Symposium registration, including three days and two lunches, is $90 if paid prior to Nov. 20.
Overview

• Fascinating
• Popular with those high on the industry
• Best kept technology secret
Study of birth records in UK and Europe

- Women - under-nutrition (400 – 600 cal/d) first half of gestation and adequate subsequently
- Babies - normal birth weight, proportionally longer & thinner
- As adults – increased incidence of diabetes, obesity and cardiovascular disease
The Barker Hypothesis

- Maternal nutrition impacts the fetus’s future growth, development, and risk of disease after birth and into adulthood. (Barker, 1992)
Principles

• Critical periods of fetal development
• Permanent effects that change susceptibility to disease
• Involves structural changes to organs
• Placenta plays key role
• Fetus attempts to compensate

• Fetal cellular mechanisms differ from adult
• Passed on, but does not involve changes in genes (epigenetics)
• Different effects for male and female

From *Life in the Womb: The Origin of Health and Disease* by Peter W. Nathanielsz, M.D., Ph.D.
Figure 1. Effects of maternal nutrition on bovine fetal skeletal muscle development. The dates are estimated mainly based on data from studies in sheep, rodents, and humans and represent the progression through the various developmental stages. Nutrient restriction during midgestation reduces muscle fiber numbers, whereas restriction during late gestation reduces both muscle fiber sizes and the formation of intramuscular adipocytes.
Steer Progeny

No supplement

Protein Suppl (last trimester)

↑ ADG, HCW
↑ marbling score, % choice

Larson et al, 2009

Native pasture

Improved pasture

d 120 -180 of gestation

↑ Wn wt, ADG, HCW

Underwood et al. 2010
Heifer Progeny

No supplement

- No difference
  - Age at puberty
  - Cycling before
  
  Martin et al, 2007

Protein Suppl (last trimester)

- ↑ Weight - adj 205 day, prebreeding, yearling preg check time and as 2 yr olds
- ↑ Final Pregnancy rate
  - ↑ Calved 1st 3 wks
- ↓ Age at puberty
  - Trend higher PR

  Funston et al, 2010

- 100 vs 65 % Energy last 1/3
  - Earlier puberty
  
  Corah et al, 1975

- No diff
  - Hfr wt at prebreeding
  - Calf production or heifer calf rebreeding

100 vs 65 % Energy last 1/3
Earlier puberty
Corah et al, 1975
Animal Health

No supplement

Protein Suppl (last trimester)

100 vs 65% Energy last 1/3
↑ Morbidity and mortality
Corah et al, 1975

Fewer steers treated
Mullinkiks et al 2008
Larson et al 2009

↑ Live calves weaned
Stalker et al 2006

No difference
Treated prior to wean or feedlot, Stalker et al 2006
Respiratory treats prior to weaning, Larson et al 2009
Thrifty phenotype as a result of under-nourished fetus

• Increased appetite
• Prone to insulin resistance and obesity
• Ewes – consumed 50% more feed, no improvement feed efficiency,
• Put on more fat, internal and subcutaneously
Obese Ewes

Fed to normal weight

Maint. Diet during preg

F1 generation

Daughters –
Insulin resistant
↑ Glucose & insulin concentrations

F2 generation

↑ Internal fat
Under-nourished ewes early to mid-gestation

Campus farm flock

- Fetal growth retarded
- Pancreas altered
- Heart enlarged

Nomadic range flock (no supplement)

- Normal fetal growth
- Placenta more efficient

Mid gestation

Adults

- ↑ appetite
- Insulin resistant
- Hypertensive

Normal – adapted to low inputs
Replacement heifer decision tools

• Own cost of production - KSU budget
• NPV spreadsheet – Ag Manager

Livestock decision tools
http://www.agmanager.info/Tools/default.asp#LIVESTOCK

• Comparing Purchasing vs Raising Beef
Replacement Females Spreadsheet
Currently under news on right column at:
http://www.anisci.colostate.edu/beef/index.html
Shifts in heifer development thinking

**Traditional**
- Emphasis on puberty
- Target weight 60 – 65%
- Feedlot system
- Cheap grain, relatively easy to make them fat

