Agricultural Experiment Station U. S. Department of Agriculture

Department of Animal and Range Sciences
CLAYTON LIVESTOCK RESEARCH CENTER
PROGRESS REPORT

Route 1 Box 109 Clayton, New Mexico 88415 505-374-2566

Progress Report No. 94 (December, 1994)

Starch availability estimates from two commercial laboratories using steam-flaked corn and steam-flaked milo

G. C. Duff, M. L. Galyean, J. Rakestraw[1], D. Cross[1], and S. L. Armbruster[2]

Steam flaking is widely used by the feedlot industry to improve grain utilization. Measurement of bulk density is a simple in-plant procedure that can be used to determine degree of processing; however, it reveals nothing about the degree of gelatinization of the grain. Starch availability measurements by commercial laboratories should provide estimates of the degree of gelatinization, but limited information is available concerning analytical variation in such estimates. Likewise, data are limited regarding estimates of starch availability among commercial laboratories for samples varying in bushel (flake) weight. Our objectives were to evaluate the within- and between-assay variability in starch availability estimates for steam-flaked corn (SFC) and steam-flaked milo (SFM) for two commercial laboratories and to obtain starch availability estimates from these two laboratories for SFC and SFM varying in bulk density.

Samples for both studies were collected and sent to Laboratory 1 (L1) and Laboratory 2 (L2) from Cimarron Feeders, Texhoma, OK. To determine the within- and between-assay coefficients of variation (CV), SFC and SFM samples were collected at mid-morning in 5-gallon buckets and stored frozen. Samples were collected from one roller set to yield a 27 pound/bushel flake weight for SFC and a 26 pound/bushel flake weight for SFM. The 18 inch x 36 inch Ferrell Ross rolls had a medium corrugation (14 Stevens), and the cabinet (21-foot rectangular chest) was maintained at 200° F. Within-assay CV was determined on 10 samples sent to L1 and L2 on one day for both SFC and SFM. For SFC, one sample sent to determine the within-assay CV, plus nine other samples sent to the two laboratories on nine different days, were used to determine between-assay CV. For SFM, the between-assay CV was determined on nine samples sent on nine different days. A second set of samples was collected to examine the effects of bulk density on starch availability estimates from L1 and L2. Samples were collected for 24, 26, 28, and 30 pounds/bushel flake weights for both SFC and SFM. All samples were collected at mid-morning into two, 5-gallon buckets, with temperature and roll conditions described previously, yielding 16 samples of each flake weight of SFC and SFM. Samples were sent on the same day of collection to L1 and L2 (eight samples of each flake weight to each laboratory). Assuming a CV of 5% (average of within- and between-assay CV), eight samples would be needed to detect a 10% difference at $P < .05$ with a 95% power of the test (Berntson, 1991).

Laboratory 1 used a gas production technique, and values are expressed as milliliters/gram of grain, whereas L2 used an enzyme conversion technique and values are expressed as milligrams of glucose release/gram of dry matter. Briefly, L1 fermented the grain samples in Diazyme 200 and yeast, and measured gas production for 4 hours. Laboratory 2 incubated the grain samples in buffer plus Taka-Diastase for 4 hours and then measured glucose concentration. Means, standard deviations, and CV were obtained using SAS (1987). In addition, starch availability was regressed against flake weight (SAS, 1987).

Means, standard deviations, and CV for within-assay and between-assay starch availability estimates for SFC and SFM are presented in Table 1. For SFC, both laboratories had similar within-assay variation as evidenced by similar CV. Furthermore, both laboratories had lower CV with SFC for the between-run assay than for the within-run assay. For SFM, the within-assay variability was less for L1

Table 1. Within- and between-assay coefficient of variation for starch availability estimates from two commercial laboratories using steam-flaked corn and steam-flaked milo

	Laboratory 1[b]			Laboratory 2[b]		
Item[a]	Mean	SD	CV	Mean	SD	CV
SFC						
Within	61.0	3.60	5.90	174.1	8.86	5.09
Between	59.5	2.26	3.80	190.5	8.26	4.34
SFM						
Within	73.1	.74	1.01	211.5	12.88	6.09
Between	70.7	3.52	4.97	216.8	8.47	3.91

[a]SFC = steam-flaked corn; SFM = steam-flaked milo.
[b]n = 8.

Table 2. Effects of flake weight on starch availability estimates from two commercial laboratories

	Laboratory 1[b]			Laboratory 2[b]		
Item/ flake weight[a]	Mean	SD	CV	Mean	SD	CV
SFC						
24	63.1	.91	1.45	163.6	4.52	2.77
26	61.2	.81	1.33	159.1	6.15	3.87
28	57.0	.69	1.21	154.3	7.08	4.59
30	52.7	.80	1.53	143.1	3.48	2.43
SFM						
24	71.1	1.38	1.94	217.7	9.52	4.37
26	68.1	1.02	1.50	205.2	15.16	7.39
28	63.3	1.04	1.64	179.9	10.91	6.07
30	62.2	3.46	5.56	175.7	4.35	2.48

[a]SFC = steam-flaked corn; SFM = steam-flaked milo. Flake weights are expressed in pounds/bushel.
[b]n = 8.

