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Effect of Increasing Feed Allocation or Added Soluble Fiber on the Performance and Behavior of Late Gestation Sows

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Summary

A total of 1,479 mixed-parity sows and gilts (1050, PIC) were used to evaluate the effects of increased feed allocation or added soluble fiber in diets fed the last two weeks of gestation on sow performance and behavior. Sows were housed in 28 pens containing 47 to 55 sows per pen. Each pen was equipped with three computerized gestation feeders. Pens of sows were blocked in groups to account for date of pen loading and then allotted to one of three treatments with nine or ten replications per treatment. Treatments consisted of: 1) control diet (corn-soybean meal-DDGS-based) fed at 5.5 lb/sow/day, 2) increased allocation of the control diet by 2.5 lb/sow/day (8.0 lb total feed/sow/day), and 3) 5.5 lb/sow/day of control diet plus 2.65 lb/d of added soybean hulls to provide over 100 g/d soluble fiber (8.15 lb total feed/sow/day). Pens contained sows with different breed dates and treatments started when the first sows reached d 104 of gestation. Sows were weighed the day before the start of treatment diets being offered and again when they entered farrowing. Sows were video recorded continuously, and video was analyzed on d 3 and 5 in six 2-h timeframes (0100 to 0300, 0500 to 0700, 0900 to 1100, 1300 to 1500, 1700 to 1900, and 2100 to 2300). Aggressive bouts were defined as: 1) sows knocking or pushing pen mates with their head; 2) sows mounting pen mates; or 3) sows forcefully biting ear, face, body, or vulva of pen mates. Sow body lesions and vulva lesions were also recorded the day before exposure to treatment and then again d 3 and 5 after exposure and finally upon entry to farrowing to measure the frequencies of scores. Four sows per pen were selected and had tear stain scores recorded the day before exposure to treatment and upon entry to farrowing to measure the frequencies of scores. One sow per pen was selected based on average body condition and parity of the pen for determination of salivary cortisol levels on d 3 and 5. Increasing feed allocation or added soluble fiber increased ($P < 0.05$) ADG compared with the control group. Increased feed allocation resulted in a greater ADFI compared

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with the added fiber treatment, and sows fed added dietary fiber had greater ADFI compared with control sows ($P < 0.05$). Regardless of treatment, vulva lesion and tear stain scores numerically became more prevalent at the end of the study as sows were entering farrowing. There were no differences in number of pigs born alive, stillborn, or weaned between treatments. There was a treatment × time interaction for total aggressive bouts ($P < 0.001$). Although the means did not separate at most timeframes, numerically, increased feed allocation and added fiber reduced total aggressive bouts at timeframes 0100 to 0300, 0500 to 0700, and 0900 to 1100, but had an inverse effect at timeframe 1700 to 1900. Sows fed added fiber diets had lower ($P < 0.05$) salivary cortisol levels compared with sows fed increased feed allocation, with control-fed sows intermediate. In conclusion, increasing feed allocation or added soluble fiber resulted in greater ADFI, as expected, which translated into an increase in ADG. Fewer total aggressive bouts were observed for the high feed allocation and added fiber treatments earlier in the day, but numerically increased total aggressive bouts at night. These data indicate that increased feed allocation or added fiber only in late gestation affected aggressive interactions, especially around the feed stations in the early morning. This reduction in aggression in the morning potentially led to differences between treatments in their physiological stress indicators taken at similar timepoints.

Introduction

Over the past 10 years, research has been conducted surrounding gestation aggression in response to the increased implementation of group housing[4],[5],[6]. However, a majority of this research has been focused on strategies to reduce aggression immediately after mixing. Despite the importance of focusing on gestating sow aggression immediately after mixing, there is a need for research on strategies to manage late gestation aggression. Field reports from production systems suggest that there is an increase in late gestation aggression specifically during the last week before loading sows into the farrowing room, visible through an increase in vulva biting. One explanation for this increased aggression right before farrowing may be the restructuring of the social dynamic as sows are being removed and placed in farrowing facilities, similar to the shifts in the dynamics seen during the initial mixing event4.

Nutritional strategies may serve as an easily implementable method to increase satiety and reduce aggression. One potential strategy would be to increase the sows' daily feed allocation the week before farrowing. This strategy may lead to increased duration of satiety throughout the day, potentially leading to fewer aggressive bouts within the pen. This strategy is common practice when initially mixing groups of animals to decrease aggression; however, little research has shown its effects during late gestation[7].

[4] Stevens, B., G. M. Karlen, R. Morrison, H. W. Gonyou, K. L. Butler, K. J. Kerswell, and P. H. Hemsworth. 2015. Effects of stage of gestation at mixing on aggression, injuries and stress in sows. Anim. Behav. Sci. 165:40–46. doi:10.1016/j.applanim.2015.02.002.

[5] Greenwood, E. C., K. J. Plush, W. H. E. J. van Wettere, and P. E. Hughes. 2016. Group and individual sow behavior is altered in early gestation by space allowance in the days immediately following grouping. J. Anim. Sci. 94(1):385–393. doi:10.2527/jas.2015-9427.

[6] Verdon, M., R. S. Morrison, M. Rice, and P. H. Hemsworth. 2016. Individual variation in sow aggressive behavior and its relationship with sow welfare. J. Anim. Sci. 94(3):1203–1214. doi:10.2527/jas.2015-0006.

[7] Muller, T. L., R. J. E. Hewitt, and R. J. van Barneveld. 2015. Nutritional management strategies to reduce aggression at mixing of unfamiliar sows. Co-operative Research Centre for High Integrity Australian Pork. https://porkcrc.com.au/wp-content/uploads/2014/12/1C-115-Final-Report.pdf

Apart from increased feed allocation, increased soluble fiber inclusion in the diet is another potential way to increase satiety in group-housed sows. Literature has evaluated ingredients high in soluble polysaccharides such as sugar beet pulp and soybean hulls on their abilities to limit physical activity compared with other fiber sources[8]. Fiber fermentation within the colon is also thought to stabilize glucose and insulin, other factors affecting satiety[9]. However, additional research is needed on increased fiber inclusion within late gestation diets in a commercial setting.

