Keto in Space: Menu Options and Food Processing for Vegan, Kosher, and Carnivore

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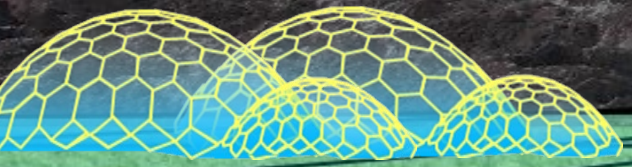
NSS ISDC 2023 27 May 2023, Frisco TX, USA, Earth



NSS NATIONAL SPACE SOCIETY ISDC 2023 International Space Development Conference Frisco, TX May 25-28

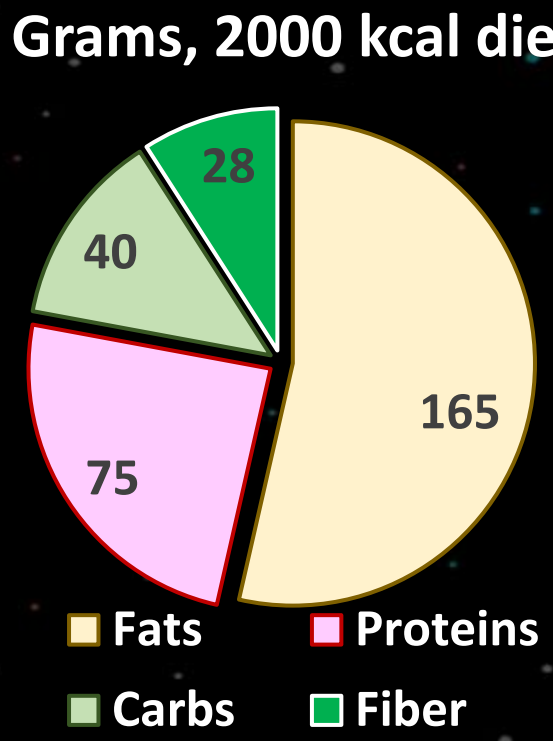
ST. LOUIS SPACE FRONTIER

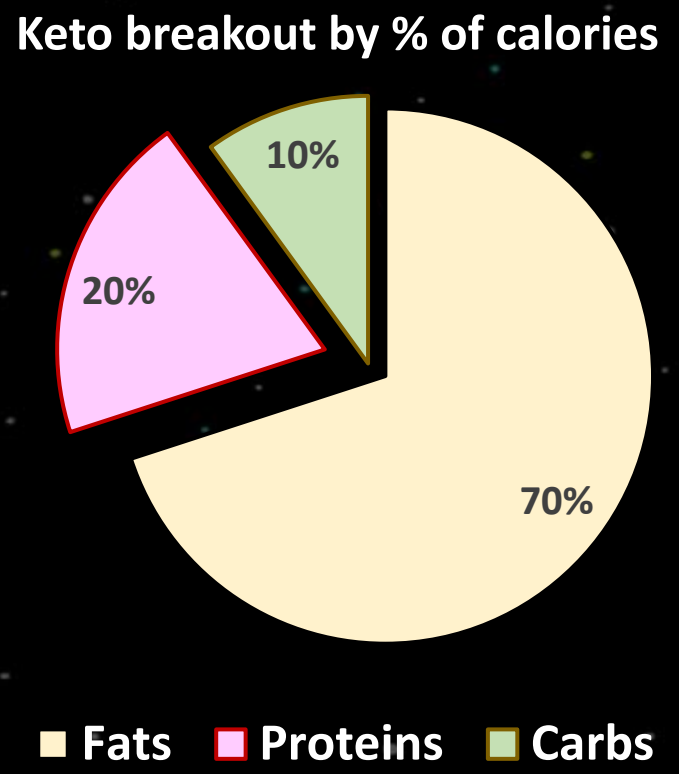
Overview

- What is a Keto Diet?
- Food Processing
- What Crop Options lead to Keto-friendly Menus
  - Vegan, limited processing, no fermentation or fungus
  - Vegan, fermentation and processing, w/fungi
  - Insects
  - Fish and Shrimp
  - Chickens et al.
- Menus and Dinner

What is a Keto Diet?

