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PURDUE EXTENSION

AS-576-W

Animal Sciences

EXPERT REVIEWED

Optimizing Feed Withdrawal Programs

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Introduction

Fecal and pathogen contamination of broiler carcasses in processing plants is a fairly common issue in the poultry industry. In an effort to reduce carcass contamination at processing plants, commercial producers have, for many years, typically pulled their birds off feed prior to catching, loading, and transporting the broilers to the processing plant (Wabeck, 1972; Bilgili, 1988). Producers' choices to remove feed are based on research that shows withdrawing feed prior to transport and processing reduces the amount of ingesta in the gastrointestinal tract and reduces the incidence of torn or ruptured gastrointestinal tracts, therefore decreasing the likelihood of carcass contamination (Bilgili, 1988).

More recently, producers who weren't withdrawing feed prior to catching and transporting were encouraged to do so when the United States Department of Agriculture (USDA) implemented its pathogen reduction program in the form of the Hazard Analysis and Critical Control Point (HACCP) system. In HACCP, the USDA created a "zero tolerance performance standard for visible feces and ingesta on dressed carcasses," thus inadvertently encouraging the use of a feed withdrawal method to reduce carcass contamination (USDA, 1996).

Feed Withdrawal Timeline

The timeline for feed and water withdrawal can be anywhere from 2 to 24 hours. The ideal withdrawal period, however, should be short enough to avoid considerable losses in live weights or carcass yields, but long enough to allow the digestive tract to become empty (Veerkamp, 1986). Generally, research indicates that the optimal feed withdrawal time is between 8 and 12 hours prior to processing, as this withdrawal period yields the lowest occurrence of carcass contamination and carcass yield losses (Wabeck, 1972). It is important to note that total feed withdrawal time also includes catching, transport, and time spent in the plant holding area prior to processing.

Optimal feed withdrawal time is also affected by a number of factors that impact digestive tract clearance time, including:

1. Health status of the broiler
2. Feeding program or feed composition
3. Lighting program
3. Environmental temperature extremes
4. Excitement caused by catching and crating (Buhr et al, 1998).

Withdrawal times do vary widely in the industry as scheduling of catching, loading, transporting, and processing can become very complex when plants are processing thousands of birds on a daily basis (Wabeck, 1972; Buhr et al, 1998). Although the length of the feed withdrawal may seem unimportant, it affects a number of financial and product safety and quality issues, such as: carcass contamination and yield, plant line efficiency, live weight loss and grower payments, and the safety and quality of the processed product (Northcutt, 2000).

How Does Feed Withdrawal Decrease Contamination at the Processing Plant?

- Birds arrive at the processing plant with empty digestive tracts and hence a lower bacterial load on their feathers and feet, because less feces is excreted, and less are released into the scald water after stunning.
- Empty intestines occupy a much smaller area of the body cavity and are, therefore, less likely to be torn or cut by evisceration equipment.

Factors Affecting Optimal Feed Withdrawal Periods

Placing in Coops Versus Leaving on Litter

Many producers are unaware that cooping birds before the digestive tract has cleared can hinder further

digestive tract clearance. Birds held in coops retain digesta in the crop, proventriculus, and gizzard for a longer period of time when compared to birds left on litter during feed withdrawal (Summers and Leeson, 1979). The decrease in gastrointestinal tract clearance in cooped birds may be caused by the inactivity and stress associated with cooping (May and Deaton, 1989). Bilgili (1988) has suggested that producers avoid any unusual activity within the house once broilers are cooped in order to minimize bird stress. Figure 1 illustrates the differences in digestive tract clearance when birds are on litter or placed in coops.

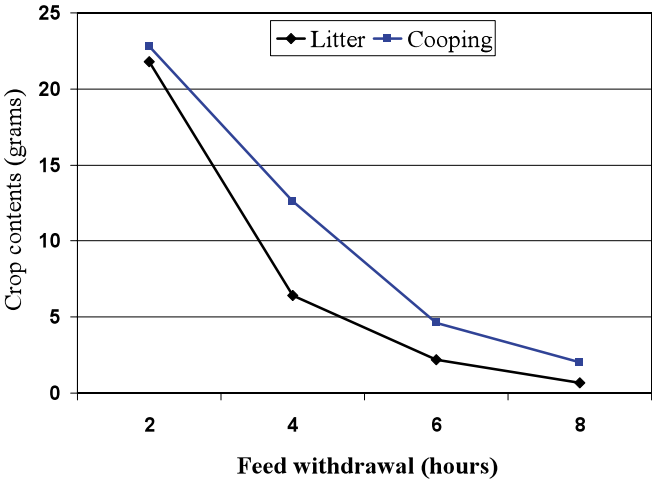


Figure 1. *Crop contents (g) as feed withdrawal time increases. Litter vs. cooping (May et al, 1990).*

However, birds left on litter are more likely to ingest litter as feed withdrawal time increases. Unfortunately, eating litter can increase the consumption of the bacteria that reside in the litter and increase the odds of pathogenic contamination at the plant. Ideally, birds would be held on litter for roughly four hours or until the digestive tract has cleared, at which point they would be placed in coops.