The overall objective of this study was to evaluate strategies including an increased feed allocation or increased fiber inclusion using soybean hulls on sow performance, pen behavior, and physiological stress indicators compared with control-fed sows in group housing within commercial conditions.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The experiment was conducted at a commercial sow farm in Carthage, IL. The barn contained 28 pens, with each pen (36.66 × 27.66 ft) equipped with three computerized gestation feeders (Gestal; Jyga Technologies, St-Lambert-de-Lauzon, QC, Canada) and four cup drinkers to provide ad libitum access to water. Sows were fed to the set dietary treatment feed allocation and the allocation of feed each day began at 0100 in the computerized feed system.

Animals and diets

A total of 1,479 mixed-parity sows and gilts (1050, PIC) were used. Sows were housed in 28 pens containing 47 to 55 sows/pen. Pens of sows were blocked in groups to account for date of pen loading and then allotted to one of three treatments with nine or ten replicate pens per treatment. Pens contained sows with different breed dates and treatments started when the first sows reached d 104 of gestation. Treatments consisted of: 1) control diet (corn-soybean meal-DDGS-based) fed at 5.5 lb/sow/day, 2) increased allocation of the control diet by 2.5 lb/sow/day (8.0 lb total feed/sow/day), and 3) 5.5 lb/sow/day of control diet plus 2.65 lb/d of soybean hulls to provide 100 g/d soluble fiber (8.15 lb total feed/sow/day; Table 1). Sows were weighed the day before the start of treatment and again upon entering the farrowing house. Litter counts were taken upon birth and then again at weaning to determine litter performance data. Total sow fallout was recorded during the study and included abortions, deaths in gestation, and lactation death or removal in farrowing.

Within each pen, four sows were selected based on average parity of the pen and average body condition to serve as the focal sows of the pen. All four of these sows had tear stains scored when recording initial BW and again when entering farrowing. Tear stains were recorded on a 0 to 5 scale (Table 2). At initial weight, d 3, and d 5 after exposure to treatment and then upon entry to farrowing, all sows within the pen had body and vulva lesion scores recorded. Sow body lesion was recorded on a scale of 0 to 3 with

[8] Wensley, M. R., M. D. Tokach, J. C. Woodworth, R. D. Goodband, J. M. DeRouchey, and J. T. Gebhardt. 2023. Feeding strategies to improve sow satiety in pen gestation housing. J. Swine Health Prod. 31:137–140. doi:10.54846/jshap/1323.

[9] de Leeuw, J. A., A. W. Jongbloed, and M. W. A. Verstegen. 2004. Dietary fiber stabilizes blood glucose and insulin levels and reduces physical activity in sows (Sus scrofa). J. Nutr. 134:1481–1486. doi:10.1093/jn/134.6.1481.

vulva scoring on a scale from 0 to 2. All scores were recorded by the same observers across the duration of the experiment.

Video analysis

Using video cameras (PAR-ALLTXIRA28WL: Fixed lens, IP67 Weatherproof, 2 Megapixel Turret, 2.8mm lens with 30fps(60Hz); Innovative Video Technology, Hauppauge, NY) connected to a network video recording system (PN3A-64FNH: NTSC/PAL, 64 Ch TVI NVR, AC110-240V; Innovative Video Technology, Hauppauge, NY), sows were video recorded continuously. Recorded video was analyzed on d 3 and 5 in six 2-h timeframes (0100 to 0300, 0500 to 0700, 0900 to 1100, 1300 to 1500, 1700 to 1900, and 2100 to 2300). Aggressive bouts were defined as: 1) sows knocking or pushing pen mates with their head; 2) sows mounting pen mates; or 3) sows forcefully biting ear, face, body, or vulva of pen mates. Aggressive bouts were defined as either "feeder aggressive bouts" or "non-feeder aggressive bouts". Feeder aggressive bouts were defined as bouts that occurred while at least one sow was standing behind the feed stations with her nose on the station. All other aggressive bouts were labeled "non-feeder" bouts. The combination of both feeder and non-feeder aggressive bouts was labeled as "total" aggressive bouts.

Biological tissue and fluid analyses

Within each pen, one sow was chosen to have salivary cortisol levels analyzed. Saliva was collected between 0700 and 0900 on d 3 and 5 after exposure to treatment. Saliva samples were collected using Oasis Diagnostics Super-SAL Universal Saliva Collection Kit (Oasis Diagnostics, Vancouver, WA). Sows voluntarily chewed on the collection device until fully saturated. Samples were compressed into 2-mL containers and stored at -4.0°F on farm until samples were moved to the University of Missouri and stored at -112.0°F until analysis. Samples of focal sows were analyzed using a commercially available ELISA kit for salivary cortisol (IBL Cortisol Free in Saliva ELISA; Minneapolis, MN) following the manufacturer's instructions.

Sows selected for salivary collection were also tracked through farrowing for collection of piglet blood and hair cortisol. The day before weaning, all piglets within the litter were weighed and the male and female closest to the average weight of the litter were chosen for collection. Piglets were restrained on their back for 3 min to induce a stress response, and then blood samples were taken in tubes containing an anticoagulant (Greiner Bio-One North America Inc., Monroe, NC). Blood samples were spun down within 4 h of sample collection with plasma samples being stored at −112°F (−80°C) until further analysis. Cortisol analysis was performed on all plasma samples using an IBL America Cortisol ELISA Kit (IBL ELISA; Minneapolis, MN).

At the same time as blood collection, hair samples were collected for additional cortisol analysis. A hair sample was collected from the rump and dorsal area of the piglets and processed as previously described by Byrd et al.[10].

[10] Byrd, M. H., L. F. Brito, J. Musa, S. Diggs, L. K. Senn, H. Wen, P. H. F. Freitas, J. L. Byrd, F. Tiezzi, C. Maltecca, Y. Huang, A. P. Schinckel, and J. S. Johnson. 2025. Characterizing the effects of gestational heat stress on reproductive efficiency and thermoregulation in replacement gilts divergently selected for thermotolerance in the F1 generation. J. Anim. Sci. 103:skaf353. doi:10.1093/jas/skaf353.

Statistical analysis

Sow performance data were analyzed using the lmer function from the lme4 package in RStudio [Version 4.0.2 (2020-06-22), R Core Team, R Foundation for Statistical Computing, Vienna, Austria] with pen serving as the experimental unit and sow as the observational unit in a randomized complete block design. Pens were grouped into blocks to account for pen loading date. Treatment was used as a fixed effect in the model and pen and block served as random effects. Sow parity and days exposed to treatment were included as covariates in the model. Count data, including subsequent litter characteristics (total born, liveborn, stillborn, mummies, and weaned) were analyzed using a negative binomial distribution using a log link function. Proportion data, including percent sow fallout, were analyzed using a binomial distribution.

