

## Session 6

### Principles to Practice: Agrobiodiversity

#### Speaker: Daphne Miller

- If you're involved in agriculture, you're involved in nutrition
  - What is grown determines a population's health
- Engaging with farmers can expand nutritionists' understanding of the link between food and health
- Studying local diets can provide insight into long-term health benefits of certain foods
- Longevity Paradox: the generation tied to the land can be healthier than the generation that has left it
  - The Marche region in Italy has the highest number of centenarians per capita in the country
    - Monks at Marche monastery follow disciplined routine of prayer and farm work, and their diet is limited to the products produced in the region
    - In contrast, the younger generation in Marche is completely disinterested in this way of life. Health of this generation could suffer over the long term
- When we think about the transition from an agrarian economy to a modern urban economy, we too often focus on what we've gained with our modern amenities. There needs to be more focus on what we've left behind when we've moved away from an agrarian way of life.
  - In one study that compared the prevalence of diabetes between rural and urban areas, the urban areas overwhelmingly had a higher percentage of diabetics in their populations
    - Misra, A. and O.P. Ganda. 2007. Migration and its impact on adiposity and type 2 diabetes. *Nutrition* 23: 696-708.
    - Contributing factors include smoking, stress, sedentary lifestyle
- So what have we lost?
- **Crop Diversity**
  - Tarahumara population in Copper Canyon, Mexico
    - "Tarahumara" = "those who walk well"
    - Genetic cousins of Pima tribe of Arizona
    - Incidences of diabetes vastly lower in Tarahumara than in Pima
      - Schulz, L.O., et al. 2006. Effects of traditional and western environments on prevalence of type 2 diabetes in Pima Indians in Mexico and the U.S. *Diabetes Care* 29: 1866-1871.
  - "Three sisters" of corn, squash, and beans is a common intercropping technique
    - Combination has a health benefit as well
      - Beans have low glycemic index (sugar is not taken up quickly into the bloodstream)
      - Corn has high glycemic index (sugar is taken up quickly into bloodstream)
      - Combining beans and corn in taco has lower glycemic index than just consuming corn. Diversity in diet is key.

- Sayago-Ayerdi, S.G., et al. 2005. In vitro starch digestibility and predicted glycemic index of corn tortilla, black beans, and tortilla-bean mixture: Effect of cold storage. *Journal of Agricultural and Food Chemistry* 53: 1281-1285.
  - The Seven Countries Study was the first to link diet and lifestyle to cardiovascular disease
    - Researchers assigned odds ratios to major foods (>1 contributing to death; <1 preventative)
    - Men in Crete had lowest rate of heart disease compared to other populations of males
      - The odds ratio of the foods in Crete were not drastically different from Western diets.
      - The way the food was prepared and the portions consumed, as well as an active lifestyle, were all important factors.
      - A. Keys, editor. 1980. *Seven countries: A multivariate analysis of death and coronary disease*. Harvard University Press.
  - Dietary diversity can have a significant impact on long-term health
    - 37 million have macular degeneration (~95% are in developing countries)
      - The eyes are early indicators of poor health; much more sensitive to nutrition than other parts of body
      - Good biological model for studying diet
    - As dietary diversity goes up, eye disease goes down
      - Belanger, J. and T. Johns. 2008. Biological diversity, dietary diversity, and eye health in developing country populations: Establishing the evidence-base. *EcoHealth* 5: 244-256.
- **Perennials and native seeds**
  - Shrinking germplasm of crops
    - Varieties of rice cultivated has shrunk from 40,000 varieties to dozens
  - When we talk about modern junk food, that's only one part of the story. When germplasm is lost, medicine is lost.
    - Research by ethnobotanists have found over 300 native species in that area that lower blood sugar
      - Cactus harvested by Tarahumara may be as effective as diabetes medication in slowing release of glucose into the bloodstream
      - Andrade-Cetto, A. and M. Heinrich. 2005. Mexican plants with hypoglycaemic effect used in the treatment of diabetes. *Journal of Ethnopharmacology* 99: 325-348.
  - Plants grown by indigenous communities can have different nutrient profiles than commercial greens
    - It is critical that this germplasm is not lost

- “Chemotypes”: the same genus/species in different areas/conditions will actually give you a different nutrient profile (essential oils, etc.)
  
