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January 12, 2001

Ms. Kathleen Downey
Organic Materials Review Institute
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Eugene, OR 97440-3758

Dear Ms. Downey,

The National Organic Standards Board (NOSB) will be meeting in March and as you know, the Board intends to address the review of Amino Acids tabled in October 1999. Willowbrook Feeds is a leading producer of certified organic poultry feed in the western United States. A related company Petaluma Poultry Processors is an industry pioneer in certified organic and natural poultry (broiler) production. This letter represents the positions of both companies.

We are seriously concerned about the upcoming NOSB vote on whether to approve or prohibit the use of dl-methionine and it's analog in poultry feeds. We expect that the NOSB will rely considerably on the findings of OMRI to make this decision. We have read and thoroughly studied these findings and have found numerous points that should be corrected or expanded for the review to be an accurate representation of the use and effects of synthetic amino acids in livestock feeds. We strongly urge OMRI to revise the existing review of Amino Acids submitted previously to the NOSB.

Attached is a summary of our major concerns with the OMRI review. In addition, we have identified specific areas for reconsideration in the existing review wherever possible by Section Title and Paragraph Title. We encourage you to give utmost consideration to the following comments and revise the review to reflect all the facts necessary for the NOSB to responsibly carry out its authority.

Thank you for your respectful review of our comments.

Sincerely,

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SUMMARY OF GENERAL CONCERNS

1. Inappropriate or outdated research:

a) Studies refer to ruminant production or human nutrition, neither of which are relevant to the issues faced in poultry production

b) Key studies are outdated and do not take into consideration more recent research

c) Current poultry specific research (attached) supports the inclusion of dl-Methionine in organic poultry feeds

2. Fundamental misunderstandings about the issues:

a) The effects of amino acid imbalance on the utilization of amino acids (and the resulting impacts on the environment and animal health)

b) Incorrect assumption that the CODEX language addresses amino acids

c) Research studies cited used feeding methods such as force feeding, once-a-day feeding, and caged birds that are not standard practices in organic poultry production

3. Alternatives proposed are not available or feasible:

a) Pasture based systems are not practical for younger birds (under 28 days of age)

b) Alternative feed ingredients are either not available or prohibitively expensive.

Amino Acids

Livestock

Status

OFPA

Amino acids do not appear on the list of synthetics that may be allowed (7 USC 6517(b)(1)(C)(i). The NOSB may want to discuss whether or not the administration of synthetic amino acids in the absence of any symptoms of illness would be considered a growth or production promoter and therefore categorically prohibited in livestock production for such purposes (7 USC 6509(c)(3)).

Comment: The suggestion that an amino acid would be considered a growth promoter is presumptive and inaccurate. A growth promoter would change the normal metabolic pathways and cause an animal to grow at an abnormal rate. Amino acids correct deficiencies in the animal's diet and allow it grow at it's genetic potential.

Historic Use

Crystalline amino acids were generally not used as feed supplements in organic livestock production until very recently. Most current use in organic production appears to be as a supplement for laying hen feed rations.

Comment: Organic certification inspection records document that organic poultry feeds have historically included synthetic amino acids.

International

The Codex guidelines do not address livestock materials at this point (Joint FAO/WHO Standards Programme. 1999).

Comment: Since the preparation of this document, the CODEX draft guidelines of Appendix II (ANINORM 01/22), Item 18, regarding substances used as feedstuffs, makes reference to not allowing synthetic nitrogen compounds. OMRI has interpreted this to indicate prohibition of amino acids, further referenced in OMRI Draft Livestock Policy Changes, September 18, 2000, Section II, Livestock Nutrition, B. Amino Acids, which presumes "amino acids are prohibited under the Codex guidelines". There are numerous essential vitamins containing nitrogen currently allowed under organic certification, which would be prohibited if this line of reasoning were followed. Again, the point should be underscored that the CODEX draft guidelines speak to synthetic nitrogen compounds only, such as urea, not to synthetic amino acids.

OFPA 2119(m) Criteria

1. The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems.

2. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment.

While it is nutritionally essential, methionine excesses are far more toxic to poultry than similar excesses of tryptophan, lysine, and threonine (National Research Council, 1994). Force-feeding methionine to excess can result in death to chicks (National Research Council, 1994).