**Nontraditional**
- Puberty less of an issue - heifers becoming pregnant on the cow
- Low cost, low gain lower target weight
- Open yearling heifers profitable
## Heifer weight at breeding

<table>
<thead>
<tr>
<th></th>
<th>Low gain (53%)</th>
<th>High Gain (58%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin Wt</td>
<td>469</td>
<td>469</td>
</tr>
<tr>
<td>Winter ADG</td>
<td>1.1</td>
<td>1.41</td>
</tr>
<tr>
<td>Prebreeding wt</td>
<td>636</td>
<td>689</td>
</tr>
<tr>
<td>Prebreeding BCS</td>
<td>5.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cycling</td>
<td>74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>85&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Preg 45 d</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>Preg 2&lt;sup&gt;nd&lt;/sup&gt; calf</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Preg 3&lt;sup&gt;rd&lt;/sup&gt; calf</td>
<td>94</td>
<td>92</td>
</tr>
<tr>
<td>Preg 4&lt;sup&gt;th&lt;/sup&gt; calf</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Funston & Deutscher, 2004
Forage vs Drylot (normal) Development

Average daily gain: kg/d

Salverson et al., 2005
Forage vs Drylot (normal) Development

Average daily gain; kg/day

-2
-1.5
-1
-0.5
0
0.5
1
1.5

May 18 to May 25
May 25 to June 14
June 14 to Aug 13
Aug 13 to Nov 9

**
*

Range
Normal
Effect of 5 lbs DDGs fed 30 days on pasture to heifers after AI

Perry et al, 2011
Effect of grazing prior to synchronization on weight change after AI

Herd 1, 30 d graze

Herd 2 (70 d grazing)

P=0.07

P<0.01

Perry et al, 2011
Effect of grazing prior to synchronization on AI pregnancy success

<table>
<thead>
<tr>
<th></th>
<th>Pasture</th>
<th>Drylot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd 1</td>
<td>50 % (12/24)</td>
<td>46 % (11/24)</td>
</tr>
<tr>
<td>Herd 2</td>
<td>59 % (57/96)</td>
<td>50 % (49/98)</td>
</tr>
<tr>
<td>Total</td>
<td>58 % (69/120)</td>
<td>49 % (60/122)</td>
</tr>
</tbody>
</table>

P = 0.17
Higher pregnancy rates
natural service or AI?

• No difference was detected
6,310 first service natural mating
13,942 first service AI

NZ dairy cattle

Williamson et al., 1978
## Results from on-farm field demonstrations of fixed-time AI in Missouri

<table>
<thead>
<tr>
<th>Item</th>
<th>Herds</th>
<th>Cows inseminated</th>
<th>AI pregnancy rate</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed-time AI</td>
<td>73</td>
<td>7028</td>
<td>4327/7028 (62%)</td>
<td>38 – 86%**</td>
</tr>
</tbody>
</table>

*three handlings with last being AI

** Only 7 of 73 herds realized pregnancy rates < 50% from fixed-time AI

Patterson et al., 2011
Fixed-time AI pregnancy rates in heifers

Perry et al; 2011
Pregnancy rate to fixed-time AI, 8 locations, 4 states, 1538 cows

Hill et al., 2011
Protocol Sheets/Estrus Synchronization Planner

BEEF HEIFER PROTOCOLS - 2011

**HEAT DETECTION**

1 Shot PG

- Heat detect & AI

7-day CIDR®-PG

- Heat detect & AI

MGA®-PG

- Heat detect & AI

**HEAT DETECT & TIME AI (TAI)**

Select Synch + CIDR® & TAI

- Heat detect and AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.

MGA®-PG & TAI

- Heat detect and AI day 33 to 36 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.

14-day CIDR®-PG & TAI

- Heat detect and AI day 30 to 33 and TAI all non-responders 72 hrs after PG with GnRH at TAI.

**FIXED-TIME AI (TAI)**

7-day CO-Synch + CIDR®

- Perform TAI at 54 ± 2 hr after PG with GnRH at TAI.

MGA®-PG

- Perform TAI at 72 ± 2 hr after PG with GnRH at TAI.

