REVISED FEBRUARY 1999

Brooding Management of Broilers

Ross Tech

ROSS

ROSS TECH 99/34

Genetic progress over the last 10 years has steadily improved broiler economic performance. One component of this is growth potential which has increased each year by 60 grams at six weeks of age. In order to achieve a standard processing weight (of e.g. 2kg), the age at which a flock of broilers are killed has fallen by, on average, 1 day per year over this time. Birds of 2kg that were killed at 49 days in 1988 are now killed at 39 days. The consequence of this change is that the brooding period now takes up a much bigger proportion of the whole growing period and is more important in the final performance of the flock. Over the same 10 year period, the equipment used in brooding and starting chickens has changed, and some of these changes have significant consequences for the well-being of the day-old chick.

Our customers have become more focussed on the predictability of performance and uniformity of the product at all stages, especially in the processing plant. Many features of broiler management can affect uniformity and, in some cases, small changes in management technique can make a previously unimportant factor critical (e.g. the need for more feeding space once feed intake control is initiated)

This Ross Tech is aimed at encouraging better general management and especially brooding management for broiler flocks, to improve performance and uniformity.

1. Chick Supply & Planning

a. Age of Parent Flocks

Young breeder females lay small eggs, which in turn produce smaller chicks (chick weight is usually 65-68% of egg weight). The small chicks can perform very well, provided that they can be managed separately from chicks produced by more mature parents. Planning broiler placements to separate chicks from young parents will improve their subsequent performance. Mixing will give a lighter flock on average, with much poorer uniformity. The flock will also be more difficult to manage - e.g. setting drinker & feeder heights.

b. Nutritional Status of Parent Flocks

If a young parent flock is fed a diet deficient in linoleic acid, essential amino acids, or vitamins then chick quality will suffer. It is advisable to feed breeder parents a pre-breeder diet from 15-16 weeks, and introduce them to the layer diet by about 21 weeks. If peak feed allowances are low, nutrient levels may need to be increased. For further details on breeder nutrition refer to our Parent Stock Management Manual.

c. Breed

Mixing breeds at the hatchery can ease the planning process. However, modern broiler breeds will grow along different growth curves, even if terminal weights are very similar. Mixing breeds can set up a very uneven flock.

d. Health Status of Parent Flocks

Healthy broiler parents have the greatest chance of producing healthy broiler chicks. Parents should be free of all salmonellae, *Mycoplasma synoviae* and *M.gallisepticum*. Prior to coming into lay, parent stock should have protective antibody titres to infectious bronchitis (IB) (including local variants), avian rhinotracheitis (ART), reovirus, Newcastle disease (NDV), avian encephalomyelitis (AE), infectious bursal disease (IBD) and chick anaemia virus (CAV). Poor or late seroconversion for CAV in parent stock may result in poor uniformity of the progeny. Control of coccidiosis should be either via the use of live attenuated vaccine or in-feed medication.

e. Vaccination of Broilers

In broad terms, broiler parent flocks with the serological status described previously will produce progeny with maternal immunity offering protection over the first three weeks of life. High field challenges may require intervention with vaccines within this three-week time period. Broilers will require vaccinal protection against NDV, IB and IBD. Recent advances in ART research suggest that protection may only be required during the final week of broiler production. Coccidiosis control is commonly achieved by in-feed medication although the future may see a generalised move towards the use of live attenuated vaccines in the first week of life.

In some countries, broiler stock grown to heavier weights may require vaccination against Mareks disease. Different countries currently vaccinate with Rispens or HVT strains at the hatchery prior to dispatch. Sub-clinical effects of Mareks disease can be a cause of broiler variability. As field challenges will vary between geographical areas, specific vaccination programmes should be discussed with the local veterinary surgeon.

2. House Preparation & Environment

Houses and equipment must be cleaned, disinfected and set-up in time for the brooders to be started and temperatures to reach the desired level before the chicks arrive. Temperatures should be checked at chick level - with the short turn-around periods usual for broiler houses, the floor might still be cold when the air at 1 metre above is warm. For the comfort and survival of the chick, the floor temperature is the more relevant. The final arbiter of whether or not temperatures are correct must always be chick behaviour and stockmen must be responsive to changes in behaviour.

