Supplementing Fat to the Reproducing Beef Female

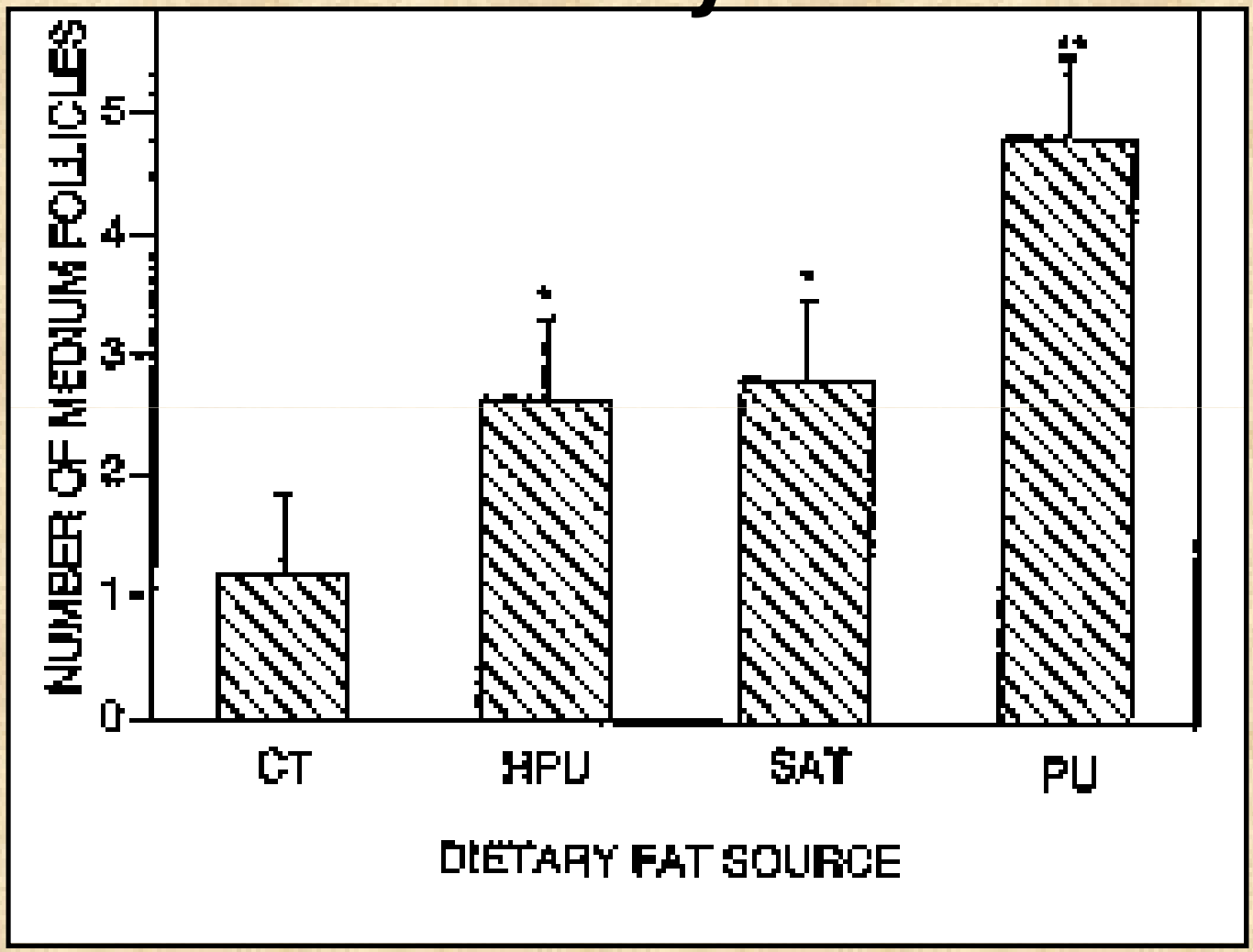
Bret W. Hess

Positive Responses to Supplemental Lipids

Enhanced ovarian follicular growth and function

Increased life span of the corpus luteum

Source of Dietary Fat Affects Follicular Dynamics



Adapted from Thomas et al. (1997)

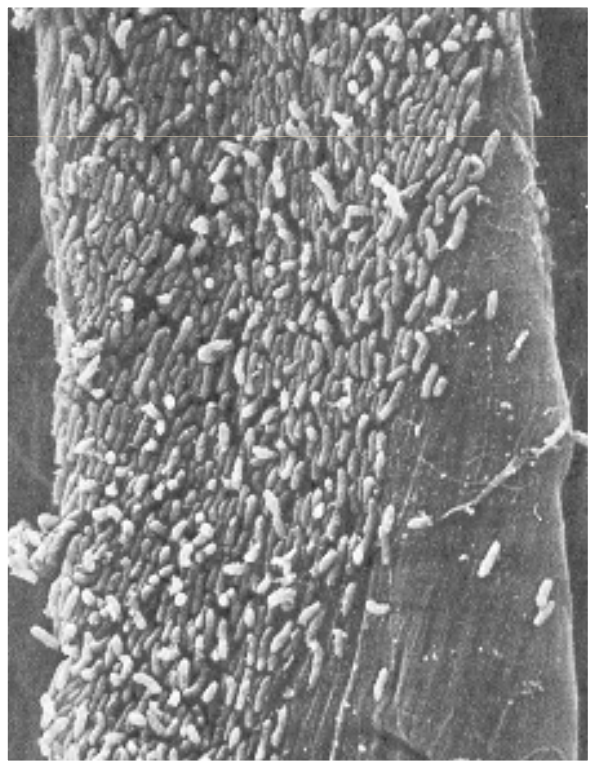
Ruminal Metabolism of Fat

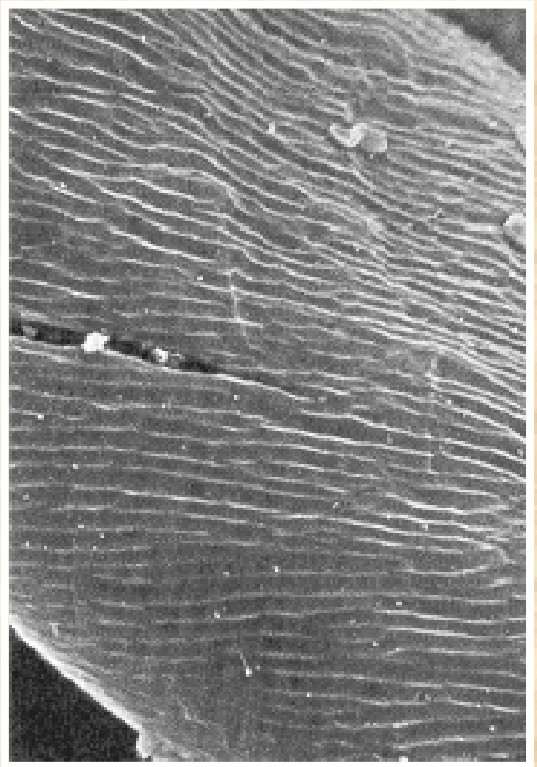
H3C –CH2– COOH

H_2C –O – C18:1

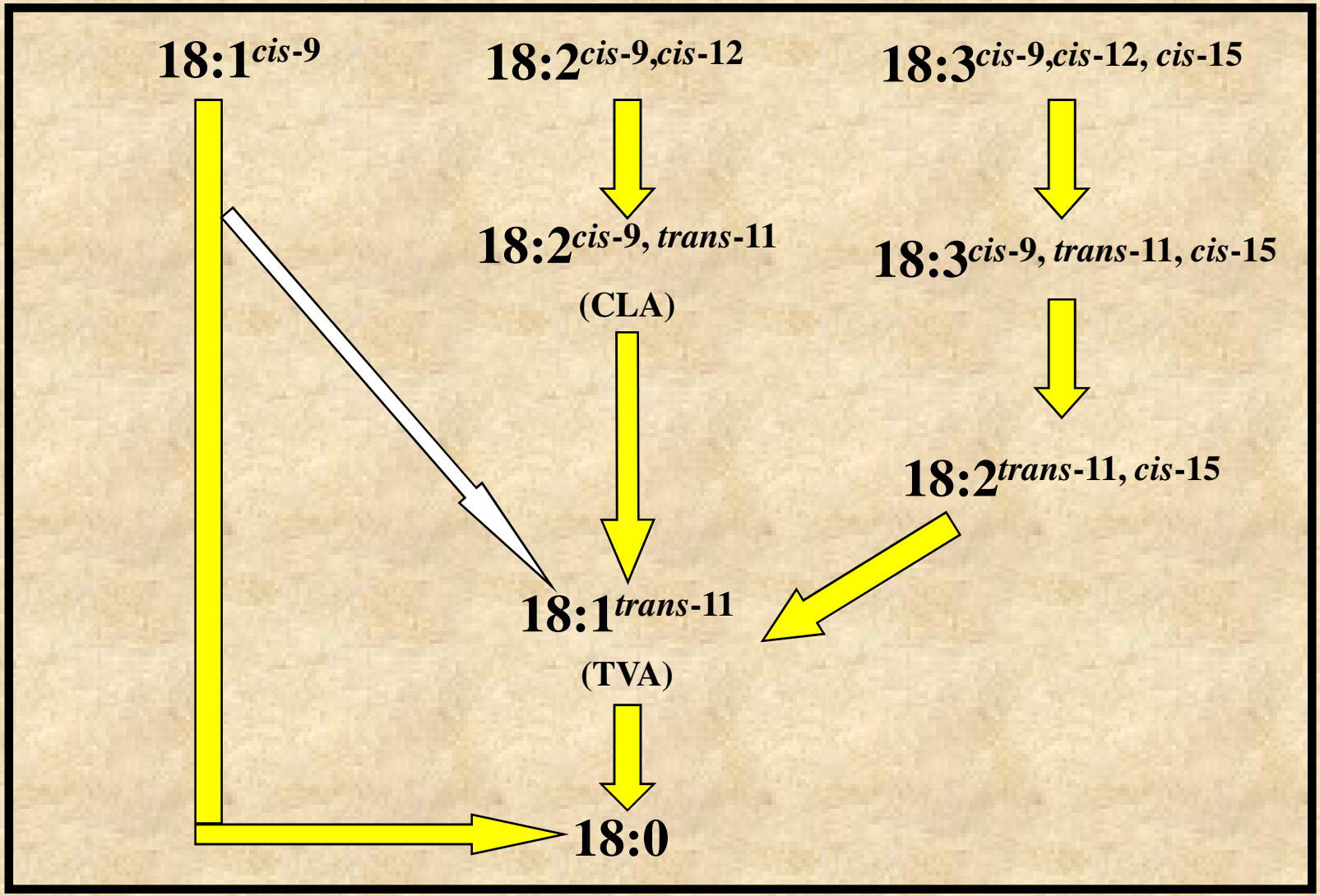
H-C –O – C18:2

H_2C –O – C18:3

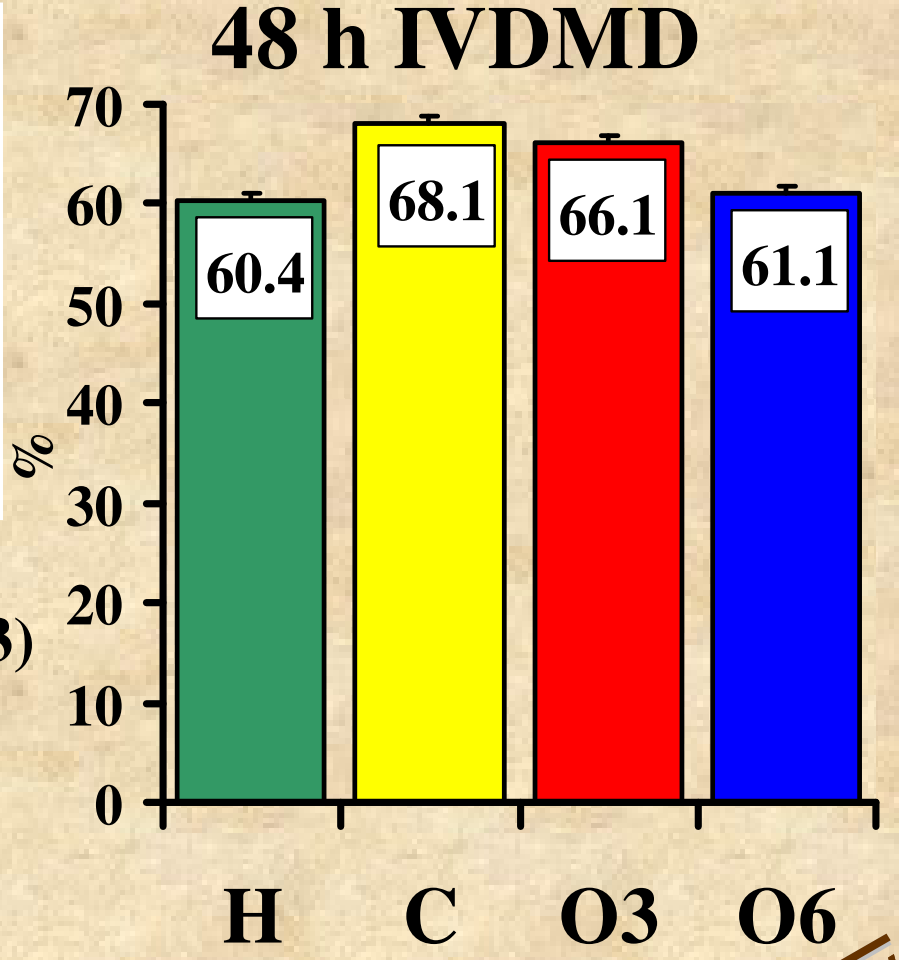




Ruminal Biohydrogenation



Level of Supplemental Fat Affects In Vitro Digestion



Hay vs Supplements ($P = 0.0003$)

Linear ($P = 0.0001$)

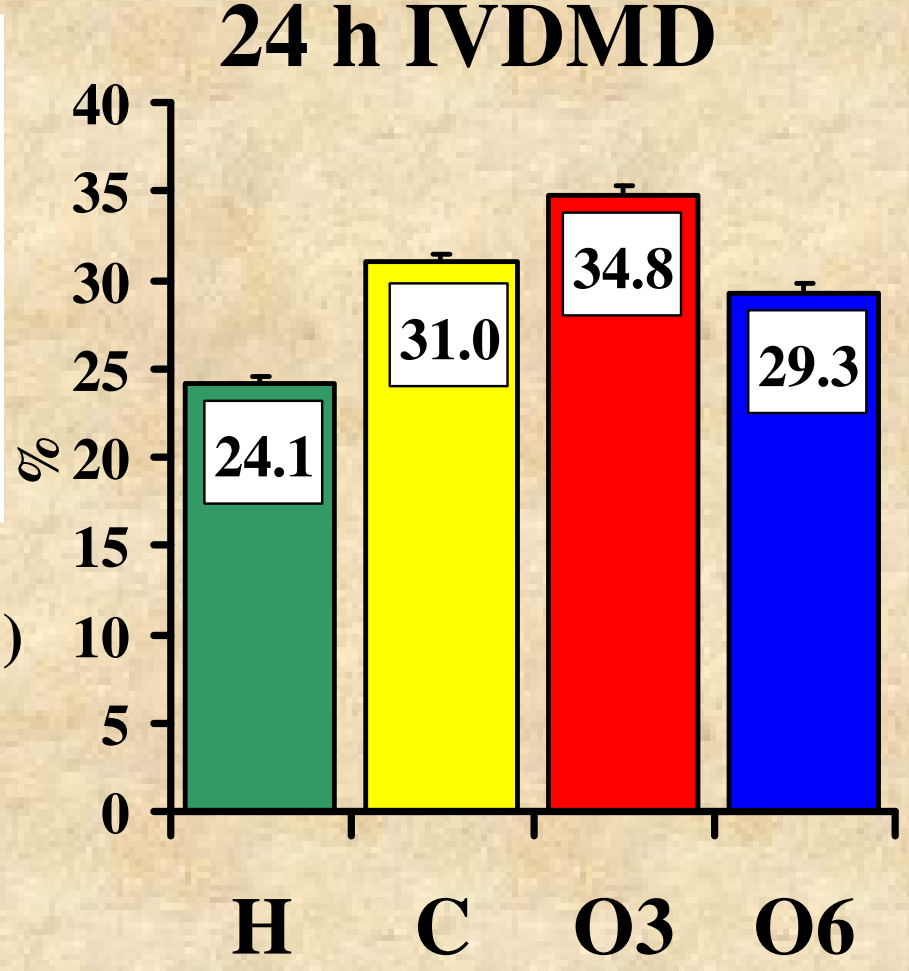
Whitney et al. (2000)

UW

Level of Supplemental Fat Affects In Vitro Digestion

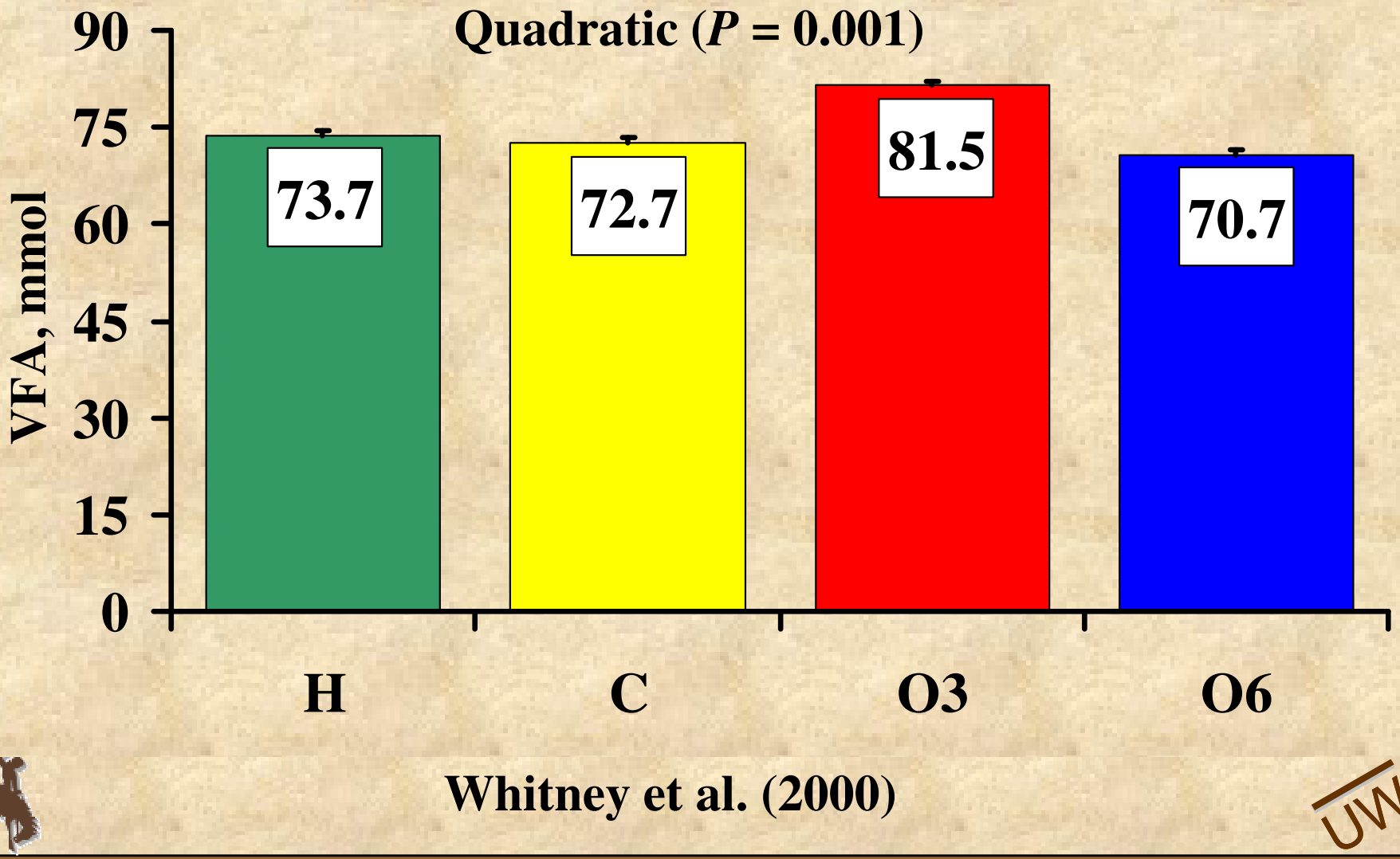
Hay vs Supplements ($P = 0.001$)

Quadratic ($P = 0.001$)

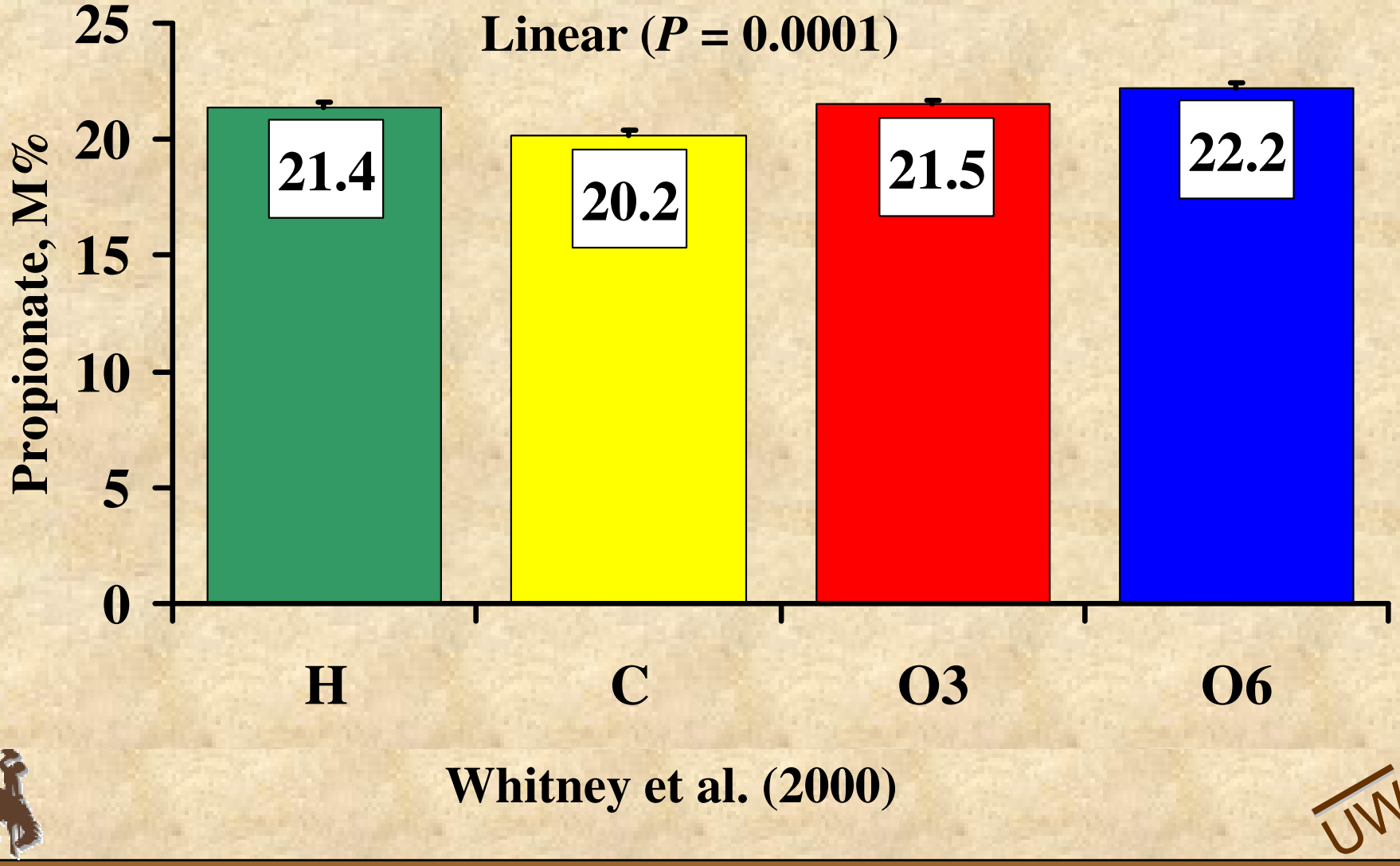


Whitney et al. (2000)

