

Nutritional Enhancement of Animal Sourced Foods to Better Fulfill Dietary Recommendations- Land Animals

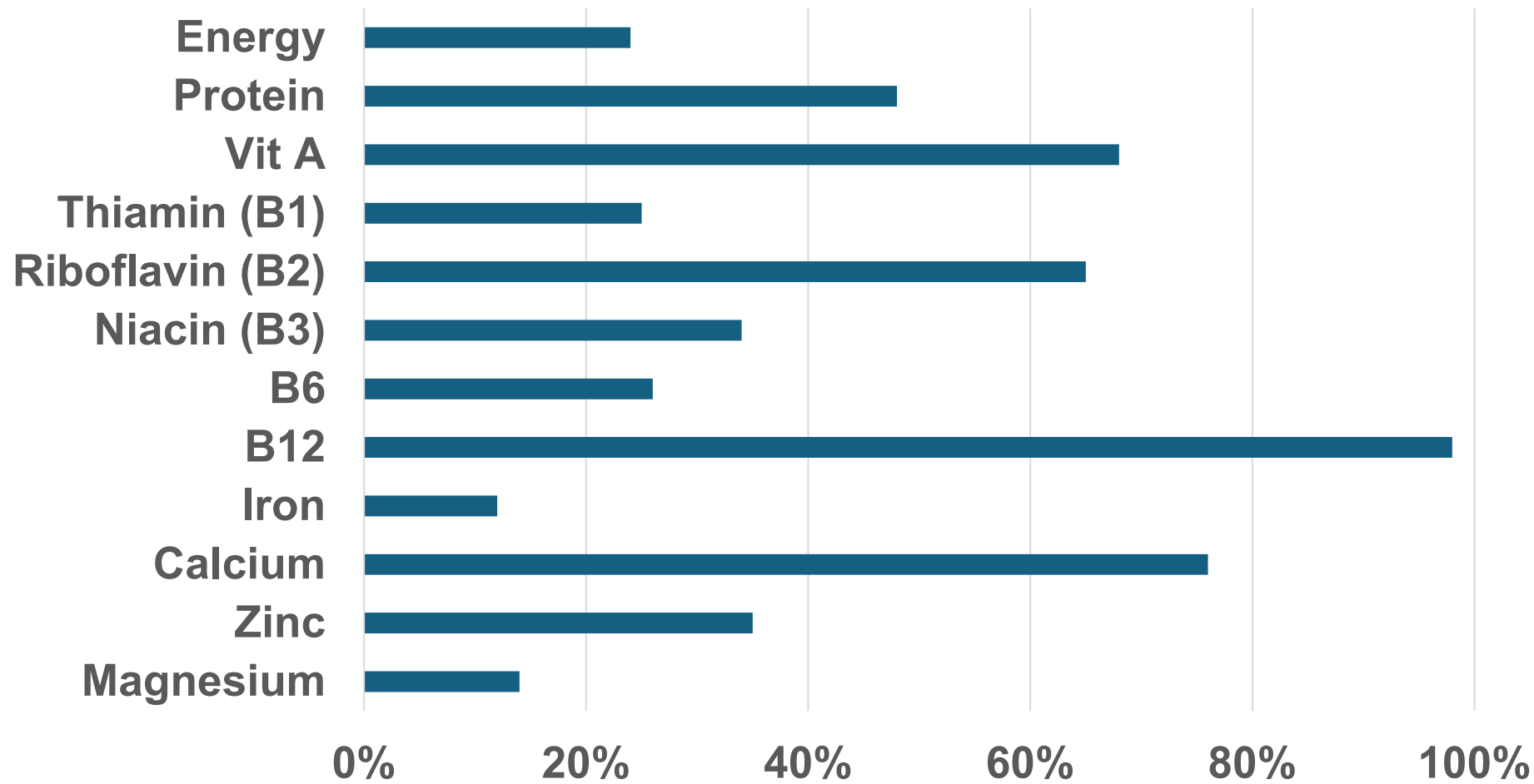
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Contribution of ASFs in the nutrient supply