Sow aggressive bouts, sow salivary, piglet hair and plasma cortisol levels were summarized using the GLIMMIX procedure of SAS OnDemand for Academics (SAS Institute, Inc., Cary, NC). Aggressive bouts were reported as a count per hour within each score category by treatment. The model for aggressive bouts included treatment, day, time, and their interactions as fixed effects with block as a random effect. Sow salivary cortisol levels were log-transformed and then back-transformed to give estimated means. The model included treatment, day, and their interactions as fixed effects with block as a random effect. The model for piglet plasma and hair cortisol levels included treatment as a fixed effect with block and liveborn as random effects. All lesion scoring data were presented through descriptive statistics as the frequency within each score category due to models failing to converge. All results were considered significant with $P \leq 0.05$ and marginally significant with $0.05 < P \leq 0.10$.

Results and Discussion

As expected, the addition of soybean hulls to the fiber diet led to increased soluble dietary fiber being 3.59%, with the control diet fed to both control and increased feed allocation sows being 2.82% respectively.

There were no differences in initial sow weights before starting treatment (Table 3). However, at entry into farrowing, sows fed the added fiber diets were heavier ($P < 0.05$) than those on the control diet with sows receiving increased feed allocation intermediate. Increasing feed allocation or added soluble fiber increased ($P < 0.05$) ADG compared with sows fed the control diet. Increased feed allocation resulted in a greater ADFI compared with the added fiber treatment, and sows fed increased dietary fiber had greater ADFI compared with control sows ($P < 0.05$). With the increased concentration of soluble fiber through the addition of soybean hulls in the diet, soluble fiber intake would have been 132.7 g/d if sows consumed their entire feed allocation. When considering the average feed intake of added fiber fed sows, soluble fiber intake was still above the 100 g/d target at 113.0 g/d. No differences were observed in total born, born alive, mummies, stillborn, number weaned, or percentage of sow fallout between treatments.

There were minimal numerical differences in frequency of vulva, body lesion, and tear stain scores observed between treatments (Figures 1 to 6). However, regardless of treatment, vulva lesion and tear stain scores numerically became more prevalent at the end of the study as sows were entering farrowing.

For all categories of aggressive bouts, there was a treatment × time ($P \leq 0.048$) interaction observed (Table 4). Across all categories of aggressive bouts, there was a numerical reduction in aggressive bouts from 0100 to 0700 for sows receiving increased feed allocation or added fiber. However, the inverse is seen from 1300 to 2300, where sows fed the control diet had numerically fewer aggressive bouts than sows fed either increased feed allocation or added fiber. This interaction is potentially explained by sows fed either the increased feed allocation or added fiber treatments having a greater level of satiety; therefore, when the feed system reset at 0100 each day, sows on the dietary interventions might have been less likely to immediately approach the feeder compared with control sows.

For the main effects of the non-feeder aggressive bouts, sows fed increased feed allocation or added fiber had more ($P < 0.05$) aggressive bouts compared with sows fed the control diet between the hours of 1700 and 1900, with no differences observed at the other timepoints.

For the main effects of the feeder aggressive bouts, sows fed either increased feed allocation or added fiber had fewer ($P < 0.001$) aggressive bouts from 0500 to 0700. Furthermore, from 0100 to 0300 and 0900 to 1100, sows fed added soluble fiber had fewer ($P < 0.001$) instances of aggressive bouts at the feeder compared with sows fed the control diet, with sows fed an increased feed allocation intermediate.

For the main effects of total aggressive bouts, from 0500 to 0700, sows fed added fiber had fewer ($P < 0.001$) aggressive bouts than sows fed the control diet while sows fed the increased feed allocation were intermediate. At both 0100 to 0300 and 0900 to 1100, there were observed differences ($P \leq 0.012$) among treatments, but the means did not separate. Numerically, added fiber fed sows had the lowest number of aggressive bouts at those time frames; however, there were no differences observed throughout the other timeframes.

Sow salivary cortisol levels showed both a treatment ($P = 0.006$) and day ($P = 0.036$) effect (Table 5). Sows provided the added fiber diet had lower ($P < 0.05$) cortisol levels compared with sows having an increased feed allocation, with sows fed the control diet intermediate. Within sow cortisol data, a day effect was also observed with sows having decreased cortisol levels on d 3 compared with d 5. There was no difference in piglet plasma cortisol levels; however, piglets from sows fed added soluble fiber had numerically the lowest plasma cortisol levels after the induced stress event. Inversely, piglet hair, which is an indicator of longer-term stress, showed a tendency ($P = 0.071$) for piglets from sows fed the increased feed allocation to have a numerically higher hair cortisol level compared with piglets from sows fed the control and added fiber diet. Furthermore, there was an effect of sex ($P = 0.014$) with barrows having reduced hair cortisol levels compared with gilts.

In conclusion, increasing feed allocation or added soluble fiber resulted in greater ADFI, as expected, which translated into an increase in ADG. Fewer total aggressive bouts were observed for the increased feed allocation and added fiber treatments earlier in the day, but in return these treatments had numerically increased total aggressive bouts at night, indicating sow behavior and physiological stress indicators were affected by treatments during late gestation. Regardless of treatment, sow aggression in pens decreased as the day progressed. Increased feed allocation or added soluble fiber in diets show potential as mediators of aggression around feeders early in the day.

Acknowledgments

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Table 1. Diet composition (as-fed basis)

Item	Control	Added fiber
Ingredient, %		
Corn	62.59	42.15
Soybean meal, 47.7% CP	4.75	3.20
Corn DDGS	29.00	19.55
Soybean hulls	---	32.50
Calcium carbonate	1.89	1.28
Monocalcium phosphate, 21% P	0.22	0.15
Salt	0.47	0.32
L-Lys-HCl	0.28	0.19
L-Thr	0.05	0.03
L-Trp	0.02	0.01
Choline chloride, 60%	0.12	0.08
Vitamin and trace mineral with phytase[1]	0.25	0.17
Engage M[2]	0.05	0.05
Sal-curb[3]	0.33	0.33
Total	100.00	100.00
Calculated analysis		
Standardized ileal digestible amino acids, %		
Lys	58	52
Ile:Lys	76	76
Leu:Lys	246	219
Met & Cys:Lys	78	72
Thr:Lys	76	73
Trp:Lys	20	19
Val:Lys	95	91
His:Lys	58	44
NE, kcal/lb	1,117	899
CP, %	15.42	13.82
Crude fiber, %	3.5	14.0
NDF, %	13.90	27.47
ADF, %	5.35	16.32
Ca, %	0.84	0.74
STTD P, %	0.40	0.29
Chemical analysis[4]		
CP, %	15.96	14.47
Crude fiber, %	3.32	13.20
Total dietary fiber, %	22.34	35.78
Insoluble dietary fiber, %	19.52	32.20
Soluble dietary fiber, %	2.82	3.59

[1] Quantum Blue (AB Vista, Plantation, FL), provided an assumed release of 0.14% STTD P with 750 FTU/kg in the control diet, and assumed release of 0.09% STTD P with 505 FTU/kg in the added fiber diet.