Comment: Force-feeding is not a common practice. In the study, the amino acids were from purified sources and not from a mixture of purified amino acids and intact proteins normally encountered in practical rations. This study is based on a force-feeding rate of three to four time's normal usage of dl-methionine, which should be mentioned to justify any reference to toxicity.

This is an abnormal situation not likely to occur in field conditions. Not only would producers be reluctant to implement any practice that would lead to high field mortality, feeding methionine in excessive amounts is cost prohibitive for the farmer (methionine costs $1.50/pound versus $0.10 per pound for typical organic broiler ration).

4. The effect of the substance on human health.

Methionine is essential in small amounts in the human diet, and is sold over-the-counter as a dietary supplement. The L- form of methionine is used extensively in human medicine for a variety of therapeutic purposes including pH and electrolyte balancing, parenteral nutrition, pharmaceutical adjuvant, and other applications. It is in fact one of the top 800 drugs in human medicine (Mosby, 1997). Methionine may cause nausea, vomiting, dizziness, and irritability and should be used with caution in patients with severe liver disease (Reynolds, 1996).

The D- form of methionine is not well utilized by humans (Lewis and Baker, 1995). Individuals may have allergic reactions to the D- isomers or a racemic mixture of DL-methionine. While a number of amino acids are considered GRAS for human consumption and as feed supplements, DL-methionine is not (see 21 CFR 172, 21 CFR 184, and 21 CFR 570.35). DL-methionine is unique among amino acids cleared for food use in that it is the only one listed that explicitly says it is not for use in infant feed formulas (21 CFR 173.320). When heated to decomposition, methionine emits dangerous and highly toxic fumes (NIEHS, 1999).

Comment: The research above reflects direct consumption of methionine in the human diet. However, a racemic mixture of DL-methionine is well utilized by animals. In fact, no residual DL-methionine is found in broiler meat and therefore, no human health risks are posed by using synthetic amino acids in organic poultry feed.

In reference to the research concerning methionine heating, methionine decomposes at 280 degrees F. It is unlikely that feed for animals would ever be heated to temperatures exceeding 200 degrees F. encountered in pelleting feed.

5. The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.

Although methionine is nutritionally essential for all mammals, it can be significantly toxic according to rat studies (Regina, 1992). In pigs, excess methionine can actually suppress weight gain (Baker, 1989). The rate of methionine depletion from tissue pools is high, therefore the potential for methionine wastage is high if supplementation of intact protein diets with pure sources in a once-a-day feeding regimen is employed. On the other hand, pure sources of amino acids are more bioavailable than intact-protein sources (Baker, 1989).

Comment: "Once-a-day" is not the normal practice of feeding animals. Most feeding is ad-libitum with the animal eating throughout the entire day.

Amino acid requirements may be affected by environmental temperature extremes, basically because of the effect on feed intake, but amino acid supplementation will only affect weight gain if it improves feed intake. Methionine may range from first to third-limiting amino acid depending on the species, stage of production, and type of diet being supplemented (Baker, 1989).

Comment: There are more recent papers that explore the effect of amino acids on growth rates, body composition and feed consumption. Baker, (1989) is a paper that was published 11 years ago and there are more recent studies that define amino acid requirements with greater clarity. Other papers or references include Jeroch, (1995), Deschapper, (1995), Mack, (1999), Waibel, (2000) and Degussa Feedback Special (1995)(1996), HAN (1992).

For ruminants, the factors affecting the benefit of amino acid supplementation become even more complex due to the fact that 70% of bovine protein synthesis is a result of microbial conversion. Moreover, unprotected forms of methionine, such as DL-methionine, will be degraded in the rumen although it may still have a positive effect on enhancing microbial synthesis. Nonetheless, research continues on ways to protect DL-methionine such as with coatings of synthetic plastics or zinc methioninate complexes. Whenever certain factors change--species, age, environmental conditions, level of performance, energy content of the feed, vitamin dosing--the amino acid requirements of the animal change as well (Degussa, no date).

Comment: The review should be referring to papers that examine performance under conditions encountered in normal growout conditions of temperature and housing specific to poultry production. There is a body of research that has enabled the nutritionist to change rations to properly balance the amino acid requirements of any species at any age or climatic condition.

