

Dietary Protein and Health

NUTR 207 Module 6
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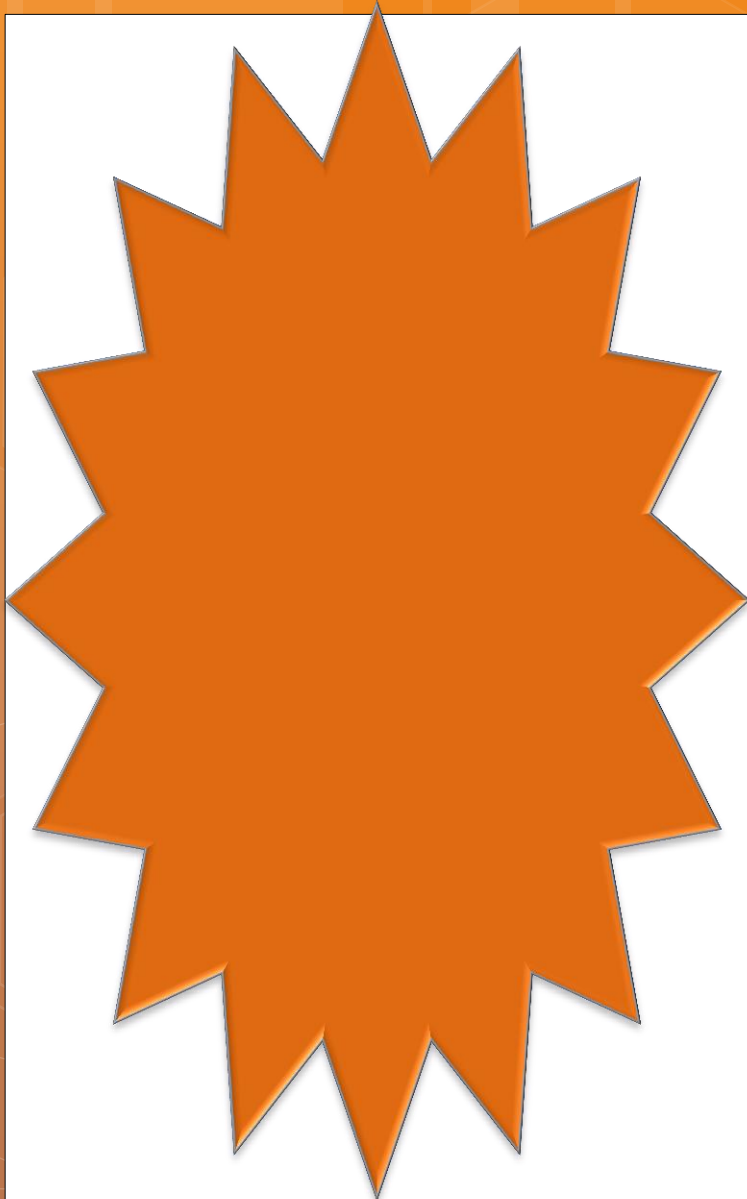
Get involved:

Impact 200

- <https://impact200.agorize-platform.com/en/challenges/mcgill>
- McGill's 200th anniversary in 2021, the Bicentennial team is working on an initiative to foster awareness amongst students with the unique opportunities which will be presented to them this academic year. Chief among these opportunities is **impact200, a challenge which enables student teams to achieve funding for sustainability-related proposals and projects**
- See video on announcements

Learning Objectives

- Discuss protein quality, use, and need; discuss the concept of nitrogen balance; and compute protein needs.
- Compare the major forms of protein malnutrition, and discuss why consuming excess protein is not recommended.
- Summarize the health issues with various diets.



True or
False?

Age is not a
determinant of
protein intake
requirements..



Protein Requirements and Dietary Sources

Protein Requirements

Depend on:

- 1 Age
- 2 Stage of life
- 3 Special conditions or requirements
- 4 Protein quality

How much do people really need?

Dietary Reference Intakes

- Adult (19-50 years)
 - **0.8** grams of protein/kg/day... may need updating...
 - **~ 10-35%** of total calories (AMDR)
- Requirements differ for other groups
 - Infants and growing children
 - Women of childbearing age
 - Elderly
 - Athletes
 - Cancer/Illness

Food Protein: Quality, Use, and Need

• Requirements?

DRI recommended intakes:^a

- Acceptable macronutrient distribution range (AMDR) is 10–35% of total energy
- 0.8 g protein per kilogram of body weight per day
- Women: 46 g/day; men: 56 g/day

Canada's Food Guide (make protein foods 1/4 of your daily meals and snacks):

- Meat- and plant-based protein foods
 - Choose lean meats and poultry and prepare them with little or no added sodium or saturated fat
 - Choose beans, peas, lentils, tofu, nuts, and seeds more often
- Milk- and milk alternative-based proteins
 - Choose unsweetened lower-fat milk, cheeses, and yogurt
 - Choose unsweetened fortified low-sodium soy beverages

World Health Organization

- Lower limit: 10% of total Calories from protein
- Upper limit: 15% of total Calories from protein

^aProtein recommendations for infants, children, and pregnant and lactating women are higher; see the Dietary Reference Intake (DRI) table.



In class activity

- A) Calculate your personal daily protein intake using the DRI of 0.8g/kg/day
- B) Calculate how many grams of protein for 10-35% of 2000 kcal intake

RDA Amino Acids (AA)

RDA (mg/kg body weight/day) for indispensable [+ conditionally indispensable^a] amino acids for adults 19 years and older (You can use the following mnemonic to help you remember these amino acids: **L**indsay **L**ikes **T**he **I**solation **M**ore **T**han **V**ery **H**eavy **P**ressure.)

Leucine	42
Lysine	38
Threonine	20
Isoleucine	19
Methionine (+ cysteine ^a)	19
Tryptophan	5
Valine	24
Histidine	14
Phenylalanine (+ tyrosine ^a)	33

Dispensable/Nonessential Amino Acids

Alanine
Aspartic Acid
Asparagine
Glutamic Acid
Serine

^aConditionally Indispensable Amino Acids

Arginine
Cysteine
Glutamine
Glycine
Proline
Tyrosine

Protein sources in the Canadian diet

2015

Protein is a source of energy. Children get 15.6% of their daily energy intake from protein; for adults, it's 17.0%. Sources of protein include meat, poultry, fish and shellfish, eggs, dairy products, nuts and seeds, and legumes.



