Effect of dietary fiber incorporation on the characteristics of pregnant sows slurry

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[1]Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, C.P. 90, 2000 Road 108 East, Lennoxville, Quebec, Canada J1M 1Z3; [2]Department of Animal Science, Laval University, Quebec, Quebec, Canada G1K 7P4; and [3]INRA, Station de Recherche Porcine, 35590 Saint-Gilles, France.

Massé, D.I., Croteau, F., Masse, L., Bergeron, R., Bolduc, J., Ramonet, Y., Meunier-Salaün, M.C. and Robert, S. 2003. **Effect of dietary fiber incorporation on the characteristics of pregnant sows slurry**. Canadian Biosystems Engineering/Le génie des biosystèmes au Canada **45**: 6.7-6.12. Feeding pregnant sows with a bulky diet rich in dietary fibers could improve animal welfare without providing excessive feed energy. However, this type of diet would have an impact on manure volume and composition, and a diet treatment to improve sow welfare by reducing their persistent hunger cannot be recommended without examining its impact on manure composition and handling. This study investigated the effects of high-fiber diets on the daily production and physico-chemical characteristics of manure slurry from pregnant sows. Three isoenergetic diets, very high-fiber (VHF), high fiber (HF), and concentrated (C), were fed twice daily to two groups of four fourth parity pregnant sows. Fecal and urine production was measured separately on days 17 and 18 of the 21-day treatment period. Physico-chemical analyses were performed on a slurry sample (mixture of feces and urine). Dietary fiber addition significantly ($P < 0.05$) increased fecal mass but tended to decrease urine production. Consequently, manure slurry (feces plus urine) production was similar with all diets, but total solids (TS) content was significantly increased ($P < 0.05$) as fiber addition increased. Mean TS concentration was 3.8, 11.1, and 18.3% in the manure from sows fed the C, HF, and VHF diets, respectively. As a result, manure slurry consistency was changed from a liquid state (less than 10% TS) when the C diet was fed to a semi-solid state (TS content between 10 and 20%) with the two high fiber diets. The use of high fiber diets may thus cause a challenge with the liquid manure handling, storage, and land application systems currently used on many commercial farms. Other major changes in manure slurry characteristics due to dietary fiber incorporation included significant ($P < 0.05$) increases in apparent viscosity, total and soluble chemical oxygen demand, and volatile fatty acid concentrations. Total amount of mineral elements excreted in the manure slurry was not affected by dietary fiber addition. **Keywords:** diet amendment, environment, livestock effluent, manure characteristics, swine manure slurry.

Une alimentation riche en fibres peut améliorer le bien-être des truies en gestation, sans offrir un excès d'énergie calorifique. Ce type de diète, cependant, pourrait avoir un impact sur le volume et la composition du lisier. La présente étude vise à examiner les effets d'une alimentation à haute teneur en fibres sur la production quotidienne et les caractéristiques physico-chimiques du lisier des truies en gestation. Deux groupes de quatre truies en gestation de quatrième rang de mise bas ont été soumis à trois régimes isoénergétiques administrés deux fois par jour pendant 21 jours: très haute teneur en fibres (VHF), haute teneur en fibres (HF) et concentrée (C). Les matières fécales et l'urine produites ont été mesurées séparément lors des dix-septième et dix-hutième journées de la période expérimentale. Les analyses physico-chimiques ont porté sur un échantillon de lisier (mélange des matières fécales et de l'urine). L'ajout de fibres alimentaires tend à accroître de façon significative ($P < 0{,}05$) la production de matières fécales mais à réduire la production d'urine. Par conséquent, la production de lisier (matières fécales et urine) a été similaire sous les trois régimes alimentaires, mais le taux de matière sèche (m.s.) a significativement augmenté ($P < 0{,}05$) avec l'ajout de fibres alimentaires. Le taux de m.s. s'est établi à 3,8 %, 11,1 % et 18,3 % dans le lisier des truies soumises aux régimes C, HF et VHF, respectivement. La consistance du lisier est passé d'un état liquide (moins de 10 % de m.s.) sous un régime C à un état semi-solide (de 10 % à 20 % de m.s.) sous les deux régimes à haute teneur en fibres. L'utilisation de régimes à haute teneur en fibres pourrait donc causer des difficultés quant aux systèmes de manutention, d'entreposage et d'épandage de fumier liquide actuellement utilisés sur les fermes commerciales. Parmi les autres changements du lisier attribuables à l'ajout de fibres alimentaires figurent des hausses significatives ($P < 0{,}05$) de la viscosité apparente, de la demande chimique en oxygène totale et soluble ainsi que des concentrations d'acides gras volatils. L'ajout de fibres alimentaires n'a pas eu d'incidence sur la quantité totale d'éléments minéraux retrouvés dans le lisier. **Mots clés:** modification des régimes, environnement, effluent animal, caractéristiques du fumier, lisier de porc.

