THE TOTAL ASPECTS OF POULTRY LITTER AND COW WASTES AS FEED INGREDIENTS

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Approximately 2 billion tons of farm animal wastes are produced each year in the United States. Since a large portion of the wastes are from animals which are managed under intensive systems, these must be disposed of. In the past, animal wastes have been used mainly as fertilizer, but economic studies indicate that the plant nutrient content of these wastes, in many cases, is not sufficient to justify the cost of handling. Wastes from different species of animals appear to have nutritional value for certain phases of animal production. Possibly, a more economically feasible approach to disposal of the wastes would be recycling by feeding, at least a portion of the wastes.

Nutritional Value of Poultry Wastes

Poultry wastes are usually high in nitrogen (crude protein content). The crude protein content of broiler litter and cage layer manure has averaged 28% or higher. It is apparent that poultry wastes vary considerably in crude protein content, which would preclude the use of standard values. However, lots of wastes could be analyzed as is commonly done for forages, which may also vary considerably. It appears that 40% or more of the total nitrogen in broiler litter and layer manure is in the form of protein. The remainder is in the form of non-protein nitrogen, the main constituent of which would be uric acid. Other non-protein nitrogen fractions are ammonia, urea and creatine. Cattle are able to utilize all of these non-protein nitrogen sources quite efficiently.

Researchers from Virginia, Pennsylvania, Michigan State, Florida and USDA have found that nitrogen in poultry wastes is utilized quite efficiently. In addition, poultry wastes may be important sources of energy for ruminants. For example, in studies at Virginia Tech it was found that the digestibility of energy for broiler litter, calculated by difference, was 64% in sheep. On the average the litter contained 1108 kcal. of digestible energy per pound and 59.8% TDN, on a dry basis. These values compare quite favorably with those for roughage such as alfalfa hay. The ash content of poultry wastes is fairly high. In a sampling of broiler litter from different parts of Virginia the ash content was 31%. Laying house litter has been shown to contain 8-34% ash, dry basis. The high ash content would result in a lowering of the energy value of poultry wastes. However, some components of the ash would be quite valuable. Poultry wastes are good sources of calcium and phosphorus.

The digestibility of dry matter and organic matter of poultry wastes has been shown to be substantial. In early studies at Virginia Tech we
found that the digestibility of broiler litter dry matter, calculated by difference, was about 60%. Florida researchers reported that 81% of the organic matter in citrus pulp litter was digested. Workers from Maine reported that the apparent digestibility of energy in laying house poultry litter was 59%. Digestibility of dry matter of caged broiler manure was reported to be 54%. The digestibility of dry matter of caged layer manure has varied from 39 to 57%. Digestibility of organic matter in caged broiler and layer manure has been 61 to 67%.

We have ensiled broiler litter with corn forage, which resulted in sharp increases in crude protein content of the silage. The materials ensiled very well when 15 to 30% of litter, on a dry basis, was mixed with corn forage prior to ensiling. Including litter in silage resulted in increased dry matter intake and nitrogen retention in sheep and had no marked effect on the apparent digestibility of dry matter.

Researchers at the University of Arkansas were the first to report concerning the effects of feeding poultry litter to ruminants. They found that the performance of gestating-lactating ewes fed a ration containing ground chicken litter was similar to that of ewes fed a ration containing soybean meal. They also reported that when energy intake was equalized, rate of gain of fattening steers was similar to that of cattle fed cottonseed meal. Researchers from Georgia found that the rate of gain of steers fed a fattening ration containing 30% corn cob broiler litter was similar to that of control steers.

In the early 1960's, in experiments in Virginia, we observed similar rate of gain for steers fed a fattening mixture containing 25% peanut hull or wood shaving broiler litter as for steers fed a control mixture; all cattle were fed 2.2 lb. of long hay, in addition. Feed efficiency was highest for the cattle fed the peanut hull litter and lowest for those fed the control ration. In later research we found that feeding broiler litter with four base materials - peanut hulls, corn cobs, grass hay and soybean hulls, resulted in similar performance in fattening cattle. Performance was higher in steers when mixtures contained 25% litter, compared to 40%.

In periods of drought in Australia wood shaving broiler litter has been used, in addition to wheat. In Arkansas beef cows and calves were successfully wintered on tall fescue pastures supplemented with a mixture of 20% corn grain and 80% oat straw broiler litter, with no harmful effects.

