IDENTIFYING THE EFFECTIVE FIBER VALUE OF WHISKEY DISTILLERS DRIED GRAINS WITH SOLUBLES IN LACTATING DAIRY COW DIETS

Charles R. Staples, Bradley S. Oldick,
Estelle Hirchert, and Juan Velasquez
University of Florida, Gainesville 32611

Introduction

The industrial processing of seed crops results in a primary product usually used for human consumption. A byproduct of the manufacturing processes often is a valuable feedstuff for livestock. So valuable are these byproducts that they have been labeled coproducts, making them of equal value to the primary products of the milling industries.

One popular coproduct from fermentation of grains for alcohol production is distillers dried grains with solubles (DDGS). The residue is nearly devoid of starch but protein, fat, fiber, minerals, and vitamins become concentrated approximately three fold from the original grain itself. Yeast cell numbers are quite high in the residue as well (Distillers Feed Research Council). Because of its high nutrient content and animal acceptability, the residue has become an attractive feedstuff in diets of lactating dairy cows.

An average nutrient concentration of DDGS was determined by several researchers over several sampling times. Average concentrations varied from 24.9 to 30.6% for crude protein, from 7.4 to 12.8% for crude fat, from 33.0 to 42.8% for NDF, and from 14.3 to 19.9% for ADF (Chase, 1991). Regular chemical analyses is necessary to arrive at an average value for DDGS from a particular supplier.

The DDGS frequently comprise 15 to 40% of the concentrate fed to lactating cows. At these higher concentrations, DDGS provides a significant portion of dietary fiber. However, the fiber is of very short particle length and therefore is thought to exert less stimulation to chewing (eg. low in effective fiber) compared to traditional roughage sources. Sources of long fiber are needed in the diet to maintain rumen health, prevent metabolic disorders, and maintain milk fat concentration.

Mertens (1992) suggests that at least 75% of the total dietary NDF must be in the long or coarsely chopped form to maintain animal performance. Can coproduct feedstuffs contribute effective fiber to the diet? Because many coproduct feedstuffs exist in the finely ground form, their NDF values have been assigned an adjustment factor to account for their smaller particle size (Mertens, 1992). These crude adjustment factors are based upon "practical

Presented at the 6th Florida Ruminant Nutrition Symposium, Gainesville, January 12-13, 1995

experience" because "there are no data to develop these adjustments for individual feeds." Finely ground coproducts containing < 40% NDF were assigned an adjusted NDF value of 12% (similar to corn and soybean meal). Those containing > 40% NDF were assigned an adjusted NDF value of 30% of its analyzed NDF value. Selected coproduct feedstuffs using this system of Mertens (1992) are listed in Table 1.

Table 1. Concentration of ADF, NDF, and adjusted NDF (ANDF) in commonly used coproduct feedstuffs (Mertens, 1992).

Feedstuff	ADF	NDF	ANDF[1]
	----------% DM----------		
Beet pulp	21.5	41.3	12.0
Brewers grains	23.0	47.0	14.1
Citrus pulp	17.5	22.0	12.0
Corn DDGS	19.0	38.0	11.4
Corn gluten feed	10.0	35.0	10.5
Cottonseed hulls	70.0	89.0	71.2
Cottonseed, whole	34.0	49.0	41.7
Peanut hulls	65.0	74.0	22.2
Rice bran	19.0	33.0	12.0
Soybean hulls	46.0	64.0	19.2
Wheat middlings	13.2	36.5	12.0

The need for scientifically derived adjustment factors for the "effective" fiber in ground, fibrous coproduct feedstuffs prompted this research. Although many coproducts in Table 1 are fed on Florida dairies, whiskey DDGS was chosen for study due to its popularity of use as a good source of dietary protein and energy. How much of the fiber in DDGS can be charged toward the dietary recommendation of 25 to 28% NDF for lactating dairy cows (NRC, 1989)?

Experimental Material and Methods

The effect of DDGS on cow performance may be influenced by several factors. Dietary treatments were chosen to evaluate potential effects by some factors. One factor is the main roughage source used in the diet. In this study, corn silage alone or an equal mixture of corn silage plus rhizoma peanut silage served as the main roughage sources. An additional factor potentially influencing DDGS effects is the proportion of concentrate in the diet. Whiskey DDGS may have greater opportunity to contribute effective fiber when diets contain more concentrate and less traditional roughage sources. In this study, three concentrate to forage dietary ratios were formulated; that is, 70:30, 55:45, and 40:60 (DM basis). Enough DDGS was included in the diets to adequately test its fiber value. All diets were formulated to contain 0 or 20% DDGS of diet DM. Therefore 12 dietary treatments were fed in a 2 x 3 x 2 factorial design to 48 multiparous lactating dairy cows in a three period study. Each period was 32 days long with the first 18 days for diet adjustment and the last 14 days for data collection.