Selected nutrients provided by ASFs in
the current U.S. food supply

Commodity ASFs are produced in intensive production systems

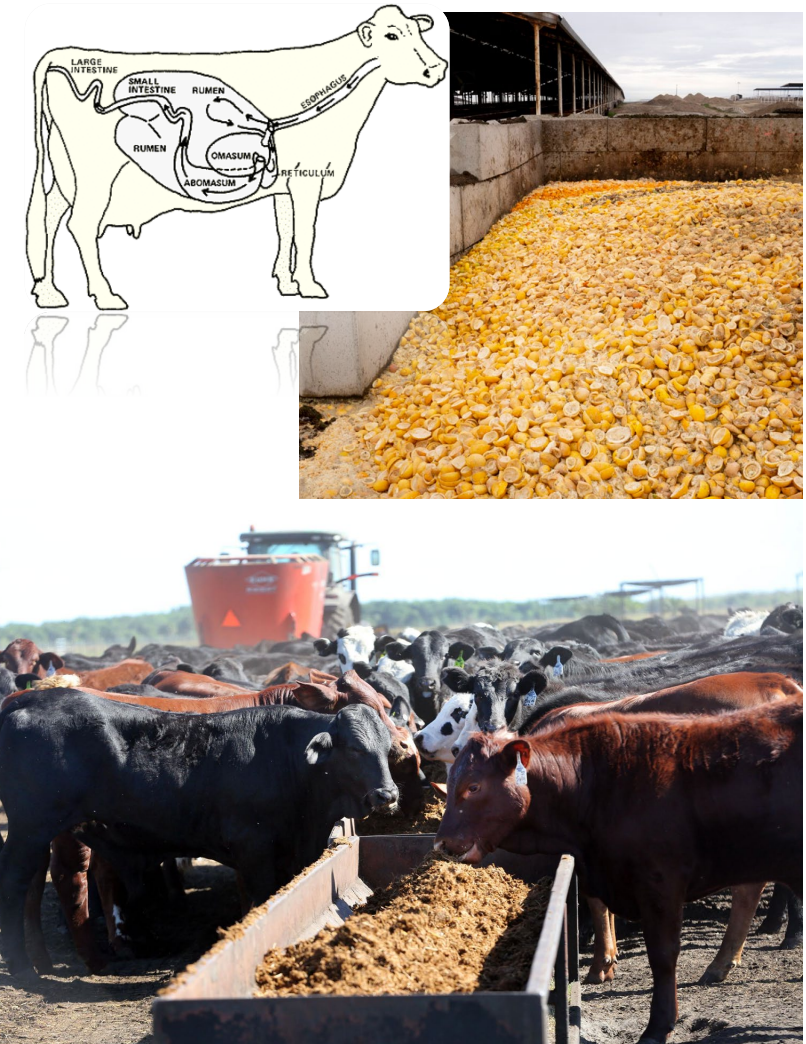
- Are designed to maximize production while minimizing costs.
- Produce sufficient supply of ASFs at ‘affordable’ prices.



Intensive production systems upcycle food wastes and by-products

- Millions of tons of **human-inedible by-products** from the biofuel and agri-food industries
 - Make up **10-40%** of livestock feeds in the U.S.
- **Food wastes** from manufacturing or grocery stores
 - Cull fruits/vegetables, bakery wastes, etc.

Example: 12.5 million tons/year being diverted to animal feed in California.



Commodity ASFs are processed in industrial plants

- Meat packers/processors (slaughter and fabrication)
- Dairy processors
- Egg farmers

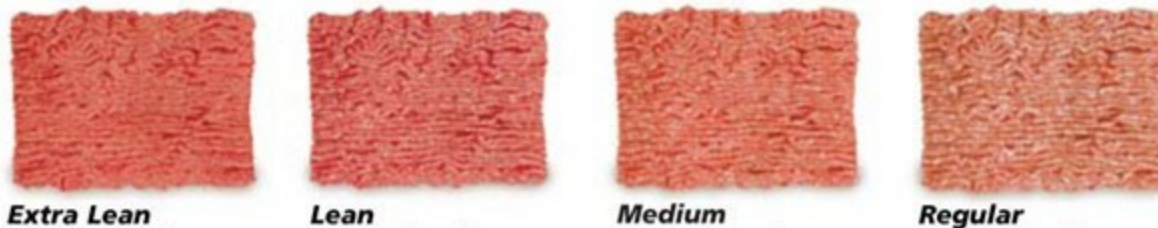
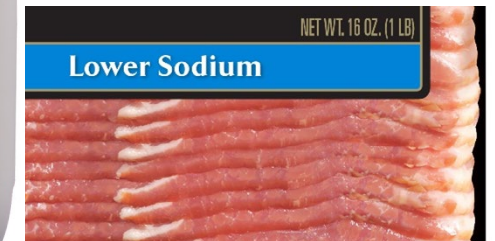
Priorities:

