Effect of feeding fermented extruded corn stover on reproductive performance of pregnant sows

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ABSTRACT
The objective of the study was to determine the effects of dietary supplementation of fermented extruded corn stover on back fat thickness, reproductive performance and serum hormone in sows during late pregnancy. A total of 48 pregnant sows (24 Landrace and 24 Yorkshire) were randomly assigned into four experimental treatment groups (0%, 10%, 15% and 20% fermented extruded corn stover). Back fat thickness results showed that no significant differences on control group compared to each fermented treatment groups (P<0.05) at 55 and 105 days of gestation, respectively. Reproductive performance results demonstrated that control group had a lower litter size per head than 10% fermented extruded corn stover group (P<0.05), respectively. The results showed that leptin hormone was higher in control group than 10%, 15% and 20% treatment groups (P<0.05), respectively. Our findings suggested that 10% fermented extruded corn stover increased the litter size per head in pregnant sows.

Key words: Back fat thickness, Fermented extruded corn stover, Hormone, Pregnant sows, Reproductive performance

INTRODUCTION
Cereal grain such as corn is the main dietary source of carbohydrates for human and animals (Park et al., 2010). Generally, corn stover is either burnt or left in the fields in hilly mountainous areas of South West China results in organic matter wastage and atmospheric pollution (Chen et al., 2014). There is a need to develop and use different methods of feed processing for corn stover (throughout) such as fermentation and extrusion. To use corn stover as animal feeds will decrease air pollution and increase value in animal production (Oladosu et al., 2016). According to Rojas and Stein (2016) feed processing can upgrade nutritional value of feeds and extrusion results in improved production performances. Sows that are in late gestation and early lactation when fed with supplemental fattening feeds, their neonatal survival can be improved (Hou et al., 2014). According to Guillimet et al. (2007) dietary fiber supplements reduce body fatness at farrowing that results to longer parturition and high rate of piglet mortality. There is little information on the quality and safety of the ingredients for animal feed that are used by small scale pig producing farmers. Many studies have been conducted on the impact of nutrient digestibility and growth performance whereas the research of effect on reproductive performance is less clear. Feeding of sows during the pregnancy period require supplemnetations (Park et al., 2010), hence we hypothesized that fermented corn stover might be a supplement for pregnant sows.

The objective of the present study was to investigate the effects of dietary supplementation of fermented extruded corn stover on back fat thickness, reproductive performance and serum hormone in sows during the late pregnancy. This study will provide basic scientific understanding of fermented corn stover as supplement on late stages of pregnant sows.

MATERIALS AND METHODS
Study site: The study was conducted as explained by Tyasi et al. (2017). Briefly, experimental area is located at latitude 43°42′ N and longitude 126°12′ E. The annual rainfall is about 570.3mm during the dry season between September to February, and raining period is between March and August.

Corn stover preparation: Corn stover was purchased from the local company in Changchun City of Jilin Province in the Republic of China. The leaves were removed and dried at a temperature of 60-70 °C until the constant weight was achieved. Corn stover was completely dried and cut into smaller pieces (10-30 cm), then crushed into fine powder to allow passing through a >3.5 mm mesh mini laboratory sieve.

Corn stover fermentation: The fermentation of corn stover for the current study was prepared as described by Chang et al. (2012). Briefly, commercial baking yeast was purchased and used as Saccharomyces cerevisie to speed up the fermentation process. The yeast was then inoculated into medium, containing glucose 50gL⁻¹, peptone 5gL⁻¹, MgSO₄·7H₂O 1gL⁻¹, K₂HPO₄ and 5 gL⁻¹ of yeast. The medium
was autoclaved at 121 °C (249 °F) for 15 minutes. After autoclaving, the yeast was inoculated and kept on the orbital shaker for a period of 18 hours at 30 °C, 50 rpm. The microbial fermentation of the corn stover was carried out according the method explained by Chang et al. (2015).

**Experimental design and sows feeding management:** A total of forty eight healthy pregnant sows (24 Landrace and 24 Yorkshire) were used for the current study. Pregnant sows were randomly assigned into 4 experimental treatment groups (0%, 10%, 15% and 20% fermented extruded corn stover) with 12 replicates per group. Completely randomised design was used for the current study. The experimental diets contained corn and soybean meal as raw material were prepared according the NRC (1998) pig’s nutritional requirements, as well as control group diets (Table 1). The experimental group diets were replaced by fermented puffed corn stover (10%, 15%, 20%) respectively, corresponding proportions in the diet corn, soybean meal and the bran, mixture in addition to 3 sets of test fodder. All the procedures involving sows were approved by Animal Research Ethics Committee of the Jilin Agricultural University, China.