Ingredient composition of the experimental diets is listed in Table 2. The concentrate portion was primarily corn-soybean meal based. Whole shelled corn was purchased and coarsely ground before mixing with other feedstuffs. Soybean meal (49%) and blood meal were the primary protein feedstuffs in the diets containing no DDGS. The DDGS replaced corn, soybean meal, and blood meal in the appropriate diets. The chemical composition of DDGS used in this study was 27.5% CP, 16.2% ADF, 43.6% NDF, 12.0% fat, .16% Ca, .75% P, .28% Mg, .96% K, and .39% S.

Milk production was measured three times daily. Milk samples were collected at nine consecutive milkings during each week of the last two weeks of each experimental period and analyzed for fat content by NIR. Dry matter intake was measured daily. Digestibility was estimated using the marker ratio (chromic oxide) technique. Cows were dosed twice daily for 10 days with 10 g of chromic oxide per dose and fecal grab samples were collected twice daily the last five of the 10-day period.

Results and Discussion

As expected, the estimated NEL of the diets decreased with decreasing concentrate in the diet from approximately .77 to .68 Mcal/lb (Table 3). Concentration of dietary crude protein averaged 16.3% across diets, ranging from 15.8 to 16.9%. Ruminally undegradable protein concentration was maintained to at least 6.1% of diet DM by judiciously feeding blood meal. All diets of 70% concentrate and devoid of DDGS were below the minimum recommended dietary concentration for NDF of 25 to 28% (NRC, 1989) whereas both diets of 70 and 55% concentrate and devoid of DDGS were below the minimum recommended dietary concentrations for ADF of 19 to 21% (NRC, 1989). The NDF from DDGS contributed approximately 9% of diet DM across diets containing DDGS and 30, 25, and 21% of dietary NDF for diets containing 70, 55, and 45% concentrate, respectively. Those diets containing DDGS contained a greater concentration of ether extract due to the greater concentration of ether extract in DDGS than corn and soybean meal.

Traditional forages and DDGS were compared on a nearly equal fiber basis. From Table 3, the diet of 70% concentrate served as the diet of greatest fiber deficiency (approximately 21% NDF and

Table 2. Ingredient composition of corn silage- or corn silage plus rhizoma peanut (RP) silage-based diets formulated with or without dried distillers grains plus solubles (DDGS) and to three concentrate to forage ratios.

	Corn silage-based						Corn and RP silage - based					
	Without DDGS			With DDGS			Without DDGS			With DDGS		
	Concentrate to forage ratio (DM basis)											
Item	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60
	% DM											
Corn silage	30.0	45.0	60.0	30.0	45.0	60.0	15.0	22.5	30.0	15.0	22.5	30.0
RP silage	-	-	-	-	-	-	15.0	22.5	30.0	15.0	22.5	30.0
Ground corn	44.7	29.9	15.1	33.0	17.7	2.9	47.9	34.8	21.6	36.4	22.8	9.5
Soybean meal	16.7	16.1	15.3	9.0	9.4	9.1	13.5	11.0	8.9	5.9	4.5	2.2
Molasses	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
DDGS	-	-	-	20.0	20.0	20.0	-	-	-	20.0	20.0	20.0
Blood meal	.3	.9	1.5	-	-	.3	.3	1.0	1.5	-	-	.5
Mineral premix	3.3	3.1	3.1	3.3	3.1	3.1	3.1	3.1	2.8	3.1	3.1	3.1
TMS	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.1	1.1
Dicalcium phosphate	.6	.6	.6	.3	.3	.3	.7	.7	.7	.4	.4	.4
Calcium sulfate	.3	.3	.3	.3	.4	.2	.3	.3	.4	.1	.1	.2

Table 3. Chemical composition of corn silage- or corn silage plus rhizoma peanut (RP) silage-based diets formulated with or without dried distillers grains plus solubles (DDGS) and to three concentrate to forage ratios.

