



Optimizing Broiler Feed Conversion Ratio

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This article has been written specifically for poultry producers in Latin America. However, the recommendations given are expected to be useful and informative for other world regions. The aim of this article is to provide information on areas for consideration/action if a flock FCR problem exists. For further guidance on specific management actions that should be put in place please refer to the Broiler Management Manual and your local Technical Manager.

SUMMARY

Introduction

Feed conversion ratio (FCR) is a measure of how well a flock converts feed intake (feed usage) into live weight. Small changes in FCR at any given feed price will have a substantial impact on financial margins. Solving, or preventing, FCR problems in a flock requires both good planning and good management. The key to preventing FCR problems is ensuring that throughout the brooding and grow-out period, good management practices are in place so that bird performance is optimized.

Determining the scale of the problem

Before investigating the cause of an FCR problem, it is necessary to be certain that a problem does exist. For this, normal patterns and patterns of change in FCR must be identified and understood. Having established that a real problem exists, the next step is to determine the scale of the problem.

Determining the cause of an FCR problem

There are a number of different factors that can negatively impact flock FCR.

- Hatchery management: conditions during the hatching process will affect growth rates and FCR through their effect on gut development. Inappropriate conditions during chick transport can also impair early chick development and final flock FCR.
- Brooding: the brooding period is a critical time for gut development and hence the efficiency of feed utilization. Management during this time is therefore key.
- Measurement failure: over-estimation of actual feed usage and / or under-estimation of actual live weight will inevitably lead to an apparent worsening of FCR which is not real.
- Feeding management: inappropriate feeding and feeder management will affect flock FCR through its affect on feed intake and feed spillage. Feeding space, feeder height and the provision of good quality feed is important.
- Water management: the provision of adequate drinking space and a source of clean water is essential. A reduction in water intake will lead to a reduction in feed intake and an increase in FCR.
- Temperature: maintaining the correct environmental temperature and avoiding temperature fluctuations is important if FCR is to be optimized.
- Feeding program: the provision of the correct nutrient density at the correct age will optimize feed intake and growth, and ensure the efficient utilization of nutrients.
- Feed formulation and manufacturing: errors during the feed manufacturing process are difficult to diagnose but can lead to feeds of reduced quality being offered to the birds, affecting FCR.
- Mortality and disease: high mortality, especially late mortality, will result in a significant increase in flock FCR. Causes of mortality should be rapidly identified so that appropriate corrective actions can be put in place.
- Biosecurity: a good biosecurity program is essential for maintaining bird health and optimizing performance.
- Pre-slaughter: feed withdrawal is a necessary part of the slaughter process and should be done 8-10 hours before the expected slaughter time. It is important that feed withdrawal is timed accurately as excessive periods without feed prior to slaughter will result in a loss in body weight and an increase in FCR.

Conclusion

FCR problems have a significant economic impact. Any factor which affects the feed usage, growth or health of the broiler will worsen flock FCR. Correcting an FCR problem requires communication and coordination across the whole production unit. Traceability and accountability at every level is necessary.

The remainder of this article provides more detail on the points summarized on page one.

INTRODUCTION

Feed conversion ratio (FCR) is a measure of how well a flock converts feed intake into live weight and provides an indicator of management performance, and also profit at any given feed cost. As feed costs represent 60-70% of the total cost of broiler production, the efficient conversion of feed into live weight is essential for profitability, and small changes in FCR at any given feed price can have a substantial impact on financial margins.

Solving or preventing FCR problems in a flock requires both good planning and good management. Anything that affects live weight, feed intake or feed wastage will influence FCR. The key to preventing FCR problems is ensuring that throughout the brooding and grow-out period, good management practices are in place.

Management practices should always ensure that feed intake is optimized and feed wastage minimized, as a reduction in feed intake per se (as opposed to feed usage; feed intake plus feed wastage) will not be beneficial to FCR. Quite the opposite, because live-weight gain is positively correlated to feed intake, high feed intakes will usually improve FCR. This is because birds growing faster reach slaughter weight in fewer days.

