

## Feed Withdrawal for Broiler Chickens

Before broiler chickens are shipped to the processing plant, feed is withdrawn on-farm to assist in emptying the birds' digestive tracts and reduce the chances that the carcasses will be contaminated during processing. A carcass can be contaminated while hanging on the processing line if food leaks out of the crop through the mouth; feces are excreted from the vent; or material in the digestive tract is released by nicking, cutting or tearing the intestine during processing. Any of these contaminants may contain bacteria that will adhere to the carcass. Proper feed withdrawal produces an empty gut that can be processed efficiently without contaminating the body cavity or surface of the carcass.

The trend in recent years has been to process birds after a short feed withdrawal time. The result has been less contamination during processing and reduced loss in carcass weight (shrink) prior to processing. Economically, the reduced shrink has been the most significant benefit of this trend.

### Types of Contaminants

When investigating methods of reducing contamination, it is important to determine the type of material contaminating the carcass. The seven possible sources of carcass contamination are

1. Feed
2. Feces
3. Watery gut contents
4. Litter
5. Broken down intestinal lining
6. Bile
7. Cecal Contents

Each of the types of contaminants has a different cause.

**Feed** – can contaminate the carcass if the birds do not drink enough water after the feed is withdrawn to empty out the crop.

**Feces** - can be a problem if the feed withdrawal is not long enough or a disturbance of the birds has slowed the passage of feed through the gut. The gut does not need to be completely empty for the carcass to be processed properly.

**Watery Contents** – in the crop, gizzard and intestines can occur if the birds keep drinking after they have consumed enough water to pass the feed out of the crop. Some strains of broiler chickens naturally stop drinking after the crop has emptied while others continue drinking. The strains that keep drinking may have watery gut contents if the birds are allowed access to water more than two hours after the feeders are empty.

**Litter** - consumption can be a major problem if large quantities of feed were spilled at the feeders while the birds were growing in the barn. During feed withdrawal, the birds may eat feed that is in the litter and at the same time pick up manure and feathers from the bedding. This material has a high bacteria content and may lead to contamination if the birds eat it prior to being loaded onto the truck.

**Broken Down Intestinal Lining** - starts to accumulate in the intestine after the birds have gone without feed for six hours. As long as the birds are eating regularly, they keep a constant flow of the blood to the intestine and the villi lining the intestine remain intact to absorb nutrients from the next meal. (Villi are microscopic "fingers" on the inside surface of the intestine that absorb the nutrients from the feed.) Once the gut empties, the birds do

not maintain the flow of blood to an intestinal lining that is no longer absorbing feed. The birds shunt blood away from the intestine and the villi start to slough off. By 15 hours without feed or “off-feed”, the gut lining is totally broken down and this broken down material is found throughout the intestine. Natural bacteria in the gut grow on the cellular material released as the intestinal lining is sloughed and produce large quantities of gas. If the intestine is nicked, torn or cut during this time, the mucoid intestinal material in the gut will leak or bubble out.

**Bile** – can be dumped from the gall bladder into the intestine if the birds have been without feed for an extended time. While the birds are eating, bile routinely moves from the liver, down a duct into the intestine. Very little bile is stored in the gall bladder as long as it is needed in the intestine to assist in digestion of the food. As the gut empties, however, the liver shunts the bile that it produces into the gall bladder to be stored until the next meal. The storage of bile starts approximately four hours after the last meal. By twelve hours off-feed, the gall bladder is quite enlarged due to buildup of bile. At about this same time, released intestinal lining has accumulated in the intestine and its movement in the gut may stimulate the release of large quantities of bile from the gall bladder. After 12 hours off-feed, some gall bladders will shrink in size as they release bile while others continue to store bile and grow in size.

**Cecal contents** - build up as the time off-feed is extended. While the bird is eating, the ceca dump their contents regularly, but dumping becomes irregular after the birds do not eat for four hours and the amount of material in the ceca starts to increase. Improper stunning can cause a death struggle in which the birds dump most of their cecal contents into the intestine. If the intestine is filled with released gut lining at the same time, a large volume of wet, bacteria laden material is produced in the gut and may leak out of the vent onto the carcass.



