Turkey Litter as an Alternative Feedstuff for Beef Cattle

Michigan State University
Michigan State University Extension
S.K. Varghese, A.R Rahn, H.D. Ritchie, R.M. Cook and B. Salem, Animal Science Dept.;
I.J. Krupp and T.M. Johnson, agricultural agents, Ottawa Co.

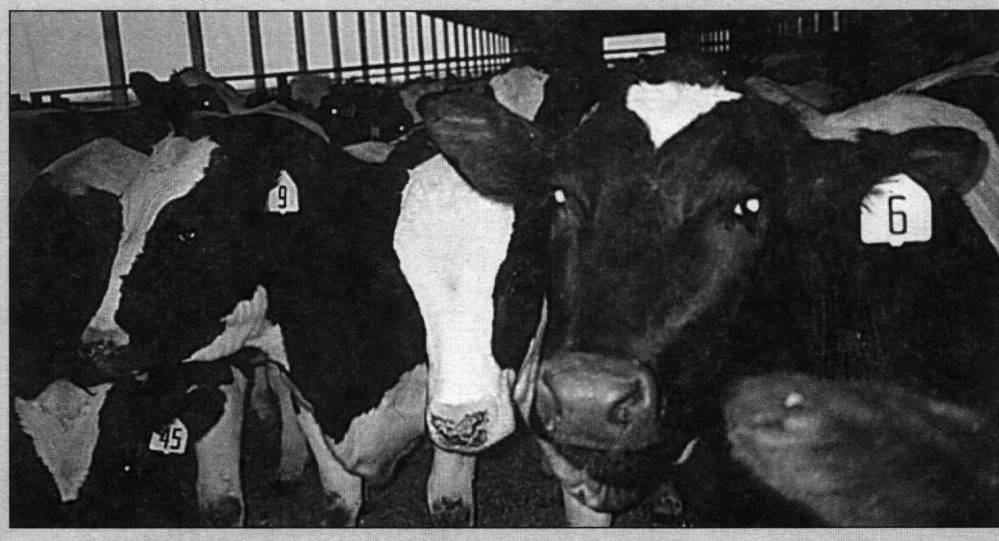
Issued December 1998
8 pages

Extension Bulletin E2681, New, December 1998

Turkey Litter as an Alternative Feedstuff for Beef Cattle

By

S.K. Varghese, A.P. Rahn, H.D. Ritchie, R.M. Cook and B. Salem, Animal Science Dept.;
I.J. Krupp and T.M. Johnson, agricultural agents, Ottawa Co.



MICHIGAN STATE
UNIVERSITY
EXTENSION

Introduction

Millions of tons of poultry litter are produced annually as a by-product of the U.S. chicken and turkey industry. For centuries, farmers have used this product as fertilizer. It is also used as a soil amendment, as an energy source and as an alternative feed, especially for ruminants.

The ruminant digestive system allows cattle to use by-products such as poultry litter. They can use the nitrogen in poultry litter to synthesize protein. Poultry litter is also a good source of energy and minerals, especially calcium and phosphorus.

In Michigan, it is estimated that the production of 5.5 million turkeys annually also produces 300,000 tons of turkey litter. Most of the turkeys in Michigan are produced in Ottawa and Allegan counties. Nutrient overloading of the soil prevents further use of the litter as a fertilizer in these counties. Phosphorus levels have increased dramatically in Ottawa County; therefore, turkey producers need to dispose of the litter in some way other than applying it to the soil. Waste disposal has become the top priority for the poultry industry in Michigan.

Currently, the cattle feeding industry of Michigan ranks 14th in the nation. There is potential for expansion of the industry in the state. Currently, one of the priorities of the cattle industry is to use alternative feedstuffs to reduce the cost of production.

In 1995, Michigan State University funded a field trial to evaluate the use of deep stacked turkey litter (DSTL) as an alternative feed for growing and finishing cattle. This trial, conducted in Ottawa County during 1995-96, showed that feeding DSTL is technically sound and economically plausible.

The turkey litter that the producer often finds difficult to dispose of could become a viable feedstuff for the cattle producer, thereby generating more income for the turkey enterprise. Turkey litter is a combination of manure, spilled feed, wood shavings and feathers. In our study, deep stacked turkey litter (DSTL) had a value in the range of $75 to $112 per ton to the cattle feeder. DSTL proved to be a feasible alternative feedstuff. Currently, several cattle producers in the western region of the state have begun using this byproduct.

