Distillers Dried Grains With Solubles in Digestibility Tests With Dogs

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Pet food industry sales based on dollar volume and tonnage have continued to escalate with each year during the past twenty-five years exceeding the previous year. The 1979 volume of dog and cat foods sold through grocery stores was estimated to be $3.288 billion and 4,246,000 tons (McCook, 1979). Of those dog foods sold, 83.9% of the nutrition was in the dry type of food. The 2,222,500 tons of dry dog foods require an immense supply of ingredients. Distillers grains with solubles are being used in a series of digestion trials to determine their use as a source of protein, energy and fiber for dogs.

Fiber is important in the dog's diet since it aids in the regulation of intestinal activity and helps prevent either diarrhea or constipation perhaps by acting like thousands of tiny sponges which absorb enough water to form a firm consistency which is soft enough to prevent constipation and absorbtive enough to provide the form. Many different fiberous materials have been used for this purpose including beet pulp, citrus pomace, apple pomace, and many other fiber rich foodstuffs.

Early Work With Corn Distillers Solubles

McCay, *et al* (1957) studied the replacement of 7% meal scrap, 7% wheat germ, 7% kibbled corn, or tomato pomace and 5% nonfat dry milk solids with 7% distillers solubles in the diets of growing Beagle pups. They found the replacement with distillers solubles to be satisfactory when weight grains and blood parameters were used as criteria. Additional experiments with reproduction demonstrated Beagle bitches produced and weaned satisfactory litters while consuming the distillers solubles diets. Metabolism trials with 7, 15, and 3 corn distillers dried solubles demonstrated these levels could be fed without difficulty and dogs did not dislike those diets with levels of solubles up to 30%.

Later reports of a Beagle breeding trial with 7% distillers dried solubles compared with 7% meatscraps demonstrated that conception was excellent and litter size and weaning rate was as satisfactory on the corn distillers solubles as with the 7% meatscrap control (Wanner, *et al* 1958). Continued growth and reproduction experiments with Beagles and Cocker Spaniel puppies further confirmed that 7% corn distillers dried solubles was satisfactory for growth of puppies of both breeds. At the end of five years, no deleterious effects were encountered when corn distillers dried solubles replaced other ingredients in four different diets (Wanner and McCay, 1960). Additional trials to determine levels of corn distillers dried solubles which might be used in puppy diets during growth confirmed that 7% of corn distillers dried solubles gave favorable results with growing Beagle puppies, and with females during repro-

duction, however, at the 30% level of corn distillers dried solubles diets were noticeably less acceptable to the pups and some cases of mild diarrhea occurred (McCay, *et al* 1963).

With utilization of distillers grains as a carrier to facilitate drying solubles, the combination of corn distillers dried grains with solubles (DDGS) may find a special place in pet foods as a source of protein, energy, and fiber. With the predicted increase in "gasohol" production, perhaps more supplies of distillers dried grains with solubles will be available for pet foods, primarily dry foods.

The lysine and methionine levels of DDGS can be supplemented with those of soybean meal used extensively in canine diets. Fiber levels of DDGS have been found advantageous for diets of breeding swine (Jensen, 1977) and can be used to supply an appreciable portion of supplemental amino acids in diets of gestating swine. At dietary levels of DDGS up to 44.2% of the ration optimum gilt reproductive performance was obtained.

Two metabolism trails were conducted with twelve adult female English Pointers. Female dogs were used to facilitate urine collection. The animals were placed in individual metabolism cages two weeks prior to the beginning of the experiment to allow sufficient time for acclamation to the cages and to the experimental diet, the composition of which is outlined in Table I. The chemical composition of the diets is presented in Table II.

