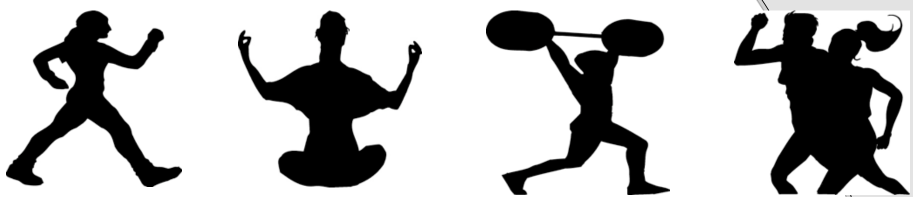

Protein & Exercise

FCS 608- Sports Nutrition
Presented By:
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The Importance of Protein

- Composed of C, H, O, N
- Primary structural material
- Many physiological roles in the body
- Crucial due to amino acid components
  - Needed for synthesis of various body proteins & nitrogen molecules
  - 9 Essential
  - 11 Nonessential

Protein Needs

- Current Normal Adult RDA: 0.8 g/kg/day
- Scientific data suggests certain athletes may need more
  - Endurance: 1.2 – 1.4 g/kg/day
  - Strength: 1.2 – 1.7 g/kg/day

Protein & Exercise

- Protein is the "Third Choice of Fuel"
- Athletes are concerned with:
  - **What type of protein**
    - Food, protein powders, amino acid mixtures
    - BCAA's: main amino acids oxidized for energy, role in muscle building
  - **When to eat protein**
    - 1 – 2 hours after training session
    - Enhance anabolic processes in muscle
  - **How much to eat**
    - Endurance & Strength Athletes

Biochemistry of Protein

- Digestion
- Absorption
- Metabolism
- Excretion

Protein Digestion

- Stomach
  - HCL denatures protein structure
  - Activation of pepsinogen to pepsin
  - Pepsin hydrolyzes peptide bonds in protein/ polypeptides
- In Small Intestine
  - Acid chyme stimulates release of regulatory hormones and peptides (secretin and cholecystokinin)
  - Zymogens secreted by the pancreas further responsible for protein and polypeptide digestion.
  - Peptidases enable peptide digestion and amino acid absorption in the distal small intestine.

Protein Absorption

- Occurs in Small Intestine
  - most in the proximal small intestine
- Carriers required; paracellular absorption can also occur
- In general
  - BCAA absorbed faster than smaller amino acids
  - Neutral AA ↑ rates of absorption dibasic and dicarboxylic AA
  - EAA absorbed faster than NEAA
- Over 60% of amino acids are absorbed in the form of small peptides.

Protein Metabolism

- **Anabolism**: building up of tissue proteins
- **Catabolism**: breaking down proteins
  - For energy
- Dependent on nutritional status of the individual
- Need enough of all essential amino acids (EAAs) in the diet
  - Primary source of EAAs
- If exogenous protein supply is low
  - fasting or starvation
  - degradation occurs to provide energy

Protein Metabolism

- **Liver-**
  - Primary site for the uptake of most (50%-65%) amino acids (AAs)
- Regulates absorbed AAs and adjusts the rate of metabolism according to needs
- Exception- branched-chain amino acids (BCAAs)
  - BCAAs are more rapidly metabolized in muscles and adipose tissue

Protein Metabolism

- BCAAs that arrive at the muscles
  - Important to exercise and sport
- Following a meal with protein, AAs usually in excess
  - Skeletal muscle typically experiences protein synthesis
- Fasting or strenuous exercise
  - muscle breaks down protein to AAs
- Nitrogen (N) transported through the bloodstream and liver in transamination and deamination processes
  - Alanine-glucose cycle
- Results in synthesized **glucose**
- Transported back to the muscle and used for energy

Protein Excretion

- Ammonia produced from oxidation is toxic
  - Accumulation can quickly cause death
  - Must be safely removed from the body
- **Urea cycle** (ornithine cycle):
  - Removes ammonia by converting to urea
  - Takes place in the liver
- Urea, which is water soluble, is transported to the kidneys and is readily excreted
- Healthy individuals with appropriate protein intake urinary urea N represents approximately 80% of all urinary N

Protein Excess

- Increased calcium excretion
- Decreased kidney function
- Edema
- Liver dysfunction
- Vitamin B6 deficiency
- Dehydration
- Coronary Artery Disease
- Build up of Ketones

Protein Deficiency

- Increased intestinal permeability
- Edema
- Anemia
- Muscle atrophy
- Vitamin A deficiency

What Current Research Studies Indicates….

