High Protein Dairy Products Manufacture and Formulation

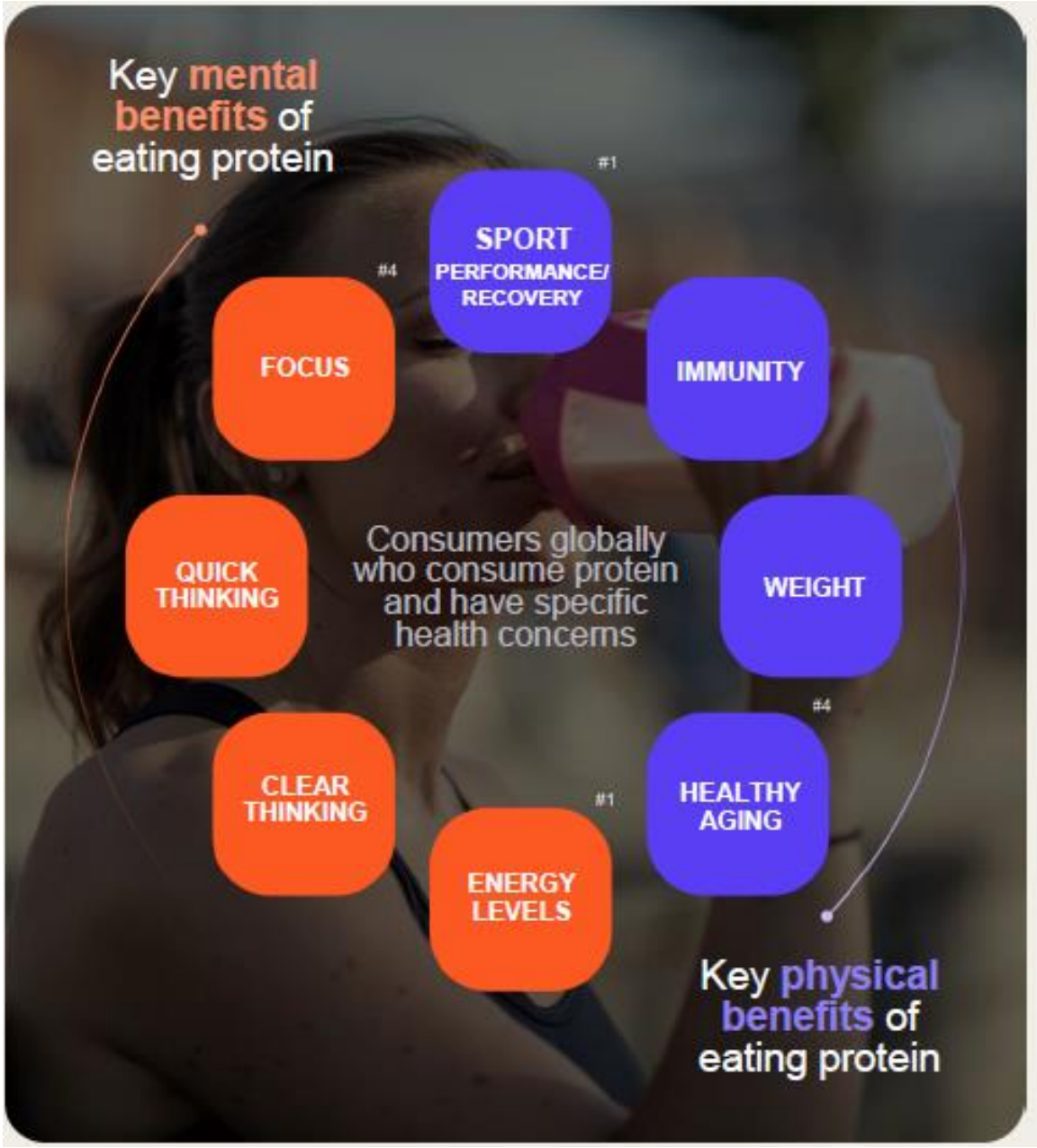
Learning Objectives

- Consumer interest in protein
- Elevating Protein with Dairy Ingredients
- Formulation considerations
- Processing high protein dairy products

INNOVA MARKET INSIGHTS

Consumers interest in eating protein from dairy products

GLP-1



How much protein should we consume in a day?

