

FLUSHING AND POULT ENTERITIS

Peter R. Ferket
Extension Poultry Nutritionist
North Carolina State University

Enteric health and nutrition are intimately related. Poor enteric health can adversely affect food digestion, gut motility, and nutrient absorption by several means. Likewise, poor nutrition and feed quality can either increase a bird's susceptibility to enteric disorders or directly cause them. Often it is difficult to discern the true cause of enteric disorders in poultry, whether it is pathogenic or nutritional in origin. My objective is to present general information on common nutritional factors that influence gut health.

Feed intake is one of the first things a grower will see change when poultry succumb to some kind of enteric disorder. Like all animals, poultry will not eat normally when they do not feel well. People often confuse this behaviour with feed refusal associated with a feed quality problem. To discern whether feed refusal is due to poor feed quality or infectious disease, one must have a broad perspective of the situation. If the feed refusal problem is company-wide then feed quality is usually the suspected cause. If the problem is only among a few farms, then disease management is often the suspected cause. Do not be quick to judge until all the facts have been carefully studied.

Maintaining feed intake is especially important to avoid mortality or severely stunted growth when birds are afflicted with an enteric disorder. One of the first symptoms observed in a flock afflicted with poult enteritis is a distressful vocalization and impatient pacing behavior along the feeder lines about 24 hours before the diarrhea starts. The poults seem to be disturbed about the feed, and they will not eat it. A spike in mortality may occur until about 3 days later when many of the birds begin to consume feed again.

A similar response can be observed in broilers subjected to a sudden decrease in the duration of light exposure after 14 days of age. After about 14 days of age, the diurnal feeding behavior in broilers is established and a change in lighting program will adversely affect feed intake in some birds. For example, if a bird is accustomed to feeding during a time that has changed from a light to a dark period, it will go hungry for several days until it learns to eat during the light period. Often a spike in mortality follows shortly after the birds begin eating, and dead birds are often found with their intestines full of feed. In other words, realimentation following a period of inanition due to management or enteric disorder can cause a spike in flock mortality.

This spike in mortality is associated with hypophosphatemia (Frank Edens, 1996, personal communication, North Carolina State University, Raleigh, NC). While the birds are off feed, their phosphate reserves deplete, but when they begin to consume feed again, the high demand to phosphorylate the influx of glucose for ATP production in the liver and muscle tissue, drains blood phosphate reserves to fatally low levels. This response is especially evident during stressful conditions, which require a cascade of ATP phosphorylation. In addition, it is common for animals to develop respiratory alkalosis and metabolic acidosis during periods of starvation, and this will also cause a shifting of phosphorus into cells (Mostellar et al., 1964). This phenomenon is thought to be created by the phosphate trap resulting from glucose-6-phosphatase deficiency leading to type I glycogen storage disorder. Therefore, it is important that a grower take every measure possible to keep the afflicted poults eating to maintain blood phosphorus and other critical nutrients. In realimentation after starvation, hypophosphatemia can be induced by inadequate dietary

phosphorus. Therefore, top dressing the feed with a highly available source of phosphate or supplementation of drinking water with a soluble source of phosphorus when the poults show the first signs of feed refusal may help prevent the birds from becoming hypophosphatemic and dying upon realimentation.

Palatability of the feed is extremely important to maintain feed intake of young birds (especially poults) when they experience an intestinal upset. Palatability is more influenced by textural properties than by flavour because poultry have few taste buds and a relatively dry mouth, especially when they are dehydrated because of diarrhea. Small firm pellets and good crumbles with few fines is ideal to maintain palatability. Too much dry fines in feed is difficult for birds to consume, much like it is difficult for us to eat a big mouth full of dry crackers without something to wash it down. Dumping feed pans, cycling feed lines, and getting the birds up and moving frequently may encourage feeding activity. Some people claim that afflicted birds can be encouraged to eat by top dressing the feed with grit, coarse ground corn, whole kernel wheat, whole rolled oats, powdered milk, molasses or confectionery sprinkles. Starter diets containing coarsely ground corn is better than finely ground corn because it results in less fines in the crumbled feed and the poults are able to freely select the high carbohydrate ingredient if they need it. Diets containing high fat (about 7.5% total dietary crude fat) improve feed palatability by reducing fines and increasing oral lubrication. It may also slow food passage rate, thus improving feed utilization.

Dietary crude protein level and amino acid balance can influence the susceptibility of poultry to enteric disorders by affecting nitrogen metabolism and enteric microflora. Excess crude protein or poor amino acid balance can be a metabolic stress to chicks and poults, thereby adversely affecting feed intake, feed conversion, and growth. Excess dietary protein and amino acid forces the birds to eliminate nitrogen *via* the kidneys, which elicits a flushing (diuresis) response. Excess dietary protein may also shift the microflora to a more proteolytic population (e.g. clostridia), which can adversely affect gut health. Amino acid balance can be improved by reducing dietary crude protein to about 90% of NRC recommendations and supplementing with lysine, methionine and threonine.