% of Canadians who eat these sources of protein on any given day*



93.6%
DAIRY PRODUCTS



63.4%
MEAT



56.2%
EGGS



43.5%
POULTRY



33.7%
NUTS OR SEEDS



17.4%
FISH OR SHELLFISH



14.3%
LEGUMES

*Excluding soups (ready-to-serve, canned, condensed, or dehydrated), baby food products, fats (e.g., butter and animal fat), and plant based beverages (e.g., soy milk, coconut milk, and almond milk). Meat includes red meat and processed meat.

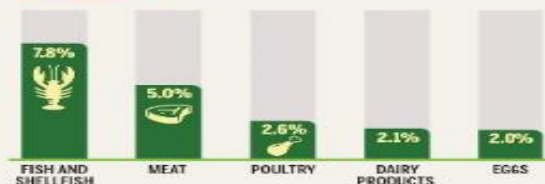
1.6%
OF CANADIANS

exclude fish and shellfish, meat, and poultry from their diet.

Canadians living in large urban areas are more likely to exclude fish and shellfish, meat, and poultry from their diet (1.9%) than those living in small urban or rural areas (0.6%).



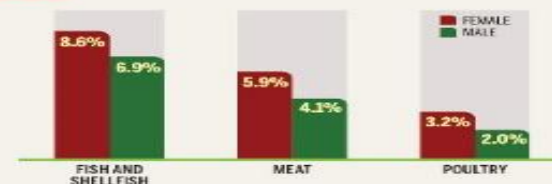
More Canadians exclude fish and shellfish from their diet than any other sources of protein.



Includes household population aged 1 and over in the 10 provinces.
Source: 2015 Canadian Community Health Survey – Nutrition



Women and girls are more likely to exclude fish and shellfish, meat or poultry from their diet.



ISBN 978-0-660-25386-5
Catalogue number: 11-627-M



Statistics Canada
Statistique Canada

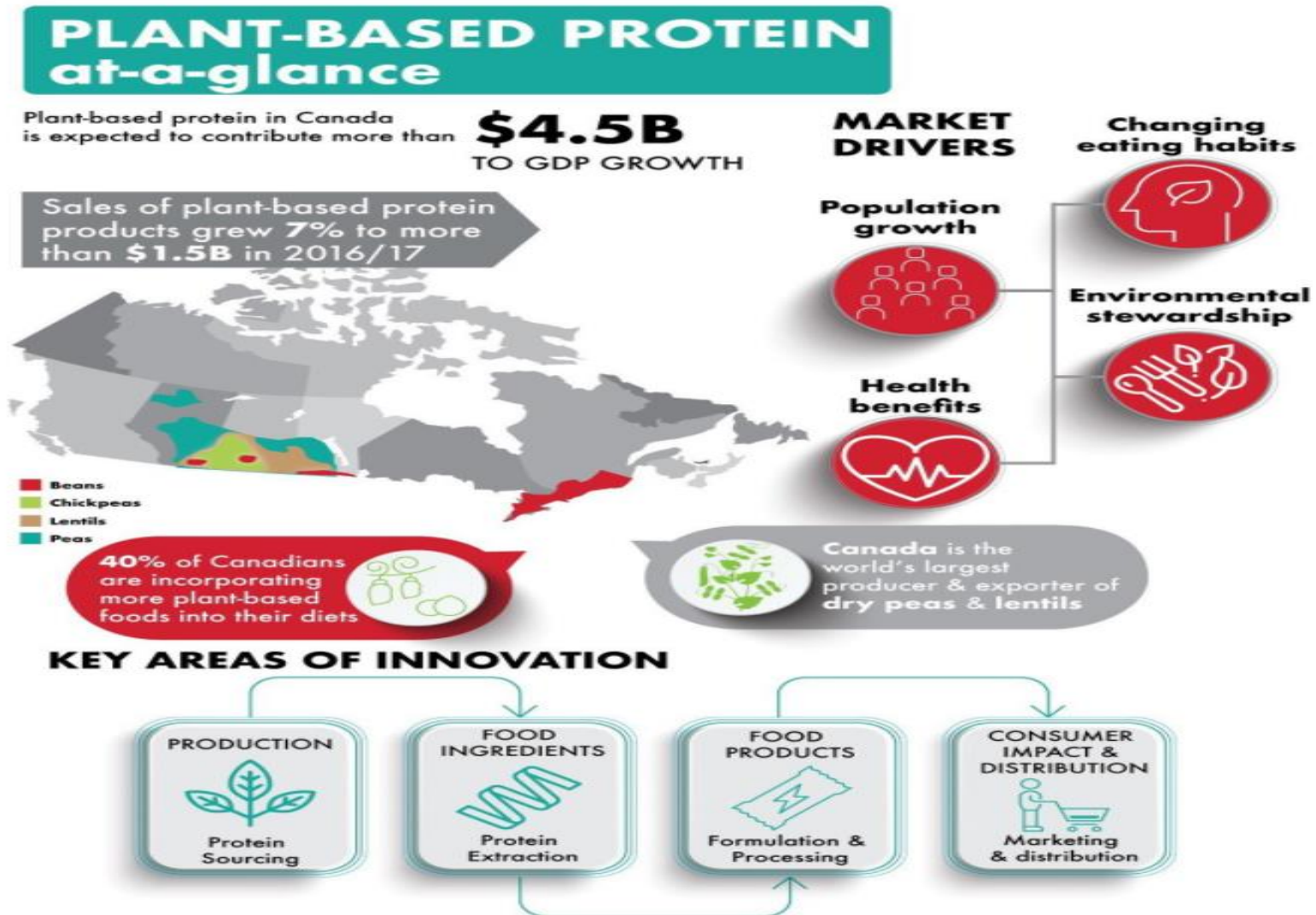
www.statcan.gc.ca

Canada

Source: Statistics Canada. Protein Sources in the Canadian Diet, 2015. <https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2018004-eng.htm>.

Are we
getting
Enough?

