Objectives

- Review the basics of protein, protein metabolism and recommended daily intake
- Differentiate protein needs for life stages, optimizing health and with select medical conditions
- Apply current protein recommendations to planning
- Identify ways to incorporate protein in recipes and menus

Protein Basics

- Proteins are compounds of carbon, hydrogen, oxygen, & nitrogen (occ. sulfur) atoms
- Atoms make up each amino acid
- Amino acids combine to make up specific chains that form a protein

The Essential AA (Indispensable)

- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine

*Must be consumed via protein containing foods

The Non-Essential AA (Dispensable)

- Arginine*
- Alanine
- Asparagine
- Aspartate
- Cysteine* [requires methionine]
- Glutamate
- Glutamine*
- Glycine*
- Proline*
- Serine
- Tryptophane* [requires phenylalanine]

- Easily synthesized from carbohydrate molecules and amine groups
- *Conditionally essential

Estimated Essential AA Requirements

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Infants, Age 3–4 mo</th>
<th>Children, Age 1–2 y</th>
<th>Children, Age 10–12 y</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histidine</td>
<td>28</td>
<td>7</td>
<td>7</td>
<td>8–12</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>70</td>
<td>31</td>
<td>28</td>
<td>10</td>
</tr>
<tr>
<td>Leucine</td>
<td>101</td>
<td>73</td>
<td>42</td>
<td>28</td>
</tr>
<tr>
<td>Lysine</td>
<td>103</td>
<td>64</td>
<td>44</td>
<td>12</td>
</tr>
<tr>
<td>Methionine plus cystine</td>
<td>58</td>
<td>27</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Phenyalanine plus tyrosine</td>
<td>125</td>
<td>69</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Threonine</td>
<td>87</td>
<td>37</td>
<td>28</td>
<td>7</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>17</td>
<td>12.5</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Valine</td>
<td>9.2</td>
<td>3.8</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Total w/ histidine</td>
<td>714</td>
<td>312</td>
<td>254</td>
<td>84</td>
</tr>
</tbody>
</table>

*From WHO/UNICEF (1985)
Based on estimated average activity, of amino acids in human milk or from milk formulas, from infant and elder (1967)
- Based on achievement of nitrogen balance sufficient to support adequate lean tissue gain (10 mg N/kg per day). Data from Harper and Kli (1967)
- Based on the range of requirements for position nitrogen balance. Data from Williams et al. (1996) from data of Brouwer et al. (1985).
- Based on the highest estimate of requirement to achieve nitrogen balance. Data from several investigations (reviewed in 1984).
Protein Functions

- Create enzymes that catalyze body’s chemical reactions
- Synthesize peptide hormones that are key for metabolism
- Structure (muscles, connective tissue, skin, hair, nails)
- Transport (e.g. albumin, hemoglobin, transferrin, etc.)
- Immunity – creation of antibodies (immunoglobulins)

Protein & the Human Body

- Protein is not “planned” for energy
- Protein is needed to maintain “normal”
  - Growth, Recovery, Adaptation
  - Virtually every bodily process relies on protein

<table>
<thead>
<tr>
<th>Body*</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal Muscle</td>
<td>43%</td>
</tr>
<tr>
<td>Skin &amp; Blood</td>
<td>15%</td>
</tr>
<tr>
<td>Liver &amp; Kidney</td>
<td>10%</td>
</tr>
<tr>
<td>Other Organs</td>
<td>32%</td>
</tr>
</tbody>
</table>

*Adult

Chart adapted from Mary Litchford’s Protein Powders, Potion, & Elixers

Protein Recommendation

- Recommended Daily Allowance
- Built on “survival”; not “optimal”
- Protein is not “stored”; needs daily replenishment
- No UL has been established
- Inadequate protein = kwashiorkor and eventually death

<table>
<thead>
<tr>
<th>Life Stage</th>
<th>Protein (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td></td>
</tr>
<tr>
<td>0–6 months</td>
<td>9.1*</td>
</tr>
<tr>
<td>6–12 months</td>
<td>11.0</td>
</tr>
<tr>
<td>Children</td>
<td></td>
</tr>
<tr>
<td>1–3 yrs</td>
<td>13</td>
</tr>
<tr>
<td>4–6 yrs</td>
<td>19</td>
</tr>
<tr>
<td>13–18 yrs</td>
<td>34</td>
</tr>
<tr>
<td>19–30 yrs</td>
<td>53</td>
</tr>
<tr>
<td>31–50 yrs</td>
<td>56</td>
</tr>
<tr>
<td>51–70 yrs</td>
<td>56</td>
</tr>
<tr>
<td>&gt; 70 yrs</td>
<td>56</td>
</tr>
<tr>
<td>Marijuana users</td>
<td>34</td>
</tr>
<tr>
<td>9–11 yrs</td>
<td>34</td>
</tr>
<tr>
<td>14–18 yrs</td>
<td>46</td>
</tr>
<tr>
<td>19–30 yrs</td>
<td>46</td>
</tr>
<tr>
<td>31–50 yrs</td>
<td>46</td>
</tr>
<tr>
<td>51–70 yrs</td>
<td>46</td>
</tr>
<tr>
<td>&gt; 70 yrs</td>
<td>46</td>
</tr>
<tr>
<td>Pregnant/Lactation</td>
<td></td>
</tr>
<tr>
<td>14–18 yrs</td>
<td>71</td>
</tr>
<tr>
<td>19–30 yrs</td>
<td>71</td>
</tr>
<tr>
<td>31–50 yrs</td>
<td>71</td>
</tr>
</tbody>
</table>