	Corn silage-based						Corn and RP silage - based					
	Without DDGS			With DDGS			Without DDGS			With DDGS		
	Concentrate to Forage Ratio (DM basis)											
Item	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60
DM, %	56.2	47.7	41.5	56.3	47.9	41.6	61.0	53.3	47.4	61.1	53.3	47.9
OM, %	93.2	92.9	92.5	93.0	92.8	92.5	91.8	91.8	91.4	92.2	92.1	91.3
NEL, Mcal/lb	.76	.72	.68	.77	.73	.68	.76	.72	.67	.77	.72	.68
CP, % DM	15.8	16.5	16.1	16.4	16.5	16.4	16.5	15.9	16.0	16.9	16.6	16.4
RUP, % DM	6.1	6.1	6.1	6.5	6.3	6.1	6.1	6.1	6.1	6.5	6.2	6.1
NDF, % DM	21.4	28.0	34.5	30.0	36.6	42.7	20.5	26.6	32.7	29.7	35.4	41.0
ADF, % DM	12.3	16.5	20.7	16.2	20.8	25.0	12.7	17.2	21.6	16.9	21.3	25.9
EE, % DM	3.0	2.8	2.6	4.8	4.6	4.4	3.1	3.0	2.8	4.9	4.8	4.7
Ca, % DM	.71	.76	.79	.71	.73	.71	.96	.99	1.1	.84	.88	1.07
P, % DM	.50	.48	.45	.53	.49	.48	.52	.48	.47	.53	.46	.49
K, % DM	1.05	1.09	1.20	1.02	1.10	1.17	1.06	1.10	1.19	1.02	1.13	1.19
Mg, % DM	.23	.23	.24	.26	.26	.27	.27	.27	.29	.29	.30	. 32
Na, % DM	.64	.63	.64	.73	.68	.69	.78	.63	.66	.74	.60	.68
S, % DM	.25	.26	.28	.29	.30	.29	.25	.25	.26	.24	.25	.27
Fe, ppm	256	279	285	246	251	256	298	376	315	234	267	271
Mn, ppm	68	76	83	61	74	80	77	76	81	92	77	89
Cu, ppm	15	19	15	25	18	25	20	14	15	23	20	23
Zn, ppm	76	77	77	75	84	86	82	87	75	84	81	86

12.5% ADF averaged across both forage treatments). Dietary concentrations of NDF were increased approximately to the same degree by replacing concentrate with forage (55:45 concentrate:forage) on one hand (from 21 to 27.3% NDF) and by replacing concentrate with DDGS (70:30 concentrate:forage) on the other (from 21 to 29.8% NDF). The change pattern of ADF was similar to NDF; it increased from 12.5 to 16.8% as the concentrate to forage ratio decreased from 70:30 to 55:45 and it increased from 12.5 to 16.5% by replacing corn-soybean meal with DDGS (70:30 concentrate:forage diet).

Diets containing 20% DDGS were consumed in equal amounts to control diets (49.9 vs. 50.8 lb of DM/d) (Table 4). Although forage source did not influence DM intake (50.2 vs. 50.6 lb/day for corn silage and corn silage-rhizoma peanut silage respectively), the concentrate to forage ratio was an important factor. Intake of DM decreased linearly from 53.3 to 46.9 lb/d as proportion of concentrate decreased (Table 4). Cows consumed more NDF (17.9 vs. 13.7 lb/d) and ADF (10.4 vs. 8.4 lb/d) when fed DDGS as expected because DDGS contained more NDF than corn and soybean meal.

Apparent DM digestibility was lower in diets containing DDGS compared with control diets (65.0 vs. 67.1%) resulting in less daily intake of apparently digested DM (32.8 vs. 34.4 lb/day) (Table 4). However apparent digestibility of NDF (55.1 vs. 48.2%) favored diets containing DDGS. As a result of greater intake of NDF and greater digestibility of NDF, intake of apparently digestible NDF was greater by cows fed diets containing DDGS (10.0 vs. 6.6 lb/day).

Cows fed DDGS produced 2.5 lb/day more milk (61.3 vs. 58.8 lb/day) and 2.2 lb/day more 4% fat-corrected milk (57.6 vs. 55.4 lb/day) than cows fed control diets (Table 5). In order to augment chances to optimize milk production from feeding DDGS, Chase (1991) offered the "tentative" guideline of limiting protein from corn products to 50 to 60% of total dietary protein. Diets in this study met this guideline in that corn products contributed approximately 60% of the total dietary protein. As expected, milk production decreased as concentrate in the diet decreased (62.6, 59.9, 57.7 lb/day for 70, 55, and 40% concentrate diets respectively). Forage source did not influence milk production.

Milk fat percentages for cows fed diets of deficient to marginal fiber concentrations were much greater than expected in this study. Feeding coarsely ground corn rather than finely ground corn may have contributed to these elevated values. As expected, milk fat percentage increased linearly with increasing proportion of dietary fiber (3.53, 3.62, and 3.69% for 30, 45, and 60% forage respectively.)

Digestion of fiber by ruminal microorganisms results in the production of acetic acid primarily which in turn serves as the chief precursor for synthesis of milk fat. As a result, milk fat percent was chosen as the measure of effective fiber in DDGS.

Table 4. Intake of DM and digestible DM and apparent digestibility of corn silage- and corn silage-rhizoma peanut (RP) silage-based diets formulated with or without dried distillers grains plus solubles (DDGS) and to three concentrate to forage ratios.