14-day CIDR®-PG

- Perform TAI at 66 ± 2 hr after PG with GnRH at TAI.

**COMPARISON OF PROTOCOLS FOR BEEF HEIFERS**

<table>
<thead>
<tr>
<th>HEAT DETECTION</th>
<th>COST</th>
<th>LABOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Shot PG</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>7-day CIDR®-PG</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Low</td>
<td>Low/Medium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEAT DETECT &amp; TAI</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Synch + CIDR®</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>(TAI non-responders 72-84 hr after PG)</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>(TAI non-responders 72-84 hr after PG)</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>14-day CIDR®-PG</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>(TAI non-responders 70-74 hr after PG)</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**FIXED-TIME AI (TAI)**

CO-Synch + CIDR®

- TAI 54 ± 2 hr after PG with GnRH at TAI

MGA®-PG

- TAI 72 ± 2 hr after PG with GnRH at TAI

14-day CIDR®-PG

- TAI 66 ± 2 hr after PG with GnRH at TAI

* The times listed for Fixed-time AI should be considered as the approximate average time of insemination. This should be based on the number of heifers to inseminate, labor, and facilities.
HEAT DETECTION

Select Synch

Select Synch + CIDR®

PG 6-day CIDR®

Heat detect and AI days 0 to 3. Administer CIDR® to non-responders and heat detect and AI days 9 to 12. Protocol may be used in heifers.

HEAT DETECT & TIME AI (TAI)

Select Synch & TAI

Select Synch + CIDR® & TAI

PG 6-day CIDR® & TAI

Heat detect and AI days 0 to 3. Administer CIDR® to non-responders & heat detect and AI days 9 to 12. TAI non-responders 72 - 84 hr after CIDR® removal with GnRH at AI. Protocol may be used in heifers.

COMPARISON OF PROTOCOLS FOR BEEF COWS

<table>
<thead>
<tr>
<th>Protocol Description</th>
<th>Cost</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Synch</td>
<td>Low</td>
<td>Medium/High</td>
</tr>
<tr>
<td>Select Synch + CIDR®</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>PG 6-day CIDR®</td>
<td>Medium</td>
<td>Medium/High</td>
</tr>
</tbody>
</table>

HEAT DETECT & TAI

Select Synch

(TAI non-responders 72-84 hr after PO)

Select Synch + CIDR®

(TAI non-responders 72-84 hr after PO)

PG 6-day CIDR®

(TAI non-responders 72-84 hr after PO)

FIXED-TIME AI (TAI)

7-day CO-Synch + CIDR®

(TAI 60 to 66 hr after PO with GnRH at TAI)

5-day CO-Synch + CIDR®

(TAI 72 ± 2 hr after 1st PG with GnRH at TAI)

Two injections of PG 8 ± 2 hr apart are required for this protocol.

- The times listed for “Fixed-time AI” should be considered as the approximate average time of insemination. This should be based on the number of cows to inseminate, labor, and facilities.

Approved 12-01-10

Beef Reproduction Task Force

CystoMune®, Factrol®, Fertagyl®, OvuCyt®
astroPLAN®, Estrumate®, In-Synch®,
Lutalyse®, ProstaMax®
Products

GnRH

Cystorelin®, Factrel®, Fertagyl®, OvaCyst®

PG

Estrumate®, In-Synch®,
Lutalyse®, ProstaMate®, estroPLAN®

• Make sure to give the correct injection on the day specified in the protocol
• Within product category, all products are equally effective
• Use at label dose
• Follow BQA guidelines for all injections
Features

- Recommended systems for cows & heifers
- Select systems by type
  - Heat detect & AI systems
  - Heat detect & cleanup AI systems
  - Fixed-Timed AI Systems
- List of daily activities
- Generates Barn Calendar
- Cost per AI pregnancy
- Support materials

Now free download updated 2011 version

http://iowabeefcenter.org/estrus_synch.html
Fixed-time AI

45 d natural service breeding season
Proportion calving each day following fixed-time AI

Less than 8 calves per 100 each day

Cumulative Calf % by:
- day 15 = 64%
- day 21 = 70%
- day 30 = 77%
- day 42 = 91%

Schafer, 2005