- **Traditional technologies**
  - Modern post-harvest practices have a dramatic effect on nutrient content of products
    - Avocado and olive oil extracted by traditional presses had a higher nutrient profile than oils extracted by industrial processes
    - Field-dried wheat has different flour profile than bin-dried wheat
      - Dias, A.S., A.S. Bagulho, and F.C. Lidon. 2008. Ultrastructure and biochemical traits of bread and durum wheat grains under heat stress. *Brazilian Journal of Plant Physiology* 20: 323-333.
  - Traditional processing can be combined with modern sanitary techniques
  - Traditional ways of raising poultry/livestock can impact nutrition profile of products
    - The eggs of pastured chickens had more vitamins than the eggs of caged chickens
      - Mungai, C., et al. 2013. The effects of husbandry system on the grass intake and egg nutritive characteristics of laying hens. *Journal of the Science of Food and Agriculture* 94: 450-467.
  
- **Soil Vitality**
  - Soil biodiversity is significantly higher on organic farms than on conventional farms
    - Number of species in organic soils much higher than soils under conventional production
      - “The difference between an international city and a country club”
    - Organic production also led to higher fruit quality and antioxidant activity
      - Reganold, J.P., et al. 2010. Fruit and soil quality of organic and conventional strawberry agroecosystems. *PLoS One* 5: e12346.
  - High soil biodiversity can increase the nutritive content of crops
    - Antunes, P.M. et al. Linking soil biodiversity and human health: Do arbuscular mycorrhizal fungi contribute to food nutrition? In: D. Wall, ed. *The Oxford Handbook of Soil Ecology and Ecosystem Services*. Oxford University Press.
  - Inter-biome communication
    - Emerging field of research is finding how much human health is affected by microbiomes in digestive tract
      - Soil biodiversity has a role in this
    - Link between lower biodiversity and higher incidences of allergies. Urban populations exposed to less biodiversity than rural populations.
      - Ege, M.J, et al. 2011. Exposure to environmental microorganisms and childhood asthma. *New England Journal of Medicine* 364: 701-709.
      - Haahtela, T., et al. 2013. The biodiversity hypothesis and allergic disease: World Allergy Organization position statement. *World Allergy Organization Journal* 6: 3.

- Hanski, I., et al. 2012. Environmental biodiversity, human microbiota, and allergy are interrelated. *Proceedings of the National Academy of Sciences* 109: 8334-8339.
  - Healthy soil (high biodiversity) boosts soil carbon storage
    - Fernandez-Martinez, M., et al. 2014. Nutrient availability as the key regulator of global forest carbon balance. *Nature Climate Change* 4: 471-476.
- **Community**
  - Community values and traditions have an impact on personal health
    - Example of a Kentucky family working together to cure tobacco
      - Increased exposure to nature, microorganisms
    - *Hara hachi bu* = “eat until you are eight parts full”
      - Confucian tradition of not taking more than you need
      - Can have profound effect on overall health
    - Modified fasts of Greek Orthodox encourage healthier consumption
      - Lower rates of obesity in Greek Orthodox communities
        - Sarri, K.O., et al. 2003. Effects of Greek Orthodox Christian Church fasting on serum lipids and obesity. *BMC Public Health* 3: 16.
  - Community values can have an impact on environmental quality
    - Steiner community in Sweden has a soil museum, the schoolchildren participate in gardening, farmers conduct research trials and post results for community
- **Take-away Lessons**
  - By losing...
    - crop diversity we lose dietary diversity
    - native seeds we lose phytonutrients
    - traditional technologies we lose healthy macronutrients
    - soil vitality we lose protective bacteria
    - community we lose healthy eating patterns
- **Going Forward**
  - We need to rediscover our “farmacy”
  - We need to find a common language between health practitioners and agronomists