Grown in Canada:



Food Protein: Quality, Use, and Need

**The body's
response to
protein
depends on:**

the body's state of health

other nutrients and energy
taken with the protein

protein quality

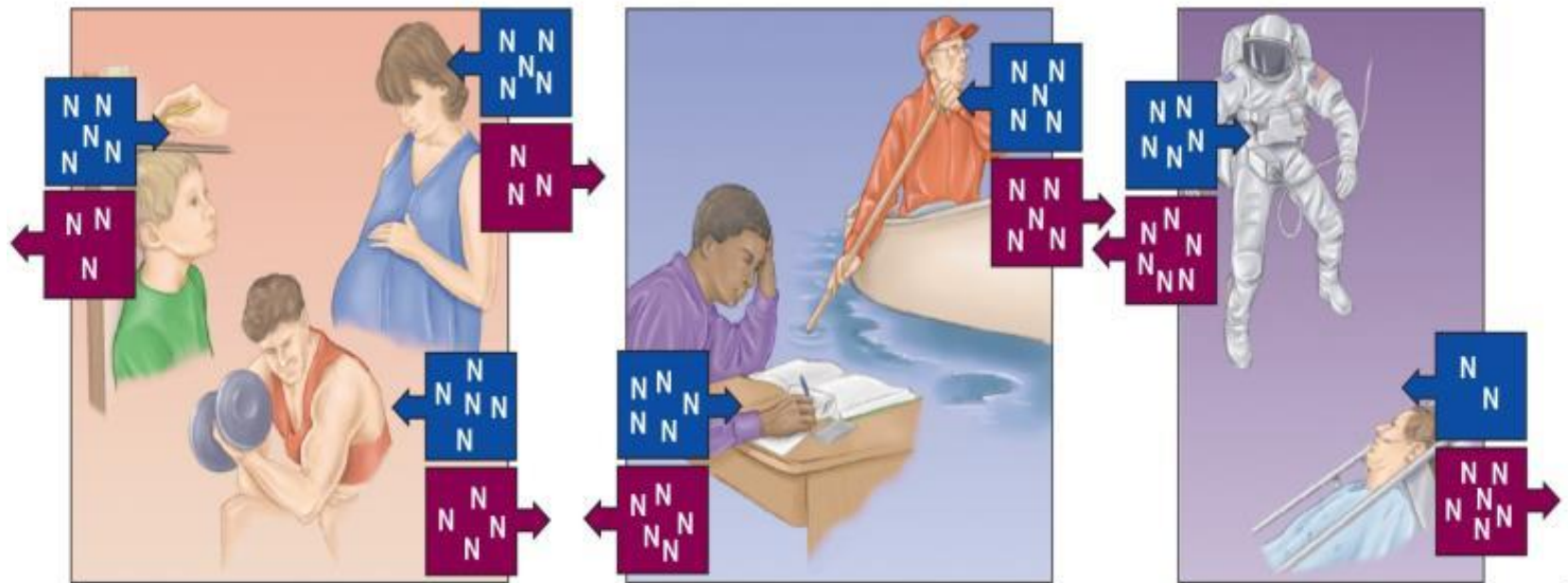
Nitrogen Balance

- Underlying daily protein needs is **nitrogen balance**
- Compares nitrogen excreted with nitrogen consumed
 - ▶ Zero balance (equilibrium)
 - ▶ **Nitrogen in = Nitrogen out**
 - ▶ Positive balance
 - ▶ **Nitrogen in > Nitrogen out**
 - ▶ Negative balance
 - ▶ **Nitrogen in < Nitrogen out**

Nitrogen Balance

Figure 6-15

Nitrogen Balance



Positive Nitrogen Balance

These people, a growing child, a person building muscle, and a pregnant woman, are all retaining more nitrogen than they are excreting.

Nitrogen Equilibrium

These people, a healthy college student and a young retiree, are in nitrogen equilibrium.

Negative Nitrogen Balance

These people, an astronaut and a surgery patient, are losing more nitrogen than they are taking in.

