cycling, subjects drank an iso-carbohydrate drink containing CHO or CHO + PRO.
- Protein was dairy sourced.
- Muscle glycogen and plasma hormones measured over a 4-hr post-exercise period.
- Results: Exercise ↓ glycogen, CHO/PRO ↑ glycogen reaccumulation by ~25% as compared to CHO alone.

J Appl Physiol 2002;93:1337-1344.

More Whey, Less Casein?

- There may be a difference in the anabolic response to various proteins.
- Free amino acids plus RT increases MPS.
- Casein is purported to be absorbed slower than whey.
- After leg extensions, subjects drank isonitrogenous casein or whey (1-hr.).
- Data revealed that plasma AA levels differed b/w the groups, though both caused + change.
- Whey induced a greater peak leucine value (indicator of MPS).
- Conclusion: both WH and CAS induce + changes in MPS and protein balance, though they have different effects on plasma values of AA.

Ref: *Med Sci Sports Exerc* 2004;36(12):2073-2081.

Soy Good…Soy Good

- Soy has beneficial effects on bone density in women.
- The effects of soy on bone metabolism in healthy men is unknown.
- Serum insulin-like growth factor (IGF-1) is associated with bone formation and muscle accretion.
- 40 gm Soy or milk-based protein tested in healthy men for 3 months.
- Results: No real effect on markers of bone formation or resorption, but only soy ↑ IGF-1 irrespective of the age of the subject.

Ref: *J Nutr* 2002;132:2605-2608.

And Now...

- Pre-exercise CHO/PRO supplementation has a + effect on MPS. So does post-exercise supplementation.
- Does pre-exercise PRO alone (vs. Pla.) followed by a post-exercise CHO/PRO supplement affect hormones or metabolism?
- 25 gm Whey + caseinate proteins.
- Results: PRO supplementation 30 min. prior to RT ↓ serum GH, testosterone and FFA, while ↑ serum insulin during RT.
- PRO also ↑ EPOC and RER 2-hr. post-recovery.

Ref: *Med Sci Sports Exerc* 2005;37(11):1990-1997.

Specialized Protein Admixture

- Whey protein combined with L-glutamine and BCAAs vs. Whey alone in Weight Trainers over 10-weeks.
- 40 gm whey/5gm glutamine 3gm BCAA vs. whey alone.
- 10-week training study. Diet 1.6gm/kg PRO, hypertrophy styled training per ACSM guidelines
- W/G/BCAA mixture > W for weight gain and exercise performance.

Colker CM, et al. Effect of supplemental protein on body composition and muscular strength in healthy athletic male adults. *Curr Ther Res* 2000; 61:19-28.

Biotest Surge™

- **2:1 ratio of CHO/PRO fed 1 & 2 hr. post-exercise (isocaloric to CHO group).**
- **60 min time trial (cycling AM) repeat cycling PM.**
- **AM performances = b/w groups**
- **PM performances decreased significantly less in CHO/PRO versus CHO ($p \leq 0.05$).**
- **Thus CHO + PRO ingested post-exercise appears to aid in subsequent exercise performance.**
- **Protein source; dairy.**

Berardi J, et al.Early post-exercise carbohydrate + protein ingestion post exercise improves performance 6 hours later. *Sp Nutr Rev J* 2004;1(1):s1-14abstract. Med Sci Sports Exerc. 2006;38(6):1106-13.

Moo Moo

- Comparison of skim milk/CHO/Placebo
- 2-hr treadmill run @ 65% VO2 max
- Ingestion of the skim milk (flavored) enhanced & supported protein utilization during recovery
- Additionally, ↑ GH & maintenance of circulating AA occurred – protein sparing effect
- CHO drink, no effect beyond > CHO used for energy
- Ratio is 1.5 to 1

Miller SL, et al. Metabolic response to provision of mixed protein-carbohydrate supplementation during endurance exercise. *Int J Sports Nutr Exerc Metab* 2002;12:384-397.

Chocolate Milk

- 19 men, untrained
- Milk vs. CHO-electrolyte drink
- Ingested immediately post-workout (10-week RT program)
- Body composition (DXA), strength, endocrine hormones, REE measured pre-post.
- Results – Similar strength gains, Trend for gains in weight and muscle in the milk group. Other parameters not different.

