Improving brooding for large broilers

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Importance of brooding phase

The brooding phase is a critical phase in the life of chickens. During this early period the ability to self regulate body temperature is not completely functional. The immune system, digestive system, muscles and bones are developing at rapid rates. Any reduced development or damage incurred during these first days may not show in performance until later in life. Typical results of improper brooding practices are poor livability and flock uniformity, ascites, flip overs, heart attacks, leg problems, depressed body weights, poor feed conversion and increased processing plant condemnations (Meijerhof and Furmanek; Visser, 1998). It is essential to provide the optimal temperature for the chick's comfort and development. Significant improvements can be achieved with slight adjustments to growers brooding practices. The broiler business is getting more competitive and profits in live production are found in paying attention to the small details. This period requires more attention, not always given by growers.

Appropriate management of optimal temperatures in broiler houses has a tremendous economical and environmental impact on broiler production. This factor has become even more important lately for poultry growers, since fuel costs for brooding have increased considerably over the last 1 and one half years and currently are $1.40 to 1.80 per gallon for propane gas.

How to help growers to do optimum brooding?

Several factors are necessary for good brooding. Three important ones are to provide adequate temperature, air quality and to offer easy access to water and feed for the entire flock. This is not very easy as it sounds, since in each flock and in each house we deal with a very variable population of birds. Some growers are still not conscientious about the importance of all these factors during the first days of life of a flock. The misconception that some extra heat during brooding is always better is well accepted by technicians and growers.

Guidelines for brooding?

Current guidelines developed by integrators for the brooding process are either a best guess situation with regards to what the house temperature should be for the new hatchlings, or base on research data produced years ago. The grower is expected to maintain the proper house temperature during cool weather by having the house temperatures at prescribed levels and ventilate as needed to maintain proper air quality with regards to moisture and ammonia. This requires the use of a certain amount of fuel. Often the growers will reduce fuel usage by restricting the ventilation of the house. This

however can result in elevated moisture and ammonia levels that can have detrimental influence on growth and performance of the broilers.

Genetic selection has resulted in broilers having a increased growth rates. They consume more, at a faster rate, and have a higher metabolic heat production, needing lower brooding and environmental temperatures than in previous years in order to maintain their thermoneutral comfort zone. You can observe in Table 1 a comparison between heat production and the calculated thermoneutral temperatures between chickens of the 1970's and modern chickens. Our field data shows that many growers and integrators may be using excessive air temperatures at certain times during the grow- out period for large broilers because of their uncertainty as to the "needed temperature by the chicks".

Table 1. A comparison of heat output and calculated comfort temperature[1] for male and female broilers of 1970's and today.

Age days	Heat production, kJ/d				Comfort temperature, °F			
	1970's		2004's		1970's		2004's	
	Males	Females	Males	Females	Males	Females	Males	Females
7	180	180	204	200	90	90	84	84
14	410	350	468	458	86	85	77	78
21	760	620	845	843	82	81	68	70
28	1030	866	1260	1250	78	75	60	63
35	1444	1030	1545	1600	74	70	54	58
42	1650	1165	1785	1840	71	65	53	59

[1]Calculated as the average of the lower and the upper critical temperature within the thermoneutral range. *Adapted from Gous and Morris, 2005, WPSJ 61(3): 463-475.*

What are the optimum temperatures?

Providing adequate brooding temperature for a flock of chickens is not as easy as it sounds, since broiler flocks are a variable population of birds. Variations in hatchlings' body weights of more than 5 grams indicate that you have different birds with different environmental needs for optimum growth. Optimal conditions for a flock vary according to the genetic line (breed) and age of the breeder flocks, season of the year, hatcher temperatures, transportation conditions from the hatchery to the farm, and the type of brooding equipment to name a few (Nichelmann and Tzchentke, 2003).