	Corn silage-based diets						Corn and RP silage - based diets						
	Without DDGS			With DDGS			Without DDGS			With DDGS			
	Concentrate to forage ratio (DM basis)												
Item	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:60	SEM
Intake, lb/d													
DM[1]	54.2	51.3	46.7	51.7	50.9	46.1	52.9	51.7	47.8	54.3	49.8	46.9	1.8
NDF[1,2]	11.4	14.3	16.1	15.4	18.9	19.7	11.0	13.6	15.6	16.1	17.7	19.3	0.5
ADF[1,2,4]	6.6	8.4	9.6	8.3	10.7	11.6	6.9	8.8	10.3	9.1	10.7	12.2	0.3
Apparent dig, %													
DM[1,2,3]	72.1	65.7	64.5	65.1	66.1	60.6	68.0	66.7	65.6	66.0	65.8	66.5	1.5
NDF[2]	49.0	47.5	48.9	52.4	58.7	51.7	44.4	47.2	52.2	55.2	54.6	58.3	2.7
Intake, lb/d													
Digested DM[1]	39.7	34.1	30.3	34.0	34.0	28.2	36.1	34.5	31.8	36.2	33.0	31.6	1.8
Digested NDF[1,2]	5.8	6.9	7.8	8.2	11.2	10.1	4.9	6.4	8.2	9.0	9.6	11.7	0.6
Undig NDF[1,2,3,4]	5.7	7.5	8.3	7.3	7.7	9.7	6.2	7.2	7.4	7.2	8.0	7.8	0.3

[1]Linear effect due to increasing proportion of dietary forage, $P < .05$.
[2]DDGS vs. no DDGS, $P < .05$.
[3]Forage by linear effect of NDF interaction, $P < .05$.
[4]Corn silage vs. rhizoma peanut silage, $P < .05$.

Table 5. Milk Production and Composition by Dairy Cows Fed Corn Silage and Corn Silage-Rhizoma Peanut (RP) Silage-based Diets Formulated With or Without Dried Distillers Grains Plus Solubles (DDGS) and Formulated to 21, 28, and 35% Neutral Detergent Fiber (NDF).

	Corn silage-based						Corn and RP silage - based						
	Without DDGS			With DDGS			Without DDGS			With DDGS			
	Concentrate to Forage Ratio (DM basis)												
Item	70:30	55:45	40:60	70:30	55:45	40:60	70:30	55:45	40:30	70:30	55:45	40:60	SEM
Milk production, lb/d[1,2]	61.4	59.1	56.1	63.9	60.7	60.3	61.3	58.9	56.0	63.9	60.6	58.2	1.5
Milk fat, %[2]	3.44	3.60	3.78	3.57	3.64	3.69	3.59	3.72	3.68	3.52	3.54	3.62	.07
Milk fat production, lb/d[1]	2.09	2.13	2.10	2.28	2.21	2.24	2.20	2.18	2.05	2.23	2.14	2.12	.06
4% fat-corrected milk (FCM) prod, lb/d[1,2]	55.9	55.7	54.0	59.7	57.5	57.7	57.5	56.3	53.1	59.1	56.4	55.0	1.4
Milk production efficiency, lb FCM/lb of DMI[2,3]	1.06	1.11	1.15	1.16	1.12	1.27	1.08	1.10	1.14	1.09	1.12	1.18	.05

[1]DDGS vs. no DDGS, $P < .01$.
[2]Linear effect due to increasing proportion of dietary forage, $P < .01$.
[3]DDGS vs. no DDGS, $P < .06$.

