EFFECTS OF SHORT-TERM OILSEED SUPPLEMENTATION ON PLASMA FATTY ACID COMPOSITION IN LACTATING BEEF COWS

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Introduction

• The results of short-term increases in energy, termed “flushing” have long been known to be beneficial to reproduction in sheep (Perkins, 1984; Nottle et al., 1997)

• Flushing cattle has been shown to be equivocal (Perkins, 1984)
  - Embryo quality was improved (Nolan et al., 1998)
  - Did not influence follicular growth or any other reproductive parameter measured (Dunne et al., 1999; Mackey et al., 1999)
Introduction

• Supplementation of fat can influence energy status and subsequent plasma fatty acids.

• Observed difference in short time frame
  – Plasma fatty acids differ within 7 days of initiation of dietary treatment (Filley et al., 1999; Scholljegerdes et al., 2006)

• Of particular importance to reproduction is linoleic acid (18:2\(n-6\)), which is the precursor to the 2-series prostaglandins.
Introduction

- An increase in dietary $18:2n-6$ will increase PGF$_2\alpha$ production (Lammoglia et al., 1997; Filley et al., 1999; Grant et al., 2005)
  - May negatively influence embryonic survival (Mattos et al., 2003; Hess et al., 2005)

- Linolenic acid ($18:3n-3$) can inhibit $20:4n-6$ production and thereby decrease the formation of PGF$_2\alpha$ (Mattos et al., 2000)

- Rolled flaxseed (source of $18:3n-3$) or rolled sunflower seed (source of $18:2n-6$) fed for 8 weeks starting 28 days prior to the breeding season (Ambrose et al., 2006)
  - Early pregnancy loss (32 to 90 d) of 4.8% and 11.4% for cows fed flaxseed versus sunflower seeds, respectively
Introduction

• Timed AI is becoming increasingly attractive to livestock producers because of the reduction in labor requirements associated with heat detection
  – AI conception rates are generally lower than protocols using heat detection

• Therefore development of a short-term feeding program that coincides with a timed AI protocol may help increase AI conception rates
Objective

To evaluate the efficacy of a short-term increase in dietary energy and essential fatty acids around the time of AI until maternal recognition of pregnancy on plasma fatty acid concentrations over time in lactating beef cows grazing summer range
Materials and Methods

• 24 multiparous cows (initial BW = 512 kg; BCS = 5.5)
  – Confirmed cyclic via ultrasound and serum P4
• 6 ruminally cannulated heifers (initial BW = 523 kg)
• Randomly allotted to three treatments
  – Control = Grazing only
  – Soybean = Grazing plus whole soybeans-based supplement fed at 0.57% of BW
  – Flaxseed = Grazing plus whole flaxseed-based supplement fed at 0.52% of BW
Experiment Timeline

Select Synch + CIDR & TAI

- Start Supplementation
- GnRH
- PGF$_2$$\alpha$
- CIDR®
- 72 hr Heat detect and breed
- d 0 d 7 d 10 d 28
- GnRH
- TAI
- Blood collections
- d 28
- End Supplementation
Forage DM intake
Con vs. Suppl. $P = 0.05$

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Soybeans</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb/d</td>
<td>17.8</td>
<td>15.3</td>
<td>15.0</td>
</tr>
</tbody>
</table>
Total DM intake
Con vs. Suppl. $P = 0.01$

- Control: 17.8 lb/d
- Soybeans: 22.5 lb/d
- Flaxseed: 21.5 lb/d
Average Daily Gain
Con vs. Suppl. $P = 0.01$

- **Control Soybeans Flaxseed**
  - Control: 1.28 lb/d
  - Soybeans: 1.83 lb/d
  - Flaxseed: 2.43 lb/d
18:2\textit{n-6} Intake

Con vs. Suppl. $P < 0.001$
Flax vs. Soybean $P < 0.001$

<table>
<thead>
<tr>
<th></th>
<th>g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>17.7</td>
</tr>
<tr>
<td>Soybeans</td>
<td>224.6</td>
</tr>
<tr>
<td>Flaxseed</td>
<td>83.9</td>
</tr>
</tbody>
</table>
Plasma 18:2\textit{n}-6

Maternal recognition of pregnancy

Stopped supplementation

TAI

CON  WSB  FLX

Days of experiment

mg 18:2\textit{n}-6 / g of freeze-dried plasma
18:3\textit{n}-3 Intake

Con vs. Suppl. $P < 0.001$
Flax vs. Soybean $P < 0.001$

- **Control**: 27.9 g/d
- **Soybeans**: 26.4 g/d
- **Flaxseed**: 173.6 g/d
**Plasma 18:3n-3**