The conversion of feed to live weight is a complex process and the cause of a poor or high FCR is usually multi-factorial. Correcting an FCR problem requires a multi-disciplinary approach, with input and coordination across all areas of management, health and nutrition (**Figure 1**).

Figure 1: Factors affecting broiler feed conversion.



THE SCALE OF THE PROBLEM

Before investigating the potential causes of an FCR problem, the scale of the problem should be determined; because if the problem exists in one or just a few farms, the route of investigation and potential solutions will be different to those that would be put in place if the problem was company-wide.

On-farm FCR is calculated as the total feed usage of the flock divided by the live weight measured at the processing plant. Any factors that result in an over-estimation or artificial increase in feed usage, or an under-estimation of live weight, will lead to an apparent increase in FCR which is not real. For example:

- Inaccuracies in the weigh scales at the processing plant leading to under-estimation of live weight: if this problem exists, all farms will be affected. This can be prevented if weighing equipment is regularly calibrated and a consistent weighing methodology is used.
- Miscalculations of feed intake: for example due to feed delivery amounts not being accurately measured or due to significant amounts of feed wastage.
- Feed shipments going to the wrong farms: this will result in individual farms having a high FCR and others having a low FCR, but the average FCR for the company will remain unaltered.
- Feed and birds being stolen: if this is being done in an organized manner, all farms will be affected.

Other causes of an FCR problem being incorrectly diagnosed are:

- Seasonal fluctuations in FCR. In open-sided housing, there will be fluctuations in FCR due to normal seasonal variations in temperature, humidity and day length.
- Changes in bird handling procedures.
- Incorrect energy levels assigned to the feed.
- Seasonal raw material changes.

Accurate determination of the scale of the problem requires an understanding of what the normal pattern and pattern of change in FCR should be. This will be achieved through continuous data recording and the collection of long-term historical records.

Once an FCR problem has been correctly identified and the scale of the problem is understood, an investigation into what is causing the problem and how to solve it can be started.

DETERMINING THE FACTORS AFFECTING FCR

Hatchery Management

There is now plenty of evidence to show that conditions during the hatching process have an effect on growth rate and FCR. For example, overheating embryos in the later stages of incubation will have a detrimental effect on gut development and subsequent nutrient digestion and absorption.

Furthermore, if temperature and ventilation conditions during chick transportation are not optimized, early chick development can be impaired and final flock FCR will be negatively affected.

Management on the Farm

Brooding

Due to genetic improvements in daily live-weight gain, the brooding period (the first 10 days of a chick's life) now represents almost 25% of the total life of a flock. The brooding period is a critical time for the development of a fully functioning and active gut which is able to convert feed efficiently. Having the correct brooding management in place (**Figure 2**) is therefore critical to lifetime performance and efficiency of feed utilization.

Figure 2: Example of a good brooding set up.



Feeding and the Feeding System

Insufficient feeding space will result in reduced growth rates and poor flock uniformity and FCR. The actual amount of feeding space required will vary depending upon the feeding system being used, stocking densities and the desired slaughter weight.

It is important that feeders are maintained at the correct height for bird age. Feeder height should be adjusted daily according to bird size to ensure that bird access to the feeders is optimized and feed spillage minimized. A small amount of feed spillage from the feeders is normal, but excess feed spillage markedly worsens FCR. It is also important to ensure that the amount of feed put into the feeders corresponds to the expected feed intake to bird age. Feeders should not be allowed to become too full as this will lead to an increase in feed spillage and an apparent increase in feed intake.

During feed transportation and distribution, segregation of feed constituents can occur, particularly if the feed quality is poor. This can lead to a build up of fine particles in the base of the feeder. To prevent/reduce this, it is good practice to switch feeders off for a short period each day. This will allow the birds to completely empty the feeders, reducing feed wastage and helping to maintain the quality and form of the feed presented to the birds.

Water and Management of the Water System

As with feeders, it is necessary to ensure that there is adequate drinking space for the number of birds in the house and that drinker height is adjusted daily in line with bird growth.

The water being supplied to the flock should be clean, fresh, of good quality and be available 24 hours a day. The levels of bacterial contamination, minerals and organic matter should be checked regularly to ensure that they remain within acceptable levels. During the first week or so of production, regularly flushing drinker lines will help to maintain water quality during this critical period.

