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Effects of Replacing Supplemental Sucrose with Beef During Mid to Late Gestation on Maternal Health and Fetal Development using a Sow Biomedical Model

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Objectives

The objectives of this study were to investigate the influence of substituting supplemental sucrose with beef on maternal health and fetal development using a sow biomedical model.

Materials and Methods

Multiparous crossbred sows (BW = 222 kg; n = 21; rep = 3) were individually housed from d 30 to 111 (± 0.58) of gestation. From d 30 to 39, a complete sow ration (corn-soybean meal-based, CSM) was fed at 1% of d 30 gestational BW. On d 39, daily dietary ration was adjusted to 1% of d 39 gestational BW which was fed daily at 0700 h from d 40 to 110 (± 0.58). Sows were randomly assigned to 1 of 4 isocaloric supplement treatments; 126 g CSM to serve as a control (CON, n = 5), 110 g cooked ground beef (BEEF, n = 6), 85.5 g sucrose (SUCR, n = 5), or 54.8 g BEEF and 42.7 g SUCR (B+S, n = 5). Dietary supplements were fed daily at 1100, 1500, and 1800 h from d 40 to 110 (± 0.58). Blood was collected via jugular venipuncture from sows on d 29 and 111 (± 0.58). Blood chemistry was immediately analyzed, and serum samples were collected for lipid panel and insulin concentrations. Bodyweights were measured on d 30, 39, 54, 68, 82, 96, and 111 (± 0.58). Tenth rib and last rib SQ fat depth were measured on d 35, 70, and 110 (± 0.58) via ultrasound. Sows were euthanized on d 111 (± 0.58). Reproductive tract (RT), pancreas, kidney, liver, heart, heart fat, lung, semimembranosus and abductor (SM), and semitendinosus (ST) weights were collected and recorded from each sow. Two median weight male and female fetuses were selected from each sow for tissue collections. Fetal tissue collection was the same as sows with the addition of testes and no RT weight. A repeated measures design, with sow as the repeated measure, was modeled using the MIXED procedure of SAS using compound symmetry variance covariance matrix. Sow data fixed effects were replicate, sow, and treatment. Fetal data fixed effects were replicate and fetal weight category. Covariates were determined for each individual trait depending on goodness of fit. A treatment by day interaction was used for sow data while a treatment by sex interaction was used for fetal data. Alpha level was 0.05.

Results

Dietary treatment did not influence gestational BW ($P \geq 0.99$), SQ fat depth ($P \geq 0.09$), blood chemistry ($P \geq 0.21$), or serum concentrations ($P \geq 0.07$). Dietary treatment did not influence sow tissue weight ($P \geq 0.42$). Compared with CON, BEEF fetuses had greater fetal BW ($P = 0.01$), crown to rump length ($P = 0.01$), nose to crown length ($P < 0.01$), heart girth ($P = 0.02$), and abdominal girth ($P = 0.05$). Dietary treatment did not influence fetal growth characteristics of median weight male and female fetuses ($P \geq 0.23$). Compared with BEEF, SUCR fetuses had heavier liver weights (31.43 ± 2.06 and 40.13 ± 2.09, respectively; $P = 0.04$). There was a dietary treatment by sex interaction for fetal kidney weight with BEEF males having lighter kidney weights compared with all other interactions ($P = 0.03$). Dietary treatment did not influence any other fetal tissue weight ($P \geq 0.09$).

Conclusion

Beef and/or sucrose supplementation during mid-to-late gestation has minimal effects on swine maternal health and fetal development. Differences in fetal liver and kidney weights should be examined further. Further research is needed to determine the effect of gestational supplementation on human health and development.