- **CON**
- **WSB**
- **FLX**

- **Maternal recognition of pregnancy**
- **Stopped supplementation**
- **TAI**

**Day of experiment**

- **mg of 18:3n-3 / g of freeze dried plasma**

- **0**  |  **3**  |  **6**  |  **9**  |  **12**  |  **15**  |  **18**  |  **21**  |  **24**  |  **27**  |  **30**  |  **33**  |  **36**  |  **39**  |  **42**  |  **45**  |  **48**  |  **51**  |  **54**  |  **57**  |  **60**  |  **63**  |  **66**  |  **69**  |  **72**  |  **75**  |  **78**  |  **81**  |  **84**  |  **87**  |  **90**  |  **93**  |  **96**  |  **99**  |  **102**  |  **105**  |  **108**  |  **111**  |  **114**  |  **117**  |  **120**  |  **123**  |  **126**  |  **129**  |  **132**  |  **135**  |  **138**  |  **141**  |  **144**  |  **147**  |  **150**  |  **153**  |  **156**  |  **159**  |  **162**  |  **165**  |  **168**  |  **171**  |  **174**  |  **177**  |  **180**  |  **183**  |  **186**  |  **189**  |  **192**  |  **195**  |  **198**  |  **201**  |  **204**  |  **207**  |  **210**  |  **213**  |  **216**  |  **219**  |  **222**  |  **225**  |  **228**  |  **231**  |  **234**  |  **237**  |  **240**  |  **243**  |  **246**  |  **249**  |  **252**  |  **255**  |  **258**  |  **261**  |  **264**  |  **267**  |  **270**  |  **273**  |  **276**  |  **279**  |  **282**  |  **285**  |  **288**  |  **291**  |  **294**  |  **297**  |  **300**  |  **303**  |  **306**  |  **309**  |  **312**  |  **315**  |  **318**  |  **321**  |  **324**  |  **327**  |  **330**  |  **333**  |  **336**  |  **339**  |  **342**  |  **345**  |  **348**  |  **351**  |  **354**  |  **357**  |  **360**  |  **363**  |  **366**  |  **369**  |  **372**  |  **375**  |  **378**  |  **381**  |  **384**  |  **387**  |  **390**  |  **393**  |  **396**  |  **399**  |  **402**  |  **405**  |  **408**  |  **411**  |  **414**  |  **417**  |  **420**  |  **423**  |  **426**  |  **429**  |  **432**  |  **435**  |  **438**  |  **441**  |  **444**  |  **447**  |  **450**  |  **453**  |  **456**  |  **459**  |  **462**  |  **465**  |  **468**  |  **471**  |  **474**  |  **477**  |  **480**  |  **483**  |  **486**  |  **489**  |  **492**  |  **495**  |  **498**  |  **501**  |  **504**  |  **507**  |  **510**  |  **513**  |  **516**  |  **519**  |  **522**  |  **525**  |  **528**  |  **531**  |  **534**  |  **537**  |  **540**  |  **543**  |  **546**  |  **549**  |  **552**  |  **555**  |  **558**  |  **561**  |  **564**  |  **567**  |  **570**  |  **573**  |  **576**  |  **579**  |  **582**  |  **585**  |  **588**  |  **591**  |  **594**  |  **597**  |  **600**  |  **603**  |  **606**  |  **609**  |  **612**  |  **615**  |  **618**  |  **621**  |  **624**  |  **627**  |  **630**  |  **633**  |  **636**  |  **639**  |  **642**  |  **645**  |  **648**  |  **651**  |  **654**  |  **657**  |  **660**  |  **663**  |  **666**  |  **669**  |  **672**  |  **675**  |  **678**  |  **681**  |  **684**  |  **687**  |  **690**  |  **693**  |  **696**  |  **699**  |  **702**  |  **705**  |  **708**  |  **711**  |  **714**  |  **717**  |  **720**  |  **723**  |  **726**  |  **729**  |  **732**  |  **735**  |  **738**  |  **741**  |  **744**  |  **747**  |  **750**  |  **753**  |  **756**  |  **759**  |  **762**  |  **765**  |  **768**  |  **771**  |  **774**  |  **777**  |  **780**  |  **783**  |  **786**  |  **789**  |  **792**
Plasma 20:4n-6

CON  WSB  FLX

Maternal recognition of pregnancy

Stopped supplementation

Day of experiment

mg of 20:4n-6 / g of freeze-dried plasma
Plasma Total Fatty Acids

mg of total fatty acids / g of freeze-dried plasma

CON  WSB  FLX

Stopped supplementation

Day of experiment

0  3  6  9  12  15  18  21  24  27  30  33  36  39  42  45  48  51  54  57
AI Pregnancy Rate

\[ P = 0.84 \]

- Control: 62.5%
- Soybeans: 75.0%
- Flaxseed: 62.5%
Overall Pregnancy Rate

\[ P = 0.77 \]

- Control: 75.0%
- Soybeans: 87.5%
- Flaxseed: 87.5%
Conclusions

- Additional fat reduced forage intake
- Cow performance was improved with fat supplementation
- Supplemental whole soybeans increased plasma 18:2\textit{n-6}
- Supplemental whole flaxseed increased plasma 18:3\textit{n-3}
Conclusions