- Ketogenic diets focus on fats and protein as calorie sources, minimizing (calorie containing) carbohydrate intake to force the body to burn body fat while preserving lean muscle
- Paleo diets are similar but focus on unprocessed foods.
- Fiber >28g, higher is better





Ratio by mass of (Fat+ Protein+ Fiber+ Ash)/ (Caloric Carbohydrates) should be > 7

Adapted from data in: "Diet Review: Ketogenic Diet for Weight Loss"
The Nutrition Source, Harvard School of Public Health plus US RDA recommendation for Fiber

Ground Rules

- Space Settlement is less than 3 years old (determines crop options)
- Keto eaters are a minority of the population
- Bell Peppers are a stand in for most vine veggies (i.e. tomatoes, etc.)
- Rice is a stand in for most grains
- Diet Options include:
  - Vegan, min processing (e.g. roasting peanuts, etc.)
  - Vegan, heavy processing but no peanuts (e.g. includes fermentation)
  - Vegan, processed foods and peanuts
  - Seafood proteins (kosher, non-kosher, etc.)
  - Insect proteins
  - Birds (kosher, non-kosher, etc.)
  - Rabbits
  - Multi-mix

Unprocessed Green Crops

			Dry Mass Components					
Crop	% water	Kcal/kg (wet)	Proteins	Fats	Carbs*	Fiber	Ash	(Fat+P+F+A)/C
Peanuts (Raw)	7%	5630	28%	53%	8%	9%	2%	11.29
Sunflowers (Seed)	5%	6090	20%	51%	18%	8%	3%	4.56
Soybeans (Raw)	9%	4460	40%	22%	23%	10%	5%	3.38
Soybean Sprouts	69%	1220	42%	22%	27%	4%	5%	2.70
Cyanobacteria	90%	260	61%	4%	25%	4%	6%	3.00
Green Algae (cellular)	90%	383	61%	10%	24%	4%	1%	3.17
Duckweed	93%	2913	25-40%	3%	28%	26%	18%	>2.57
Lettuce (Arugula)	92%	250	31%	8%	25%	19%	17%	3.00
Cabbage	92%	250	17%	1%	42%	32%	8%	1.38
Bell Peppers	94%	230	12%	2%	66%	15%	5%	0.52
Pinto Beans	11%	3470	10%	3%	70%	11%	6%	0.43
Quinoa	13%	3680	15%	6%	68%	7%	3%	0.46
Rice	10%	3700	9%	4%	83%	3%	1%	0.20
KETO ideal			> 24%	> 54%	< 13%	> 9%		> 7

