Challenges in food quality, safety and intolerances.

W. Jean Dodds*

Hemopet, Salinaz Avenue Garden Grove, California, United States

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Editorial

Nutrition is now recognized to play a key role in maintaining the health and longevity of human and animal populations and their resistance to disease [1-4]. Genetic, genomic and epigenetic functions have been shown in the last two decades to be directly and indirectly impacted by foods and the diet. As a result, medical practitioners, pediatricians, veterinarians have started applying genomics to the field of nutrition making Nutritional genomics (nutrigenomics) a vital part of assuring the quality and safety of human, livestock, and pet foods [3-7].

Foods are now accepted as functional ingredients in the prevention, management and treatment of health-related issues. As different diets alter gene expression and are responsible for the production of proteins and metabolites, it becomes important to understand the relationship between nutrition and gene expression.

It enables one to design an optimal diet based on a genotype of a person or animal. The results will ultimately affect these individuals at the level of their genomes which will have profound effects on their phenotype of observable traits [1-6]. Food constituents achieve this effect by "up- or down-regulating" target genes, thereby altering their expression. The conclusion of this evolving molecular knowledge indicates that diets for animals (and humans) should be designed and tailored to the genome or genomic profile of individuals in order to optimize physiological homeostasis, disease prevention and treatment, and athletic, obedience, growth or reproductive performances. The critical importance of this approach is that it individualizes dietary intervention to prevent, mitigate or cure chronic diseases [4-7].

Support for applied basic and clinical nutrition research is even more important today when our planet and world population is feeling the effects of global warming with reduction of the ozone layer.

The future of human, animal, plant agriculture and the well-being of us and companions and other animals is dependent upon providing funding for this research.

Food Quality and Safety Issues

Recent attention has also been focused upon the need for sustainable agriculture and the methods and oversight applied to raising animals, fish and plants, as a source of organic foods. Food quality and safety issues are paramount in both human and animal foods [8-10].

GMO foods

Safety claims related to the ingestion of foods from genetically modified organisms (GMO) have been based until very recently solely on industry-funded studies [9]. By contrast, industry-independent studies have linked GMOs and glyphosate to kidney damage and disease as well as other health problems [9-11]. While limited testing on processed human foods has detected significant levels of GMOs, no testing appears to have been performed on commercial pet foods.

Food Contamination

Mycotoxins

Contamination of extruded commercial dry food with several types on mycotoxins has been described [12]. Levels above the defined detection limit were found for three types of mycotoxins in 81-100% of the 48 tested feeds. Further investigation is clearly needed into the potential risk derived from chronic exposure of pet animals to low doses of mycotoxins in commercial pet foods [12-13].

Microbials

Raw *vs* cooked food diets: The debate over which type of diet is best for dogs and other pets-raw meat-based or cooked meat-based-often stirs strong emotions and polarizes people into taking "sides", often with no room for acceptance of the other viewpoint [1,14-17].

Food recalls: Many of us prefer to believe that the foods we and our pets eat are healthy and safe, even if we and they overeat fatty foods or those with a high glycemic index (high sugars and starches) [18]. However, both the human and pet food industries have more recently been inundated with food recalls for contamination with microbes including bacteria, viruses and parasites [19-38]. Every food type has been implicated, even candies.

***Salmonella*, *Listeria*, *Campylobacter*, *E. coli* and Parasites:** One prominent recent example of a contaminated plant used in foods is "Kratom", a plant native to Southeast Asia [25]. According to the US FDA, this outbreak from *Salmonella* contamination associated with kratom-containing capsules, teas and powders, underscores the risk that harmful bacteria may contaminate these products when not subjected to manufacturing controls to eliminate that risk, in addition to the overall safety concerns for kratom itself [25].

Other food recalls in human and pet foods have primarily concerned contamination with *Salmonella* (many sources from animals, fish and plants), *Listeria* (mostly from bovine species), and *Campylobacter* bacteria, Hepatitis A virus in undercooked shellfish, and parasites.