Lighting

Interestingly, the lighting conditions after feed withdrawal also affect emptying of the gastrointestinal tract. Lighting improves crop clearance both before and after cooping (May et al, 1990). It is generally recommended that light be maintained for the entire feed withdrawal period (Figure 2).

Feeding Regimen and Temperature

When compared with continuously-fed broilers, meal-fed broilers have a slower digestive tract clearance rate when subjected to feed withdrawal (Table 1). Additionally, birds that have been fasted and subsequently re-fed prior to feed withdrawal also have longer digestive tract clearance rates (May et al, 1988).

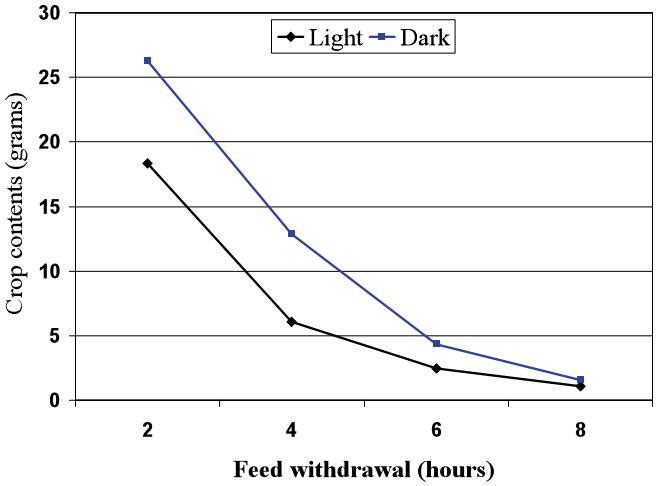


Figure 2. *Crop contents (g) as feed withdrawal time increases. Light vs. Dark (May et al, 1990).*

Temperature does not have a direct effect on clearance rates, but temperature extremes in the house can cause inconsistencies in feed intake which will affect digestive tract clearance rate.

Processing

Intestinal Characteristics

It has been suggested that the 8 to 12 hour feed withdrawal period is optimal for processing due to the observation that the gastrointestinal tract is empty and flattened with mild intestinal sloughing during this period, while feed withdrawal periods of 14, 16, or 18 hours lead to heavy sloughing due to intestinal cell necrosis (Northcutt et al, 1997), loss of the protective mucus layer (Thompson and Applegate, 2006) and increased propensity for food-borne pathogens, such as *Salmonella*, to begin to attach to the intestinal epithelia (Burkholder et al., 2003).

The tensile strength of the intestine is also affected as feed withdrawal time increases. Tensile strength, is a measure of intestinal integrity and of the potential for intestinal breakage during processing. The stronger the intestinal tract, the less likely it will be to break at the plant, thereby reducing the need for reprocessing or condemnation. Interestingly, the tensile strength of the small intestine decreases by nearly 10 percent as the length of feed withdrawal continues past 14 hours (Bilgili and Hess, 1997). Thus, as feed withdrawal time increases past 14 hours, the probability of intestinal breakage and subsequent contamination (and condemnation or reprocessing) increases.

Live Weights and Processing Yields

Because grower payment is often based on live weights at the plant, producers are often concerned about the loss of live weight (or live shrink losses)

Table 1. Effect of feed withdrawal period and feeding regimen on contents of intestinal tract. May et al, 1988.

		Feed Withdrawal Period (hours)			
		2	**4**	**6**	**8**
Digestive Tract Segment	**Feeding Regimen**	**---------- Contents, grams ----------**			
Crop	Meal	25.8	3.3	0.1	0
	Continuous	0.3	0	0	0
Proventriculus + Gizzard	Meal	20.6	19.0	16.0	12.4
	Continuous	16.9	14.3	14.3	12.8
Small Intestine	Meal	35.7	32.2	19.2	7.9
	Continuous	19.8	11.1	10.0	7.7

incurred by feed withdrawal programs. This is a valid concern, as research has indicated that as feed withdrawal time increases, live weight shrink increases (Rasmussen and Mast, 1989; Lyon et al, 1989). In fact, for every hour off feed, birds will lose roughly 0.2 to 0.3% of their body weight (Table 2).

Additionally, eviscerated weights will decrease as time off feed increases, as evidenced by the decrease in the pectoralis major relative to body weight (Figure 3) as the feed withdrawal period increases.

Losses Caused by Excessive Feed Withdrawal Periods

Problems Associated with Excessive Feed Withdrawal Periods (> 14 hours)

- Decrease in intestinal integrity leading to higher incidence of torn intestines
- Higher incidence of contaminated carcasses
- Economic losses due to increased loss of live weight.(Figure 4)

Table 2. Effect of feed withdrawal on live shrink loss.