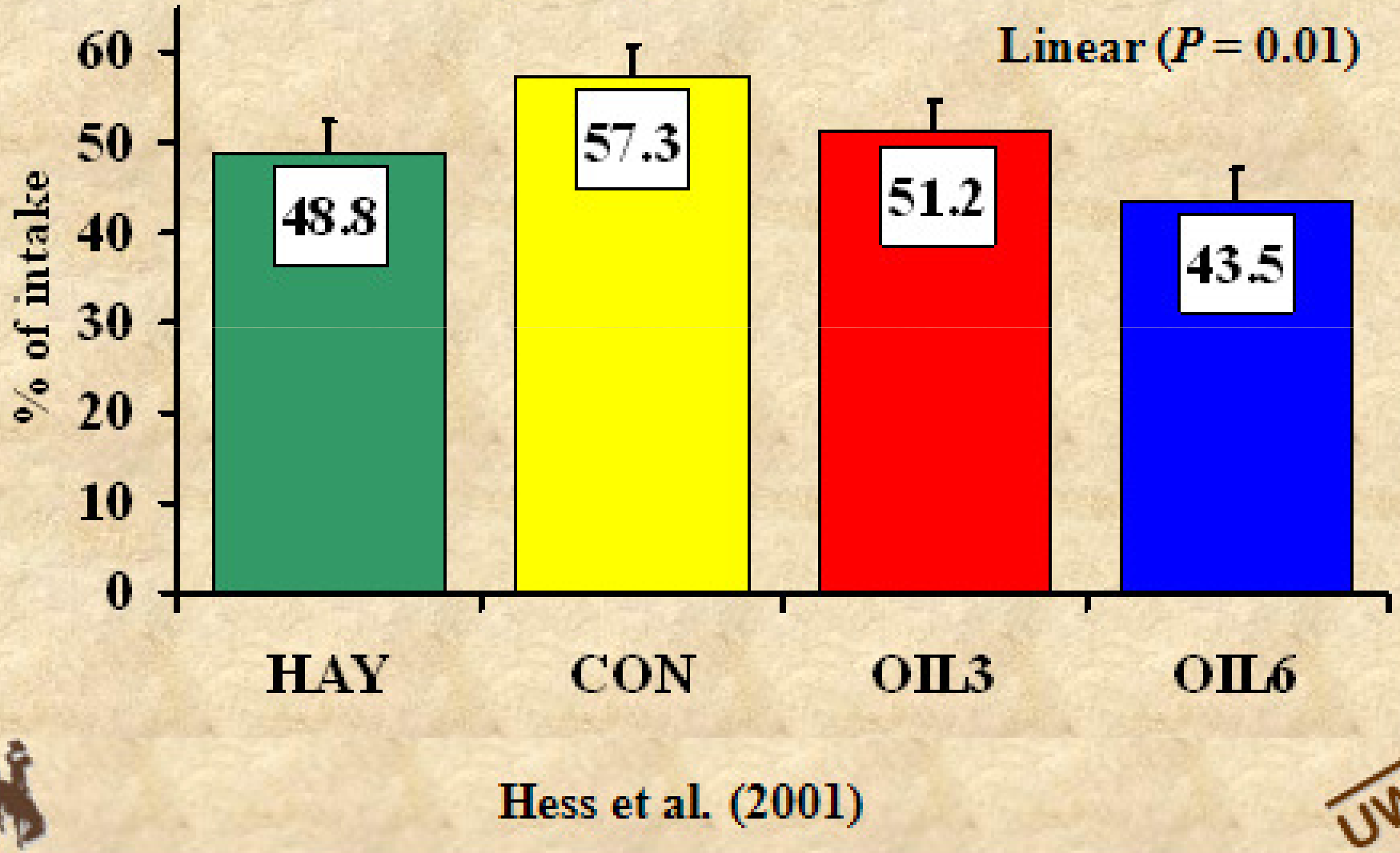
Level of Supplemental Fat Affects In Vitro VFA



Level of Supplemental Fat Affects In Vitro Propionate



Ruminal NDF Digestibility in Heifers Fed Varying Levels of Fat



Hess et al. (2001)

Intake and DE of Straw-Based Diets Supplemented with Fat

Item	Percent added animal fat				
	0	2	4	8	SE[b]
Intake/day					
Dry matter, g/kg body wt$^{.75}$	70.9	78.0	86.8	68.5	4.97
Digestible energy, Mcal	11.5[c]	13.4[cd]	16.1[d]	11.8[c]	.88

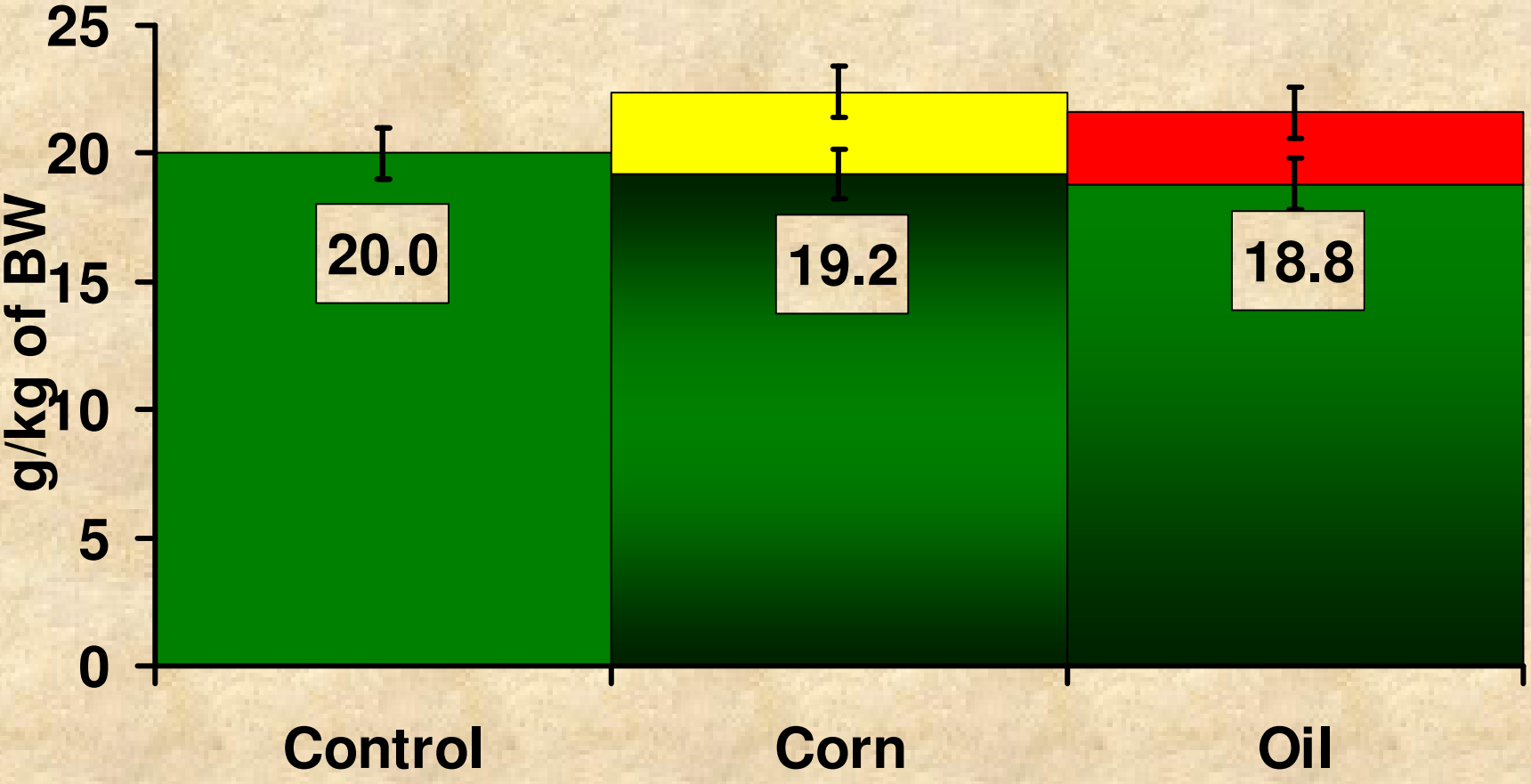
[a]Each value is the mean of three steers.

[b]Standard error of the mean.

[c,d,e,f]Means within a row with superscripts that do not have a common letter differ (P<.05).

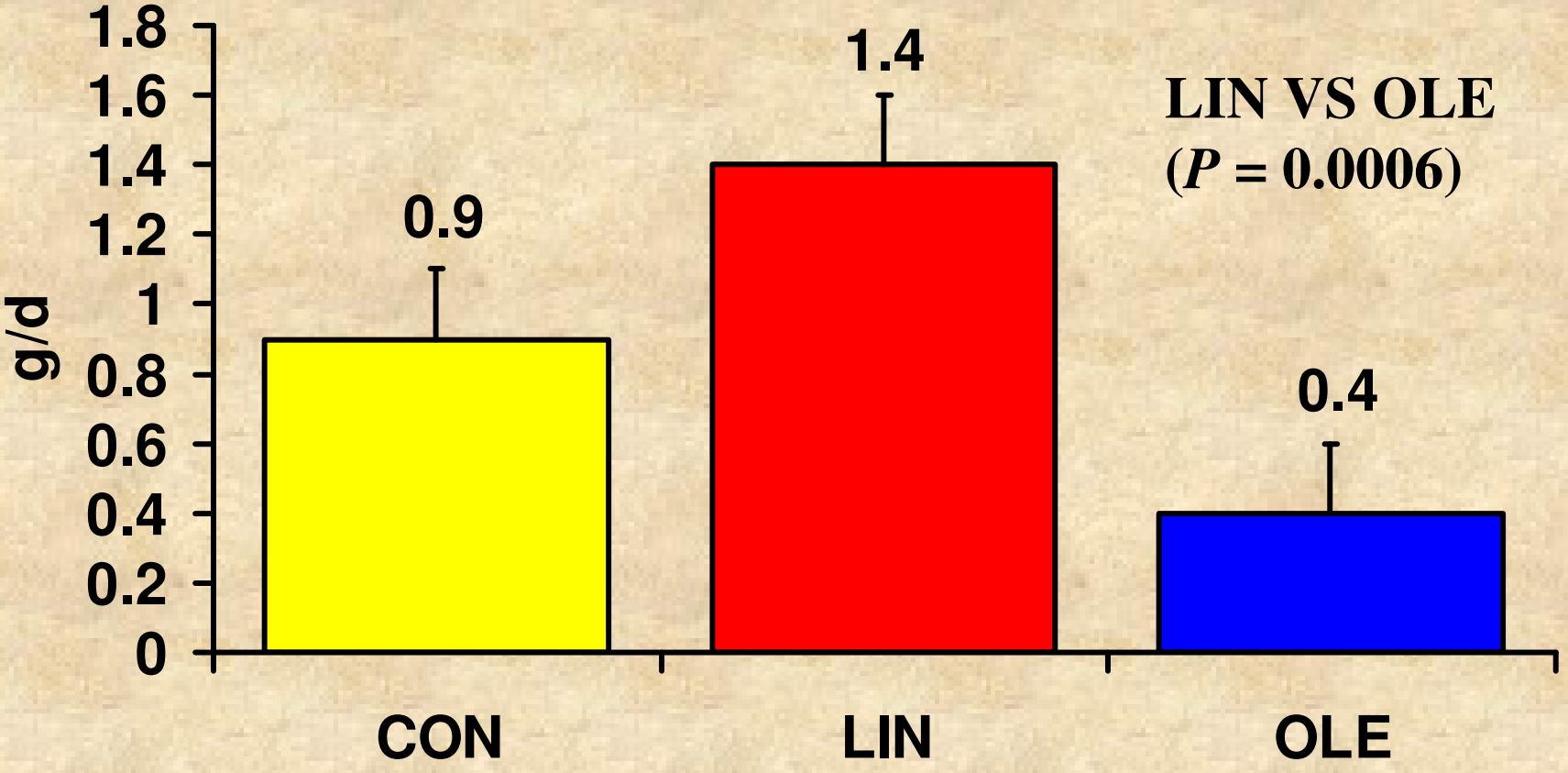
Adapted from Moore et al. (2001)

Forage & Total OM Intake by Heifers Supplemented with Fat



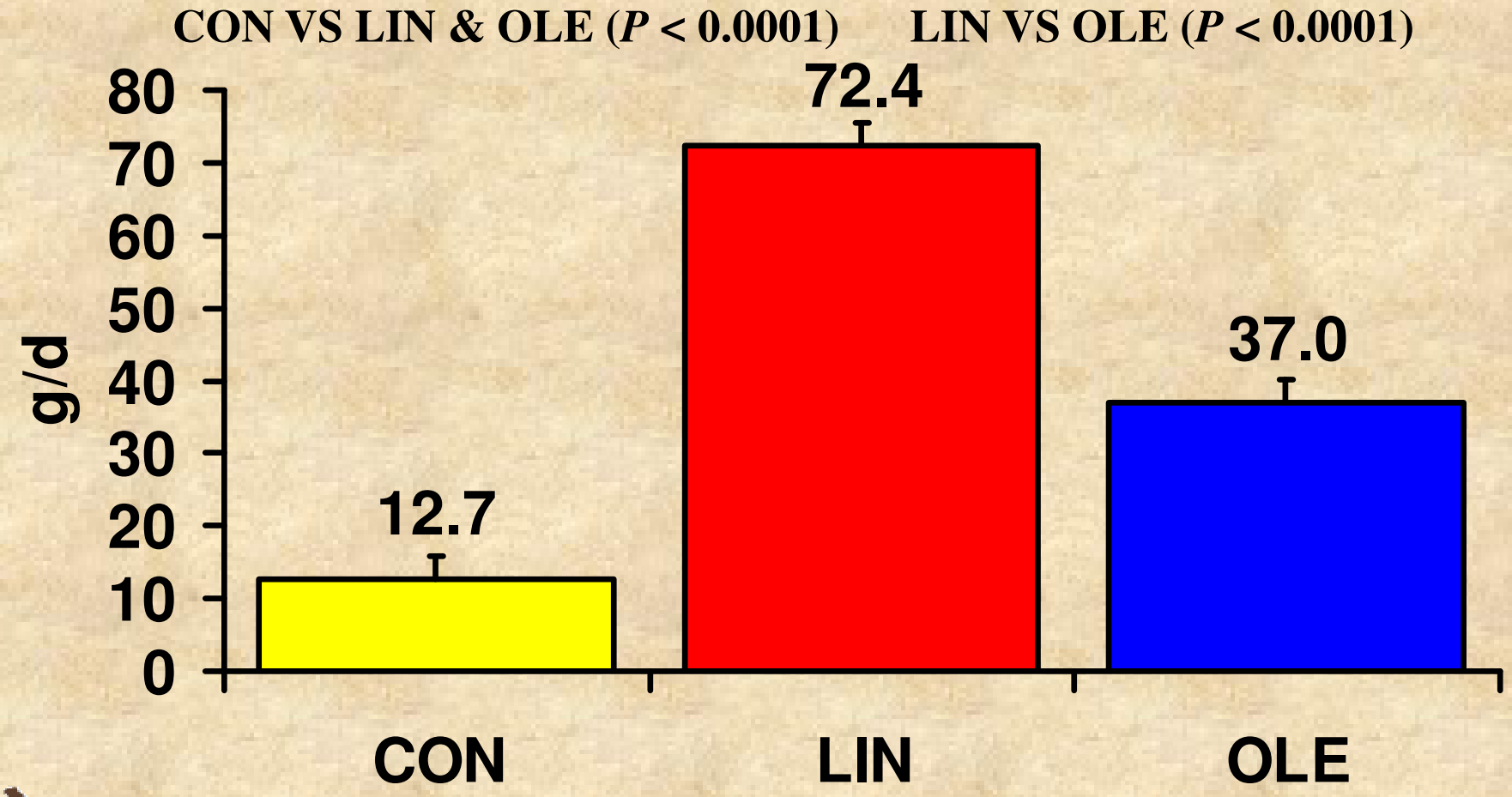
Brokaw et al. (2001)

Flow of CLA to the Duodenum of Cows Fed Fat



Scholljegerdes et al. (2004)

Flow of TVA to the Duodenum of Cows Fed Fat



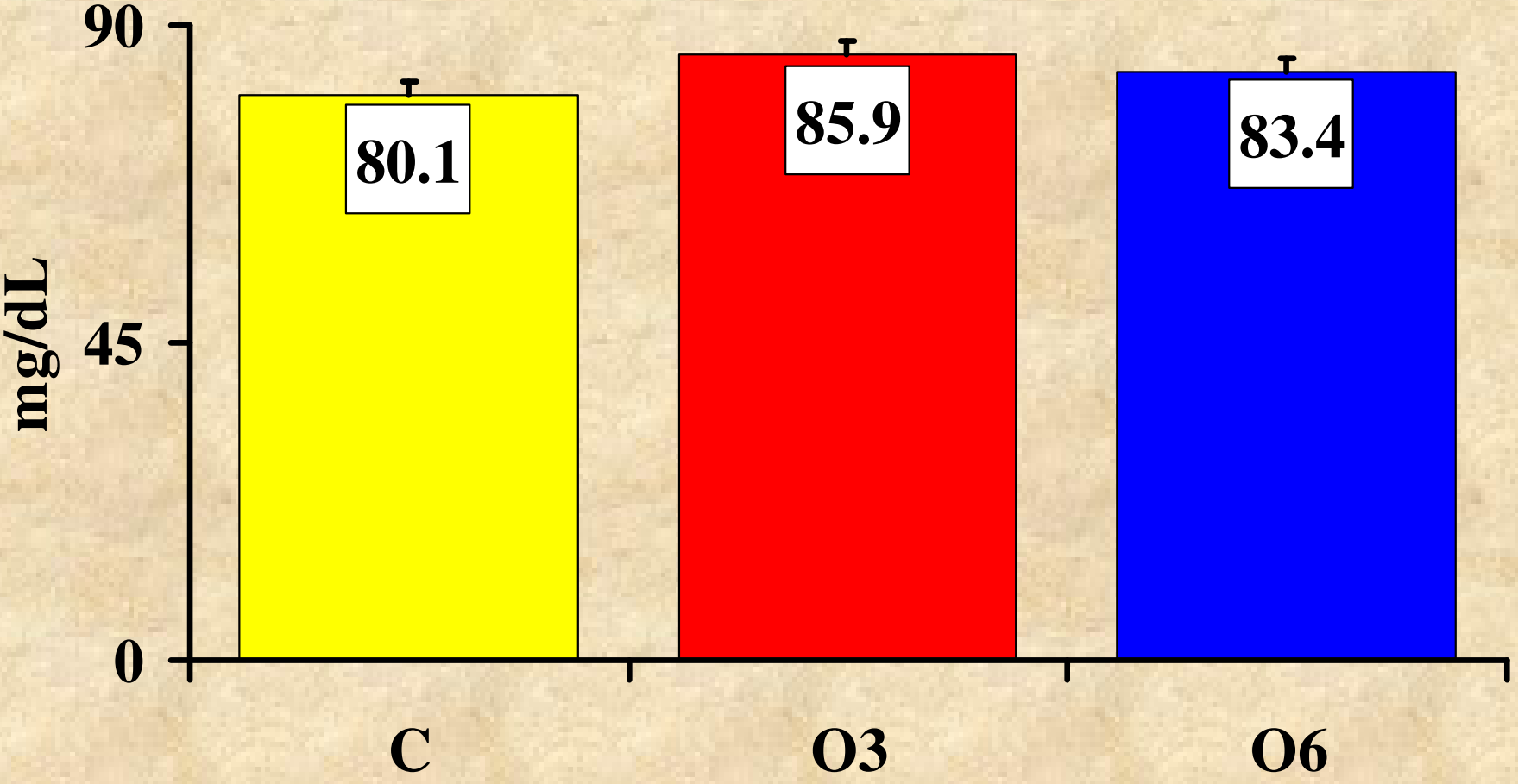
Scholljegerdes et al. (2004)

Supplemental Fat Throughout The Beef Female's Lifecycle

- Replacement Heifers
- Prepartum Cows
- Postpartum Cows

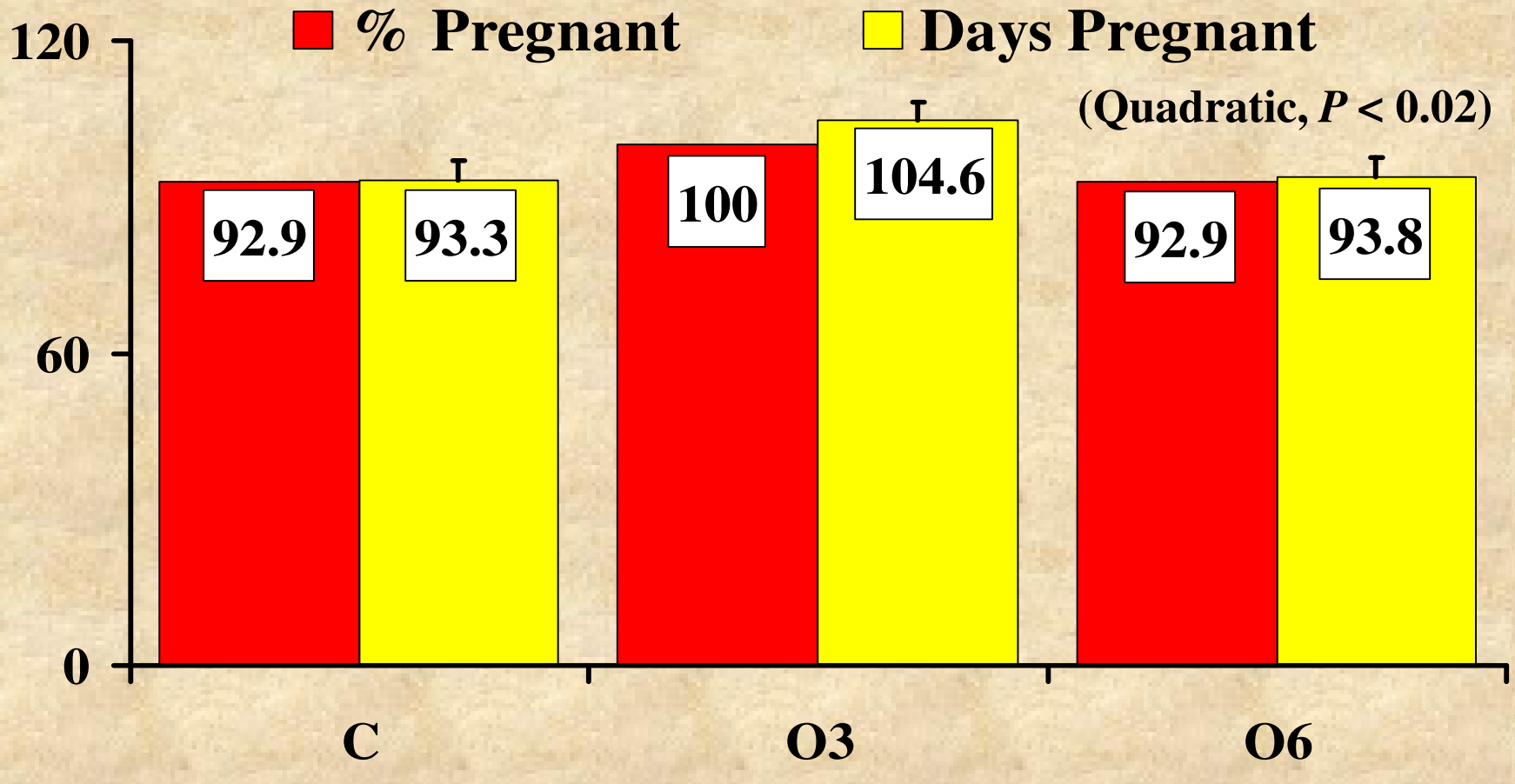
Supplemental Lipids for Replacement Heifers