**Cecal material in the colon**

### **Windows of Processing Opportunity**

Two windows of opportunity exist to successfully process chickens. Between these windows, is a “wall” where potential for contamination is high and line speeds may need to be reduced significantly. The first window occurs at eight to 12 hours after a bird stops eating. At this time, the gut is almost completely empty but still strong and unlikely to break during processing. Any individual bird that is off-feed for 15 to 16 hours poses a potential problem at the plant. The intestine will be weakened by the extended hours off-feed and filled with gas and released intestinal lining. The probability of carcass contamination increases dramatically during this period. The second window normally starts at 18 hours off-feed. By this time, the bird has flushed out the released intestinal lining and has started to produce new villi. A bird processed in this second window of opportunity will have a weaker intestine than a bird processed in the first window, but the intestine will contain very little material that could contaminate the carcass if the intestine is damaged during processing.

### **Pattern of Meal Eating and Gut Emptying in a Flock**

In a normal flock, a bird will eat about once every four hours. Immediately after eating a meal, the bird will drink, solubilize some of the feed in the crop and pass that feed into the stomach (proventriculus) and then on to the gizzard. Thirty to 45 minutes later, the bird will drink again,

solubilize more feed in the crop and pass it on for digestion lower in the digestive tract. After another 30 to 45 minutes, the bird drinks again, solubilizes the rest of the feed in the crop and passes it down the digestive tract. It takes three drinks of water for the bird to solubilize all the feed in the crop and pass it on to the stomach. After the crop is empty, the bird will wait another two to three hours before wanting to eat another meal. The four-hour interval between meals involves approximately 1½ hours of drinking to solubilize the feed and empty the crop followed by approximately 2½ hours in which the crop is empty but the bird does not yet eat another meal.

Since not all birds in a barn eat a meal at the same time, some birds have full crops and others have empty crops at any given time. In a flock where the individual birds eat regularly, only 30 to 40% of the birds in the barn will have feed in their crop at one time. In flocks where birds have their individual meals at four-hour intervals, it would be expected at any point of the day to find that one quarter of the birds have just eaten, another quarter ate one hour ago, a quarter ate two hours ago and a final quarter ate three hours ago and will be starting to eat another meal in the near future.

Because not all birds are at the same level of gut fill at any given time, there are limitations in how precisely feed withdrawal can be controlled in a flock. At the time the feeders are raised or pans are empty, some birds will have just eaten and others last ate four hours earlier. The birds ready to start another meal when feed is withdrawn will be four hours closer to emptying their digestive tracts than the birds which have just finished a meal at the time of feed withdrawal. As an example, if feed is withdrawn at 2 a.m. and the birds are processed at 10 a.m., the birds which had just finished a meal at 2 a.m. will have been off feed for eight hours at processing. The birds in the barn which were just about to start a meal at 2 a.m. (and had eaten their last meal at 10 p.m.) will have been off-feed 12 hours at the time of processing. Because not all birds eat at the same time, there is a range of off-feed times between individual birds when a flock is processed.

The range in withdrawal times between birds in a flock can be further increased by binge eating (irregular eating pattern). Two possible causes of binge eating are light restriction and cool temperatures. When the lights are turned off for more than four hours at a time, the birds will become hungry and binge eat when the lights are turned back on to try to make up for the feed they did not eat when the barn was dark. If the barn is too cool, birds in the barn will sit on the floor and be reluctant to stand up and make way for birds that want to walk to the feeders. If the barn temperature is just 3 C (5°F) too cool, half the birds may have to be hungry before enough birds will stand up and allow easy access to the feeders. At the time feed is withdrawn from a flock that binge eats, some of the birds may have just finished a meal and others may not have eaten for five or six hours.