INTRODUCTION

In commercial livestock operations, the diet of pregnant sows is restricted to limit weight gain and fat deposition during the gestation period. This restrictive diet can have negative repercussions on animal behaviour, as it induces persistent hunger and favours the development of stereotypies, defined as regularly repeated movements without an obvious function such as biting and chewing (Bergeron et al. 2000). Feeding pregnant sows a diet high in dietary fibers has been shown to improve animal welfare, because it reduces hunger and limits metabolic energy waste associated with stereotype behaviours, without providing animals with excessive feed energy (Bergeron et al. 2000; Brouns et al. 1994; Mroz et al. 1986; Robert et al. 1992, 1993, 1997). Dietary fiber addition could also enhance sow reproductive performances (Cromwell et al. 1989; Matte et al. 1993; Mroz et al. 1986).

Previous studies on fiber incorporation into the diet of pregnant sows were mostly concerned with the impact on transit time, digestibility, and assimilation rates of various fibrous sources, reproductive performance, and animal behaviour (Bergeron et al. 2000; Brouns et al. 1994; Cherbut et al. 1988; Cromwell et al. 1989; Ehle et al. 1982; Étienne 1985; Filer et al. 1986; Matte et al. 1993; Mroz et al. 1986; Palisse et al. 1979;

Table 1. Composition of the gestation diets.

	Diets		
	Very-high fiber (VHF)	High-fiber (HF)	Concentrated (control) (C)
Daily allowance (kg/d)	4.5	3.5	2.5
	Ingredients (g/kg)		
An oat hull	449.9	265	-
Alfalfa meal	281	267.7	-
Wheat bran (15.3% CP)	162	94	149
Barley	74	100	250
Corn (7.8% CP)	-	61	295.2
Canola meal	-	75	100
Gluten meal	-	100	100
Soya meal	-	-	51
Canola oil	12	10	5
Limestone	5.2	8.6	20.7
Salt	3.8	5.1	7.9
Choline	1.1	1.4	1.9
Biotin	1	1.1	1.5
L-Lysine HCl	1	0.3	-
Dicalcium phosphate	6.4	8.8	14
Vitamin premix	0.9	1.1	1.7
Mineral premix	0.5	0.7	1
Folic acid	0.1	0.1	0.1
	Chemical composition		
Digestible energy (kJ/kg)	7159	9201	12,894
Protein (%)	10.8	13.0	15.1
Lysine (%)	0.5	0.6	0.7
Crude fiber (%)	23.0	18.2	5.3
Ca (%)	1.0	0.9	0.9
P (%)	0.5	0.6	0.8
Neutral detergent fiber (%)	28.4	23.5	7.8
Acid detergent fiber (%)	49.4	42.5	20.5

Robert et al. 1992, 1993; Stanogias and Pearce 1987; Varel et al. 1984). The effect of high fiber diets on daily production and physico-chemical characteristics of manure slurry was not investigated. A diet treatment to improve sow welfare by reducing their persistent hunger cannot be recommended without examining its impact on manure composition and handling. Fiber addition will increase fecal mass of pregnant sows, but it may also decrease urine output by reducing adjunctive drinking, which is an abnormal behaviour developed by hungry sows during pregnancy. Robert et al. (1992, 2000) reported that water consumption was reduced by up to 50% when sows were fed a high fiber diet (3.6 kg/d, 20.4% crude fiber) as opposed to a concentrated restrictive diet (2.0 kg/d, 2.2% crude fiber). Sows fed a high fiber diet produced less urine but more feces than sows fed a concentrated restrictive diet. As a result, total volume of manure slurry was similar with both diets, but dry matter content was greater in the manure slurry from sows fed a high fiber diet (14.6%) compared to sows fed a concentrated (3.2%) diet.

The objective of this study was to evaluate the impact of dietary fiber incorporation on behaviour of pregnant sows as well as on the volume and characteristics of manure slurry. Effects on animal behaviour were discussed in Bergeron et al. (2000). This paper reports on manure slurry production and characteristics and discusses the possible impact on manure management practices.