One of the major objectives in the brooding period is to develop appetite in the young chick. High temperature has the effect of depressing appetite resulting in problems with slow starting chicks and poor subsequent uniformity. The temperature guidelines given in the following sections should be regarded as maximum temperatures to prevent problems of over heating of chicks and to develop appetite.

a. House Temperature - Spot Brooding

Initial house temperature should be 25-27°C (75-80°F). House temperature should be reduced in line with brooder temperature to achieve a final house temperature of 20-22°C (68-72°F) by 24-27 days.

The initial temperature under the brooders should be 29-31°C (87.8-91.4°F). Thereafter, temperature under the brooders should be reduced by an average of 0.2-0.3°C (0.4-0.6°F) per day. (See Table 1).

b. House Temperature - Whole House Brooding

Where a whole house brooding system is used, the initial brooding temperature at chick level should be 29-31°C (84-88°F). House temperature should be reduced gradually, in response to bird behaviour and condition, to achieve a final temperature of 20-22°C (68-72°F) by 21-24 days. (See Table 1).

c. Humidity

Humidity in the hatcher, at the end of the incubation process will be high. (Relative Humidity (RH) approx. 80%). Houses with whole house heating, especially where nipple drinkers are used, can have RH levels as low as 25%. More traditionally equipped houses, with spot brooders (which produce moisture as a by-product of combustion) and open water surfaces in bell drinkers have a much higher RH, usually over 50%. To limit the shock to the chicks of transfer from the incubator, RH levels in the first 3 days need to be around 70%.

RH within the boiler shed should be monitored daily. If RH falls below 50% in the first week the chick will begin to dehydrate causing negative effects on performance and action should be taken to increase RH.

If the house is fitted with spray nozzles for cooling the older broilers in high summer temperatures, then these can be used to raise RH to the desired level at placement. If not, large containers of open water placed in front of the heaters will boost RH levels to more acceptable levels. Chicks kept at appropriate humidity levels are less prone to problems with dehydration and generally make a better, more uniform start.

As the chick grows the ideal RH falls. High RH from 18 days can cause problems with wet litter. As birds increase in weight RH levels can be controlled using ventilation and heating systems.

TABLE 1: BROODING TEMPERATURES

WHOLE HOUSE		SPOT BROODING			
Age (days)	Temp °C (RH=60-70%)	Age (days)	Temp °C		
			Brooder Edge	at 2m diameter	House
			A	B	C
D/O	29	D/O	30	27	25
3	28	3	28	26	24
6	27	6	28	25	23
9	26	9	27	25	23
12	25	12	26	25	22
15	24	15	25	24	22
18	23	18	24	24	22
21	22	21	23	23	22
24	21	24	22	22	21
27	20	27	21	21	21

D. Interaction of Temperature and Humidity

All animals will lose heat to the environment by evaporation of moisture from the respiratory tract and through the skin. At high RH less evaporative loss occurs increasing the apparent temperature. The temperature experienced by the bird is dependent on the dry bulb temperature and RH. High RH increases the apparent temperature at a given dry bulb temperature whereas low RH decreases it. The temperature profile in table 1 assumes RH in the range 60 to 70%.

The temperature experienced by the chick can be expressed by calculating the Apparent Equivalent Temperature.

Table 2 shows the predicted dry bulb temperature required to achieve the target temperature profile over a range of RH. The information in table 2 can be used in situations where RH is observed to vary from the target range (60-70%) in table 1.

In RH's outside the target range the temperature of the shed at chick level can be adjusted to match that given in table 2 taking care at all stages to monitor chick behaviour to determine that the chick is experiencing an adequate temperature. If subsequent chick behaviour indicates the chicks are too cold or too hot the temperature of the shed should be adjusted appropriately.

E. Ventilation

Keeping chicks warm at placement is vital. Some chilled chicks will die, and many more will grow poorly. Warmth should not be achieved at the expense of fresh air, however. Sealing every gap in a poorly insulated house in order to achieve brooding temperatures at least gas cost will cause oxygen depletion and the build-up of noxious gases such as carbon dioxide. This may lead to problems with ascites when the birds are older and a number of sub-clinical problems affecting performance.

3. Equipment

It is important to consider the young chicks as well as the growing broiler when selecting equipment. It is also important to ensure that all chicks have unlimited access to feed and water. Historically, supplementary feeders and drinkers were supplied for a few days to get chicks started. The supplementary feeders have been replaced by floor feeding, but less attention is paid to drinker systems, largely because of the high labour requirement of so doing. This can be especially detrimental where humidity levels are low.