Dietary Guidelines For Americans

USDA

For decades, the U.S. dietary guidelines and other sources have recommended that people consume 0.8 grams of protein per kilogram of body weight each day, or about 54 grams daily for a 150-pound person.

The new recommendation advises people to consume 1.2 grams to 1.6 grams of protein per kilogram of body weight – up to double the previous advice. The guidance says adults should consume at least 100 grams of protein per day with half or more coming from animal sources.

For 150 lb person that translates to 82 – 110 gm protein/day and possibly more for older adults

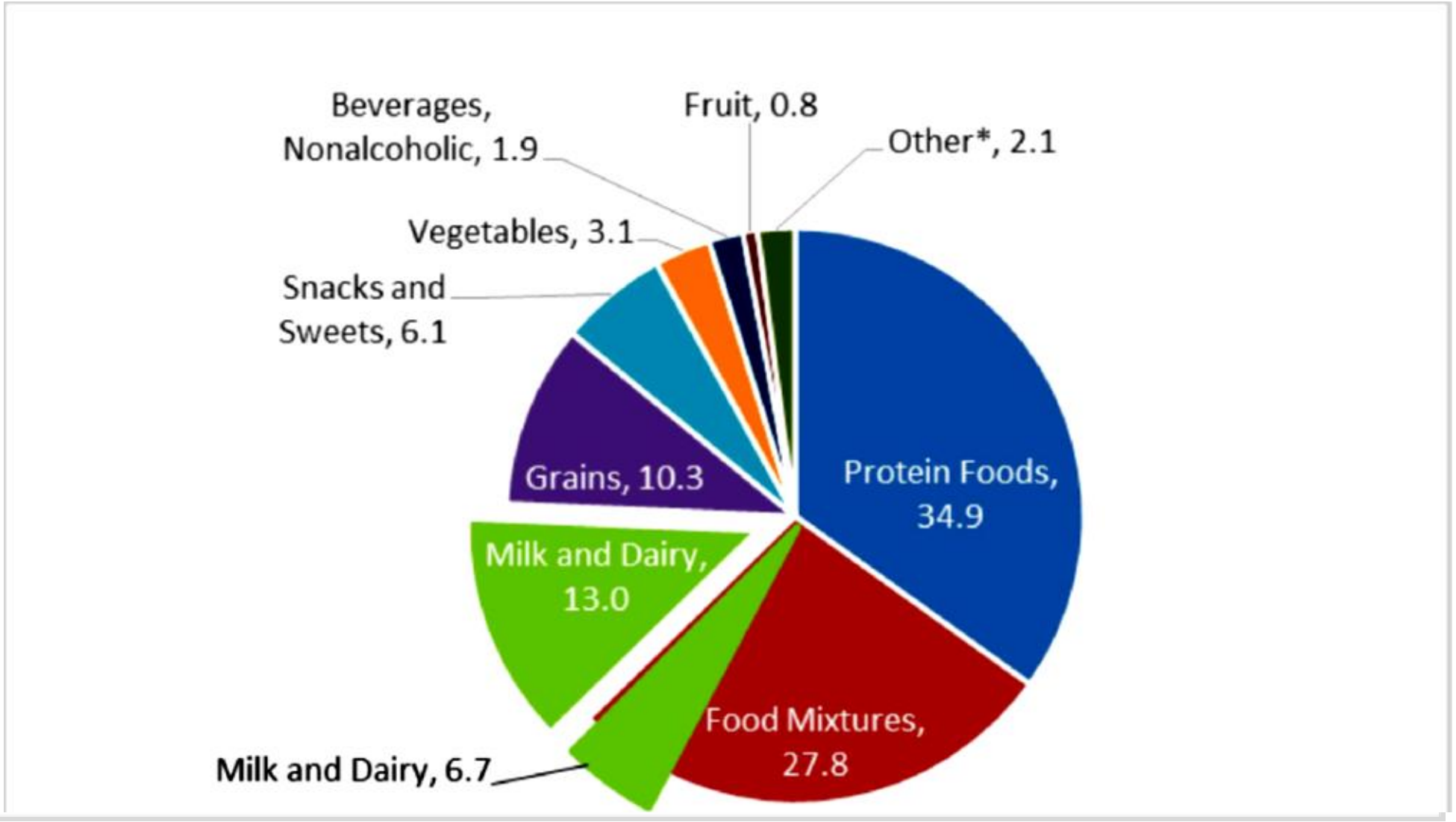


Figure 1. Food sources of protein in the diet of Americans ages 2 years and older; percentage of the total daily protein intake (NHANES 2007-2010).