## **Natural Cycle**

The events observed in broiler chickens as time off-feed progresses are part of a natural cycle that occurs every night in chickens in the wild. In nature, chickens eat during the day and rest at night. Their intestines empty during the night and the intestinal lining begins to slough. The sloughing occurs because birds do not maintain the flow of blood to an intestinal lining that is not absorbing food. At the same time, cecal dumping and reverse peristalsis helps to carry the fermented nutrients from the ceca into the intestine. This material is rich in B vitamins produced by bacteria in the ceca and helps wild birds meet their nutritional requirements.

## Examination of Digestive Tracts of Birds at Different Stages of Feed Withdrawal

A bird's digestive tract will undergo a fairly typical pattern of change as time off-feed progresses. By knowing the signs of how the digestive tract changes, it is possible to examine viscera on the processing line and estimate how long individual birds have been off-feed. Careful observation also provides signs of improper feed and water withdrawal. Some of the signs to watch for are outlined below.

### Zero Hours of Feed Withdrawal

Feed and digesta are found in the crop, stomach (proventriculus), gizzard and intestine. Because it is full of digesta, the intestine is round and tubular and will remain round as long as it is prepared to accept new feed (up to about four hours after the last meal). Some isolated areas of the intestine will not contain digesta due to the peristaltic muscle movements which move feed through the intestine in "waves." The gut wall is very elastic and curls back on itself when cut open lengthwise. As long as feed is passing through the gut, the ceca dump their contents on a regular basis and will be relatively small compared to later stages of feed withdrawal.



### Two Hours of Feed Withdrawal

As long as the birds have had two or three drinks of water, most of the feed in the crop has been solubilized and passed into the stomach and gizzard. The crop is almost completely empty and the duodenum (loop of intestine immediately after the gizzard) is starting to empty.

### Four Hours of Feed Withdrawal

The crop is empty but the gizzard contains some feed. The gizzard is a "hang down" organ and generally passes out feed only as new feed enters. Since the bird has stopped eating, no new feed is entering the gizzard to push out the remaining feed. The gizzard empties only if the bird drinks excess water or after a long feed withdrawal time.

The gall bladder is small but will start to increase in size as feed is no longer passing through the upper half of the intestine. The liver will start to shunt bile to the gall bladder to be stored instead of passing it on to the intestine. Liver colour has not yet changed. For the most part, the intestine still has a rounded, tubular appearance.



## Six Hours of Feed Withdrawal

Ideally, the gizzard contains firm, dry material which is comprised mostly of feed. The last feed to enter the gizzard has been squeezed hard by the gizzard muscle, helping to “wring out” most of the moisture in the feed. If the bird drank excess water after emptying the crop, the gizzard will contain watery fluid and the last feed in the gizzard will be in the intestine. Due to reduced peristaltic muscle movement, this material may remain in the intestine for ten hours until the gut lining breaks down and creates sufficient liquid in the gut to help flush out the remaining feed. Until then, this material is often trapped in the last third of the intestine. It is desirable to keep the last feed in the gizzard.



**Ideal gizzard with firm dry feed.**



**Empty gizzard with fluid inside.**

The top half of the intestine starts to flatten due to the absence of digesta. The size of the duodenum is at a minimum at this time. Afterwards, it will get larger in both length and diameter due to gas production. The duodenum lies in the portion of the body which will be cut by the body cavity opener and vent cutter as the carcass hangs on the processing line in the plant. A small duodenum is less likely to be cut during this process.

The intestines have their maximum breaking strength and will maintain this resistance to breakage for the next six hours. After 12 hours off-feed, intestine breaking strength declines dramatically. The gall bladder is still small but starting to increase in size as the liver begins to shunt bile to it.

## Eight Hours of Feed Withdrawal

(Start of First Window)

The duodenal loop is enlarged due to the gas production that occurs as the gut lining breaks down and bacteria numbers increase. The rest of the intestinal lining is intact and very little of it will release when lightly scraped with scissors. Cutting open the intestine at mid-gut (at Meckel's diverticulum or the yolk stalk remnant) will reveal villi in good condition. If a finger is placed under the intestine and scissors are used to scrape the exposed villi on that section of intestine, a rough surface similar to a cat's tongue



**Intestinal lining readily scrapes off exposed duodenum.**

can be felt. The intestine is almost completely empty of feed and most of the intestine is flat. Small amounts of gas are present in the intestine.