Medical conditions: Alter Protein Needs

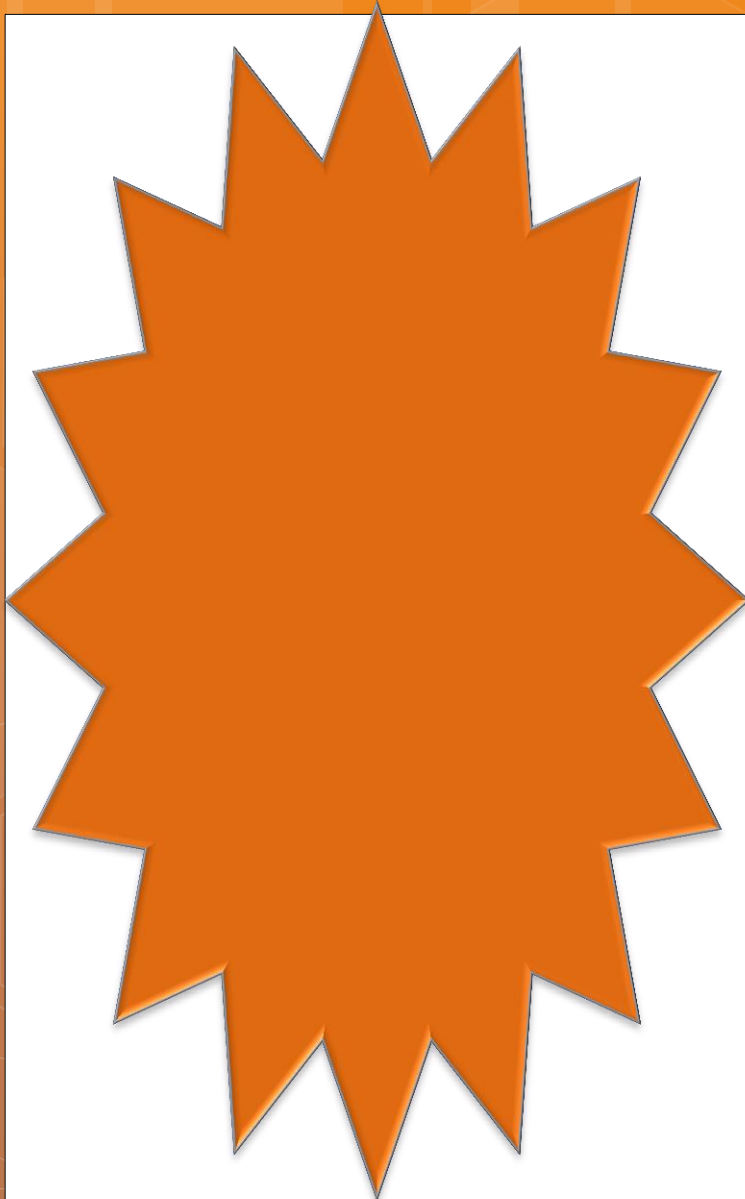
- Kidney disease

- Decreased renal function
- Increased risk of kidney stones
- Unable to filter

- Liver disease

- Reduced gluconeogenesis from amino acids



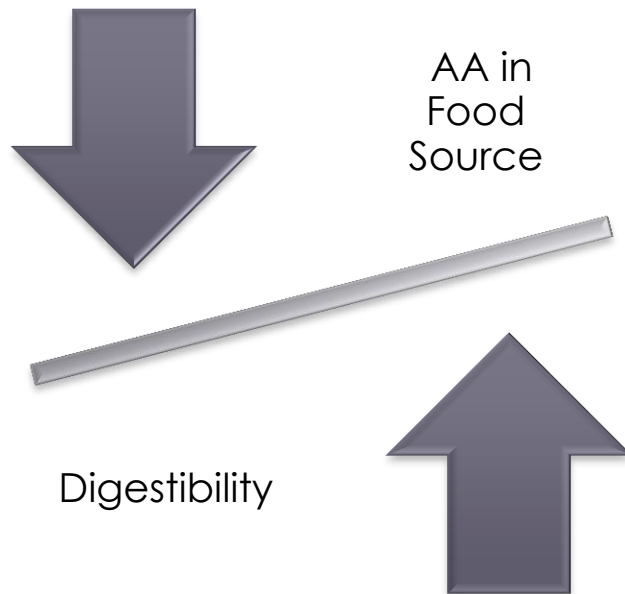


True or False?

Plant proteins are lower in quality than animal proteins..

What Does “Protein Quality” Mean?

- Protein Quality is based on:



A. Source of Protein (AA composition)

- Animal versus plant based sources

A. Digestibility

- Dependent on the source

A) Sources of Dietary Protein

Animal-Based protein Complete aa array

• Meats...:

- Beef
- Poultry
- Pork
- Eggs
- Fish, etc.



• Dairy

- Milk
- Yogurt
- Cheese, etc.



A) Sources of Dietary Protein

Plant-Based protein: lower quality aa array, incomplete proteins

- Plant alternatives:

- Legumes
- Nuts
- Nut butter
- Soy-based products
- Seeds



- Plant beverage alternatives:

- Soy-based products



- Grain products:

- Quinoa
- Bulgur, etc.



Quality of Protein: Amino Acid Composition

- ◉ Limiting amino acid
 - Essential amino acid
 - Insufficiently provided by a food protein
 - **Limits** body's ability to build new proteins that require it

B) Protein Digestibility

Depends on food source:

- Animal sources of protein are **highly** digested (>90%)
- Plant sources are **less** digestible:
 - Legumes – 80-90%
 - Grains, other plant foods – 60-90%
- Moist heat improves digestibility; dry heat impairs digestibility

Quality of Protein Depends on Amino Acid Composition and digestibility

- High-quality protein
 - Animal sources (easily digestible)
 - Source of ALL essential amino acids
- Low-quality protein
 - Plant sources (not as easily digested)
 - DO NOT provide all essential amino acids

Limiting (insufficient) amino acids will slow protein synthesis

Food Protein: Quality Ranking

- Measuring protein quality
 - Protein digestibility–corrected amino acid score (**PDCAAS**)
- Scale of 100 to 0
 - 100 = proteins that are most readily digested and balanced for human needs
 - Wheat bread: 25



Complementary proteins

- Combination of 2 or more plant-source proteins whose AA assortments complement each other to give all the essential AA in sufficient amounts
- Essential AA missing from food are provided by the other

Figure 6-14

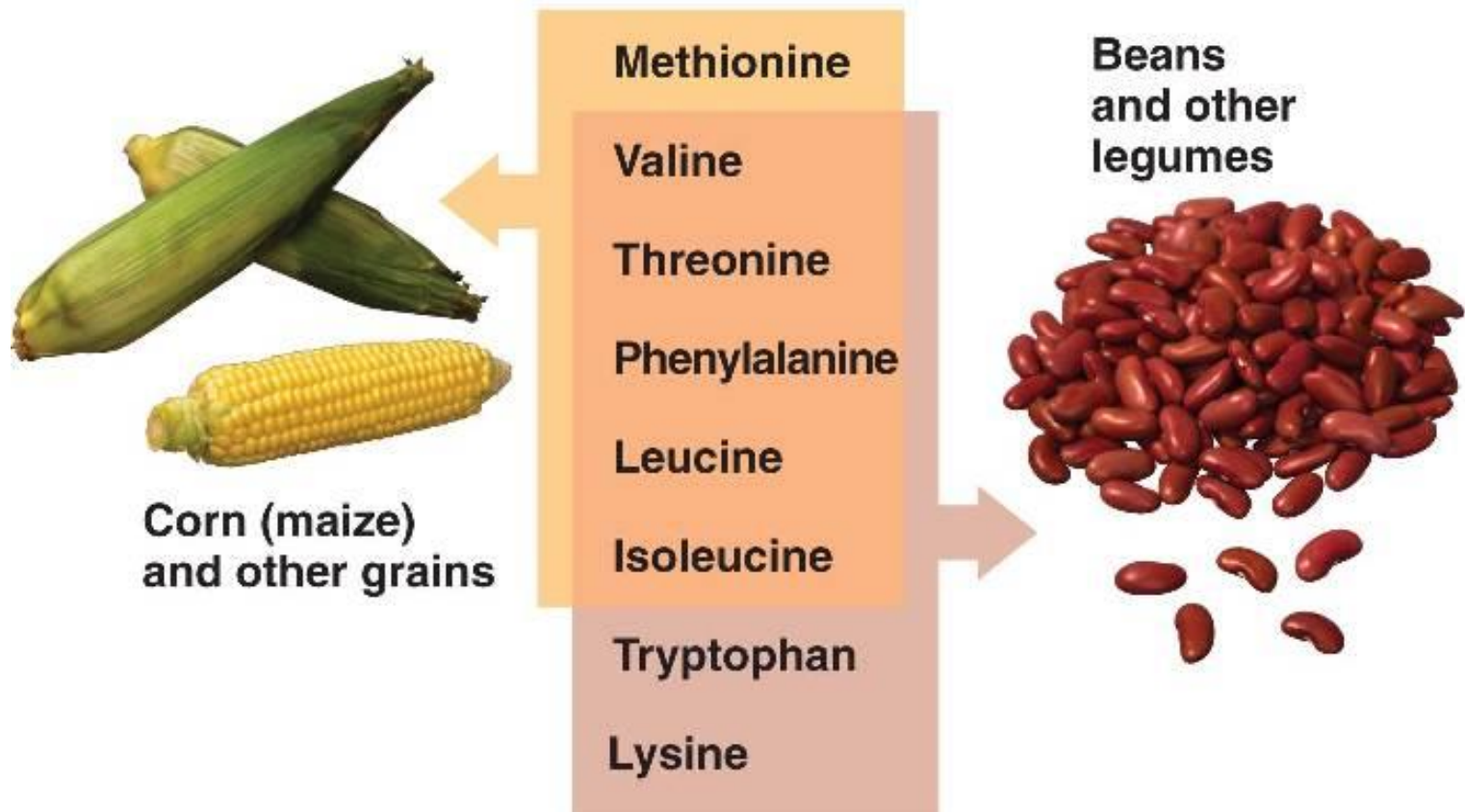
Proteins That Complement Each Other Work Together