Time Off Feed (hours)	Live Shrink Loss (%)[1]	(%)[2]
0	--	--
4	1.9	--
8	2.9	--
10	--	3.4
12	3.6	--
16	4.5	--
20	4.9	--
24	5.6	7.74
Average Loss/Hour	**~ 0.23%**	**~ 0.33%**

[1] Papa, 1991

[2] Thompson and Applegate, 2003, unpublished data

Conclusions

The optimal feed withdrawal period of 8 to 12 hours should be strived for as much as possible to minimize fecal and digesta contamination of carcasses and pathogen contamination while at the same time maximizing potential yield.

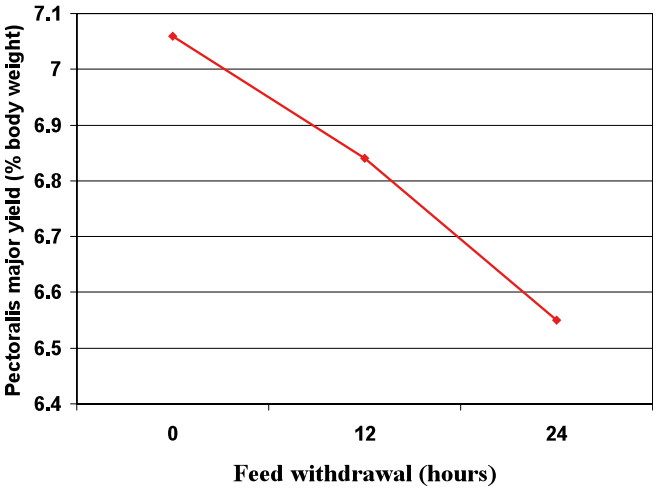


Figure 3. *Change in pectoralis major yield (as a percent of body weight) as feed withdrawal period increases (Thompson and Applegate, 2006).*

Grower reimbursement during feed withdrawal

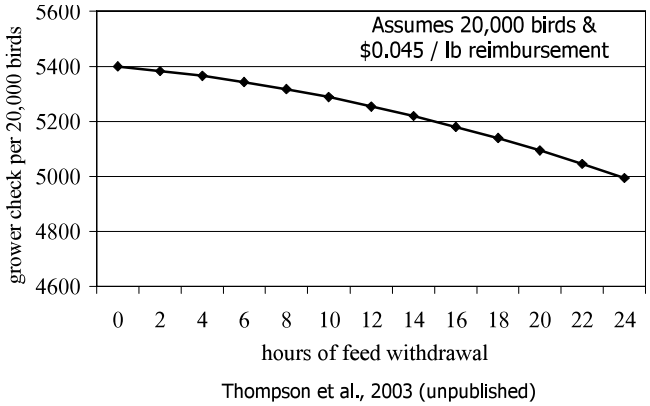
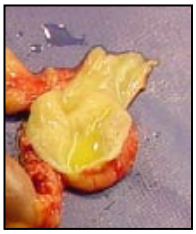


Figure 4. *Grower payment loss during the course of feed withdrawal.*

Changes in the Intestinal Tract as Feed Withdrawal Time Increases

0 Hours off Feed, 0 Hours off Water
Bird has recently eaten and the intestines are rounded, full, and in good condition. Feed is found from the crop down into the cloaca. Crop and gizzard are full.

2 Hours off Feed, 0 Hours off Water
Intestines are still full, rounded, and in good condition. Contents of crop are more watery and gizzard still contains feed.



4 Hours off Feed, 0 Hours off Water
Intestines are still rounded with a decrease in intestinal contents. Bird would normally eat again at this point.

Changes in the Intestinal Tract as Feed Withdrawal Time Increases (continued)

6 Hours off Feed, 2 Hours off Water
Intestine appears to have more digesta than at 4 hours, possibly feed passed from the crop and gizzard.

8 Hours off Feed, 4 Hours off Water
Intestinal content begins to decrease and intestinal tract has begun to flatten. This point represents the beginning of optimal feed withdrawal time (8-12 hours). Intestinal contents are minimal and intestinal strength is optimized until 12 hours off feed.

10 Hours off Feed, 6 Hours off Water
Intestine is almost empty. This is the optimal feed withdrawal time, as intestinal strength has not yet diminished.

Changes in the Intestinal Tract as Feed Withdrawal Time Increases (continued)

12 Hours off Feed, 8 Hours off Water
Intestinal tract is empty and intestinal strength will begin to decrease after this point. Note the dry appearance (loss of mucus) and pin-point hemorrhages.

20 Hours off Feed, 16 Hours off Water
Intestinal content is watery due to extensive intestinal cell necrosis. Optimal processing time has passed.

24 Hours off Feed, 20 Hours off Water
Similar to 20 hours off of feed, cell necrosis and sloughing occurring.

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