

## Influence of Roughage Level and Processing Method on the Digestion of High Corn Rations

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### Story in Brief

The influence of roughage level and steam flaking of corn on digestion by steers was studied in 2 trials. In trial 1, the rations contained whole shelled corn with cottonseed hulls added at levels of 0, 7, 14 and 21 percent. Digestibility of dry matter, cellulose, acid detergent fiber, protein and starch all decreased as roughage level increased to 14 percent but increased slightly to 21 percent roughage to values similar to ratio 7.

In trial 2, steam flaked corn with 0 or 21 percent roughage was compared with dry rolled corn with 0 or 21 percent cottonseed hulls. Digestibility of dry matter, organic matter, cellulose and protein were higher for 0 percent cottonseed hull diets than on the 21 percent roughage rations. Starch digestion was unchanged with roughage level but at both roughage levels digestibilities of all nutrients analyzed were higher with steam flaked than dry rolled corn.

### Introduction

The processing of corn grain in high concentrate finishing rations has become common practice. Two of the more popularly used processing methods for corn have been steam flaked and dry rolling. When roughage levels are below 15-20 percent, whole shelled corn rations can produce equal performance to rations containing processed corn. At higher roughage levels, however, corn should be processed in some manner for optimum performance. This apparent processing method by roughage level interaction is commonly attributed to the "roughage factor" of whole shelled corn. This study was conducted in an attempt to 1) further understand the reasons for this roughage level effect on utilization of whole shelled corn, 2) to study the effects of roughage level on the utilization of steam flaked and dry rolled corn and 3) to compare these processing methods at two roughage levels.

## Procedure

### Trial 1:

Four hereford steers averaging 900 lbs. were housed in metabolism stalls and fed hourly by means of automatic feeders in order to obtain maximum feed intakes. Steers were fed one of the rations shown in Table 1 with rations being switched at 2 week intervals till each steer received each ration. All rations contained whole shelled corn with cottonseed hulls (CSH) supplying all the roughage in the rations. CSH levels were 0, 7, 14 and 21 percent of the rations.

Feces were collected on days 10 through 13 of each 2 week period. Feed and feces were analyzed for dry matter, cellulose, acid detergent fiber, starch and crude protein.

### Trial 2:

The procedures and steers in trial 2 were the same as those used in trial 1. The rations are shown in Table 2. The rations fed were steam flaked or dry rolled corn with 0 or 21 percent cottonseed hulls.

Table 1. Dry Matter Composition of Rations in Trial 1.

Ingredient	Ration <sup>1</sup>			
	0	7	14	21
Whole shelled corn	90.0	82.0	74.0	66.0
Cottonseed hulls	--	7.0	14.0	21.0
Cottonseed meal	--	1.0	2.0	3.0
Supplement	10.0	10.0	10.0	10.0
Ground corn			1.0	
Cottonseed meal			3.2	
Urea			0.6	
Vitamins & Minerals			1.5	
Lignin source			3.6	

<sup>1</sup> Rations identified by level of cottonseed hulls.

Table 2. Dry Mater Composition of Rations in Trial 2.

Ingredient	Ration <sup>2</sup>			
	SF-0	SF-21	DR-0	DR-21
Corn	90.0	66.0	90.0	66.0
Cottonseed hulls	--	21.0	--	21.0
Cottonseed meal	--	3.0	--	3.0
Supplement <sup>3</sup>	10.0	10.0	10.0	10.0

<sup>1</sup> Same composition as in trial 1.

<sup>2</sup> SF represents steamflaked corn, DR dry rolled and number refers to percentage of cottonseed hulls.

The steam flaked corn<sup>1</sup> was prepared by steaming corn for 20-30 minutes at 210-220°F at atmosphere pressure and then rolled to produce a product with a density of 34 lb. per bushel.

Dry rolled corn was prepared by passing the corn through rollers adjusted to crack all kernels. The density of the final product was 53 lb. per bushel.