In general, legumes provide plenty of the amino acids isoleucine (Ile) and lysine (Lys), but fall short in methionine (Met) and tryptophan (Trp). Grains have the opposite strengths and weaknesses, making them a perfect match for legumes.

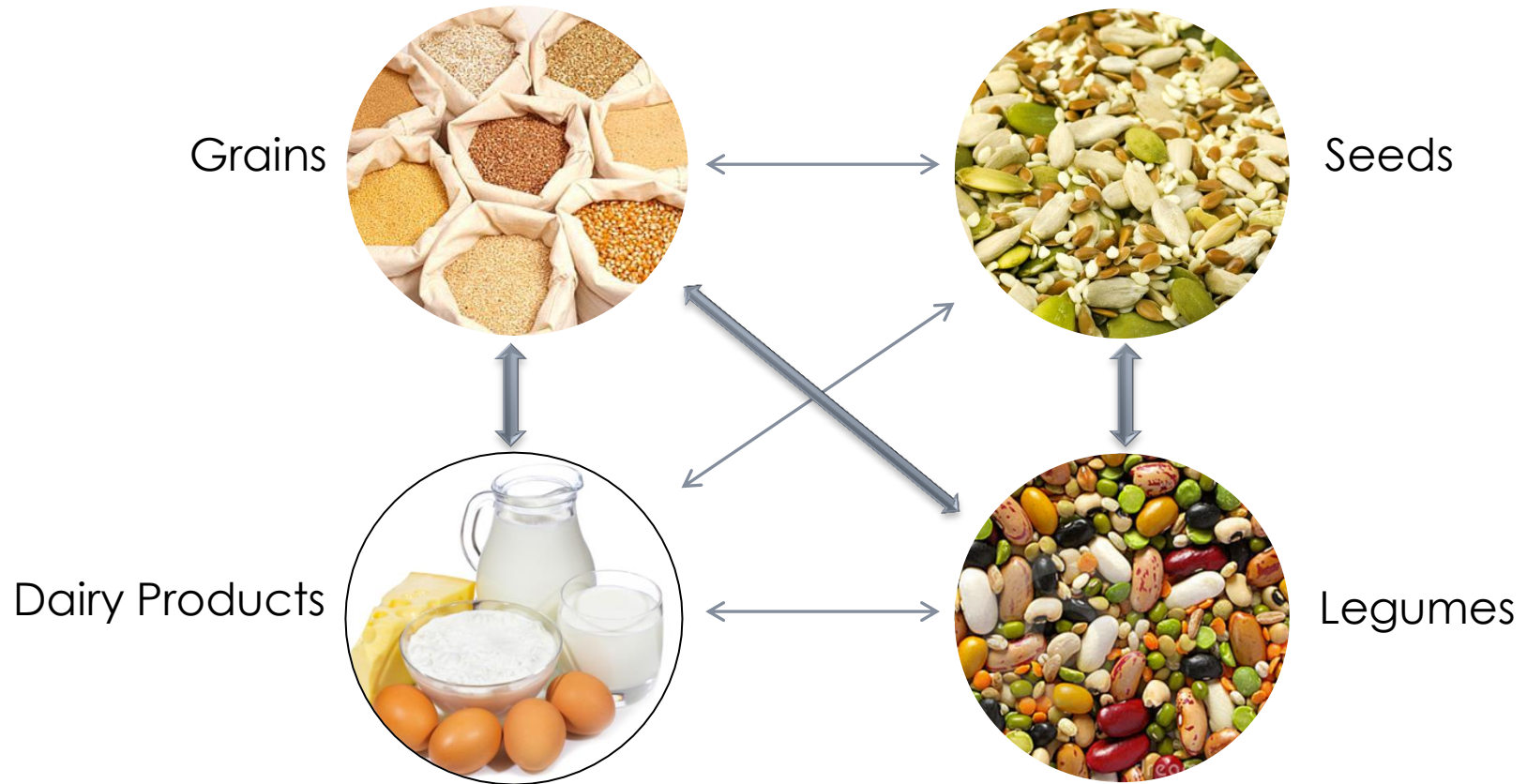
	Ile	Lys	Met	Trp
Legumes	✓	✓		
Grains			✓	✓
Together	✓	✓	✓	✓

Complementary Proteins

Essential amino acids for adults



Complementary Proteins



- You **do not** need to eat complementary proteins at each meal, but many cultures combine these foods naturally in their recipes..

Complementary Protein in Different Cultures

Mexico

- Beans and rice



Japan

- Tofu and rice



South Asia

- Dhal and rice



Latin America

- Corn chips and bean dip



Middle East

- Pita and falafel



Everywhere!