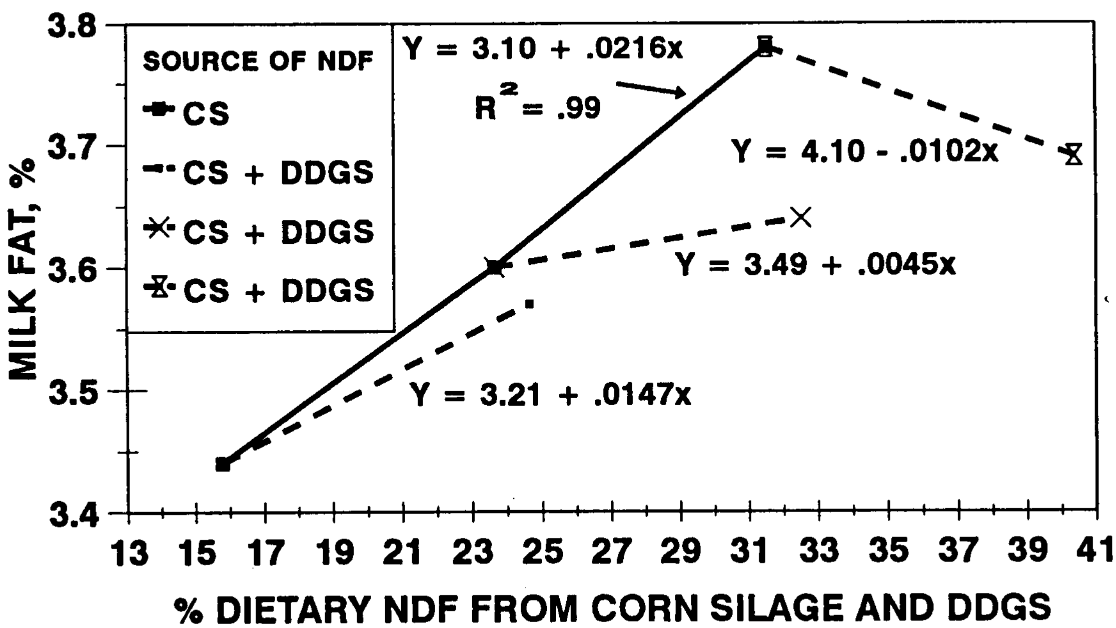
Although milk fat percentage is not a clear indicator of other important roles of dietary fiber such as chewing and rumen function, it does have a positive relationship to these as well. Swain and Armentano (1994) showed that milk fat percentage was a more sensitive measure of fiber character of coproduct feedstuffs than was time spent eating and ruminating. A standard of effective fiber to which DDGS can be measured against must be included in the treatments. In this study, the forages of corn silage and rhizoma peanut silage served as the standards. Their effective fiber is arbitrarily assigned a value of 100%. The effective fiber value of corn and soybean meal are assigned values of 0%. The influence of these forage sources on milk fat concentration is measured as they contribute a greater proportion of fiber to the diet. As fiber from DDGS replaced that of corn silage and/or rhizoma peanut silage, the effect of DDGS fiber on milk fat content was calculated as a percentage of the effect of the traditional forage sources on milk fat content.

A standard response curve plotting dietary NDF coming from forage or DDGS against milk fat percentage allows a comparison of effective NDF from these two sources (Figure 1). The linear regression of increasing dietary corn silage without DDGS was: milk fat percentage = 3.10% + .0216 x % dietary NDF from corn silage; r^2 = .99. In other words, milk fat percent increased .02 percentage units for each 1% increase in dietary NDF coming from corn silage. Plotting the effect of replacing corn-soybean meal with DDGS in the 70% concentrate diet on milk fat percent resulted in a slope of .0147. The slope of the line representing corn silage NDF divided by the slope of the line representing DDGS NDF indicates that DDGS NDF was 68% as effective in raising milk fat content as was corn silage NDF (.0147 ÷ .0216 = .68). Therefore the NDF content used in ration formulation would be its chemically determined NDF value multiplied by its effective NDF value (eg. 44% x .68 = 30%).

When the standardized diet was 55% rather than 70% concentrate, the effective NDF value calculated for DDGS was diminished. Slope for DDGS NDF was .0045 compared to .0216 for corn silage NDF resulting in an effective NDF value of 21% for DDGS (.0045 ÷ .0216 = .21).

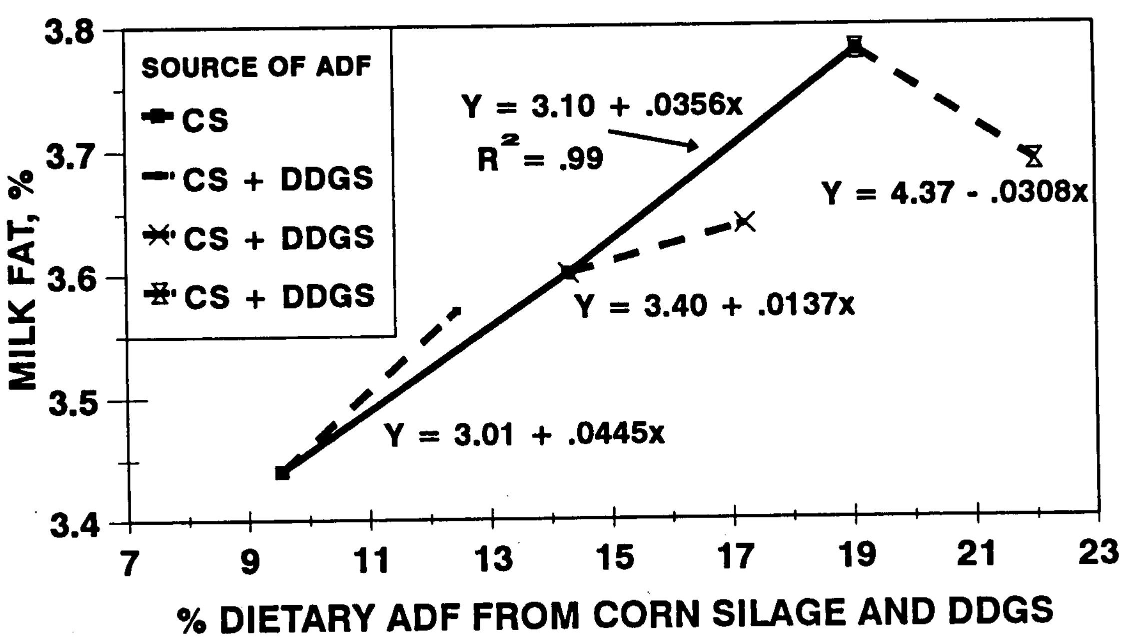
When DDGS was added to the diet that exceeded minimum NDF and ADF recommendations (NRC, 1989), milk fat content decreased indicating that the effective fiber value of DDGS was negative. However, this NDF contribution was outside the NDF range of the standardized regression line and therefore is beyond the scope of valid comparison. Nevertheless it appears that the effective fiber value of a coproduct such as DDGS dwindles as dietary NDF concentration increases. An average effective NDF value for DDGS was 45% ((68% + 21%) ÷ 2) when incorporated into fiber-deficient diets. Swain and Armentano (1994) suggested that the coproducts corn gluten feed, oat hulls, dried brewers grains, beet pulp, and barley malt sprouts shared a common effectiveness factor of 50% although they differed in calculated effective NDF values from 22