- Food safety
- Quality (Consumer acceptance)
- Shelf life



Nutritional enhancement- Post-harvest approaches (Examples)

- Vitamin D fortified milk (since 1940s)
- Dairy products: different fat content options
- Omega-3 fortified milk
- High protein/lactose free milk
- Trimming excess fat
- 'Low sodium' products
- Leanness options (ground meat)

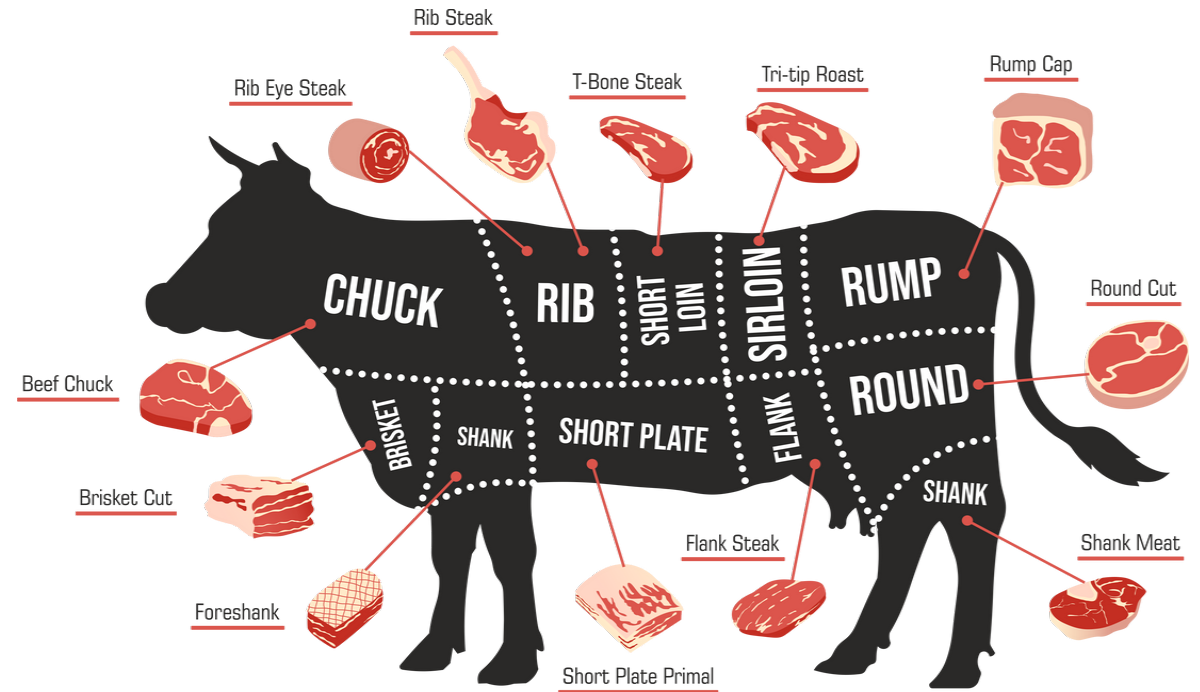


Reduced external fat



Post-harvest opportunities for cut-specific labels (consumer awareness)