How much protein in a serving?

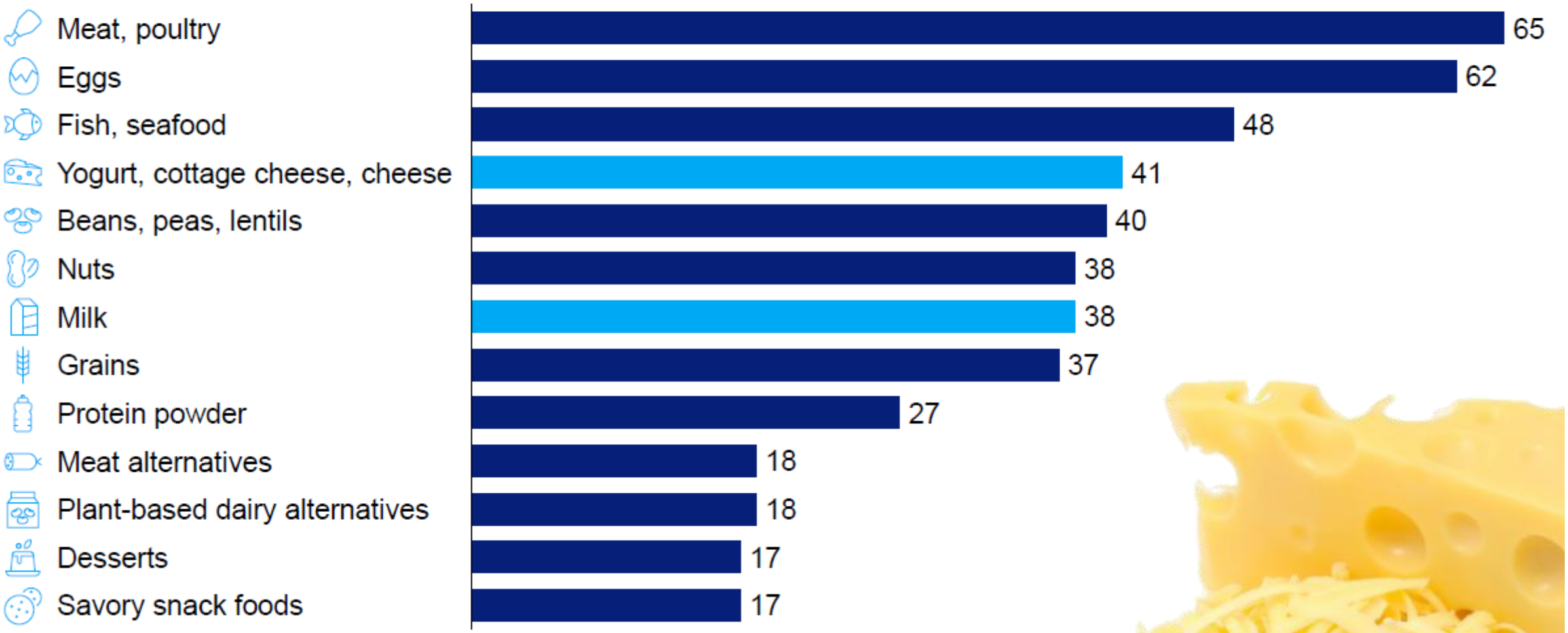
Milk, whole, 1 cup	8 g
Cheese, natural, 1.5 ounces[a]	10 g
Cheese, processed, 2 ounces	10 g
Cottage cheese, low-fat, ½ cup	13 g
Yogurt, plain, low-fat, 1 cup	12 g
Yogurt, Greek, plain, non-fat, 6 ounces	17 g
Whey-based protein powder, 2 tbs	9 g

[a] Examples are cheddar, Swiss and muenster.

Source: USDA National Nutrient Database for Standard Reference, Release 26.