FIG 1. CHANGE IN MILK FAT % BY INCREASING DIETARY NDF FROM CORN SILAGE AND DRIED DISTILLERS GRAINS SOLUBLES (DDGS)



UNIVERSITY OF FLORIDA, 1995

FIG 2. CHANGE IN MILK FAT % BY INCREASING DIETARY ADF FROM CORN SILAGE AND DRIED DISTILLERS GRAINS SOLUBLES (DDGS)



UNIVERSITY OF FLORIDA, 1995

to 71%. Clark and Armentano (1993) determined that dried distillers grains had an effective NDF value of 100% compared to alfalfa silage when milk fat test was used as an index of effective fiber. Alfalfa silage made up 30% of diet DM and dietary NDF concentration was 21.3%.

The same approach was used to calculate the effective ADF of DDGS when fed in corn silage-based diets (Figure 2). The linear regression of increasing dietary corn silage without DDGS was: milk fat percentage = 3.10% + .0356 x % dietary ADF from corn silage; r^2 = .99. The slope for added DDGS ADF using the 70% concentrate diet was .0445 which was greater than the slope determined for corn silage ADF indicating that ADF from DDGS was more effective per unit of ADF than corn silage; that is, 125% more effective. Swain and Armentano (1994) also found corn gluten feed, oat hulls, and barley malt sprouts to have greater effective ADF (as measured by increased milk fat content) compared to alfalfa silage whereas NDF from these coproducts proved less effective than NDF from alfalfa.

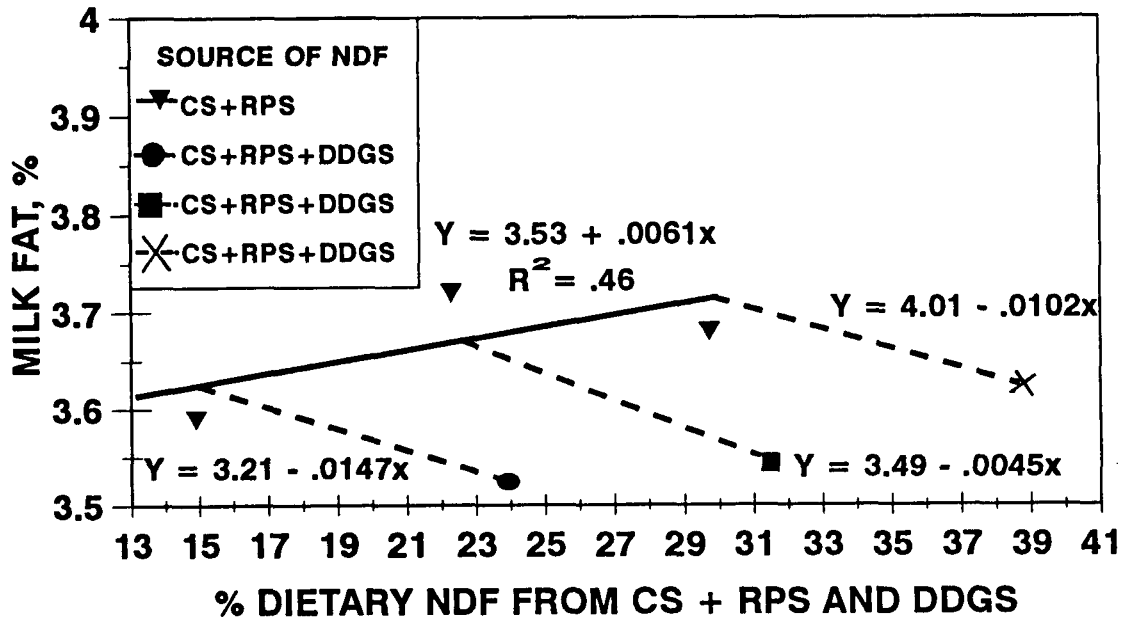
With the 55% concentrate diet as the starting point, the calculated slope for effect of DDGS ADF on milk fat percentage was .0137 (Figure 2), resulting in an effective ADF value for DDGS of 38% (.0137 ÷ .0356 = .38). As in the case of NDF, the percentage of added ADF from DDGS to the high forage diet (60% forage) lay outside the range of NDF coming from corn silage, thus exceeding the range of valid comparison.