MATERIALS and METHODS

Animals and housing

Twenty-one fourth parity sows (Yorkshire X Landrace), weighing an average of 200.1 kg, were placed in individual gestation stalls with partially slatted floors. In each stall, the feeder was fixed to the front door and a water bowl, equipped with a level-controlled float provided an ad libitum supply of fresh water. Room temperature was maintained at 18°C and the lights were on from 6:00 to 18:00 h. The animals were cared for according to the AAFC code (Agriculture and Agri-food Canada 1993) and the Canadian Council on Animal Care (1993) guidelines.

Experimental treatments

The sows were fed a concentrated diet (2.5 kg/d) for six days after breeding. They were then randomly allocated to one of four treatments according to a Latin square design (Cochran and Cox 1957). The three experimental treatments, described in Table 1, consisted of a very high-fiber diet based on oat hulls (VHF), a high-fiber diet based on oat hulls and alfalfa (HF), and a concentrated diet (C). The diets were formulated to ensure similar daily intakes of digestible energy (32,200 kJ/d; Table 1). Each dietary treatment was fed to each sow for 21 days, including a 4-day period during which the new diet was introduced by gradually increasing its proportion in the daily allowance.

During the experimental period, all sows also received a concentrated diet, served ad libitum (CAL), for 21 days. This diet treatment was included in the experiment for behavioural purposes, to compare feeding motivation of satiated and hungry sows (Bergeron et al. 2000). However, manure volume and characteristics of sows fed the CAL diet were not considered in the statistical analysis and are not discussed in the text because the diet is not representative of commercial rearing conditions of pregnant sows.

The entire experiment lasted until day 90 of gestation. The sows received 60% of their daily allowance at 7:30 h and 40% at 14:15 h. Daily water intake was measured using a graduated bottle connected to the water distribution system in each stall. The water distribution system prevented spillage. Additionally, the floor around the water system was checked regularly during the 48 h measurement period, and it was always dry. The water coming out of the graduated bottles was thus entirely drunk by the sows.

Table 2. Mean values and standard deviations for water consumption, urine and feces masses, slurry mass, and urine to feces ratio for pregnant sows fed 3 different diets.

Diet	Very-high fiber (VHF)	High-fiber (HF)	Concentrated (control) (C)
Water consumption (L/d)	12.59±5.91	14.86±9.07	15.22±7.08
Urine mass (kg/d)	5.24±2.59	9.25±7.74	11.40±7.12
Feces mass (kg/d)	6.74±1.58 [a]	3.99±1.16 [b]	1.60±0.82 [c]
Mass of slurry (kg/d)	10.16±2.94	11.98±9.34	12.37±8.06
Urine to feces mass ratio	0.77±0.32 [a]	2.30±1.45 [b]	7.89±4.83 [c]

[a,b,c] Within rows, mean values with different letters are significantly different at $P < 0.05$.

Feces and urine sampling and analysis

A false flooring was placed in each stall to allow separate collection of feces and urine. Feces and urine were collected during 48 consecutive hours on days 17 and 18 of the treatment period. For each 24-h period, feces and urine productions were weighed before being mixed in a closed container to prevent NH_3 volatilisation and liquid evaporation. The mixture (manure slurry) collected on each day was homogenized and total mass was measured before a one-litre sample was collected and frozen until analysis.

Manure slurry samples were analysed for soluble and total chemical oxygen demand (SCOD and TCOD) by the closed reflux colorimetric method (APHA 1992). Soluble COD concentration was measured in the supernatant from a sample centrifuged at 41,000 G for 45 minutes. Apparent viscosity was analysed with a Brookfield viscometer model RVT (Brookfield Engineering Laboratories, Inc.; Stoughton, MA). Total solids (TS) concentration was determined by drying a 100-mL sub-sample for 24 h at 105°C. Volatile solids (VS) concentration was measured by incinerating a dry sample at 550°C for 2 h. Ammonia nitrogen (NH_3-N) and total Kjeldahl nitrogen (TKN) were analysed according to the macro-Kjeldahl method (APHA 1992) with a Tecator 1030 Kjeltec auto-analyzer (Tecator AB, Höganäs, Sweden). pH was measured with a pH meter (PHM92 Lab, Radiometer Analytical, Bagsvaerd, Denmark). Volatile fatty acids (VFAs) were analysed using a Perkin Elmer Autosystem gas chromatograph (Perkin-Elmer Corporation; Norwalk, CT) equipped with a high-resolution megabore column (J&W Scientific; Folsom, CA) connected to a flame ionization detector. Phosphorus and other inorganic elements were measured by inductively coupled plasma spectrometry using methods 957.02 and 984.27 of AOAC (1998).