Serum Glucose in Heifers Fed Varying Levels of Fat



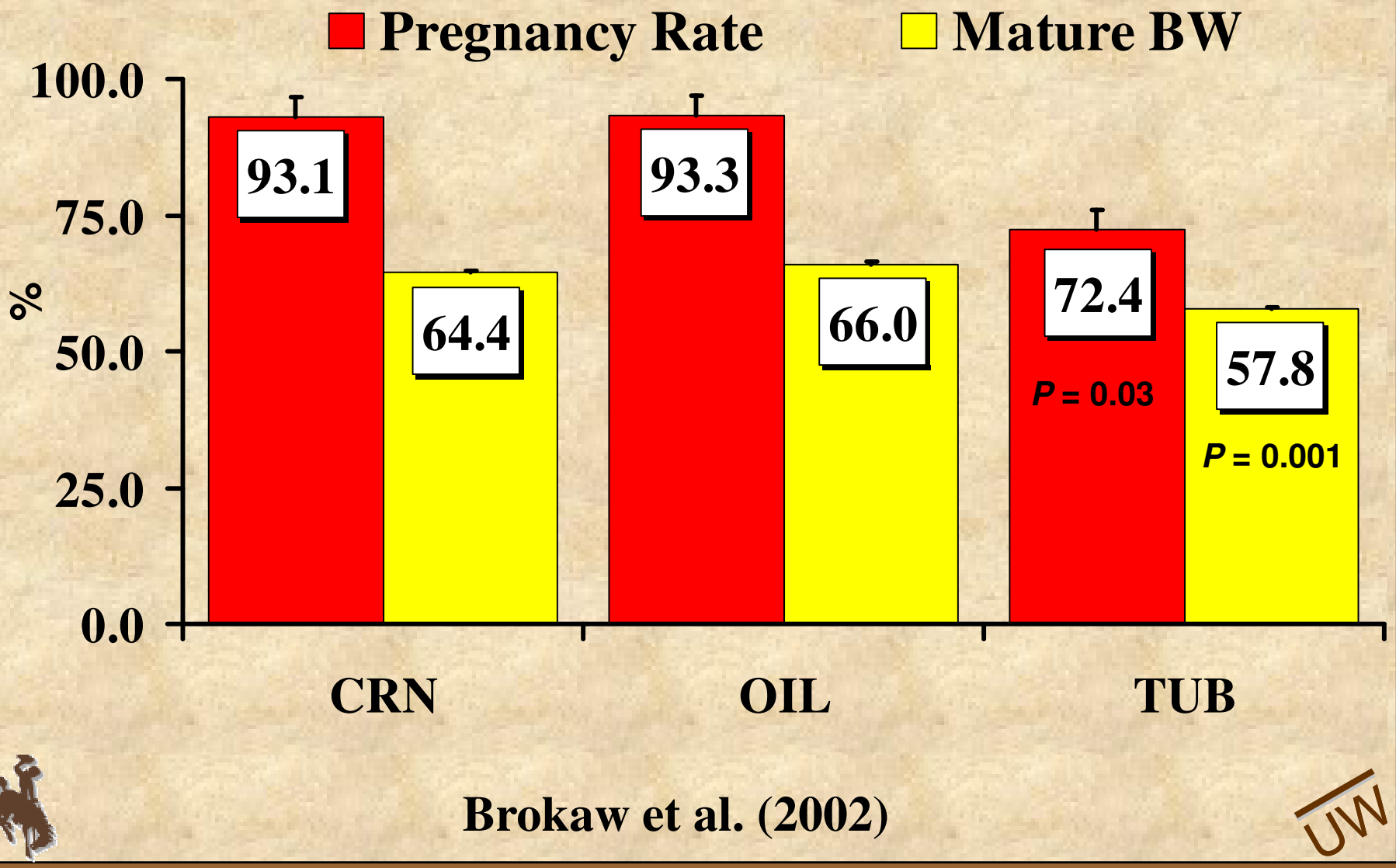
Quadratic ($P = 0.02$); Whitney et al. (2000)

Reproductive Success of Heifers Fed Varying Levels of Fat



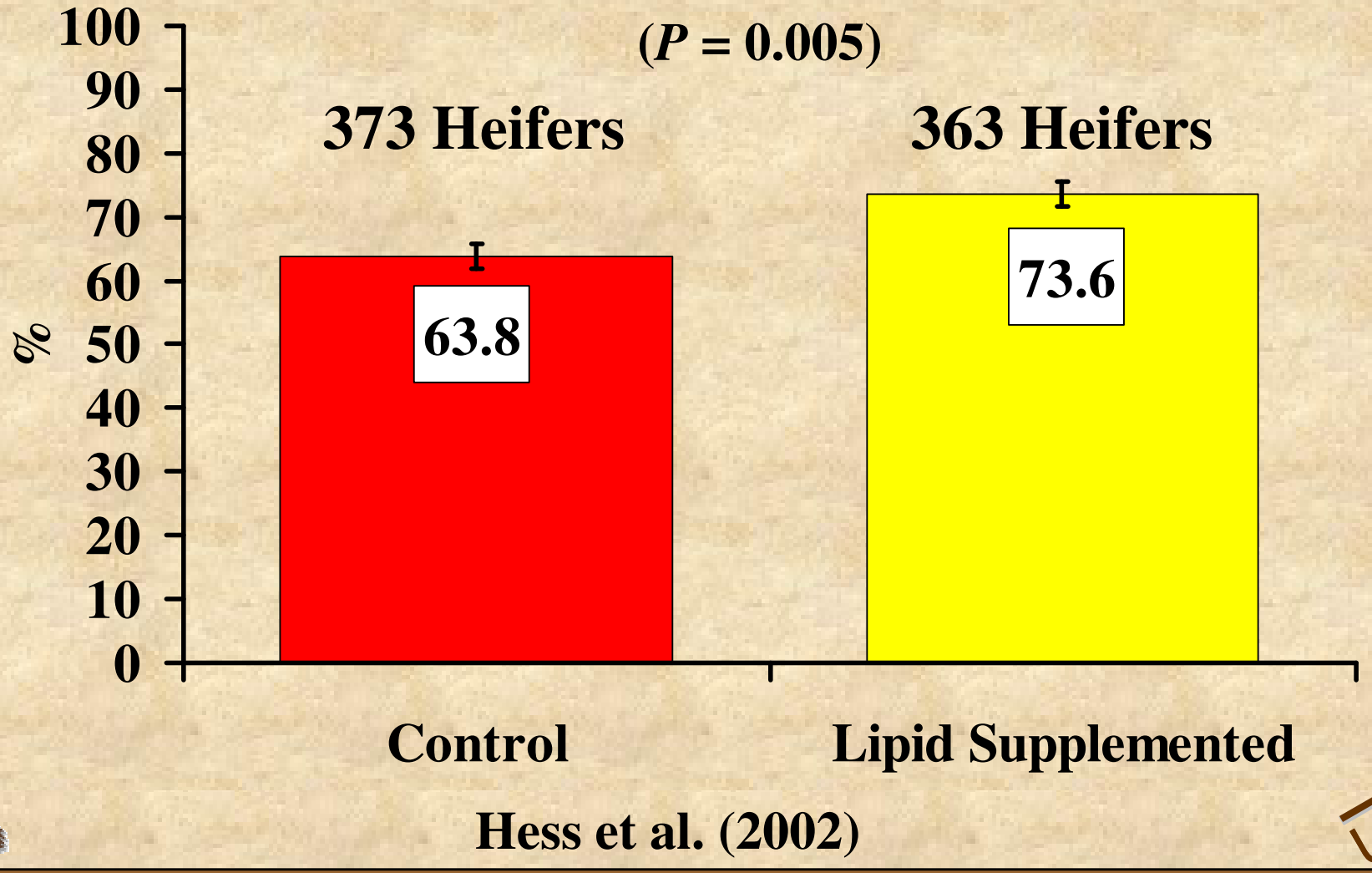
Whitney et al. (2000)

Pregnancy & BW Relationship

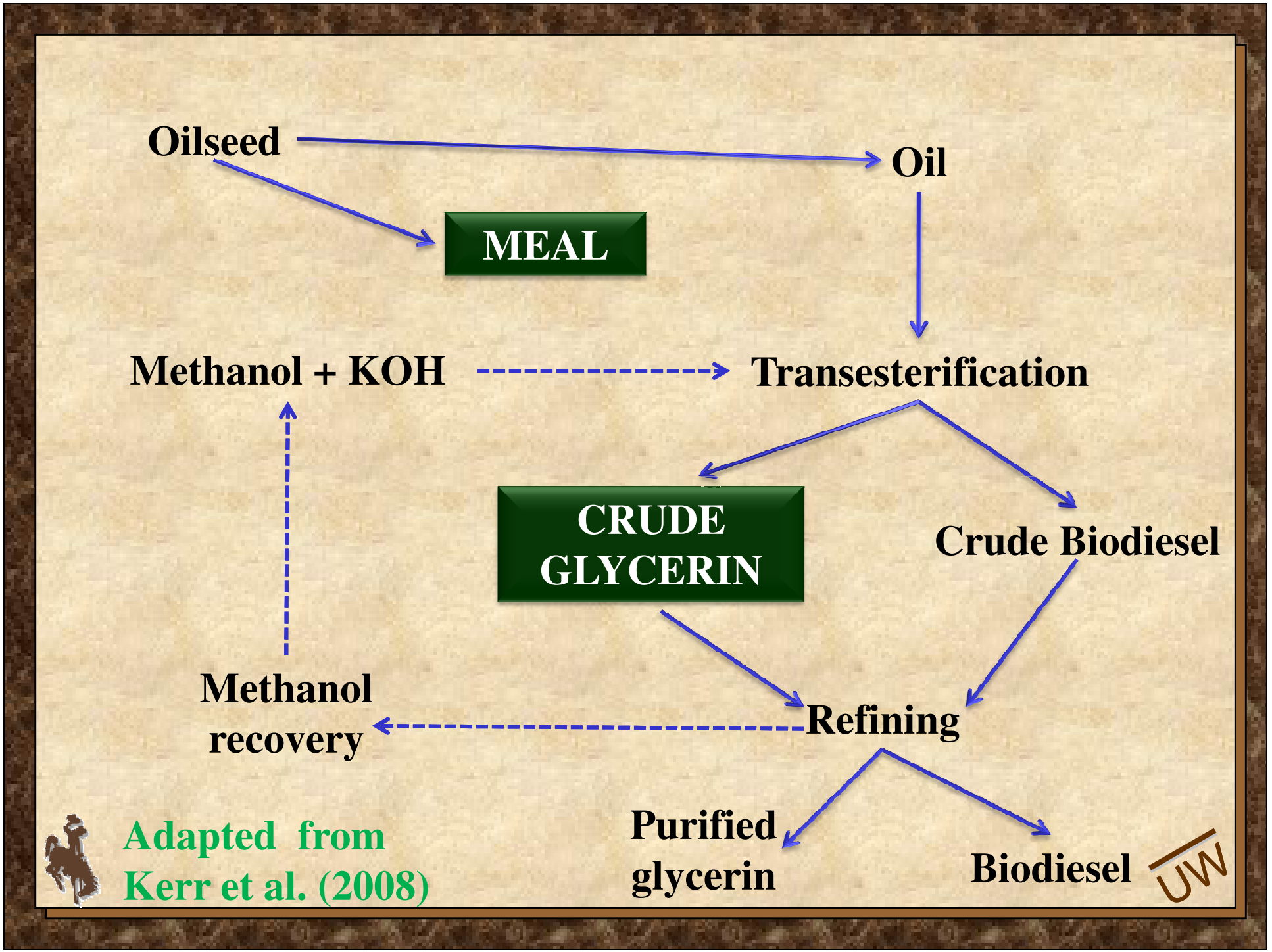


Brokaw et al. (2002)

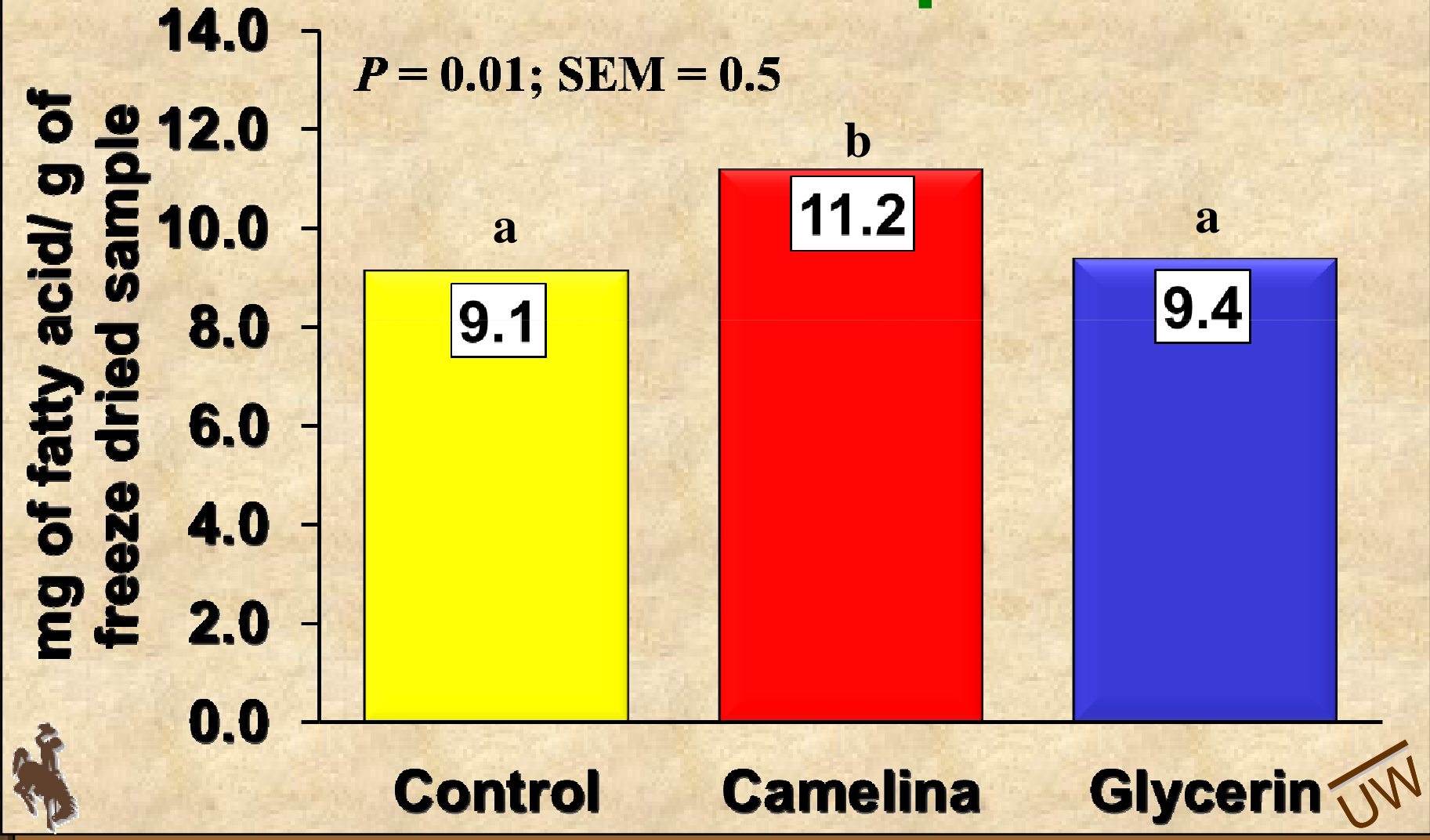
Pregnancy Rates by Heifers Fed Supplemental Lipid Prepuberal



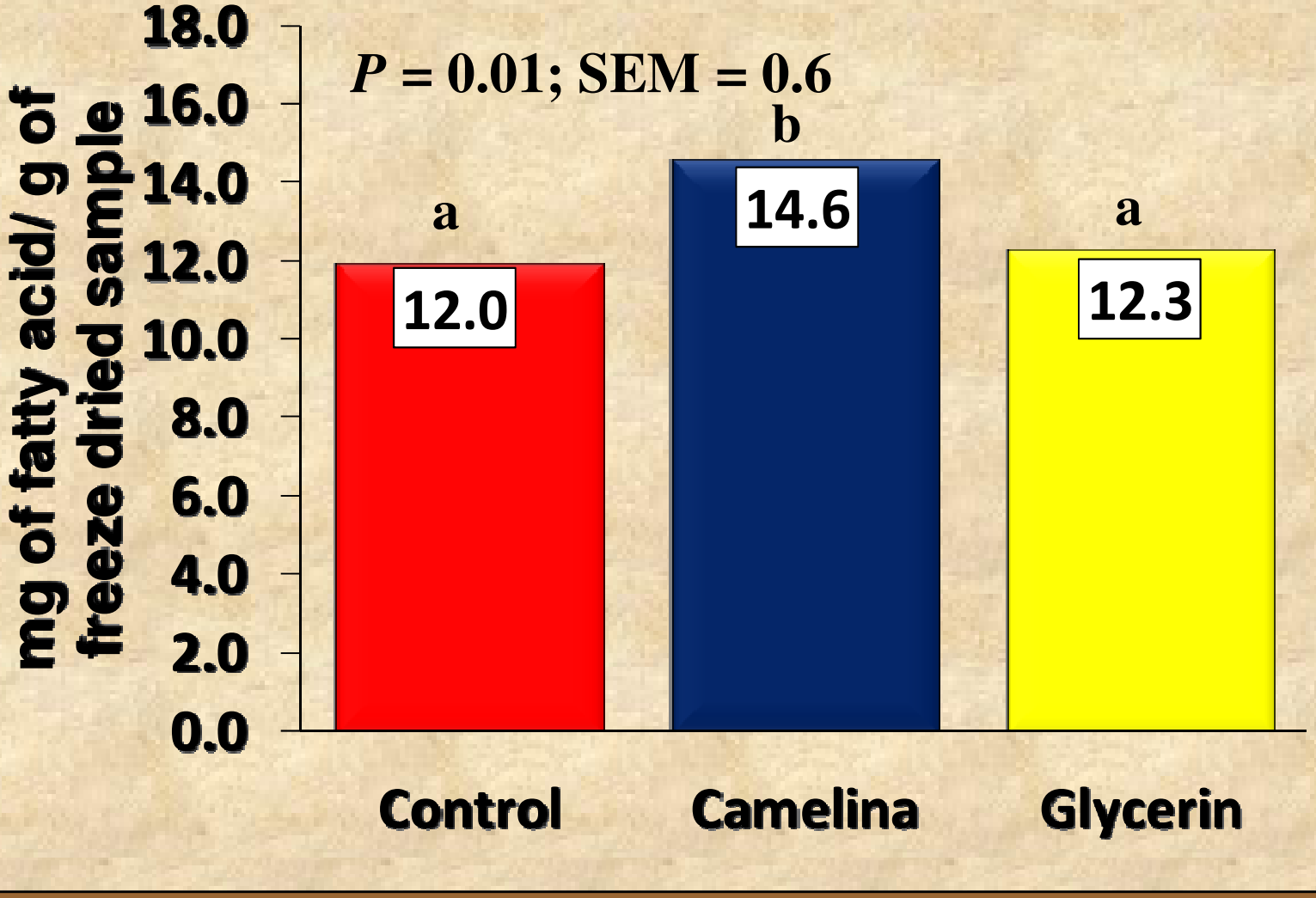
Hess et al. (2002)


Oilseed
Oil
MEAL
Methanol + KOH
Transesterification
CRUDE GLYCERIN
Crude Biodiesel
Methanol recovery
Refining
Purified glycerin
Biodiesel
Adapted from Kerr et al. (2008)
UW

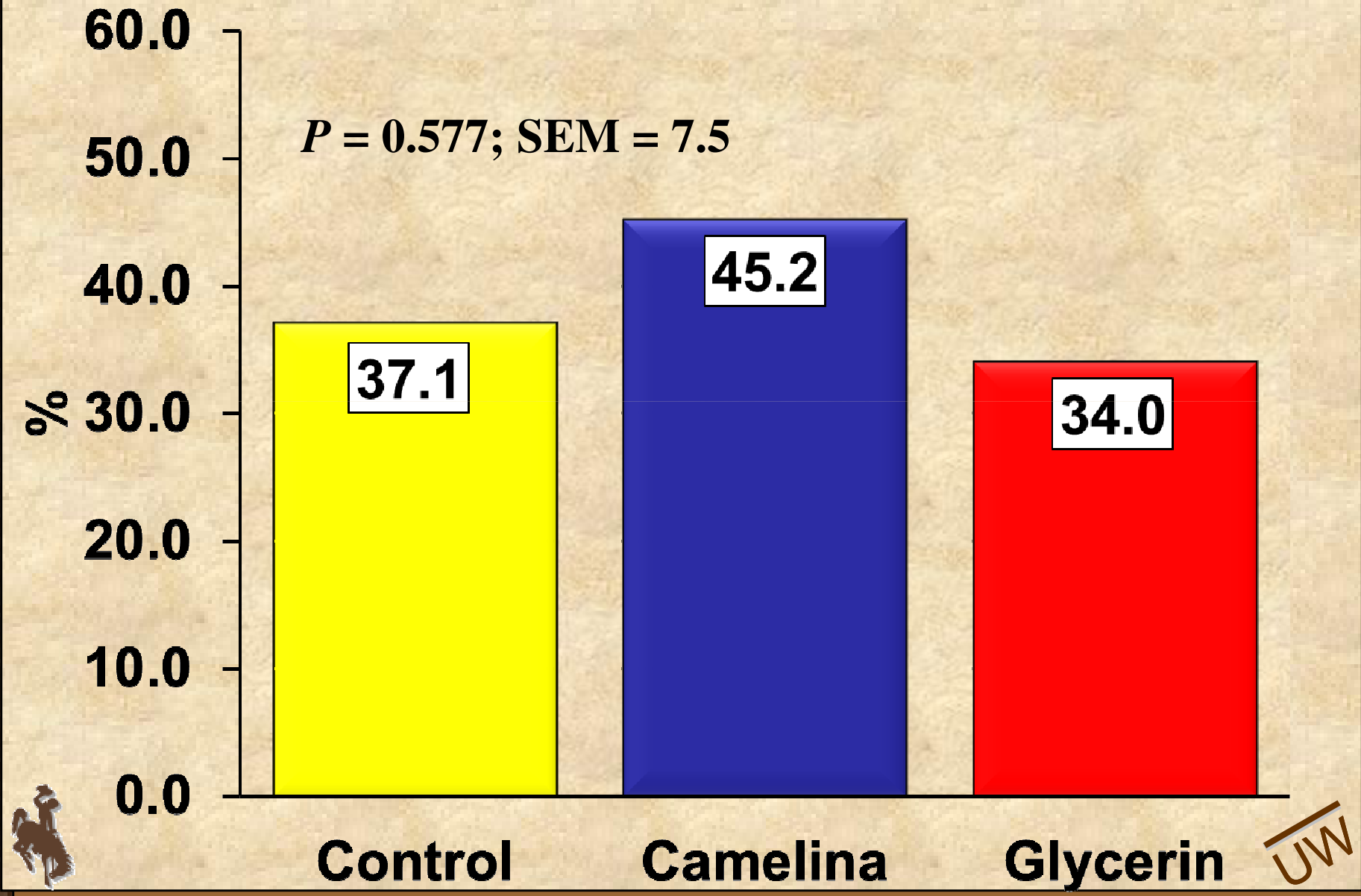
Plasma *cis-isomers* in Heifers fed Camelina Co-products



