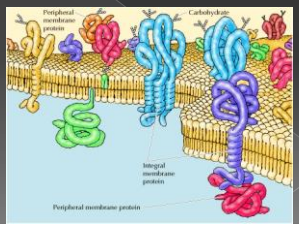
Filling in the Protein Gap

Lynn Spalding, RD, CSG

Protein is in all Cells

- Making up the structural tissue for muscles and tendons, transport oxygen or hemoglobin, catalyze all biochemical reactions as enzymes and regulate reactions as hormones.



Objectives

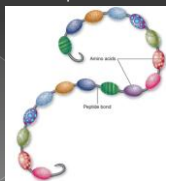
- Understand the role of protein in wound healing
- Explain protein digestion and utilization for tissue repair
- Identify key elements in modular protein supplements for efficient evaluation
- Recommend protein products with confidence

Classifying Amino Acids

- Essential AA (9)
  - Cannot be made by the body, so must be supplied in the diet
- Nonessential AA (11)
  - Can be made by the body
  - Nonessential AA (11)
- Conditionally Essential AA (6)
  - Essential only in certain conditions like in the presence of a wound when their demands increase

WHAT IS PROTEIN?

- Complex organic molecule
- Made of individual "building block" units called amino acids (AAs) that are linked together
- 20 different AAs in human proteins
  - Composed of carbon, hydrogen, oxygen, and **nitrogen**
  - vital to the body's growth & function
- The human body contains ~100,000 different proteins



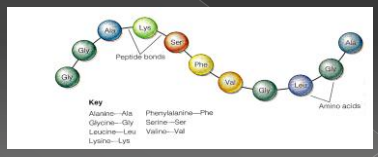
Berg JM, et al. Biochemistry. 5th ed. New York, NY: WH Freeman & Co.; 2002

Classification of Amino Acids

Essential-9 (Indispensable)	Non-Essential-11 (Dispensable)	Conditionally-Essential-6 (Conditionally indispensable)
Histidine	Arginine	Arginine
Isoleucine	Cysteine	Cysteine
Leucine	Glutamine	Glutamine
Lysine	Glycine	Glycine
Methionine	Proline	Proline
Phenylalanine	Tyrosine	Tyrosine
Threonine	Alanine	
Tryptophan	Aspartic acid	
Valine	Asparagine	
	Serine	
	Glutamic Acid	

Making a Protein

- Cells assemble the 20 AAs in a specific sequence according to information provided by DNA
- The order of the AAs determines its function
- The 1 AA is joined to the next by a PEPTIDE bond



Protein Quality

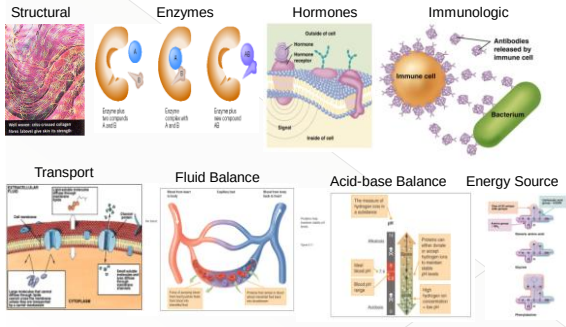
- High Quality: Complete protein
  - Contains all the essential AAs in amounts that meet or exceed the amounts needed by humans
    - Animal proteins
    - Dairy proteins
    - Soy protein
- Low-Quality: Incomplete protein
  - Too low in one or more of the essential AAs to support human growth and development
    - Cannot serve as a sole source of protein in the diet
    - Most plant proteins are incomplete proteins

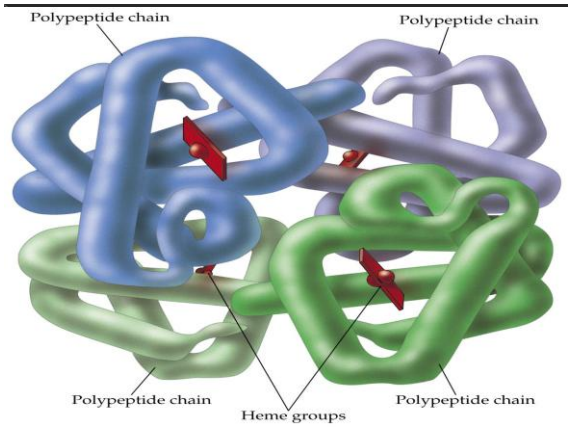
McDonald L, et al. *The Protein Book: A Complete Guide for the Coach and Athlete*. 1st ed. Salt Lake City, UT: Lyle McDonald Publishing; 2007.