Monitoring water consumption is a useful way of determining if a flock is receiving adequate water. Consumption will vary with feed intake but generally the ratio of water to feed intake is 1.6-1.8:1. A reduction in water intake will result in a reduced feed intake and potentially an increased FCR.

Temperature

If environmental temperature falls below the birds' zone of comfort (i.e. birds become cold), feed intake will be increased. The extra energy provided by this increase in intake will be used to maintain body temperature and not for growth, and an increase in FCR will occur. If environmental temperature increases above the birds' zone of comfort (i.e. birds become hot), feed intake will be reduced, growth will slow and flock FCR will again be increased (**Figure 3**). If relative humidity is high, problems of high environmental temperature are made worse as it becomes more difficult for the birds to lose excess heat. To compensate for this, dry bulb temperatures will need to be reduced. If relative humidity is low then dry

bulb temperatures will need to be increased in order to maintain bird comfort. Monitoring bird behavior is critical for determining if environmental conditions are correct.

Figure 3: Heat stressed birds.



Ventilation

Inadequate ventilation, particularly later on in the production cycle, will result in birds becoming too hot. Ventilation rates should be matched to the actual biomass within the house. In order to do this, a sample of birds should be weighed weekly.

In areas where external environmental temperatures are high and open-sided housing is used, appropriate feed intakes may be maintained by:

- Encouraging feeding during the cooler parts of the day.
- Providing correct nutrient levels and balance, together with the use of highly digestible feed ingredients, and the provision of optimum physical feed form.

Nutritional Factors

Feed Texture

Feed pellets, crumbs or mashes of a poor physical and texture quality (see **Figure 4** for an example of a good quality pellet) will show significant degradation between leaving the mill and being placed in front of the bird. This will have a series of negative impacts on broiler FCR.

- Increased feed wastage prior to bird ingestion.
- Reduced feed intake and reduced growth rate.
- Increased time spent at the feeder. This will result in an increased amount of energy spent on feeding thus reducing the energy available for growth.
- Incomplete or inefficient digestion of the feed.

Figure 4: Example of a good quality pellet.



The Feeding Program

It is important that the feeding program is matched to the birds' requirements. The provision of the correct nutrient density at the correct age, particularly energy and essential amino acids, is important for efficient feed utilization. If dietary energy or protein content is lower than recommended, FCR will be poorer as the bird has to consume more feed to achieve the same live weight.

The starter feed should be fed for a period of 10 days and should be in the form of a good quality crumb or mini-pellet. The starter diet is relatively high in protein content to encourage feed intake and growth. As the bird ages it requires relatively more energy and less protein so feeding the starter feed for longer than recommended will result in an energy deficit and a waste of protein. This will slow down growth and worsen FCR. If the starter feed is not fed for long enough, a deficit of protein will occur, growth will be reduced, and FCR increased.

The grower diet is normally fed for a period of 14-16 days. Changing to the grower diet normally involves a change of feed texture (from crumb/mini-pellet to pellet), and a change in nutritional content as energy is increased and protein reduced in line with the birds requirements. Feed physical form is particularly important at this time.

The finisher feed is fed from around 25 days of age until slaughter. The finishing period represents a period of rapid change in body composition and if a diet of inadequate nutritional quality is fed, fat deposition can be increased which will result in a poorer FCR.

A pellet of greater than 3-4 mm (8/64-10/64 in) in diameter for the grower and finisher is not recommended as it will reduce feed intake and growth rate and may increase FCR. When feeding a mash, a coarse, uniformly distributed particle

size is needed. As with any diet, the proportion of fines (small, dusty particles) must be minimized if broiler performance and FCR are to be optimized.

Feed Formulation and Manufacturing

Errors or difficulties during the feed manufacturing process can lead to feeds of reduced quality being presented to the birds. Some of the problems that can occur during the manufacturing process are highlighted below.