The most recent pet food recall was for a cat food that was contaminated with both *Salmonella* and *Listeria spp*., and caused acute illness in 2 kittens and one died [26].

Campylobacter spp. are now considered to be major triggering agents of acute polyradiculoneuritis (APN), an immune-mediated peripheral nerve disorder in dogs that shares many similarities with Guillain-Barre syndrome in humans. With regard to dogs, a recent study comparing dogs suffering from suspected APN and healthy dogs after consumption of raw chicken found raw chicken consumption to be clearly a risk factor for the development of APN and that it was potentially mediated by infection with *Campylobacter spp*. [27].

Escherichia coli is a common fecal contaminant that can be found in many consumed human and animal foods.

Most common parasites present in all foods include: Tapeworms (*Taenia spp, Echinococcus spp*.) typically from feeding undercooked pork and in dog feces; *Toxoplasma gondii* protozoa in cats and rodents; *Crytosporidiums spp*. from contaminated shellfish, salad greens, and unpasteurized raw milk; *Entamoeba histolytica* protozoa; *Trichinella spiralis*, the pork roundworm; *Opisthorchiidae spp*., the fluke flatworm; Ascarid roundworms; and *Trypanosoma cruzi* causing Chaga's disease from the feces of infected beetles that feed on mammalian blood.

Heavy metals

A 2018 report from the Clean Label Project (Denver, Colorado) after analysis at an independent laboratory found that 53 (40%) of the 134 brands of commercial animal- and plant-based food powders purchased from retail shelves or on-line sources contained substantial amounts of heavy metals. Even more disturbing, those products certified as organic were twice more likely to have heavy metal contaminants than the non-organic powders [28]. The most commonly found heavy metals were lead, mercury, cadmium, and arsenic. About 10% of whey-based powders had lead levels above health guidelines.

Additionally, these powders were tested for Bisphenol A (BPA), a known endocrine disrupter. Measurable levels of BPA were found in 55% of the tested powders-28 contained twice the regulatory limit and one powder has an astounding level more than 25 times the allowed level in just one serving. Those people eating vegetarian or primarily vegetarian diets are best advised to avoid plant-based food powders.

The good news about this study is that egg-based protein powders did not contain lead and minimal levels of the other heavy metals.

Thimerosal is an ethyl mercury-containing compound used mainly in vaccines as a bactericide [29]. The kidney, liver and brain are key targets for mercury toxicity, and a recent published study showed cell death (apoptosis) and fibrotic changes in human kidney cells exposed to thimerosal [30].

Euthanasia solution

Of all the recent food recalls, perhaps the most alarming and disgusting was the admission that the tallow added to a popular company's line of pet foods contained pentobarbital euthanasia solution from deceased pets [31]. After the initial report from canned pet food, subsequent multiple testing of 24 brands of wet canned pet foods found only one popular brand that repeatedly tested positive for pentobarbital, albeit in very small amounts. But, no amount of this solution is permitted in foods.

Food Intolerances and Sensitivities

Adverse food reactions in people and pets typically express clinical signs that closely mimic those of environmental allergen and contact exposures [1,4,5,19]. This clinical syndrome is clearly increasing in frequency worldwide, and is often first recognized when adult family members observe their household pets experiencing similar symptoms of one or more cutaneous, respiratory or gastrointestinal signs. In elderly people and pets, there can also be loss of memory, confusion and reduced cognition [1,5].

However, important confounding factors have been revealed now that the multinational commercial pet food industry has focused largely on producing foods in dry kibble and wet canned forms. The question arises then whether modern domestic companion animal dogs and cats can adequately digest and assimilate dry commercial pet foods, when they are ancestrally carnivorous. While cats have maintained their need to be carnivores, dogs have evolved with domestication over time to adapt genomically to a starch-rich diet [32, 33].