Plasma UFA in Heifers fed Camelina Co-products

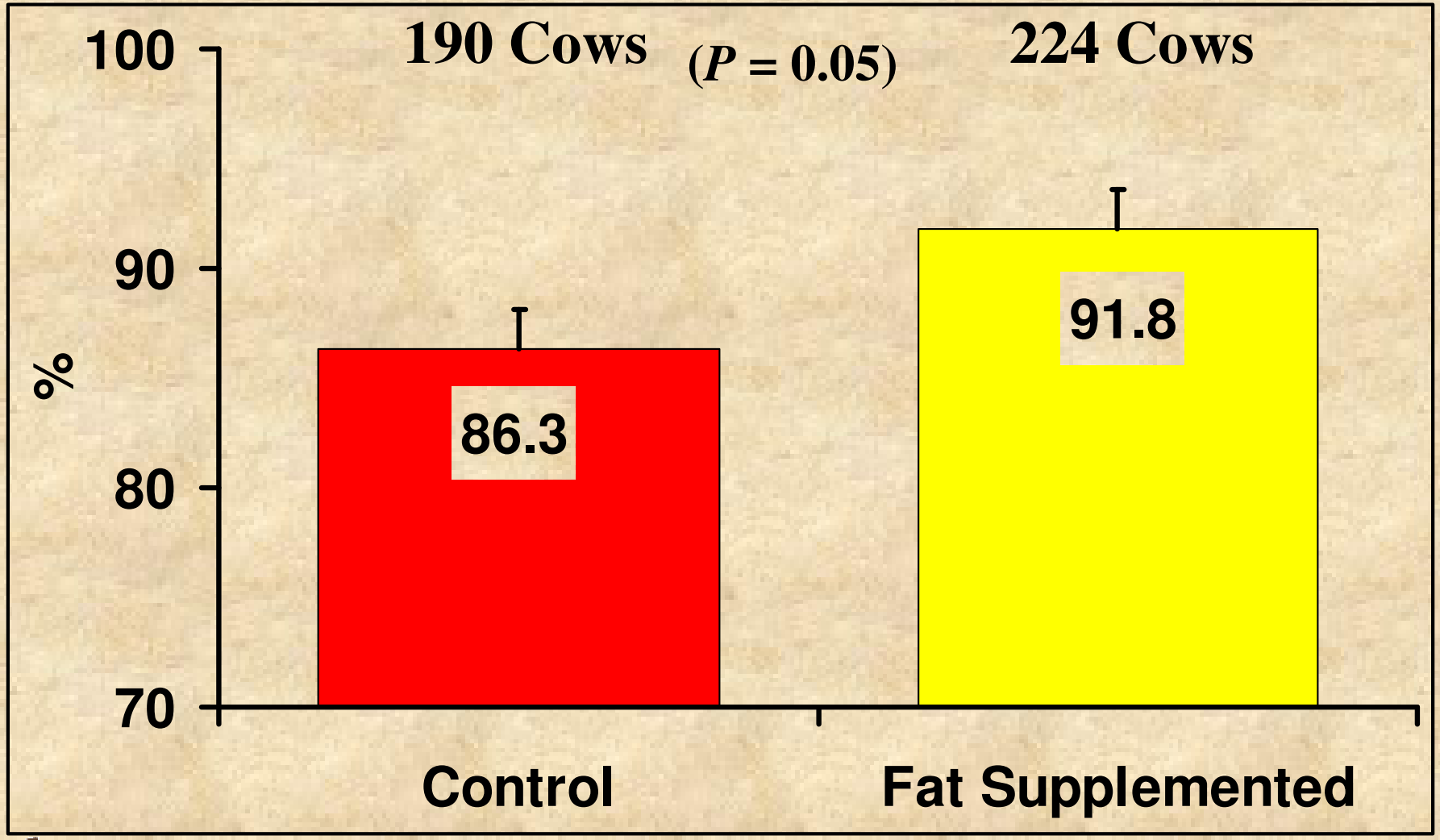


Overall Conception Rates to AI



Supplemental Fat for the Prepartum Cow

Pregnancy Rates



Hess et al. (2005)

“Does increased intake of fat, aside from its obvious contribution to caloric density of the diet, contribute to postpartum recovery?”

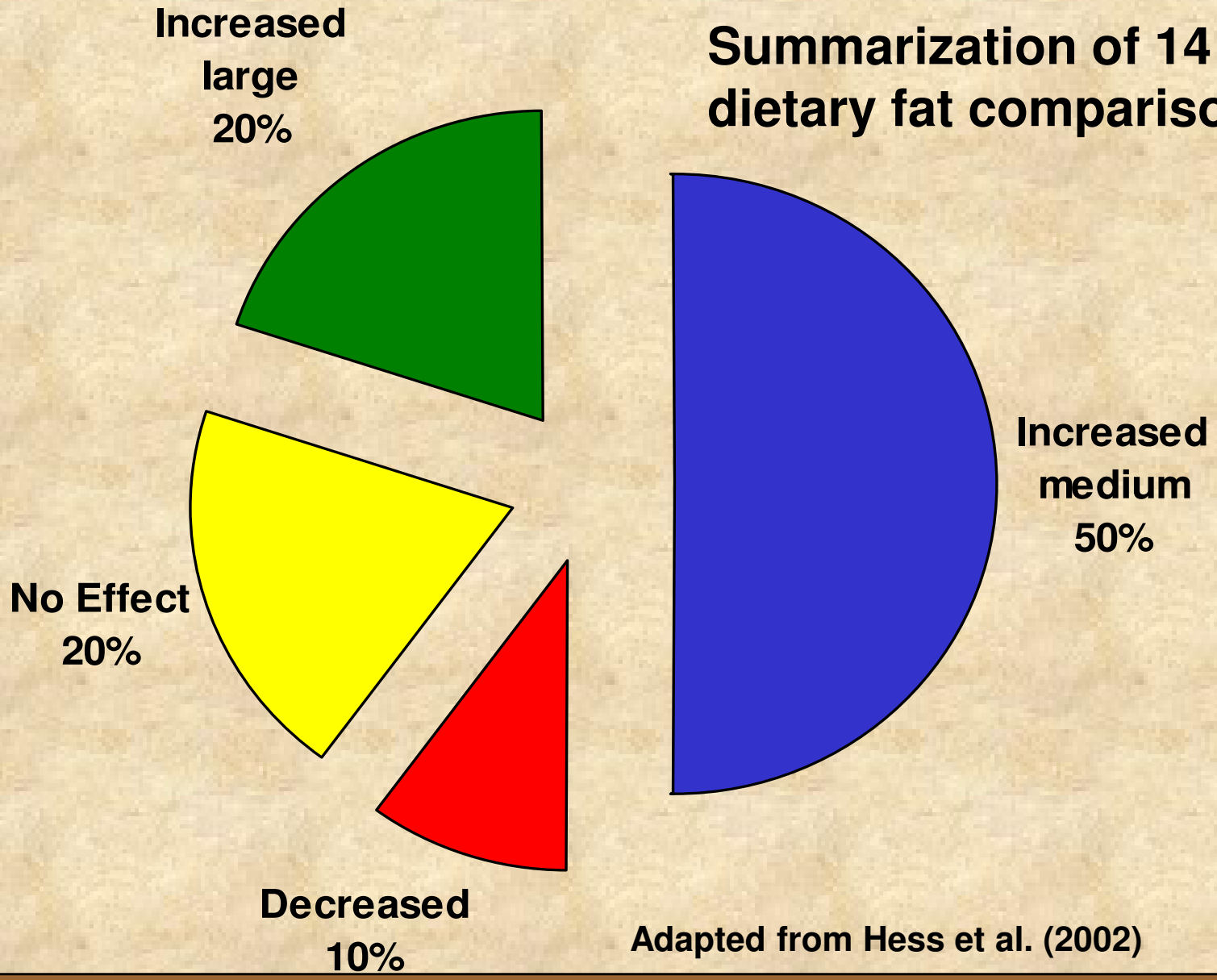
(Williams and Stanko, 2000)

Supplemental Fat for the Cylcing Cow


CENTIMETERS
INCHES

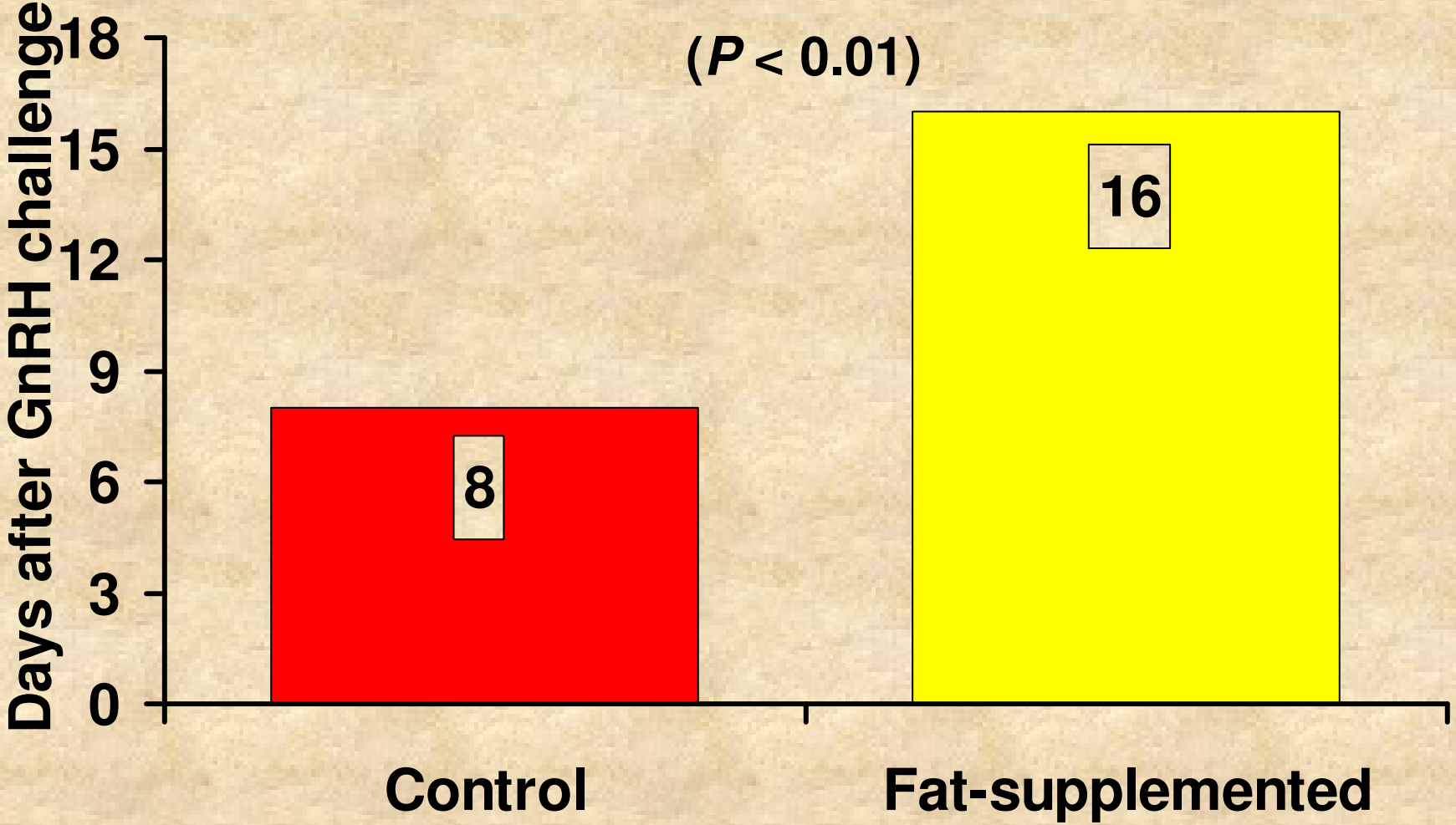
Ovarian Follicles

Summarization of 14 dietary fat comparisons.



Adapted from Hess et al. (2002)

Duration of Luteal Function

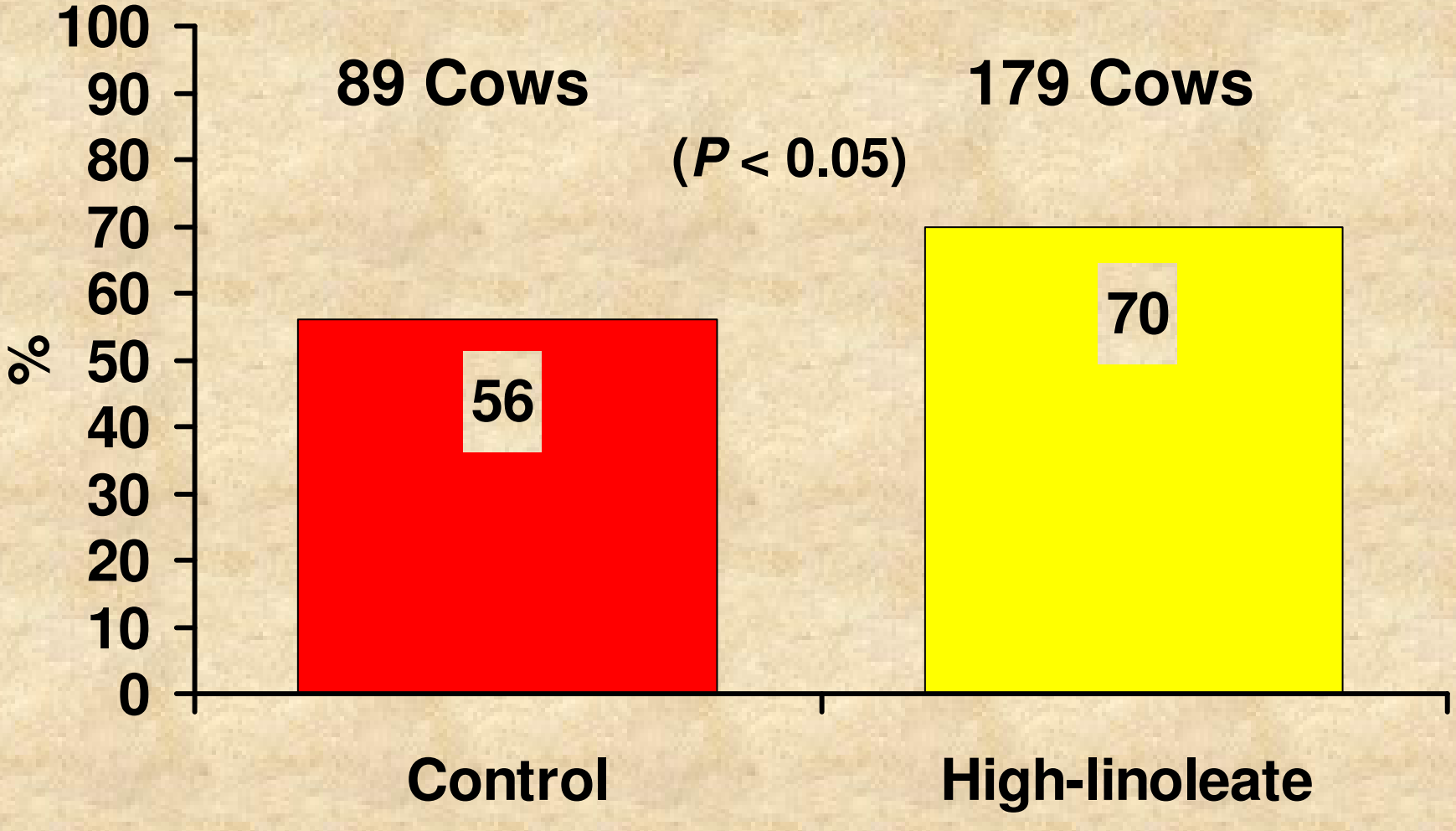


Adapted from Williams (1989)

"Linoleic acid and eicosapentaenoic acid (found in fish meal) are proven inhibitors of cyclooxygenase in endometrial tissue of dairy cows. As a result, endometrial secretion of $PGF_{2\alpha}$ can be suppressed, thus potentially preventing early embryonic death. This process may be aided by the effect fat has in suppressing estradiol- 17ß secretion, thus reducing uterine $PGF_{2\alpha}$ secretion and decreasing the sensitivity of the corpus luteum to $PGF_{2\alpha}$."

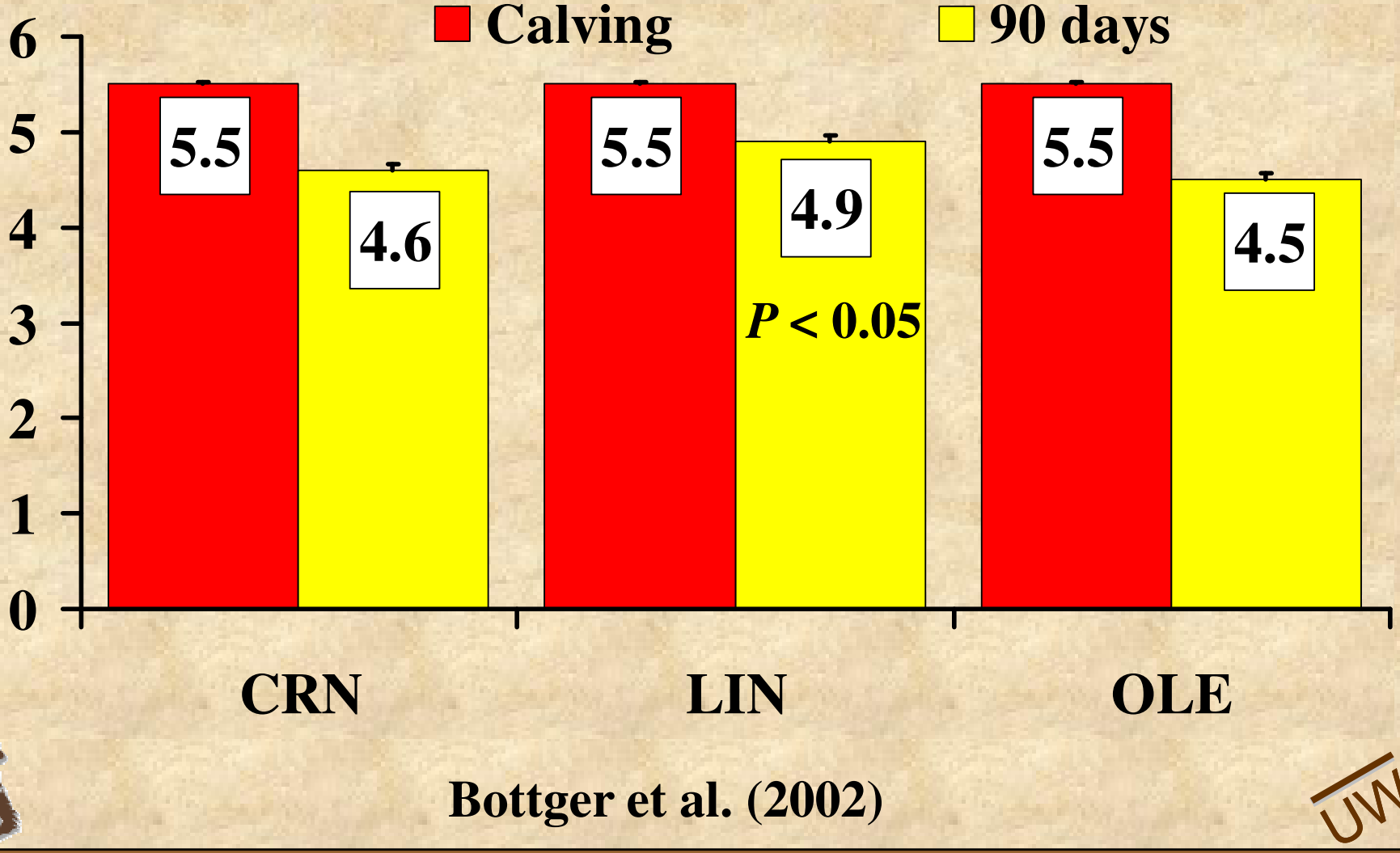
(Staples et al., 1998)

Pregnancy Rates



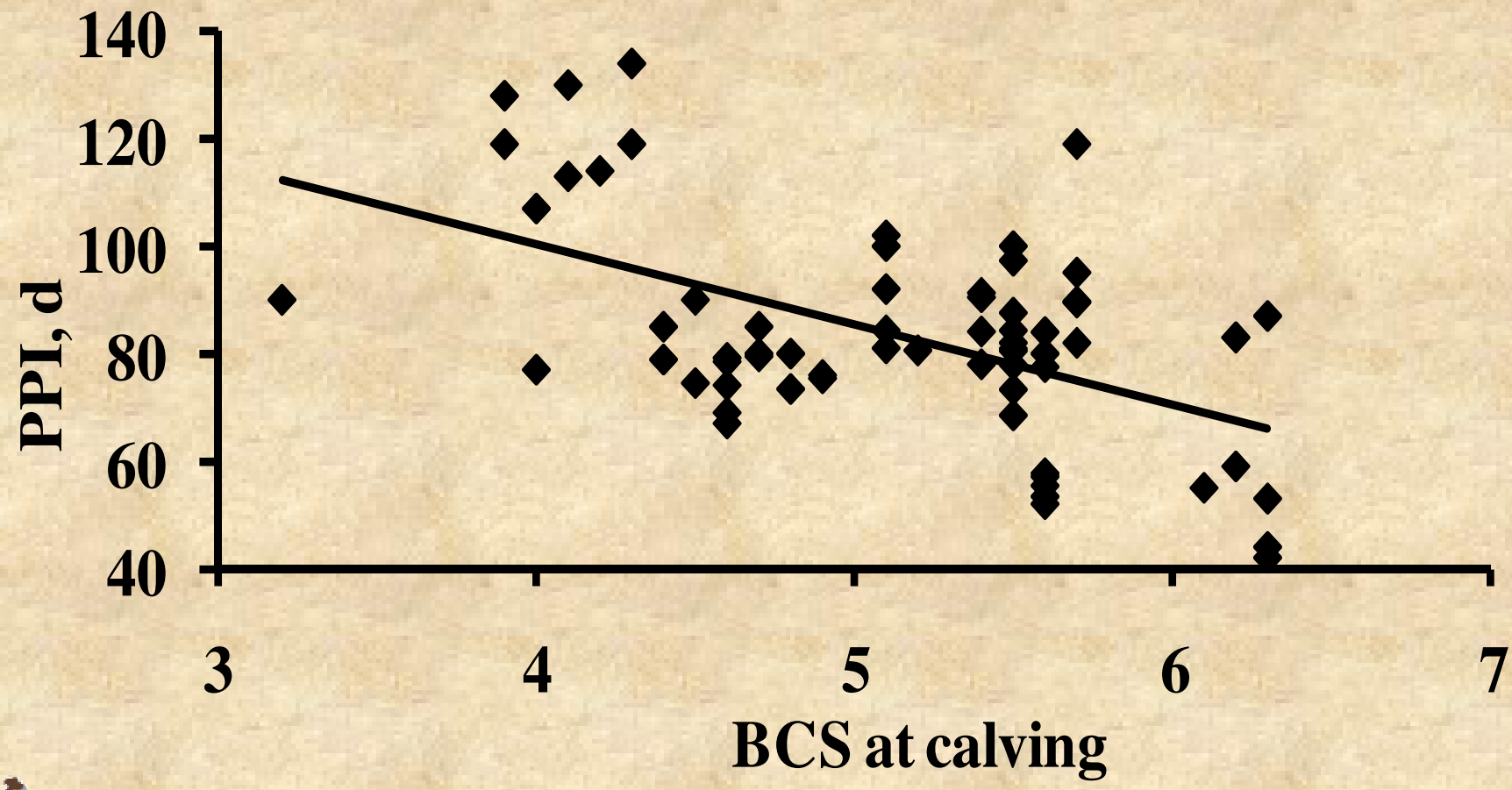
Adapted from Bellows (1999)