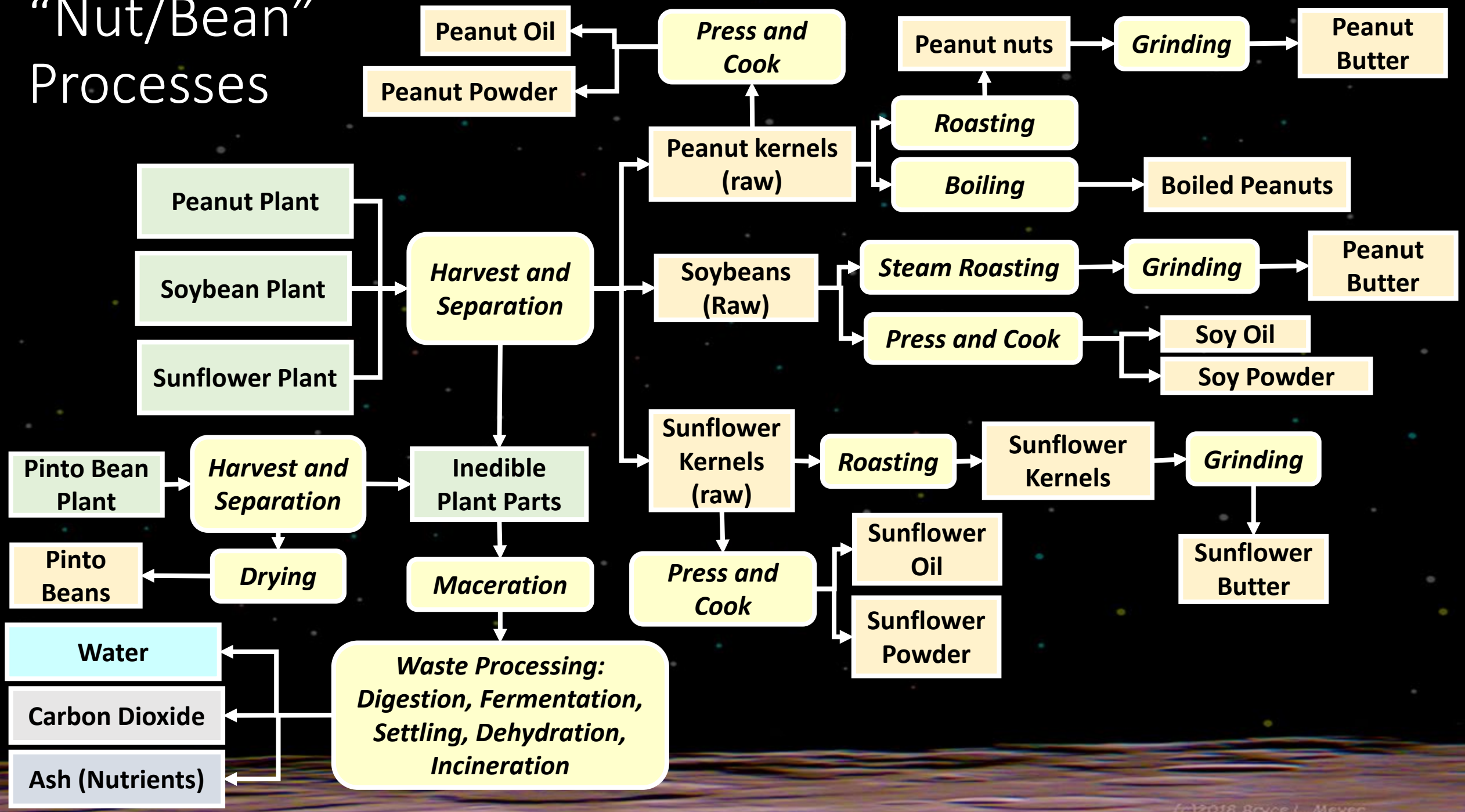
Fungi, Tofu, Kimchi

			Dry Mass Components					
Crop or Product	**% water**	**Kcal/kg (wet)**	**Proteins**	**Fats**	**Carbs ***	**Fiber**	**Ash**	**(Fat+P+F+A)/C**
Brewer's Yeast	5%	3250	43%	8%	15%	28%	6%	5.67
Lion's Mane	89%	430	23%	2%	28%	38%	9%	2.57
Oyster Mushrooms	89%	410	31%	4%	35%	21%	9%	1.86
Shiitake Mushrooms	89%	440	21%	2%	35%	37%	5%	1.86
Tofu	82%	830	30%-56%	27%-30%	1%-15%	6%	7%-28%	6+
Kimchi	94%	150	19%	9%	14%	28%	30%	6.14
KETO ideal			> 24%	> 54%	< 13%	> 9%		> 7

