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Feeding Broiler Litter to Beef Cattle

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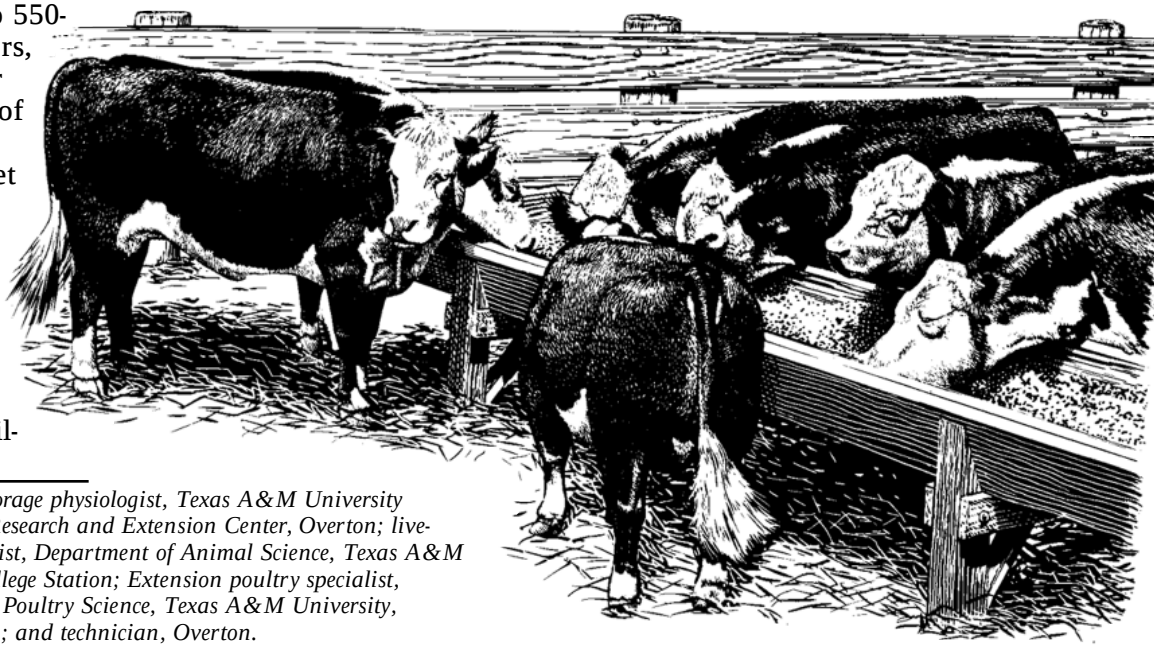
Broiler production in Texas has expanded at an annual rate of 7 percent since 1986 with 371 million broilers produced in 1994. Broiler litter (mixture of poultry excreta, bedding material, wasted feed and feathers) is usually removed from the poultry houses on an annual basis. Because of its high nutrient content, poultry litter is usually applied to agricultural land as fertilizer with an economic value of $20 to $30/ton. Broiler litter has a higher value as a feed for beef cattle. Cattle are ruminants and can digest material high in cellulose, hemicellulose and fiber. Byproducts of many grain and food processing industries (i.e. citrus pulp, sugar beet pulp, brewers grain, corn gluten, fish meal, cotton hulls, and rice bran) are fed to cattle. In the 1960s researchers in Virginia brought attention to the economics of feeding broiler litter to beef cattle. Feed quality litter is high in protein and minerals but low in energy relative to grain or high quality forage. If used as a protein and mineral supplement in a feed ration, feed quality broiler litter has a value of about $100/ton; soybean and cottonseed meal are valued at $200/ton. When fed at a 1:1 ratio with corn to 550-pound heifers, broiler litter has a value of $106/ton (McCaskey et al., 1994). Following is a discussion of the advantages and disadvantages of feeding broiler litter to beef cattle utilizing information from other states and two surveys on broiler litter feeding in the eastern half of Texas.