- Peanut butter and bread





Protein and Health

Protein Deficiency

- Consuming too little protein
 - Protein and energy deficiency go hand-in-hand
- Protein-energy undernutrition (PEU)
 - Most widespread form of malnutrition worldwide
- Takes on 2 forms:
 - Marasmus
 - Kwashiorkor

Protein Deficiency

- Protein/Energy Malnutrition (PEM)
 - Weight loss
 - Wasting
 - Stunting



Kwashiorkor



Marasmus

Features of Marasmus and Kwashiorkor in Children

Table 6–3

Features of Marasmus and Kwashiorkor in Children

Separating PEU into two classifications oversimplifies the condition, but at the extremes, marasmus and kwashiorkor exhibit marked differences. Marasmus–kwashiorkor mix presents symptoms common to both marasmus and kwashiorkor. In all cases, children are likely to develop diarrhea, infections, and multiple nutrient deficiencies.

Marasmus	Kwashiorkor
Infants and toddlers (less than 2 yrs)	Older infants and young children (1 to 3 yrs)
Severe deprivation or impaired absorption of protein, energy, vitamins, and minerals	Inadequate protein intake or, more commonly, infections
Develops slowly; chronic PEU	Rapid onset; acute PEU
Severe weight loss	Some weight loss
Severe muscle wasting with fat loss	Some muscle wasting, with retention of some body fat
Growth: <60% weight-for-age	Growth: 60 to 80% weight-for-age
No detectable edema	Edema
No fatty liver	Enlarged, fatty liver
Anxiety, apathy	Apathy, misery, irritability, sadness
Appetite may be normal or impaired	Loss of appetite
Hair is sparse, thin, and dry; easily pulled out	Hair is dry and brittle; easily pulled out; changes colour; becomes straight
Skin is dry, thin, and wrinkled	Skin develops lesions

Too Little Protein...

- Can lead to:
 - Learning deficiencies/shortened attention span
 - Stunted height
 - Increased rate of infections/illness



Poverty Cycle

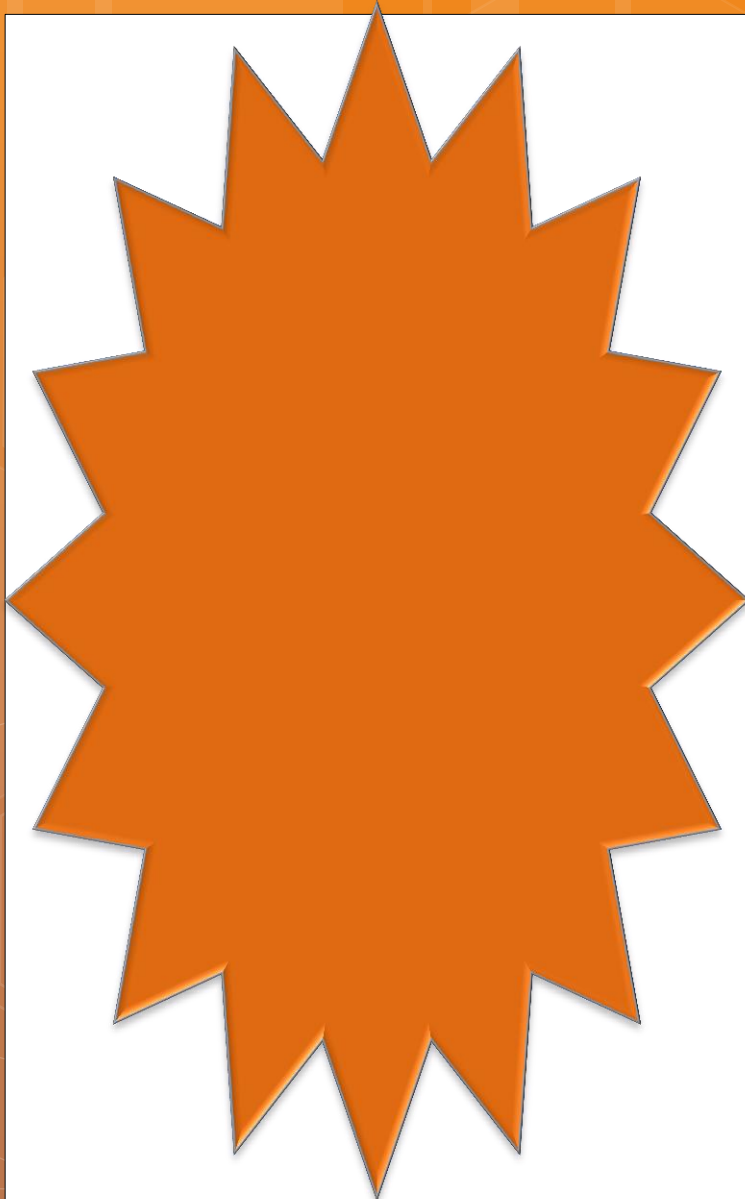
Poverty: unequal access to resources & education plus environmental stress & conflict

- → Family food shortages, inadequate care & feedings practices, poor living conditions & health care services
- → Poor diet, disease development
- → Malnutrition
- → Disability death

Excessive Protein Intake

- Overconsumption (>AMDR)
 - High protein diets may include;
 - Extra calories, saturated fat and cholesterol
 - Replacement of other food groups
- Health Risks
 - Heart disease
 - Kidney disease
 - Adult bone loss
 - Cancer
- Environment... sustainable?





True or False?

Athletes require
the same amount
of protein as
nonathletes

Protein Requirement for Athletes

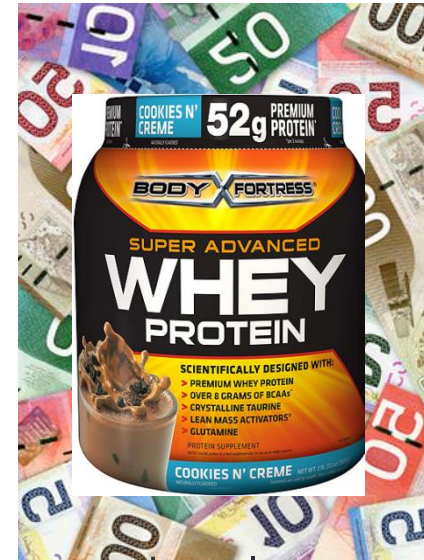
- Protein needs are dependent on activity
 - Intensity
 - Duration
 - Type (endurance/resistance)
- Athletes require more protein for muscle:
 - Repair
 - Building
 - Maintenance