- Changes in types and origins of raw ingredients due to issues of availability, harvest quality, etc.
- Quality of raw ingredients - presence of fungus, mycotoxins, etc.
- Errors during manufacture of mixes and concentrates, such as cross-contamination.
- Incorrect nutritional values within the feed formulation matrix.
- Inappropriate grinding - inadequately or excessively ground raw materials will reduce pellet quality and durability. This may lead to a high percentage of fines in the finished feed and increased segregation during transportation and distribution.
- Inadequate mixing or incorrect raw material inclusion will result in nutrient imbalances in the finished feed.

Errors during the feed manufacturing process can be difficult to diagnose so it is important that inventories for the manufacturing procedure and good management of process practices are in place. This should include all micro ingredients - vitamins, minerals, amino acids and other additives.

Remember, increasing diet nutrient density can be expected to improve FCR, but not necessarily the margin over feed cost.

Mortality and Disease

High mortality, especially late mortality, will result in a significant increase in FCR. The dead birds will have consumed a significant amount of feed but will not contribute to final flock live weight. Causes of mortality need to be addressed urgently.

Diseases such as necrotic enteritis, viral enteritis or conditions like dysbacteriosis, which affect the integrity and functioning of the gut, all have significant implications for the efficiency of feed use and FCR. Adequate biosecurity measures need to be in place to prevent the occurrence of such diseases.

Runting and stunting syndrome will also have a significant effect on flock uniformity and growth rate. Intestinal absorption and bird viability are reduced, rejects are increased, and the efficiency of feed utilization is decreased.

Finally, there should be a proper program in place, supervised by a veterinarian, for the prevention and monitoring of coccidiosis.

Biosecurity

Ideally, sites should be single-age (as opposed to multi-aged) and should be isolated from other poultry or livestock units.

A good biosecurity program is essential for maintaining bird health and optimizing performance. A biosecurity program should ensure that:

- Visitor numbers are minimized.
- Risk assessment protocols are in place.
- Farm entry protocols are in place (showering in and out, changing footwear, etc).
- Hands are sanitized and footwear is changed upon entry to each house.
- Each farm has its own dedicated equipment. Non-dedicated equipment must be thoroughly disinfected before entry and use on a farm.
- Adequate down-time is given to reduce pathogen carry-over.
- Houses are wild bird and rodent free.
- Clear and implemented procedures are in place for:
 - house cleaning and disinfection,
 - litter management and disposal,
 - feed hygiene, transport and delivery,
 - water management and sanitization,
 - dead bird disposal.

Pre-slaughter

Excessive Shrinkage

Feed should be withdrawn from the birds 8-10 hours before the expected slaughter time (this is long enough to allow the contents of the gut to be emptied and reduce fecal contamination at the processing plant). This period should include catching, transport and holding time. Water withdrawal should be delayed for as long as possible.

Feed withdrawal is a necessary part of the slaughter process, but once feed has been removed all birds will begin to lose weight. A bird will usually lose up to approximately 0.5% of its body weight per hour when off feed for up to 12 hours (with water removed only when necessary). So a 1.80 kg (4 lb) broiler will lose approximately 9 g (0.3 oz) of weight per hour. If they are allowed to go over 12 hours without feed, weight loss increases to 0.75-1.0% of body weight per hour.

For example, if we compare a 1.80 kg (4 lb) bird with a feed conversion of 1.57, processed after 8 hours off feed (first load), to the same bird processed after 18 hours off feed (second load), it would weigh 1.68 kg (3.7 lb) and have an FCR of 1.68. Actual weight loss will depend on factors such as environmental temperature, sex and bird age (weight loss will be greater at higher temperatures, in males and in older birds). This loss in weight and increase in FCR represents a huge financial loss to the farmer, so it is important that feed withdrawal is timed accurately and that excessive shrinkage is avoided.

CONCLUSION

Problems of FCR represent a real waste to the broiler farmer and have a significant economic impact. Any factor which reduces the feed intake, growth or health of the broiler will worsen flock FCR.

Correcting an FCR problem requires communication and coordination across the whole production unit, from feed manufacturer to farmer and processor. If problems and solutions are to be identified rapidly, traceability and accountability at every level is vital.

Observe → Investigate → Identify → Act!



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