Feed Quality Broiler Litter

Not all broiler litter is suitable for livestock feed. It is estimated that only about 35 percent of the broiler litter produced in Alabama is of sufficient quality to be fed to cattle (Ruffin and McCaskey, 1993). The composition of broiler litter is quite variable due to the amount of soil contamination, type of litter, number of batches of birds reared on the litter, and poultry house management (McCaskey, 1995). The nutrient and mineral variability of broiler litter fed in Texas during the 1993-94 winter is reported in Table 1 along with the recommended range and maximum levels for beef cattle diets.

Feed quality litter should be at least 19 percent crude protein (3 percent N), less than 28 percent ash and 25 percent moisture, and free of rocks and hardware such as nails and wire. Average protein percentage was 21.5 with a



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range from 13.2 to 38.9 percent (Table 1). Obviously some of the broiler litter being fed did not meet the minimum protein percentage of about 19 percent for feed quality litter. About 40 percent of the crude protein in broiler litter may be in the form of non-protein nitrogen which is primarily uric acid (Ruffin and McCaskey, 1993). Therefore, beef calves should weigh at least 450 pounds to be able to take advantage of non-protein nitrogen. If the broiler litter contains more than 25 percent moisture when stored in a pile, it can heat up to temperatures above 140 degrees F and cause up to 50 percent of the protein to be unavailable to livestock because of excess heating. The ash portion of poultry litter is composed of soil and minerals. Litter contains about 12 to 15 percent ash as minerals. Ash content higher than this indicates soil contamination of the litter when it was removed from dirt-floor broiler houses. If the litter is to be fed, it is important to include as little soil as possible to keep the percent ash below 28. Nitrogen and acid detergent soluble nitrogen are negatively correlated with ash (Stephenson et al., 1990).

The average content of most nutrients in broiler litter being fed in Texas was slightly higher than the recommended maximum feeding level (Table 1). However, the average copper level (547 ppm) was 5 times greater than the recommended maximum level. Feeding broiler litter at more than 50 percent of the total diet will result in over feeding protein and minerals and increase the chance of copper toxicity. Broiler litter is low in energy and void of vitamin A (Subcommittee on Feed Composition, 1982). Supplementation of broiler litter to overcome these limitations will be discussed later.

Managing Broiler Litter for Feeding

Because of the variability in nutrient content of broiler litter, a composite sample should be taken from 5 to 10 sites in the litter pile and sent to a laboratory (university of private) to determine nutrient concentration. If the litter is of low quality (below 19 percent protein), feeding practices may have to be altered and future broiler litter purchased from other sources. Broiler litter contains pathogenic bac-

Table 1. Average and range of nutrients in 61 poultry litter samples fed to livestock in Northeast Texas during the 1993-94 winter and the recommended nutrient range and maximum levels for beef cattle diets (Nutrient Requirements of Beef Cattle, Sixth Revised Edition, 1984, National Research Council).

Nutrient	Average	Range	Recommended Range	Maximum Level
Moisture %	22.3	14.0 - 38.9	—	—
Protein %	21.5	13.2 - 31.4	7.0 - 16.0	—
Nitrogen %	3.44	2.11 - 5.02	1.1 - 2.6	—
Phosphorus %	1.79	1.06 - 2.74	0.17 - 0.39	1.0
Potassium %	2.59	1.42 - 3.70	0.50 - 0.70	3.0
Calcium %	2.15	1.18 - 3.99	0.16 - 0.58	2.0
Magnesium %	0.55	0.29 - 0.90	0.05 - 0.25	0.4
Sodium %	0.97	0.53 - 2.18	0.06 - 0.10	10.0[a]
Zinc ppm	499.0	248.0 - 703.0	20.0 - 40.0	500.0
Iron ppm	1742.0	320.0 - 8533.0	5.0 - 100.0	1000.0
Copper ppm	547.0	43.0 - 1336.0	4.0 - 10.0	115.0
Manganese ppm	545.0	284.0 - 835.0	20.0 - 50.0	1000.0
Sulfur ppm	5001.0	457.0 - 7360.0	800.0 - 1500.0	4000.0
Boron ppm	74.0	54.0 - 158.0	- - -	-
Chlorine ppm	9218.0	3103.0 - 23960.0	- - -	-
Selenium ppm	1.22	0.82 - 2.08	0.05 - 0.3	2.0
Arsenic ppm	40.0	10.0 - 64.0	- - -	50.0

[a]As salt (NaCl).

teria and residues from medicated poultry rations such as antibiotics and coccidiostats. The most economical method to eliminate this risk when litter is fed to cattle is deep stacking the litter.