Rankin JW et al. Effect of post-exercise supplement consumption on adaptations to resistance training. *J Amer Coll Nutr* 2004;23(4):322-330.

Accelerade®

- Can a CHO-PRO drink affect aerobic performance?
- Accelerade vs. CHO-electrolyte drink.
- 9 trained cyclists. 3hr controlled rides followed by a 85% VO_{2max} ride until exhaustion.
- 200 ml drinks q 20 min (~4:1 ratio Accelerade)
- CHO-PRO drink allowed cyclists to perform exercise~7 minutes longer (~26% improvement) than CHO-electrolyte drink.

Ivy J et al. Effect of a carbohydrate-protein supplement on endurance performance during exercise of varying intensity. *Int J Sports Nutr Exer Metab* 2003;13:388-401.

Accelerade®

- Accelerade vs. Gatorade on endurance and markers of muscle damage.
- 15 male cyclists performed two rides.
- First ride, 75% VO_{2peak} exhaustion ride, 2nd ride 12-15 hr later at 85% VO_{2peak}.
- Subjects consumed 1.8 ml/kg during the rides
- Results, CHO-PRO 29% longer vs C+E (1st ride). CHO-PRO 40% longer than C+E (2nd ride).
- Plasma CPK 83% lower after CHO-PRO vs. C+E

Saunders MJ et al. Effects of a carbohydrate-protein beverage on cycling endurance and muscle damage. *Med Sci Sports Exerc* 2004;36(7):1233-1238.

Colostrum

- Colostrum is secreted during the first 3 days post delivery. Strengthens immune system.
- Cow's colostrum (native protein) structurally related to human.
- Athlete's use it to enhance work capacity.
- May impact HgH, IGF-1 levels & FFM
- Data indicates performance enhancer for cyclists and field hockey players
- Branded products tested include Impact™

Ref: *Med Sci Sports Exerc* 2002;34(7):1184-1188. *Nutrition* 2002;17(3):243-247. *J Appl Physiol* 1997;83(4):1144-1151. *Eur J Appl Physiol Occup Physiol* 1998;77:427-433. *Int J Sports Nutr Exerc Metab* 2002;12:461-469

Protein in the Glycogen Depleted Athlete.

- Can protein feeding be ergogenic?
- Does the macronutrient affect perceived exertion during exercise?
- Can feeding during exercise affect glucose and insulin kinetics?
- Does protein feeding alone impact short-term MPS?

Study Overview

- Randomized 8 athletic male subjects who were experienced weight lifters and could follow the following basic protocol:
  - RDBCT
  - Low-carbohydrate diet
  - Complete 15 sets of glycogen depleting leg extensions (150 reps at graduated resistance)
  - Drink assigned beverage (20 minute break)
  - Complete 3 sets of reps to failure at 70% 1-RM
  - Blood and psychological tests throughout sessions.

Objectives

- Primary - quantify & compare the effects of the 3 drinks on repetition and workload over 3 sets.
- Secondary - quantify & compare the effects on perceived exertion and biochemical markers of anabolism and catabolism.

Kalman D. 2007 NSCA National Conference: Macronutrient Selection in Feeding Athletes who are Glycogen Depleted: Effects on Performance. July 2007.

Test Drinks

- Carbohydrate - 45 grams (maltodextrin/glucose)
- Casein Hydrolysate - 45 grams PeptoPro®
- Casein Hydrolysate + CHO - 15 gm Pro, 30 gm CHO
- All flavored and sweetened and colored to be as identical as possible (DSM).
- Powdered product mixed by the staff in 500 ml water (blended/shaken)

Kalman D. 2007 NSCA National Conference: Macronutrient Selection in Feeding Athletes who are Glycogen Depleted: Effects on Performance. July 2007.

Inclusion/Exclusion

- Males, aged 18 - 40
- Minimal hx of RT (6 months)
- Signed informed consent
- No vegan, ketogenic or carbohydrate restrictive eaters enrolled (excluded).
- Baseline diet proved to be 40% CHO or less.
- Hx of AAS, GH usage or creatine in past 90 days.

Kalman D. 2007 NSCA National Conference: Macronutrient Selection in Feeding Athletes who are Glycogen Depleted: Effects on Performance. July 2007.