Protein/AA Supplementation

- Protein Supplements
 - No improvement in performance
 - No evidence for weight loss
- Amino Acid Supplements
 - Can limit absorption of other AAs

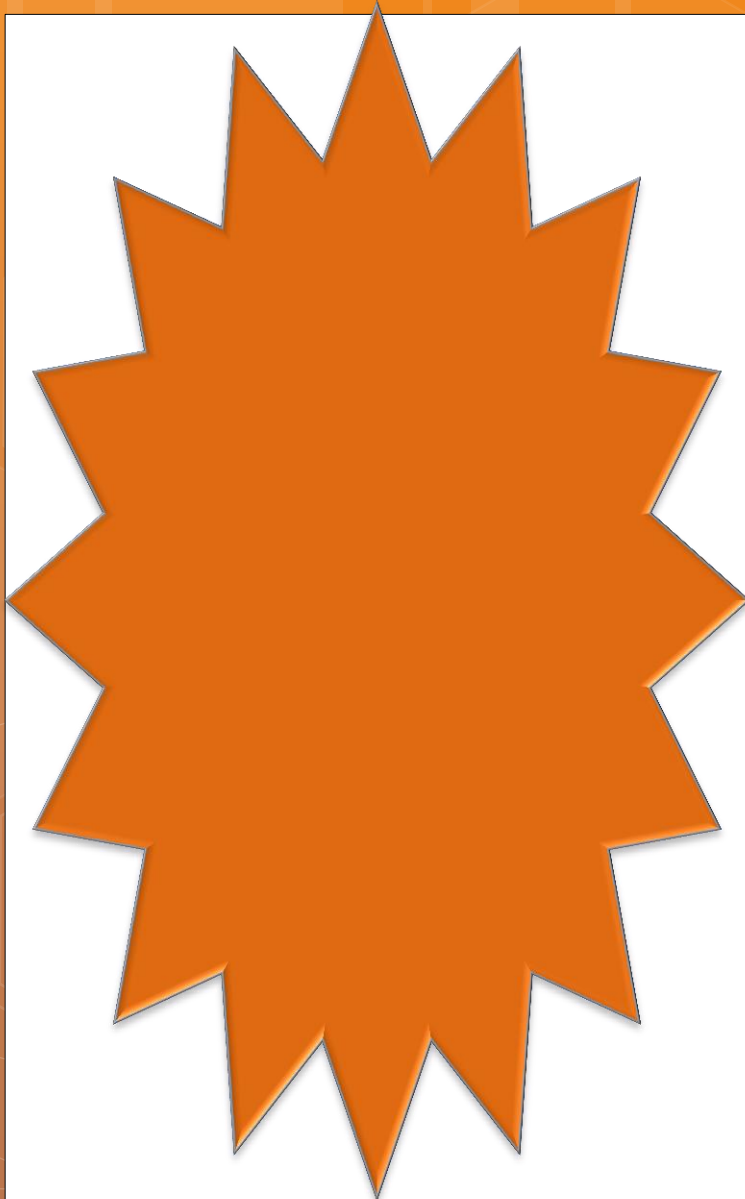
Amino acid supplements are regulated as natural health products in Canada



Warning: Much is still unknown!

- taker of AA supplements cannot be certain of their safety or effectiveness



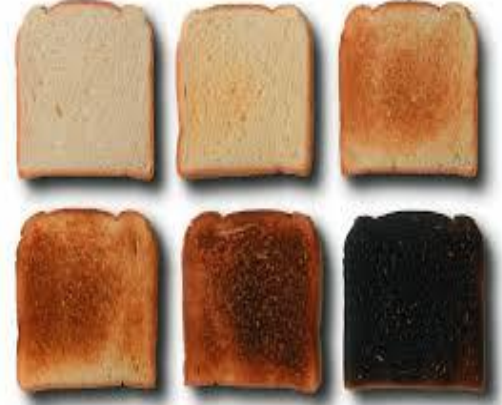


True or False?

Leaner meats produce less carcinogens when cooked at high heat

Smoked, Grilled & Well-Done Meat

- Charred foods have high amounts of heterocyclic amines (HCA)
 - Reduce charring by limit cooking at high temperatures (BBQ, pan frying, broiling, etc)
 - Use low temperature methods (steam, stew, roast)
 - Marinate or add dressing
- Leaner meats, poultry and seafood produce less HCAs at high heat



Acrylamide

- Acrylamide is a chemical that can form in some foods during high-temperature cooking processes, such as frying, roasting, and baking.
- Forms in food from sugars and the amino acid Asparagine
- Maybe associated with increased risk of cancer... more studies needed
 - Eg. French fries, chips, cookies, bread, cereals, etc.
- Avoid overcooking and go easy on fried foods.. Follow the CFG 😊

<https://www.fda.gov/food/chemicals/acrylamide-questions-and-answers>

<https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/food-processing-induced-chemicals/acrylamide/acrylamide-food-food-safety.html>



Protein for Vegetarians

Types of Vegetarianism

Types of Vegetarianism	Restrictions
Partial vegetarian/Flexitarian	Includes some seafood, poultry, dairy, eggs; excludes/limits certain meats (ie. Red meat)
Vegetarian	Includes plant based foods and eliminates some or all animal-derived foods
Pesco-vegetarian	Include fish and seafood in diet
Lacto-ovo vegetarian	Includes dairy and eggs; excludes flesh and seafood
Lacto-vegetarian	Includes dairy; excludes flesh, seafood and eggs
Vegan/Strict vegetarian	Plant based foods; eliminates some or all animal-derived foods

Protein for Vegetarians

- Follow Canada's Food Guide
 - Legumes, eggs, soy-based meat substitutes, nuts, seeds
 - Milk and/or fortified soy drinks



Protein Recommendations for Vegetarians/Vegans

- ◉ DRI
 - Same as for non-vegetarians
- ◉ Plant-based protein sources
 - Soy and soy products: tofu, tempeh, ..
 - Legumes and their 'flours'
 - Nuts/nut butters, seeds
 - Meat alternatives (textured vegetable protein, veggie burgers, etc)
 - Grains: Seitan
- ◉ Aim for variety of fresh, whole, and fortified products