Nutrient Composition of Turkey Litter

The nutrient composition of turkey litter can vary considerably, depending on the management practices of the turkey grower and the source. Factors affecting nutrient composition include whether the litter comes from the brooder house or from the grower house, the number of grow-out cycles between house clean-outs, and whether the litter was collected from under the feeder and water lines or from a full clean-out. The use of new equipment such as the "Poultry House Keeper" in turkey houses to collect litter may also result in considerable variation in its nutrient value.

Nutrient values for DSTL are presented in Table 1. This is for litter obtained from a grower house collected after four grow-out cycles of birds. The litter was collected to a depth of 6 inches and was removed from around the feeder and water lines.

Regulatory Status

In 1967, the Food and Drug Administration (FDA) published a policy in the Federal Register (21 CFR 500.4) not sanctioning the use of poultry litter as animal feed. In 1980, the FDA published a policy (45 FR 86272) revoking its earlier (1967) policy. The current policy essentially leaves to individual states the responsibility for regulating feeding animal waste.

In 1982, the American Association of Feed Control Officials (AAFCO) published a model regulation for processed animal waste. The important points of this regulation are:

1. The waste must be processed so that it will be free of pathogenic organisms.
2. If it can be documented by records that animals producing the waste were not fed drugs, no withdrawal period is required and the waste can be fed to any class of animals.
3. If it cannot be documented by records that the animals producing waste were not fed drugs, a 15-day withdrawal period is required prior to slaughtering the animals or using their milk or eggs.

Many states, including Michigan, have adopted the AAFCO regulation as their official position on animal waste recycling. Attempts to commercialize animal waste byproducts and ship them across state lines for refeeding would involve the FDA.

Storing Turkey Litter

Litter may be stored in an open-ended building if such a building is available. This will protect it from rain and snow and prevent potential runoff. Stacking on concrete is recommended because it will prevent mixing soil and litter. Mixing with soil will increase the ash level in the lit-

ter, which may reduce intake. Litter with high levels of ash (over 30 percent) is not recommended for feeding.

Natural Resources Conservation Service (NRCS) offices in some states have provided cost-share funds for constructing storage buildings. Producers may wish to contact their local county NRCS representatives to see if cost-share funds might be available.

Poultry litter stored in an enclosed structure can sometimes develop too much heat and cause spontaneous combustion. This is difficult to control and may burn down the building that houses the litter. Care should be taken that litter stored in buildings be kept 2 feet away from the walls.

Litter can also be stored in the open, preferably on concrete pads to prevent high levels of ash in the DSTL. If litter is stored on a dirt floor, the portion of the litter close to the ground should be used as fertilizer rather than as feed because it may contain high levels of ash.

Litter may also be stored in upright silos, pit silos or aboveground bunkers. Proper covering is important to prevent water penetration if litter is stored in pit or bunker silos.

If the litter is not stored in a building or in an upright silo, it is advisable to cover the stack to protect it from the weather, prevent nutrient loss and reduce the risk of overheating. Plastic sheets (6 mil) may be used for this purpose. Covering the stack, however, should be done only after the first week of stacking. Care should be taken that the plastic is not torn during covering. Old tires may be placed on top of the plastic to prevent the wind from blowing it off the stack.

Pile is covered with plastic after the initial heating (one week).

Deep Stacking Turkey Litter

Processing litter before feeding is very important. Generally, it has gone through some fermentation in the turkey house and therefore contains minimal levels of bacterial pathogens. It should be further processed, however, to kill any remaining pathogens.

Deep stacking litter is the most economical and efficient processing method reported in the literature. Turkey litter should be stacked at least 6 to 8 feet high, and packed. Under proper deep stacking conditions (moisture level between 25 and 35 percent), the litter should heat up within 3 to 5 days to a temperature of about 130 to 140 degrees F. If the moisture level of the litter is over 35 percent, the stack may not heat up to the desired temperatures. **Caution:** If heavy tractors are used for packing, the pile of litter may not heat up to 130 degrees F.