Methods

- 5 sets of 10 reps at 30, 45 and 60% 1-RM.
- 60-90 second rest between sets.
- 20-minute rest (with drinking assigned drink).
- 3 sets repetitions to failure at 70% 1-RM with 3-minute rest between sets.
- Borg scale and blood tests polled/pulled at specific time points.

Results - Performance

Post-Rest Set	Protein	Carbohydrate	Isocaloric Mix	P:C	P:M	C:M
Set 1	26.4 ± 14.4 (8) 25.5 (3 Š 54)	32.4 ± 13.7 (8) 32 (10 Š 56)	27.6 ± 12.3 (8) 28 (10 Š 50)	p=0.228	p=0.505	p=0.307
Set 2	24.1 ± 8.4 (8) 25 (6 Š 33)	28.5 ± 12.3 (8) 28.5 (6 Š 44)	27.3 ± 13.9 (8) 22.5 (15 Š 57)	p=0.284	p=0.586	p=0.765
Set 3	24.3 ± 8.6 (8) 24.5 (10 Š 41)	25.5 ± 11.3 (8) 26.5 (3 Š 38)	24.5 ± 9.2 (8) 22.5 (16 Š 44)	p=0.707	p=0.954	p=0.791
Sum of All 3 Sets	75 ± 25 (8) 79 (19 Š 99)	86 ± 33 (8) 95 (19 Š 120)	79 ± 32 (8) 72 (43 Š 137)	p=0.218	p=0.672	p=0.525

Results - Work Load

Times	Pro	Carb.	Isocaloric Mix
Reps 1 vs. Reps 2	0.669	0.368	0.926
Reps 1 vs. Reps 3	0.670	0.138	0.382
Reps 2 vs. Reps 3	0.954	0.084	0.168
Linear 1—2—3	0.609	0.056	0.321

Results - Perceived Exertion

Assessed After…	Protein	Carbohydrate	Isocaloric Mix	P:C	P: M	C: M
Post-Rest Set 1	17.63 ± 2.62 (8) 18 (13 – 20)	17.25 ± 2.38 (8) 18 (13 – 20)	17.13 ± 2.36 (8) 17.5 (13 – 20)	0.670 (np)	1.000 (np)	1.000 (np)
Post-Rest Set 2	18.00 ± 1.85 (8) 17.5 (15 – 20)	18.50 ± 1.31 (8) 19 (17 – 20)	18.38 ± 1.85 (8) 19 (15 – 20)	0.784 (np)	0.414 (np)	0.854 (np)
Post-Rest Set 3	18.38 ± 2.45 (8) 19.5 (13 – 20)	19.13 ± 1.13 (8) 19.5 (17 – 20)	18.88 ± 1.36 (8) 19.5 (17 – 20)	0.850 (np)	0.586 (np)	1.000 (np)
Average of All 3 Post-Rest Sets	18.00 ± 1.82 (8) 17.83 (15.67 – 20)	18.29 ± 1.16 (8) 18.83 (16.33 – 19.67)	18.13 ± 1.69 (8) 18.67 (15 – 19.67)	0.865 (np)	0.833 (np)	1.000 (np)

Performance

- Equal between all groups
- Biggest falloff over time in performance was the CHO only group.
- Perceived exertion - equal over the test/performance tests for all groups.
- Biggest drop off for the CHO only group

Glucose-Insulin Findings

- Glucose levels relatively flat for Cas-Hydro and Cas-Hydro+CHO groups.
- Increased over time for CHO only group.
- No difference between groups for insulin.
- After the subjects completed the glycogen depleting exercise, drank their assigned drink and rested for 20-minutes, insulin was significantly elevated from baseline in the Cas-Hydro and Cas-Hydro+CHO group ($p=0.018$ and 0.0036, respectively), but not the CHO group ($p=0.073$). Two minutes after completing the exercise test insulin was significantly elevated relative to post-rest only in the Cas-Hydro group ($p=0.025$) remaining elevated at the 10 minute post-exercise mark (0.021).