• Supplemental whole soybeans increased fatty acid concentrations in the plasma earlier than whole flaxseed

• Plasma arachidonic acid was greater in cows fed whole flaxseed

• Whole soybeans increased total plasma fatty acid concentration by breeding
Implications

• Feeding either whole soybeans or whole flaxseed starting at the beginning of estrous synchronization will increase the supply of key fatty acids known to influence reproduction and improve animal energy status
EFFECTS OF SHORT-TERM OILSEED SUPPLEMENTATION ON PLASMA FATTY ACID COMPOSITION IN HEIFERS

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³NDSU-Dickinson Research and Extension Center, Dickinson ND
Introduction

- **Heifers supplemented with whole sunflower seeds** (Funston et al., 2002)
  - 0, 30, 60 d prior to TAI
  - Four locations (n = 1,014)

- **Diets**
  - Sunflower = 11.6% CP, 7.1% Fat
  - Control = 11.7% CP, 3.4% Fat
AI Pregnancy Rate

$P > 0.10$

Funston et al., 2002
Objective

To evaluate the efficacy of a short-term increase in dietary energy and essential fatty acids around the time of AI until maternal recognition of pregnancy on growth performance and AI conception rates in developing beef heifers fed a forage-based diet.
Materials and Methods

• All heifers were determined to be pubertal using the Heat Watch system prior to initiation of experiment

• 96 cross bred heifers (Initial wt. 870 lbs)
  – Blocked by weight and randomly assigned to 12 pens with 8 heifers per pen and 4 pens per treatment
**Materials and Methods**

Table 1. Initial ingredients and chemical composition of diets provided to heifers

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Soybean</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredient, % as fed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chopped hay</td>
<td>99.7</td>
<td>83.1</td>
<td>86.2</td>
</tr>
<tr>
<td>Pellet&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.3</td>
<td>16.9</td>
<td>13.8</td>
</tr>
<tr>
<td>Chemical composition, DM basis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>91.2</td>
<td>90.9</td>
<td>91.3</td>
</tr>
<tr>
<td>CP</td>
<td>12.5</td>
<td>15.8</td>
<td>15.9</td>
</tr>
<tr>
<td>TDN</td>
<td>59.5</td>
<td>64.9</td>
<td>65.1</td>
</tr>
<tr>
<td>Total fatty acids</td>
<td>0.91</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Ca</td>
<td>0.53</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>P</td>
<td>0.17</td>
<td>0.23</td>
<td>0.24</td>
</tr>
</tbody>
</table>

<sup>1</sup>Estimated based on forages of similar quality.

<sup>2</sup>Pellet composition: Control = 61.1% CaCO3, 30.0% Salt, 6.82% CHS/PN TM-FDLT, 1.5% Mineral oil, 0.53% SCH/PN VT-FDLT; Soybean = 75.8% soybean; 21.0% corn, 2% CaCO3, 1.0% Salt, 0.23% CHS/PN TM-FDLOT, 0.02% CHS/PN VT-FDLT; Flaxseed = 45% flaxseed, 51.7% Soybean meal, 1.9% CaCO3, 1.2% Salt, 0.28% CHS/PN TM-FDLT, 0.02% CHS/PN VT-FDLT.
Heifer Intake
Con vs Supplement $P = 0.03$

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Soybeans</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb/hd/d</td>
<td>24.7</td>
<td>26.9</td>
<td>27.0</td>
</tr>
</tbody>
</table>

P = 0.03
Heifer Gain

$P = 0.72$

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Soybeans</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb</td>
<td>61.7</td>
<td>60.8</td>
<td>62.7</td>
</tr>
</tbody>
</table>
Heifer Average Daily Gain

\( P = 0.94 \)

- **Control**: 2.20 lb/d
- **Soybeans**: 2.17 lb/d
- **Flaxseed**: 2.24 lb/d
Heifer Gain to Feed

\[ P = 0.21 \]

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Soybeans</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb of gain/lb of feed</td>
<td>0.089</td>
<td>0.081</td>
<td>0.083</td>
</tr>
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</table>
AI Pregnancy Rate

$p = 0.42$

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>50.0</td>
</tr>
<tr>
<td>Soybeans</td>
<td>47.3</td>
</tr>
<tr>
<td>Flaxseed</td>
<td>34.5</td>
</tr>
</tbody>
</table>
Overall Pregnancy Rate

Soybean versus Flax $P = 0.12$

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Soybeans</th>
<th>Flaxseed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>91.0</td>
<td>97.0</td>
<td>84.5</td>
</tr>
</tbody>
</table>

Overall Pregnancy Rate

Soybean versus Flax $P = 0.12$
Conclusion

• Feeding fat at 3% of the diet was not enough to increase ADG or G to F

• Overall conception rates did not differ due to large variation
Implication

• Further study is warranted due to the large numerical difference with Soybean in overall pregnancy rates.

• Level of fat should be increased in order to see the benefit of additional energy in growth performance.
Questions