The Power of Protein: Separating Hype from Reality

May 6, 2014
Objectives

1. Outline the multiple health benefits of protein, beyond muscle building (e.g. satiety/weight mgmt., healthy aging, blood sugar control, etc.)

2. Compare the IOM’s recommended range of protein intake (10-35cal %) to the RDA minimum intake (0.8g/kg/day) and identify specific demographic groups that may benefit from the higher levels.

3. Design diets that include evenly-distributed protein levels throughout the day from a variety of sources, starting with breakfast.

4. Identify foods that are high-quality sources of protein.
The Power of Protein: Separating Hype from Reality
Latest Research Exploring the Role of Protein Quantity & Timing of Consumption on Health Outcomes

Heather Leidy, PhD
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University of Missouri
## Disclosures for Heather Leidy

<table>
<thead>
<tr>
<th>AFFILIATION/FINANCIAL INTERESTS</th>
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<td>Grants/Research Support:</td>
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<td>Other Financial or Material Support/Honorarium:</td>
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Protein Benefits: Assembling the Pieces

**Benefits**

- Weight Management
- Healthy Living
- Sarcopenia
- Type 2 Diabetes
- Obesity (across the lifespan)
**Meta-analysis**

- 24 trials in 1063 adults
- Duration of energy restriction: 12 ± 9 wk
- Intake: 1550 ± 270 kcal

**Standard Protein Diet:**
0.72 g·kg⁻¹·d⁻¹ (18 ± 2%)

**High Protein Diet:**
1.25 g·kg⁻¹·d⁻¹ (30 ± 2%)

Wycherley TP, et al., 2012; AJCN; 96: 1281-98
High Protein following Weight Loss

4 wk VLED followed by 6 month weight maintenance in 113 adults

NP: 15% Protein
HP: 18% Protein (additional 30 g protein/day)

Compared to NP, the HP Group:

- Lower % Weight Regain:
  20 vs. 60%, p<0.05
High Protein following Weight Loss

4 wk VLED followed by 6 month weight maintenance in 113 adults

NP: 15% Protein
HP: 18% Protein (additional 30 g protein/day)

Weight Loss/Re-gain

*HP vs. NP p<0.05

Lejeune et al., 2005; Brit J Nutr; 93: 281-289
High Protein & Energy Intake

5-month long-term ‘free-living’ study
2 weeks of normal protein & 2 weeks of high protein (30% of intake)
12 weeks of high protein (free-living)

NP       HP       HP-Ad Libitum

Daily Intake

-441 ± 63 kcal/d

Body Weight

-4.9 ± 0.5 kg

Weigle et al. 2005 Am J Clin Nutr; 41-48
Protein Benefits: Assembling the Pieces

- Increased Dietary Protein
- Weight Loss
- Fat Loss
- Lean Mass Retention
- Reduced Intake
- ‘Metabolism’
- RMR
- TEF

Resting Energy Expenditure

Thermic Effect of Feeding
Additional +100 kcal

Protein Benefits: Assembling the Pieces

Increased Dietary Protein
Reduced Intake
Fat Loss
Increased Weight Loss
Protein Synthesis
Lean Mass Retention
‘Metabolism’ TEF RMR

Acute Protein-rich Meal Response
30 g protein was consumed
5h protein synthesis measured

Symons et al., 2007; AJCN 86: 451-456
Protein Benefits: Assembling the Pieces

- Food Reward/Cravings
- Reduced Intake
- Satiety/Satiation
- Increased Dietary Protein
- Weight Loss
- ‘Metabolism’
- TEF
- RMR
- Lean Mass Retention
- Protein Synthesis

Why do we eat? Why do we stop?
Physiological & Hedonic Eating Behavior

Physiological Hunger

Reward-driven ‘Hunger’

Physiological Satiety

Reward-driven Satisfaction
Physiological & Hedonic Eating Behavior

Perceived Sensations

Hunger

Leptin

Ghrelin

Insulin

PYY

GLP-1

CCK

Fullness

Hypothalamus

Brain Stem

Circulation

Physiological Signals

Pancreas

Stomach

Duodenum

Ileum

Adipose
Physiological & Hedonic Eating Behavior

Perceived Sensations

Hunger
Fullness

Physiological & Hedonic Eating Behavior

External Cravings

Physiological Signals

Leptin
Insulin

PYY
GLP-1
CCK

External Reward

Circulation
Vagus
Nerve
Pancreas
Stomach
Duodenum
Ileum
Adipose
Hypothalamus
Brain Stem

Leptin
Ghrelin
Insulin

PYY
GLP-1
CCK

Does Protein (+) Influence Both Types
**HP Meals & Perceived Sensations**

**Acute studies in overweight & obese adults & young people providing meals as**

- **Normal Protein (NP):** 13-20g Protein (10-15% intake)
- **High Protein (HP):** 28-50g Protein (25-40% intake)

**4-h Post-meal Responses**

![Graphs showing 4-hour post-meal responses for Hunger and Fullness.]