Recent work has shown how important temperature during incubation is in post hatch performance (Nichelmann and Tzchentke, 2003; Black and Burggren, 2004; Yalçin et al., 2006). The work has shown how incorrect embryonic temperature can result in detrimental effects on the size of some important embryonic organs (heart, yolk sac, intestines, muscle and bones, etc.). Maturation of the chick is an important determination of performance. The new hatchlings enter into a process of going from primarily a poikilothermic to a homeothermic entity. During this process, the hatchlings deep body temperature is directly affected by ambient temperature and as such is subject to drafts.

bedding/floor temperature, and heat sources (Visser, 1998). This means every hatch may need slightly different brooding temperatures.

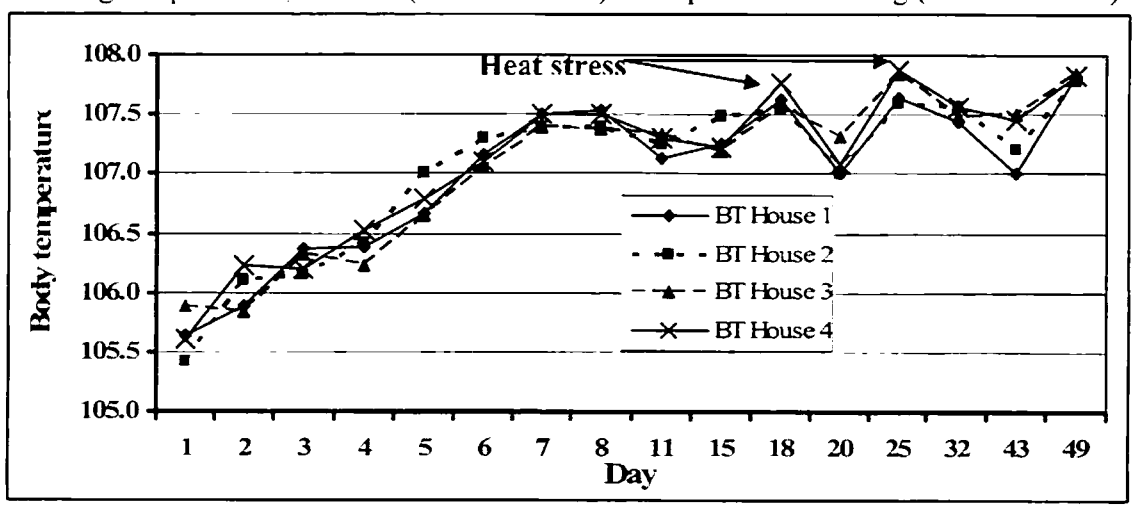
All the previous conditions make every flock a little bit different in their thermoregulatory abilities. It is clear that optimal house temperatures for brooding might not be the same for every flock. Our data suggests that recommended temperatures are needed to avoid poor performance. But, to obtain the best performance of every flock requires some art and science that each grower must develop and apply to individual houses.

The optimum air temperature depends more on the bodyweight and the growth rate of the flock than on the actual age. If a flock grows faster produces more heat and growers should adjust the temperature profile as well. If we keep on controlling the house temperature based on a standard profile, not adjusting for the increased growth, we are not only spending more fuel than necessary, but we are also punishing the bird for the extra growth that it gave us, and as a result some chickens will reduce their feed intake, and consequently the flock uniformity and the average growth rate will go down again (Meijerhof, 2007).

Tools to assess optimum brooding temperatures!

Our preliminary work under lab and commercial conditions indicates that chick body temperature can help broiler growers to gauge proper house temperatures. Chick body temperature data can be easily collected with pediatric thermometers at very low cost. Rectal temperatures of 104 to 105 °F are normal physiological temperatures that we need to maintain during the first week. Rectal chick temperature will rise to 105 or 106 °F after 5 days of age. Higher body temperatures during the first week are detrimental and should be avoided (Figure 1). Rectal temperatures are indicators of effective temperature which is dependent upon environmental temperature (dry bulb), relative humidity and air speed.

Figure 1. Chicken body temperatures (°F) in four chicken houses exposed to two brooding temperatures, Control (House 3 and 4) and optimum brooding (House 1 and 2).