Body Condition Scores of Cows Fed Lipids Postpartum

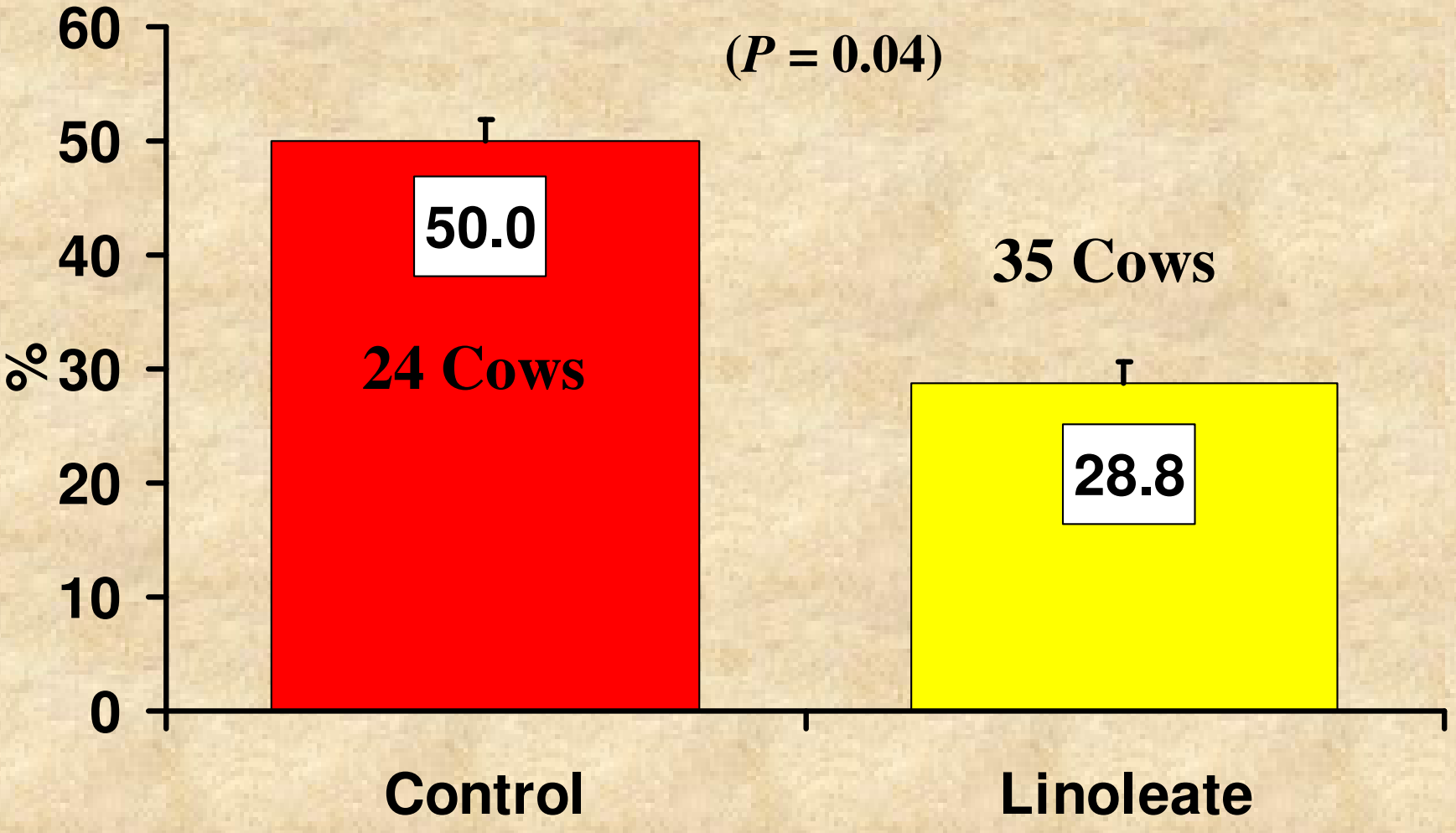


Bottger et al. (2002)

Body Condition Score at Calving Affects Return to Estrus

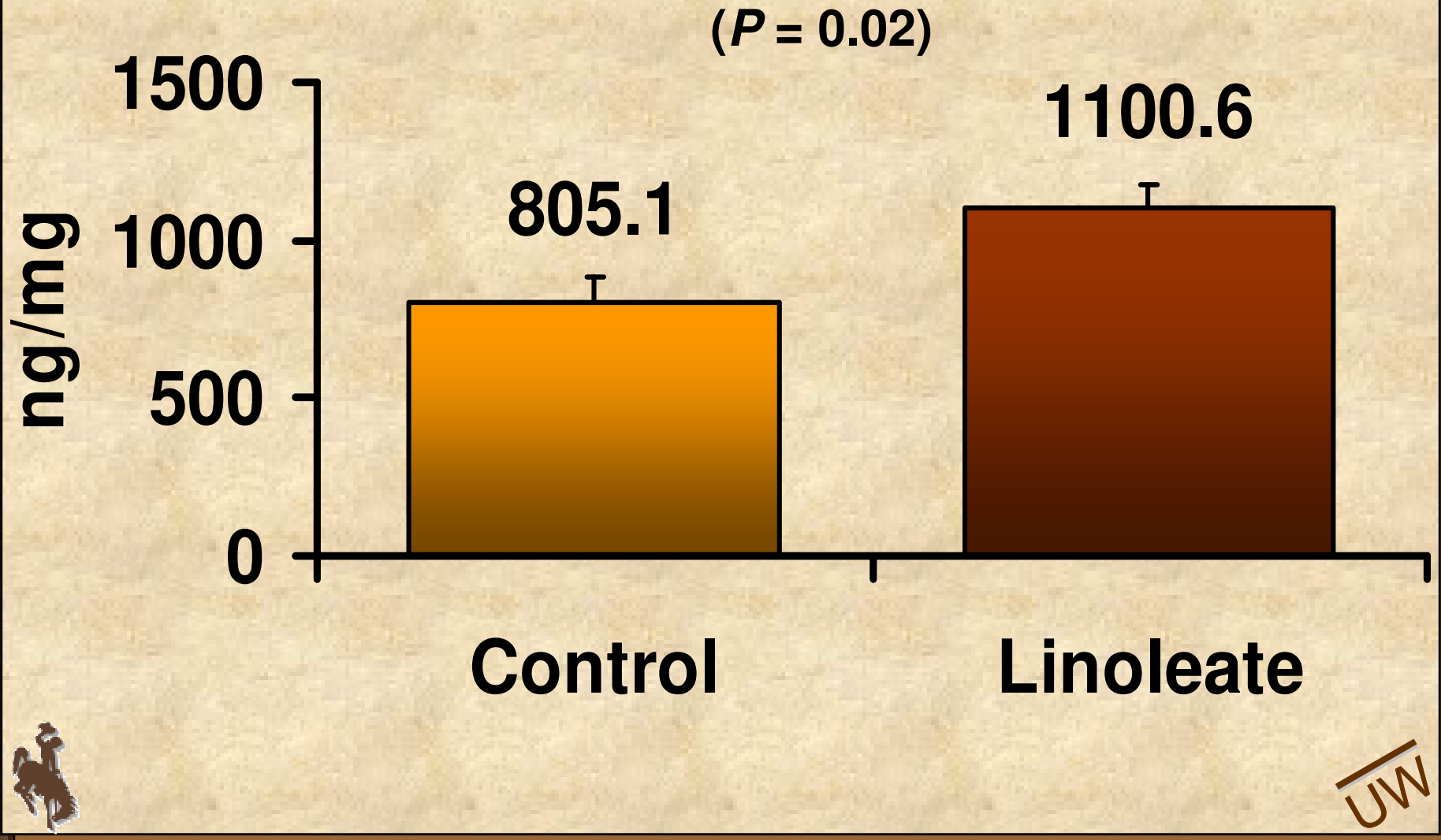


First Service Conception Rates

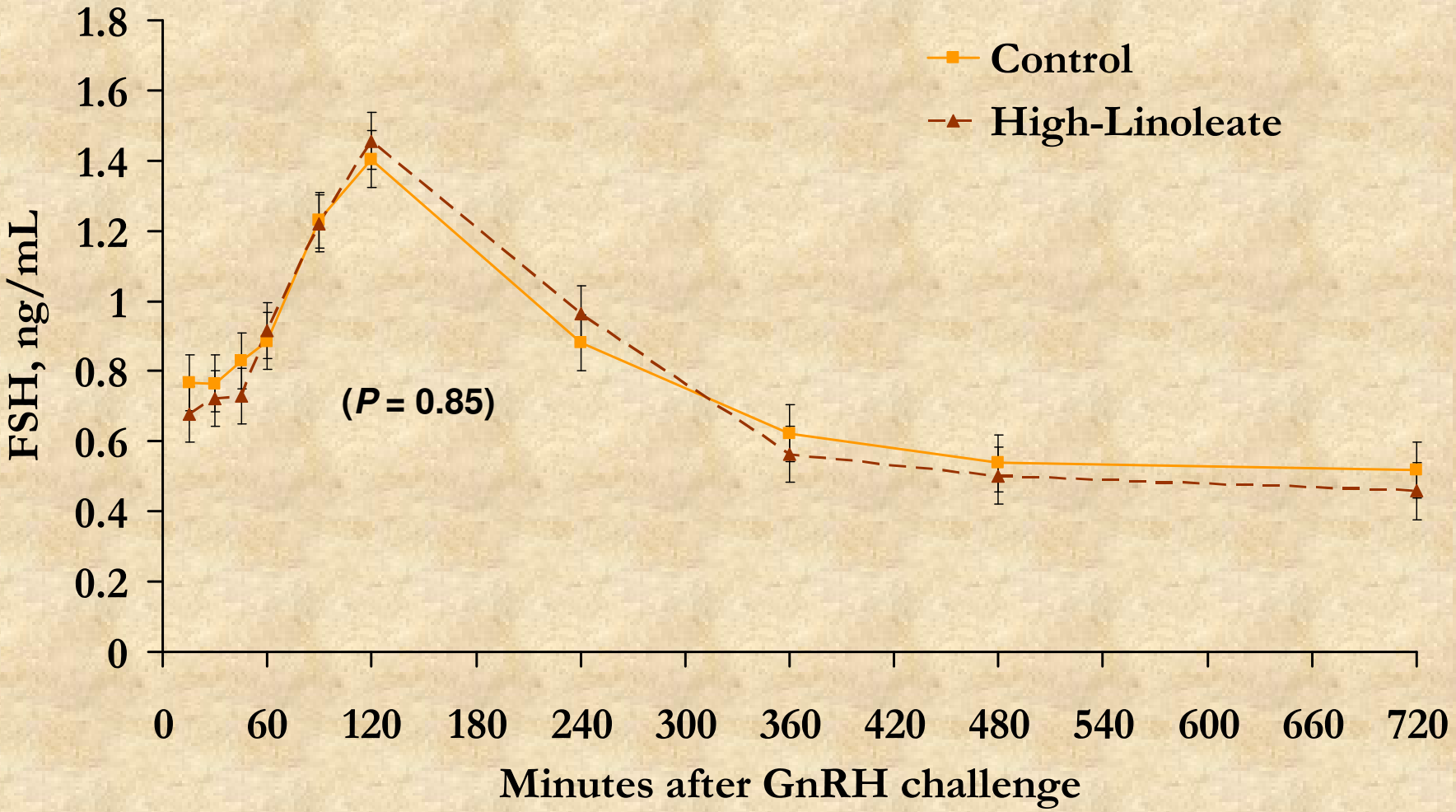


Hess (2003)