Amino Acids Bond Together

- Dipeptide – 2 AAs
- Tripeptide – 3 AAs
- Oligopeptides – 4-10 AAs
- Polypeptide – >10 AAs
- Proteins in the body & diet are long polypeptides (100s of AAs)

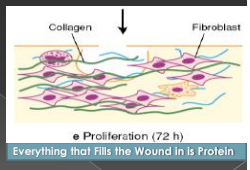
Protein Has Multiple Functions





Functions of Protein in Wound Healing

- Collagen synthesis
  - gives strength to bone & skin
- Epidermal cell proliferation
- Skin integrity
- Resistance to infection
- Angiogenesis
- Oncotic pressure maintenance



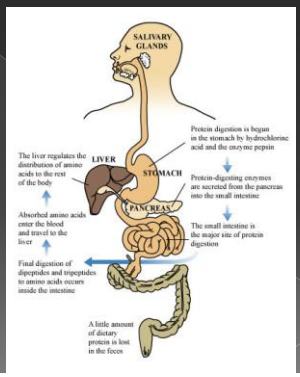
Proteins in Foods

- No natural food is 100% protein
- Animal foods typically have more protein than plant foods

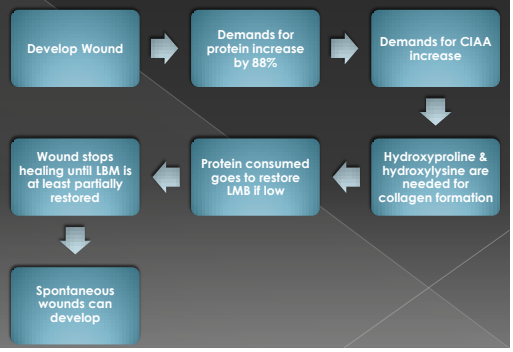
Wound increases Protein Needs

- Increase in glucose production in excess of need
- Increase in breakdown of protein for glucose production
- Catabolism of muscle protein
- Inefficient use of fat stores for energy utilizing protein
- Arginine & Glutamine go to wound leading to depletion

Protein Digestion



Adequate Protein will Achieve Optimal Wound Healing



Protein Requirements

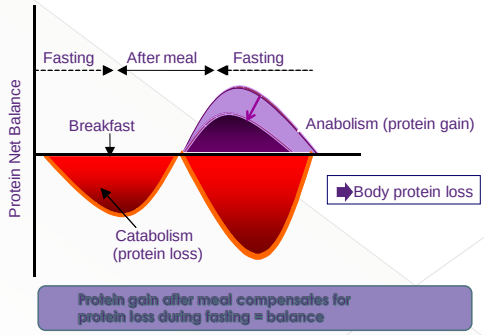
Condition	grams/kg body wt/day
Healthy adult <60	0.8
Healthy adult >60	1.0
Minor Surgery	1-1.1
Major Surgery	1.2-1.5
Presence of wound	1.5
Pressure ulcer	1.2-1.5
Burns	1.5 - 2.0

Prevention and treatment of pressure ulcers: clinical practice guideline. Washington (DC): National Pressure Ulcer Advisory Panel; 2009. 51-120

Nitrogen is found only in Protein

- If nitrogen excretion is > the nitrogen content of the diet = negative nitrogen balance, an indication of tissue destruction (Catabolism)
- If the nitrogen excretion is < the content of the diet = positive nitrogen balance, indicating the formation of protein (Anabolism)
- Skin is in a negative protein status when a wound is present