* Adequate Intake


Example as explained by Professor Luc Van Loon “You are what you just ate” FNCE Session 2017
The “Real” Protein Needs

- Not really a ‘protein’ need; it is an ‘amino acid’ need
- More protein when:
  - Physically active
  - Pregnant / Lactating
  - Child / Young Adult (growing)
  - Older (losing lean muscle)
  - Injured, ill, repairing
  - Not absorbing protein normally (e.g. post-bariatric surgeries)
- Baseline vs. Optimal
  - IOM / 2015 Dietary Guidelines says 10%-35% of calories
    - 2000 calories = 50g to 175g

Protein and...

- Heart Health
  - No consistent link between [lean] animal protein and increased risk of CVD
  - Milk / milk products may be protective
  - Poultry & fish suggested to reduce CVD risk for women
  - FDA allows claim for 25g soy protein per day (w/ low sat. fat / chol)
    may reduce risk of heart disease
  - Higher protein intakes may benefit BP; especially from plant protein.
- Diabetes
  - Higher intakes of total and animal protein associated with increased risks of T2D
    - Higher plant protein intake tended to be associated with lower risk of T2D.
  - High protein diets help improve CVD risk in people with diabetes

Protein and...

- Bone Health
  - Protein makes up “50% of bone volume and ~30% of bone mass
  - Theory = high [skewed to animal] protein diets cause osteoporosis
    - Research says - with adequate calcium, protein is beneficial to bone health
- Cancer
  - Theory = protein enhances tumor growth
    - Research is inconsistent
  - Soy associated with reduced risk of breast cancer
    - With breast cancer soy decreased death risk and recurrence
  - Red meat / processed meat linked with increased risk
  - No association found btw animal PRO and colorectal cancer
  - Overall cancer incidence lower in vegetarians
    - Higher colorectal cancer reported in veg vs. meat eaters.

Protein and...

- Renal Health
  - Myth = higher protein diets (in elderly) harms kidneys
  - Truth – increased protein intake doesn’t hurt kidneys that are functioning WNL
    - Accelerated renal decline observed in mild renal insufficiency with high [nondairy] animal protein intake
  - Plant protein may slow renal decline in diabetics

Protein and...

- Aging
  - Important to maintain lean mass and avoid sarcopenia
    - 3-8% lean muscle loss per decade after age 30
  - High quality protein in senior diets increased muscle protein synthesis by 50%
- Inactivity & Aging Muscle

Protein and...

- Weight Management
  - With an equal energy intake, protein increases satiety better than CHO and Fat
  - Higher protein intake promotes greater fat loss (preserves lean muscle)
  - No data to support superiority for source of protein
    - Animal protein is thought to have greater effect on increasing thermogenesis
Recommendations
• 20g protein at eating occasions
• More (e.g. elderly) when anabolic response is lower
• Space eating ‘equally’ across the day
• [Healthy] elderly 1.0-1.2 g/kg BW
• 1.2-2.0 g/kg BW for repletion
• Post-Bariatric procedures with malabsorption plan for +30% of calculated protein needs
• Wound healing [NPUAP guidelines] 1.25 - 1.5g/kg
• Critically ill [ASPEN] 1.2 – 2.0g/kg (if BMI <30)

Protein Deficiency
• Kwashiorkor rare!
• What you might see in physical exam:
• Hair loss: easily falls out; thin; lackluster; pigmentation changes
• Brittle nails: dull; horizontal ridges
• Edema (very severe cases)

Protein Deficiency
• What you might see in physical exam:
• Loss of lean mass (weight loss) ... check the muscles
  • Orbital, temple, clavical, arms, scapula, ribs, legs, calf
• Edema (very severe cases)

Protein Deficiency
• Other s/s:
• Slow healing; Lowered immunity
• Fatigue / weakness

Proteins & Lab Data
• Serum proteins are not sensitive or specific to intake
• To date, no research links an increase in albumin/prealbumin to a higher protein/calorie intake
• Albumin / Pre-albumin
• Impacted by a multitude of factors
• Protein status IS linked to morbidity and mortality