- *NP vs. HP; p<0.01*

Leidy et al. 2007 Obesity; 1215-1225; Leidy et al. 2010; Obesity; 18(9): 1725-1732

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HP Meals & Hormonal Responses

Acute studies in overweight & obese adults & young people providing meals as

- Normal Protein (NP): 13-20g Protein (10-15% intake)
- High Protein (HP): 28-50g Protein (25-40% intake)

4-h Post-meal Responses

Leidy et al. 2007 Obesity; 1215-1225; Leidy et al. 2010; Obesity; 18(9): 1725-1732
Acute study in 15 adults; 160 kcal afternoon snacks
No Snack: 0 g Protein
Yogurts: 5 g, 14 g, or 24 g protein/serving

HP Meals & Food Reward/Cravings

**Acute studies in overweight & obese teens providing meals as**

- Normal Protein (NP): 13-18g Protein (14-18% intake)
- High Protein (HP): 35-50g Protein (40% intake)

**Pre-lunch Food Stimuli**

**Pre-Lunch Activation (NP > HP)**

- NP Breakfast
- HP Breakfast

**Insula (food cravings)**

- Pre-frontal (executive control)
Protein Benefits: Assembling the Pieces

**Dietary Factors**
- Quantity (How much?)
- Quality (What type?)
- Food Form (What form?)
- Timing of Consumption (When?)

Food Reward/Cravings

Reduced Intake

Satiety/Satiation

Fat Loss

Increased Dietary Protein

Reduced Intake

Weight Loss

Lean Mass Retention

‘Metabolism’

TEF

RMR

Protein Synthesis
Protein Quantity: Diet
(Wt. Management)

% Daily Calories as Protein

Upper Range

Lower Range

25-30%

~ 1.2-1.6 g protein/kg/d
( ~ 90-150 g/d)
Protein Quantity: Meal (?)

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Acute Meal Responses
Consumption of 350 kcal meals containing 15-30 g protein/meal

Red: sig. satiety differences

Paddon-Jones & Leidy; Curr Opin Clin Nutr Metab Care; 2013 17: 5-11
Protein Timing

Example Intake of Breakfast Consumers

Protein Intake (g)

Breakfast: 10g
Snack: 17g
Lunch: 6g
Snack: 30g
Dinner: 65g

Protein @ Breakfast

Post-meal Fullness AUC (au*180 min)

- HP-Breakfast
- HP-Lunch
- HP-Dinner
- NP

Fullness (au)

0 2 4 6 8 10 12
0 30 60 90 120 180

Post-meal Time (min)

* Leidy; British J Nutrition; 2009; 101: 798-803

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Protein Timing

**Example Intake of Breakfast Consumers**

- Breakfast: 10g
- Snack: 6g
- Lunch: 17g
- Snack: 6g
- Dinner: 65g

**Breakfast Frequency**

- Children
- Adolescents
- Adults

**Obesity Rates (%)**

- Year: 1965 to 2010

Leidy; British J Nutrition; 2009; 101: 798-803
Protein-rich Breakfast

Overweight ‘breakfast-skipping’ adolescents followed 3 breakfast patterns:

- **Breakfast Skipping** (control)
- **NP Breakfast Cereals*** (350 kcal); 15% Protein (13g) / 65% CHO / 20% Fat
- **HP Breakfast Egg/Beef*** (350 kcal); 40% Protein (35g) / 40% CHO / 20% Fat

- **Egg n’ Beef Burrito**
- **HP Waffle, Fruit Syrup & Beef Sausage**
- **Egg n’ Beef Strata/Casserole**
- **HP Pancakes, Fruit, Beef Sausage**

- 2 oz Lean beef
- 2 Servings (1/2 cup) liquid eggs
- 1 serving dairy (1 cup milk; 2 oz cottage cheese/Greek yogurt)
  - Whole grain (6 g fiber)
  - No added sugar
Protein-rich Breakfast

Overweight ‘breakfast-skipping’ adolescents followed 3 breakfast patterns:

- Breakfast Skipping (control)
- NP Breakfast Cereals* (350 kcal); 15% Protein (13g) / 65% CHO / 20% Fat
- HP Breakfast Egg/Beef* (350 kcal); 40% Protein (35g) / 40% CHO / 20% Fat