Protein metabolism = (nitrogen) balance



Patients often Struggle to Achieve Recommended Nutritional Intakes

Age-related factors:

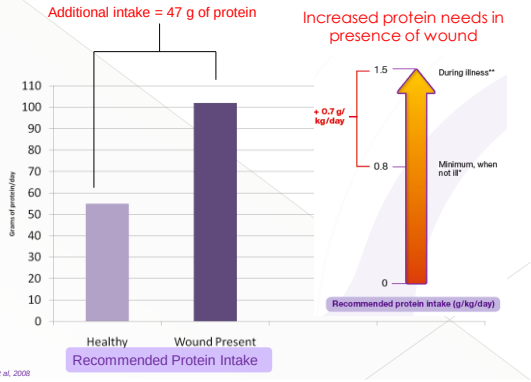
- Poor dentition, dementia, depression, social isolation, decreased appetite, early satiation, loss of taste & smell, less thirst, side effects of medication …

"Anorexia of aging":

- Decline of total energy & protein intake by ~30%

Hays & Roberts, 2006; DiFrancesco ,2007

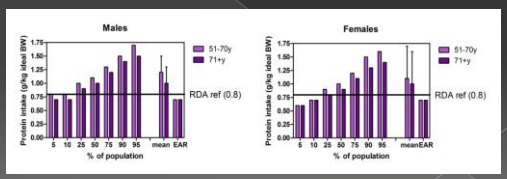
Example of pt weighing 150lbs



Wolfe et al, 2008

Protein Deficiency in Elderly

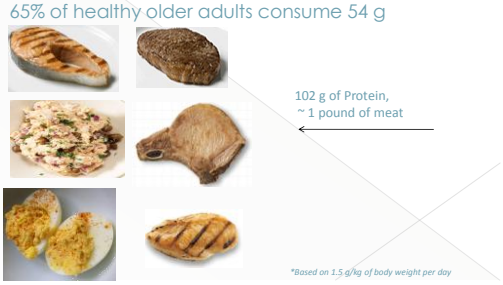
- Decline of protein intake with aging
- ~25% of healthy elderly do not reach RDA
- 50% of healthy elderly (71+y) do not reach 1.0 g/kg bw/d



Fulgoni et al, 2008

High Protein intake is Required for Wound Healing

- 150 lb resident with a wound needs ~102 g of protein*
- 65% of healthy older adults consume 54 g



**Based on 1.5 g/kg of body weight per day*

Intake Lowest in Institutionalized Elderly

- 20-35% have protein intake below 0.7g/kg bw/d (vs 10% in healthy/frail)
- Elderly in institutions with low protein intake are at risk of frailty
- Unintentional wt loss in residents was associated with 74% greater likelihood of developing pressure ulcers

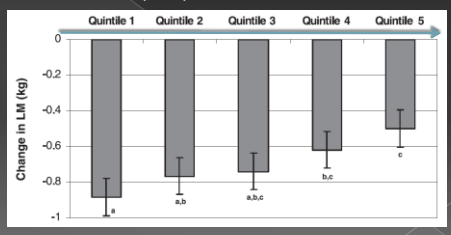
Tieland et al, 2011; Bartali 2006

Inadequate Protein Intake

- Contributes to increased skin fragility, decreased immune function, poorer healing and longer recuperation from illness

High protein intake : Counteract muscle loss

Dietary protein intake is associated with skeletal muscle mass change in elderly (over 3yrs). The higher protein intake (x-axis) the lower the muscle loss (Y axis).



Houston et al, 2008

Elderly have Accelerated Muscle Loss

- Comparing inactive healthy young vs healthy old inactive adults consuming RDA for protein
- Older adults lost 3 X more muscle in 1/3 of the time
- By comparison, inpatient hospitalized elderly had ≥ 3X more muscle loss in 1/10 of the time
- There was a 30% decrease in protein synthesis in just 10 days of inactivity in older adults

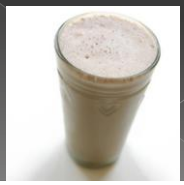
Paddon-Jones et al., J clin; Kariba ain P et al., JAMA 2007.