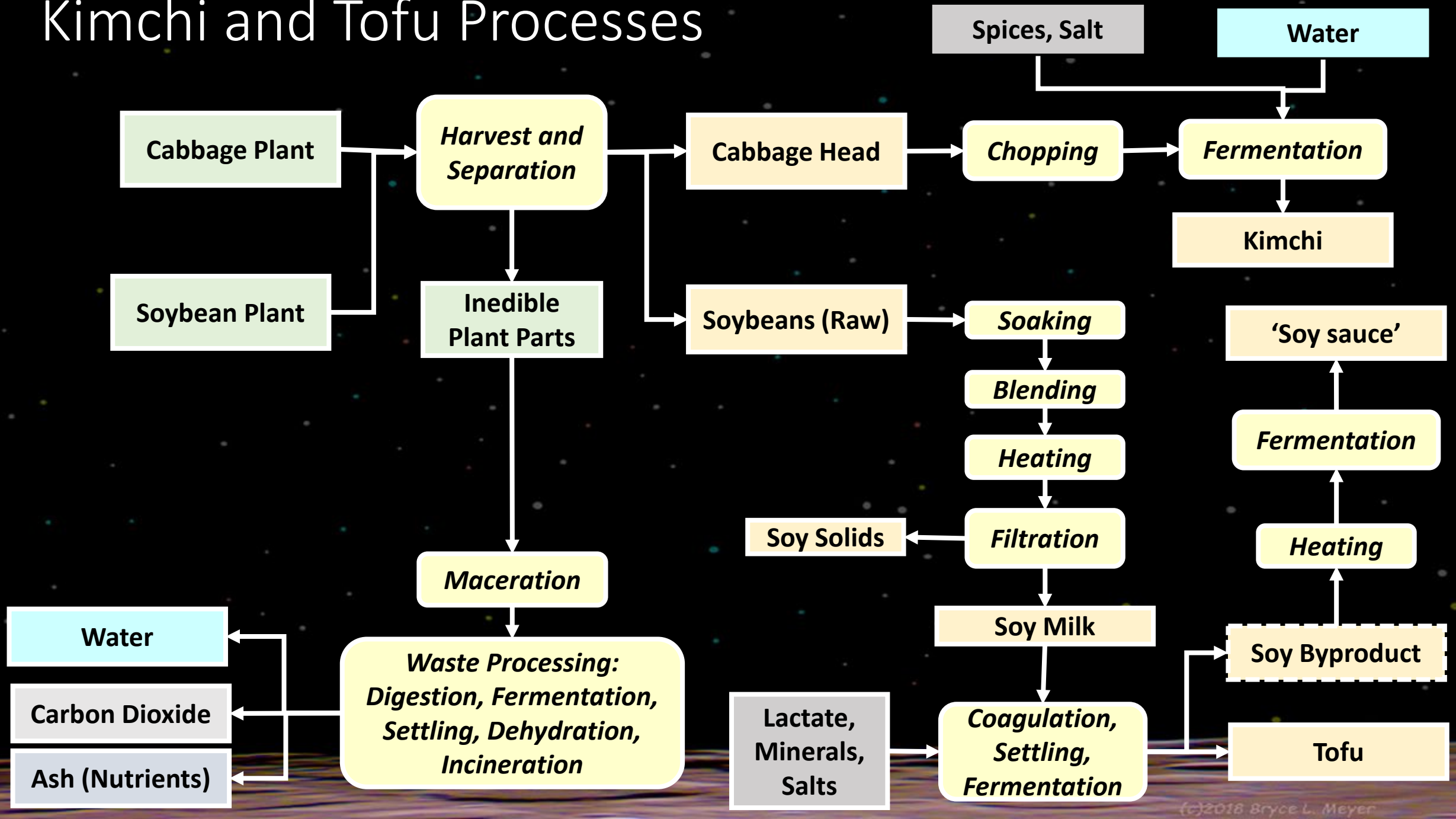
Meats

			Dry Mass Components					
Crop (raw)	**% water**	**Kcal/kg (wet)**	**Proteins**	**Fats**	**Carbs***	**Fiber**	**Ash**	**(Fat+P+F+A)/C**
Tilapia	77%	960	86%	7%	0%	0%	6%	*(0 carbs)*
(Silver) Carp	76%	1270	71%	23%	0%	0%	6%	*(0 carbs)*
Chicken (meat+skin)	65%	3190	54%	44%	0%	0%	2%	*(0 carbs)*
Blue crab (meat)	79%	870	86%	5%	0%	0%	9%	*(0 carbs)*
Shrimp (meat)	78%	850	92%	2%	0%	0%	6%	*(0 carbs)*
Rabbits-meat	73%	1360	76%	21%	0%	0%	3%	*(0 carbs)*
Chicken-egg	76%	1430	53%	40%	3%	0%	4%	*32*
Crickets (Gryllus)	73%	1375	56%	22%	8%	8%*	6%	*12*
Mealworms	68%	1520	53%	35%	9%	0%	3%	*11*
Snail (meat)	79%	900	77%	7%	10%	0%	6%	*9*
Asian Clam (meat)	79%	860	61%	12%	19%	0%	8%	*4*
KETO ideal			**> 24%**	**> 54%**	**< 13%**	**> 9%**		**> 7**