- Endurance Exercise
- Carbohydrates & Endurance Exercise
- Strength/Power Athletes
- Supplements

Protein & Endurance Exercise

Branched-Chain Amino Acids Activate Key Enzymes in Protein Synthesis after Physical Exercise

Blomstrand, Eva; Eliasson, Jorgen; Karlsson, Hakan, Kohnke, Rickard. Stockholm, Sweden. The Journal of Nutrition 136:269S-273S 2006

Purpose

- The purpose of this study was to review if BCAA's have anabolic effects on protein metabolism by increasing protein synthesis and decreasing the rate of protein degradation in resting muscle. It also wanted to see what effect resistance exercise had on protein synthesis vs. endurance exercise.

Methods

- Study was more of a review of articles comparing the effects of exercise on protein synthesis

Conclusion

- The article reviews suggested that an increased availability of BCAAs stimulates translation of specific mRNAs in muscle during recovery of resistance exercise.
- There is a lack of data to see the relationship of BCAA and endurance exercise.

Evaluation

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- Compared multiple studies (makes the subject and theory more reliable)

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- Review of studies so there was no real protocol, methods, etc.
- Not enough information on endurance exercise and its relationship with protein synthesis.

Protein, Carbohydrates & Endurance Exercise

Carbohydrate and protein hydrolysate coingestion's improvement of late-exercise time-trial performance

Saunders, M. J., Moore, R. W., Kies, A. K., Luden, N. D., & Pratt, C. A. (2009). **Carbohydrate and protein hydrolysate coingestion's improvement of late-exercise time-trial performance**. *International Journal of Sport Nutrition and Exercise Metabolism, 19*, 136-149.

Purpose

- Primary Purpose: to determine whether a CHO and protein hydrolysate (ProH) beverage would bring out improvements in performance during time-trial cycling versus a CHO beverage alone.
- Secondary purpose: to determine whether treatment with CHO+ProH lessened signs of muscle disruption as compared with CHO.

Methods

- Randomly counterbalanced double-blind design
- 13 recreationally competitive male cyclists
- either a CHO+ProH beverage or CHO beverage
- 2 computer simulated 60 km time trials
- Participants with 2 or more risk factors for coronary artery disease were excluded

Measurements

- VO2 max
- respiratory exchange rate (RER)
- ratings of perceived exertion (RPEs)
- blood glucose
- heart rate
- lactate
- Plasma creatine phosphokinas (CK) and muscle soreness ratings were assessed before and after 24 hours

Results

- CHO+ProH beverage improved time-trial performance
  - All occurring in the final lap (late stage) of the test
- Plasma CK and muscle soreness ratings were high in the CHO trial, but not with CHO+ProH

Implication

- Addition of ProH to the CHO drink may have prolonged the time to muscle fatigue.
- ProH may have reduced markers of muscle disruption

Evaluation

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- Adequate background information and review of related literature.
- Previous studies ambiguous and did not examine differences of late stages
- Design strong enough to address previous ambiguities
- explanation of protein hydrolysates
- Conclusion valid
- Results supported ProH use

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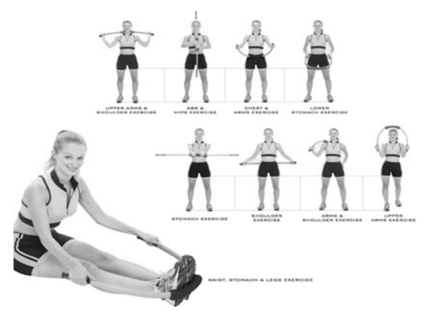
- Use of more references, including contrasting literature
- Small sample size of 13
- Need larger sample for more accurate results
- Can not be generalized to all athletes, only:
  - Males
  - Endurance cyclists

Resistance Exercise Increase Postprandial Muscle Protein Synthesis in Humans



Witward, Oliver P.; Tieland, Michael; Beelen, Milou; Tipton Kevin D.; Van Loon, Luc J.C.; Koopman, Rene. (2009). Resistance Exercise Increase Postprandial Muscle Protein Synthesis in Humans.*Medicine and Science in Sports and Exercise*, 41(1), 144-154.