To process broiler litter for feeding, it should be stacked a minimum of 4 to 5 feet deep under a roof or plastic cover so that it is protected from rain. If the litter gets wet, nitrogen (protein) will be lost through volatilization and leaching. When litter contains about 20 percent moisture, it will reach a temperature of 130 to 140 degrees F for one to three weeks which is sufficient to destroy any pathogens. Litter containing about 25 percent or more moisture will heat to 160 degrees F, which will decrease the digestibility of the protein (McCaskey et al., 1990). The excessive heating can be reduced if the litter stack is covered in an air-tight manner with 6-ml polyethylene plastic (Rankins, 1995). Litter that is charred or blackened and has the appearance of large particles of coffee grounds is typical of heat damaged broiler litter.

Feeding Broiler Litter

Broiler litter has its greatest economic value if fed as a protein and mineral supplement. Calcium and phosphorus requirements of beef cows can be met by feeding 3 lbs./hd/day. Feeding dry cows 7 to 8 lbs./day and cows nursing calves 10 to 11 lbs./day will satisfy protein requirements if broiler litter is the only source of protein. Assuming average quality hay or pasture makes up the remainder of the diet, 5 to 10 lbs./hd/day of broiler litter should be sufficient to meet the protein and mineral requirements of beef cattle.

If broiler litter can be obtained at a low cost ($8 to $20/ton) cattle producers may want to maximize the amount of litter being fed since it is less expensive than hay. Because broiler litter is low in energy, it must be supplemented with an energy source such as grain, grain by-products, rice bran, or processed bakery products for lactating cows, stockers, and replacement heifers. General recommendations for percent corn in a broiler litter ration are 10 to 20 percent for dry cows, 30 to 35 percent for cows nursing calves and 50 percent for stocker calves and replacement heifers (Ruffin and McCaskey, 1991). The corn should be cracked or ground because cattle tend to waste feed when fed whole corn rations. In all cases 4 to 5 lbs./hd/day of hay should be fed to reduce herd health problems and improve animal performance. Adding 10 to 20 percent corn to broiler litter for dry cows primarily makes the ration more palatable. Once cows become accustomed to eating broiler litter, many producers eliminate corn from the ration of dry cows. Vitamin A, which is essential for normal growth and reproduction, may become limiting if the litter feeding period exceeds 100 days without green grass. It can be added to the ration (1500 I.U./lb feed). Auburn University recommends mixing Bovatec or Rumensin to the ration for young growing animals to prevent bloat (B. G. Ruffin, personal communication). Herd health problems tend to increase as broiler litter becomes a larger percentage of the total diet.

Potential Herd Health Problems

Hardware disease. Nails, wire, and other metal objects may fall on the poultry house floor and be removed with the poultry litter during clean out. Nails are especially common in the first clean out of a newly constructed poultry house. Producers who use a mixer wagon can use magnetic plates on the discharge chute to collect metal objects from the litter. Producers feeding a small number of cattle will pass the litter through a screen to remove large objects; however, this is not as effective as a magnet. Screening the litter will also remove large wood chips.

Milk fever (downer cows). Milk fever is associated with a calcium or magnesium deficiency or an imbalance with other minerals in the diet. A cow's requirement for calcium increases dramatically after calving because of milk production. A cow will partially meet this higher calcium demand by utilizing calcium stored in the bone. Studies in Alabama have shown that beef cows on a 20 percent corn and 80 percent broiler litter diet that contained more than 2 percent calcium had lower serum (blood) calcium levels than cows on a total hay ration (Rude and Rankins, 1995). Serum calcium levels of cows on the poultry litter-corn ration that also received 3.5 pounds of hay per day had intermediate serum calcium levels. This demonstrates the importance of feeding some hay with broiler litter to help keep the serum calcium level up to reduce the risk of milk fever. Rankins (1995) believes that calcium resorption from the bone is severely reduced by the excessive intake of calcium from litter

before calving. Some long-stem hay should also be fed to stocker cattle or replacement heifers on a 50:50 corn-broiler litter diet for rumen stimulation. Steers weighing 600 to 700 pounds on a corn-broiler litter ration gained twice as much (1.7 lbs. per day) when fed about 4 lbs. hay per day than steers not fed hay (0.9 lbs. per day) (Rude and Rankins, 1995b).