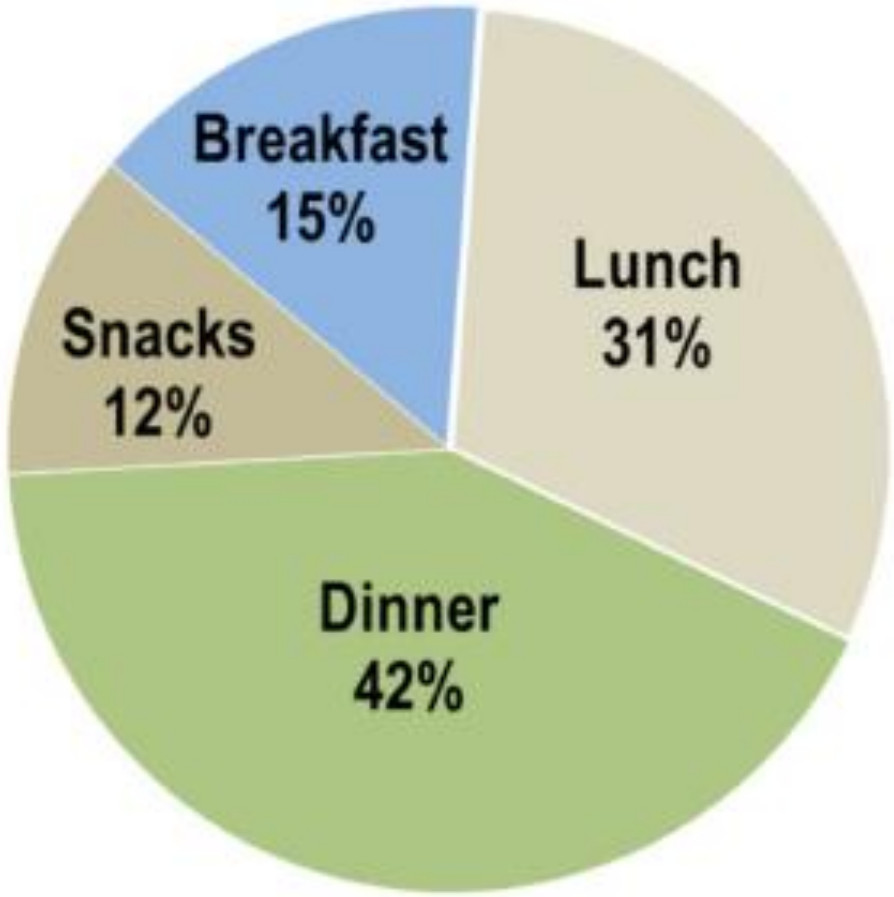
Yogurt, cottage cheese, cheese and milk are preferred sources of protein . . . *Clean, Simple ingredient statements*