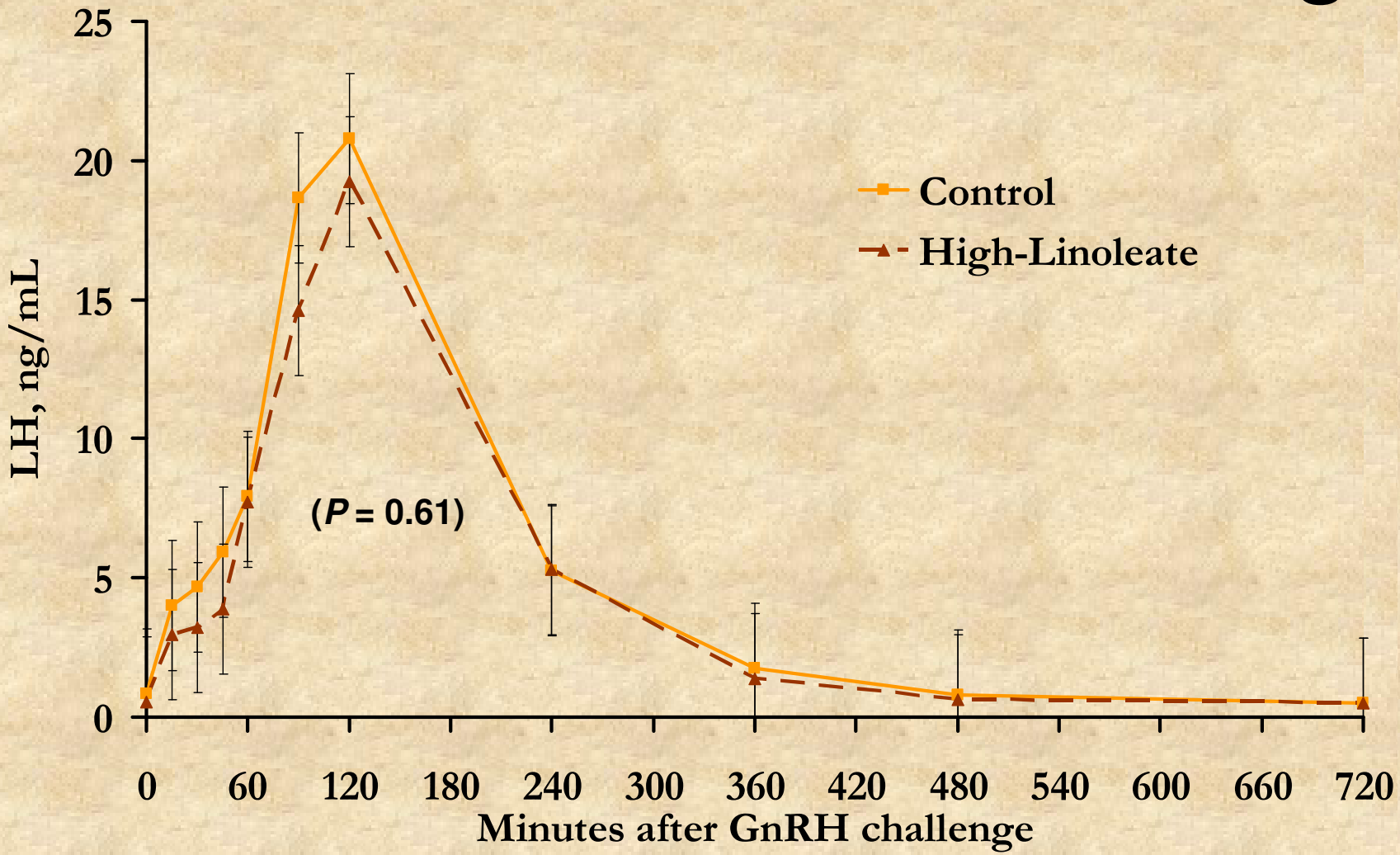
Anterior Pituitary FSH



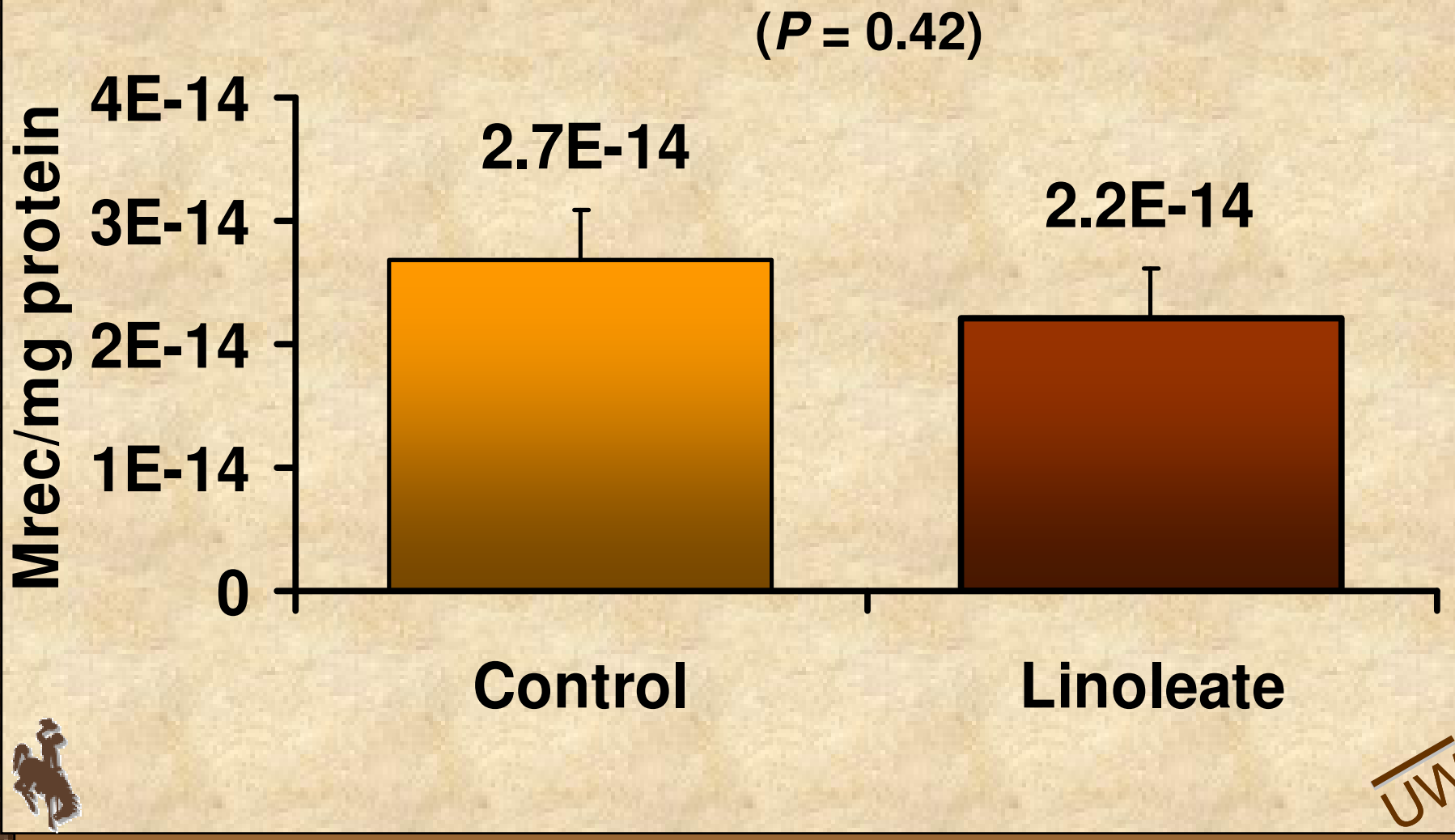
Serum FSH After GnRH Challenge



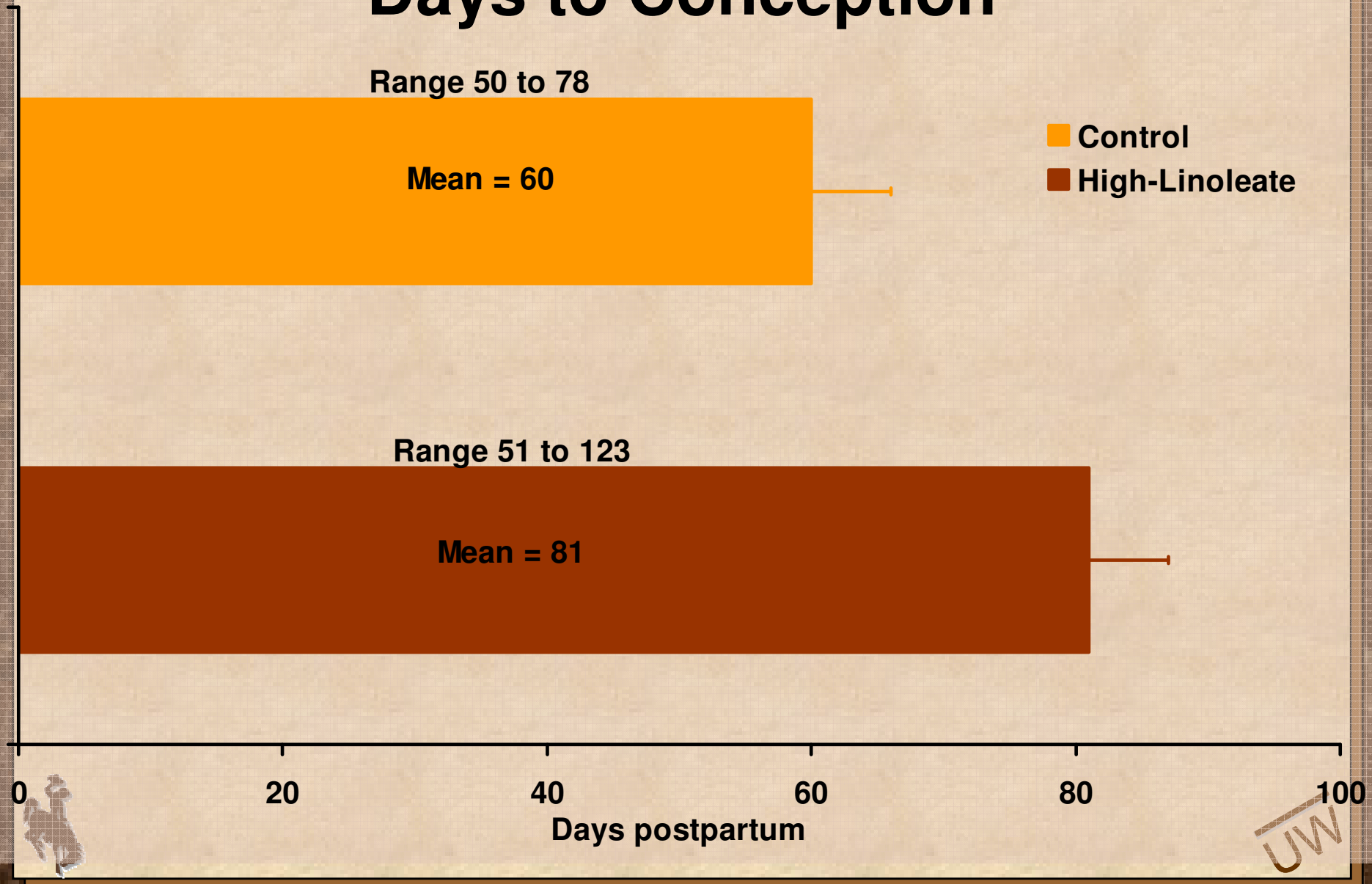
Serum LH After GnRH Challenge



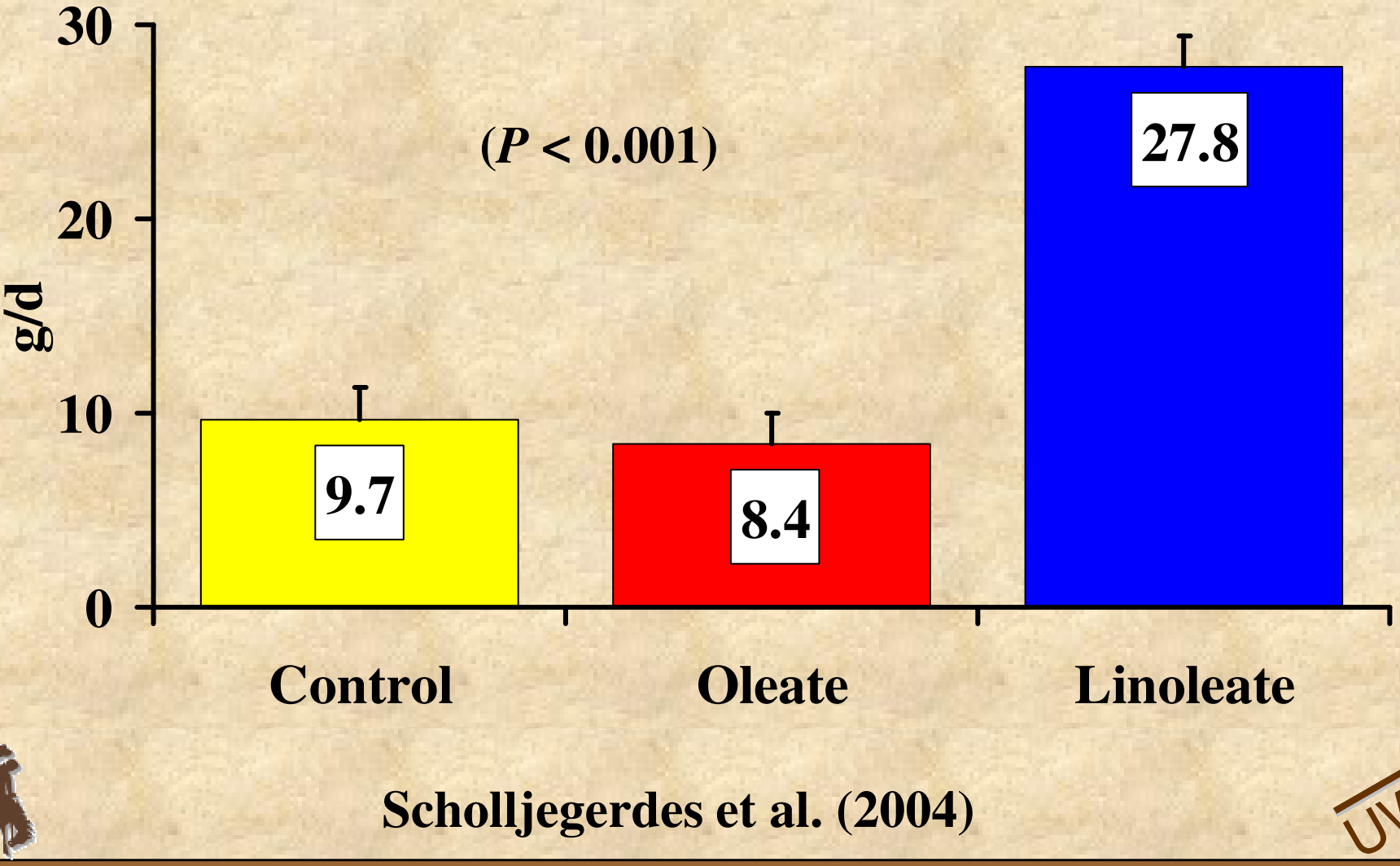
Anterior Pituitary GnRH Receptors



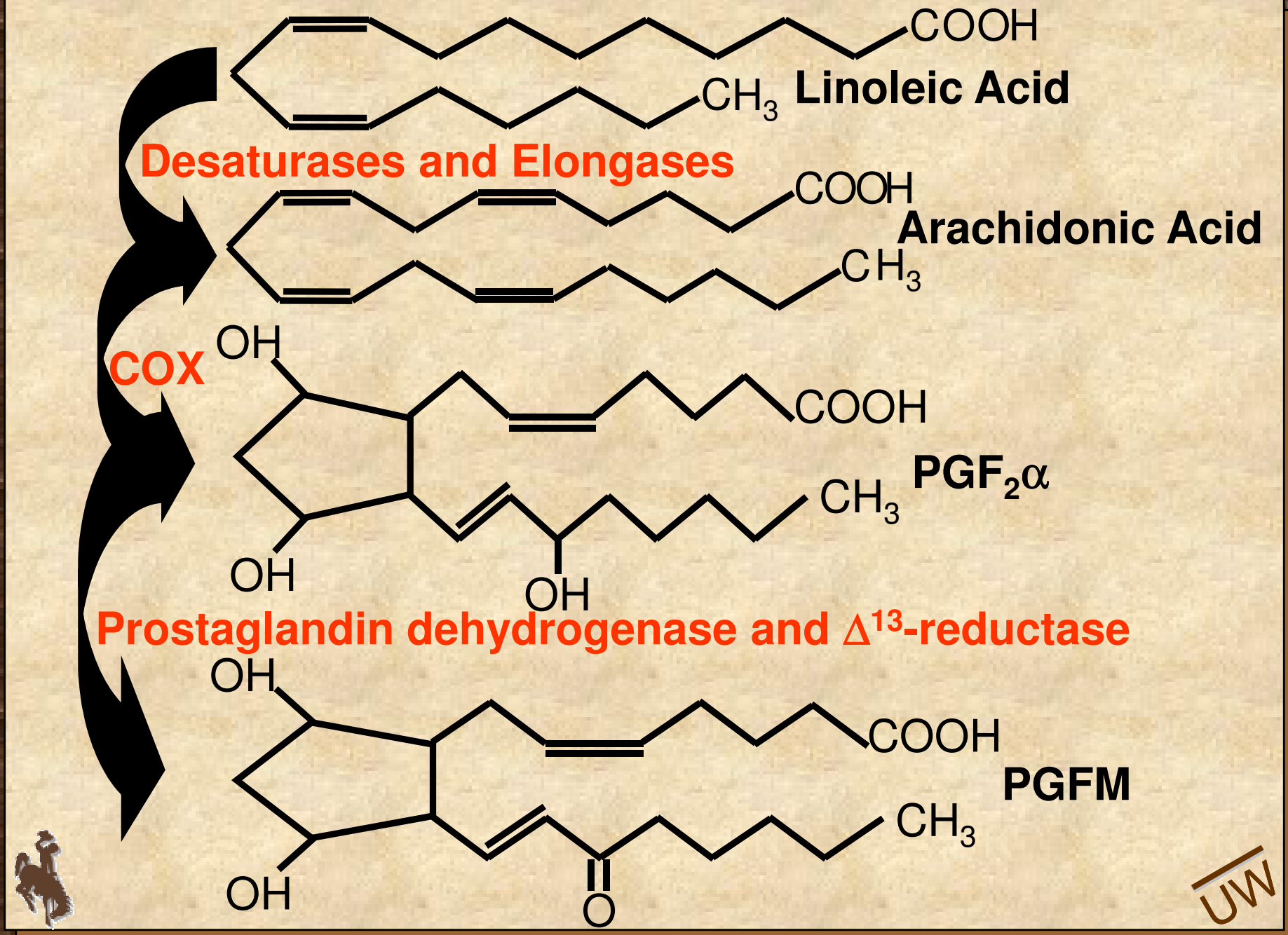
Days to Conception



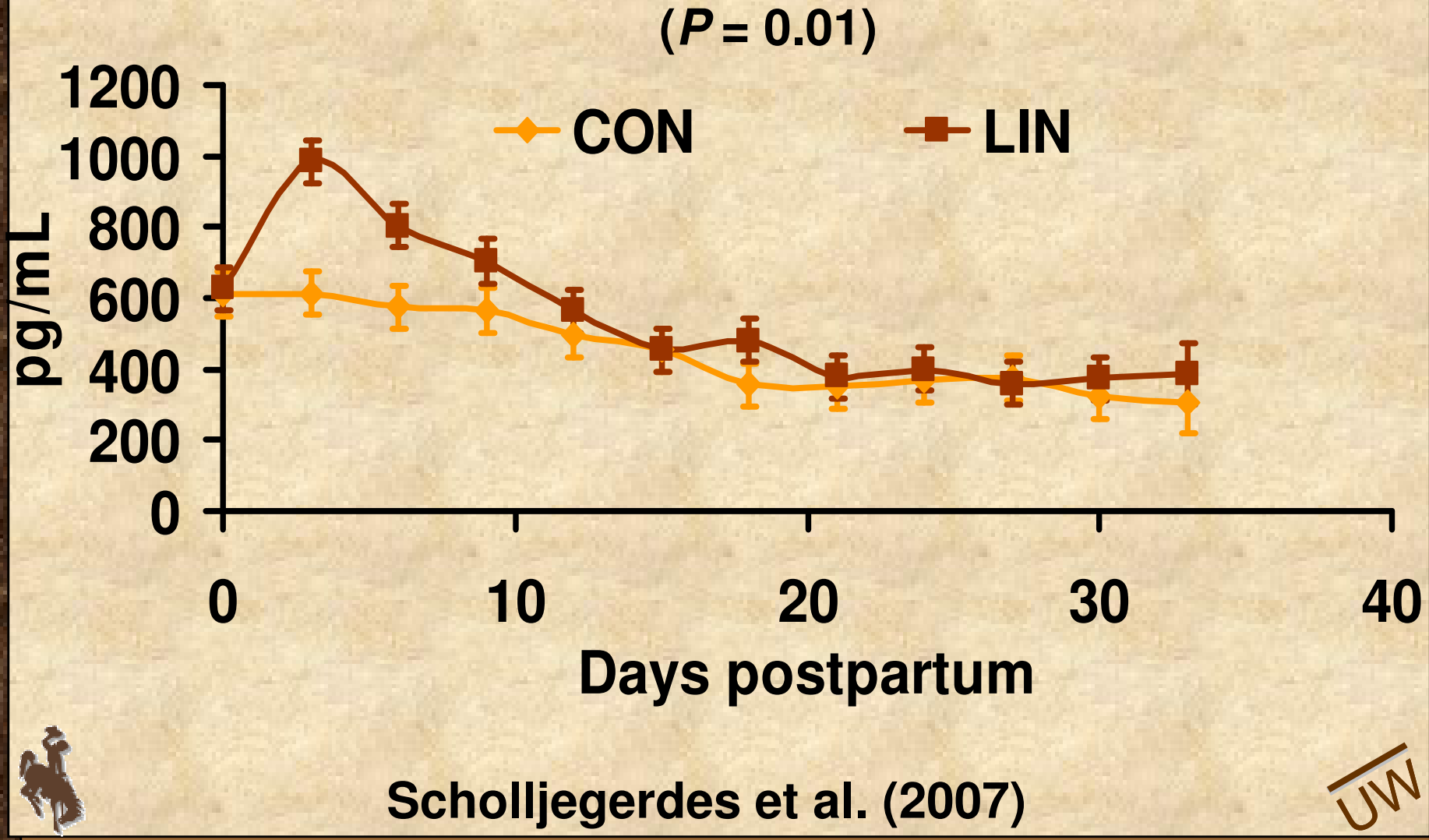
Doudenal Flow of 18:2 in Cows Supplemented with Lipids



Scholljegerdes et al. (2004)

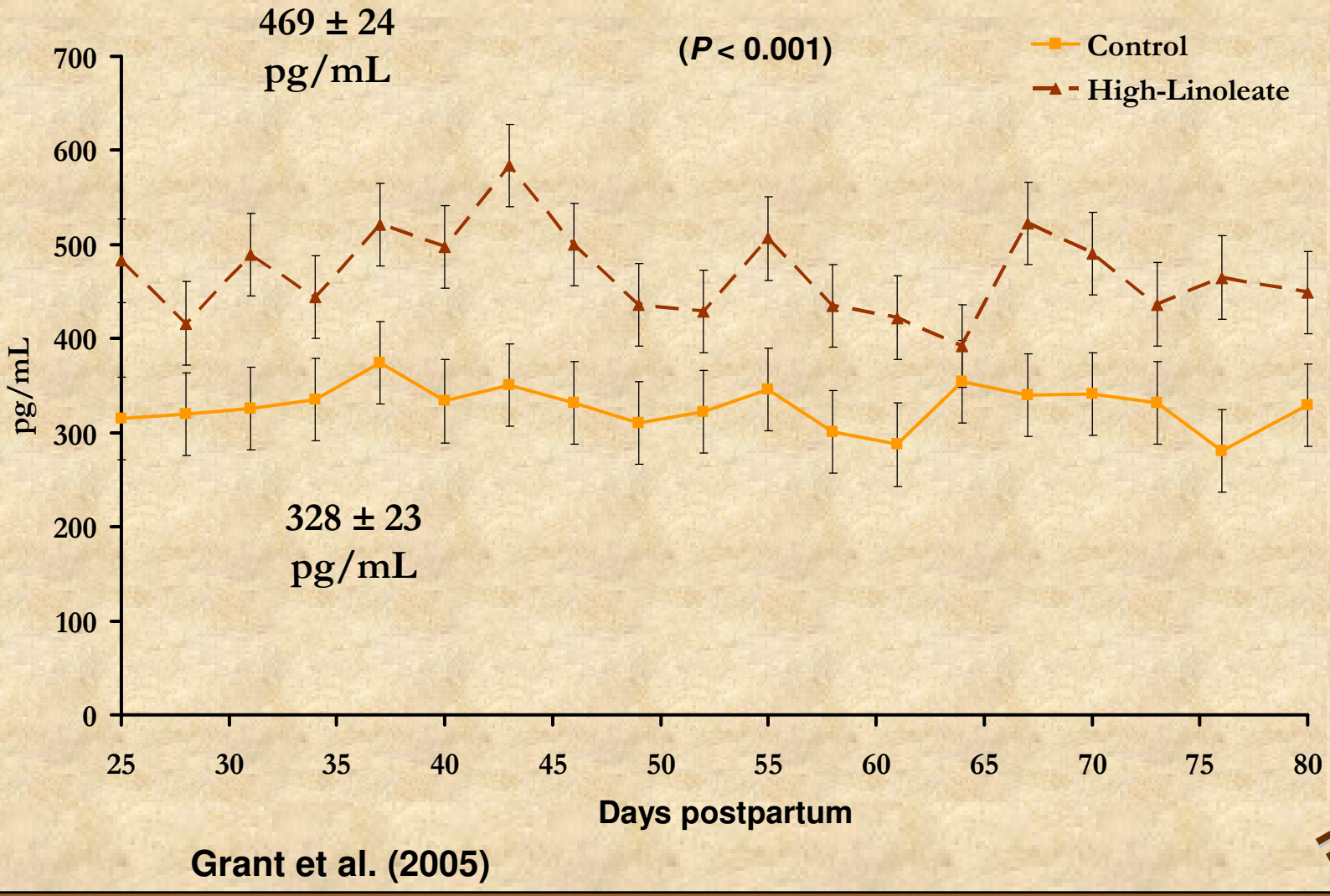

COOH
CH3
Linoleic Acid
Desaturases and Elongases
COOH
Arachidonic Acid
CH3
COX
OH
COOH
CH3
PGF2α
OH
OH
Prostaglandin dehydrogenase and Δ13-reductase
OH
COOH
PGFM
CH3
OH
O
UW

Serum Concentrations of PGFM



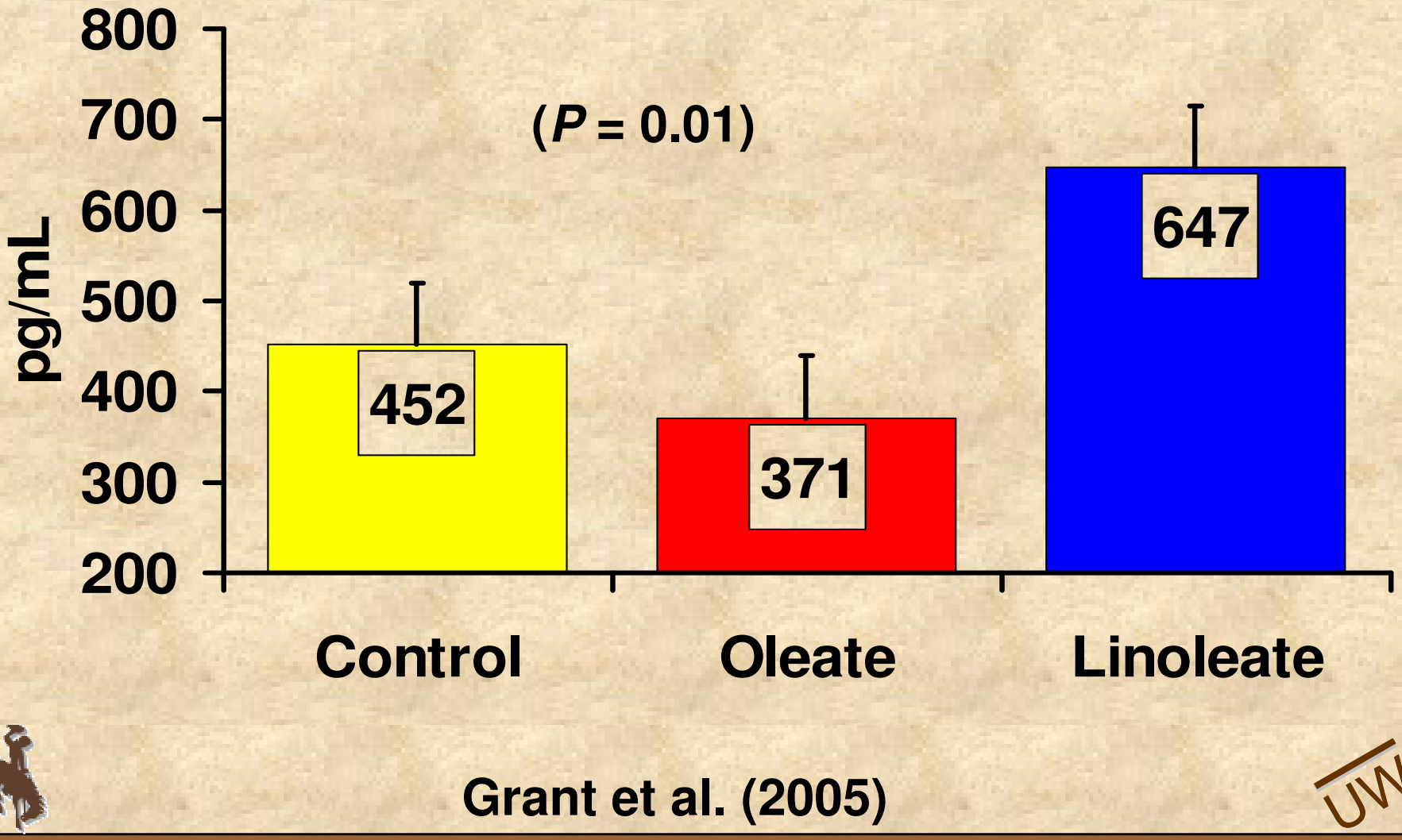
Scholljegerdes et al. (2007)

Serum Concentrations of PGFM



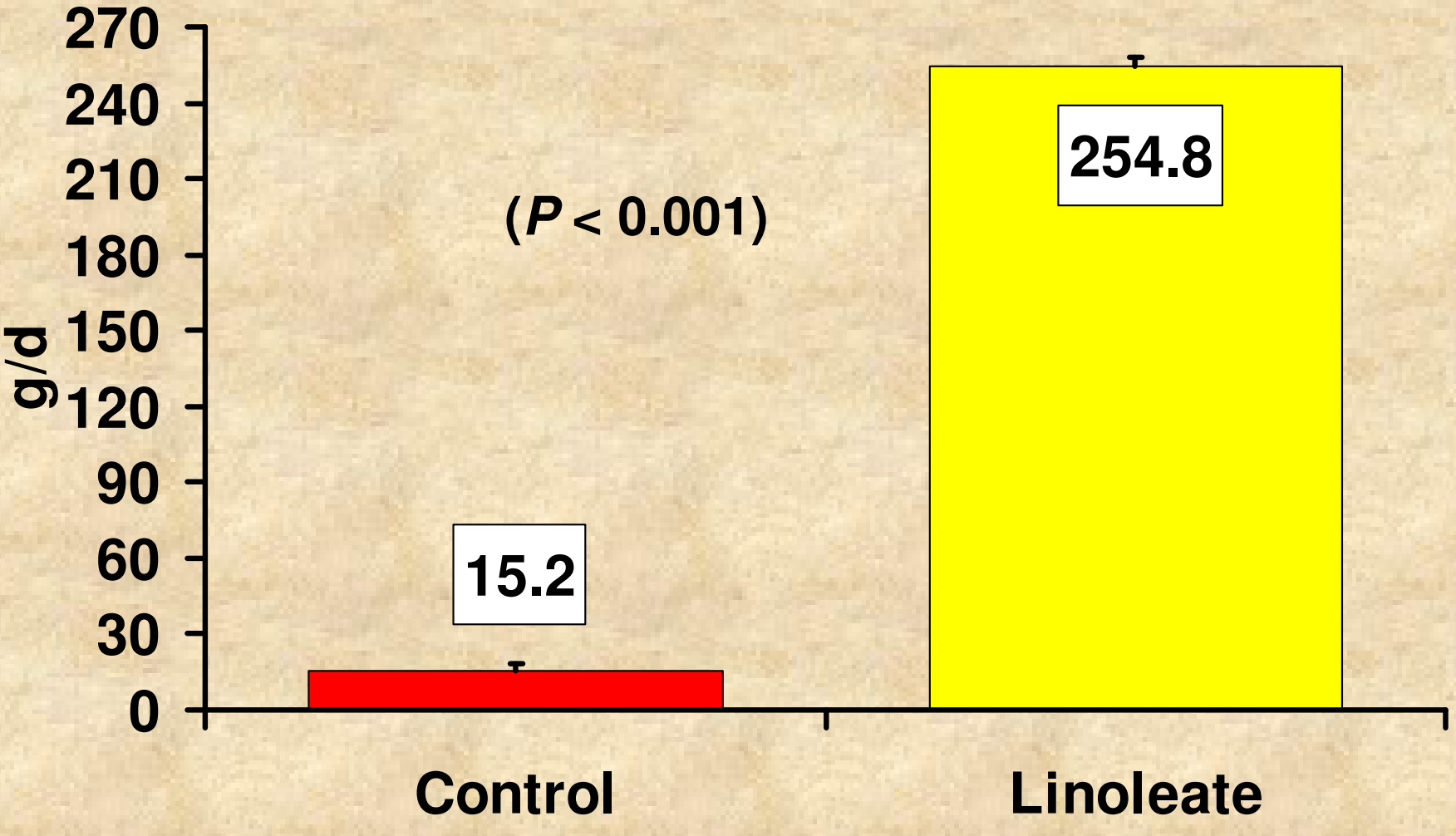
Grant et al. (2005)

Serum PGFM in Cows Fed Lipids Postpartum



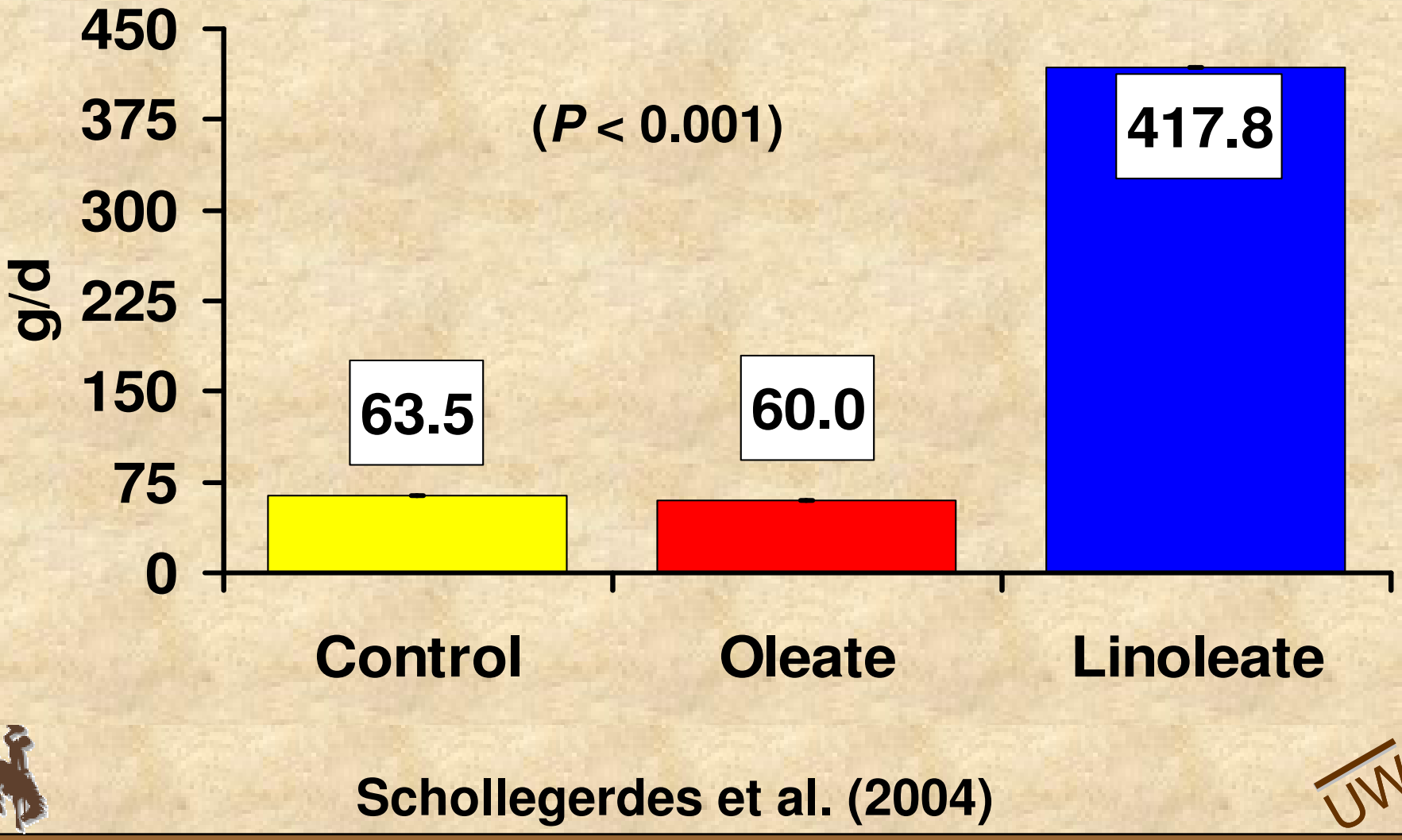
Grant et al. (2005)