Age Related Conditions Leading to Need for Supplementation

- Pressure Ulcer prevalence is up to 28% in LTC & 18% in Acute Care
- 88% increase in protein needs when wound is present
- PEM prevalence of up to 85% in LTC & 50% in Acute Care
- Sarcopenia: 10-20% decline in LBM per decade
- Increased metabolic Stress → increased demand for Conditionally essential AA
- Reduction in gastric acid→ decreased breakdown & absorption of food
- Impaired swallowing
- Reduced efficiency of chewing, decreased salivary production
- Early satiety & decline in appetite

Protein Supplement

- It has been shown that impairment of protein synthesis of old muscle after meal ingestion could be normalized by high levels of AAs



(Volpi et al., 1998; Welle et al., 1994; Masoni et al., 1993).

Factors to Consider when Selecting Supplements

- Composition (whey, casein, collagen)
- Digestibility(hydrolyzed, intact)
- Serving size (1oz-8oz)
- Total grams of protein
- Quality (complete protein)
- Taste (sweet, bitter)
- Texture (gritty, smooth)
- Volume (fluid required)
- Prep time (powder, liquid)
- Viscosity (thin, nectar, honey)
- Mineral level (Na, K, Phos)
- Lactose level
- Calories (high, low)

Satiety cues and intestinal changes with age

- Quicker filling of distal antrum (fullness ↑)
- Slower gastric emptying (fullness ↑)
- Smaller and thicker villi (absorption ↓)
- Decreased mucosal surface (absorption ↓)

Satiation in elderly is largely controlled by gastric processes & ingested volume

Cook *et al*, 1997; Donini *et al*, 2003; Clarkston *et al*, 1997; Davy *et al*, 2008; Van Walleghen *et al*, 2007

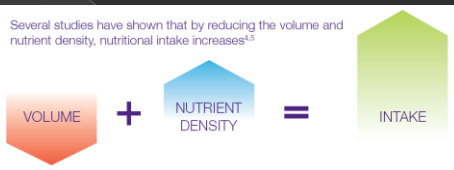
Compliance to Oral Nutrition Supplement (ONS)

- Compliance to large volume ONS is low: ~**50-65%**
- Consumption of ONS varies in different studies:
  - 65% nursing home residents
  - 62% medical and surgical wards
  - 54% acute geriatric patients
  - 47% wards, incl. general medical, surgical, care of the elderly
- Effects low compliance:
  - Negatively affects clinical outcome
  - Financial waste

Ross, 1999; Lawson et al, 2000; Gosney, 2003; Belo et al, 1987; Remsberg et al, 2001; Peake et al, 1998; Joosten and Elst, 2001; Lad et al, 2005; Roberts et al, 2003; Kayser-Jones et al, 1998

Low volume + high nutrient density

- Several studies have shown that by reducing the volume and nutrient density, nutritional intake increases[4,5]



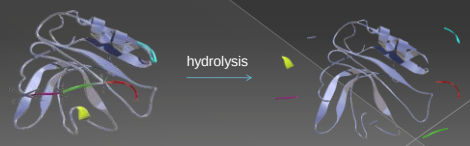
The Solution:
Less Volume, More Nutrition

Powered Modular Protein Supplements in HealthCare Settings

- Typically whey, soy, casein, or combination
- Contain milk protein (allergen) and lactose
- High in essential AAs, low in conditionally essential AAs
- Require mixing with 4-8 oz of liquid or in food
- Often changes consistency or texture of food
- Low calorie to protein ratio
- High amount of waste
- Difficult to document consumption accurately

Hydrolyzed Protein

- Many residents on antacids delaying protein denaturation & have malabsorption
- Broken down for efficient absorption & rapid utilization

