



Better Chicken Health: Deep Litter Manure Management

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By Harvey Ussery



This outdoor run has a bed of straw litter which will absorb manure and convert it into rich compost for the garden

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If you are around any livestock operation, regardless of species, and you smell manure — you are smelling mismanagement. — Joel Salatin

Repugnance for what comes out the far end of an animal is not merely cultural conditioning — our senses are warning us of potential danger: Feces can be a vector for disease. Joel's quote above implicitly advises us to trust that repugnance: If it smells bad, it could be dangerous. But it also implies that there are ways to manage manure so it doesn't stink, giving us our most important hint that its threat to chicken health has been neutralized. Properly handled manure, in other words, is not a danger.

How compost works

Many folks have already experienced the transformation of things yucky into not only something pleasant, but a valuable resource: the alchemy of the compost heap, which starts with manures and rotting vegetation and ends with compost, smelling as sweet as good earth, ready to fertilize the garden. The compost heap is our model for making the same transformation in the henhouse.

You assemble a compost heap from nitrogenous materials such as manures and spent crop plants, mixed with carbonaceous ones such as leaves and straw. Coarse materials will eventually compost, but if you make the effort to shred them more finely, the composting process speeds up considerably. Inconceivable numbers of microbes multiply in the pile, using the nitrogen in the manures and fresh green matter as a source of energy to break down the tough, fibrous high-carbon materials into simpler components. The ideal balance of carbon to nitrogen in the mix is 25 or 30 to 1. Too much nitrogen is signaled by the smell of ammonia, meaning that some of the nitrogen — a potential source of soil fertility — is being lost to the atmosphere. (Ammonia is a gas of nitrogen and hydrogen, NH_3 .)

Moisture in the heap is essential to the microbes driving decomposition, though it must not be soaking wet — a condition that would inhibit decomposers while favoring pathogens. Oxygen also is essential for the decomposers, so you turn the heap over completely at least twice during decomposition, maybe more. Heat is a byproduct of the composting process — a well-made compost heap becomes amazingly hot. The end result of this devoted effort is compost, one of the best possible fertility amendments a gardener can find.

It is possible to make the chicken coop in effect a slow-burn compost heap if you leave the earth itself as the floor, and keep it covered deeply with high-carbon organic litter. The sorts of decomposer microbes at work in the compost heap — and in the soil food web — migrate out of an earth floor into the deep litter; the slight wicking of moisture out of the earth helps them proliferate and thrive. If you have an existing building with a wood or concrete floor to use for poultry housing, by all means avoid the effort and expense of building new. You can still use deep litter to keep the henhouse sweet with a couple of tweaks discussed below, including the use of straw as litter and the additional decomposition time of constructed-floor litter in a compost heap before use in the garden.

Oh, and all that laborious shredding and turning of the compost to assist its breakdown? Just leave that to the chooks.

Materials for deep litter

The droppings laid down by the birds are rich in nitrogen, so naturally — as in the compost heap — we want a lot of carbonaceous material in the litter to balance it. In contrast to the ideal C:N ratio for a compost heap, however, the higher the carbon content of the deep litter, the better. That is, the more carbon in the mix, the more chicken manure the litter can absorb before its nitrogen drives the C:N ratio out of balance, resulting in production of ammonia.

The high-carbon material chosen for the deep litter depends on what is cheapest and most readily available to you. It should ideally be somewhat coarse, so the scratching of the chickens fluffs it up and incorporates plenty of oxygen, assisting its breakdown by microbes and discouraging growth of pathogens. I prefer oak leaves, but that's mostly because a close neighbor, who has half a dozen mature white oaks on her place, prefers to get rid of the accumulating leaves in the fall. She even hauls them over and dumps them in a big pile at my place. I say “God bless ‘er!”

Kiln-dried wood shavings are excellent, with their extremely high carbon-to-nitrogen ratio (500:1), but are an additional expense if you have to purchase them. I recently bought some shavings for \$5 per 2 1/2-cubic-foot bale (expands to 8 cubic feet) to use as brooder bedding. Buying enough to deep-bed the entire henhouse would be expensive indeed.

Wood chips might serve — they too are extremely high in carbon and last a long time before they have to be replaced. Joel Salatin uses them as the litter in his Raken House — he cleans out only once a year, when even this coarse woody material has been reduced to compost by the microbes and the constant working of the chickens. Sawdust is satisfactory, though it doesn't fluff up as much as other materials.

Whether using sawdust, wood shavings or wood chips, be sure to use either kiln-dried or aged material — “green” woody materials may support the growth of molds, whose spores could be bad for your birds’ respiratory systems, and yours.

Note that old hay and certain crop residues, such as soybean vines, are not appropriate as litter materials — with a significant nitrogen content of their own, they do not effectively balance the nitrogen in the poultry droppings and quickly heat up.