[2] Calcium aluminosilicate, United Animal Health, Sheridan, IN.

[3] Formaldehyde solution and propionic acid, Kemin Industries, Des Moines, IA.

[4] Crude protein and crude fiber analysis were analyzed in duplicate by University of Missouri Agricultural Experiment Station Chemical Laboratory. Total, insoluble, and soluble dietary fiber analyses were analyzed in triplicate at the Monogastric Nutrition Lab at the University of Missouri.

Table 2. Scales used to determine body lesions, vulva lesions, and tear staining scores

Body lesion scoring	
0	No injuries.
1	≤ 4 superficial injuries.
2	5 to 10 superficial injuries and/or less than 2 deep wounds.
3	≥ 11 superficial injuries and/or more than 3 deep wounds.
Vulva scoring	
0	No damage to the vulva.
1	Recent damage, including fresh or scabbed bite wounds but not including old scarring. Vulva lesion > 3 cm length or 1 cm diameter.
2	Deep tissue injury.
Tear stain scoring	
0	No signs of staining.
1	Staining is barely detectable and area stained does not extend below eyelid.
2	Staining is obvious and area stained is approximately < 50% of total eye area.
3	Staining is obvious and area stained is approximately 50 to 100% of total eye area.
4	Staining is severe, area stained is approximately ≥ 100% of total eye area, and area stained does not extend below the mouth line.
5	Staining is severe, area stained is > 100% of total eye area, and area stained extends below the mouth line.

Table 3. Effect of increasing feed allocation or soluble fiber inclusion in late gestation diets on sow and litter performance

	Feeding strategy				
Item	Control	Increased feed allocation	Added fiber	SEM	*P* =
Sow performance[1,2]					
Initial BW, lb	582.7	579.0	585.7	5.81	0.710
Farrow entry BW, lb	609.3[a]	622.6[ab]	630.1[b]	5.27	0.036
ADG, lb	2.28[a]	3.70[b]	3.93[b]	0.051	< 0.001
ADFI, lb	5.33[a]	7.67[c]	6.94[b]	0.059	< 0.001
Litter characteristics					
Total born, n	17.23	17.02	16.93	0.203	0.529
Born alive, n	15.23	14.91	14.92	0.190	0.366
Stillborn, n	1.53	1.62	1.59	0.085	0.696
Mummies, n	0.42	0.42	0.39	0.041	0.694
Weaned, n	12.48	12.61	12.48	0.185	0.835
Sow fallout, %[3]	7.0	8.4	8.1	1.29	0.710

[a-c] Means within a row with different superscripts differ (P < 0.05).

[1] A total of 1,479 mixed-parity sows and gilts (1050, PIC) were used to evaluate the effects of increased feed allocation or soluble fiber included in diets fed the last two weeks of gestation. ADG and ADFI were measured from when first sows within pen reached d 104 of gestation, until all sows entered farrowing.

[2] Treatments included: 1) control diet (corn-SBM-DDGS-based) fed at 5.5 lb/sow/day, 2) increased allocation of the control diet by 2.5 lb/sow/day (8.00 lb total feed/sow/day), and 3) 5.5 lb/sow/day of control diet plus 2.65 lb/d of soybean hulls to provide 100 g/d soluble fiber (8.15 lb total feed/sow/day)

[3] Sow fallout is defined as sow mortality or removal from the initiation of trial through the end of subsequent lactation.

Table 4. Effect of increasing feed allocation or soluble fiber inclusion in late gestation diets on aggressive bouts among gestating sows

	Feeding strategy				
Item	**Control**	Increased feed allocation	Added fiber	SEM	*P* =
Non-feeder bouts[1,2]					
0100 to 0300	19.07	15.35	16.61	2.303	0.451
0500 to 0700	26.99	25.10	21.28	2.256	0.168
0900 to 1100	17.79	19.18	13.36	2.373	0.183
1300 to 1500	12.43	19.07	14.86	2.244	0.103
1700 to 1900	6.14[a]	15.83[b]	13.95[b]	2.192	0.004
2100 to 2300	6.10	7.78	8.08	2.220	0.785
Feeder bouts[1,3]					
0100 to 0300	14.91[a]	9.61[ab]	5.37[b]	1.536	< 0.001
0500 to 0700	20.33[a]	11.72[b]	6.81[b]	1.534	< 0.001
0900 to 1100	14.47[a]	8.50[ab]	6.87[b]	1.534	< 0.001
1300 to 1500	6.21	5.29	7.51	1.568	0.286
1700 to 1900	0.58	2.20	3.89	1.637	0.162
2100 to 2300	0.68	0.73	1.21	1.686	0.921
Total aggressive bouts[1,4]					
0100 to 0300	33.91	24.94	21.92	2.920	0.010
0500 to 0700	47.31[b]	36.81[ab]	28.12[a]	2.920	< 0.001
0900 to 1100	32.23	27.68	20.18	2.920	0.012
1300 to 1500	18.57	24.34	22.27	2.991	0.356
1700 to 1900	6.67	18.05	17.89	3.091	0.009
2100 to 2300	6.68	8.52	9.25	3.187	0.818

