Early Puberty in Our Girls: Is it really the beef?

NDSU Beef College
Eric Berg
The #1 question I am asked

So... What do you do for a living? Ugh
The #2 question I am asked

Are the hormones in meat making girls reach puberty early?
What does the science say?

- Young American girls are reaching the onset of puberty at an earlier age.
- The trigger for precocious puberty can be a complex interaction between genetics, hormones, and environmental factors including contact with industrial chemicals, pesticides, estrogen-containing cosmetics, and phytoestrogens.

What does the science say?

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NDSU NORTH DAKOTA STATE UNIVERSITY
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- Vegetable-based diets

What is the physiological link?
HYPOTHESIS

• Pre-pubertal gilts are a suitable biomedical model for young human females to assess pre-pubertal diet on attainment of puberty

• Beef obtained from estrogenic implanted cattle during feedlot finishing does not alter the timing of puberty compared those fed non-implanted “natural” beef, or tofu
OBJECTIVE

• Determine if pre-pubertal gilts supplemented ground beef from estrogenic implanted steers possess altered sex-hormone blood profiles and reach sexual maturity sooner than contemporaries receiving a nutritionally similar diet containing “natural” beef or tofu
MATERIALS & METHODS – Pigs

• 33 crossbred gilts (18 d of age) selected on same birth date

• Common sire (Danbred 610) and dam line (Danbred 241)
  – Progressive Swine Technol. (St. Edward, NE)

• 24 pigs (54 d of age) randomly assigned to individual pens based on uniformity of littermates & BW (24.5 ± 3.2 kg)
MATERIALS & METHODS – Diets

• Base diet: corn/canola base
  – Limit fed 3.7% BW
MATERIALS & METHODS – Diets

- **TOFU**: 198 g cooked tofu
- **IMP**: 113 g hamburger from a steer implanted twice with Synovex Choice™
  - 100 mg TBA & 14 mg of 17β-estradiol
- **NAT**: 113 g hamburger from a non-implanted steer
- **CON**: no supplement
MATERIALS & METHODS – Data

• Daily feed intake & weekly BW recorded
• Blood samples collected once a week at 24 kg & then twice weekly at 68 kg
MATERIALS & METHODS – Estrus Detection

- At 90 kg, gilts co-mingled in a community pen for 30 min where visual signs of estrus were monitored
- Visual estrus confirmed chemically; circulating progesterone >1 ng/mL
- After first visual estrus, gilts were humanely harvested
MATERIALS & METHODS – Estrogenicity

• Estrogenic activity determined by E-Screen
  – In vitro assay
  – Assesses estrogen-dependent proliferation of human mammary epithelial cell line (MCF7-BOS)
    • Obtained from the laboratory of Drs. Anna Soto & Carlos Sonnenschein, Tufts University School of Medicine, Boston, MA
MATERIALS & METHODS – Statistics

• Treatment effects were analyzed for
  – Growth performance
  – Carcass composition
  – Days to puberty attainment

• Treatment was the fixed effect, litter the random variable, & gilt the experimental unit

• Statistical significance was set at P < 0.05.
Compositional analysis (%) of supplemental dietary treatments

<table>
<thead>
<tr>
<th></th>
<th>Treatments¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NAT</td>
</tr>
<tr>
<td>Raw patty weight, g</td>
<td>113.00</td>
</tr>
<tr>
<td>Cooked patty weight², g</td>
<td>64.00</td>
</tr>
<tr>
<td>DM (as-fed), %</td>
<td>44.61</td>
</tr>
<tr>
<td>Estradiol equivalents, ng/kg supplement (as fed)³</td>
<td>10 ± 3.4</td>
</tr>
</tbody>
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**Nutritional composition, %**

<table>
<thead>
<tr>
<th></th>
<th>NAT</th>
<th>IMP</th>
<th>SOY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>75.00</td>
<td>85.68</td>
<td>57.99</td>
</tr>
<tr>
<td>Crude fat</td>
<td>19.81</td>
<td>9.74</td>
<td>24.24</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.08</td>
<td>0.07</td>
<td>0.82</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.58</td>
<td>0.63</td>
<td>0.90</td>
</tr>
<tr>
<td>Gross energy, Mcal/kg</td>
<td>6.20</td>
<td>5.68</td>
<td>6.03</td>
</tr>
</tbody>
</table>
Daily Human Estrogen Production

- 480,000ng Non-pregnant Women
- 136,000ng Normal Adult Male
- 41,500ng Boys (before puberty)
- 54,000ng Girls (before puberty)

Source: Hoffman & Drew, 2015. (Presented as the amount per day of estrogen in the female and male adult cycles.

1 ng/3oz serving would be the same ratio as 1 corn kernel in 1279 semi-truck loads of corn (assumes 72,800 kernels/bushel and 900 bushels/semi truck load)

Using the same corn analogy...

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Daily Estrogen Production</th>
<th>1 ng = 1 kernel of corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pubertal Male</td>
<td>41,500 ng</td>
<td>6.6 bushel</td>
</tr>
<tr>
<td>Adult Male</td>
<td>136,000 ng</td>
<td>1.9 bushels</td>
</tr>
<tr>
<td>Adult Female</td>
<td>480,000 ng</td>
<td>6.6 bushels</td>
</tr>
<tr>
<td>Pregnant Female</td>
<td>20,000,000 ng</td>
<td>274.7 bushels</td>
</tr>
</tbody>
</table>

Measures
- 2.2 pounds (lb) = 1 kilogram (kg)
- 1 kilogram (kg) = 1000 grams (g)
- 1 gram = 1,000,000,000 nanograms (ng)

Estrogen Content of Foods

- 20,000 ng E2 ultra-low dose birth control

Food Product

- Beef, non-implanted steer
- Beef, estradiol-implanted steer
- Milk
- Peas
- Wheat germ oil
- Cabbage
- Eggs
- Soybean oil

Source: Adapted from Hormone Working Party of Animal Health Register
Estradiol equivalence (ng) for treatments across four dietary phases ($E_2$Eq/Kg BW)
- Avg body wt (kg)
- Loin muscle area (LMA; cm²)
- 10th rib fat depth (BF, cm)
Days of age and standard error of gilts at first observed heat (estrus)

No Diff; P = 0.55
NDSU Research - RESULTS

Uterine weight (grams) per pound BW & days of age at slaughter

![Bar chart showing uterine weight results for different groups.](image-url)
NDSU Research - RESULTS
Conclusions

- Consumption of beef obtained from cattle that had received Synovex Choice did not alter the timing of puberty or body composition of gilts used in this study.
- Accepting gilts as a viable bio-medical model for human girls, we conclude that daily consumption of one beef serving early in physiological development does not lead to precocious puberty.
Acknowledgements

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