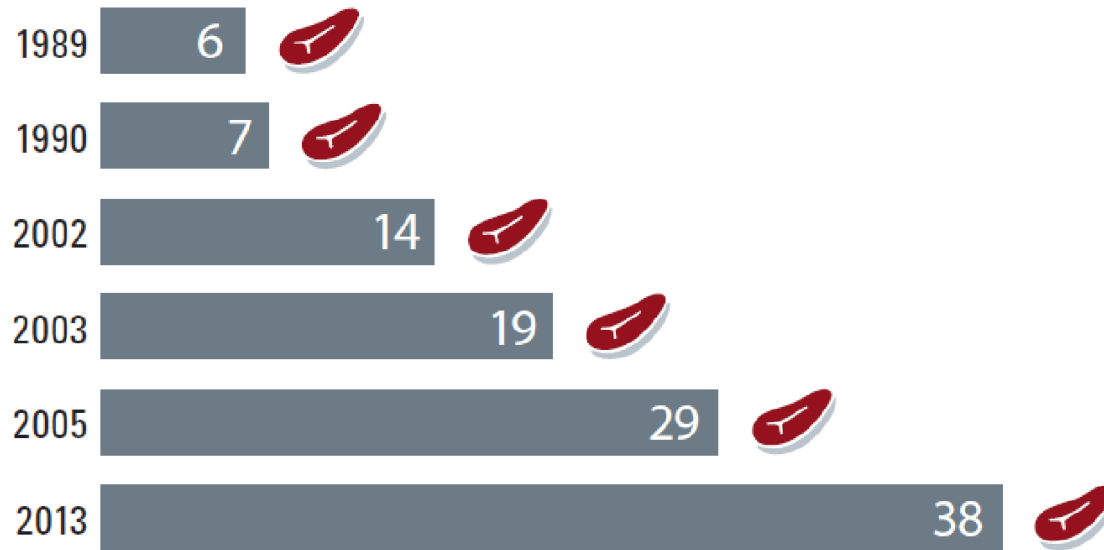
- Not all cuts created equal!
- Iron (8 to 18 %DV)
- Phosphorus (15 to 26 %DV)
- Zinc (25 to 45 %DV)
- B6 (11 to 37 %DV)
- B12 (22 to 65 %DV)



Percent Daily Value (DV) per 3-oz serving (85 grams)

Nutritional enhancement- Pre-harvest approaches

1) Genetic Selection for leaner carcasses



**Number of Beef Cuts Meeting
USDA Guidelines for Lean (<10% fat)**



40% leaner than 1970

Nutritional enhancement- Preharvest approaches

2) Animal Nutrition

Potential for nutritional enhancement

Eggs > Milk > Meat



Nutrients that respond well to dietary manipulations:

- Fatty acids, vitamins (A, E, D, B vitamins) and some trace minerals (e.g. Selenium and Iodine)

Pre-harvest approaches- Animal Nutrition

- **Eggs:** The most successful example of nutritionally enhanced ASFs

Omega-3 enriched eggs

Consumption of one egg from hens fed 10% flaxseed provides 261 mg of ALA and 81 mg of DHA.

- 8-10 times more total omega-3's than regular eggs



Flaxseed



Pre-harvest approaches- Animal Nutrition

Vitamin and trace mineral bio-fortified eggs

Produced by supplementation of layers diet with extra amounts of vitamins and trace minerals (i.e. above the animal requirement levels).

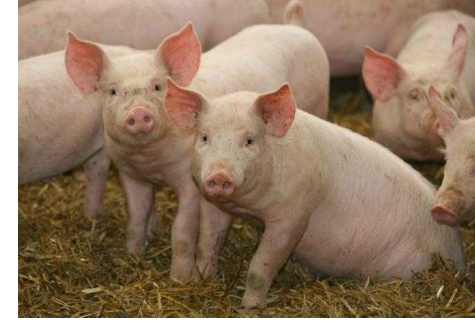
Fold increase relative to regular eggs:

- **Vitamin A (2 X)**
- **Vitamin D (3-6 X)**
- **Vitamin E (2-5 X)**
- **B vitamins (1.1-1.5 X)**
- **Iodine (3-4 X)**
- **Selenium (2-3 X)**