Leucine interpretation

- Upon examining the within-group changes, the Isocaloric Mix group showed the greatest number of time-points with significant changes in leucine. The post-drink/rest leucine value was significantly elevated in the Carbohydrate and Isocaloric Mix (Cas-Hydro+CHO) groups ($p=0.005$ and 0.012, respectively). The Isocaloric Mix group also had significantly elevated leucine levels at the 2- and 10-minute post-exercise time points, relative to baseline and post-rest periods ($p=0.009$, 0.007, 0.047, and 0.038), respectively. It appears that the Isocaloric Mix has the greatest effect on leucine levels.

Phenylalanine - interpretation

- No real differences between groups.
- Within each test group, each increased from baseline.
- More and further out time-points needed for leucine and phenylalanine.

CPK/LDH Results

- No significant difference between groups for effects on these markers of muscle damage.
- Casein-Hydrolysate group was seen to have a significant reduction in CPK value at the 10-minute post-exercise time point, relative to the 2-minute post-exercise time point ($p=0.021$).
- Casein Hydrolysate group and the Cas-Hydro+CHO group experienced significant increases in LDH at the 2-minute post-exercise time point, relative to the post-rest period ($p=0.022$ and 0.040, respectively).

Results

- Supplementing glycogen depleted athletes Cas-Hydro and Cas-Hydro+CHO supports athletic performance to the same degree as CHO alone.
- In fact, the CHO group tended to decrease in performance to the greatest degree over time.
- Perceived exertion did not differ.

Results - II

- Between the groups there was not a significant difference for an effect on glucose or insulin.
- CHO was not insulinogenic (in this study), however Cas-Hydro and Cas-Hydro+CHO was.
- No effect on lactate.
- Leucine and phenylalanine were not equally affected. It appears that the Cas-Hydro+CHO may be the most anabolic amongst the groups, though more research is needed.
- CPK/LDH no different between groups.

Thoughts

- This study is the first to demonstrate that a glycogen depleted athlete does not necessarily need CHO to perform well in subsequent exercise.
- Similar format to sports that have a break (half-time).
- The ingestion of Cas-Hydro and Cas-Hydro+CHO is just as supportive as CHO alone for supporting exercise and perceived exertion.
- Prior research indicates that CHO + PRO has a positive impact on exercise performance, recovery and MPS.
- Now we have evidence that Cas-Hydro and Cas-Hydro+CHO (reverse 2:1 ratio) is an option for fuel.
- Therefore the common nutrient in all of the positive studies is PRO, thus more research is needed.
- The future studies need to go out to 24 to 72 hours post exercise to measure effects on anabolism and catabolism.

Kalman D. 2007 NSCA National Conference: Macronutrient Selection in Feeding Athletes who are Glycogen Depleted: Effects on Performance. July 2007.

PROTEIN

- Long term data confounding variables
- P. Lemon PhD. Advises: Athletes needs are 1.5xRDA 12-15% of overall dietary intake
- Aerobic athletes: Carbohydrate major fuel source
- Anaerobic & perhaps Aerobic: CHO-PRO important
- Rule of thumb 1.2 – 2.0 gm/Pro/kg
- Ratio of 1.7 - 7:1 CHO-PRO post-exercise (depending upon duration of exercise).
- Consider pre or during exercise as options for protein consumption.

McArdle WD, Katch FI, Katch VL. Sports & Exercise Nutrition.
Lippincott Williams & Wilkens. 1999. Driskell J, Wolinsky I. Nutritional Assessment of Athletes.
CRC Press 2002.

Take Home Points

- Each protein source has its own unique metabolic effect.
- Soy is now a viable alternative for supporting muscle growth. Other effects include cholesterol and bone health management.
- Dairy proteins have a varied effect since so many exist.
- Data indicates that whey is absorbed the fastest, casein slower and soy somewhere near casein.

Take Home Points II

- Data tells us that post workout it might be best to flood the bloodstream with the EAA's - whey is best for this.
- Over a 24-hr period it is effective to have nitrogen released slowly in the body to enhance the potential for supporting MPS - thus casein or soy are useful.
- Ingesting dairy sourced protein during the workout also appears to support performance just as well as CHO.

More Info?

- Come to The ISSN Annual Conference in June: www.theissn.org
- Stay tuned to the www.pnshow.com
- Read JISSN, JSCR, SCJ, JAP, MSSE journals.
- Many good textbooks to choose from.
- Questions?
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