Average values of 25 chickens per house per day (50 chickens per treatment)

Optimum body temperatures can also be affected by litter conditions. Litter temperature is different than the air temperature which is measured at chick height. Litter temperature creates the comfort zone for the chicks, not the air temperature. Optimal body temperatures can be obtained with good house preheating and litter temperatures of

90 to 92 °F for the first day. Growers with low early mortality and excellent results normally keep litter temperature, measured one inch into the litter, higher than 82 °F during the first week. Properly calibrated infrared thermometers can help growers to determine those litter temperatures. Make sure that you help your growers to have good tools to assess best brooding conditions.

We have conducted trials under commercial conditions using rectal temperatures to determine optimal house temperatures for broilers. As an example, the results of one of these trials indicated that the optimal brooding treatment had better average body weight gain (77g) (Table 1). better flock uniformity (Table 2), 4 points improvement in feed conversion and 39% savings in fuel during the grow-out cycle of 63 days (Table 3). These improvements may have an annualized impact of almost 2 million dollars in a typical commercial broiler operation in North Carolina. Similar results have been observed in the other trials.

Table 1. Body weights (grams) of broilers Ross-708 raised under two conditions of brooding temperatures.

Day	Treatments		Δ[1]	Mean	SEM[2]	CV %	*n*[3]	*P*-value
	Control	Optimum brooding						
7	164	162	-2	163	1.4	10.44	150	0.5085
21	743	707	-36		4.2	10.13	300	<.0001
63 d Males	4533	4560	27	4535	24	7.72	400	0.5861
63 d Females	3570	3644	74	3599	19	8.03	400	0.0123
66	4046	4123	77	4085				

[1]Difference between Optimum brooding and Control treatments
[2]Pooled standard error of the mean. SEM
[3]Sample of broilers per treatment. 100 broilers of each sex per house at 63 d of age.

Table 2. Flock uniformity (expressed as coefficient of variance CV%) at 63 days of age of broilers Ross-708 raised under two conditions of brooding temperatures.

Day	Treatments							
	Control				Optimum brooding			
	Mean	SEM	St Dev	CV%	Mean	SEM	St Dev	CV%
Males	4533	24	336.08	7.41	4560	24	336.54	**7.38**
Females	3570	20	277.80	7.78	3644	17	239.59	**6.57**

Table 3. Live performance parameters of broilers Ross-708 raised under two conditions of brooding temperatures.

Parameter	Treatments		Δ[1]
	Control	Optimum brooding	
Feed conversion, g:g	2.18	2.17	- 0.01
Adjusted feed conversion	1.92	1.88	- 0.04
Fuel usage, gallons	1160	710	450

[1]Difference between Optimum brooding and Control treatments

The type of brooder affects temperature profile

Adjusting temperatures to obtain proper air and litter temperatures change according to the type of brooders used in each farm or house. Forced air furnaces require higher temperature settings because they heat the air which in turn heats the floor. A conventional pancake brooder directs approximately 40% of its heat to the floor and 60% to the air. Radiant brooders project approximately 90% of their heat to the floor and 10% to the air. Radiant tube heaters are very efficient to warm litter surface, but can overheat chickens if target temperatures are maintained similar to the ones used with other types of brooders. Since pancake and radiant brooders direct heat to the floor, the air temperature required to get the desired floor temperature is lower than that required for forced air furnaces.

To make adequate adjustments of air temperature in a tunnel ventilated house is necessary to have proper placement of sensors/thermostats. They should not be too close to a brooder or too low to the ground where birds can crowd around the sensors and give a false high temperature. They should also not be too close to the side wall, brood curtain or where air is entering the house.

Other house conditions to consider in optimum brooding

Used litter produces some heat due to bacterial activity. Pre-heating the house sufficiently should increase litter temperature giving the birds a better start. If birds have a good start, their better feed intake and metabolic heat production will help to drop the temperatures of the house much more quick, saving even more gas than the spent initially used on pre-heating the house.

In very dry conditions (less than 35% relative humidity) the temperature required to obtain comfortable effective temperature is lower. However, for optimum flock performance, try to keep the relative humidity of the brooding zone between 60 and 70%. Higher temperatures can give you lower first-week mortality, because they favor the survival of small chicks, but it can reduce your final flock performance and profitability due to heat stress in the larger baby-chicks coupled with increased gas usage. These differences will be magnified when you are growing heavy birds (> 6 lbs).