Some producers may turn the stack two or three times in order to achieve a temperature of 130 degrees or higher. In such cases, the stack may overheat and the litter may take on a charcoal color. Litter from such a process may be of lower quality because of reduced nitrogen availability and lower dry matter digestibility.

If the litter is packed thoroughly with a heavy tractor, oxygen will be eliminated and anaerobic fermentation will take place. This produces lactic acid, which can help destroy harmful pathogens and will result in improved nutritional quality. Further, during the course of storage, uric acid and urea will be broken down to ammonia. This also plays a role in destroying pathogens.

Turkey litter should be deep stacked for a minimum of 3 to 6 weeks prior to feeding. A longer period (8 to 10 weeks) of "curing" is recommended before feeding litter to cattle if the temperature does not reach 130 degrees F.

Taking the Temperature of Stacked Litter

A long probe (4 feet) is needed to measure the temperature of the stack. This can be obtained from a distributor of grain handling equipment for approximately $50. More sophisticated equipment is available for temperature monitoring, if desired.

Taking pile temperature using probe, three to five days after stacking.

The temperature should be taken at least 2 feet down from the top surface and 2 feet in from the sides. You may need to use a shovel to dig into the pile prior to probing. Allow the probe to remain in place at least 15

minutes to determine the temperature. It is advisable to take the temperature at various locations throughout the length of the stack. Take at least six readings in a stack of 100 to 200 tons of litter. Because the temperature will peak and then decrease and stabilize during the first week, it is advisable to take the temperature on the fifth day after stacking the litter.

Sampling for Nutrient Content, Pathogens, Pesticides and Heavy Metals

It is important to be consistent in sampling the litter. Start by removing a sample 2 feet below the surface. Collect about one-half pound of litter into a bucket or a large plastic bag. Move 6 to 8 feet away from the first site and collect another sample. Mix the samples every time a new sample is added to the bucket. Repeat this procedure in several locations. Using the same procedure, take samples from the side of the stack.

Taking litter sample for pathogen and nutrient analyses.

Take four to six samples from the side and four to six samples from the top of a 100- to 200- ton stack of litter. After collecting all the samples, spread the litter on newspaper on the floor. Mix it thoroughly by hand, using plastic gloves. After thorough mixing, collect a composite sample (1 pound) in a labeled plastic bag for analysis.

Samples should be refrigerated or frozen if kept overnight. Mail the sample by overnight delivery, if possible.

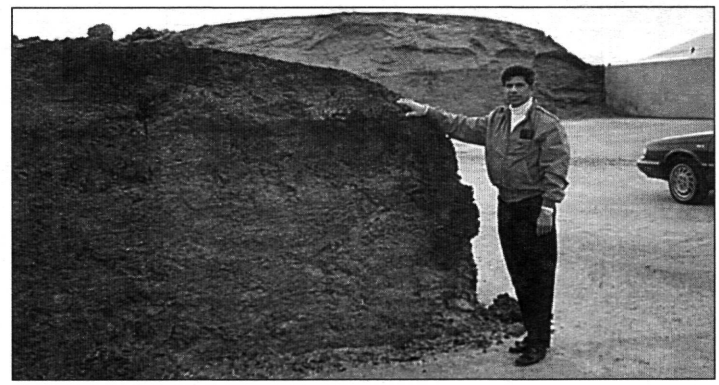
In the Michigan State University trial conducted in Ottawa County, samples were sent to laboratories at MSU for analyses of microbial pathogens, pesticides and heavy metals. Microbial pathogens analyzed included Campylobacter jejuni, Salmonella, Coliform and Clostridia species. Halogenated compounds (pesticides) analyzed were DDT, DDE, PCB, etc. Heavy metals included arsenic, lead, mercury, copper and cadmium. The results showed that pathogens, pesticides and metals were either not present or present at levels within FDA guidelines.

Nutrient analyses were carried out at the Northeast DHI Forage lab (730 Warren Road, Ithaca, NY 14850). Averages and ranges for seven samples are shown in Table 1. Crude protein, available protein, calcium, phosphorus and ash levels were consistent with previously published literature values. TDN estimates were based on an equation using acid detergent fiber (ADF).