4. Infectious Causes of Poor Uniformity

Although the majority of uniformity problems can be related to management and nutrition, there are a number of infectious causes of poor uniformity. These agents may cause clinical or subclinical problems.

A. Bacteria

Any systemic bacterial infection in the day-old chick will affect health and performance or even cause death. By far the most common isolate from this condition is *Escherichia coli*. The presence of this bacterium in faeces allows infection of the egg by penetration of the egg shell. Yolk sac infection will occur commonly following this. *E.coli* can also infect chicks via the respiratory route resulting in lesions involving the respiratory tract and internal organs. Inappropriate early management practices leading to chilling, starvation and dehydration will markedly increase susceptibility to bacterial infection.

TABLE 2: TEMPERATURE PROFILES FOR DIFFERENT RELATIVE HUMIDITIES

Age (days)	Ideal Temp °C	RH% range	Temperature at RH%						
			40	50	60	70	80	90	100
0	29.0	65-70	35.5	33.0	30.5	28.6	27.0	25.5	24.0
3	28.0	65-70	34.5	32.0	29.5	27.6	26.0	24.5	23.0
6	27.0	65-70	33.5	31.0	28.5	26.6	25.0	23.8	22.5
9	26.0	65-70	32.0	29.7	27.5	25.6	24.0	22.5	21.0
12	25.0	60-70	29.5	27.2	25.0	23.8	22.5	21.0	19.5
15	24.0	60-70	28.5	26.2	24.0	22.5	21.0	19.8	18.5
18	23.0	60-70	27.0	25.0	23.0	21.5	20.0	18.8	17.5
21	22.0	60-70	26.0	24.0	22.0	20.5	19.0	17.8	16.5
24	21.0	60-70	25.0	23.0	21.0	19.5	18.0	17.0	16.0
27	21.0	60-70	25.0	23.0	21.0	19.5	18.0	17.0	16.0

The temperature profiles are predicted by calculating the Apparent Equivalent Temperature for the target whole house brooding temperature and RH (Table 1). The dry bulb temperatures required to maintain Apparent Equivalent Temperature are then calculated for each different RH.

Infection with *Mycoplasma* leads to significant under performance and it is therefore important that both parents and broilers are free from this disease.

Recent changes in regulations relating to the use of in-feed digestive enhancers have lead to an increase in the finding of necrotic enteritis. This disease is caused by *Clostridium perfringens* type C. Although in clinical outbreaks the gross pathology caused by the destruction of the lining of the small intestine is usually characteristic, histological investigation of runted birds has shown subclinical necrotic enteritis as early as seven days of age. There is an association of this disease with coccidiosis or other causes of enteritis.

B. Fungi

Fungal effects on runting and stunting relate to the ingestion of any of a number of toxins. Exposure to the mycotoxin e.g. ochratoxin or aflatoxin, occurs most often through the consumption of contaminated feed resulting in liver damage. The broiler then fails to thrive due to the metabolic capacity of the liver being compromised. Infection with the actual fungi e.g. *Aspergillus* is associated with high mortality and therefore presents as a different clinical syndrome.

C. Parasites

The *Eimeria* species of coccidia are the most important parasitic cause of poor broiler uniformity currently. This is frequently seen as an interaction with necrotic enteritis. Although the clinical outbreak of coccidiosis with characteristic bloody droppings, scour, depressed birds and mortality is easily recognised by the experienced farmer, a subclinical infection that affects growth by causing a low level intestinal irritation is more difficult to detect and may require histology for accurate diagnosis. Inclusion of appropriate coccidiostat medication in-feed is essential although live attenuated coccidial vaccines may be used in the future. Round worm infection may interact with the presence of coccidiosis but the problem is usually confined to free range systems.

D. Viruses

There are many potential viral causes of infectious stunting syndrome. The situation is particularly complex as a large number of viruses may be isolated from the normal broiler. Indeed, it is possible that a combination of agents is required to produce the clinical condition. The most convincing evidence relates to enteric infection with reovirus. However, when these viruses are isolated and re-introduced to healthy chickens, clinical signs are not always reproduced.

In infectious stunting syndrome, birds will often display clinical signs of diarrhoea, nervousness, litter eating, helicopter feathering and excessive drinking together with poor growth. Although autogenous vaccines have been used in the treatment of this disease, the results have often been unrewarding. Furthermore, autogenous vaccines allow the possibility of spread of other diseases within a population and their use is to be discouraged. This leaves good biosecurity and hygiene as the best defence against these potential causes of unevenness in flocks.