Preferred protein sources, %, 2025



Source: IFIC

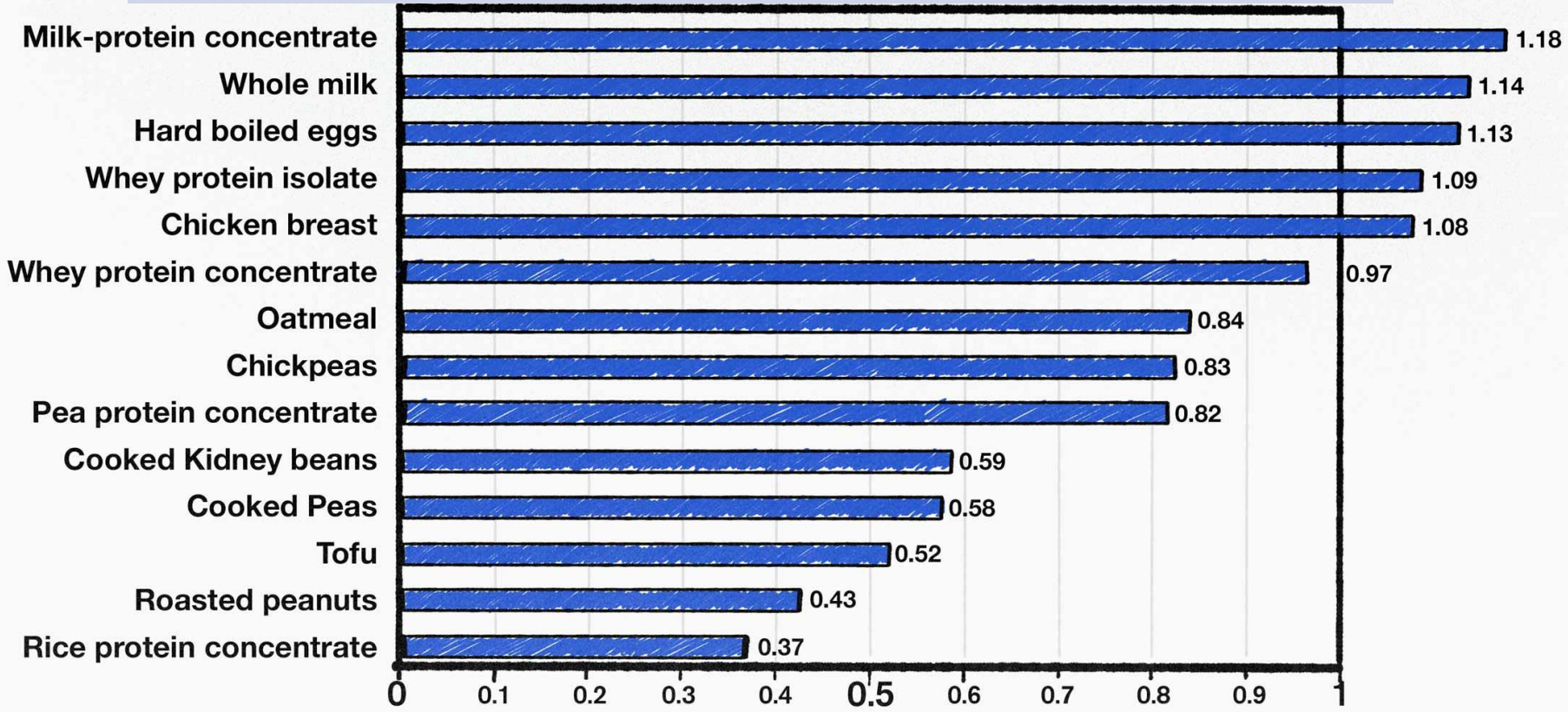
Figure 6. Average percentage of daily protein intake from meals and snacks, U.S. population 2 years old and older (NHANES 2001-2008).



Protein Quality

How easily your body can digest the protein

DIASS – digestability, essential amino acids, bioavailability)



DIAAS Score. Sourced from:
The impact of protein quality on the promotion of resistance exercise-induced changes in muscle mass, Dr. Stuart M. Phillips, Nutrition & Metabolism 2016, Potential impact of the digestible indispensable amino acid score as a measure of protein quality on dietary regulations and health, Marinangeli & House, Nutrition Reviews 2017

outlive

Food	DIAAS
Milk Protein Concentrate	1.18
Whey Protein Isolate	1.09
Soy Protein Isolate	0.90
Pea Protein Concentrate	0.82
Rice Protein Concentrate	0.37
Whole Milk	1.14
Chicken Breast	1.08
Egg (Hard Boiled)	1.13
Cooked Peas	0.58
Cooked Rice	0.59
Corn-based Cereal	0.01
Hydrolyzed Collagen	0.00

Higher Protein Dairy Foods
Formulation Considerations

- Sensory Properties – Flavor, Texture, Appearance
- Processability – Viscosity, Heat/Mass Transfer
- Shelf Life and Stability
- Regulations & Labeling
- Cost

Dairy Beverages (4-10% protein)

Instability – separation

Unacceptable texture/mouthfeel:

- Chalky/gritty texture
- Excessively high viscosity

- Processing
  - Foaming
  - Hydration
  - Heat exchanger fouling

Mocha – ultrafiltered milkshake

~10% Protein

INGREDIENTS:
Ultra Filtered Skim Milk, Brewed,Coffee (Water, Coffee),Cream, Cocoa (ProcessedWith Alkali) Potassium Phosphate, Sea Salt, Lactase Enzyme, Pectin, Natural Flavor, Caffeine, Sucralose, Acesulfame Potassium, Monk Vitamin A Palmitate, Vitamin D3
Contains: Milk.