> Intensive animal production leads to the inefficient utilization of nitrogen in feed and hence its waste in animal excreta. Supplementation with amino acids, especially synthetic ones, which are absorbed more rapidly, may counteract this loss. However, amino acid losses from the rumen in dairy cattle may indicate that this benefit is more likely to be seen in pigs and poultry (Tamminga and Verstegen, 1992). Nonetheless, livestock management modifications such as more efficient use of animal excreta, i.e. manure, or less intensive animal production could also counteract this problem.

Comment: The reduction in nitrogen excretion occurs when the amino acids are balanced in proper proportions to each other and there aren't excesses of any amino acids, which must be transaminated (converted to energy) with the excess nitrogen excreted. In the article by Mijs (1999), it was the conclusion of Dutch researchers that nitrogen pollution from properly designed intensive animal production units was lower than that from free range or deep litter operations.

The subject of the second sentence is prejudicially placed after the negative posture of the first. We would suggest the statement that "supplementation with amino acids, especially synthetic ones, which are absorbed more rapidly, may counteract the potential inefficiency of utilization of nitrogen in feed and hence its waste in animal excreta."

> Managing the nitrogen cycle is seen as a challenge to livestock producers (Tamminga and Verstegen, 1992; Tamminga, 1992; Morse, no date). Poultry layer operations are experiencing increased costs and regulations for manure management (Sloan, et al., 1995). Supplementation with amino acids may allow dietary protein and excretory nitrogen levels to be reduced with a minimum reduction in egg output (Summers, 1993; Sloan et al., 1995). Amino acid supplementation is not the only means identified to reduce nitrogen pollution from animal manure. Other potential solutions include lower animal densities; more frequent rotations; better manure storage, handling, and application techniques; use of enzymes; improved processing of the feed; and selection of more appropriate land and locations to graze and shelter animals (Archer and Nicholson, 1992; Tamminga, 1992; Tamminga and Verstegen, 1992; Bedford, 1995).

Comment: A review of the literature from BASF (1994) indicates that formulation of the feed to match the nutrient requirements and the use of amino acids are some of the most efficient means of reducing nitrogen excretion. That combined with better manure handling can result in conservation of nitrogen.

Poultry should be confined for at least the first 4 weeks of life to ensure proper growth and minimal stress. A broiler will consume approximately 30% of the feed

used to produce a 5-pound bird under conditions that are not as conducive to conserving nitrogen as some of other methods mentioned. It is important that the most efficient use of nitrogen occur during this period. (If rations are not formulated to the ideal protein model nitrogen loss will be maximized.) The nitrogen is excreted as uric acid on the surface of the feces and begins to decompose rapidly because of bacterial action and the unstable nature of uric acid.

It is possible to reduce ammonia emissions by as much as 31% by using synthetic amino acids to reduce crude protein content of the ration. (Ferguson, 1998). Reduction of ammonia emissions reduces power costs incurred to provide ventilation over and above the normal amount needed. If the ammonia is not removed, health threatening, hazardous conditions exist for poultry and workers.

Of the "potential solutions" noted, the selection of more appropriate locations may be problematic. Economics, land use restrictions, access to markets and climate must be considered. The review must not recommend solutions that impact the ability of regulations to be flexible to operations in diverse geographies, climates and under local restrictions on land use.

6. The alternatives to using the substance in terms of practices or other available materials.

The production factors cited as reasons to supplement limiting amino acids may be addressed by changes in animal and land management practices, novel feed sources, and better feed handling. Methionine is also found in naturally occurring proteins. Alternatives include improved pasture management, a balanced supplemental ration composed of organic grains, legumes, and oilseed meals. Feed sources with high percentages of methionine are bloodmeal, fishmeal, corn gluten meal and sunflower seed meal. In ruminants, sources of mineral sulfur such as gypsum and Epsom salts can be converted to methionine (National Research Council, 1989). Natural sources of essential amino acids and appropriate feed regimens exist to assure adequately balanced rations. DL-methionine is one of the few amino acids not able to be produced economically by fermentation (Areki and Ozeki, 1991). It seems unlikely that a non-synthetic, non-GMO source of isolated L-methionine will be commercially available at a cost competitive with organic feed.