Phosphorous and inorganic element concentrations were measured on manure slurry samples collected on day 18 of each treatment. All other parameters were analysed on samples from each of the two collection days.

Statistical analysis

Statistical analyses were performed on mean parameter values from both sample collection days. Each parameter was analysed according to the model:

$$Y_{ijkl} = \mu + \theta_i + \alpha_{(i)j} + \rho_{(i)k} + \tau_i + \varepsilon_{(ijkl)} \quad (1)$$

where:

- Y = least standard mean of the dependant variable,
- μ = general mean,
- θ_i = effect of the square,
- $\alpha_{(i)j}$ = effect of the animal fitted in the square,
- $\rho_{(i)k}$ = effect of the sampling period fitted in the square,
- τ_l = effect of the diet, and
- $\epsilon_{(ijkl)}$ = residual effect.

When treatment effect was significant, non-orthogonal contrasts were utilized to compare diets VHF, HF, and C. Statistical analyses were performed using the SAS statistical package (SAS 1988) and the significant level was fixed at 0.05. Two variables necessitated mathematical transformation to comply with the analysis of variance basic hypothesis of normal distribution. The feces to urine mass ratio and the apparent viscosity underwent square root and logarithmic transformations, respectively. For daily slurry mass, missing data for an entire square in the first period of the experimental period reduced the number of degrees of freedom to nine for treatment effect. Finally, missing water consumption data for one sow on one day was estimated by a method presented by Steel and Torrie (1980) and a manual adjustment of the test with one less degree of freedom was performed.

RESULTS and DISCUSSION

Water consumption and manure slurry production

Manure slurry production and characteristics from the three experimental diets are presented in Tables 2 through 4. Daily water intake by pregnant sows tended to decrease as dietary fiber addition was increased (Table 2). However, daily water intake was highly variable and the difference among diet treatments was not statistically significant. Urine production consistently decreased with an increase in dietary fiber addition (Table 2). Urine production was 54% lower in sows fed the VHF diet than the control diet ($P = 0.06$). Mroz et al. (1986) also reported a decrease in urine output from 17.34 to 6.32 kg/d as the mass of oat hull in the daily ration of pregnant sows increased from 0 to 2.15 kg/d. A 28% reduction in urinary production by pregnant sows was also observed by Robert et al. (2000) when a high fiber diet (3.6 kg/d, 20.4% crude fiber) was fed as opposed to a concentrated restrictive diet (2.0 kg/d, 2.2% crude fiber).

Daily fecal mass increased significantly with an increase in dietary fiber addition (Table 2). The increase in fecal mass may be due to a combination of factors such as 1) higher mass of undigested fibers or bacteria in the feces due to increased feed intake in the form of non-digestible fiber, 2) increased water retention capacity of excreted fibers, and 3) excretion of non-digested products, other than fibers, resulting from a dragging effect by the fibers (Egron et al. 1996). In this study, the evacuation of non-digested fibers and water adsorption by the fibrous material during transit through the gastrointestinal system may largely explain the twofold and fourfold increases in fecal mass for diets HF and VHF, respectively, compared to the control diet. Water retention by excreted dietary fiber has

Table 3. Mean values and standard deviations for chemical and physical parameters of manure slurry from pregnant sows fed 3 different diets.