Table I. Ingredients Present in Diets Fed in Both Experiments

Dietary Constituents	Level of DDGS (%)						
	0	4	6	8	0	8.9	15.7
	Trial 1				Trial 2		
Extruded corn	54.5	50.5	48.5	46.6	53.6	48.6	45.0
Soybean meal	30.0	30.0	30.0	30.0	30.9	27.6	25.0
DDGS	0.0	4.0	6.0	8.0	0.0	8.9	15.7
Tallow[1]	10.0	10.0	10.0	10.0	10.0	9.4	8.8
Vitamin mix[2]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Mineral mix[3]	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Table II. Chemical Composition of Diets Fed in Both Experiments

Item	Level of DDGS (%)						
	0	4	6	8	0	8.9	15.7
	Trial 1				Trial 2		
Crude Protein (%)	19.6	16.9	17.4	21.4	21.5	21.5	21.5
Starch (%)	16.4	19.9	17.2	17.9	19.2	22.7	14.5
Dry Matter (%)	88.9	88.7	89.2	89.0	93.1	93.1	96.9

In trial 1, a completely randomized design having 2 periods, 4 treatments, and 3 replications per treatment was employed. Average initial animal weight was 19.4 kg. Each period consisted of a 5-day preliminary period and a 5-day collection period. Total fecal and urine collections were made with a 10% aliquot of feces and a 5% aliquot of urine saved for analysis.

Feces were dried at 50°C approximately 7 days prior to analyses. Treatments were 0, 4, 6 or 8% distillers dried grains with solubles (DDGS) substituted for corn in the diet on an equal percentage basis. Each dog was offered a ration of 600 gms. of a treatment diet moistened with water once daily. Individual wet feed refusals were recorded daily. Drinking water was provided at all times.

Following a 7-day rest period, trial 2 was initiated. Average initial animal weight was 19.1 kg. A switchback design having 3 periods, 3 treatments, and 4 replications per treatment was used. Dogs were randomly assigned to all replications and all dogs received all treatments. Other conditions were as described for trial 1. Treatments were 0, 8.9 or 15.7% DDGS. All diets were isonitrogenous and isocaloric. Each dog was offered a ration of 600 gms of diet

Table III. Summary of Data Collected in Trial 1

Item	Level of DDGS (%) 0	4	6	8	SEM
Dry matter digestibility (%)	83.6	83.4	82.3	82.1	1.2
Starch digestibility (%)	97.8	99.2	98.2	95.3	1.6
Fecal dry matter (%)	17.7	16.4	16.4	16.5	1.3
Fecal wet weights (gm excreted/5 days)	2513.1	2499.7	2812.7	2298.6	247.4
Fecal dry weights (gm excreted/5 days)	447.3	402.3	446.8	384.4	39.3
Protein intake (gm/5 days)	480.9	414.6	451.2	510.6	33.5
Protein excreted (gm/5 days)					
Fecal	85.8	85.4	85.7	87.7	7.8
Urinary	264.3	282.6	247.1	252.1	42.6
Total	350.1	368.0	322.8	339.6	46.6
Absorbed protein (gm/5 days)	395.2[a,b]	329.3[a]	365.5[a,b]	422.8[b]	74.4
Retained protein (gm/5 days)	130.9[a,b]	57.3[b]	143.8[b]	170.8[a]	25.3
Retained protein (% of intake)	27.9[a]	13.9[b]	32.1[a]	34.2[a]	5.8

SEM = standard error of the mean.
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[a,b]Means in the same row not followed by the same letter are different ($P<.05$).

[1]Bleachable fancy tallow for these diets was obtained from National Rendering, Peoria, IL 61601.
[2]Composed of the following vitamins (per pounds of diet): Vitamin A, 500,000 U.S.P. units; Vitamin D_3, 100,000 I.C.U.; Vitamin E, 4,000 I.U.: menadione sodium bisulfate, 150 mg; thiamine mononitrate, 200 mg; riboflavin, 150 mg; pantothenic acid, 600 mg; niacin, 1 gm; choline chloride, 30 g; vitamin B_{12}, 2 mg.
[3]Composed of the following minerals (% of mineral mix): $CaHPO_4$, 65%, NaCl, 15.4%, K_2Co_3, 14%; $MgCo_3$, 3.3%; $Feso_4.H_2O$, 1%; $MnSo_4.H_2O$, .05%; $COCl_2.6H_20$, .02%; $CuSO_4$, 1%; NaF, .02%; $ZnCo_3$, .2%; KI, .01%; $NaSe0_3$, .0001%.

moistened with water once daily. Drinking water was provided at all times. Individual wet feed refusals were recorded daily.

Parameters measured in both trials included: percent dry matter digestibility, percent dry matter in feces, percent starch digestibility, nitrogen balance, fecal dry weights and fecal wet weights.