**Intestine is empty but villi are intact.  
Very little lining will scrape off.**



**Some gas may be observed in  
the intestine.**

The liver has now been depleted of glycogen for several hours and is darker and smaller than at zero hours of withdrawal.

#### **Twelve Hours of Feed Withdrawal (End of First Window)**

Most of the intestine (beyond the duodenum) is flattened. Flattened intestines are less likely to be nicked, cut or torn when the body cavity opener and vent cutter cut into the carcass as it hangs on the processing line. The villi are not as easy to feel when performing the “cat’s tongue” scratch test and the intestine does not readily curl back on itself when cut lengthwise. From this point on, a steady decline in intestinal breaking strength occurs.



**Flattened intestine**

#### **Thirteen Hours of Feed Withdrawal**

Enough broken down intestinal lining has accumulated in the duodenum to trigger the gall bladder to release bile. Reverse peristalsis, the backward movement of material which regularly occurs in chicken digestive tracts, carries the bile from the intestine into the gizzard. Some of this bile may then run back into the crop during processing. Green bile staining of the gizzard is a good indicator that a bird has been off feed for 13 hours or longer. Some gall bladders now start to appear smaller as they dump their bile contents.



**Green gizzard contents**

Coagulated protein may appear in the gizzard. This protein is from broken down gutting lining that has been carried into the gizzard by reverse peristalsis. The protein coagulates when it reacts with the acid in the gizzard, much the same way cottage cheese forms when the protein in milk reacts with an acid.



**Bile in a cut open crop**

### **Fifteen to Seventeen Hours of Feed Withdrawal**

The intestine is almost entirely rounded as it fills with gas and gas may bubble out if the intestine is nicked. The entire gut lining is broken down and sloughed lining is found in much of the intestine. Almost nothing is felt when performing the “cat’s tongue” scratch test to detect villi. Due to dehydration, the crop tends to stick to the carcass and is difficult to pull out; crops and sometimes stomachs will break as the viscera are removed from the carcass. The gizzards are becoming more difficult to peel.



**Gas bubbling out of nicked intestine.**



**Lining readily scrapes off most of intestine.**



**Orange tinged, sloughed intestinal lining.**

## **Eighteen Hours of Feed Withdrawal** (Start of Second Window)

The broken down intestinal lining has passed out of the bird and the intestinal villi are starting to rebuild. The villi can be detected with the “cat’s tongue” scratch test and little material scrapes off when scissors are run over the exposed intestinal lining. The intestine is now flattened again and little gas production is visible. The intestine has lost about one-third of its breaking strength during the past six hours and the crops are still difficult to remove due to dehydration. Contamination is lower than “between the windows” because the intestines are now empty and relatively dry instead of being filled with gas and sloughed intestinal lining. If the bird does not receive feed in the next several hours, the intestinal lining will begin to slough again.



**Rebuilt intestinal lining**

### **A Guide to Judging Time of Withdrawal After First Window Has Passed**

#### **Signs Feed Withdrawal Has Extended Beyond First Window (13+ Hours)**

- Crops and stomachs break more easily during processing.
- Gizzards and sometimes crops are stained green with bile.
- Some gizzards are completely empty.
- Gizzards are tougher to peel.
- More gizzards contain feathers, litter or feces.
- Denatured protein (“cottage cheese”) is found in some gizzards.
- Some gall bladders (those that have not dumped their contents) are greatly enlarged.
- Bile, urates or orange casts (sloughed lining) are seen in the truck crates or floor.

#### **Signs Feed Withdrawal Has Reached Second Window**

- Smaller, shorter duodenum.
- Flattened intestine.
- Little sloughing or gas in intestine.
- Can feel villi during “cat’s tongue” scratch test.
- Some or all of signs of extended withdrawal listed above.

#### **Do Not Be Fooled by False Signs**

- Reverse peristalsis can bring previously sloughed material back into the duodenum. If the villi are rejuvenated, the sloughed material in the duodenum is old.
- Feed found in the crop could be due to water run back from the gizzard. Suspect this problem if the gizzard is empty.
- Excess water consumption can flush bile out of the gizzard. Bile staining may not be observed in every bird after 13 hours of withdrawal. Watch for excess fluid.