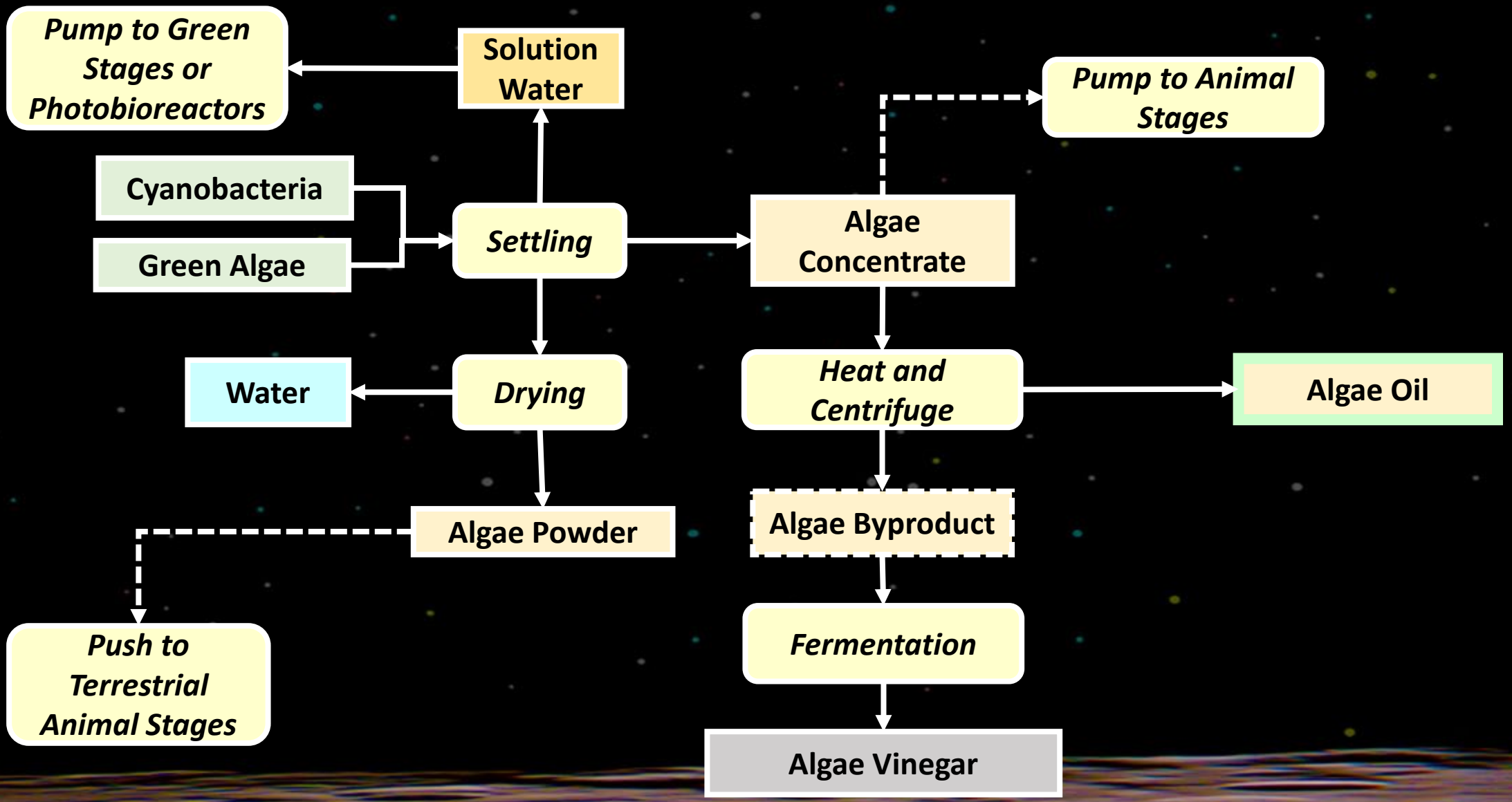
"Nut/Bean" Processes



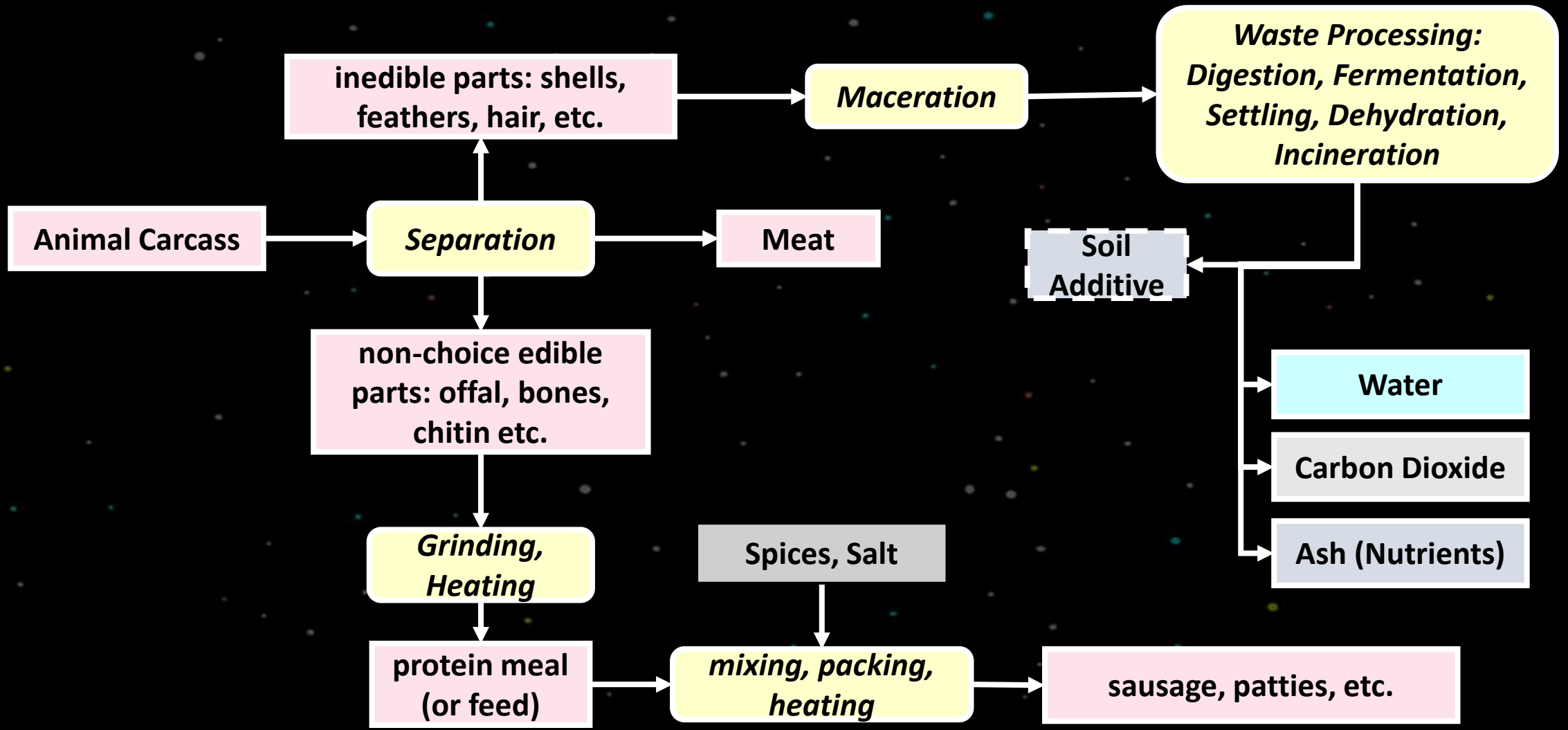
Kimchi and Tofu Processes



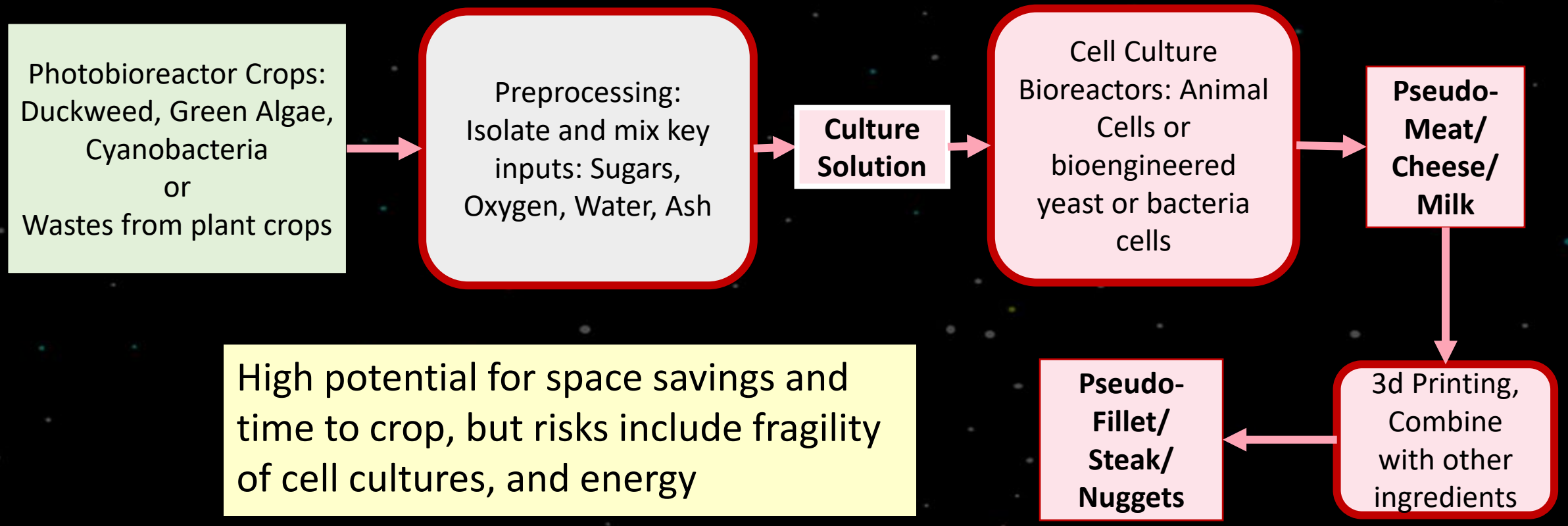
Algae Processing



Animal Processing



What about Direct Assembly and Vat Cultures? (Maybe vegan, maybe not…)



High potential for space savings and time to crop, but risks include fragility of cell cultures, and energy

Glop Option (Not Recommended, but…)

Keto (2000 kcal), (Fat+P+F+A)/C =7+/-, w/nutritional mins

- With Just Photobioreactors and Aerobic + Anerobic Bioreactors:
  - Process Algae into Algae Oil, then take byproducts and feed to yeast bioreactors
  - Maybe: make gummies, sheets of dried algae, yeast and oil into ‘cheese’.