Starch was measured according to the procedure outlined by Macrae and Armstrong (1968). Nitrogen was determined by the Kjeldahl method (AOAC, 1965). Data was subjected to analysis of variance as described for completely randomized (Steel and Torrie, 1960) and change-over designs (Federer, 1955). Differences between means were computed using Duncan's multiple Range Test (Duncan, 1955).

Results and Discussion

Trial 1. All parameters measured showed similar results across all treatments except protein absorption and retention (Table III). Dogs on the 4% DDGS diet had significantly less protein apparently absorbed (329.3 gms) than the dogs on the 8% DDGS diet (442.8 gms). Animals receiving the 4% DDGS treatment also had significantly less protein apparently retained and less protein retained as a percent of protein intake than dogs receiving the 0% and 8% diets. Percent dry matter digestibility, percent dry matter in feces, fecal dry weights, fecal wet weights and percent starch digestibility were all unaffected by treatment.

Table IV. Summary of Data Collected in Trial 2

Item	Level of DDGS (%) 0	8.9	15.7	SEM
Dry matter digestibility (%)	84.8[a]	83.6[a]	79.9[b]	0.8
Starch digestibility (%)	89.5	94.1	93.2	1.6
Fecal dry matter (%)	16.2[a,b]	15.6[a]	17.9[b]	0.8
Fecal wet weights (gm excreted/5 days)	2299.5	2631.8	3021.0	352.7
Fecal dry weights (gm excreted/5 days)	392.5[a]	406.7[a,b]	529.5[b]	44.7
Protein intake (gm/5 days)	542.4	513.4	564.0	41.4
Protein excreted (gm/5 days)				
Fecal	83.8	82.2	98.3	8.2
Urinary	222.3	214.9	220.6	43.0
Total	306.1	298.1	318.9	49.0
Absorbed protein (gm/5 days)	460.9	430.2	465.7	35.4
Retained protein (gm/5 days)	226.9	215.4	245.1	36.5
Retained protein (% of intake)	41.6	43.1	44.3	6.8

SEM = Standard error of mean.
[a,b] Means in the same row not followed by the same letter are different ($P < .05$).

Trial 2. Data for trial 2 are presented in Table IV. When DDGS was included in the diet at levels of 0, 8.9 and 15.7%, dry matter digestibility was significantly lower (79.9%) at the highest level of DDGS. Animals fed the 0% and 8.9% DDGS diets had dry matter digestibilities of 84.8% and 83.6% respectively. Similarly, percent dry matter in feces was 16.2 and 15.6% for the 0 and 8.9% levels of DDGS respectively, but was significantly higher (17.9%) at the 15.7% DDGS level. This is to be expected since a higher level of fiber with increased levels of DDGS might result in a somewhat drier excrement (Cooper and Tyler, 1959) due possibly to a slower rate of digesta passage.

Protein apparently absorbed and protein apparently retained were unaffected by treatment as was percent starch digestibility. Fecal dry weights (gm/5 days) were significantly lower (392.5 gm) for dogs receiving the 0% DDGS diet than for dogs on the 8.9 and 15.7% DDGS diets (406.7 and 529.5 gm, respectively). However, there was no significant differences in fecal weight between treatments.

From these experiments, it appears that DDGS can be successfully incorporated into dog rations without significantly altering the utilization of other dietary nutrients.

Summary

Two trials were designed to test the feasibility of incorporating distillers dried grains with solubles (DDGS) into dog rations. Twelve adult female English Pointers were offered 600 gm of moistened diet daily throughout two metabolism studies. In trial 1, DDGS was substituted for corn (on an equal percentage basis) at levels of 0, 4, 6 and 8% of the diet. Absorbed and retained nitrogen were significantly lower at the 4% DDGS level. Percent dry matter digestibility, dry matter in feces, starch digestibility, and fecal wet and dry weights were unaffected by treatment. In trial 2, DDGS was incorporated into isonitrogenous and isocaloric diets at levels of 9, 8.9 and 15.7%. Percent dry matter digestibility was significantly lower while percent dry matter in feces and fecal dry weights were significantly higher for those animals receiving 15.7% DDGS. All other parameters; protein apparently absorbed, protein apparently retained, percent starch digestibility, and fecal wet and dry weights (gm) were unaffected by treatment.

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