In the 1994-95 Texas survey, 12.5 percent of beef cattle producers (7 of 55 producers) reported problems with milk fever. All were feeding some hay, and six of the seven were mixing grain with the broiler litter. Incidence of milk fever did increase with broiler litter feeding level with five of the seven cooperators feeding more than 10 lbs./hd/day. Further investigation revealed that six of the seven cooperators reporting downer cow problems fed hay fertilized with broiler litter. Nutrient composition of all hay samples in the survey were compared based on fertilization with commercial fertilizer or broiler litter (Table 2). Hay fertilized with broiler litter was significantly higher in phosphorus, potassium, sodium, and zinc. A similar survey in eastern Oklahoma reported hay fertilized with broiler litter was significantly (P>.05) higher in protein, phosphorus, potassium, sodium, and copper than hay not fertilized with broiler litter (Smith et al., 1993).

Table 2. Nutrient composition of hay, fed to beef cattle consuming broiler litter, fertilizer with commercial fertilizer or broiler litter during the 1994-95 winter.

Component	Commercial Fertilizer	Broiler Litter
	%	
Crude protein	8.00	7.71
Phosphorus	0.197	0.261*
Potassium	1.49	1.85*
Calcium	0.367	0.389
Magnesium	0.171	0.190
	ppm	
Sodium	527.0	730.0*
Zinc	41.7	54.3*
Iron	450.0	450.0
Copper	8.50	7.92
Manganese	133.0	137.0

*P<.07.

Samples of the soil on which these hays were produced were also analyzed and compared on the basis of fertilization practices. Soils fertilized with broiler litter were significantly higher in pH, phosphorus, salinity, zinc, iron, copper and sodium (Table 3). Calcium level of soils fertilized with broiler litter was five times greater than soils fertilized with commercial fertilizer, but was not significant because of the large variability in calcium level within each type of fertilization program. This does not mean that hay fertilized with broiler litter is automatically high in phosphorus. Soil phosphorus level will depend on the rate of litter applied and the number of years litter was used.

Table 3. Soil analysis from pastures fertilized with either commercial fertilizer or with poultry litter for hay production in 1994.

Component	Commercial Fertilizer	Poultry Litter
pH	5.31	6.15*
	ppm	
Nitrogen	11.8	20.0
Phosphorus	27.8	218.0*
Potassium	89.0	149.0
Calcium	744.0	3763.0
Magnesium	106.0	152.0
Salinity	165.0	292.0*
Zinc	0.74	6.30*
Iron	50.4	34.8*
Copper	0.74	3.84*
Manganese	10.6	13.1
Sodium	17.4	33.1*
Sulfur	18.5	49.3

*P<.10.

The elevated soil phosphorus levels resulted in a 32 percent higher phosphorus content in the hay. However, broiler litter fertilization did not significantly increase the calcium concentration of the hay. In the Oklahoma study (Smith et al., 1993), broiler litter fertilization also increased the phosphorus concentration of the hay 38 percent but not the calcium concentration. Indications are that the higher phosphorus-calcium ratio in hay grown on high phosphorus soils may interact with the existing mineral imbalance of the broiler litter

being fed. Data from this survey indicate that feeding hay produced on soils with more than 200 ppm phosphorus to cows eating poultry litter will increase the incidence of milk fever. Many producers feeding broiler litter anticipate a 1 to 3 percent death loss due to milk fever. However, even with this death loss it may often be more profitable to feed the less expensive broiler litter than traditional protein and mineral supplements.