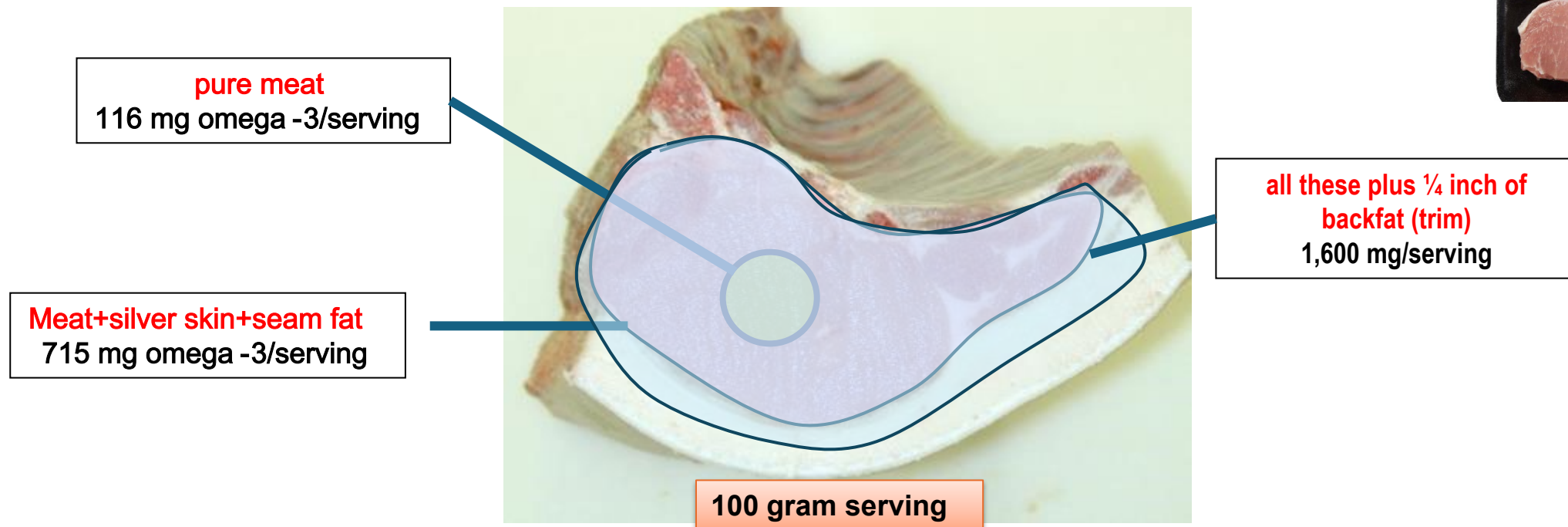


Pre-harvest approaches- Animal Nutrition

Omega-3 pork



When feeding 5% flaxseed for 11 weeks we found...



Note: Omega-3's are highly enriched in backfat; not so much in lean meat.