Even though the DSTL samples in the MSU trial were free of bacterial pathogens, it is highly recommended that every cattle producer who plans to feed DSTL conduct an analysis for pathogens prior to feeding. Send a sample to the Pathology Laboratory at Michigan State University (U.S. Postal Service: Animal Diagnostic Lab, P.O. Box 30076, Lansing, MI 48909 or any other
carrier: B629 West Fee Hall, Michigan State University, East Lansing, MI 48824-1316). The analysis costs approximately $25 and the results can be obtained within 2 weeks. There are also other laboratories in the state that could conduct a pathogen analysis of DSTL. Contact your local agent for such information. It is also a good idea to have an analysis run on the nutrient composition of the DSTL so that you can more accurately formulate your ration.

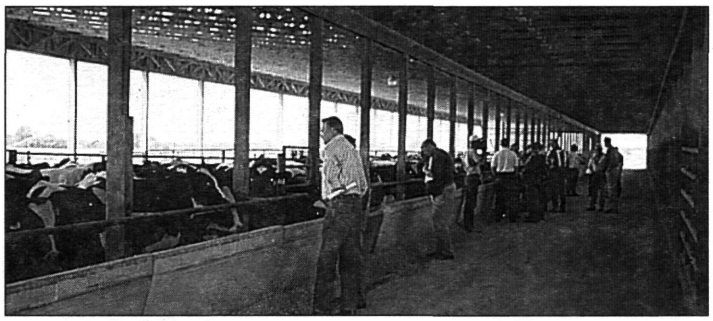
Feeding the Cattle

Cattle need at least 2 weeks to become acclimated to the litter diet. Therefore, it is recommended that they be introduced to it at low levels and increased to higher levels on a day-to-day basis for about 2 weeks. At the end of this 2-week period, cattle should readily consume the diet. For best results, it is recommended that the litter be mixed with a moist fermented feed such as corn silage or haylage.



Deep stacked turkey litter pile that has not been covered. Half of stack has already been fed to cattle. It is important that DSTL is removed from one end only.

Cattle may be fed once or twice a day. In large operations, the litter and other ingredients may be measured and mixed prior to feeding. In small operations, where a mixer is not available, put the desired quantity of ingredients together and mix them mechanically with a fork or front-end-loader. When introduceing DSTL into the diet, top the litter-silage mix with ground or cracked corn to entice the cattle into consuming it.



Michigan cattle producers observe feeding DSTL diets to cattle.

What level of litter should one feed to cattle? This depends on various factors such as the cost of conventional ingredients and most importantly, the age, size and status of the animals.

The MSU DSTL trial in Ottawa County was conducted using 150 Holstein steers. They were randomly allotted to one of three diets: 0, 20 and 40 percent DSTL. The composition of the diets is presented in Table 2. After the preliminary introductory period, the cattle readily consumed the diets.

No physical problems were observed in the cattle fed the DSTL diets. Their gains were similar to that of cattle fed the control diet. The trial lasted for 294 days. The performance of the cattle and the cost of the diets, with the DSTL valued at zero dollars, are presented in Table 3.

Average daily gains for the cattle fed the diets containing 0, 20 and 40 percent DSTL were 2.53, 2.47 and 2.56 pounds, respectively. Feed costs per pound of gain for the 0, 20 and 40 percent DSTL treatments were 65, 50 and 46 cents, respectively. Prior to slaughter, a 15-day withdrawal period was observed in compliance with the AAFCO regulation.

After the cattle were sold and slaughtered, carcass data were collected, including carcass weight, quality grade, backfat thickness and yield grade. Tissue samples were also analyzed for pesticides. Carcass data are presented in Table 4. Average yield grades were 3.2, 2.7 and 2.2 for the 0, 20 and 40 percent groups. Quality grade was lowest for the 40 percent DSTL-fed group, with 25 percent of the cattle in this treatment grading "Select". This was probably because of the lower dietary energy level in this treatment. To alleviate this problem, we recommend that producers reduce the level of DSTL in the diet to 20 percent during the last two months prior to marketing, thereby increasing the energy level of the diet. Backfat thickness of cattle fed 40 percent DSTL was significantly lower than the control and 20 percent groups.