Purpose

The purpose of this study was to examine the impact of acute bouts of resistance-type exercise on muscle protein synthesis in the fed state.

Methods-Subjects

- 10 untrained males
- No history of participating in any regular exercise program and were asked to refrain from heavy physical exercise and stay on a normal diet for 3 days during the experiment.
- Body comp was assessed
- Subjects single leg on rep max was determined

Methods-Protocol

- Consumed meal night before experiment (55% carbohydrate, 25% protein, 30% fat)
- Breakfast (52% carbohydrate, 34% protein, 4% fat)
- Subjects rested supine 1 hour before exercise.
- 5 min warm-up on bike
- Unilateral lower limb exercises
- Arterial blood and muscle biopsies were obtained from the vastus lateralis of the exercised and non exercised leg after 45 min programs were complete.

Results

- Plasma insulin, glucose, phenylalanine, and BCAA concentrations reached maximal levels after cessation of exercise and returned to normal after 2-4hrs.
- Phenylalanine levels were significantly higher in the exercised leg
- Muscle protein synthesis is stimulated sooner in the exercised leg

Conclusion

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- Tested exercised vs unexercised on same body so it was more accurately comparable
- Regulated diet
- That correct diet and exercises did positively effect protein synthesis

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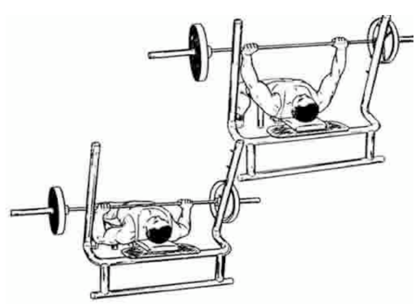
- Small number of subjects
- Only tested untrained individuals
- Only males
- Only in fed state

Protein & Strength/Power Athletes

Effect of Protein Intake on Strength, Body Composition and Endocrine Changes in Strength/Power Athletes



Hoffman, J.R., Ratamess, N.A., Kang, J., Falvo, M.J., Faigenbaum, A.D. (2006). Effect of protein intake on strength, body composition and endocrine changes in strength/power athletes. *Journal of the International Society of Sports Nutrition, 3(2), 12-18.*

Purpose

- **Primary Purpose**

  Examine whether protein intakes above recommended levels (> 2.0 g/kg/day) provide strength and body composition improvements in strength/power athletes

- **Secondary Purpose**

  Examine the effect of varying protein intakes on resting hormonal concentrations

* Recommended Level of Protein Intake: 1.6 – 1.8 g/kg/day

Subjects

- 23 males
- Collegiate strength/power athletes
- Inclusion Criteria
  - At least 2 years of resistance training experience
- Exclusion Criteria:
  - Subjects using any anabolic agents 6 months prior to onset of study

Methods

- Subjects Completed:
  - Resistance training program for 12 weeks
  - Daily Training Logs
  - 3-day dietary recalls per week

Measurements

<u>Prior to Training Program & After</u>

- Hormone Assessment:
  - Blood samples obtained
- Body composition estimates
  - Percent fat, bone mineral density, lean tissue

<u>During Training Program</u>

- Strength Assessment:
  - One-Repetition Maximum (1-RM) Strength Test

Methods

Based on the average weekly protein intakes determined for the 12 week study

Group	Daily Protein Intake	Number of Subjects
Below Recommended Daily Protein Intake (BL)	1.0 – 1.4 g/kg/day	8
Recommended Daily Protein Intake (RL)	1.6 – 1.8 g/kg/day	7
Above Recommended Daily Protein Intake (AL)	> 2.0 g/kg/day	8

Results

Strength Improvements in AL Group

	1-RM Bench Press Improvement	1-RM Bench Squat Improvement
RL	42%	22%
BL	35%	63%

However, strength improvements observed in the AL group were also NOT statistically significant

* AL = Above Recommended Daily Protein Intake

Results

- Between the groups, no significant difference
  - daily caloric intake
  - Δ body mass
  - Δ lean body mass
  - Δ percent body fat
  - on resting hormone concentrations

Conclusion/Discussion

For collegiate Strength/Power Athletes:

- Study does NOT provide support for a protein intake greater than recommended levels
  - No significant body composition improvements
  - No significant effect on resting hormone concentrations
- Caloric Intake Problem