Pre-harvest approaches- Animal Nutrition

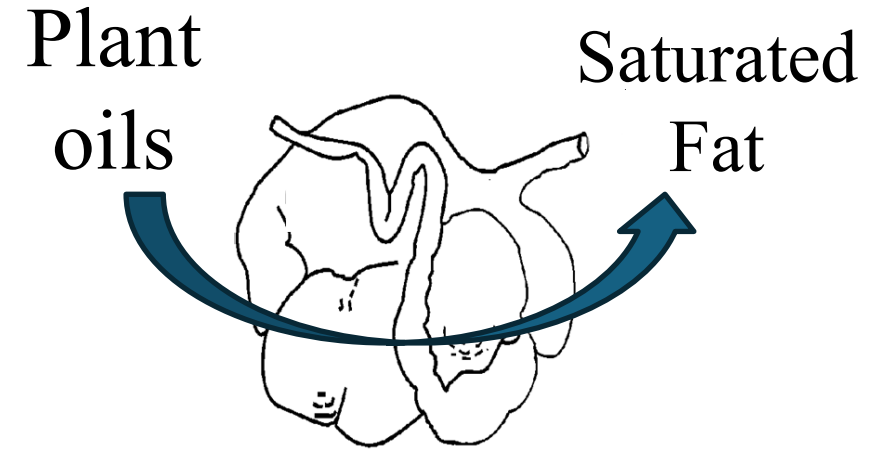
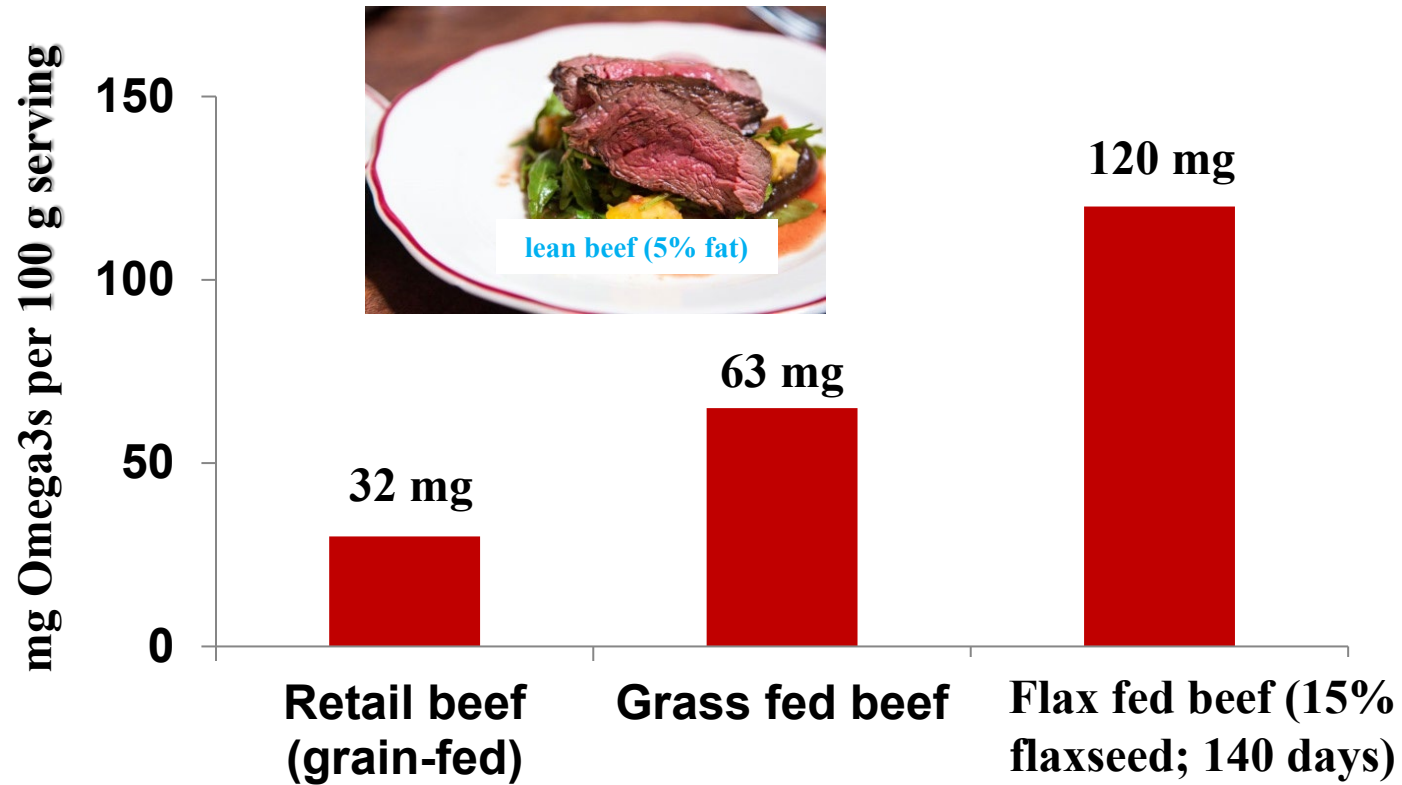
Omega-3 pork Cont.

- Production of sausages incorporating trim fat would seem to be a successful tactic for producing omega-3 enhanced pork products.
- Limited production in North America, and at a much larger scale in Finland mainly for export to China.



Pre-harvest approaches- Animal Nutrition

Omega-3 Beef



100g serving
lean pork (5% fat)