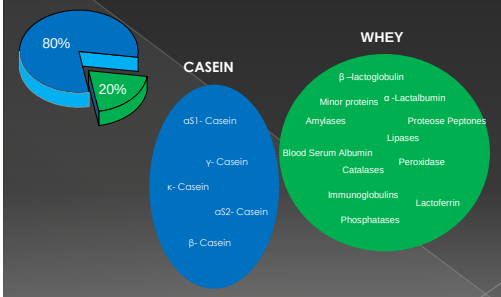


Borlase BC, et al. *Surgery, Gyn & Obstetrics*. 1992;174:181-188. Cummings JH, et al. Am J Clin Nutr. 2001;73:415S 420S. Roberts PR, et al. *Nutrition*. 1998;14:266-269. Rowe B, et al. *J Am Coll Nutr*. 1994;124:323-330.

Liquid Modular Protein Supplements in HealthCare Setting

- Collagen based, some contain combination of collagen + whey or collagen + casein
- Highly concentrated with up to 15gm protein/30 ml
- Typically hydrolyzed for faster absorption and assimilation resulting in greater bioavailability
- Contain significantly more nitrogen rich conditionally essential AAs than powders
- No mixing required
- Easily administered orally and to tube feed pts
- Easy and accurate documentation of intake

Milk Proteins



Collagen Protein

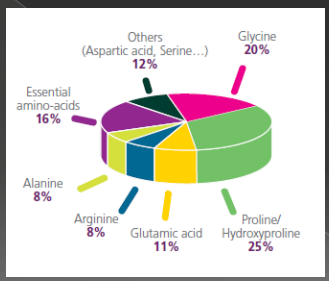
- Source: beef hide, fish, porcine, bone
- 95% protein by wt.
- High in conditionally essential AA, equal in essential AA per serving compared to whey & casein
- Liquid form
- Due to high solubility, able to Concentrate protein in liquid form (15-17g per 1 fl oz)
- Hydrolyzed form
- High in AA needed for collagen formation only found in collagen: proline, hydroxyproline, hydroxylysine
- Lactose free

Whey Protein

- Liquid which separates from the curd when milk curdles
- The majority of Whey Products are in powdered form:
  - Whey Protein Concentrate (WPC) : 34-80% protein by wt ($)
  - Whey Protein Isolate (WPI) : 85-95% protein by wt ($$)
  - Whey protein hydrolysates ($$$)
- WPIs give high clarity, WPCs give opacity
- Clearer WPIs gives cleaner taste
- Hydrolysates have bitter taste and strong sulphur odor
- ~5-6 grams of protein in 4-8 oz of fluid, low calorie ~30 per serving
- High in Phosphorus
- Whey is rapidly digested and results in quick rise in plasma AAs (fast protein) stimulating protein synthesis

Berg JM, et al. *Biochemistry*. 5th ed. New York, NY: WH Freeman & Co.; 2002.
Boirie Y, et al. *Proc Natl Acad Sci U S A*. 1997;94(26):14930-14935.
Rossi AL, et al. *J Nutraceuticals, Functional and Medical Foods*. 2000;3(1):33-44.

Hydrolyzed Collagen Protein Composition

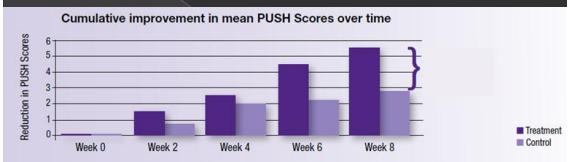


Casein Protein

- Casein is the most abundant protein in milk
- 85-95% protein by wt
- Hydrolysates have bitter taste and strong sulphur odor and costly
- ~5-6 grams of protein in 4-8 oz of fluid, low calorie ~30 per serving
- High in Phos, Na, K and contains lactose
- Intact form
- Casein has a slow rate of digestion, and results in a slow but steady release of AAs into circulation
- Casein reduces muscle protein breakdown better than whey protein

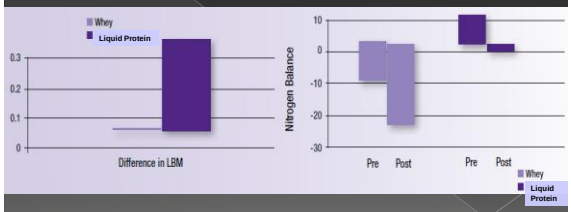
Phillips SM, et al. *J Am Coll Nutr*. 2009;28(4):343-354.

