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Effects of High-Amylase Corn on Performance and Carcass Quality of Finishing Beef Heifers

Syngenta Seeds developed Enogen® Feed Corn (EFC) that has been genetically enhanced to contain an α-amylase enzyme trait to enhance ethanol production. Corn is well established as the principal ingredient fed to U.S. finishing cattle. A 2016 survey of consulting feedlot nutritionists indicated that 100% of their clients used corn as the primary gain source in finishing diets.[1] The published research evaluating feeding EFC to finishing cattle is limited and has used dry-rolled corn or high-moisture corn.[2, 3, 4, 5] However, the 2016 survey also showed that for finishing cattle diets, steam flaking (70.8%), high-moisture harvesting and storage (16.7%), and dry rolling (12.5%) were the primary grain processing methods. It is extensively documented that steam-flaking corn improves energy (starch) utilization from corn.[6, 7, 8]

Kansas State University researchers theorized that α-amylase within EFC could potentially be enhanced through the steam-flaking process.[9] Their preliminary studies indicated that targeted starch availabilities for flaked grain could be achieved with lesser degrees of processing in EFC compared with control grain, thereby increasing throughput and decreasing energy expenditures associated with steam flaking. Thus, these researchers conducted two experiments to evaluate processing characteristics of EFC: in vitro digestion and effects on feedlot performance, carcass characteristics, and liver abscess incidence.

In Experiment 1, grain mixtures were prepared using whole shelled EFC and mill-run corn as a control (CON). These grain types were flaked to a density of 28 lb/bushel and mixtures with 0%, 25%, 50%, 75%, or 100% EFC were prepared. Enzymatic starch availability and in situ dry matter disappearance (ISDMD) were evaluated. High-amylase corn improved starch availability and all measures of microbial digestion compared with the CON corn. Enzymatic starch availability improved linearly ($P < 0.01$) with an increasing percentage of EFC in flaked grain mixtures (Table 1). EFC also increased ISDMD (linear; $P < 0.01$), with 100% EFC resulting in an 32% increase (46.0 vs. 34.8%).

Table 1. Effects of increasing proportion of steam-flaked EFC in grain mixtures on starch availability and ISDMD.

	Proportion of grain mixture as EFC, %					P-value
Item	0	25	50	75	100	Linear
Starch availability, %[1]	45.0	47.7	50.5	50.7	52.7	<0.01
ISDMD, %[2]	34.8	39.5	40.8	43.8	46.0	<0.01

[1]Measured using the refractive index method, with a total of 18 samples per treatment.
[2]Measured using six ruminally fistulated steers by incubating corn flakes in Dacron bags ruminally for 14 hours (270 observations, 54 per treatment).
Adapted from Horton et al., 2020.

Experiment 2 used 700 beef heifers (867 lb initial weight) fed finishing diets with steam-flaked corn (85.4% on dry mater basis) as CON or EFC for 136 days. Mill-run corn was steam-flaked to 28 lb/bushel with a production rate of 6 tons/hour. To achieve similar starch availability, EFC was steam-flaked to 30 lb/bushel with a production rate of 9 tons/hour, thereby decreasing steam-conditioning time for EFC compared with CON. In the 2016 survey of consulting feedlot nutritionists, the average bulk density recommended for steam-flaked corn was 27 lb/bushel. The ration contained 33 g/ton of monensin but no tylosin.

Heifers in this trial were blocked by body weight, stratified, and then randomly assigned to 28 dirt-surfaced pens (25 animals per pen). Heifers were transitioned to finishing diets at the start of the trial over 21 days using three step-up diets with concentrate:roughage ratios of: 60:40, 71:29, and 92:18 (7 days per step) for gradual adaptation to the finishing diet. Treatments were applied during dietary adaptation and both grain types were steam flaked daily.

The effects of EFC on feedlot performance of the heifers are shown Table 2. Cattle fed EFC were 24 lb heavier than CON on the final day ($P < 0.01$). Thus, over the 136-day trial, EFC cattle had 5.7% improved average daily gain (ADG, 3.72 vs. 3.52 lb/day, $P < 0.01$). No difference in dry matter intake was reported ($P = 0.78$). As a result, gain efficiency was improved by 5% (0.168 vs. 0.160, $P < 0.01$) for cattle fed EFC compared with CON.

Table 2. Finishing performance of heifers fed diets containing steam-flaked CON or steam-flaked EFC.

Item	CON	EFC	P-value
Initial Weight, lb	869	867	0.52
Final Weight, lb[1]	1294	1318	<0.01
DMI, lb/day	22.00	22.15	0.78
ADG, lb/day	3.52	3.72	<0.01
Gain:Feed	0.160	0.168	<0.01

[1]Gross BW (measured immediately prior to loading cattle onto trucks for transport to packing plant) multiplied by 0.96 to account for 4% shrink.
Adapted from Horton et al., 2020.

These researchers also reported that hot carcass weight was 13.2 lb greater for EFC cattle ($P < 0.01$) than CON. No differences were observed for ribeye area, fat thickness, or USDA yield grade. Cattle fed CON had greater marbling scores than EFC ($P = 0.04$), but this did not affect the USDA quality grade ($P > 0.33$). Cattle fed EFC had 23% fewer abscessed livers than CON ($P = 0.03$). This difference occurred due to fewer moderate ($P = 0.03$) and severe ($P = 0.11$) abscessed livers in the EFC group. It was noted that no previous research has identified any liver abscess effects when feeding EFC (through any processing method). A biological explanation for this effect of EFC on liver abscesses in not readily apparent.

These authors concluded that high-amylase corn could be used by producers to reduce production costs associated with steam flaking. Implications included reduced steam use, reduced grain processing (bulk density), and 50% increased mill throughput (reduced labor) which are all potential benefits that occur prior to feed being delivered to bunks. Furthermore, improvements in microbial digestion, ADG, gain efficiency, hot carcass weight, and liver abscess mitigation are potential benefits associated with feeding high-amylase corn.

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