Diet	Very-high fiber (VHF)	High-fiber (HF)	Concentrated (control) (C)
Total solids, TS (%)	18.29±3.08 [a]	11.11±4.95 [b]	3.79±2.40 [c]
Volatile solids, VS (%)	16.47±2.86 [a]	9.41±4.41 [b]	2.62±1.81 [c]
VS:TS ratio	0.90±0.01 [a]	0.83±0.04 [b]	0.67±0.01 [c]
Apparent viscosity (Pa·s)	1.997±1.946 [a]	0.299±0.439 [b]	0.020±0.015 [c]
TCOD (g/L)	147.8±42.88 [a]	110.9±48.84 [a]	37.96±18.26 [b]
SCOD (g/L)	21.08±7.29 [a]	15.91±7.31 [a]	7.80±3.90 [b]
Total VFAs* (g/L)	4.90±0.67	4.18±1.61	2.13±0.70
Acetic (g/L)	3.32±0.58 [a]	2.88±1.14 [a]	1.36±0.47 [b]
Propionic (g/L)	0.85±0.18 [a]	0.63±0.24 [b]	0.32±0.14 [c]
Butyric (g/L)	0.36±0.17 [a]	0.313±0.18 [a b]	0.17±0.07 [b]
Isovaleric (g/L)	0.19±0.05 [a]	0.19±0.09 [a b]	0.11±0.04 [b]
Valeric (g/L)	0.11±0.05 [a]	0.10±0.04 [a]	0.08±0.03 [b]
Caproic (g/L)	0.07±0.06	0.07±0.06	0.08±0.06
TKN (g/L)	4.83±1.09	4.89±2.12	4.71±2.22
NH_3-N + NH_4-N (g/L)	2.57±0.55	3.07±1.03	2.81±1.41
NH_3-N (% of TNH_3)**	7.95	8.21	14.2
pH	8.24±0.44	8.39±0.63	8.57±0.57

* VFAs = Volatile Fatty Acids. Statistical analysis not performed on this parameter.
** Calculated using formula from Snoeynik and Jenkins (1980):
$NH_3 = 10^{-9.3}(10^{-7.4}\text{-}TNH_3)/TNH_3$, where TNH_3 is total ammonia in the system.
[a,b,c] Within rows, mean values with different letters are significantly different at $P < 0.05$.

been reported by various researchers (Low 1993; Mroz et al. 1986; Partridge 1978).

The daily mass of manure slurry tended to decrease with dietary fiber incorporation, but variation was high and differences between diet treatments was not significant (Table 2). In general, the increase in daily fecal mass with dietary fiber addition was compensated by the decrease in urinary excretion. However, the urine to feces ratios in the manure slurry from sows fed the VHF and HF diets were 10 and 29%, respectively, of the ratio observed in manure from sows receiving the C diet (Table 2). The effect of dietary fiber incorporation on the urine to fecal mass ratio was statistically significant.

Manure slurry characteristics

Reduced urine to feces mass ratios translated into significant increases in manure slurry TS with dietary fiber addition (Table 3). Total solids content was increased from 3.79% for the C diet to 11.11 and 18.29% for the HF and VHF diets, respectively. As a consequence, manure slurry consistency went from a liquid state (less than 10% TS) for sows fed the control diet to a semi-solid state (between 10% and 20% TS) for sows fed the high fiber diets. Manure slurry VS content and the VS to TS ratio were also significantly increased by dietary fiber incorporation (Table 3). An increase in TS and VS content was expected given the increase in insoluble fiber intake and the low digestibility by the sows of the cellulosic substances that were present in relatively high concentrations in these diets (Stanogias et al. 1985; Keys and Debarth 1974). The increase in the VS to TS ratio reflected an increase in the organic content of the manure, which suggested the presence of undigested feed in the feces.

The apparent viscosity of the manure slurry increased significantly with dietary fiber incorporation, from 0.020 Pa·s for the C diet to 0.298 and 1.998 Pa·s for the VHF and HF diets, respectively (Table 3). Large increases in viscosity and TS content due to dietary fiber incorporation would require major changes in manure handling, storage, and land application systems currently used on commercial farms. Water addition

Table 4. Mean daily intake and excretion of inorganic elements by pregnant sows fed 3 different diets.

	Intake*			Excretion		
Diet	Very-high fiber (VHF)	High-fiber (HF)	Concentrated (control) (C)	Very-high fiber (VHF)	High-fiber (HF)	Concentrated (control) (C)
P (g/d)	22.7	25.7	20.8	18.4±3.9	18.8±4.0	17.5±3.9
K (g/d)	40.1	38.9	18.5	33.3±12.0	27.8±8.1	16.3±2.8
Ca (g/d)	38.2	36.7	24.2	31.5±7.9	32.9±8.1	24.0±5.0
Mg (g/d)	8.6	7.6	5.7	7.5±1.9	7.1±1.5	5.3±1.1
Fe (mg/d)	1004	979	579	900±245	880±203	645±163
Cu (mg/d)	77.0	86.5	62.0	68.0±26.7	77.9±23.1	61.9±6.7
Mn (mg/d)	352.8	351.1	250.5	336.0±87.7	298.2±59.3	244.2±61.3
Zn (mg/d)	456.8	492.5	396.5	420.5±111.0	432.3±87.2	361.6±85.5
B (mg/d)	49.5	36.1	15.0	34.9±16.1 [a]	27.8±12.5 [a]	14.2±6.5 [b]
Mo (mg/d)	7.8	5.0	3.2	4.6±1.6	3.8±1.1	3.0±0.5
Al (mg/d)	549.9	525.7	275.3	398.5±121.7	417.7±126.1	237.1±81.2