Concentrated Liquid Protein showed: 96% greater pressure ulcer healing in 89 residents in a double-blind, placebo controlled clinical trial



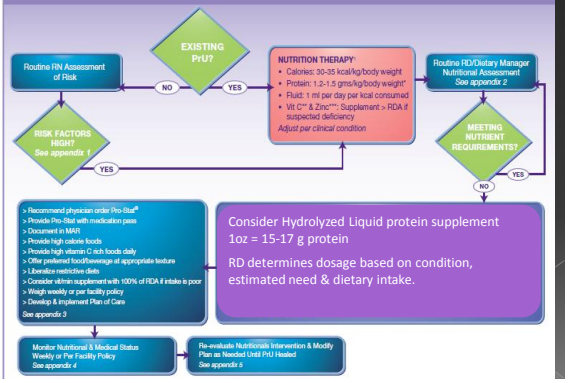
Pressure Ulcer Healing with a Concentrated, Fortified, Collagen Protein Hydrolysate Supplement: A Randomized Controlled Trial. Lee SK et al. Adv Skin Wound Care. 2006;19:92-6.

Concentrated Liquid Protein: Equivalent to Whey in Maintaining Nitrogen Balance but Superior in Preserving LBM



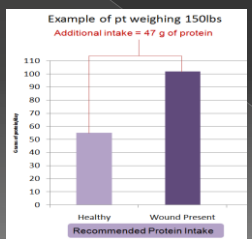
Effects of Whey and Fortified Collagen Hydrolysate Protein Supplements on Nitrogen Balance and Body Composition in Older Women. Hays et al. Journal of the American Dietetic Association. 2009;109:1082-1087.

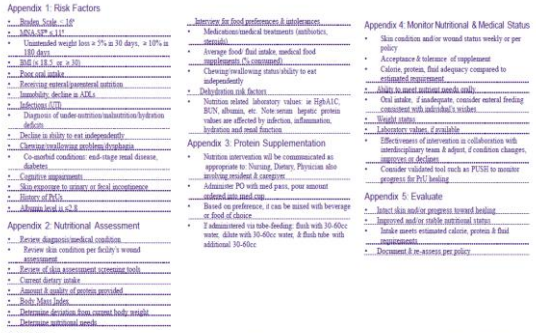
Pressure Ulcers (PrU)



Concentrated Liquid Protein Supplements help meet increased protein needs

- 1-3 servings a day will contribute 15-45 g protein to the daily intake.





Appendix 1: Risk Factors

- Braden Scale < 16*
- MNA-SF® ≤ 11*
- Unintended weight loss ≥ 5% in 30 days, ≥ 10% in 180 days
- BMI (≤ 18.5, or ≥ 30)
- Poor oral intake
- Receiving enteral/parenteral nutrition
- Immobility, decline in ADLs
- Infections (UTI)
- Diagnosis of under-nutrition/malnutrition/hydration deficits
- Decline in ability to eat independently
- Chewing/swallowing problem/dysphagia
- Co-morbid conditions: end-stage renal disease, diabetes
- Cognitive impairments
- Skin exposure to urinary or fecal incontinence
- History of PrUs
- Albumin level ≤ 2.8

Appendix 2: Nutritional Assessment

- Review diagnosis/medical condition
- Review skin condition per facility's wound assessment
- Review of skin assessment screening tools
- Current dietary intake
- Amount & quality of nutrients provided
- Body Mass Index
- Determine deviation from current body weight
- Determine nutritional needs

Interview for food preferences & intolerances

- Medications/medical treatments (antibiotics, steroids)
- Average food/ fluid intake, medical food supplements (% consumed)
- Chewing/swallowing status/ability to eat independently
- Dehydration risk factors
- Nutrition related laboratory values: ie HgbA1C, BUN, albumin, etc. Note serum hepatic protein values are effected by infection, inflammation, hydration and renal function