Nutrition Facts

Serving size 1 Can (11 fl.oz.)

Amount per serving
Calories 150

	% Daily Value*
Total Fat 2.5g	3%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 25mg	8%
Sodium 180mg	8%
Total Carbohydrate 3g	1%
Dietary Fiber 0g	0%
Total Sugars 1g	
Incl. 0g Added Sugars	0%
Protein 30g	60%
Vitamin D 5mcg	25%
Calcium 740mg	60%
Iron 0.7mg	4%
Potassium 390mg	8%
Vitamin A 200mcg	20%
Phosphorus 630mg	50%
Magnesium 40mg	10%
Zinc 4mg	35%
Selenium 20mcg	35%
Chloride 160mg	6%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Fermented Milks (Yogurt)

- 8-15 grams protein
- Fermentation time (higher buffering capacity
- Greek yogurt (concentration – acid whey generated)
- Greek yogurt (with MPC fortification – no acid whey stream)
- texture

Frozen Dairy Desserts

- 3-12 gm protein/1/2 cup serving
- 35 gm protein per 473 ml (~7%)
- Hardness (dippability)
- Texture - Meltability
- Sandiness
- Flavor release
- Processability
    - High mix viscosity
    - Heat exchanger fouling

Cottage cheese (PER 1 cup)

24g PROTEIN

5g FAT

11g CARBS

183 CALORIES

DITCHTHECARBS.COM

Cheese

TYPES OF CHEESE

HIGHEST IN PROTEIN

Food	Serving	Protein	Daily Value
Low-fat cottage cheese	1/2 cup	11.8 grams	24%
Grated Parmesan cheese	1 ounce	10.2 grams	20%
Ricotta	1/2 cup	9.3 grams	19%
Romano	1 ounce	9 grams	18%
Non-fat cheddar cheese	1 ounce	9 grams	18%
Hard goat cheese	1 ounce	8.7 grams	17%
Gruyere	1 ounce	8.5 grams	17%
Low-fat Monterey Jack	1 ounce	7.9 grams	16%
Swiss Cheese	1 ounce	7.7 grams	15%
Fontina	1 ounce	7.3 grams	15%

Label Claims

- Excellent Source of Protein: 20% or more of the Daily Value (DV) per Reference Amount Customarily Consumed (50 g) or 10 gms of protein
- Good Source of Protein: 10-19% OF THE Daily Value per Reference Amount Customarily Consumed (50 g) or 5 – 9.5 gms of protein

- Nutrient content claim (“XX grams of protein”, “high in protein”)

See:
https://www.fda.gov/food/nutrition-food-labeling-and-critical-foods/nutrient-content-claims
www.fda.gov/downloads/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/UCM594798.PDF
https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-guide

Value Added Products From Milk

Milk

Cream

- Buttermilk

Standardized Milk

Fluid milks

Cultured Milks

Frozen Desserts

Ingredients

Butter

- Milkfat fractions

Cheese

Whey Products

- WPC, WPI
- Whey Powders
- Whey protein fractions
- Lactose & related prod.

Milk Products

- NFDM,SMP,WMP
- MPC,MPI
- Milk Protein fractions etc.

Dairy Ingredient Processing

- ~5-12% total solids to ~96% total solids
- 10 – 200 time concentrated depending on the product

Milk Powders (NDM, SMP, WMP)

Milk Protein Concentrate (MPC, MPI)

Casein/ates

Dry

Standardize protein (SMP)

Remove Water/(Fat) (NDM)

Membrane, Dry

Remove Water, Fat, Lactose, Minerals

Precipitate, Dry

Remove Water, Fat, Lactose, Whey Protein, Minerals

Range of Possibilities

Cheese Making

Whey

Membrane, Dry

Remove Water Lactose, Minerals

Whey (Whey powder, WPC-34, WPC 80, WPI)