Clinical Testing

Free-living

Leidy, HJ, 2013; AJCN 97(4): 677-688
Perceived Fullness (satiety)

Satiety Signal PYY

Food Reward/Cravings

Pre-dinner Activation (NP > HP)

Hippocampus (memory/emotions)
Amygdala
Middle Frontal (executive control)

Food Reward/Cravings

Pre-dinner Activation (NP > HP)

Hippocampus Parahippocampus
(memory/emotions)

Evening Snacking

Summary of Research

- A diet rich in protein appears to be an optimal strategy to prevent and/or treat obesity through improvements in body weight management and energy intake regulation

- Mechanism of action: increased appetite control & satiety, reduced reward-driven eating behavior

- Quantities that elicit these responses: 24-35 g/eating occasion as high quality protein

- Unique benefits re: the consumption of a protein-rich breakfast
The Power of Protein: Translating Research to Practice

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Departments of Kinesiology and Allied Health
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Disclosures

- Nancy Rodriguez, PhD, RD, CSSD, FACSM
- National Dairy Council’s Whey Protein Advisory Panel
- Research Support
  - Beef Checkoff
  - Dairy Research Institute
  - American Egg Board
  - USDA, NIH, American Heart Association
- Speaker’s Bureau
  - National Dairy Council
  - Beef Checkoff
Presentation Overview

- Protein’s role in health
- Overview of protein turnover
- Practical considerations for current evidence regarding protein quantity, distribution, and quality
- Extending current evidence to recommendations for higher protein intake across the lifecycle
  - Children and Teens
  - Athletes and Active Individuals
  - Young and Middle-Aged Adults
  - Baby Boomers and Seniors
- Translation to diet design
Protein’s Role in Health

Build muscle
Deliver oxygen to tissues
Boost immunity
Provide energy
Aid satiety/fullness
Build better brains
Help metabolize other nutrients
Build stronger bones
Manage weight
Research Indicates...

Protein intake higher than the RDA may help adults prevent or manage **cardiovascular disease** and **type 2 diabetes**.

**Sarcopenia** is the progressive loss of muscle mass with age. The most practical means of increasing skeletal muscle protein for the majority of older adults is to include a moderate serving of high-quality protein with each meal.

Elevated protein intake, in combination with controlled energy intake was found to be an effective and practical **weight-loss** strategy. Animal protein had a greater positive effect than plant proteins.

Protein and calcium intake interact positively to affect **bone health**, and intakes of both must be adequate to fully realize the benefit of each nutrient on bone.

Protein is made up of building blocks and provides structural parts for a number of important body parts that allows it to function.
Essential Amino Acids

- 20 amino acids needed for the body to make protein
- *Essential* amino acids are not made by the body and must be provided in the diet
- Essential amino acids stimulate and support muscle protein synthesis and contribute to reduced protein breakdown
Review of Protein Turnover

Free Amino Acid Pool

Body Protein/Muscle

Food Protein Sources
Muscle Protein Balance

Protein Synthesis (PS) – Protein Breakdown (PB) = Protein Balance

Positive Net Balance

$PS > PB = \text{lean body mass gain}$

Negative Net Balance

$PB > PS = \text{lean body mass loss}$
Review of Protein Turnover: Effects of Exercise

Routine exercise increases protein turnover
Review of Protein Turnover: Effects of Consuming High Quality Proteins

- Consuming protein reduces protein breakdown

Body/Muscle Protein

Food Protein Sources

Free Amino Acid Pool
NET Protein Balance
Response to Nutrition and Exercise

- Exercise is essentially **catabolic**; energy is required for work
- Recovery is essentially **anabolic**; energy and rest is required to

Consistent nutrition and routine exercise important to achieve and maintain positive NET protein balance

- **Nutrients** – primarily protein – need to be consumed to achieve an anabolic state, a positive NET balance

Phillips et al., *J Am Coll Nutr*, 2005
Protein Quantity and Diet Rx: A New Way of Thinking
Protein Recommendations

Recommended Dietary Allowance (RDA)

Dietary protein recommendations based on preventing deficiency

Acceptable Macronutrient Distribution Range (AMDR)

A range of intake for promoting optimal health
AMDR for Protein
10 - 35%
Protein Consumption in the U.S.

