

Investigating Benefits of Supplementing Broiler Feed with Broiler Litter Biochar

Introduction to B.C.'s Poultry Sector

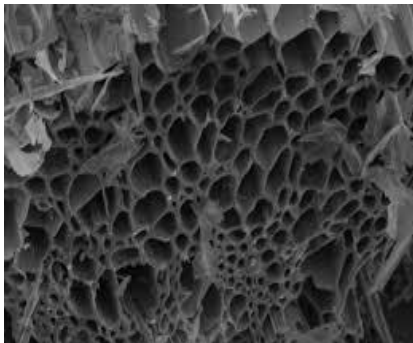
Each year B.C.'s poultry farmers raise and market over 180 million kilograms of chickens and turkeys, generating roughly \$420 million in total farm cash receipts. At any one time during the year, the Fraser Valley is home to almost 90% of the chickens and turkeys in B.C. At the end of the production cycle when chickens and turkeys are shipped for processing, litter is removed from the barn and often used as fertilizer through land application.



While litter from broiler chickens is a valuable source of crop nutrients, currently there are more soil nutrients available in B.C.'s Lower Mainland than are needed for the crops that are grown or that the land can sustain. Due to this surplus of soil nutrients, B.C.'s poultry sector has been working hard for many years to find cost-effective alternatives to the land application of used broiler litter in the Lower Mainland.

What is Biochar?

Similar to blackened charcoal found at the bottom of extinguished fires, biochar is black carbon created by heating organic material such as wood waste, straw or litter at high temperatures in oxygen-free or low oxygen environments. When applied to soils, the high surface area and porosity of biochar act as a catalyst for plant growth by helping to retain water and by providing a habitat for beneficial microorganisms to flourish.



Microscopic image of biochar

More recently, and because it helps in the grinding process and provides a habitat for beneficial microorganisms in the digestive system, it has been claimed that the consumption of biochar by broilers can increase uptake of foodstuffs and the energy contained within them. Increased uptake can result in increased weight gain and/or improved feed conversion.

Initially, while the idea of supplementing broiler feed with biochar made from broiler litter may seem strange, it should be noted that processed poultry litter has been used as a feed ingredient for almost 40 years in the U.S. Furthermore, heating broiler litter to 500°C+ for 30 minutes, (using a process called pyrolysis) is a very effective disinfection technique and ensures that biochar is free of pathogens.

Testing Potential Benefits of Biochar

To see if supplementing broiler feed with broiler litter biochar increases weight gain and/or improves feed conversion, a 35 day floor pen study with 288 male straight-run Ross 308 broiler chicks was carried out using 24 mini-pens (3ft by 4ft) assembled in the middle of a 14,000ft² poultry barn. The 24 pens were assembled in 6 blocks of 4 pens, with each block separated from the other by approximately 6 feet. Each pen contained a single 16-inch tube feeder and two nipple drinkers.

Broiler chicks were individually weighed and arbitrarily placed into the 24 pens and fed starter, grower and finisher broiler feed supplemented with 0% (T1), 0.5% (T2) and 1% (T3) biochar. The broilers were then weighed individually once weekly. All feed placed into the feeders was also weighed, and each week any feed remaining in the feeders was weighed back and replaced.

Does Biochar Really Make a Difference?

Table 1 shows average broiler placement weight, weight gain, feed consumption and feed conversion ratio for broilers fed T1, T2 and T3. While Table 1 shows small differences between weight gain, feed consumption and feed conversion ratio for broilers fed T1, T2 and T3, statistical analysis shows these differences are not significant. As such, these differences can only be attributable to chance and not as a result of supplementing broiler feed with broiler litter biochar.

Table 1: Average Broiler Weight Gain, Feed Consumption & Feed Conversion Ratio by Treatment

Treatment	Average Placement WT. (grams) ^a	Average 35 Day WT. (grams) ^b	Average Feed Consumption (grams) ^c	Average Feed Conversion Ratio ^d
T1 (0% biochar)	42.75	2,608.89	48,415	1.56
T2 (0.5% biochar)	42.15	2,561.16	47,004	1.58
T3 (1% biochar)	42.97	2,536.59	47,499	1.63

*a – Values within column not significantly different (p=0.368) b – Values within column not significantly different (p=0.574)
c – Values within column not significantly different (p=0.772) d – Values within column not significantly different (p=0.387)*

Any Ideas Why Biochar Didn't Make a Difference?

Once the feed trial was completed, laboratory analysis was performed on both the broiler litter biochar used in the study, and the litter in the 24 pens. Laboratory analysis of the broiler litter biochar showed that levels of aluminum (Al) and boron (B) were much higher than expected. While it is unknown why these levels were so high, it is important to note that the levels of Al and B may have been high enough to mitigate any benefits of supplementing broiler feed with biochar.

Laboratory analysis of the litter from the 24 pens also showed obvious trends between increased concentrations of Aluminum (Al), Iron (Fe), Manganese (Mn), Sodium (Na), Zinc (Zn), Phosphorous (P) and Chlorine (Cl), and increased amounts of biochar (Table 2). For example, the concentration of Na in litter from T2 pens was 17.6% higher than from T1 pens, while the concentration of Na in litter from T3 pens was 41.5% higher than from T1 pens. It is unknown exactly why supplementing broiler feed with broiler litter biochar would cause this to happen.

Table 2: Laboratory Analysis of Litter

Sample	Al ug/g	Fe ug/g	Mn ug/g	Na ug/g	Zn ug/g	P %	Cl ppm
T1 (0% biochar)	447.8	627.4	387.9	2,694.8	425.0	1.04	4,080.1
T2 (0.5% biochar)	495.7	691.4	393.0	3,168.5	448.9	1.08	4,135.6
T3 (1% biochar)	522.6	715.0	410.6	3,813.4	463.6	1.16	5,213.4

What Can We Conclude?

From the results of this study it can be concluded that supplementing broiler feed with broiler litter biochar had no statistically significant impact on broiler weight gain and/or feed conversion. While unknown as to why, it could be because of the nutrients in broiler litter; a result of the droppings and spilled feed that gets mixed in with the bedding material. It is therefore possible that the supplementation of broiler litter biochar resulted in the broilers being feed too high levels of certain nutrients. This assumption would go some way to explain the high levels of Sodium (Na) and Chlorine (Cl) found in the litter from T2 and T3 pens.

In other studies that have found significant benefits from supplementing broiler feed with biochar, other feedstocks were used to make the biochar; including oak, pine, coconut shells, corn cobs and peanut hulls. It is therefore possible that had an alternative feedstock be used (such as pine instead of broiler litter), supplementing broiler feed with broiler may have been a statistically significant impact on broiler weight gain and/or feed conversion.

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