Membrane, Dry

Milk Derived Whey

Micellar casein

New Fractions

New Ingredients

Concentrated Milk Proteins

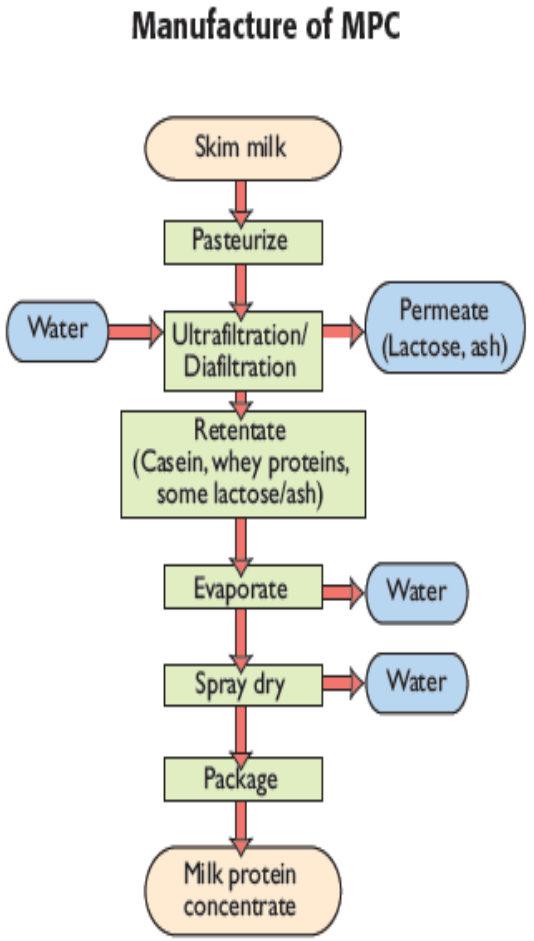
Ingredients with full complement of milk proteins*

Product	Protein %	Fat %	Lactose %	Ash %	Moisture %
MPC 40	39.5 min	1.25 max	52.0 max	10.0 max	5.0 max
MPC 42	41.5 min	1.25 max	51.0 max	10.0 max	5.0 max
MPC 56	55.5 min	1.50 max	36.0 max	10.0 max	5.0 max
MPC 70	69.5 min	2.50 max	20.0 max	10.0 max	6.0 max
MPC 80	79.5 min	2.50 max	9.0 max	8.0 max	6.0 max
MPC 85	85.0 min*	2.50 max	8.0 max	8.0 max	6.0 max
MPI	89.5 min*	2.50 max	5.0 max	8.0 max	6.0 max

(*) Protein content ≥ 85.0% is reported on a dry basis, all other parameters are reported "as is"

**Ratio of casein to whey proteins is the same as in milk*

Increasing protein:lactose, increasing protein:ash



Whey Products - Composition

(Majority of caseins removed by coagulation of milk)

	Sweet Whey	Lactose Whey	Reduced Demin. Whey	Whey Protein Concentrates 34%	50%	60%	75%	80%	Whey Protein Isolate
Protein	11-14..5%	18-24%	11-15%	34-36%	50-52%	60-62%	75-78%	80-82%	90-92%
Lactose	63-75%	52-58%	70-80%	48-52%	33-37%	25-30%	10-15%	4-8%	0.5-1%
Fat	1-1.5%	1-4%	0.5-1.8%	3-4.5%	5-6%	1-7%	4-9%	4-8%	0.5-1%
Ash	8.2-8.6%	11-22%	1-7%	6.5-8%	4.5-5.5%	4-6%	4-6%	3-4%	2-3%
Moisture	3.5-5%	3-4%	3-4%	3-4.5%	3.5-4.5%	3-5%	3-5%	3.5-4.5%	4.5%