* Daily intake was calculated by multiplying the concentration detected in one feed sample by the amount of feed given to the sows.
[a,b] Within rows, mean values with different letters are significantly different at $P < 0.05$.

may be necessary to increase manure slurry fluidity during gutter cleanup. Otherwise, the use of scrappers will be necessary to remove the thicker manure slurry from the building. Additionally, storage structures and land application equipment for semi-solid or solid manure may be required.

Total and soluble COD concentrations were significantly higher in the manure slurry from sows fed the VHF and HF diets than from sows fed the C diet (Table 3). The presence of non-digested fibrous material in the feces may have caused the large TCOD increase observed with high fiber diets. On the other hand, increased SCOD concentration with dietary fiber addition would suggest that a fraction of the fibrous material was degraded in the intestinal tract. McDougall et al. (1996) reported that plant cell walls were decomposed by a mixed flora of anaerobic bacteria in the large intestine, and the fermentation products included acetic, propionic, and butyric acids. In any case, the two to three fold increases in SCOD content indicated that the slurry from sows fed the high fiber diets contained a higher amount of organic matter readily available for biological degradation.

The concentration of all VFAs, except caproic, increased significantly with dietary fiber incorporation (Table 3). The presence of VFAs contributes to the emission of odours by slurry. Schaefer (1977) and Williams (1984) indicated that valeric and butyric acids are strong malodorous components that play an important role in the generation of repulsive odours. The increase in slurry VFA content with dietary fiber addition may thus accentuate odour intensity from manure storage and during land application. The increase in VFAs was accompanied by a reduction in manure slurry pH, from 8.57 with the C diet to 8.24 with the VHF diet ($P = 0.05$) (Table 3). A decrease in pH would reduce the proportion of NH_3 in the ammonia (NH_3 + NH_4) equilibrium system and thus decrease ammonia volatilization. The analytical method used to determine ammonia-nitrogen does not differentiate between NH_3 and NH_4. However, the proportion of NH_3-N in the total ammonia system at each pH could be calculated using equilibrium analysis (Snoeyink and Jenkins 1980) and is presented for each diet in Table 3. The proportion of NH_3 decreased from 14.2% with the C diet to 7.95% when the VHF diet was fed to the sows.

Daily intake and excretion of mineral elements were determined to evaluate the impact of dietary fiber incorporation on absorption of mineral elements by the sows (Table 4). A higher mineral content in the manure slurry could increase nutrient and mineral input during manure application. In this study, boron was the only element that was excreted in significantly higher amounts by the sows fed the two high fiber diets (Table 4). Otherwise, there was no significant treatment effect on the amount of excreted elements.

CONCLUSION

The objective of this study was to determine the impact of dietary fiber incorporation on manure slurry characteristics and management practices. Results indicated that dietary fiber addition significantly ($P < 0.05$) increased feces mass but tended to decrease urine production. Consequently, manure slurry (feces plus urine) production was similar with all diets but solids content of the slurry increased significantly ($P < 0.05$) with dietary fiber addition. The manure slurry TS concentration averaged 3.8, 11.1, and 18.3% with the C, HF, and VHF diets, respectively. Other major changes in the manure slurry due to dietary fiber incorporation included significant ($P < 0.05$) increases in apparent viscosity as well as in TCOD, SCOD, and VFA concentrations. Concentration of mineral elements in the manure slurry was not affected by dietary fiber addition.

Sows fed the two high fiber diets produced a semi-solid manure slurry (TS content between 10 and 20%) while sows fed the control diet produced a liquid manure slurry. The use of a high fiber diet might thus cause some difficulties with existing liquid manure handling systems. Water addition may be required to facilitate the evacuation of the manure from the gutter. The use of a HF diet should not require modifications of the manure storage and land application systems. However, the near solid consistency of the manure from sows fed the VHF diet may necessitate major changes in the actual liquid swine manure handling, storage, and land application practices.

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