Implication

Although elevated protein intake did not produce significantly greater strength improvements…

… results suggest that further research is necessary to determine the effect of high protein intake on strength and lean tissue accruement

Critique

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- Variety of references
- Easy to follow protocol
- Good summary of existing literature
- Sufficient detail to replicate the study
- Unexpected findings explained
- Potential direction for future studies mentioned

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- Small sample size
- Limits on generalizing results
- Questionable procedure for subject categorization
- Protein quality – was intake from supplements or food?
- Caloric intake was below recommended levels for athletes

Protein & Supplements

Impact of differing protein sources and a creatine containing nutritional formula after 12 weeks of resistance training

Kerksick,C.M., et. Al., (2007). Impact of differing protein sources and a creatine containing nutritional formula after 12 weeks of resistance training. Nutrition, 23, 647-656.

Purpose

To evaluate whether colostrums or an isocaloric and isonitrogenous blend of whey and casein in addition to creatine affects body composition, muscular strength and endurance, and anaerobic performance during resistance-training.

Methods

Experimental Design

The study is a double-blind, placebo controlled, randomized clinical trial with subjects matched according to age and FFM before the study.

Subjects

- 49 apparently healthy subjects, 18-45 years of age
- 36 are male and 13 are female

Familiarization & Testing Sessions

- Informed consent statements are signed
- Medical & Exercise History Forms are completed
- General Physical Examination was completed
- Completed practice trials of all strength testing and anaerobic capacity equipment

- Approximately 1 week separated the familiarization session with from the baseline testing session

Methods

Subjects were assigned to one of four isocaloric and isonitrogenous supplement group.

Subjects were instructed to maintain their normal diets.

Subjects performed the 1RMs and maximal repetitions to fatigue tests.

Subjects completed a anaerobic capacity sprint test on a cycle ergometer.

The training program consisted of four workouts per week (2 for upper body and 2 for lower body).

Results

- No Side-effects
- No statistically difference in food intakes
- Body Composition
  - No significant changes for total body water, body mass, % body fat, and bone mineral content.
  - Significant increases in body mass, DXA total scanned mass, and DXA FFM
  - Pro/Col, Pro/Cr, and Col/Cr groups had significantly greater increases in comparison with the Pro group for body mass and DXA total scanned mass
  - Participants who ingested Pro/Cr and Col/Cr had greater gains in DXA FFM than those who ingested Pro.

Results

- Aerobic Capacity
  - Significant increase over time for peak power across groups
  - No changes for total work and fatigue.
  - No significant peak power, total work, and fatigue index

Conclusion

- Protein supplementation from whey, casein and colostrum sources during resistance training promotes increase in body mass & FFM in addition to strength.
- The combination of whey & casein protein plus creatine or colostrum plus creatine promoted greater increase in FFM compared with protein alone or protein plus colostrim.

Critique

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- Good array of subjects and the conclusion can be generalized in terms of age and gender
- Easy to comprehend
- Consistent with similar studies

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- The study does not provide additional support of colostrum as an ergogenic agent.
- Accurate calculation of training volume is questionable.

Teaching and Communicating the Information

Human Ecological Theory

- Developed by psychologist, Urie Bronfenbrenner
- 4 levels of the environment
  - Microsystem: everyday, immediate environment
    - homes, caregivers, friends, and teachers.
  - Mesosystem: connection between aspects of the microsystem, binding one aspect to another
  - Exosystem: external influences
    - local government, the community, schools, places for worship, and local media.
  - Macrosystem: cultural influences

Human Ecological Theory

- Understanding quality of life issues for individual clients is very important
- Dietitians- evaluate an individual's diet and create an appropriate diet plan
- Different levels of the environment will each have an impact on an athlete
  - Diet and health
  - Athletic performance

Human Ecological Theory

- *Implications* central to protein and exercise:
- Familiarization with the athlete's lifestyle
  - On and off the sports ground
- Be an integral part of the team, establish trust
- Protein intake, timing, and quality of protein
  - According to the athlete's specific needs
- Flexibility in the dietary regimen
  - i.e. if the athlete finds it inconvenient to consume higher quality protein, more practical alternatives should be made available
- Protein is a vital part of a balanced diet, but it is best not to consume in excess or in replacement of other vital nutrients

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Questions??