Proteins & Lab Data
• Serum proteins are not sensitive or specific to intake
• To date, no research links an increase in albumin/prealbumin to a higher protein/calorie intake
• Serum proteins mark severity of illness not necessarily nutrition status.
• Albumin affected by:
  • Dehydration, marasmus, blood transfusions [increased]
  • Hepatic failure, metabolic stress, trauma, ascites, bed rest, inflammation, burns / wounds, cancer [decreased]
• Pre-albumin affected by:
  • Severe renal failure, corticosteroid use [increased]
  • Post-surgery, liver zinc deficiency, healing, hyperglycemia [decreased]

Bahn L. Practical Gastroenterology October 2006;46:64
Proteins & Lab Data cont.

- Retinol-Binding Protein:
  - Uncomplicated malnutrition, inflammation [decreased]
  - Renal failure [increased regardless of nutrition status]
- Transferrin affected by:
  - Hemochromatosis, ↑Fe intake, anemia, acute liver disease [increased]
  - Acute inflammation, malignancies, collagen vascular or liver diseases, anemia of chronic disease [decreased]
- C-Reactive Protein
  - Marker of inflammation
  - As long as CRP is elevated albumin / prealbumin are useless data points

Suggest Alternate Biomarkers

- ASPEN/ AND Guidelines – Adult malnutrition defined as any 2 of the following:
  - Insufficient energy intake
  - Weight loss
  - Loss of lean muscle
  - Loss of subcutaneous fat
  - Edema (that may mask weight loss)
  - Diminished functional status (i.e. hand-grip strength)

Proteins & Lab Data

- Still arguing with the nurse & physician?
  Download a copy of the Banh reference for them


Meeting Protein Needs

- Animal proteins – provide all 9 essential amino acids (EAA)
  - "Complete"
  - "High biological value"
- Protein from plant sources can be deficient in 1 or more of the EAA
  - "Incomplete"
- Whether animal or plant - different foods provide different amounts of protein
- Groups of concern:
  - Vegans
  - Older adults

Meeting Protein Needs

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Meal Planning: Plant vs. Animal

- All EAA come with animal protein intake
- Eating a plant-only based diet requires additional planning to get all EAA
- Lacking is EAA’s methionine and lysine
- “Complementary” proteins = mixing plant sources that deliver all the EAA
- Not required at each meal (used to think so)
  - Probably beneficial if delivered at each meal

Meal Planning: Distribution

- Even protein distribution across meals helps maximize protein synthesis and glycemic response.

Application Tips

- From 20g protein ~ 2g becomes muscle in ~2 hours
- Food preparation makes a difference
  - Ground meats absorbed better than whole
- Body position matters – sit up while eating
- Protein at bedtime?
  - Provide a protein containing snack prior to, or right after, “exercise”.
  - There are NO non-responders to exercise!
  - Older people synthesize muscle as well as younger people with adequate protein intake

Luc Van Loon data

Vegetarian Meal Planning

- Which Plan?
  - **Pescatarian** Includes dairy foods, eggs, fish and seafood, but no meat or poultry.
  - **Lacto-Ovo Vegetarian** Includes dairy foods and eggs, but no meat, poultry, fish, or seafood.
  - **Vegan** - no animal foods.
- Tofu – replaces meats
- Nuts/seeds
- Beans/Legumes
- Whole Grains
  - Ask your food service distributor about vegan entrees

Boosting Protein at Breakfast

Aim for 20g-25g protein at breakfast

- Eggs: Boiled, Fried, Omelet (numerous options), Scrambled, Egg Bake/Strata
- Breakfast Sandwich: egg & sausage muffin, toasted cheese, peanut butter, egg salad on toast/muffin, cream cheese & lox
- Breakfast pizza, wraps
- Ham, Sausage/Bangers (links or rings), “Hash”
- Yogurt (plain, fruited, parfait); preferably Greek
- Milk, smoothies

Putting Protein into Snacks

- The ‘usual’
  - Pudding, ice cream, shakes, nutritional supplement
- Check the Appetizers & Hors d’oeuvres Section
  - Pin wheel / Finger sandwiches
- Chicken wings, mini quiche, corn dog bites, bagel bites
- Cheese Sticks
- Veg/Fruit/Bread Cubes and Hummus/Yogurt Dips
Protein Up Recipes

- Make hot cereals/ soups (etc.) with [no/low fat] milk, Greek yogurt or liquid nutritional supplements
- Add protein powder/liquid to anything!
  - Cereals, baked goods, scrambled egg dishes, casseroles, gravies, cream soups...

Conclusion

The body has infinite wisdom and if fed right it can heal itself of [almost] any thing!

Dr. Nathan Morris

Remember the importance of protein!

References / Resources


Thank you for participating in today’s session!