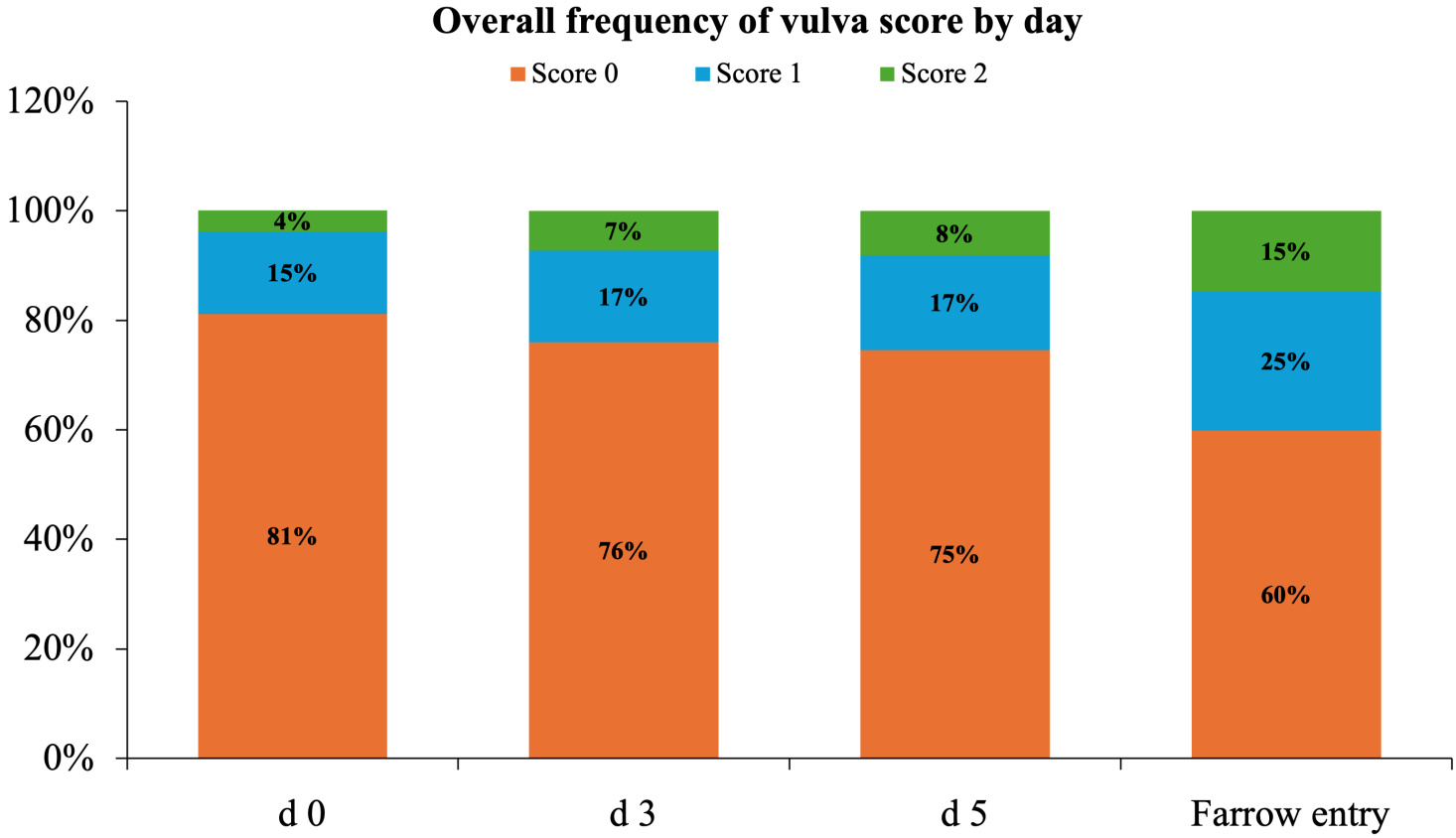
[a-c] Means within a row with different superscripts differ (P < 0.05).

[1] Value represents the number of interactions per hour of video viewed.

[2] Treatment × day × time, P = 0.310; Treatment × time, P = 0.048; Treatment × day, P = 0.998; Day × time, P = 0.348; Treatment, P = 0.402; Time, P < 0.001; Day, P = 0.381.

[3] Treatment × day × time, P = 0.873; Treatment × time, P < 0.001; Treatment × day, P = 0.774; Day × time, P = 0.483; Treatment, P = 0.003; Time, P < 0.001; Day, P = 0.253.

[4] Treatment × day × time, P = 0.456; Treatment × time, P < 0.001; Treatment × day, P = 0.943; Day × time, P = 0.324; Treatment, P = 0.187; Time, P < 0.001; Day, P = 0.869.


Overall frequency of vulva score by day
Score 0
Score 1
Score 2
120%
100%
80%
60%
40%
20%
0%
4%
15%
81%
7%
17%
76%
8%
17%
75%
15%
25%
60%
d 0
d 3
d 5
Farrow entry