Crop	Grams included
Algae Oil	185
Yeast	140
Cyanobacteria	150

A few day options: Vegan Keto (2000 kcal), (Fat+P+F+A)/C =7+/-, w/nutritional mins

Vegan, min processing

Crop	Grams included
Peanuts (Raw)	345
Sunflowers (Seed)	10
Lettuce (Arugula)	110

Vegan, no peanuts

Crop	Grams included
Sunflowers (Seed)	10
Soybean/Algae/etc. Oil	175
Lettuce (Arugula)	150
Brewer's Yeast	10
Lion's Mane	30
Tofu	405
Kimchi	5

Vegan, processing and peanuts

Crop	Grams included
Peanuts (Raw)	30
Sunflowers (Seed)	10
Soybean/Algae/etc. Oil	176
Lettuce (Arugula)	150
Oyster Mushrooms	20
Tofu	300
Kimchi	5

A few day options: Seafoods and Insects Keto (2000 kcal), (Fat+P+F+A)/C =7+/-, w/nutritional mins

Meat allows a bit of 'cheating'…

Seafood, Kosher

Crop	Grams included
Soybean/Algae/etc. Oil	60
Lettuce (Arugula)	160
Bell Peppers	40
Pinto Beans	60
Quinoa	60
Oyster Mushrooms	60
Kimchi/ Saurkraut	50
Tilapia	1000

Seafood, variety

Crop	Grams included
Soybean Sprouts	10
Soybean/Algae/etc. Oil	65
Lettuce (Arugula)	160
Cabbage	100
Bell Peppers	30
Pinto Beans	60
Quinoa	20
Oyster Mushrooms	50
Kimchi	20
(Silver) Carp	500
Shrimp (meat)	500
Asian Clam (meat)	10

Insects and Duckweed

Crop	Grams included
Soybean/Algae/etc. Oil	50
Duckweed	50
Oyster Mushrooms	20
Crickets (Gryllus)	550
Mealworms	450

A few day options: Land Animal Options Keto (2000 kcal+/-), (Fat+P+F+A)/C =7+/-, w/nutritional mins

Chickens-Kosher

Crop	Grams included
Soybean/Algae/etc. Oil	55
Lettuce (Arugula)	200
Cabbage	100
Bell Peppers	20
Oyster Mushrooms	20
Chicken (meat+skin)	350
Chicken-egg	224

Rabbits

Crop	Grams included
Soybean/Algae/etc. Oil	70
Lettuce (Arugula)	100
Cabbage	200
Bell Peppers	30
Pinto Beans	30
Shiitake Mushrooms	50
Rabbits	865

Variety

Crop	Grams included
Peanuts (Raw)	10
Soybean/Algae/etc. Oil	60
Duckweed	30
Lettuce (Arugula)	150
Cabbage	100
Bell Peppers	10
Rice	20
Kimchi	30
Chicken (meat+skin)	200
Shrimp (meat)	200
Chicken-egg	224
Asian Clam (meat)	100

In Habitat Spice Growth

- Corners, tabletops, hallways, walls inside habitats can all be added to food production and oxygen recycling, especially for spices, herbs, and dwarf fruit and coffee plants.
- Can use grey water from showers, sinks, food prep.

Spice	Time to First Harvest (wiki)
Basil	75 days
Cilantro	30 days
Dill	90 days
Fennel	100 days
Mustard	95 days
Chives	60 days
Marigold (Candula)	70 days
Mint	90 days
Tarragon	60 days
Oregano	120 days
Cumin	120 days
Ginger	200 days
Serrano Peppers*	120 days
Paprika*	150 days
Saffron	180 days
Chili Peppers*	120 days
Coriander	100 days
Garlic	180 days
Turmeric	300 days
Thyme	1 year
Rosemary	1 year
Hops	2-3 Years
Coffee**	2-3 Years
Tea**	2-3 Years
* = Same species as bell peppers	
** = large enough to require space and possibly a hydroponic stage, good for export!	

Sample Menus: Vegan

Vegan, min processing

- ground peanut crumbles, boiled peanuts on salad
  - Dressing of diluted peanut and sunflower butters, curry spice mix (minus cinnamon)
- Peanut and Sunflower bars of compressed flours
- 'Nut' soup

Crop	Grams included
Peanuts (Raw)	345
Sunflowers (Seed)	10
Lettuce (Arugula)	110

Vegan, no peanuts

- Salad with Lion's Maine slices, sunflower kernels, tofu crumbles, kimchi garnish dressed by spice infused oil
- Cheese like product of oil/yeast/tofu
- Tofu 'steak' with multi-spice mix, dressed by another spice infused oil, on bed of greens
- 'Nut' soup

Crop	Grams included
Sunflowers (Seed)	10
Soybean/Algae/etc. Oil	175
Lettuce (Arugula)	150
Brewer's Yeast	10
Lion's Mane	30
Tofu	405
Kimchi	5

Vegan, processing and peanuts

- Salad with mushroom slices, sunflower kernels, dressed by spice infused oil with peanut butter, and vinegar*
- Cheese like product of oil/tofu served with Kimchi
- Grilled Tofu 'steak' with multi-spice mix, dressed by spice infused oil, on bed of greens
- *Assuming oil is via algae: Vinegar from algae byproduct