Commercial pet foods often contain meat and flavorings not listed or specified on the label [32-34]. Thus, before ruling out a food component as an allergen, a novel protein home-made diet trial should be performed, if the dog or cat is poorly responsive to a commercial so-called "hypoallergenic" diet regimen.

Lastly, dietary restriction with limited ingredient diet formulas can be compromised because many pets also receive a variety of supplements, preventive pharmaceuticals such as those for heartworm, flea and tick exposures, as well as puppy and periodic booster vaccines. These products typically contain meat, especially beef, pork and chicken, as well as other flavorings and fish oils [34], and nearly all vaccines contain fetal calf serum [29]. This problem is more complicated when veterinary therapeutic and supplement items and over-the-counter products may not accurately list the ingredients or their antigen sources on the label or product insert [33]. When recommending diet elimination trials, only non-flavored oral or topical therapies, pill pockets, and supplements should be used. Additionally, gelatin capsules may contain either beef or pork proteins and should not be administered during a trial [34].

Grain- and Gluten-Free Diets

An estimated 40% of middle aged and older people, especially women, are selecting gluten-free diets because they feel healthier, less gas formation, bloating and abdominal discomfort, fewer rashes and headaches, and believe they have improved focus and memory [35]. These individuals do not have late onset celiac disease and many also prefer diets free of commonly used grains (corn and soy). The common gluten-containing foods to be avoided are: wheat, barley, rye, oats-unless labelled as gluten-free, kamut, spelt, and couscous. The more commonly fed gluten-free foods include: rice, quinoa, millet (a goitrogen), flax, sorghum, buckwheat, amaranth, tapioca (cassava root), and TEFF (an ancient Ethiopian grain).

Foods with Health Benefits

Examples of Foods to Maintain Health and Longevity are as follows [1,17,36-38]:

Applesauce [Unsweetened Applesauce+Antacid]: Unsweetened apple sauce given to pets at bedtime helps neutralize nighttime accumulation of gastric acid. Follow it in the morning with an antacid like famotidine (Pepcid) or licorice, 30 mins before breakfast. Helps prevent and control low-grade morning gastritis.

Beetroots: Beetroots contain phenolic acids, betalains (the red indole-derived pigment in beets that replaces anthocyanin in other pigmented foods), fiber, minerals and nitrous oxide, thereby providing have high nutritional value [36]. Beets function to regulate vascular tone, reduce blood pressure, maintain endothelial function, improve physical performance promote nitrous oxides synthesis, and are both antioxidant and anti-inflammatory.

Cranberry (*Vaccinium macrocarpon*): High in antioxidants, called pro-anthocyanidins, this berry lowers urine pH, coats the bladder lining, and is both anti-microbial and anti-cancer. Available for pets; dose 475 mg for 25-50 pounds.

DiMethyl Glycine (DMG): DMG is used for refractory seizures in infants and pets. Also used to enhance athletic performance, treat immune deficiency disorders, cancers, and cognitive disorders.

Note: Do not give supplements containing Rosemary, Oregano, Fennel or Sage to epileptics because of their neurotoxic potential. Also, no spinosad (Comfortis; Tri-Fexis), afoxolaner (NexGard), fluralaner (Bravecto), sarolaner (Simparica) and lotilaner (Credilio) for flea and tick control.

Ginger (*Zingiber officinale*): Helps in digestion, reduces arthritic pain, for nausea, and gas formation, for cough and bronchitis. Is an appetite stimulant and anti-cancer agent. Can be used as a tea.

Green Tea (*Camellia sinensis*): Tannins and polyphenol catechins in tea are anti-inflammatory and anti-microbial. Green tea is more effective than white or black tea as it releases its activity faster. Use as decoction (quick boiling of plant or herb for medicinal use) or as infusion. For itching, irritated belly, or licking of feet, make green tea bag poultice-make tea, let it cool, take the wet (not dripping wet) tea bag or thin washcloth dipped in the tea and place it over the area for about 5 minutes. Repeat as often as needed. Add green tea to pet's meals twice daily (1/4 cup per 20 pounds body weight). Bathe pets with bad skin in tea 3 times a week. Used in humans with SLE (lupus); for periodontal disease, osteoarthritic pain helps angiogenesis (less scarring, heals faster).