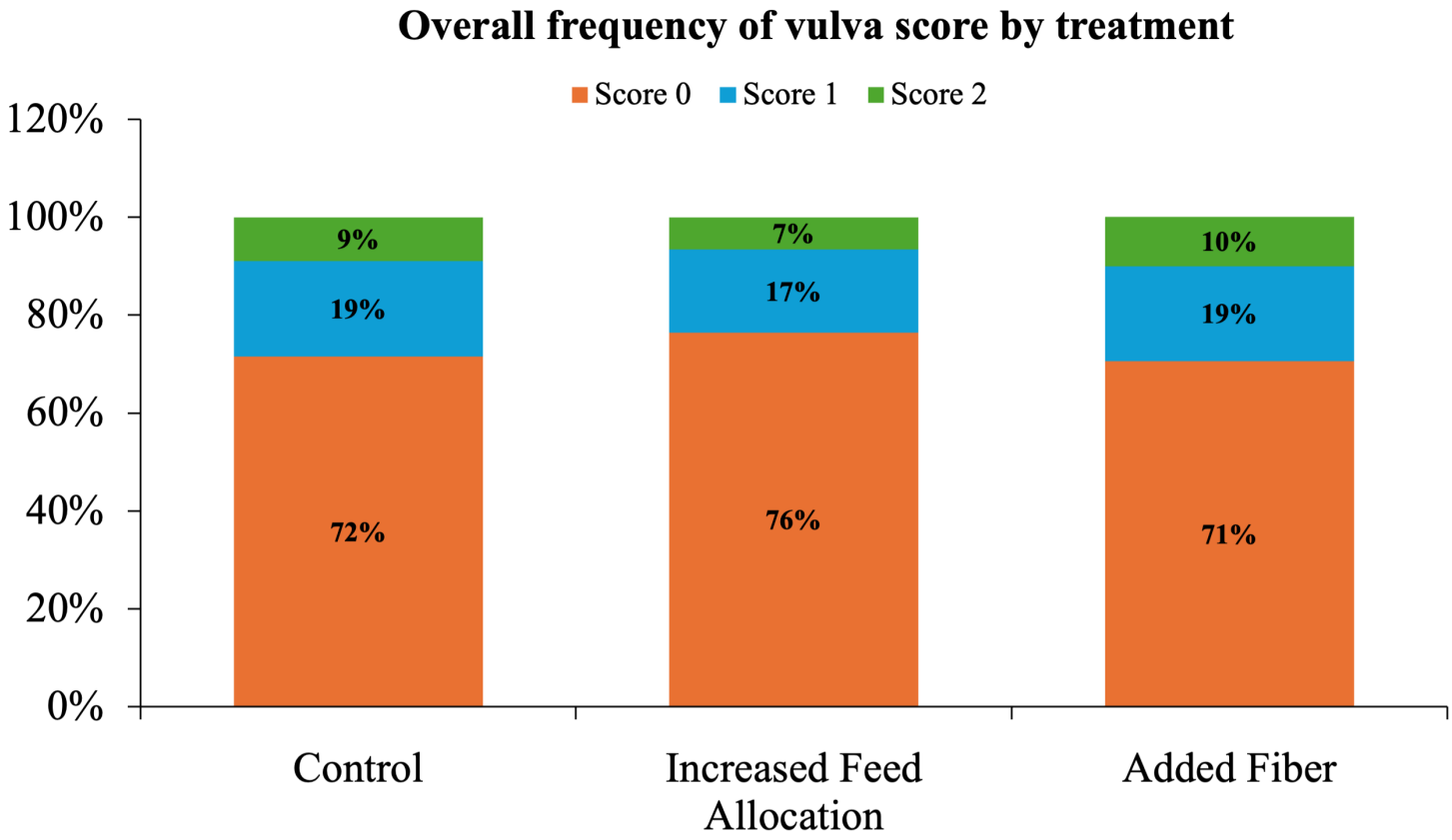
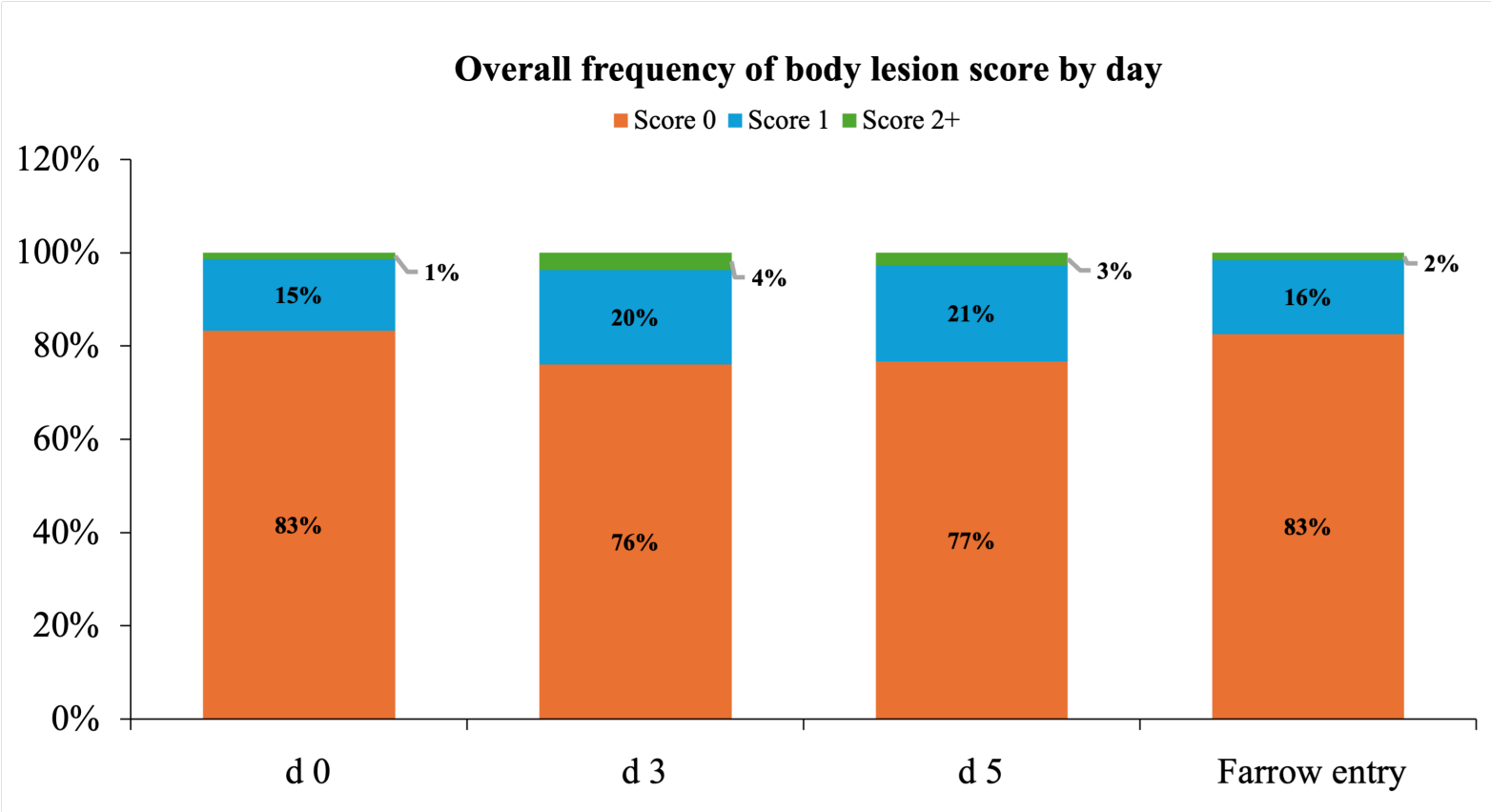