Performance and carcass quality of cattle fed rations supplemented with autoclaved or dried caged layer manure were similar to those of cattle fed soybean meal. Cornell University researchers reported that feeding 5 to 9 lb. of air dried caged layer manure had no adverse effect on milk production. At Michigan State, including 10% dehydrated poultry wastes in the grain mixture of dairy cows did not affect milk production.

Dried poultry wastes have been found to be low in protein and energy value for layers, although feeding at levels up to 25% of the diet
did not affect egg production. It appears that only a portion of the waste from layers could be recycled and the remainder would have to be handled by some other waste management system.

**Nutritional Value of Cattle Wastes**

Feeding cattle manure to laying hens had no significant effect on egg production or fertility of the eggs. In early research by Anthony of Auburn University it was found that feeding of a ration consisting of 60 parts of basal feed and 40 parts of washed cow manure resulted in average daily gains of over 3 lb. per day in steers. These same researchers fed fresh manure in rations containing concentrate alone or in combination with silage. They found that including of the manure resulted in sharp depressions in the dry matter digestibility and daily gain by cattle fed this mixture. The cattle consumed the manure containing rations readily with no visible harmful effects. Anthony found that fresh feedlot manure was a valuable ration component when it was either autoclaved or washed. This researcher explored the feasibility of mixing cattle manure with hay and ensiling the mixture to produce a product termed wastelage. Proportions of 57 parts manure and 43 parts of ground hay were used. Feeding a ration formulated to contain 40% wastelage and corn to steers produced rate of gain and feed efficiency as high or higher than steers fed conventionally formulated high-concentrate rations. Anthony also reported that wastelage would produce satisfactory performance in breeding ewes and beef cows, when supplemented with Vitamin A. Colorado researchers have reported promising results from feeding a washed, fermented solid fraction prepared from feedlot manure.

It appears that digestibility of cattle manure by ruminants is considerably lower than for poultry wastes. Researchers from U.S.D.A. and Michigan State have reported dry matter digestibility of 22 to 29% for dairy cattle manure. In recent work at Virginia Tech, it was found that including 40% dairy cattle manure in barley or corn silage at ensiling time resulted in marked depressions in dry matter digestibility of the silage. We have recently completed studies in which fecal waste from steers fed a ration containing 50% roughage was included in the ration at the level of 20%. It was found that the fecal waste had a dry matter digestibility of only approximately 16%. On the other hand researchers from Oklahoma have reported dry matter digestibilities of feedlot wastes in sheep to be between 42 and 56%.

The daily cattle wastes and the wastes which we have been working with were from cattle fed considerably higher roughage levels, presumably, than the feedlot wastes fed by the Oklahoma workers. Thus, it appears that with cattle fed fairly high roughage levels the digestibility would not be very high. One of the characteristics of the fecal wastes from cattle fed high roughage levels is a high cell wall and lignin content which would result in rather low digestibility values. Perhaps treatment of the wastes with materials such as sodium hydroxide, calcium hypochlorite and sodium chlorite would improve the utilization of the waste. In fact, U.S.D.A. researchers have found that dry matter
digestibility was improved considerably by treating dairy cattle wastes with these chemicals.

The Effect of Feeding Wastes on Quality of Product

Feeding of animal wastes have not been shown to impart undesirable flavors to the meat, milk or the eggs. In Virginia we have tested the effect of feeding different levels of poultry litter on the taste of the meat. In no case did we find that the litter had any adverse effect on taste of the product. Similar results were found by researchers at Penn State from feeding caged layer manure. Researchers at Cornell and Michigan State likewise found that feeding of poultry wastes to dairy cows did not have any harmful effects on the taste of the milk. Michigan State workers found that the taste of eggs was not affected by the feeding of processed caged layer manure to layers.