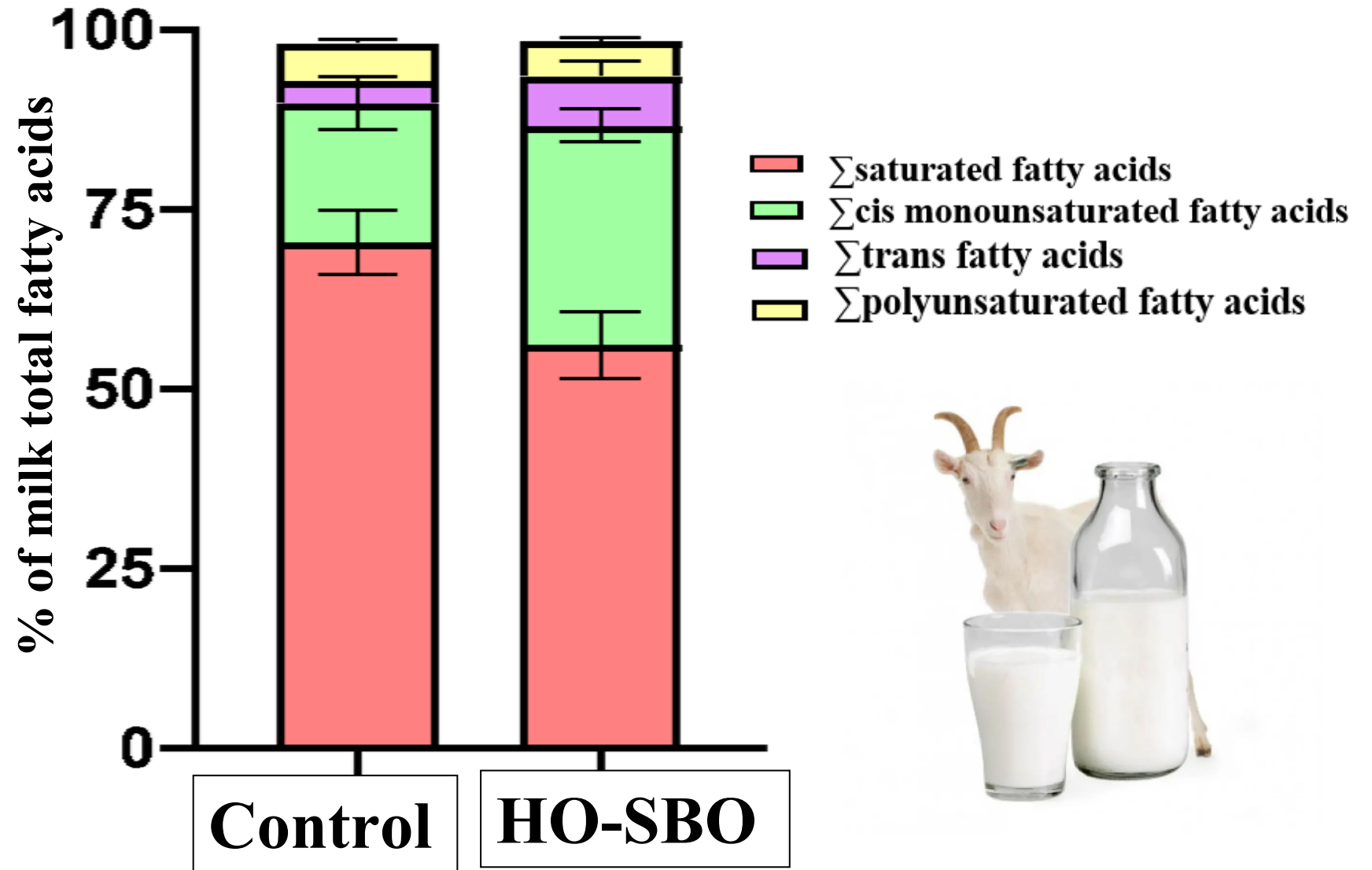
Lean pork from pigs fed
10% flaxseed for 80 days
700 mg Omega3s

Pre-harvest approaches- Animal Nutrition

Reducing saturated fats in milk- the GOAT model

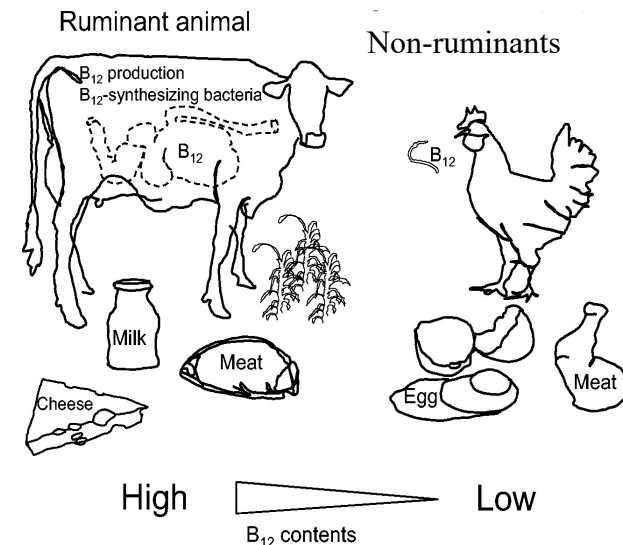
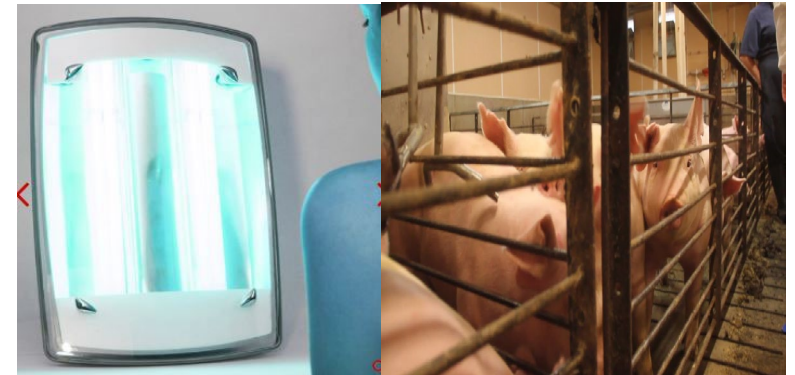
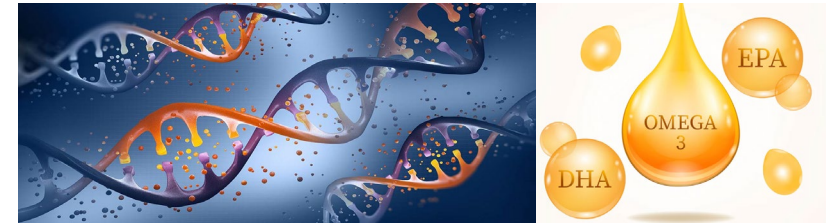