## Results and Discussion

### Trial 1:

Dry matter and ADF intakes increased with increased roughage level but starch intakes remained fairly constant, (Table 3). Digestibilities of all nutrients measured decreased as roughage levels increased from 0 to 14 percent and then increased at 21 percent CSH to levels similar to the 7 percent CSH ration (Table 4). The starch digestion values suggest that

<sup>1</sup> Courtesy of Texas County Feedyards, Guymon, Oklahoma.

Table 3. Intakes of DM, Starch and Acid Detergent Fiber.

Nutrient	Ration <sup>1</sup>			
	1	2	3	4
	<i>Trial 1</i>			
DM <sup>2</sup> (lb.)	9.8	11.5	12.51	13.0
Starch (lb.)	7.1	6.9	7.0	6.2
ADF <sup>3</sup> (lb.)	0.6	1.3	2.0	3.0
	<i>Trial 2</i>			
DM <sup>2</sup> (lb.)	9.6	11.7	9.6	11.8
Starch (lb.)	5.4	4.6	7.0	6.3
ADF <sup>3</sup> (lb.)	.7	2.4	.6	2.5

<sup>1</sup> In trial 1 rations 1, 2, 3 and 4 are rations 0, 7, 14 and 21 respectively. In trial 2 rations 1, 2, 3 and 4 are rations SF-0 SF-21, DR-0 and DR-21 respectively.

<sup>2</sup> Dry matter.

<sup>3</sup> Acid Detergent Fiber.

Table 4. Digestibilities of DM, Cellulose, ADF, Starch and Protein in Trial 1<sup>1</sup>.

Nutrient	Ration (% cottonseed hulls)			
	0	7	14	21
DM	84.3	78.4	71.8	74.9
Cellulose	78.2	65.7	54.1	66.0
ADF	46.2	42.0	32.9	46.7
Starch	96.4	94.7	92.2	95.4
Protein	71.4	64.0	60.5	64.4

<sup>1</sup> All values expressed as a percentage of total intake.

as the roughage level increased from 0 to 14 percent the rate of passage of starch through the digestive tract increased, reducing the time for digestion and lowering digestibility. The decreased DM, protein, ADF and cellulose digestion between 0 and 14 percent CSH may be due to the increase in the amount of poorly digestible CSH component. The increase noted at 21 percent CSH again suggests that rate of passage may be decreased at this roughage level.

### Trial 2:

DM and ADF intakes increased when roughage levels increased but starch intakes were slightly decreased. The dry rolled corn rations had a higher starch content and thus a higher total intake. Digestibilities obtained in trial 2 are shown in Table 5. Increasing the roughage level decreased digestibility of DM, organic matter (OM), protein and cellulose by 6-10 percentage units with both corn processing methods. This decreased digestibility might be expected simply due to the poor digestibility of the DM, OM, protein and cellulose of CSH.

Steam flaked corn rations had higher digestibilities of DM, OM, starch, cellulose and protein than dry rolled corn rations at the same roughage levels. The higher digestibilities of DM and OM on the SF corn rations is a reflection of the greater availability of the starch and protein in the SF corn.

When compared to the results of trial 1, SF corn appeared to have higher digestibilities of DM, starch and protein than WSC at the same roughage levels. While WSC and DR corn appeared to have similar digestibilities. Although these effects could be due to time differences (there was approximately a 5 month period between trials) they would be expected from results of previous research.

**Table 5. Digestibilities of DM, OM, Cellulose, ADF, Starch and Protein in Trial 2<sup>1</sup>.**

Nutrient	Ration <sup>2</sup>			
	SF-0	SF-21	DR-0	DR-21
DM	86.9	78.2	80.5	71.2
OM	88.5	79.8	82.3	72.8
Cellulose	71.6	58.1	66.1	57.6
ADF	39.6	40.3	27.1	36.8
Starch	99.5	98.9	95.7	94.1
Protein	78.2	67.2	68.2	60.5

<sup>1</sup> All values expressed as a percentage of total intake.

<sup>2</sup> SF represents steam flaked corn, DR, dry rolled, and number refers to percentage of cottonseed hulls in the diet.