What about straw? Many flocksters avoid the use of straw because, especially in the presence of the slight dampness of an earth floor, it can support the growth of *Aspergillus* molds, whose spores can cause serious respiratory problems. I have corresponded with flocksters, however, who report that they use straw over an earth floor without problems. Though I have in the past avoided straw litter, I am now experimenting with it as an addition to litter with a much higher proportion of oak leaves — so far with no mold problems. Note that there is no problem using straw as the litter over a wooden floor — the drier conditions in such a litter prevent growth of *Aspergillus*.

Nearby processing of agricultural crops may furnish other litter materials. Milling of corn, cane, buckwheat or peanuts, for example, may generate corncobs, chopped corn or cane stalks, or hulls that are available cheaply enough to be used as deep litter.

Alchemy magic

Over many years showing countless visitors through my poultry house, I’ve found that — if my visitor has ever been in a chicken house — at some point she will sniff the air with a puzzled look and ask, “Why doesn’t it stink in here?” When that happens, I know I’m on the right track with manure management.

But the transformation of “nasty” to “pleasant” is just part of the magic. Remember the comparison of the deep litter to an active compost heap — the process in deep litter is driven by the same busy, happy gang of microbes. And among the metabolites of the microbes — byproducts of their life processes — are vitamins K and B12, in addition to other immune-enhancing compounds. The chickens actually ingest these beneficial substances as they find interesting things to eat in the litter. Don’t ask me what they’re eating, but chickens on a mature deep litter do little other than scratch and peck. This is alchemy indeed: What started as repugnant and a potential vector for disease has been transformed into a substrate for health.

Should you think I’m spinning fairy tales, know that scientific experiments have borne out the benefits of a bioactive deep litter. In 1949, a couple of researchers at the Ohio Experiment Station published research on deep litter. I urge you to read the full report, but to summarize: One experiment compared two groups of growing pullets, both on old built-up deep litter, one group receiving a complete ration, the other fed a severely deficient diet. Mortality and weight gain in the two groups were virtually identical. In another experiment comparing pullets fed a severely deficient diet, groups on old, thoroughly bioactive litter suffered far lower mortality (7 as opposed to 23 percent) and achieved much higher weight gain (at 12 weeks, 2.34 compared with 1.64 pounds) than those on fresh litter. Both these and further experiments demonstrated: “Obviously, the old built-up litter adequately supplemented the incomplete ration.”

The Food and Agriculture Organization of the United Nations confirms these observations: “Microorganisms thrive on the manure in the litter and break it down. This microflora produces growth factors, notably vitamin B12, and antibiotic substances, which help control the level of pathogenic bacteria. Consequently, the growth rate and health are often superior in poultry raised on deep litter.”

Deep-litter management

Factor in the use of deep litter when designing housing for your flock — deeper litter absorbs more manure and supports more microbes, so allow plenty of space for it. Aim for a depth of 12 inches if possible. Happily, in winter you can factor in as well the role of that thick layer of organic duff in insulating the coop from the frozen ground outside — and the heat generated in an active deep litter. The temperature is nothing like that of a well-constructed compost heap, but the warmth rising out of the pack moderates air temperature in the winter house.

The great thing about deep litter is that the birds do most of the work. But there are a few things requiring input and monitoring on your part as well.

Stocking density

Salatin makes this observation about stocking density on a deep litter: If you allow 5 square feet per adult chicken, the birds' constant scratching will turn into the litter all the manure laid down, even in high-dropping areas such as those under the roosts. At 4 square feet, there will be some capping of manure under the roosts — formation of a crusty layer impervious to the hens' scratching. At 3 square feet, there will be extensive capping. If there is capping of the manure in your coop, turn it over with a spading fork from time to time, and the chickens will break it up from the cap's underside.

Let it mellow

You will see advice that the coop should periodically be thoroughly cleaned out. But as the Ohio experiments demonstrated, it is not fresh new litter that supports the health of the flock, but “old built-up” — that is, highly biologically active — litter. Thus an important implication: Never clean out the litter completely. Once beneficial levels of microbial activity are established, don't get rid of them by a *de rigueur* “thorough clean-out.” Over time, the buildup of the litter — or the need for compost for the garden — requires removing part of the litter. Leave as much as you can in place, however, to retain the benefits of the already active microbes and to “inoculate” the fresh material you add.

The whiff test

The caveat to the above rule against cleaning out too much of the litter is that inevitably the addition of nitrogen by the incoming manure will overwhelm the carbon in the mix — resulting in the generation of ammonia. Be alert to that first characteristic whiff: It is telling you that an imbalance must be corrected — both because nitrogen for soil fertility is being lost to the atmosphere, and because ammonia damages the chickens' delicate respiratory tissues. Re-establishing the necessary balance is simply a matter of generously topping off with your high-carbon litter material of choice.

Do note that ammonia's deleterious effects begin below the concentration our nose can detect (25 to 30 parts per million). With experience, you will learn to read the developing condition of the litter, so you can add fresh carbonaceous material before it starts generating ammonia.