Crop	Grams included
Peanuts (Raw)	30
Sunflowers (Seed)	10
Soybean/Algae/etc. Oil	176
Lettuce (Arugula)	150
Oyster Mushrooms	20
Tofu	300
Kimchi	5

Sample Menus: Seafood and Insect Options

Seafood, Kosher

Complex salad of greens, chopped veggies, mushrooms, algae vinegar
Pinto and Quinoa thin tortillas
Tilapia, flash fried fillets, coating in spice-oil
Fish meal: Thai fish balls (or fish dumplings) on kimchi
Spicy Fish soup
gefilte fish recipies…

Crop	Grams included
Soybean/Algae/etc. Oil	60
Lettuce (Arugula)	160
Bell Peppers	40
Pinto Beans	60
Quinoa	60
Oyster Mushrooms	60
Kimchi/ Saurkraut	50
Tilapia	1000

Seafood, variety

Complex salad of arugula, chopped veggies, mushrooms, algae vinegar, spice oil dressing
Carp, backstraps, baked, spice coated
Fish and clam soup
Spicy Coleslaw with kimchi kick
Fried butterfly shrimp in pinto-quinoa coating, and fish sauce

Crop	Grams included
Soybean Sprouts	10
Soybean/Algae/etc. Oil	65
Lettuce (Arugula)	160
Cabbage	100
Bell Peppers	30
Pinto Beans	60
Quinoa	20
Oyster Mushrooms	50
Kimchi	20
(Silver) Carp	500
Shrimp (meat)	500
Asian Clam (meat)	10

Bug Banquet (Insects and Duckweed)

Note: Insect shells= fiber…

Duckweed, vinegar, mushroom and spice salad mixed with mealworms
Cricket flour flatbread with grilled mealworms
Cricket and mealworm 'nut' snacks
Cricket and mealworm paddies and bars.

Crop	Grams included
Soybean/Algae/etc. Oil	50
Duckweed	50
Oyster Mushrooms	20
Crickets (Gryllus)	550
Mealworms	450

Sample Animal Menus

Chickens-Kosher

Eggs (3): fried, poached, boiled, etc.
Salad Mix with veggies/mushrooms and spiced oil/vinegar
Baked/Roasted Chicken
Chicken soup
Coleslaw

Crop	Grams included
Soybean/Algae/etc. Oil	55
Lettuce (Arugula)	200
Cabbage	100
Bell Peppers	20
Oyster Mushrooms	20
Chicken (meat+skin)	350
Chicken-egg	224

Rabbits

Rabbit Stew
Pan fried rabbit with pinto coating
Salad Mix with beans, mushrooms, peppers and vinegar, spiced oils
Colelslaw (or process to Sauerkraut)
ground spiced rabbit skewers (Med. style)

Crop	Grams included
Soybean/Algae/etc. Oil	70
Lettuce (Arugula)	100
Cabbage	200
Bell Peppers	30
Pinto Beans	30
Shiitake Mushrooms	50
Rabbits	865

Variety
(takes a very mature big farm..)

Eggs for breakfast, Omelets
Many soups and stews…including egg-drop
Many salad options, add-ons, and dressings (salad bar anyone?)
fried chicken, shrimp, clams in rice flour
Clam juice ends up in soups and sauces

Crop	Grams included
Peanuts (Raw)	10
Soybean/Algae/etc. Oil	60
Duckweed	30
Lettuce (Arugula)	150
Cabbage	100
Bell Peppers	10
Rice	20
Kimchi	30
Chicken (meat+skin)	200
Shrimp (meat)	200
Chicken-egg	224
Asian Clam (meat)	100

Conclusion

- You can eat keto in a 3yr old space settlement!
  - Vegan, Kosher, Meat Options
- How food is processed is very important to variety and cuisine!
- Key foods: Peanuts, Soybean/Algae oils, salad greens, and meats from insects, fish, shrimp which can eat algae products, maybe rabbits or chickens in some limited cases (older settlements) if fed plant byproducts (like inedible parts of other plants, e.g. soybean leaves, etc.)
- Byproducts from oil production can be further processed into a variety of additives and foods

References

- https://fdc.nal.usda.gov/
- https://en.wikipedia.org/wiki/Algae_fuel
- https://www.usda.gov/sites/default/files/documents/Duckweed_Fact sheet.pdf
- https://www.sciencedirect.com/science/article/abs/pii/S0308814616313565
- https://www.researchgate.net/publication/317788034_Functions_of_Duckweed_as_a_Natural_Water_Purifying_Agent_and_as_a_Feed_Source_for_Laying_Hens

BACKUP

Saturday, May 27
3:00 pm
Space Ambassadors
Frisco 5
Keto in Space. Bryce Meyer (NSS Space Ambassadors)
3:00 PM Keto in Space: - by Bryce Meyer