Budgets were developed so estimates could be made regarding the substitution values of DSTL: the DSTL price that, with the prices of all other ingredients at specified constant levels or amounts, makes the estimated net receipts per head equal. This value is dependent on the other assumptions made and is likely to change when other feedstuffs, feeder calf, fed cattle, etc., quantities or prices are altered. The impact of changes in the prices of predominant feedstuffs, i.e., corn, corn silage and protein/Rumensin supplement — was considered. The price of corn silage was directly linked to the price of corn by the formula: corn silage price ($/T) = corn price ($/bu.) x 6.5 + $6. The resulting substitution values of DSTL for the two incorporation levels based on the trial performance data are presented in Table 5. These tables show DSTL substitution values that range from a low of $43/T to a high of $124.35/T as the usage level and feedstuff price assumptions were varied. This provides an indication of the potential DSTL substitution value within the selected predominant feedstuff price ranges identified. However, producers are advised to make an evaluation for their specific contemplated use situation.

Suggested DSTL Content of Diets

For stocker and growing steers (500 pounds or more), DSTL in the diet may be used up to 50 percent. For finishing cattle, DSTL in the diets should be in the range of 20 to 30 percent of the total diet. Previous research indicates that non-lactating beef cows may be fed broiler litter up to 80 percent of total diet. The nutrient composition of the DSTL in our study is similar to that of broiler litter in other studies.

Precautions

- Ruminants can use DSTL effectively, but they also need a minimum amount of fiber. Fiber from wood shavings is not satisfactory. Therefore, feed 2 to 4 pounds of hay daily or on alternate days to support adequate ruminal function.

- Do not use turkey litter that was used to compost dead birds. This may be lethal to cattle because it can cause botulism.
- Avoid litter from turkey houses where the birds where treated for any outbreaks of diseases. Such litter should be used for fertilizer rather than cattle feed.
- Do not feed DSTL to beef cows for longer than the wintering period. Copper toxicity could occur.
- Withdraw DSTL from the diet of pregnant cows a few weeks prior to calving. Otherwise, it could result in milk fever due to calcium imbalance in the diet.
- Do not use DSTL for sheep. Sheep are more sensitive to high levels of copper and could develop copper toxicity.
- A 15-day withdrawal period of DSTL from the diet needs to be observed for cattle prior to slaughter.

Conclusion

Poultry litter has been used as a cattle feed ingredient for more than 35 years without harmful effects to humans who have consumed products from these animals. Utilizing DSTL as a cattle feed in Michigan could be profitable both to the turkey and the cattle industries as well as beneficial to the environment.

Other Information Sources

- Weaver, W.D. and G.H. Souder. 1990. Feasibility and Economics of Transporting Poultry Waste. Proceed. 1990 National Poultry Waste Management Symposium. p. 123-129.
- Fontenot, J.P. 1990. Recycling Animal Waste by Feeding to Enhance Environmental Quality. Proceed. American Feed Industry Association Nutrition Symposium. p. 56-70.
- Labosky, P., J.W. Dick and D.L. Cross. 1977. Bark Broiler Litter as a Potential Feedstuff for Ruminants. Poultry Sci. 56:2064.
- Ruffin, B.G. and J. Martin. Feeding Broiler Litter to Beef Cattle. Ala. Coop. Ext. Ser. Circ. ANR-280.
- Cross, D.L. 1977. Fermented Poultry Wastes for Cattle. Proceed. Alternate Nitrogen Sources for Ruminants. Tennessee Valley Authority Bull. Y-130.
- Cross, D.L. 1976. Turkey Litter Silage in Rations for Dairy Heifers. J. Dairy Sci. 59:919.
- Cross, D.L. 1974. Effect of Drying Temmperature and Length of Drying Time on Survival of Microorganisms in Turkey Litter. Poultry Sci. 53:1915 (Abstr.)
- Cross, D.L. 1978. Efficacy of Broiler Litter Silage for Beef Steers. J. Anim. Sci. 47:544.
- Thompson, C.S. and D.L. Cross. 1978. Economic Analysis of Broiler Litter as a Feed for Steers. C. U. Ag. Exp. Sta. Bull. 610.
- Thompson, C.S., W.T. Borders, D.L. Cross and B.F. Jenny. 1976. Technical and Economic Evaluation of Turkey Litter Silage as a Feed Source for Replacement Dairy Heifers. S. C. Ag. Exp. Sta. Tech. Bull. 1058.