Digestibility of feed ingredients may influence the severity of enteric disorders in poultry. In general, poorly digested feed results in less nutrients being available to the bird for growth and more nutrients available for gut microflora and pathogens; this is not good. Poor feed digestibility may be due to several anti-nutritional factors in feed ingredients: 1) enzyme inhibitors (e.g. trypsin inhibitor in underprocessed beans); 2) nonstarch polysaccharides in grains; 3) overcooked protein; and 4) poorly digested protein sources (e.g. keratin in feather meal or hair). In turkeys, a significant portion of the protein in starter diets comes from soybean meal. Too much dietary soybean meal (>30% of the diet) may cause malabsorption or maldigestion because of the high dietary level of the osmotically active non-starch oligosaccharides, galactomannans, raffinose and stachyose. Similar problems exist in feeding high amounts of grains containing non-starch polysaccharides such as β -glucans, arabinoxylans, and other pentosans. Poultry, especially young ones, do not have the innate enzyme capability to digest these carbohydrates, which ultimately increases microbial fermentation. Moreover, these compounds alter gut digesta viscosity, which adversely affect digestion and nutrient absorption, or they indirectly irritate the gut by increasing microbial fermentation. Dietary supplementation of enzymes, such as α -galactosidase or an endomannanase for soybean meal, β -glucanase for barley, and arabinoxylanase for wheat may alleviate the adverse effects of excess non-starch polysaccharides on birds subject to enteric disease.

Dietary fiber, fat, and feed texture all influence the severity of enteric disorders by modifying gut motility. Feed passage rate generally increases as dietary fiber content increases, and passage rate decreases as dietary fat content increases. However, in young poultry with an enteric problem, these dietary components may help normalize gut motility. Good gut motility is necessary for proper food digestion, nutrient absorption, and maintaining a healthy gut environment. Dietary fiber and feed texture (particle size and integrity) are important for proper gizzard motility. The gizzard is the "pace-maker" of normal gut motility (Duke, 1994). Unlike mammals, vigorous gut reflux (e.g. backward flow or reverse peristalsis) are normal in birds as an adaptation to compensate for a short intestine.

The reflux serve to re-expose intestinal digesta to gastric secretions, vigorously mix digesta with enzymes to enhance digestion, and discourage microbial proliferation that may cause disease or compete for nutrients. Dietary fat stimulates the reflux of digesta from the jejunum through duodenum into the gizzard, thus slowing food passage rate and improving the utilization of dietary protein and energy.

A diet free of toxic compounds should be the standard objective for every feed manufacturer. A strict quality control program will reduce the risk of inadvertent contamination of feeds with mycotoxins, phytotoxins, biogenic amines, and pharmaceuticals, and other toxic compounds. Mycotoxins may cause enteric disorders, feed refusal, and malabsorption. Oxidized fat has deleterious effects on the gut health of poults (Dibner et al., 1995), so poultry should be fed the highest quality fat possible and a liberal amount of antioxidant to prevent the development of fat rancidity.

The biogenic amines, histamine and tyramine, can cause or aggravate an enteritis problem if they exceed about 100 ppm in the diet. These amines accumulate in spoiling meat and fish by-products. Fishmeal is a common source of biogenic amines, but excessive levels of biogenic amines rarely occur if the dietary inclusion rate of fish meal is below 5%. Since there is no rapid or inexpensive test for biogenic amines, it is necessary to purchase high quality fish or animal by-product meals. Be suspicious of protein by-product meals that are much darker in colour than normal, or which have putrid, sweet, pungent, or ammonia odours. Low quality protein meals (e.g. overcooked meals) are poorly digested in the foregut and thus pass into the hindgut where they are degraded by proteolytic bacteria (e.g. clostridia, *E. coli*, etc.). These proteolytic bacteria produce biogenic amines and other toxic compounds. If possible, feed the highest quality protein by-product meal in the starter diets.

Intervention Strategies

Strict biosecurity practices are extremely important in the prevention of enteric disorders. However, in concentrated areas of poultry production, even the best biosecurity practices may not prevent enteric problems. Usually, affected birds will show a peculiar disturbed behaviour, and diarrhea starts the next day.

Any abnormal behaviour is the first clue that the birds may have an enteric upset and intervention treatments should be started immediately to reduce subsequent diarrhea, dehydration, and eventual mortality. The following are some suggestions for managing birds through an episode of enteritis or diarrhea. These suggestions are particularly helpful in helping turkey poults through a case of Poult Enteritis and Mortality Syndrome (PEMS).