Rooibos tea: used for stroke; also for headaches, insomnia, asthma, eczema, hypertension, and allergies. Free of caffeine and low in tannins.

Sage tea: used for preventing colon cancer.

Cinnamon tea: high in anti-oxidant properties.

Fennel tea and seeds: good for IBD/IBS (gas, bloating, abdominal cramps). Not for seizure patients (neurotransmitter).

Bacopa monnieri tea: stated to sharpen the mind and intellect; inhibits tumor necrosis factor-alpha (TNF-α) and interleukin 6 (IL6).

Mullein tea: very helpful for coughs and upper respiratory issues. Helps pets with partial or collapsed tracheal rings. Brew strong mullein tea (1 cup boiled water and 1-2 teaspoons of dried mullein leaves or flowers); steep for 10-15 minutes. Drink or add to food daily, as needed.

White & Black tea: given for inflamed Shar Pei wrinkles; also for diarrhea.

Hibiscus tea: helps with high blood pressure and cholesterol, for upset digestion, avian influenza, liver disease, and is stated to reduce cancer risk.

Chamomile tea: protects skin, lowers stress, regulates sleep, boosts immune system, and treats bowel issues.

Calendula (Marigold) tea or lotion: very helpful for sore throat and mouth, cancer, stomach and duodenal ulcers. Apply to the skin to soothe, and reduce pain and swelling.

Licorice (*Glycyrrhiza glabra*): For leaky gut and other digestive issues including stomach ulcers, heartburn, colic, and chronic gastritis. Also for prostate cancer, eczema, and adrenal fatigue. Acts as an anti-depressant. Can use as a tea.

Slippery Elm (*Ulmus rubra*) Bark: A demulcent (muco-protective agent); soothes stomach and intestinal lining by reducing irritation; soothes throat and cough; reduces bladder irritation. Used for heartburn and esophageal reflux. Can be used as a tea.

Taurine: This amino acid that inhibits neurotransmission can be of benefit to seizure patients. Very little information is available on the taurine content of ingredients used in home prepared diets for dogs and cats, and the foods fed to wild animals in captivity [37,38]. A parallel study from the same group reported that taurine deficiencies have been associated with the feeding of commercial lamb-meal and rice diets to dogs [38].

Turmeric (*Curcuma longa*): Turmeric is an orange colored member of ginger family with potent antioxidant and anti-inflammatory properties. Is also anti-microbial, protects against certain cancers, treats osteoarthritis, supports liver, gut, and heart health, offers pain relief, may prevent cataracts, benefits those with IBD/IBS and allergies, lowers blood sugar, and may help prevent Alzheimer's disease in people. Potentiated by black pepper, but do not use it with black pepper in dogs as they can have severe reactions. Turmeric tea and root are used like other medicinal teas.

Other supplements:

- Apple Cider Vinegar is used unfiltered and unpasteurized; place on wounds or in food.
- Dandelion root is a mild appetite stimulant, improves upset stomach and digestion. Mild laxative, which may improve liver and gallbladder function
- Tea Tree Oil (*Melaleuca alternifolia*) is potentially toxic, especially if used undiluted on wounds or sores.
- Cinnamon Bark is a potent polyphenol antioxidant and anti-inflammatory, it lowers blood glucose/ anti-diabetic, reduces risk of heart disease, high blood pressure and cholesterol, helps prevent cancer, and is neuroprotective.

- Clove Oil is given for diarrhea, hernias, bad breath**,** intestinal gas, nausea, and vomiting. Applied to gums for toothaches.

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*Correspondence to
W. Jean Dodds, DVM
Hemopet, 11561 Salinaz Avenue
Garden Grove, California 92843,
United States
Tel: 714-891-2022 ext. 115
E-mail: jeandodds@hemopet.org