Intake of Linoleic Acid



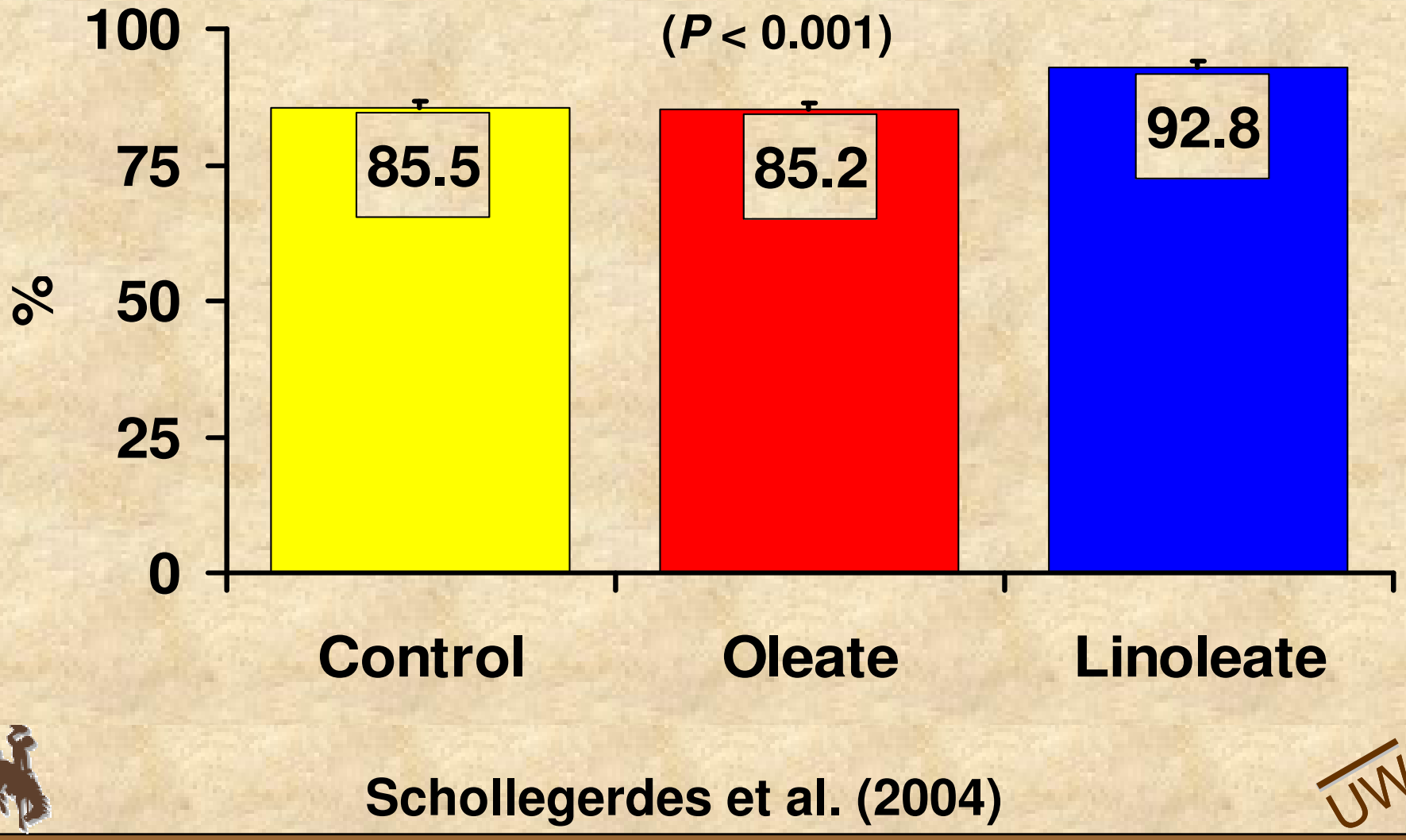
Adapted from Scholljerdes et al. (2007)

Intake of Linoleic Acid



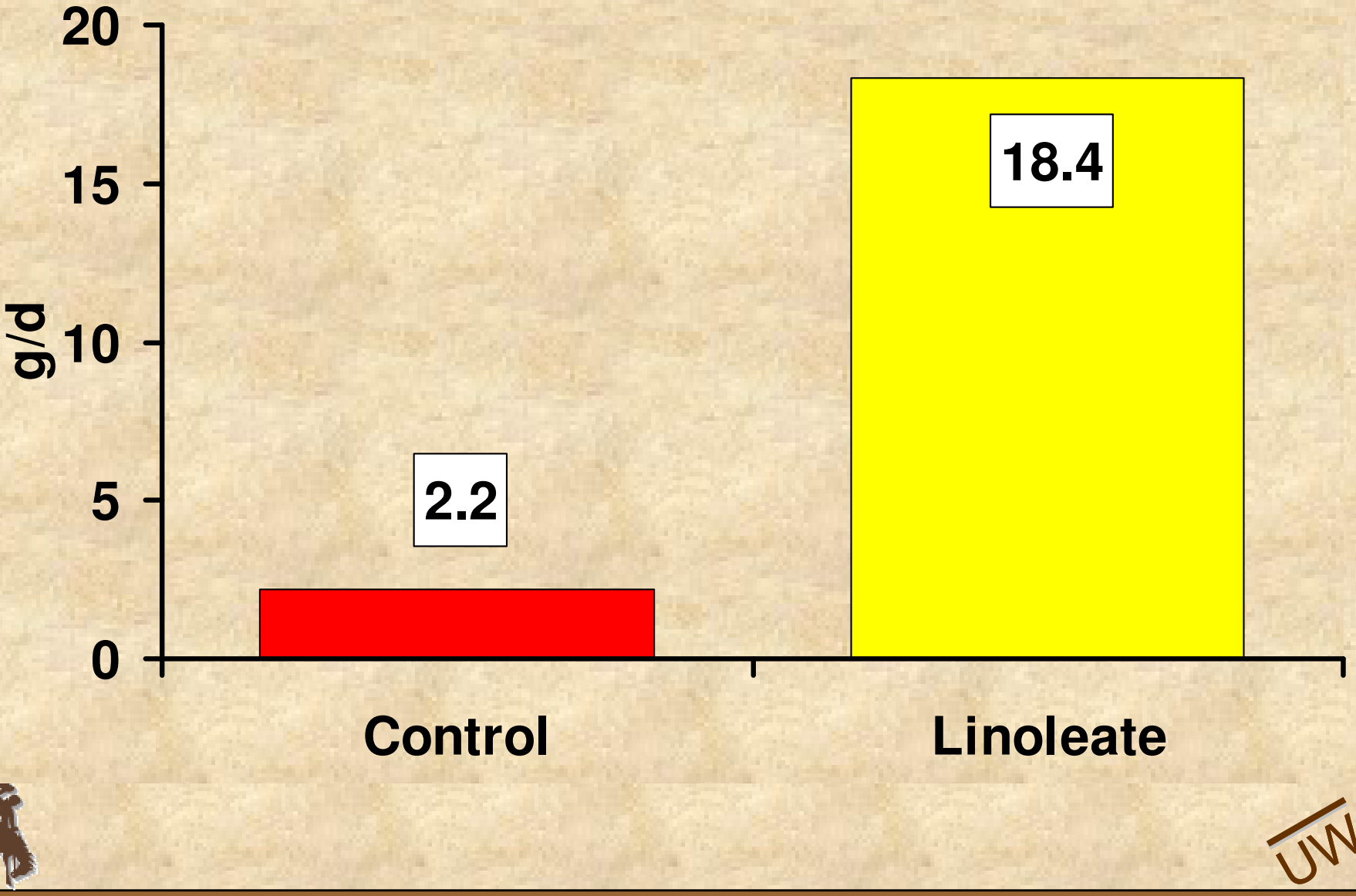
Schollegerdes et al. (2004)

Ruminal Biohydrogenation of Linoleic Acid

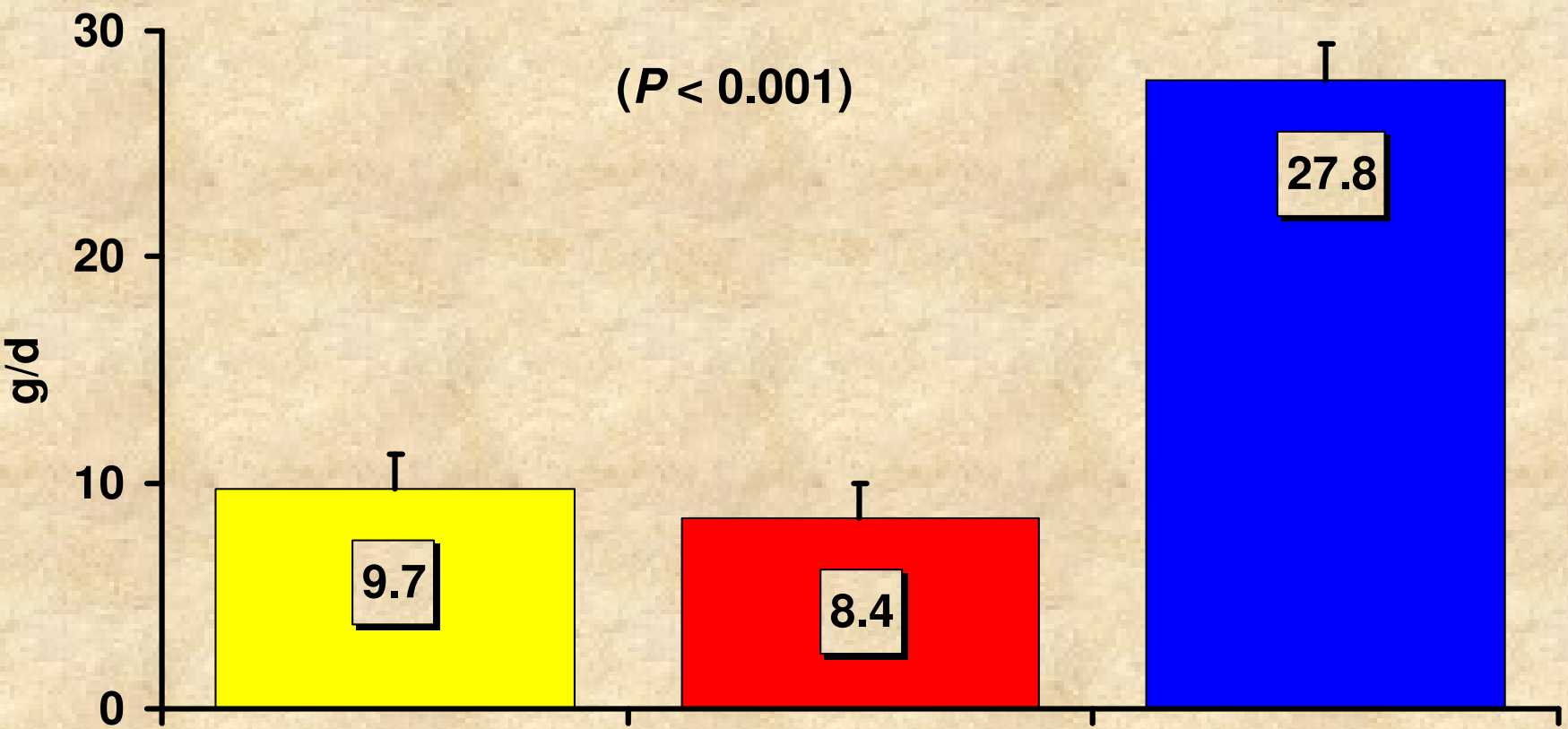


Schollegerdes et al. (2004)

Estimated Flow of Linoleic Acid

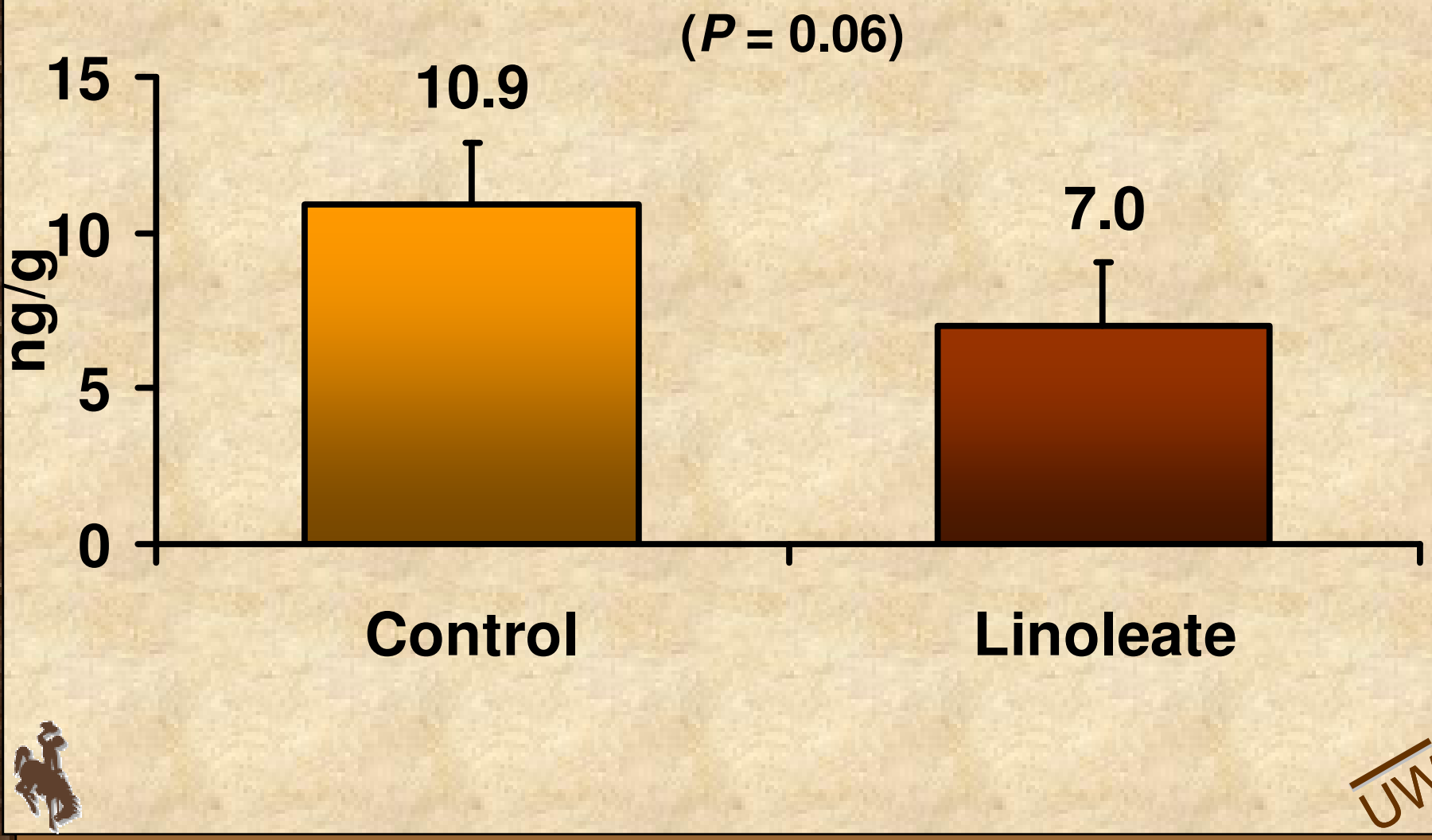


Doudenal Flow of 18:2

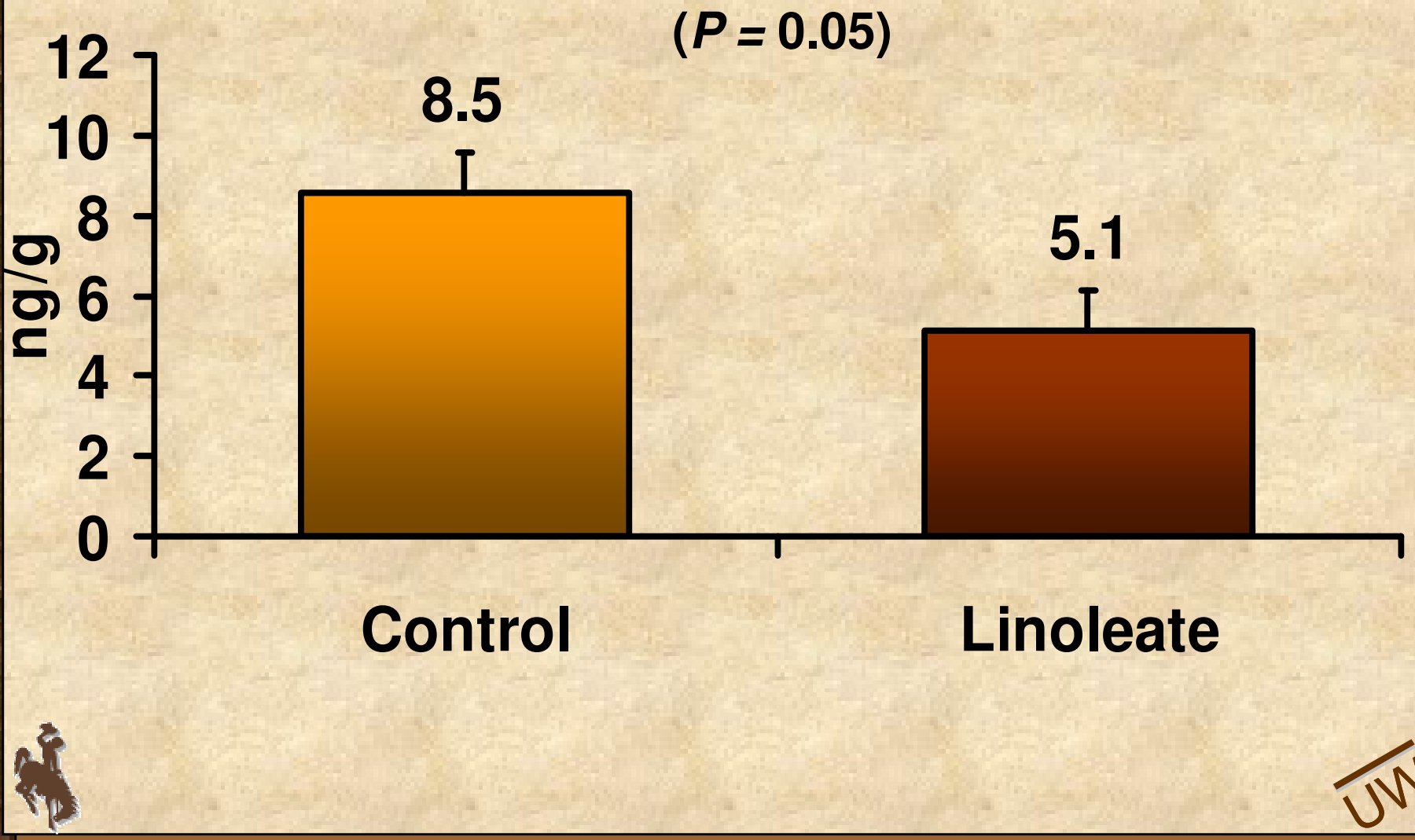


Scholljegerdes et al. (2004)