Appendix 3: Protein Supplementation

- Nutrition intervention will be communicated as appropriate to: Nursing, Dietary, Physician also involving resident & caregiver
- Administer PO with med pass, pour amount ordered into med cup
- Based on preference, it can be mixed with beverage or food of choice
- If administered via tube-feeding: flush with 30-60cc water, dilute with 30-60cc water, & flush tube with additional 30-60cc

Appendix 4: Monitor Nutritional & Medical Status

- Skin condition and/or wound status weekly or per policy
- Acceptance & tolerance of supplement
- Calorie, protein, fluid adequacy compared to estimated requirement
- Ability to meet nutrient needs orally
- Oral intake, if inadequate, consider enteral feeding consistent with individual's wishes
- Weight status
- Laboratory values, if available
- Effectiveness of intervention in collaboration with interdisciplinary team & adjust, if condition changes, improves or declines
- Consider validated tool such as PUSH to monitor progress for PrU healing

Appendix 5: Evaluate

- Intact skin and/or progress toward healing
- Improved and/or stable nutritional status
- Intake meets estimated calorie, protein & fluid requirements
- Document & re-assess per policy

References:

1. European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel. Prevention and treatment of pressure ulcers: quick reference guide. Washington DC: National Pressure Ulcer Advisory Panel, 2009.
2. Lee S K, Posthauer ME, Dorner B, Redovian V, Maloney M J. Pressure ulcer healing with a concentrated, fortified, collagen protein hydrolysate supplement: a randomized controlled trial. Advances in Skin & Wound Care, 2006 (0.1/9/2): 92-96
3. Hays et al. Effects of Whey and Fortified Collagen Hydrolysate Protein Supplements on Nitrogen Balance and Body Composition in Older Women. Journal of the American Dietetic Association. 109:1082-1087. June 2009.
4. Braden, B. The Braden Scale for pressure Ulcer prediction. Available at http://www.bradenscale.com/braden.PDF Accessed August 24, 2011.
5. MNA ® http://www.mna-elderly.com Accessed August 24, 2011.

Form	Liquid (1 oz)	Powder (1 scoop)
Serving Size	1 oz	1 scoop
Additional Fluid Required	None	4-6 oz
Protein grams	15 g	6 g
Calories	100	25
IAA	2.8 g	2.9 g
Nonessential AA	12.9 g	2.82 g
Conditionally IAA	9.86 g	1.74 g
Flavor	Variety	Unflavored
Hydrolyzed	Yes	No
Servings required to reach 45 g protein/d	1 fl oz, t.i.d = 3 fl oz	4-6 fl oz, 7.5x = 30-45 fl oz

- Compared to whey powder, Liquid Protein
  - contains 2.5 X more protein per serving
  - Healing wounds for over 30 years
  - hydrolyzed for efficient absorption
  - does not clog feeding tubes & does not require the addition of fluids & mixing which is convenient for patients and clinicians
  - contains significantly more calories to spare AA from being utilized for energy
  - Offers a variety of flavors
- A recent clinical study comparing a hydrolyzed liquid collagen based protein supplement to a whey supplement showed they were both equivalent in maintaining nitrogen balance in older adults but liquid protein was more effective in preserving LBM

Potential Benefits of Supplementation

Patient

- Effective wound healing
- Easy to swallow, nutrient dense
- Increase strength supporting independence & daily activity
- Improve quality of life

HCP

- Reduces incidence of complications such as infections, poor wound healing & PrUs
- Reduces length of hospital stay & readmissions
- Saves time & cost associated with PrU
- Better acceptance, ease of administration & monitoring
- Achievement of targeted protein intake
- Improvement in quality indicators

Stratton 2003; McMurdo 2009; Norman 2008; Rabadi 2008; Garibalda 2007; Persson 2007; NICE 2006; Milne 2009; Averell 2006; Cawood 2007; Stratton 2005; Garibalda 2006; Chapman Am J Clin Nutr 2009; Cawood 2011