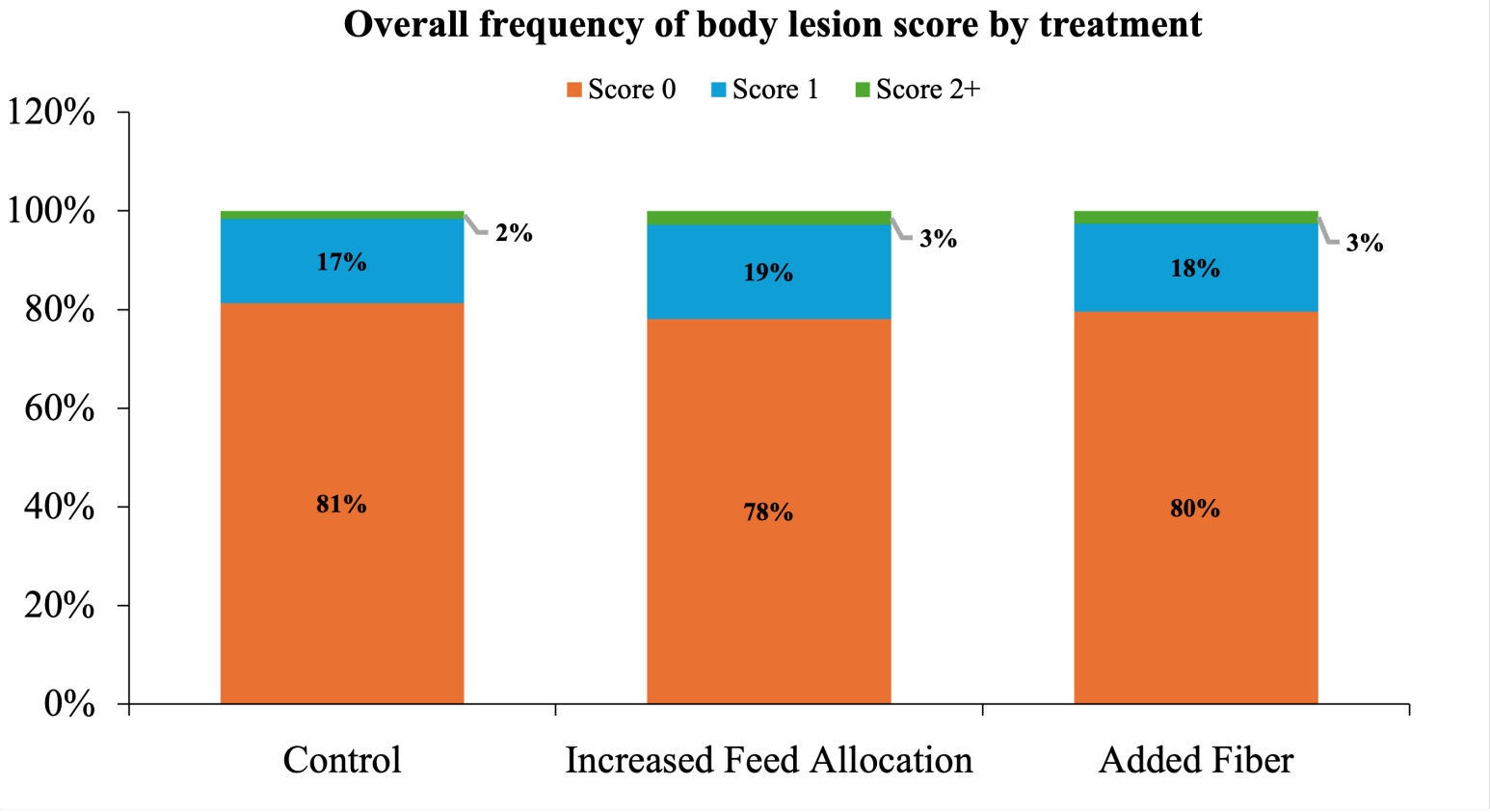