The DDGS did not provide effective fiber to elevate milk fat content when fed with the basal forage mixture of corn silage and rhizoma peanut silage. The slope of three lines representing DDGS NDF at three concentrate:forage ratios had negative coefficients (Figure 3) indicating that NDF of DDGS should be discounted 100% when formulating diets. The presence of rhizoma peanut silage in the diet eliminated the role which DDGS had played in increasing milk fat content when fed in corn silage-based diets. Legumes such as rhizoma peanut silage are known to have greater buffering ability than forage corn (Woolford, 1984). The ADF of DDGS acted in a similar fashion as the NDF of DDGS on milk fat percentage (Figure 4), appearing to contribute 0% effective fiber to the rations.

Summary

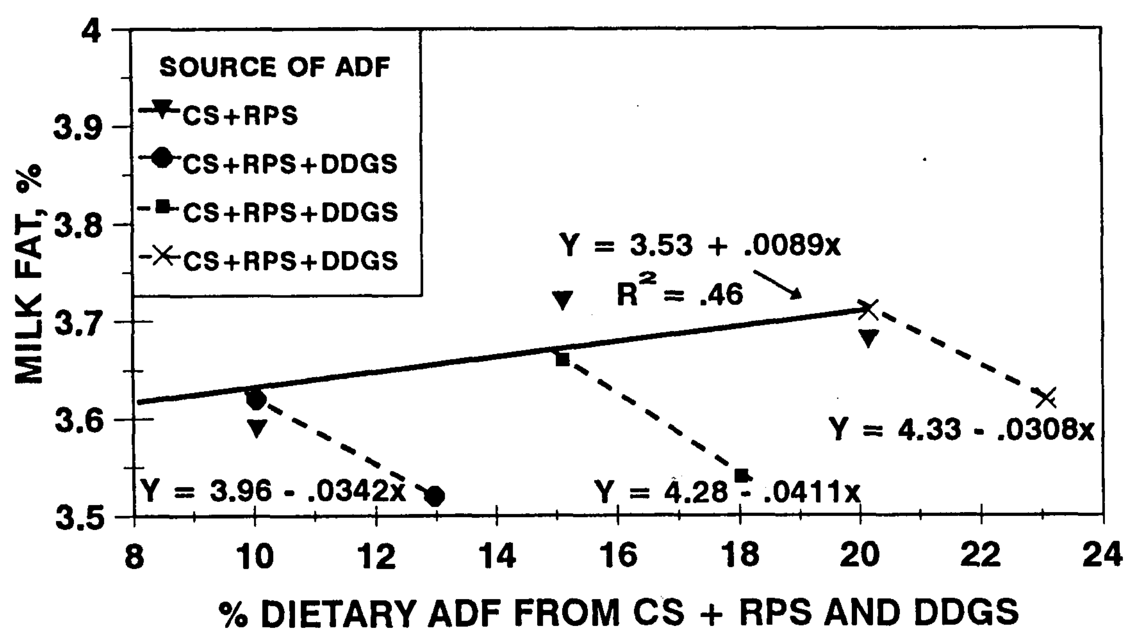
DDGS supplied 0 or 20% of dietary DM and 0 or 25 to 30% of dietary NDF in fiber-inadequate rations. Feed intake was unaffected by inclusion of DDGS. However, milk production was increased an average of 2.5 lb/day by including DDGS in diets thus improving the efficiency of milk production. Under the conditions of this experiment, the NDF of DDGS was 68% as effective as corn silage NDF in elevating milk fat content of extremely fiber-deficient diets. In marginally adequate fiber diets, the NDF of DDGS was only 21% as effective as the NDF of corn silage. When the legume, rhizoma peanut silage, replaced half of the corn silage,

FIG 3. CHANGE IN MILK FAT % BY INCREASING DIETARY NDF FROM CORN SILAGE (CS) AND RHIZOMA PEANUT SILAGE (RPS) AND DDGS



UNIVERSITY OF FLORIDA, 1995

FIG 4. CHANGE IN MILK FAT % BY INCREASING DIETARY ADF FROM CORN SILAGE (CS) AND RHIZOMA PEANUT SILAGE (RPS) AND DDGS



UNIVERSITY OF FLORIDA, 1995

effectiveness of DDGS NDF was reduced to 0%.