**Determination of back fat thickness, reproductive performance and blood serum hormone:** Pregnant sow’s back fat was detected on the first day of 55, 80 and 105 days of gestation period. The full ultra sound was done, using digital PL-201V ultra sound diagnostic system (BMV Technology Co., Ltd, China). Back fat thickness was recorded according the method of Magowan and McCann, (2006). Reproductive performance during the farrowing period including litter size per head and number of still birth per head were determined according the procedure of Chusi et al. (2016). Blood samples were collected from the ear vein of all the pregnant sows into a 5ml vacuum containing sodium citrate as an anticoagulant. The method of Yilma et al. (2015). The blood samples were analyzed with a automated analyzer Technicon Auto-analyzer (Technicon, Hialeah, USA) for total protein, urea, potassium, sodium and chloride.

**Chemical analysis:** All the corn stover samples were analyzed for crude protein (CP) and digestible energy (DE) according the procedure of AOAC, (2005). The neutral detergent fibre (NDF) and acid detergent fibre (ADF) were analyzed according the method of Van Soest (1994). Calcium (Ca), phosphorus (P), Sodium (Na) and Chloride (Cl) were analyzed in all the experimental diets according the method described by Chang et al. (2015).

**Table 1:** Feed compositions and nutrient levels of the experimental diets

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Experimental diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Control)</td>
</tr>
<tr>
<td>Corn</td>
<td>76</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>14</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>5.2</td>
</tr>
<tr>
<td>CaHPO₄</td>
<td>2</td>
</tr>
<tr>
<td>Limestone</td>
<td>1</td>
</tr>
<tr>
<td>NaCl</td>
<td>0.2</td>
</tr>
<tr>
<td>Fermentation puffed stover</td>
<td>0</td>
</tr>
<tr>
<td>NaHCO₃</td>
<td>0.6</td>
</tr>
<tr>
<td>Premix</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 2:** Effects of fermented extruded corn stover on back fat thickness in sows

<table>
<thead>
<tr>
<th>Back fat thickness (mm)</th>
<th>Experimental groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>extruded straw</td>
</tr>
<tr>
<td>55 days</td>
<td>18.73±0.09*</td>
</tr>
<tr>
<td>80 days</td>
<td>21.53±0.15*</td>
</tr>
<tr>
<td>105 days</td>
<td>22.80±0.60*</td>
</tr>
</tbody>
</table>

* * Means in rows with different superscripts differ significantly (p≤0.05)

**Statistical analysis:** The data was analyzed by one-way analysis of variance (ANOVA) with Duncan multiply range test for comparing difference among the means using statistical package for social sciences (Version 10.0 for windows, SPSS Inc., Chicago, IL). All the results were expressed as mean ± standard deviation (mean ± SD). Alpha 0.05 was the significance level of the study.

**RESULTS AND DISCUSSION**

**Effects of fermented extruded corn stover on back fat thickness:** The results of the back fat thickness (Table 2) showed that there were no significant differences on each fermented treatment groups (P>0.05) at 55 and 105 days of gestation, respectively as compared to control group. The results demonstrated that control group had a highest back fat thickness (21.53±0.15) as compare to all the fermented extruded corn stover groups (20.93±0.15, 20.87±0.09, 20.93±0.25) at 80 days of gestation (P<0.05), respectively. Our findings suggest that fermented extruded corn stover had no effects on back fat thickness of the pregnant sows. Similar results were reported by Quesnel et al. (2009).
Effects of fermented extruded corn stover on reproductive performance: Data in Table 3 show that there was no statistically significant difference between control group (12.67±1.16) and 15% fermented extruded corn stover group (12.33±2.08) in litter size per head (P>0.05), respectively. The results showed that control group had a litter size per head than 10% fermented extruded corn stover group (P<0.05), respectively. Our result also indicated that control group (12.67±1.16) in litter size per head than 20% fermented extruded corn stover group (10.00±1.00). Our data showed control group had a higher number of still births per head than all the fermented extruded corn stover groups (P<0.05), respectively. These results indicated that 10% fermented extruded corn stover had a significant effects on litter size per head in pregnant sows. Similar results were reported by Reese, (1997). However, Budino et al. (2014) reported that pregnant sows fed with higher fiber diets had a higher farrowing performance than the control group, maybe due to the origin of the fiber. Dietary fibre can improve farrowing performance of sows (Johnston et al., 2003).

Effects of fermented extruded corn stover on hormones in sows’ serum: The results (Table 4) of serum hormones on pregnancy stage of sows showed that leptin hormone was higher in control group than 10%, 15% and 20% treatment groups (P<0.05), respectively. The results of the estradiol, progesterone and prolactin hormones showed that there were no significant differences on control group compared to each fermented treatment groups (P>0.05), respectively. Our findings suggested that fermented extruded corn stover had no effect on blood serum hormones in pregnant sows. Quesnel et al., (2009) showed that high fiber dietary increased the prolactin hormone of the piglets significantly, maybe the dissimilar is because of the age of pigs.

CONCLUSION
Dietary supplementation of fermented extruded corn stover in pregnant sows might be used by pig farmers to improve the performance. Our findings suggest that 10% fermented extruded corn stover increase the litter size per head in pregnant sows. The current study provide the literature on fermented corn stover for scientific research and aid pig farmers to ferment the corn stover to feed their pregnant sows.

REFERENCES
INDIAN JOURNAL OF ANIMAL RESEARCH