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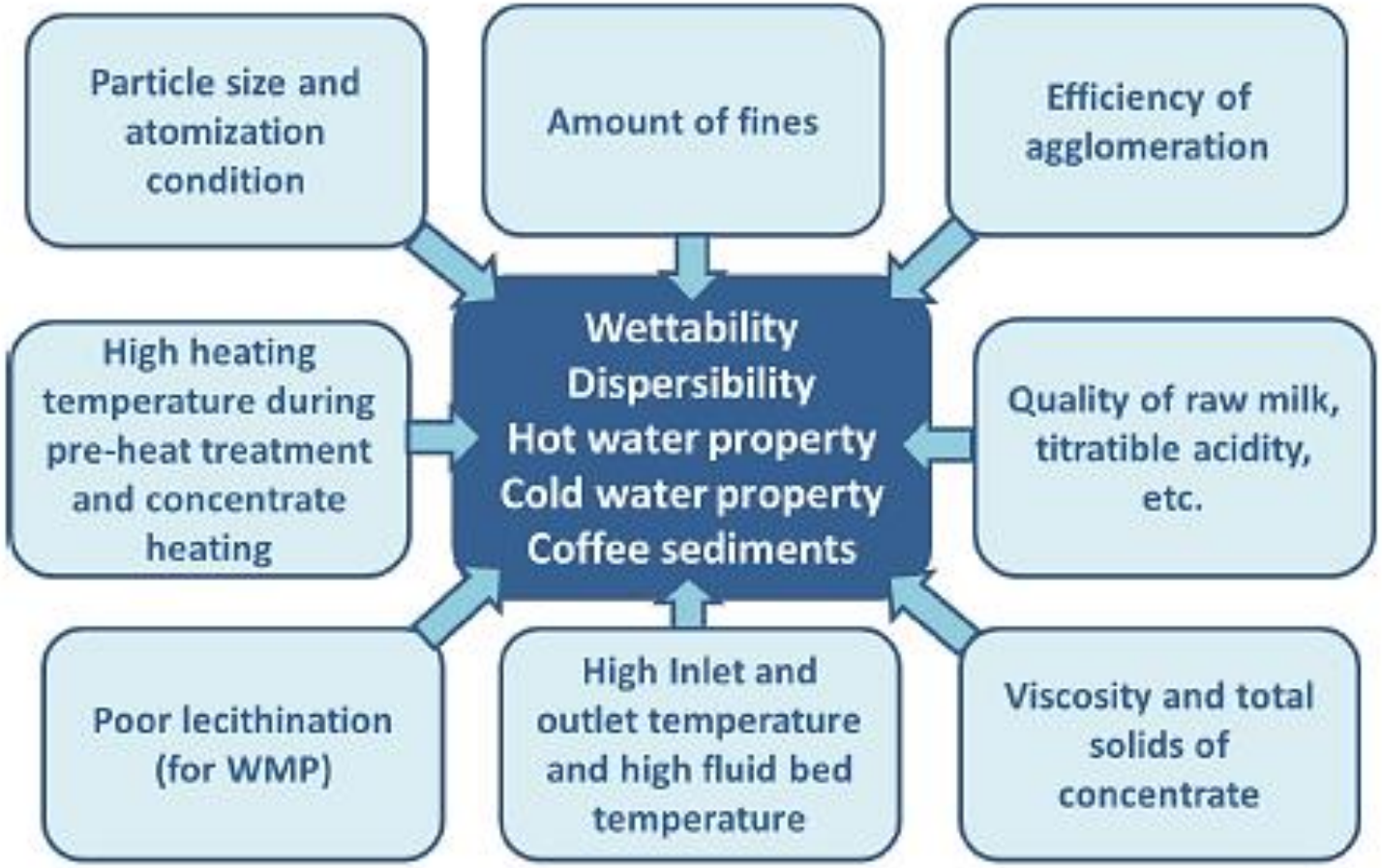
Increasing protein:lactose, Increasing protein:ash

Physical, chemical, and functional properties

- **Characterization of physical properties & significance**
  - Particle properties
  - Bulk properties
  - Degree of denaturation
  - Available (free) water
  - Rheological (flow) properties)

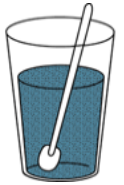
- **Functionality**
  - Solubility
  - Viscosity
  - Water binding
  - Gelation
  - Emulsification
  - Heat stability
  - Whipping/foaming
  - Sensory properties

Factors affecting the functional properties of dry dairy powders



Patel, H.(2013)

Factors Affecting Reconstitution



Solvent Properties

- Reconstitution temperature
- Water quality (hardness)
  - Minerals (Calcium)
- pH (acidity)
- Other components in solvent (availability & mobility of water
- Equipment used to reconstitute powder into milk/water

LESSONS LEARNED

- Growing consumer interest in protein
- Grams of protein, protein quality and label claims
    - Many dairy products already are a good or excellent source of protein
- Elevating Protein with Dairy Ingredients
    - Formulation considerations
    - Processing high protein dairy products

Thank you for your Attention

Questions? Comments?

High Protein Dairy Products
Manufacture and Formulation