It is important to try to keep the chicken house temperatures constant. Daily variations are normally between ± 5 °F. Sometimes, growers trying to maintain the temperature and be more efficient in gas usage, reduce ventilation and consequently the air quality. High ammonia (> 20 ppm) and carbon dioxide (> 3000 ppm – 0.3%) are as bad as low temperatures for chicks and poults. Use litter amendments to reduce ammonia production of used litter. Brooders that are too near to the ground can reduce the oxygen concentration that normally is 20.9% to 16 or 17%. Make sure your minimum ventilation system works at least one minute out of every five. The inlet system should react to the fan capacity and maintain the same pressure drop in the house regardless of the number of fans in operation. Not enough inlet leads to poor air volume and too much inlet leads

to air falling quickly onto birds. Inlets should direct air into the peak of the house, allow time for mixing and warming before the fresh air reaches the birds.

Water and feed are absolutely necessary!

This previous statement seems obvious, but in practice depending on the diligence of each grower, 5 to 15% of the chickens in a flock do not get enough access to feed and water during the first days, affecting their performance per life and the average response.

Water temperature is important to stimulate water and feed intake especially during the winter. Water temperature measured in cups or nipple samples should be comfortable to maintain body temperature. Try to maintain water temperature around 78 °F the first three days. Water temperatures lower than 70 °F during the first week increase early mortality.

Water quality is very important, and constant water sanitation during the first week is the main factor to reduce early mortality of chicks and poults. Water line cleaning and sanitation with full flushing should be done after every flock. Additionally, review the water lines during regular maintenance, dirty triggers can either keep open or stick closed, worn out triggers fail to seal. Proper water filtration and sanitation should be done during the first week. It is a relatively low volume (around 9.000 liters/house) to treat that will give a return of better flock performance. Your growers need to adjust the water pressure from the previous flock every time. Baby-chicks can not trigger the nipples at the pressure used for 6-week broilers (60 ml – 2 oz/minute). The rule of thumb for the first week, chicks need a water line pressure of 20 ml (0.70 oz)/minute. Even with excellent water lines, offer supplemental water in baby-chick drinkers.

The nipple or drinker height during the first two days should be at eye level. Nipple types with poor side activation need to be slightly higher. Later on (3-5 days), chicks should stretch their necks to drink.

Finally, make sure that your growers stimulate feed intake during the first week and especially during the first hours. You want a minimum of 95% of your birds having feed in their crops four hours after arrival. Walk birds to keep them moving and reaching the feed. Place fresh feed first thing in the morning and two or three times per day, even if feed is still in paper, lids or pans. Use enough feeder lids or feeder space. If all the feeders are constantly full of chicks, it means that there is insufficient feed space available. Keep track of the amount of feed consumed during the first week or the time that they take to consume the starter feed. Flocks that eat 1.5 lbs of starter feed in less than 16 days have the best feed conversions, uniformities and body weights. Use light intensities minimum of 2.5 foot-candles (25 lux) in the brooding area measured at chick level during the first week.

Conclusions

It is important to provide objective management tools to growers to help growers attain a more correct brooding temperature to improve broiler live performance, reduce

gas usage, allow proper ventilation, improve air environment and reduce ammonia production. Rectal temperatures can be used as a tool to adjust ambient temperature in tunnel ventilated houses with half or central brooding. Additionally, litter temperatures can help to adjust properly the house target temperatures. Results of commercial evaluations indicate that it is possible to improve broiler live performance and meat yield while conserving gas, when brooding temperatures are adjusted according to the average flock body temperatures.

You can learn to help growers to obtain the best results possible of each flock in each house with measurements of rectal temperatures, average body weight, flock uniformity and mortality during the first week. The target body weight at the end of the first week should be four times the initial average body weight. Obtaining average body weights of more than five times initial chick-weight is correlated with high late mortality and more heavy broilers culled due to leg problems.

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