Avoid wet litter

If you water inside, avoid wet litter. A soaked litter is anaerobic — deprived of oxygen — and more likely to support growth of pathogens. Wet litter also generates ammonia far more readily than drier litter.

Remember also that a lot of airflow through the coop helps keep the litter from becoming too damp. Wet litter is more likely around the waterer, so check conditions there often; scatter any wet litter out over the total litter surface, where the chickens' scratching will help dry it. Waterfowl are especially likely to wet the litter.

Remember as well, however, that the busy critters in the litter need water for their work — monitor the litter to ensure that it is not powder-dry. Caroline Cooper reports that the winter air in British Columbia is extremely dry, so from time to time her husband, Shaen, carefully adds water to the litter to keep it active. If I have a waterer inside the chicken house, I frequently empty the small amount of water in its lip directly into the litter when rinsing it out.

Using the compost

The deep-litter approach to manure management enlists the flock in the great work of soil fertility. Over time — figure at least a year — the litter will be reduced by the action of chicken and microbe to a finished compost. Sniff a handful: Like any fine compost, it will smell of earth with not the slightest hint of raw manure. In my experience, litter at this stage of decomposition is ready to use directly in the garden — it will not burn plants, it will not inhibit seed germination, and it visibly boosts the growth of crops.

I have found litter from a coop with a wooden floor too raw to apply directly in the garden. Such litter should be further broken down in a conventional compost heap before using in the garden.

Disadvantages of deep litter

In close to three decades of relying on deep litter for best manure management, I have encountered only two potential disadvantages. The slight wicking of moisture from the earth into the litter is, as said, actually a benefit. However, we once had a summer of record-breaking rains, resulting in increased moisture in the soil under the deep litter (remember, we use an earthen floor). The litter was not actually wet as a result, but was considerably damper than usual — damp enough to encourage the growth of molds. We had a number of eye infections that season, and lost an entire batch of 19 guinea keets. Once I recognized the problem, I helped decrease the moisture content of the litter by adding a lot of thoroughly dry leaves and kiln-dried shavings.

The other potential disadvantage of deep litter over an earth floor — assuming the henhouse is not on a block perimeter foundation — is the absence of a wood or concrete floor as a barrier against digging predators such as foxes, coyotes and dogs. My solution was to dig a barrier about 18 inches into the earth — using metal roof flashing, but half-inch hardware cloth would work as well — around the entire perimeter of the poultry house. That's a lot of digging (oh, my aching back!), but it prevents a lot of digging — by four-legged neighbors intent on dinner in your chicken house.

A win-win solution

I cannot overemphasize the importance of deep litter in the henhouse for the most natural and therefore the most rational manure management. A deep-litter house is more pleasant for both owner and fowl, with the birds doing most of the necessary work for us. Microbial action in the litter turns what is potentially disease-causing into a substrate for health — indeed, ripe litter as demonstrated in the Ohio studies has positive feeding benefits. Deep litter provides mental health as well — the entertainment of happily scratching an endlessly interesting deep litter, in lieu of the stress of boredom. A deep organic duff insulates the floor of the winter poultry house, while the warmth of its decomposition moderates the chill. Finally, this magic process captures the fertility in the manure for soil building, the key to food self-sufficiency. What better illustration

of the integrating strategies useful on the homestead?

This excerpt was taken with permission from The Small-Scale Poultry Flock, by Harvey Ussery, who has been working on his practical, natural-systems model for working with chickens and other domestic fowl for almost three decades.

Bioactive Litter for a Micro-flock: A tip from Kate Hunter

I'm on my second year of housing my tiny flock of layers in my shed over the winter. I build a temporary 5-foot-by-6-foot enclosure with garden caging, which gives them exactly the same space in the shed as they get in their mobile pen (7 1/2 square feet per bird). The shed's wood floor is protected from any possible moisture damage, first by a sheet of tar paper, and then a tarp, which I pin up along the inside of the caging. The tarp holds a 2-inch layer of garden soil as inoculant — that is, introduction into the litter of the same beneficial microbes in soil and in a compost heap — and then I fill with several inches of mulch. I continue adding mulch for several weeks after the girls have gone in, to an eventual depth of 12 inches. It absorbs the manure the hens produce without ever turning foul.

The litter makes for great wintertime activity — my girls love scratching in it. When it's frozen, they can't scratch it, so I go in there with a pitchfork every once in a while and turn things over for them. Then they get to scratching again. I also throw some of their feed directly on the mulch from time to time so that they have additional motivation to scratch through it and keep the mulch aerated and loose.

I emptied the tarp as soon as the housing was dismantled, and the girls were back outside last spring. I spread the litter as a fertility mulch under the apple tree. It smelled fine. There was no damage to the wood floor either.

– *Kate Hunter, homesteader, [Living The Frugal Life](#)*