[1]Cimarron Feeders, Route 1, Box 59, Texhoma, OK 73949.
[2]P.O. Box 2195, Stillwater, OK 74076.

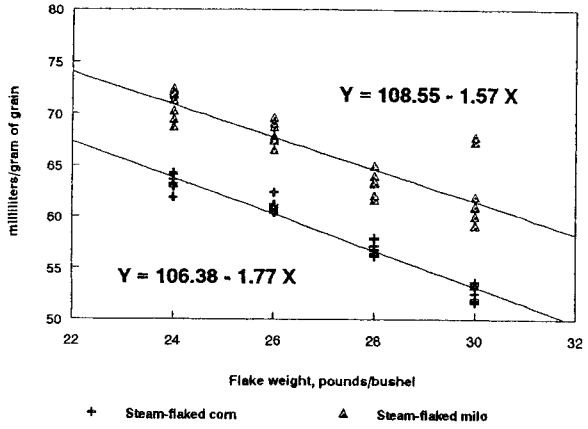

Figure 1. Effects of flake weight on starch availability estimates from Laboratory 1.

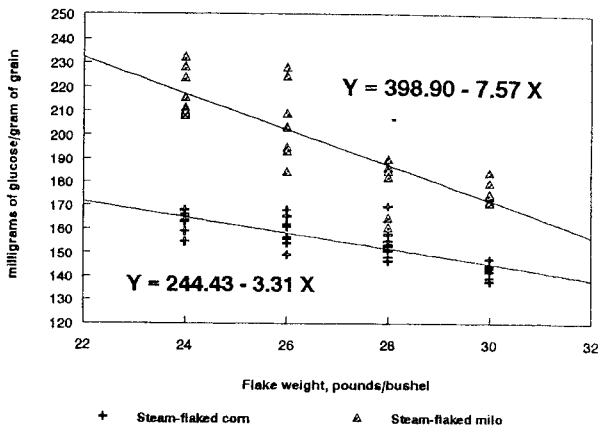

Figure 2. Effects of flake weight on starch availability estimates from Laboratory 2.

than for L2, whereas L2 had a similar between-assay CV to L1. Starch availability estimates were generally less variable for both SFC and SFM with L1, using a gas production technique, than for L2 using an enzyme conversion technique. Xiong et al. (1990) recommended a 6-hour gas production method for routine starch availability analysis compared with an enzymatic glucose release method.

Table 2 shows the effects of flake weight on starch availability estimates from the two commercial laboratories. Starch availability estimates were greater for both SFC and SFM with increased degree of processing (decreased flake weight), which has been reported previously (Xiong et al., 1990). Variability among SFC and SFM samples varying in flake weight was generally greater for L2, using an enzyme technique, than for L1, using a gas production technique, as evidenced by larger standard deviations and CV. Likewise, variability was greater for SFM than for SFC for both laboratories. This greater variability for SFM than for SFC may be related to the different sizes of the grain, and the variability in processing resulting from differences in retention time in the cabinets.

Figures 1 and 2 show the relationship between grain processing (as measured by flake weight) and starch availability. The regression equations for both SFC and SFM indicated greater sensitivity and precision from L1 with r^2 of .94 and .75, respectively. The corresponding r^2 for SFC and SFM with L2 were .65 and .71, respectively.

Based on these data, Laboratory 1, which used a gas production technique, yielded starch availability estimates that were more descriptive of changes in flake weight than Laboratory 2, which used an enzyme conversion technique. Regardless of the technique used to determine starch availability, each feedlot manager and(or) nutritionist should validate their in-plant bulk density measurements versus laboratory-determined starch availability to more clearly define their circumstances.

Literature Cited

Berndtson, W. E. 1991. A simple, rapid and reliable method for selecting or assessing the number of replicates for animal experiments. J. Anim. Sci. 69:67.

SAS. 1987. Procedures Guide for Personal Computers. Version 6 Ed. SAS Inst. Inc., Cary, NC.

Xiong, Y., S. J. Bartle, R. L. Preston, and Q. Meng. 1990. Estimating starch availability and protein degradation of steam-flaked and reconstituted sorghum grain through a gas production technique. J. Anim. Sci. 68:3880.

Department Head
Animal and Range Sciences
New Mexico State University

Department of Animal and Range Sciences
New Mexico State University
Box 30003, Department 3-I
Las Cruces, NM 88003-0003

Non Profit Organization
U. S. Postage Paid
Permit No. 162
Las Cruces, NM