25-30% of Daily Energy

~ 1.2-1.6 g protein/kg/d
(~ 90-150 g/d)
Protein Diets: Defined - *Relative*

*Lower* Protein Diet
10-15% of calories from protein

*Moderate/Higher* Protein Diet
20-35% of calories from protein
Protein Diets: Defined - *Absolute*

**Lower** Protein Diet
~1 g/kg body weight
(RDA - 0.8 g/kg)

**Moderate/Higher** Protein Diet
- 1.2 -1.5 g/kg
- 1.5 -1.8 g/kg
Misconceptions About Animal Proteins and Health

Habitual consumption of eggs does not alter the beneficial effects of endurance training on plasma lipids and lipoprotein metabolism in untrained men and women


Effects of dietary protein intake on indexes of hydration


Dietary protein intake and renal function

Protein Timing ↔ Protein Distribution
Even Distribution of Protein Throughout the Day’s Meals and Snacks can Maximize Anabolic Response Specific to Protein Utilization by the Body

Paddon-Jones and Rasmussen, *Curr Opin Clin Nutr Metab Care*, 2009
Protein Distribution

Protein-centric meals for optimal protein utilization: Can it be that simple?
Rodriguez, NR. J Nutr 2014

Dietary protein distribution positively influences 24 h muscle protein synthesis in healthy adults
Mamerow MM et al., J Nutr 2014
Quality
## BCAA Content of Foods

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*USDA National Nutrient Database for Standard Reference, Release 23; GNC WPI 28*
Animal Foods = High Quality Protein
In Considering Animal Protein …..

- Complete – high quality-proteins (provides sufficient amounts of essential amino acids)

- Enables sensible diet design (difficult to construct a low calorie diet that provides protein content of similar quality with plant foods)
The Caloric Cost of Plant Protein

7 tablespoons peanut butter
670 calories

Three ½ cup servings black beans
374 calories

1 ¼ cups raw tofu
236 calories

3 ounces lean beef
180 calories

Based on 25 grams protein

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Nutrition Basics for Growth, Development, and Optimal Protein Use

Energy Balance

Energy In = Energy Out (Maintenance)
Energy In > Energy Out (Weight Gain)
Energy In < Energy Out (Weight Loss)
Nutrient-specific Considerations: Children and Teens

Growth and Development

* Nutrient Partitioning

Nutrient-Specific Considerations

* Other essential micronutrients
Nutrient-specific Considerations: Young and Middle-Aged Adults

Maintenance of Bone and Muscle Mass: Prevention

Osteoporosis
Sarcopenia

Nutrient-Specific Considerations
Nutrient-specific Considerations: Baby Boomers

Maintenance of Bone and Muscle Mass: Reducing Progression

Osteoporosis

Sarcopenia

Nutrient-Specific Considerations
The Reality of Protein Rich Meals for Contemporary Diet Design

**Breakfast**
- 6 g
- 10 g
- 5 g

**Lunch**
- 8 g
- 6 g
- 24 g

**Dinner**
- Grand latte (skim) 16 g
- 4 g
- 24 g

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Repeated maximal stimulation of protein synthesis is important to maintain, repair, or increase muscle mass.

Total Protein: 90 g
**High-Quality Protein Sample Meal Plan**

**BREAKFAST**
- Rise and Shine Breakfast Sandwich
  - 1 whole wheat English muffin
  - 2 scrambled eggs
  - 1 ounce Canadian bacon
  - 1.5 ounce of lowfat cheddar cheese
  - 3/4 cup mix raspberries, blueberries and strawberries
  - 8-ounce glass nonfat milk

**SNACK**
- 1 ounce walnuts

**LUNCH**
- Garden Fresh Chicken Club
  - 4-ounce sliced chicken breast
  - 1 slice tomato
  - 1 slice red onion
  - 1/16 avocado
  - 2 slices of whole wheat bread
  - Orange
  - Water with lemon

**SNACK**
- 1 medium kiwi
- 1 cup lowfat yogurt

**DINNER**
- Tenderloin, Cranberry, and Pear Salad with Honey Mustard Dressing
  - 1.5 tablespoons honey mustard dressing
  - 4-ounce beef tenderloin steak
  - 1-1/2 cups romaine lettuce
  - 1/2 cup of diced pear
  - 1/8 cup dried cranberries
  - 1/16 cup chopped pecans
  - 2-ounce whole wheat roll
  - Water with lemon
Habitual consumption of protein in excess of the RDA but well within the AMDR, in combination with a physically active lifestyle will contribute to:

- Optimizing protein utilization by the body throughout the lifecycle,
- Improving various health outcomes, in particular, weight management and favorable changes in body composition
- Nutrient needs reflected in Mother Nature’s plan
- Milk – and other high quality proteins – are pivotal options in healthy diet design from early to later life
Thank You!!
Q & A

◆ Please type your questions in the dialog box on your screen.

◆ All follow up information from the webinar will be housed on this page:

  www.HealthyEating.org/2014ProteinWebinar

◆ Archived webinar
◆ PDF of the slide deck
◆ Summary of Q&A
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