Comment: There are problems with either supply or suitability with some of the alternative ingredients suggested above:

- *Blood meal, an animal protein, is prohibited in organic production.*
- *Corn gluten meal may be available in limited quantities if the sole US processor receives organic certification, however it is deficient in lysine. If used at high levels, corn gluten meal can cause an antagonism between the amino acids leucine and iso-leucine (National Research Council, 1994).*
- *Organic casein is not available and may not be for some time because of economics.*

- ***Most of the fishmeal produced is preserved with ethoxyquin, which is an unlikely candidate for the National List. There is an effort is made by a producer in the Southeast US to produce fishmeal with natural antioxidants. One of the principal antioxidants, alpha-tocopherol, is made from soybean oil from GMO soybeans. Fishmeal that is not properly preserved will continue to decompose because of oxidation of the oil. As the oil is oxidized, moisture is produced and putrefaction takes place. The temperature increase accompanying the oxidation also can cause the amino acids to become unavailable. Fishmeal can also cause a "fishy" flavor in poultry meat when used at levels needed to supply sufficient methionine to properly balance the amino acids in poultry feeds.***
- ***Sunflower meal (Salah, 1999) and sesame meal (Reddy, 1999) are discussed and compared with soybean meal and may have a role. Supplies are limited because the meals are a byproduct and there are very small amounts of organic sunflower and sesame oil produced.***

> It appears to the investigator, and to two of the three reviewers that all essential amino acids are available in organically grown feed in quantities sufficient to ensure a balanced diet. This is true of methionine as much as any other amino acid. Methionine is seldom considered limiting in ruminants given the ability of the rumen to metabolize other forms of sulfur into methionine and other sulfur amino acids (National Research Council, 1989; van Soest, 1982).

Comment: When formulating diets with the ingredients that are available at the present time (i.e. organic corn, organic soybean meal) amino acid excesses occur due to the methionine deficit in soybean meal. Increasing the crude protein of the diet to satisfy the methionine requirement of the bird usually results in poorer use of the existing methionine in the diet (Pack, 1995).

> While certain amino acids may be able to enhance production, it remains to be proven that basic animal nutritional needs are not met by organic sources or that health-threatening amino acid deficiencies will result from the withholding of synthetic amino acids.

Comment: No proof that nutritional needs of animals can be met with the existing ingredients available now or in the future was presented. There are health-threatening effects from amino acid deficiencies. The most prominent effect is the ammonia emissions that occur when excess protein is fed. At levels greater than 20 PPM, these emissions can cause eye damage and lung damage to both animals and caretakers. Cook, (1991) reported that methionine deficiency depresses immune response. Klasing, (1988) concluded that amino acid deficient chicks had an impaired immune response. Kleeman et al, (1985) discusses the effects of amino acid imbalance and the resulting physiological changes. Methionine deficiency causes poor feathering. (Elliot, no date).

> The National Academy of Sciences reports that "the greatest disagreement concerning amino acid requirements for broilers centers on the sulfur amino acids, methionine and cystine" (National Research Council, 1994). Some poultry nutrition researchers consider the claim that methionine is the first limiting amino acid to be unsubstantiated and in need of further investigation (Fisher, 1994). Even chicks that

are marginally deficient in methionine will show little difference in weight gain from those fed on an adequate diet (Buttery and Boorman, 1976). Cystine and cysteine compliment methionine in that a certain amount of methionine will be converted into those other sulfur amino acids if necessary. In many cases, methionine requirements are overestimated because assays do not accurately reflect the amounts of cystine and cysteine precursors in practical diets (Baker, 1989).

Other cases have shown significantly higher weights and faster gains from amino acid (lys+met) supplementation (Slominski et al, 1999).

Comment: There is a considerable body of research since 1994, which has defined the amino acid requirements for poultry and the relationship of cysteine and methionine. As noted previously, more current papers or references include Jeroch, (1995), Deschapper, (1995), Mack, (1999), Waibel, (2000) and Degussa Feedback Special (1995)(1996), HAN (1992). Finally, the last reference to the work by Slominski et al (1999) supports our position that synthetic amino acids are integral to poultry production on a commercially viable scale.

Also, the digestibility of practical ingredients, such as corn and soybeans, appears to be on the order of 85% or more (National Research Council, 1994). Rice and casein offer potential novel available sources of methionine (Lewis and Bayley, 1995). Yeast protein has long been known as a rich protein source relatively high in methionine+cystine (Erbersdobler, 1973; National Research Council, 1994), as well as phosphorous and B-complex vitamins (Morrison, 1951). Other potential sources of available methionine for poultry appear to be sunflower meal and canola meal (Waibel et al., 1998).