Effect of Feeding Animal Wastes on Animal Health

The feeding of wastes is not sanctioned by the Food and Drug Administration due to potential hazards from possible disease organisms and drug residues in wastes. There have been no disease problems reported from including poultry and cattle wastes in practical rations for cattle and sheep. Copper toxicity was observed in Virginia experiments in ewes fed poultry litter containing high levels of copper. The high copper levels resulted from feeding high levels of copper sulfate to the chicks. The copper problem would not likely be severe in cattle as they are not as sensitive as sheep to dietary copper. In fact, we have fed cows rations containing 80% broiler litter containing 200 parts per million of copper alone and in combination with supplementary copper equal to the amount supplied by the litter without any harmful effects. A higher incidence of abortion was reported in Pennsylvania in cows fed a ration containing poultry litter and grazed on pastures fertilized with litter. The litter was found to contain estrogenic activity and the authors suggested the abortions were due to a hormone imbalance. However, it should be emphasized that it was not proven that the feeding of litter or the use of litter as a fertilizer were responsible for the abortions.

Processing of Wastes

One of the reasons the use of wastes is not sanctioned as feedstuff is the potential hazards from disease organisms. Of course, the wastes may contain different classes of bacteria, molds and yeasts. It has been found that the pathogens found in the poultry litter are destroyed by heat treatment.

We have found that poultry litter can be pasteurized to meet the same standards as pasteurized milk by heating at 300°F for 20 minutes at a thickness of 1/4 in. We have found that the combination of chemical and heat treatment may be quite effective in pasteurizing litter. Heat processing of litter was shown to result in marked reductions in crude protein content but acidifying the litter with sulfuric acid prior to heating resulted in a reduction of nitrogen loss.
Possibly, ensiling or stacking the material would produce sufficient heat by thermophilic bacteria for pasteurization. In fact, we have found that ensiling of broiler litter with a minimum of 30% moisture would result in destruction of the coliform organisms. It appears that there is not a serious hazard from disease organisms from feeding of animal wastes since the wastes can be rendered free of pathogens by appropriate processing.

**Drug Residues**

Another deterrent to the use of animal wastes as feedstuffs is the potential hazards from drug residues. This would be an especially serious problem in feeding of poultry litter. Pennsylvania and Virginia researchers found that there were no substantial levels of pesticide residues in edible tissues of cattle which had been fed wastes from cage layers or broiler litter.

Workers from Virginia, Maine and FDA reported that broiler litter may contain certain levels of medicinal drugs which were included in poultry diets. Workers from Maine reported no detectable levels of amprolium and arsenic in tissues of lambs fed litter containing these. In Virginia we have not found any substantial levels of amprolium, nicarbazin or chlorotetracycline in muscle, kidney fat and liver from steers which have been fed up to 50% broiler litter for 121 or 198 days, with a 5-day withdrawal. Arsenic has been consistently increased in the liver by feeding broiler litter but the levels were below the normally accepted safe levels.

**Summary and Conclusions**

It appears that animal wastes have substantial nutritional value. Some wastes seem to be of higher nutritional value for cattle than others. Wastes such as poultry litter and caged layer manure are especially high in crude protein and the nitrogen is efficiently utilized by the cattle. The energy of the poultry wastes also appears to be quite efficiently utilized. It appears that the nutritional value of cattle wastes is lower than that of poultry wastes, when fed to cattle. However, the value of the cattle wastes would probably depend on the roughage level in the ration.

The wastes can be rendered free of pathogenic organisms with heat treatment, a combination of chemical and heat treatments or perhaps by stacking or ensiling.

Palatable rations can be formulated including animal wastes, provided the levels are not excessive. Also, modification of the rations to include more palatable ingredients may improve the palatability of the ration. The feeding of animal wastes does not adversely affect the taste of the meat, milk or eggs.

The only harmful effect from recycling of animal wastes by feeding which was documented was copper toxicity in sheep fed high levels of copper. This would not appear to be a serious problem in cattle since they are not as sensitive to copper.
It appears that there is not a serious problem with pesticide residues in waste or in meat from animals fed the waste. Although there is no data available it is not likely that this would be a serious problem from contamination of the milk either. The medicinal drug residue problem in animals fed poultry waste does not appear to be serious for meat production but more conclusive information is needed on this aspect. Prior to using of poultry wastes in dairy cows, research is needed to study the effect of feeding the waste containing the medicinal drugs on possible secretion of these drugs in the milk.

Utilization of wastes is a more practical approach than simply disposal. Use of animal wastes as feedstuffs would reduce the total amount of solid waste pollution. It appears that there is sufficient information so that some wastes can be recycled at this time without presenting a hazard to animal or human health. However, this practice is not sanctioned by the Food and Drug Administration at present.