Table 1. Nutrient analysis of DSTL (percent of dry matter)[a].

	Average	Range
Crude protein	33.7	31.2 - 36.0
Available protein	30.7	28.5 - 33.5
Total digestible nutrients (TDN)[b]	65.7	61.3 - 72.2
Calcium	2.7	2.0 - 3.3
Phosphorus	1.8	1.3 - 2.2
Ash	17.0	16.8 - 17.4

[a]Based on seven samples.

[b]Calculated from the following formula: TDN=88.9 (.779 x acid detergent fiber percent).

Table 2. Composition of diets (percent of dry matter).

	Treatment		
	Control	**20% DSTL**	**40% DSTL**
DSTL	0.0	22.2	39.5
Corn silage	31.9	19.6	8.1
HM shell corn	58.6	53.3	47.9
Protein supp.	9.5	0.0	0.0
Mineral/vit. supp.	0.0	4.9	4.5

Table 3. Performance summary of growing and finishishing steers fed DSTL diets.

	Treatment		
Item	**Control**	**20% DSTL**	**40% DSTL**
Number of animals	50	50	49
Days of feed	294	294	294
Initial weight (lb)	693	701	695
Final weight (lb)	1437	1427	1447
Avg. daily gain (lb/day)	2.53	2.47	2.56
Feed conversion (dry matter basis)	8.36	8.28	8.83
Feed cost/lb gain	$0.65	$0.50	$0.46
Feed cost/ton	$95.83	$66.11	$60.65

Table 4. Effects on carcass characteristics of feeding deep stacked turkey litter (DSTL) to growing and finishing steers.

	Treatment *		
Characteristic	**Control**	**20% DSTL**	**40% DSTL**
Side weight (pounds)	415.7 (7.7%)	412.2 (7.6%)	414.4 (9.7%)
Dressing percentage	58.1 (4.1%)	57.4 (3.3%)	57.4 (2.5%)
Backfat thickness (inches)	0.35 (28.1%)	0.33 (27.4%)	0.30 (33.4%)
Yield grade score	3.2 (20.5%)	2.7 (14.2%)	2.2 (31.6%)
Quality grade	35 head	40 head	39 head
Prime	8.6%	2.5%	0.0%
Choice	88.6%	97.5%	74.4%
Select	2.8%	0.0%	25.6%

* Numbers in parentheses indicate the proportion (relative to the average) that two out of three of the values fell within.

Table 5. Imputed values of DSTL based on field trial performance data.

Imputed 20% DSTL values						
Corn & silage prices			**Protein & Rumensin/lb prices**			
Corn/bu	Corn/T	Silage/T	$0.08	$0.10	$0.12	$0.14
$ 2.00	$ 71.43	$ 19.00	$ 58.00	$ 67.25	$ 76.50	$ 85.75
$ 2.50	$ 89.29	$ 22.25	$ 70.75	$ 80.00	$ 89.25	$ 98.50
$ 3.00	$107.14	$ 25.50	$ 83.75	$ 93.00	$102.25	$111.50
$ 3.22	$115.00	$ 26.93	$ 89.25	$ 98.50	$107.75	$117.00
$ 3.50	$125.00	$ 28.75	$ 96.50	$105.75	$115.00	$124.25

* Prices of other feedstuffs held constant.

Imputed 40% DSTL values						
Corn & silage prices			**Protein & Rumensin/lb prices**			
Corn/bu	Corn/T	Silage/T	$0.08	$0.10	$0.12	$0.14
$ 2.00	$ 71.43	$ 19.00	$ 43.00	$ 48.00	$ 53.75	$ 58.25
$ 2.50	$ 89.29	$ 22.25	$ 51.50	$ 56.50	$ 61.50	$ 66.25
$ 3.00	$107.14	$ 25.50	$ 60.00	$ 64.50	$ 69.50	$74.50
$ 3.22	$115.00	$ 26.93	$ 63.25	$ 68.25	$ 73.00	$ 78.00
$ 3.50	$125.00	$ 28.75	$ 67.75	$ 72.75	$77.75	$82.50

* Prices of other feedstuffs held constant.

Assumes silage price/T = corn price/bu x 6.5 plus $6.

New-12:98-IM-BP/KMF, $1.25, for sale only.