Comment: The rations in the Waibel study were balanced to a constant amino acid level in all diets with synthetic amino acids. The various protein sources were feasible because the synthetic amino acids were used. When the protein levels of the rations were increased to satisfy the amino acid requirement, the resulting imbalance depressed performance. There is an effect on performance when protein levels are increased and amino acid imbalances occur. Pack (1995) concluded that increased protein levels in broiler diets as a result of attempting to supply sufficient essential amino acids by increasing crude protein levels results in depressed amino acid utilization. Supplementation with dl-methionine improves utilization of the other amino acids.
In addition, yeast protein is referred to as a possible feed source. However, organic yeast is either not available or prohibitively expensive. The same is true for the other alternative feed sources mentioned (sunflower meal and canola meal), as discussed previously in our comments.

Optimally balancing these nutrients may be challenging to feed processors and livestock producers.

Comment: The lack of alternative ingredients which could be used to formulate better balanced rations and the inability to use synthetic amino acids will result in higher production costs, release of excess nitrogen to the atmosphere, poor bird health due to impaired immune systems, and discomfort because of poor feathering. It is difficult to estimate the exact cost of the unbalanced rations due to a lack of

data. We can estimate that replacing the synthetic methionine with intact amino acids will increase the cost of producing organic broiler meat by at least 10% and the cost of producing organic eggs by 15%. Diets formulated with the alternative ingredients, casein, sunflower meal, corn gluten meal, etc. do not have the amino acid content of the ideal protein diet, which results in optimal growth and minimal nitrogen excretion.

The NOSB may also want to discuss and consider the role of animal protein in the diets of poultry. Hens on good pasture have no need for protein supplements of animal origin (Morrison, 1951). Pasture quality will vary according to field conditions and the season. However, free-range poultry on well-managed pasture are able to supplement their diets with insects, annelids, and fresh green forage (Smith and Daniel, 1982). Temporarily confined poultry can be fed practical organic corn / soybean ration.

Comment: This statement assumes that organic poultry will be raised on pasture, which is an incorrect general assumption. Poultry producers in various regions must comply with environmental protections and weather conditions that limit the amount of time that the birds have access to pasture. Good pasture does not exist in all areas and may not be available due to economic constraints.

Also note the reference is made to twenty-year old and fifty-year old research which implies the use of older breeds which are not available in sufficient quantities for commercial production. Any reference should be appropriate to breeds in current production.

The first twenty-eight days of the bird's life should be spent in confinement because of climatic conditions. Prior to the twenty-eighth day, the feather cover is not sufficient to keep the bird warm and comfortable. During the winter in most areas pasture is not feasible and during confinement birds should be fed diets that minimize nitrogen excretion. Minimizing nitrogen excretion reduces ammonia production and excessive levels of ammonia are harmful to birds.

Depending on how other parts of the standards evolve and market conditions, novel organic products can be developed as supplements. Among the potential alternative sources include organic dairy products such as casein, organic meat by-products, and--assuming organic fish standards--organic fish meal (National Research Council, 1982 and 1994).

Macroorganisms commonly found in healthy pasture soils cannot be discounted as a source of nutrient cycling in free-range poultry systems. Given the natural feeding habits of poultry and other birds, the use of earthworms is a logical source of protein in chicken feed (Fisher, 1988). Earthworm populations of pasture depends on a number of factors (Curry, 1998). The amino acid content of earthworms will vary depending on species and food source. However, earthworms have been found to accumulate and concentrate methionine found in the ecosystem in proportions greater than for other amino acids (Pokarzhevskii, et al., 1997). As a feed

supplement, earthworms have been found to equal or surpass fish meal and meat meal as an animal protein source for poultry (Harwood and Sabine, 1978; Taboga, 1980; Mekada ET al., 1979; and Jin-you ET al., 1982 all cited in Edwards, 1998).

Comment: Again, many of the alternative feed ingredients discussed have already been addressed by our comments concerning lack of availability, excessive cost or regulatory prohibition.

The new material referred to in these studies was earthworm meal and is different than fresh earthworms. The high moisture content of fresh earthworms may cause the birds to consume less than adequate amounts of nutrients, as there are limits on the amount of feedstuffs a bird can consume.

Earthworm meal could be considered if it were not for the prohibitive cost of drying the quantities of worms necessary to produce an adequate source for methionine supplementation.