5. Feed

Day-old chicks require easy and early access to water and to a feed of high digestibility and palatability. If lights are left on after placement, feed should be immediately available. An alternative strategy, and possibly a preferable one, is to turn the lights off immediately after placement for up to 12 hours, so that the birds rest and are hungry when light is restored. This strategy should only be applied where appropriate house temperatures and humidity are achieved.

Nutrients are available to the chick from the yolk sac and from absorbed feed. The former supplies mainly lipid and protein whilst the feed will provide both of these nutrient sources together with a large proportion of carbohydrate. Utilisation of yolk sac nutrients is increased in birds which initiate early feeding, a feature which also stimulates the uptake of protective antibodies. The recent development of feed supplements which can be given during chick delivery may be helpful under conditions where transport stress on day-old chicks is very high.

Nutrient ingestion starts in the embryo at about 14 days of incubation. Consumption of amniotic fluid facilitates uptake of antibodies and also leads to some development of the digestive system. However rapid changes and development are still required in the digestive tract immediately post-hatching and both feeding and management should facilitate this. The rate of passage of feed, the secretion of digestive enzymes and the activity of gut enzymes all increase dramatically. These changes match the capacity to digest carbohydrate and protein to their increasing intake.

Amongst the digestive enzymes secreted by the pancreas, lipase secretion develops most slowly. Together with limiting levels of bile-salt production, this means that fat digestion and absorption are reduced in young chicks. Dietary fats should be kept at low levels in broiler starter feeds and the fat used should be of high digestibility. The fat in cereals and ingredients such as soya bean meal, are of high digestibility and are suitable for young chicks. Added fats should be of a similar high quality and, in particular, high levels of saturated fats, as in tallow and other mammalian fats, should be avoided. Fat impurities such as oxidation products, trans fatty acids and non-saponifiable material must be avoided.

All ingredients for starter rations must be fresh and of high quality. Proteinase inhibitors, tannins and other anti-nutritive agents should be controlled and avoided as much as possible. Feed planning and feed mill and farm hygiene should ensure that fresh food is available, especially in the very earliest stages.

Early chick growth will generally be higher if a high quality crumbled and sieved feed is used. This is particularly true where a wheat-based diet is used when use of meals will lead to pasted beaks and other intake problems. Crumbs should be fed to 7 to 10 days of age. Chicks can be started well on a meal feed, particularly if maize is the dominant ingredient, but recent research has emphasised the importance of both particle size and the distribution of particle sizes when meals are used. A medium particle size (geometric mean diameter about 0.95-1.25 mm) has given best performance in trials. However the distribution of particle size should also be reasonably narrow so that fine particles are excluded as far as possible.

In a pelleted feed system, crumbs should be followed by a pellet of 2-3mm diameter. It is preferable to separate change of feed form from change of formulation if this is possible. Thus a schedule involving crumbed starter, pelleted starter and pelleted grower or developer will help to maintain uniform growth. Other features of feeding systems which affect early growth include the introduction of whole grain feeding and the initiation of controlled feeding.

The specification of broiler starter feeds can follow conventional lines. An example is given in Table 3. Theoretical considerations suggest that broilers go through a short phase in which amino acid requirements are higher than those normally used (see Figure 1). Whether these potential responses should be exploited in practice is an economic question. However the possibility that some birds in the population are being underfed, even on typical high quality feeds, should be recognised.

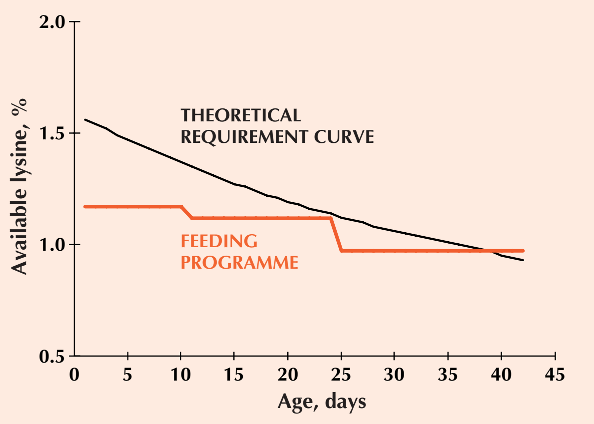
Feed formulation using the specification in Table 3 is probably as important as small variations in nutrient levels.

