

# Grain feeding and the Dissemination of Acid-Resistant Escherichia coli from Cattle

Francisco Diez-Gonzalez, Todd R Callaway, Menas G Kizoulis, James B Russell: *Grain feeding and the Dissemination of Acid-Resistant Escherichia coli from Cattle. Science*. Washington: Sep 11, 1998. Vol.281, Iss. 5383; pg. 1666, 3 pgs.

Objective: To define more precisely the role of grain in promoting the growth of acid-resistant E. coli in the rumen and colon of cattle.

*(There were two experiments in the study. The first was a more basic trial to find out if there was any substantial change. Since there was, they performed the second, more in-depth and accurate study.)*

## **STUDY 1**

**Who:** 61 mature, non-lactating, 600kg Holstein cows. They were fed on three different diets: 100% grass and hay, 40% hay and 60% grain, and 20% hay and 80% grain.

### **Methods:**

To determine the potential impact of grain feeding on E. coli in cattle, the researchers removed “colonic digesta” from the rectum of cattle that were fed hay, grass, and varying amounts of rolled corn. The pH was then measured, and the number of E. coli was determined. Then, the E. coli samples were exposed to an “acid shock” which mimicked humans’ gastric juice. The acid shock was one hour in a Luria broth of pH 2.0.

### **Results:**

Diet	# of animals	Colon pH	Total E. coli count	E. coli count after acid shock
100% grass and hay	14	7.15	20,000	< 1
40% hay and 60% grain	31	6.6	6,300,000	25,000
20% hay and 80% grain	16	5.4	63,000,000	250,000

*Acid shock – pH mimicking that of gastric juice (pH 2)  
E. coli were measured as viable cells per gram.*

## **STUDY 2**

**Who:** Nine mature, non-lactating, 600kg Holstein cows. They were surgically modified so that ruminal contents could be removed directly from the rumen. Three cattle were fed on each diet, so there was a total of nine cattle.

### **Methods:**

The nine cattle were fed every 2 hours with a rotary feeder (10 kg of dry matter per day). The feeds used were medium-quality timothy hay and a grain mixture (89% rolled corn and 11% soybean meal). The diets were 0, 45, and 90% grain with the remainder being hay. The cattle were allowed 14 days to adapt to the diet and then samples were collected

for 4 days. Samples of digesta were obtained from both the rumen and the colon. The samples were analyzed for pH, E. coli bacteria count, and volatile fatty acids (acetic, propionic, and butyric). Then the E. coli in the samples was exposed to an “acid shock” of pH 2.0 for 1 hour.

**Results:**

**RUMEN**

Diet	# of Animals	VFA increase	pH	E. coli
100% grass and hay	3	not sig.	6.8	2,000
55% hay and 45% grain	3	not sig.	6.5	6,300
10% hay and 90% grain	3	not sig.	6.4	80,000

**COLON**

Diet	# of Animals	VFA increase	pH	E. coli	E. coli survival (AS)	% E. coli survival (AS)
100% grass and hay	3	0	7.15	16,000	< 2	0.01%
55% hay and 45% grain	3	225%	6.5	40,000	300	1.30%
10% hay and 90% grain	3	400%	5.0	50,000,000	5,000,000	10%

*VFA – Volatile Fatty Acids*

*E. coli were measured as viable cells per gram.*

*AS – after acid shock*

**Applications:**

The researchers also found that after cattle had been on a 90% grain diet for some time, when they were switched to an all-hay and grass diet the number of acid-resistant E. coli was reduced to the same as if they had been on an all-hay and grass diet the whole time, after just five days.

The researchers said, “Grain feeding is a practice that promotes the production and efficiency of cattle production, and it is unlikely that American cattle will ever be fed diets consisting only of hay [although currently grassfed beef is becoming widely popular]. However, our studies indicate that cattle could be given hay for a brief period immediately before slaughter to significantly reduce the risk of food-borne E. coli infection.”