Table 5. Effect of increasing feed allocation or soluble fiber inclusion in late gestation diets on cortisol response of sows and their subsequent piglets at weaning[1]

	Feeding strategy				
Item	Control	Increased feed allo-cation	Added fiber	SEM	*P* =
Cortisol					



Sow salivary, ng/mL[2]	6.85[ab]	7.87[a]	4.19[b]	0.982	0.006
Piglet plasma, ng/mL	49.80	46.00	36.09	17.134	0.401
Piglet hair, pg/mg[3]	5.27	7.07	6.31	0.833	0.071



[1] All samples were analyzed for cortisol at the Missouri Stress Physiology Lab, Columbia, MO.

[2] Treatment × day, P = 0.386; Day, P = 0.036.

[3] Treatment × sex, P = 0.088; Sex, P = 0.014.

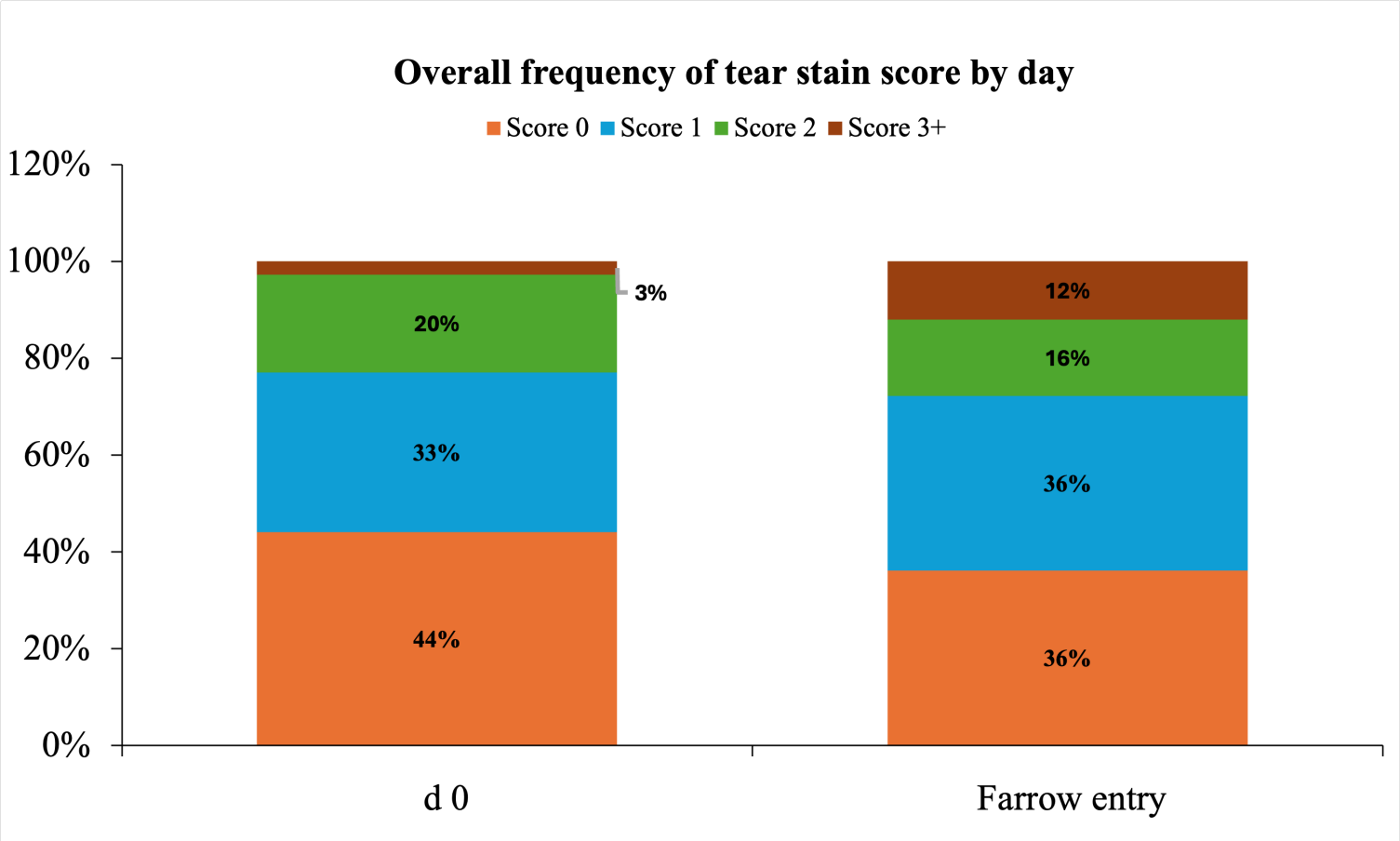
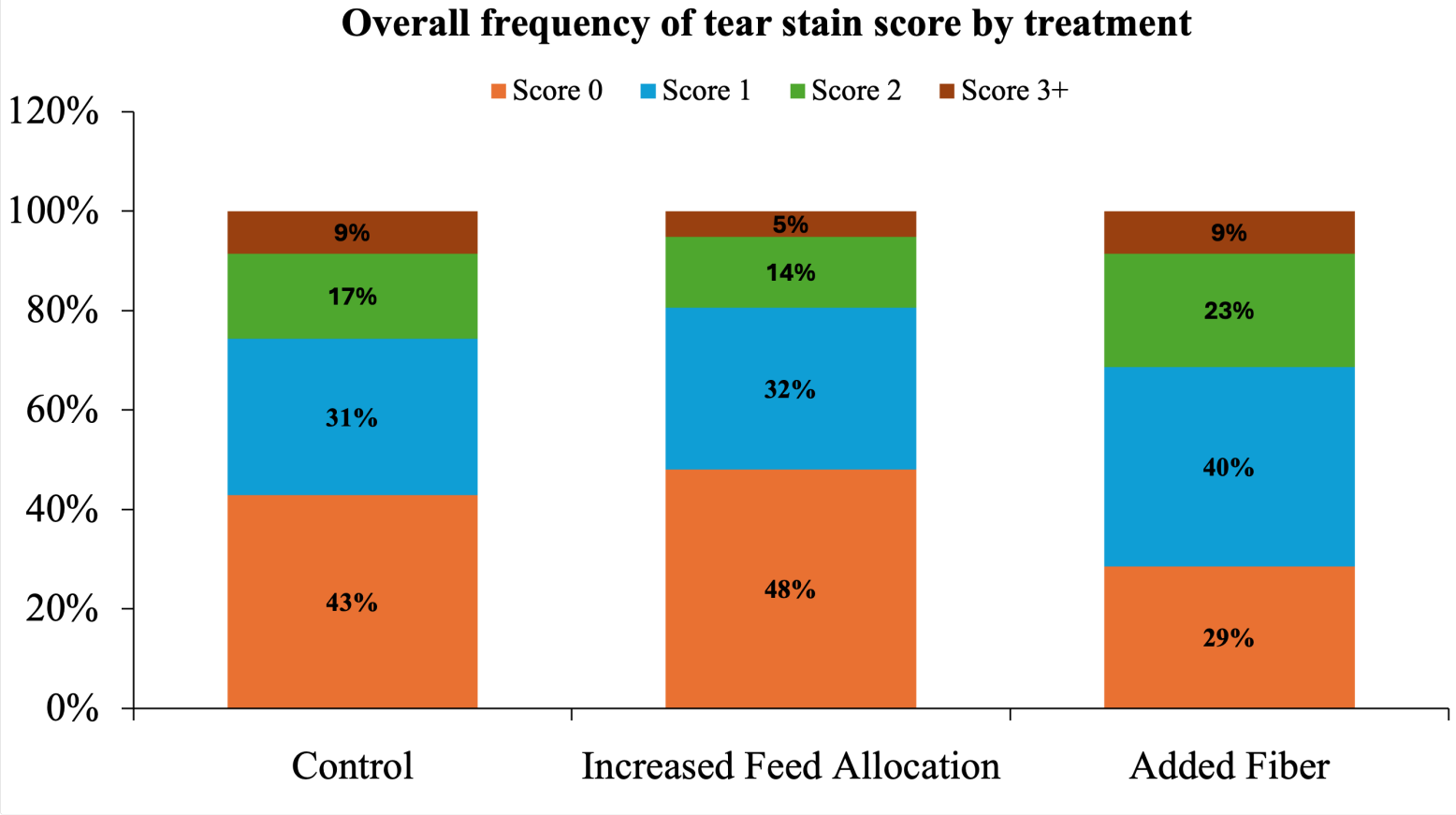


Figure 1. Vulva scores presented on 0-2 scale: 0 = No damage to vulva; 1 = Recent damage, including fresh or scabbed bite wounds but not including old scarring. Vulva lesion > 3 cm length or 1 cm diameter; 2 = Deep tissue injury. Scores of sow vulvas were recorded the day before starting treatment (d 0), then on d 3 and 5 post exposure to treatment, and upon entry into farrowing.

Figure 2. Vulva scores presented on 0-2 scale: 0 = No damage to vulva; 1 = Recent damage, including fresh or scabbed bite wounds but not including old scarring. Vulva lesion > 3 cm length or 1 cm diameter; 2 = Deep tissue injury. Scores of sow vulvas were



recorded the day before starting treatment (d 0), then on d 3 and 5 post exposure to treatment, and upon entry into farrowing.

Figure 3. Body lesion scores presented on 0-3 scale. 0 = No damage; 1 = ≤ 4 superficial injuries; 2 = 5-10 superficial injuries and/or less than 2 deep wounds; 3 = ≥ 11superficial injuries and/or more than 3 deep wounds. Scores of sow body lesions were recorded the day before starting treatment (d 0), then on d 3 and 5 post exposure to treatment, and upon entry into farrowing.