## Frequently Asked Questions

“Can you weigh livers or ceca to determine time off-feed?”

No. The absolute weight of the liver and ceca can vary with diet and strain of broiler. The weight of these organs cannot be used to easily predict how long a bird has been without feed.

“Should the gizzards be completely empty?”

Ideally, the gizzards will contain a small amount of dry feed at the time of processing. Empty gizzards are signs of extended withdrawal time or excess water consumption.

“Should you turn the water off after withdrawing feed?”

The birds need enough water to solubilize and pass all the feed in the crop (usually about two hours of water after feed withdrawal). With broiler strains that drink excess water after the crop empties, the water should be turned off after all of the feed in the crop has been passed.

“Will birds pass feed while on the truck?”

Birds will normally continue to pass feed and empty their digestive tracts while on the truck. If they pant or are chilled, passage of digesta will slow. A rough ride on bumpy roads can also slow the rate of passage.

“Should lighting programs be avoided?”

The hours of light should be restricted enough to control ascites. Beyond that, dark periods of more than four hours should be avoided because they encourage binge eating.

“Should the feed pans be totally empty?”

Some growers wait for the feed pans in the barn to be totally empty before determining that the birds are off-feed. By the time the feed pans are totally empty, however, the birds will have already been effectively without feed for four or five hours. The last 500 g (½ lb.) of feed in a feed pan is mostly fines and the birds will take four or five hours to finish these fines, compared to the half-hour needed to consume a similar amount of pellets or crumbles. As an example, if the feed pans are raised at 2 a.m. and the pans are totally empty, the birds will have been off-feed since 10 p.m. or earlier. Because of the powdery texture and elevated mineral content of the fines, birds will take themselves off-feed before the feed pans are totally empty.

## Economics of Feed Withdrawal

After food stops passing through the intestine, all living animals begin to lose weight. A 1.80 kg broiler chicken will lose about 5 grams of body weight for every extra hour of feed withdrawal. Because of this weight loss, feed to gain ratio will increase by 0.005 for each additional hour of feed withdrawal. As an example, a 1.80 kg bird with a feed conversion of 1.85 when processed at eight hours off-feed (first window) will weigh 1.75 kg and have a feed conversion of 1.90 if processed at 18 hours of feed withdrawal (second window). Because the grower has already invested all the feed and time needed to produce this bird, the lost weight is lost profit. This lost weight cannot be recovered by putting the carcass in the chill tank because the carcass will not hold any more water than normal and any extra water taken up will weep out.

Carcass yield at the processing plant should be calculated as a percentage of weight when the birds are initially taken off-feed, and not as the weight of the birds when they arrive at the plant. When feed is first removed, the digestive tract initially shrinks in weight faster than the edible portion of the carcass. After an extended withdrawal time, birds arrive at the plant with small digestive tracts that account for a lower proportion of their body weight than at the start of feed withdrawal. Based on the weight of the birds when they arrive at the plant, the percent loss of weight during evisceration may be lower and the carcass yield higher than in a bird processed after less time off-feed. The carcass yield may increase even though the total amount of edible meat on the carcass has decreased since the start of feed withdrawal. Carcass yields based on the weight of the birds at the time of feed withdrawal better reflect the true loss in saleable product as feed withdrawal is extended.

## **Summary**

Proper feed withdrawal will reduce carcass contamination and improve a producer's bottom line. By understanding the birds' eating patterns and how the digestive tract reacts to time off-feed, you can better judge how to withdraw feed from your birds. The goal should be to process as many birds as possible after they have passed most of their feed, but before the intestinal lining has started to slough. Flocks handled in this manner will process more easily, with less contamination, fewer broken crops and stomachs, and increased edible meat delivered to the plant.

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## **Reference**

Stan Savage. 1998. Feed Withdrawal: A practical look at its effect on intestine emptying, contamination and yield. Pfizer Inc..