What adjusted NDF value should be assigned to DDGS? Ten of twelve published experiments in which diets contained at least 50% concentrate reported numerically greater milk fat percentages when dried distillers grains replaced concentrate ingredients (Clark and Armentano, 1993; Hawkins and Little, 1967; McGuffey et al, 1990; Owen and Larson, 1991; Palmquist and Conrad, 1982; Warner and Loosli, 1968). The average increase was .2 percentage units of milk fat with DDGS fed at an average of about 26% of diet DM (12.7 to 50%). Therefore DDGS appears to regularly increase milk fat content of high concentrate diets. The variability of a calculated adjusted NDF value appears quite large depending upon the standardized forage used in the slope ratio technique as shown in work reported here and from the University of Wisconsin. Based upon work done up to this point in which milk fat was used as an indicator of effective fiber, assigning an effective NDF value of 50% of chemically analyzed NDF appears to be a satisfactory value until further work in longer term studies is carried out.

The effect of the ether extract of DDGS on milk fat percentage can not be separated from the effect of DDGS fiber in these treatments. Feeding additional dietary fat can increase milk fat content (Staples et al., 1991). Nevertheless the control treatments were formulated to contain no supplemental fat. Adding a fat source to the control diet alone would have created diets dissimilar in two ingredients and would not have solved problems of interpretation.

Diets were fed for approximately one month in this trial. The effects of "marginally fiber-deficient diets" containing coproducts as significant contributors of dietary fiber on animal health (eg. rumen, feet, etc.) during the first 150 days of lactation is unknown. Although chewing activity was not recorded in this study, work at Wisconsin (Clark and Armentano, 1993) has indicated that ruminating and eating times by cows fed distillers grains was similar to cows fed a 30% alfalfa silage diet but less than that of cows fed a 44% alfalfa silage diet. Thus DDGS may help elevate milk fat content in low fiber diets but provide little stimulus to chewing activity for maintaining normal rumen function. However, saliva production for buffering of the rumen may be less important in diets in which starch is replaced with highly digestible structural carbohydrates such as the case when DDGS replaces corn and soybean meal. The replacing of rapidly fermentable starch with finely ground NDF in high concentrate diets may create a ruminal environment more conducive to fiber digestion and improved rumen health.

References

Chase, L.E. 1991. Using distillers grains and hominy in dairy cattle rations. Page 13 in Proc. Alternative Feeds for Dairy and Beef Cattle. Univ. Mo., Columbia.

Clark, P.W. and L.E. Armentano. 1993. Effectiveness of neutral detergent fiber in whole cottonseed and dried distillers grains compared with alfalfa haylage. J. Dairy Sci. 76:2644.

Distillers Feed Research Council. Distillers Grains. Des Moines, IA.

Hawkins, G.E. and J.A. Little. 1967. Combined effects of type of forage fed, of concentrate ingredients and of pelleting concentrate on rumen fermentation, milk yield, and milk composition. J. Dairy Sci. 50:62.

Owen, F.G. and L.L. Larson. 1991. Corn distillers dried grains versus soybean meal in lactation diets. J. Dairy Sci. 74:972.

Mertens, D.R. 1992. Nonstructural and structural carbohydrates. Page 219 in Large Dairy Herd Management. Van Horn and Wilcox, ed. Amer. Dairy Sci. Assoc., Champaign, IL.

McGuffey, R.K., H.B. Green, and R.P. Basson. 1990. Lactation response of dairy cows receiving bovine somatotropin and fed rations varying in crude protein and undegradable intake protein. J. Dairy Sci. 73:2437.

National Research Council. 1989. Nutrient Requirements of Dairy Cattle. 6th rev. ed. Natl. Acad. Sci., Washington, DC.

Palmquist, D.L. and H.R. Conrad. 1982. Utilization of distillers dried grains plus solubles by dairy cows in early lactation. J. Dairy Sci. 65:1729.

Staples, C.R., W.W. Thatcher, and M.C. Lucy. 1991. Effect of increasing dietary fat content on production and fertility of lactating dairy cows. Page 89 in Proc. Second Annual Florida Ruminant Nutr. Symp., Gainesville, FL.

Swain, S.M. and L.E. Armentano. 1994. Quantitative evaluation of fiber from nonforage sources used to replace alfalfa silage. J. Dairy Sci. 77:2318.

Warner, R.G. and J.K. Loosli. 1968. The effect of corn distillers dried grains with solubles and other ingredients on milk fat percentage. Page 23 in Proc. Distillers Feed Conf.

Woolford, M.K. 1984. The silage fermentation. Marcel Dekker, Inc., New York.