The following points should be emphasised:

- use only fresh, high quality ingredients of known composition.
- use added fats only at levels required for good feed processing, possibly up to 1% added fat.
- use high quality vegetable fats even at these low levels.
- cereal use will be largely determined by economics and availability. This, together with the above policy on fat usage, will largely determine the energy level achieved.
- dietary enzymes will probably be beneficial, but should not be used to cover poor quality cereals.
- use of moderate levels of high quality fish meal, up to 4%, continues to be a good practice.
- higher fibre vegetable protein sources should be avoided as far as possible.
- good control of mineral balance in feed formulation (and manufacture) is essential.

Good nutrition in the early stages of chick growth will contribute to high levels of overall performance and to maintenance of a uniform flock.

FIGURE 1: Graph comparing a theoretically calculated lysine requirement with a typical practical feeding programme. The theoretical curve is calculated to give the potential growth and body composition of a modern broiler genotype male.



In Summary

Excellent growth and uniformity of broiler chicks can be achieved by implementing best management practices in a number of areas:

- **chick supply and planning**
- **house preparation and environment**
- **appropriate equipment**
- **good biosecurity and health management of parents and broilers**
- **good nutrition of parents and broilers**

The modern broiler's performance requires that we put more emphasis on the brooding conditions in order to achieve uniform flocks at depletion and processing.

This Ross Tech concentrates on components of broiler management which are most likely to benefit flock uniformity. For more detailed information please refer to the Ross Broiler Management Manual.

Acknowledgement: The data in table 2 were produced by M Mitchell and R Hunter of Roslin Institute (Edinburgh).

TABLE 3: SPECIFICATION FOR A BROILER STARTER FEED

Nutrient or Constraint		Level	Comments
Crude protein	%	21-23	lower levels of high quality protein are generally beneficial to young chicks
Metabolisable Energy	MJ/kg kcal/kg	12.60 3010	depends on ingredient availability & economics
Oil	*total level* % *added* %	4-7 1-2	 highly digestible fat only
Lysine	*total* % *available* %	1.36 1.18	
Methionine	*total* % *available* %	0.53 0.48	
Methionine + Cystine	*total* % *available* %	0.98 0.87	
Threonine	*total* % *available* %	0.91 0.79	
Tryptophan	*total* % *available* %	0.23 0.20	
Calcium	%	0.95	
Available Phosphorus	%	0.50	
Sodium	%	0.16-0.20	balance electrolytes
Potassium	%	0.60	balance electrolytes
Chloride	%	0.16-0.22	balance electrolytes
Linoleic Acid	%	1.25	
Choline	mg/kg	400	Do not include in premix

LEVELS IN PREMIX				
		Wheat-based Feed	Maize-based Feed	
Vitamin A	iu/kg	15000	14000	
Vitamin D3	iu/kg	5000	5000	
Vitamin E	iu/kg	50	50	higher levels may be beneficial
Vitamin K	mg/kg	4	4	
Thiamine (B1)	mg/kg	3	3	
Riboflavin (B2)	mg/kg	8	8	
Pyridoxine (B6)	mg/kg	5	4	
Niacin	mg/kg	60	65	
Vitamin B12	µg/kg	16	16	
Pantothenic Acid	mg/kg	18	20	
Biotin	µg/kg	200	150	
Folic Acid	mg/kg	2	2	
Manganese	mg/kg	100	100	
Zinc	mg/kg	80	80	
Iron	mg/kg	80	80	
Copper	mg/kg	8	8	
Iodine	mg/kg	1	1	
Molybdenum	mg/kg	1	1	
Selenium	mg/kg	0.15	0.15	

For further information on the range of technical literature available for Aviagen Stock please ask your local Technical Services Manager or contact our Marketing Department at:

Aviagen Limited
Newbridge
Midlothian
EH28 8SZ
Scotland
UK

tel: +44 (0) 131 333 1056
fax: +44 (0) 131 333 3296
email infoworldwide@aviagen.com

Aviagen Incorporated
5015 Bradford Drive
Huntsville Alabama 35805
USA

tel:+1 256 890 3800
fax: +1 256 890 3919
email info@aviagen.com

website www.aviagen.com

JULY '03

Aviagen