High-oleic soybean oil
(HO-SBO)



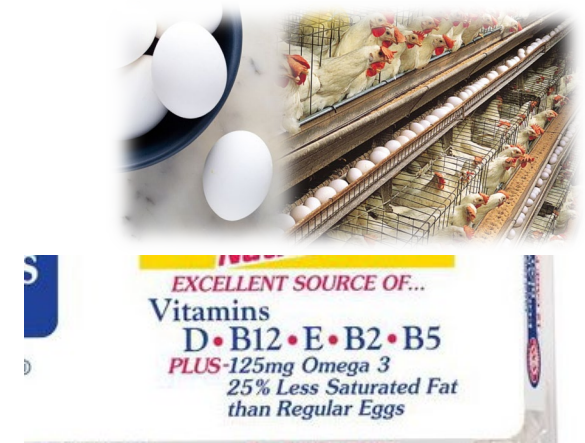
Pre-harvest approaches- other/novel methods

- Gene editing pigs and cattle to produce beneficial Omega's EPA and DHA
- Exposing pigs to UVB lighting to enhance Vitamin D levels in pork
- Cobalt supplementation in cattle to enhance vitamin B12 content of beef and milk



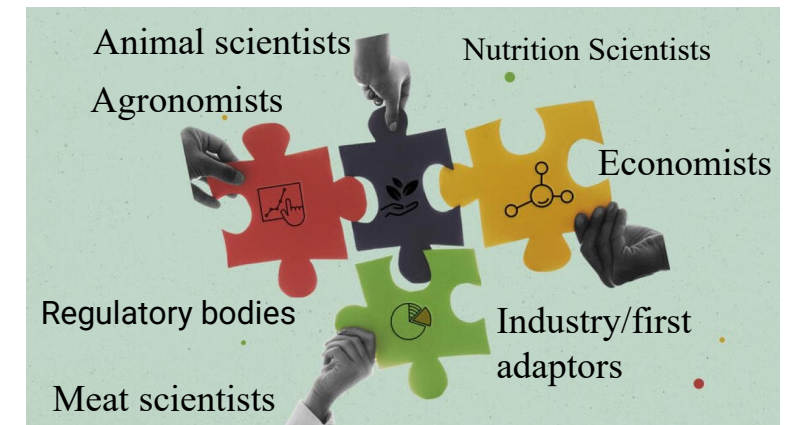
Nutritional enhancement-Pre-harvest approaches: Conclusions

- Animal nutrition is the most direct and practical approach, but currently is limited to specialty/niche products.
- In order for adoption at the industry/commodity level, there needs to be a mechanism for sharing profits along the value chain.



Nutritional enhancement-Pre-harvest approaches: Recommendations

- Drivers/incentives can be through definition of quantifiable levels required for nutritional enhancement.
- Priority funding is needed for nutritional enhancement of critical nutrients recognizing:
 - There have been many ‘**one-off**’ feeding studies showing the potential for nutritional enhancement of ASFs.
 - However....a **team approach** is required to **network aligned disciplines** required to develop ASFs and demonstrate economic feasibility, product acceptability and value for human nutrition and health.



Thank You!

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