Dystocia (calving difficulty). Calving problems are part of beef cattle production, especially with first-calf heifers. In the Texas survey, 12.5 percent (7 of 55 producers) reported dystocia problems. What portion of these difficult births are due to feeding broiler litter and what proportion are due to poor herd management (i.e., using bulls with large birthweights, overfeeding heifers before calving) is not known. There were no trends observed in the Texas litter feeding surveys on the level of broiler litter fed, or if grain, hay and minerals were fed or not. Feeding more than 10 lbs./hd/day of broiler litter would be overfeeding bred heifers which would enhance the growth of the unborn calf.

Breeding problems. Fourteen percent of the cooperators in the Texas survey reported delayed breeding or rebreeding problems in beef cows fed broiler litter. Seven of the eight livestock producers were feeding more than 10 lbs./hd/day of broiler litter. Elrod and Butler (1993) have reported a decrease in first-service conception rates of Holstein heifers fed high degradable protein levels. They concluded that the excessive protein reduced the pH in the uterus which may be detrimental to sperm and the fertilized egg. There have also been some observations of delayed rebreeding of cows on lush winter pasture that was 20 to 25 percent protein.

Copper toxicity. Copper is an essential element in animal nutrition with recommended dietary concentrations of 4 to 10 ppm for beef cattle. Maximum dietary copper levels for growing cattle are 115 ppm with higher tolerable levels for adult cattle (Subcommittee on Beef Cattle Nutrition, 1984). Copper levels reported in the 1993-94 broiler litter survey ranged from 43 to 1336 ppm with an average of 547 ppm (Table 1). Excess copper accumulates in the liver when feeding high broiler litter diets during the winter. However, the copper level decreases during the summer grazing period. Copper toxicity usually doesn't occur until after cows have been eating high litter diets for 120 days. Silanidove and Tiomkin (1992) reported a loss in body weight, weakness, and 10 to 20 percent mortality in beef cows fed more than 22 pounds of broiler litter/hd/day. Animals die suddenly when under stress due to weather or handling. Examination of the dead animal by a veterinarian is necessary to determine if copper toxicity is the cause of death. Broiler litter should not be fed to sheep since they are unable to remove excess copper from the liver.

Producer Observations

Several producers participating in the Texas survey have fed broiler litter to beef cattle for many years and shared their past experiences. Cows about 8 years of age and older are more susceptible to milk fever (calcium deficiency). It is believed that the ability to reabsorb calcium from the bone immediately after calving for milk production becomes less effective with age. Producers have also observed that milk fever problems escalate on overcast and cloudy days. Vitamin D is required for calcium and phosphorus absorption, normal mineralization of bone, and mobilization of calcium from bone. Sunlight (ultraviolet light with wavelengths between 230 and 300 nm) is necessary for formation of vitamin D in plants and animals. Therefore, periods of cloudy days could reduce vitamin D levels and restrict calcium availability. Vitamin D is available from sun-cured forages harvested as hay. To reduce the incidence of milk fever, cattle producers should consider feeding less litter to brood cows approximately 1 month before calving. Fall calving is another option to minimize milk fever problems since cows calve before the winter feeding period begins.

Summary

Broiler litter has its greatest economic value when substituted for protein (cottonseed meal, soybean meal, etc.) and mineral supplements for over-wintering beef cattle. It is critical to use feed quality litter (minimum 19 percent protein, maximum 28 percent ash) that has gone through a heat of 130 to 140 degrees F to eliminate pathogenic bacteria and residues from medicated poultry feeds. Feeding 5 lbs./day to dry cows and 10 lbs./day broiler litter to cows nursing calves with free choice average quality hay should meet their protein and

mineral requirements. Some grain or other high energy feed may have to be added to the litter for cows nursing calves. Herd health problems associated with feeding broiler litter can be reduced by not feeding more than 10 lbs./hd/day. An additional precaution against milk fever is to feed hay produced on soils with less than 200 ppm available phosphorus. An alternative feed use of broiler litter is a 50-50 mixture with corn and 3 to 5 pounds of hay/hd/day for stocker calves or replacement heifers plus an ionophore (Bovatec, Rumensin) to reduce bloat.

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