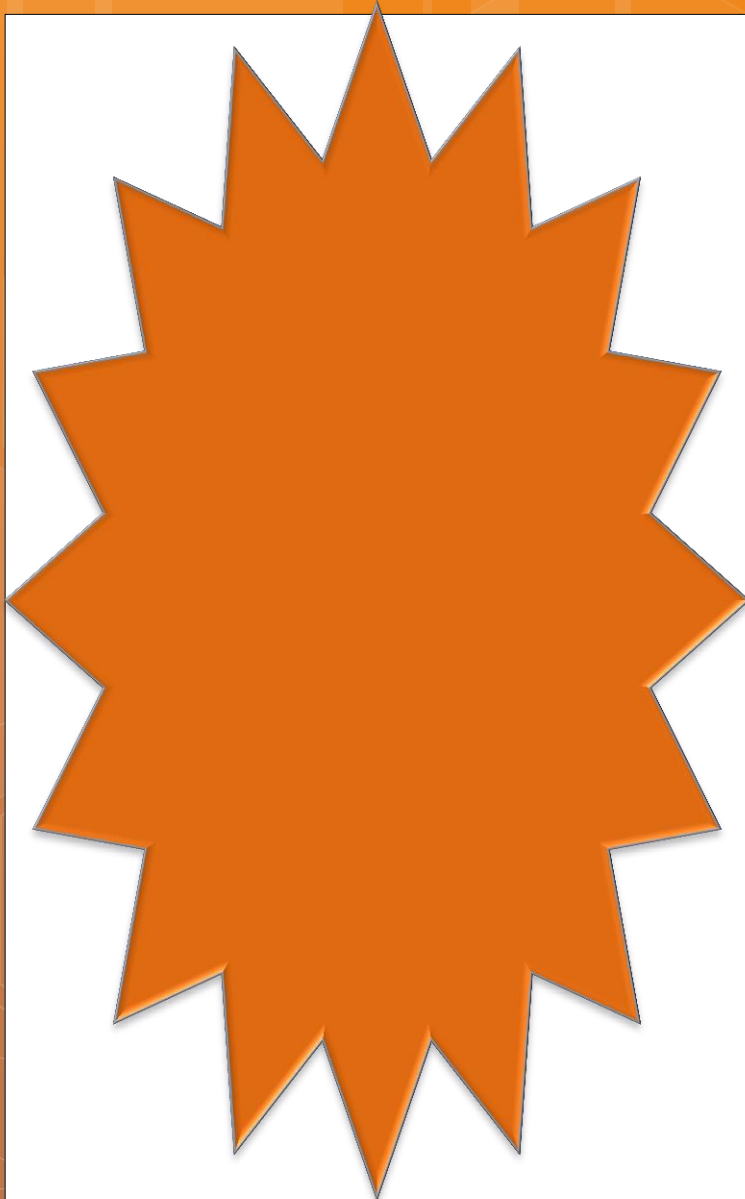
Meat substitutes

- Textured Vegetable Protein (TVP):
 - By-product of soybean oil extraction
 - Other products: Soy, Pea, chick pea, wheat proteins ..
- Often an excellent source of protein and fibre and no cholesterol
- BUT.. Products may contain added salt, SFA & other additives



Plant based Meat substitutes

- Meat analogues
 - Meatless hot dogs, burgers, ham, chicken strips, etc
 - Meat extender in recipes (e.g. chili con carne and shepherd's pie)
- Cost? - varies
- Convenience, processing?
- Healthier?: varies



True or False?

Poorly balanced
vegetarian diets
may be low in
zinc and vitamin
D

Risks of Vegetarianism...

- ◉ Vegetarian diets are often considered “healthier” than traditional Western diet, but if not well balanced can cause decreases in:
 - Protein
 - Iron
 - Zinc
 - Calcium: Broccoli vs milk
 - Vitamin D
 - Vitamin B12: Only in animal based products
 - Omega-3 fats if fish/seafood not consumed
- ◉ Deficiencies can be avoided by ensuring consumption of well balanced diet

Vegetarians Risk Iron Deficiency

Vegetarians need 1.8 times RDA for Iron

Animal iron sources (fish, poultry, meat)

- **Contain Heme iron**
- Absorbed 2-3x more efficiently than plant iron
- **Heme iron** enhances absorption of non-heme iron (plant sources)

Plants iron sources (legumes, fortified cereals, etc)

- **contain Non-heme iron, not well absorbed**
- Absorption enhanced by vitamin C
- Iron absorption limited by fiber, coffee, tea, milk, soy, etc.

Well-balanced diets are key

Sources of heme Iron



Sources of non-heme Iron



Meatless Mondays

- International movement to remove meat from diet on Mondays
 - Increased health benefits
 - Environmental impact (reducing greenhouse gas emissions)
 - www.meatlessmondays.ca
 - McGill residences...



**March to a
different
drumstick.**

**Go meatless
Monday.**



Class Activity Part B

1. Calculate the total amount of protein on the menu.
2. Compare the total grams of protein in this menu with your RDA and AMDR, as calculated in Part A (g/kg & AMDR).
3. If you were to eat the following meals, would you meet your recommended daily intake of protein?

Breakfast	Snack	Lunch	Snack	Dinner
2 eggs 2 slices of whole grain toast 2 pieces of bacon 1 glass of skim milk	1 large banana 2tbsp of peanut butter	Sandwich with 25g of turkey breast, 1 <u>tsp</u> mayo, ½ <u>tsp</u> mustard on whole grain bread	½ cup carrots 60g of hummus	100g grilled salmon 100g brown rice 1 cup steamed broccoli
	+	+	+	+

Total grams =

Food	Quantity	Protein (g)	Food	Quantity	Protein (g)
Egg	1	6	Mayonnaise	1 tbsp	0.1
Whole grain bread	1 Slice	3.6	Carrots	1 cup	1
Bacon	1 Slice	3	Hummus	60 g	5
Skim Milk	1 Cup	7	Salmon	100 g	24
Large Banana	1	1.5	Brown Rice	100 g	3
Peanut Butter	1 tbsp	4	Cooked Broccoli	1 cup	3.7
Turkey	100 g	33			

Class Activity

C) You are now a vegetarian! List 3 alternative food choices to the previous meal plan that would be appropriate for a vegetarian diet.

-
-
-



Questions?