1. Give the birds milk replacer via the drinkers.

When the birds start "running and hollering", turn the water off for 2-3 hours to build a thirst. Then mix calf milk replacer according to the directions and dispense it into the drinkers until all the birds have had a chance to consume their fill. Then, return the birds to *ad libitum* consumption of water (optionally) supplemented with electrolytes or a rehydration solution. Repeat this treatment for three consecutive days. The milk replacer, which contains casein that can coagulate in the gut, "tightens" up the birds (controls diarrhea). The milk replacer also supplies sufficient lactose to encourage the proliferation of lactobacilli and other favorable bacteria which act to competitively exclude pathogenic organisms. Moreover, the milk provides a highly available source of phosphorus and other important nutrients for the bird. Be careful not to give the birds too much milk replacer because supplying too much lactose will cause osmotic diarrhea. Do not substitute powdered milk, as used during water vaccinations, for the calf milk replacer. Powdered milk does not contain sufficient casein and other important nutrients, so it is not as effective in controlling the diarrhea.

2. Give the birds a rehydration solution.

Birds lose a lot of electrolytes during diarrhea, particularly sodium, potassium, and chloride. If serious diarrhea persists, the birds should be given the rehydration solution to replenish these important electrolytes or at least slow their depletion rate. The World Health Organization (WHO) formulation, which contains electrolytes and glucose, is a good rehydration solution. The rehydration treatment should be done every 6 hours until the diarrhea stops. The rehydration solution formulation is shown in Table 1. If the birds are not better after consuming the recommended dosage, repeat the dosage without interruption.

TABLE 1. WHO rehydration solution formulation for the treatment of diarrhea.

WATER	128 gal	1000 L
SALT (NaCl)	3.7 lbs	3.5 kg
SODIUM BICARBONATE	2.7 lbs	2.5 kg
POTASSIUM CHLORIDE	1.6 lbs	1.5 kg
DEXTROSE	21.3 lbs	20.0 kg

3. *Supplement drinking water with a commercial electrolyte pack* if the diarrhea is not very serious. This treatment helps prevent excessive loss of electrolytes during mild diarrhea. Sometimes a mild diarrhea causes a perturbation in electrolyte balance, which in turn causes a chronic, more severe case of diarrhea. Vitamin supplementation packs containing the B-complex vitamins and vitamins A, D, and E can help the poult endure the stress of enteritis. Also make sure the amount of vitamin A does not exceed 8 times the level of vitamin D. Excess vitamin A will compete with the absorption of vitamins D and E, resulting in rickets or immune deficiency problems.

4. *Use antibiotics according to the recommended program.*

Treatment of the flock with Sarafloxacin Hydrochloride (SaraFlox®WSP, Abbott Laboratories Inc., North Chicago, IL) has been shown to be effective in stopping the mortality, but it may not prevent the growth depression associated with PEMS and similar enteric disorders. Treatment for the recommended full 5-day period is very important to prevent pathogen resistance to this medication. I recommend that the birds be given a probiotic-type product immediately after a therapeutic antibiotic treatment to stabilize the gut microflora.

5. *Use whole wheat, crimped oats, or coarse ground corn in starter feed.*

Often birds exhibit feather and litter picking during an enteric upset. I think this behaviour is the bird's attempt to "jump-start" or stabilize gut motility, which is greatly influenced by gizzard function.

Young birds can consume whole wheat, which is much more nutritious than feathers or litter, and it should do a better job of satiating the gizzard. I recommend the use of about 5% wheat or clean oats added to the feed on the farm by dumping 50 to 100 lbs. of wheat into the feed line hopper.

Some turkey companies have also found that coarsely ground or cracked corn in the starter diet, or whole corn in growing and finishing diets, is helpful to encourage feed consumption and stabilize gut motility. The birds should be observed to see if they are attracted to whole grains. If they show an interest in the whole grains, it will probably be helpful. This treatment will also help birds that show some degree of feed refusal. Free choice grit along with the whole wheat or cracked corn may also be helpful, but perhaps not necessary.

6. *Betaine supplementation* of the starter diets or drinking water may help prevent or treat some of the adverse effects of enteric disorders. Betaine is an important metabolic factor involved in the absorption and utilization of fat; it is necessary for rapidly growing tissue (especially the absorptive surface of the gut and feathers), and it is involved in osmoregulation (Garlich, 1995). All of these functions are adversely affected by enteritis. Ferket (1995) reported that betaine may help control or prevent diarrhea in poultry by modulating osmoregulation. Dietary supplementation of betaine should be done at a rate of 1 to 2 kg betaine/tonne in starter feed or in feed fed when diarrhea (flushing) occurs in older birds. Drinking water supplementation of betaine to treat diarrhea should be done at a rate of 500 mg/kg body weight over a 2- to 3-day period for maximum efficacy.

Note to Reader: List of references available upon request.