Earthworms can play a role in moderating nitrogen losses as well (Blair, ET al., 1997). Enzyme treatment of feedstuffs can improve amino acid availability and also reduce nitrogen pollution (Tamminga and Verstegen, 1992), as can changes in stocking density, rotations, and manure handling.

Comment: Enzymes may improve amino acid availability with certain grains and feedstuffs. Peter et al, (2000) found that phytase did not increase the utilization of amino acids in corn gluten meal. While there are enzymes that will improve the utilization of amino acids in wheat and barley, wheat and barley are not used in broiler diets in the United States. A study by BASF (KC9404) indicates that inclusion of synthetic amino acids and resultant reduction in crude protein is one of the most effective ways to reduce nitrogen in manure.

The therapeutic uses of different amino acids also have a number of alternatives. Given that most of the treatments are to treat nutritional disorders, alternative programs of prevention and treatment will often be based on better diet. Uroliths appear to be more common in carnivorous companion animals such as dogs and cats than in herbivorous / more omnivorous farm animals. They tend to be related to acid-base balance in the rations and excessive calcium and / or magnesium relative to other cations in the diet. Ammonium chloride is another synthetic substance commonly used to acidify urine, but sodium chloride (common salt) may be used to treat urinary tract calculi in sheep (Aiello, 1998). Hepatic lipidosis is a condition of excessive fat in the liver commonly associated with caged birds and is related to the fact that wild diets are much lower in fat than seed diets fed to captive species (Aiello, 1998). A diet that has less fat and living conditions that allow birds to exercise more appears to be a practical, viable alternative.

Comment: Hepatic lipidosis is not normally encountered in poultry that are fed well-balanced rations where sufficient amounts of amino acids and adequate levels of other nutrients are provided. The study also refers to deleterious impacts on caged birds, which is not an allowed practice under organic farming standards.

7. Its compatibility with a system of sustainable agriculture.

The feeding of isolated amino acids produced by the use of non-renewable fossil fuels and toxic chemicals is not compatible with a system of sustainable agriculture.

Comment: Fossil fuels are used to produce grains as well. The reduction in the amount of feed required to produce a unit of animal protein when amino acids are included in feed rations, may offset the amount of fossil fuel used to produce the excess feed required when unbalanced rations are used.

Synthetic amino acids increase animal production by lowering feeding costs, overcoming nutritional and stress related diseases associated with confinement, and reducing manure output.

Comment: Poultry grown in well managed, properly ventilated houses are under less stress than birds exposed to temperature and weather extremes. With the use of good ventilation systems, conditions are provided that enhance the comfort zone for the animal. Heat and humidity extremes cause reductions in feed consumption and can affect their health. Pasture conditions cannot be controlled.

While this is not by itself unsustainable, amino acids thus facilitate high-input concentrated confinement animal production seen as antithetical to sustainable agriculture. Most importantly synthetic amino acids discourage the integration of a whole-systems approach to cycling nutrients, particularly nitrogen, as part of an integrated crop-livestock production system.

Comment: It is the reviewer's assumption that the use of amino acids facilitate high-input concentrated animal confinement and that confinement equates to the scale of the operation. The approval of amino acids must not imply that organic poultry production be regulated by scale. Confinement can be sustainable if managed in a sustainable manner. It does not necessarily include lack of exercise, fresh air and sunlight. It does not necessarily involve the use of prophylactic veterinary medicine or regular use of antibiotics and it does not necessarily exclude an integrated crop-livestock production system or whole system nutrient cycling.

Increased efficiency of protein conversion reduces the amount of nitrogen excreted (Summers, 1993; deLange, 1993). The cycling of nutrients from animals is part of an integrated farming system, and the environmental effects of manure management require looking at the big picture (Archer and Nicholson, 1992). What is viewed as a liability in confinement animal systems--nitrogen production--is seen in cropping systems as a limiting factor resource. Reduction of nitrogen pollution may require improved range or pasture management, and with that either more frequent rotations or lower stocking rates.

Comment: As in other animal and crop production standards, sustainability must include economic viability. To assume that nitrogen reduction may require

additional land for fewer animals, also assumes higher cost to maintain equal revenue or face the alternative of lower production yields, loss of markets, decrease of purchases of feed from other organic producers who rely on the organic poultry industry for revenue and eventual loss of market share.