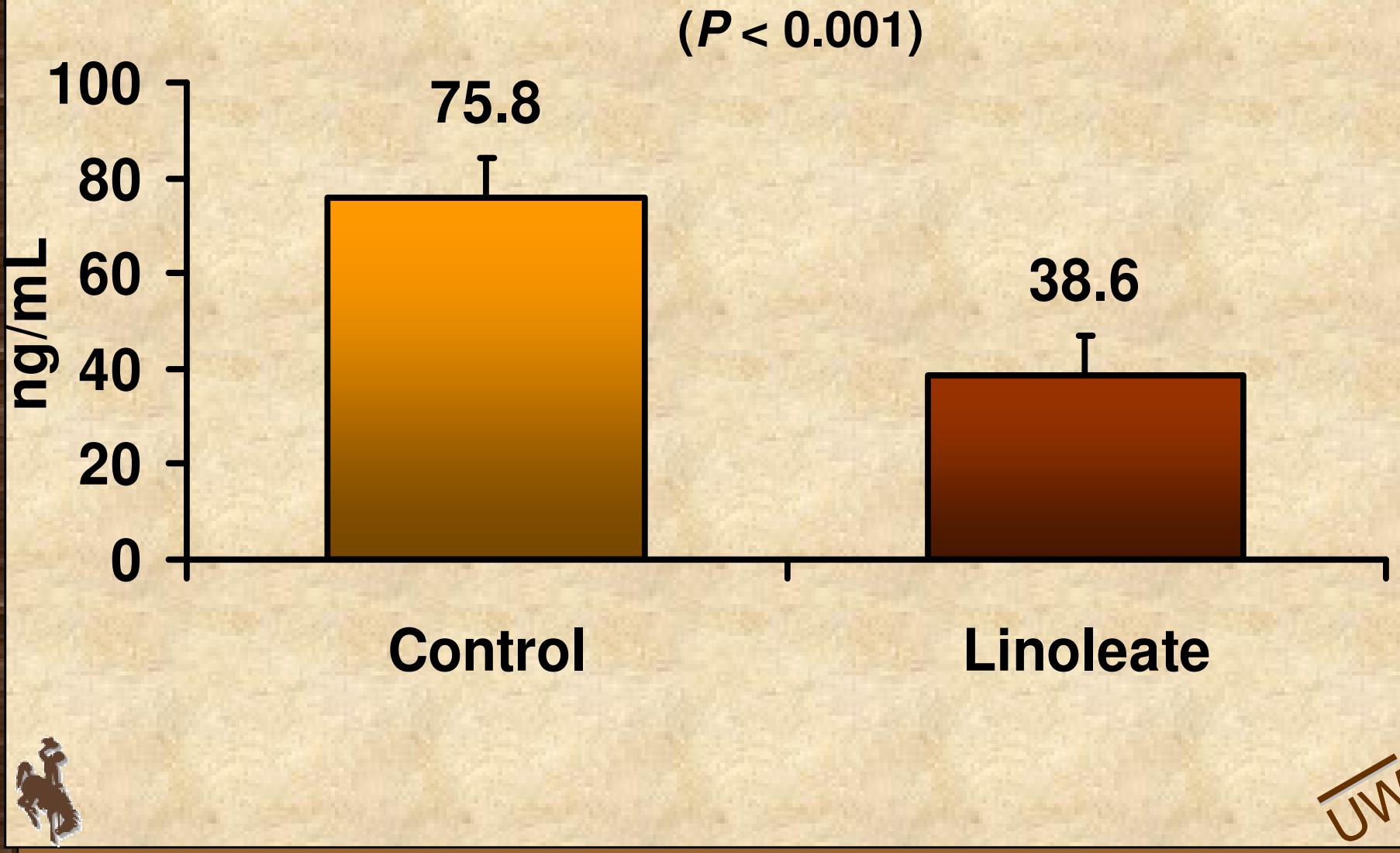
Preoptic Area IGF-I



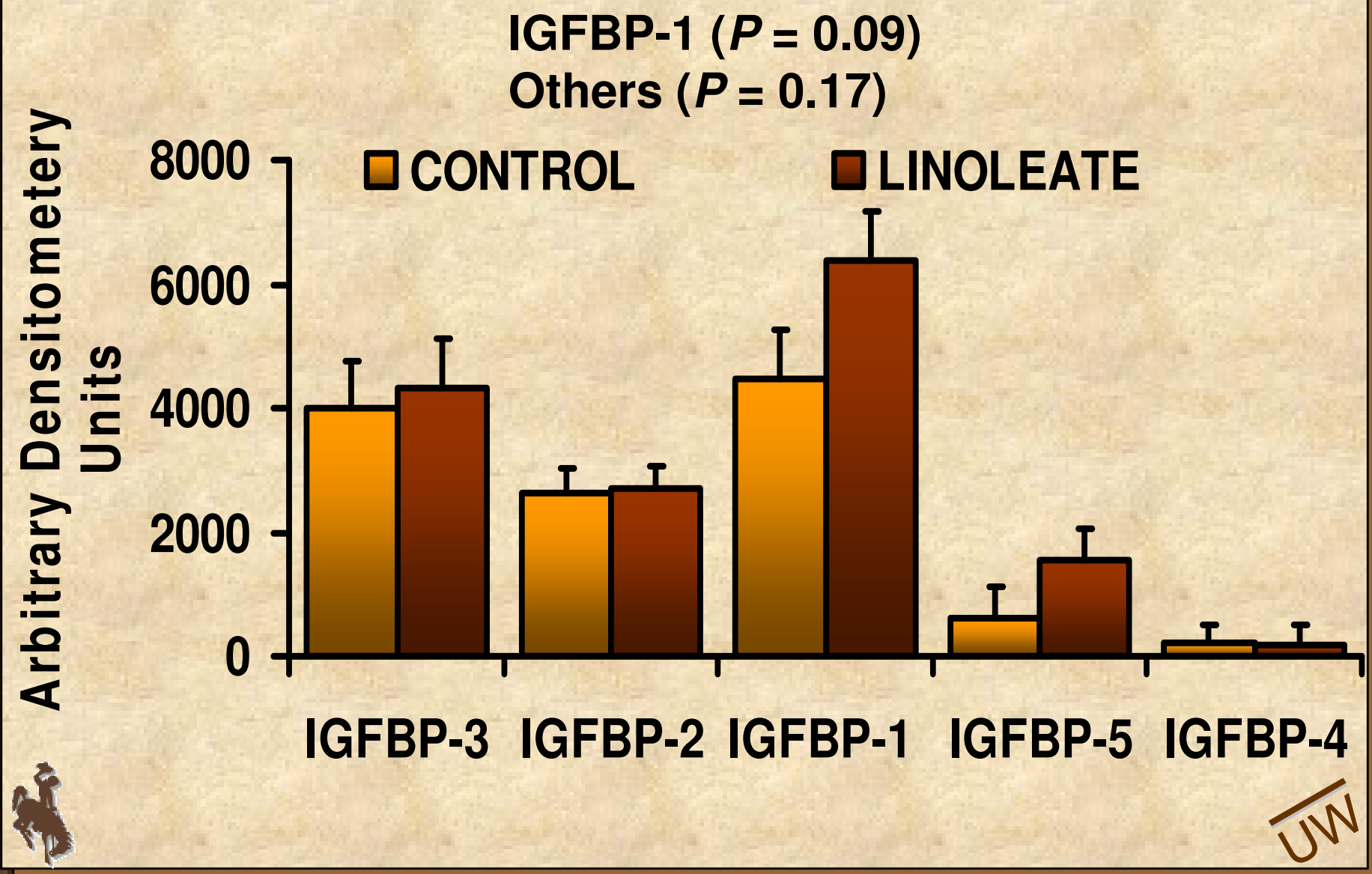
Medial Basal Hypothalamus IGF-I



Follicular Fluid IGF-I



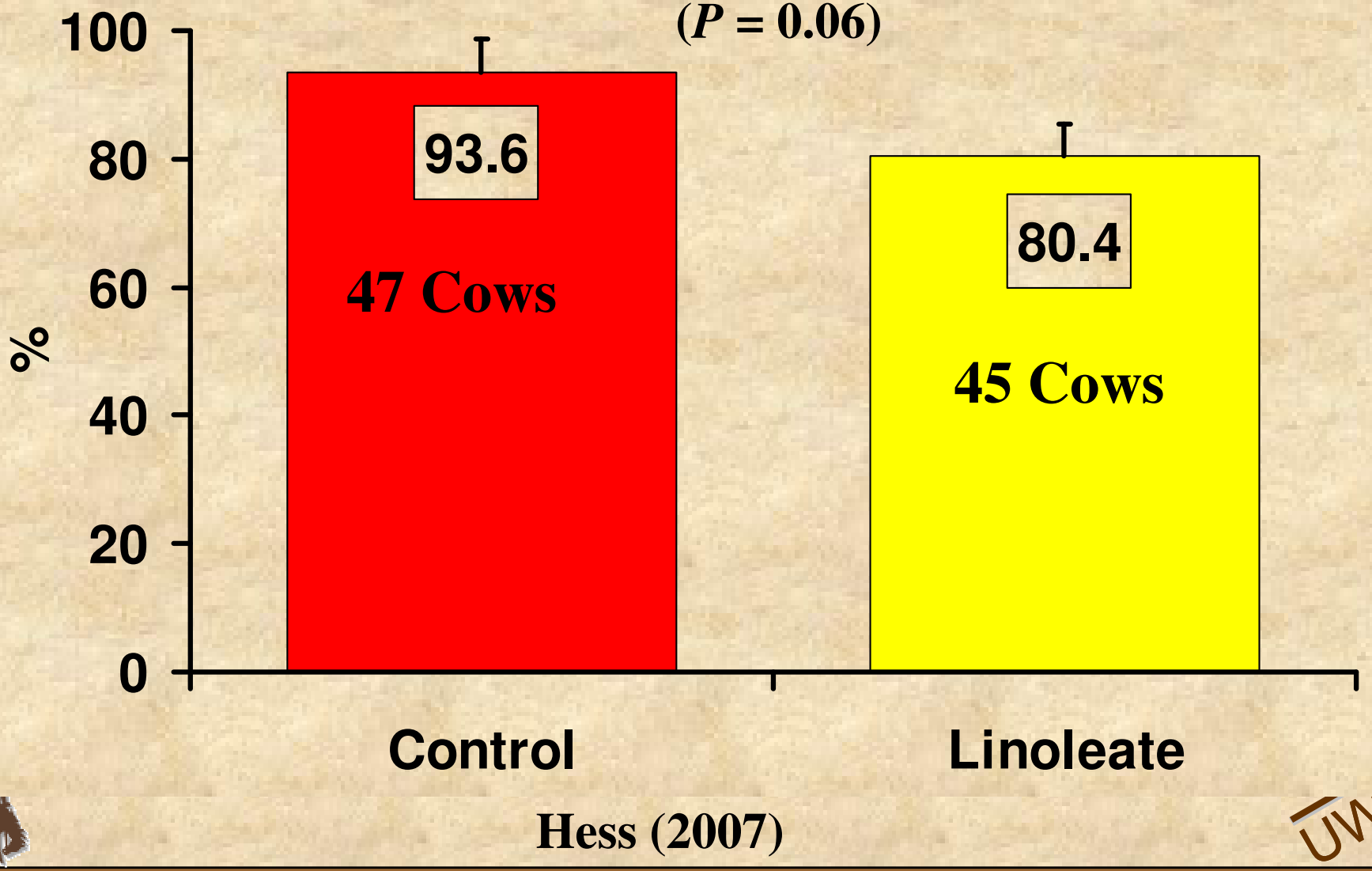
Pooled Follicular IGFBP



“Perturbations of the IGF-I system as a result of supplemental linoleic acid may reduce reproductive function in beef cows.”

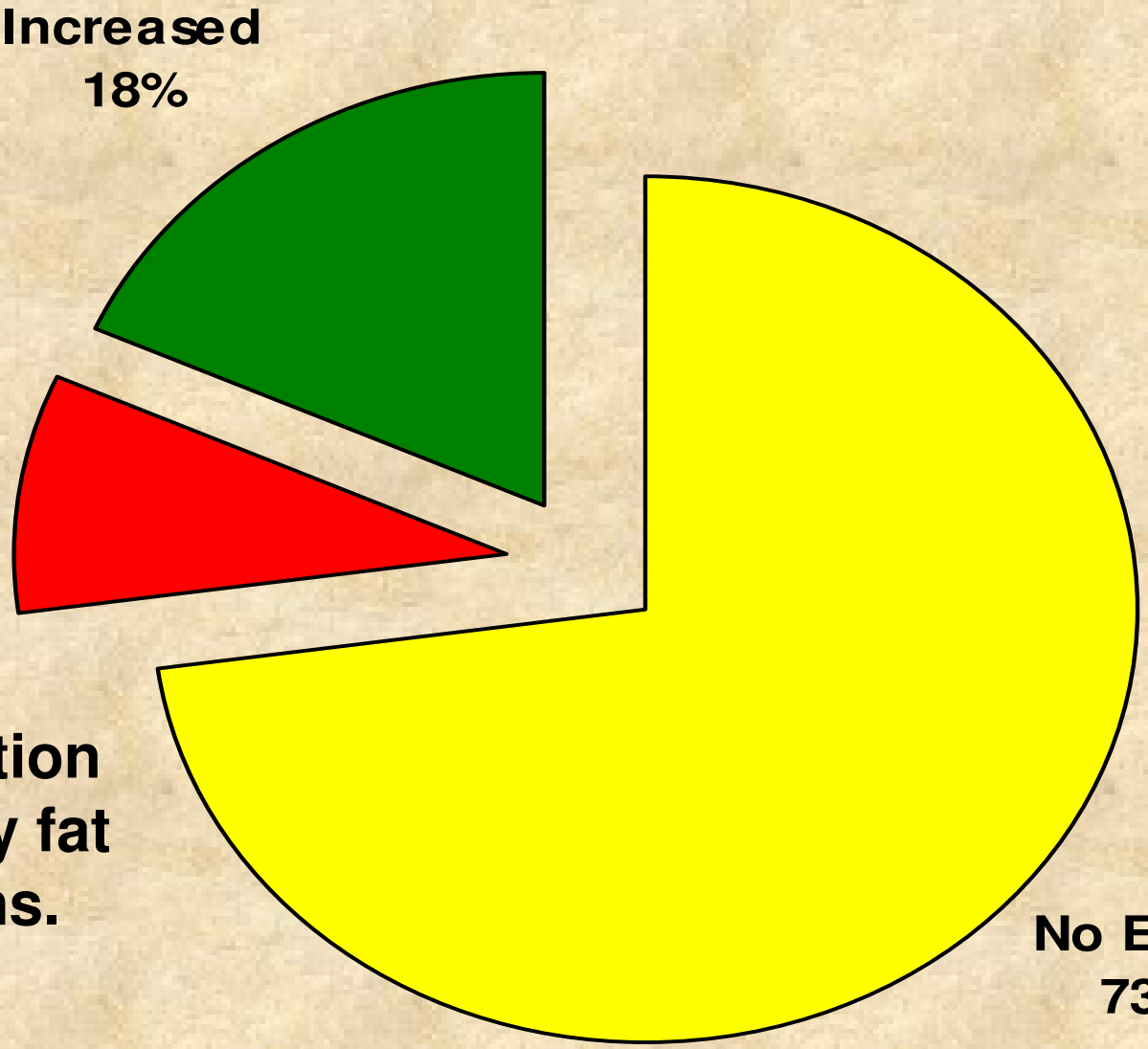
(Scholljegerdes et al., 2003)

Pregnancy Rates



Hess (2007)

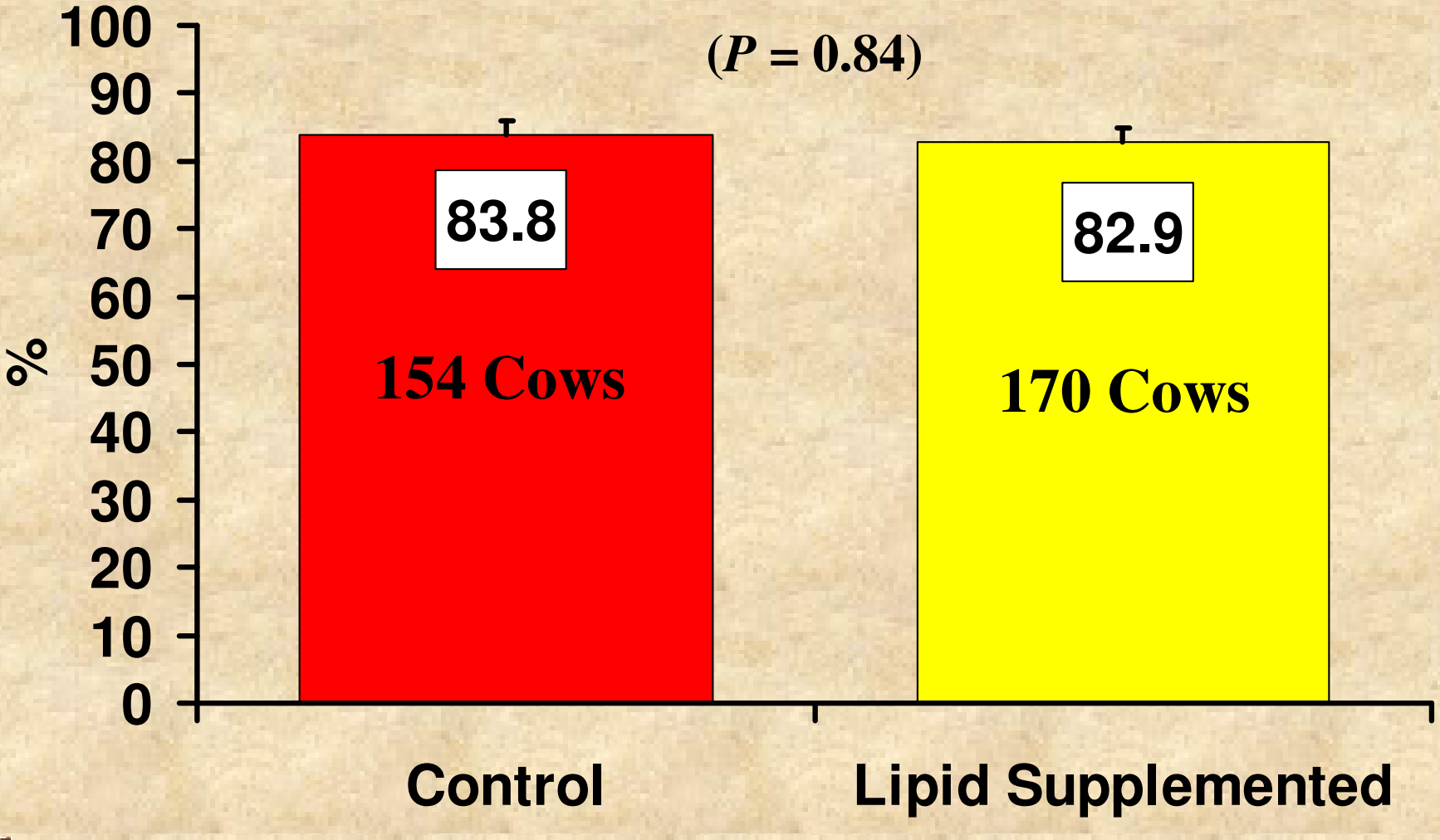
Detection of Normal Estrus



Summarization of 11 dietary fat comparisons.

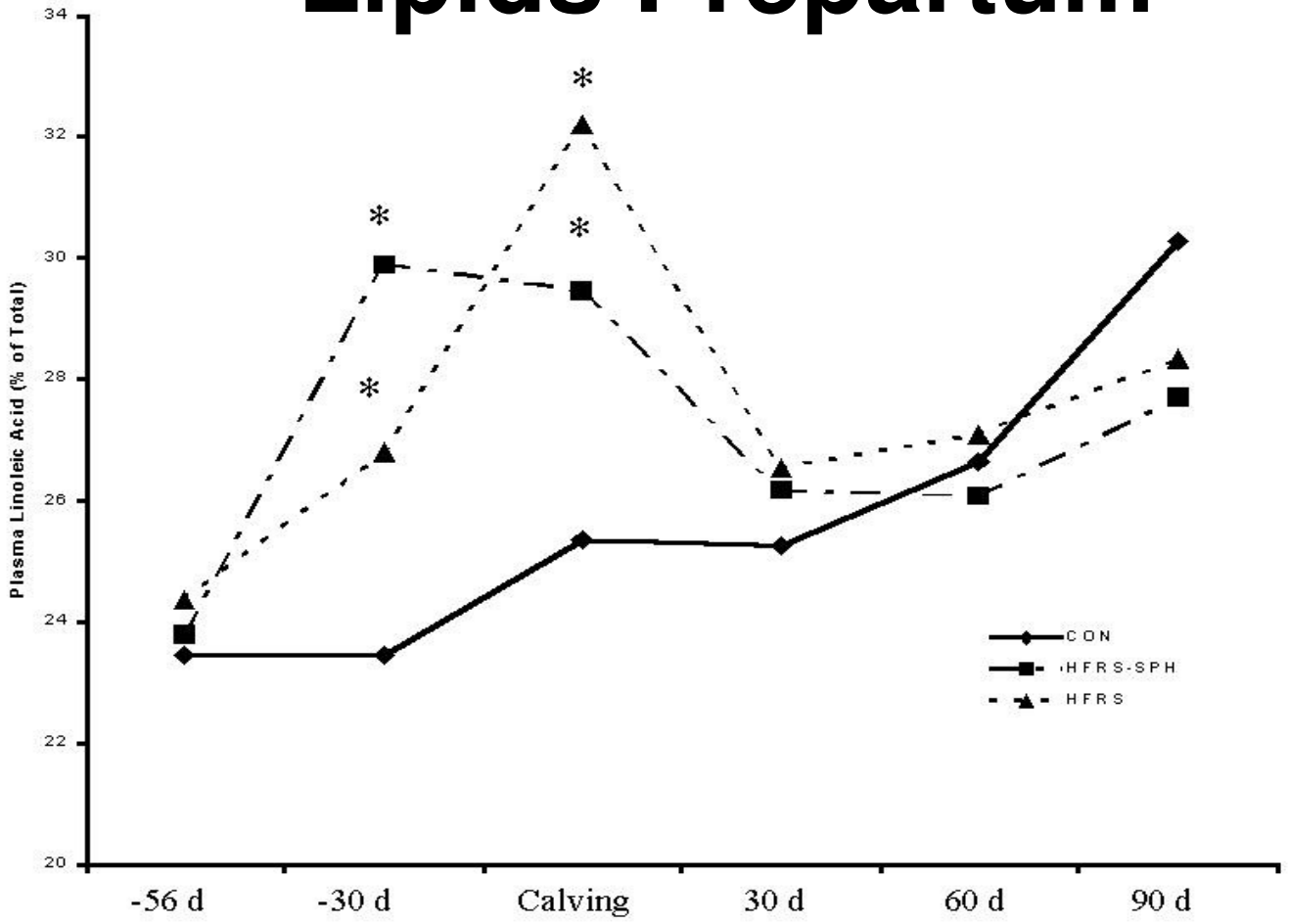
Adapted from Hess et al. (2002)

Overall Pregnancy Rates



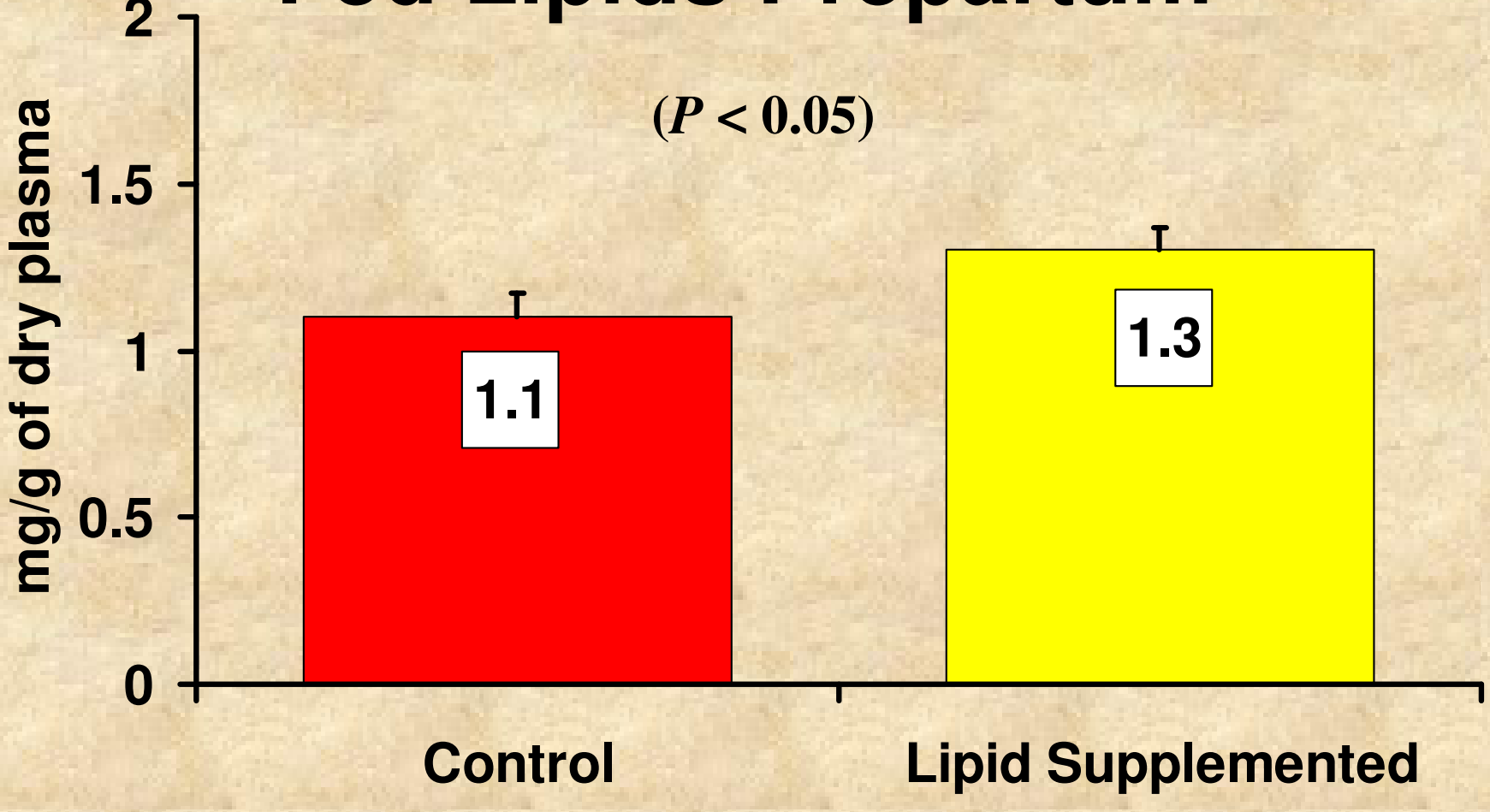
Hess et al. (2002)

Plasma 18:2 of Cows Fed Lipids Prepartum



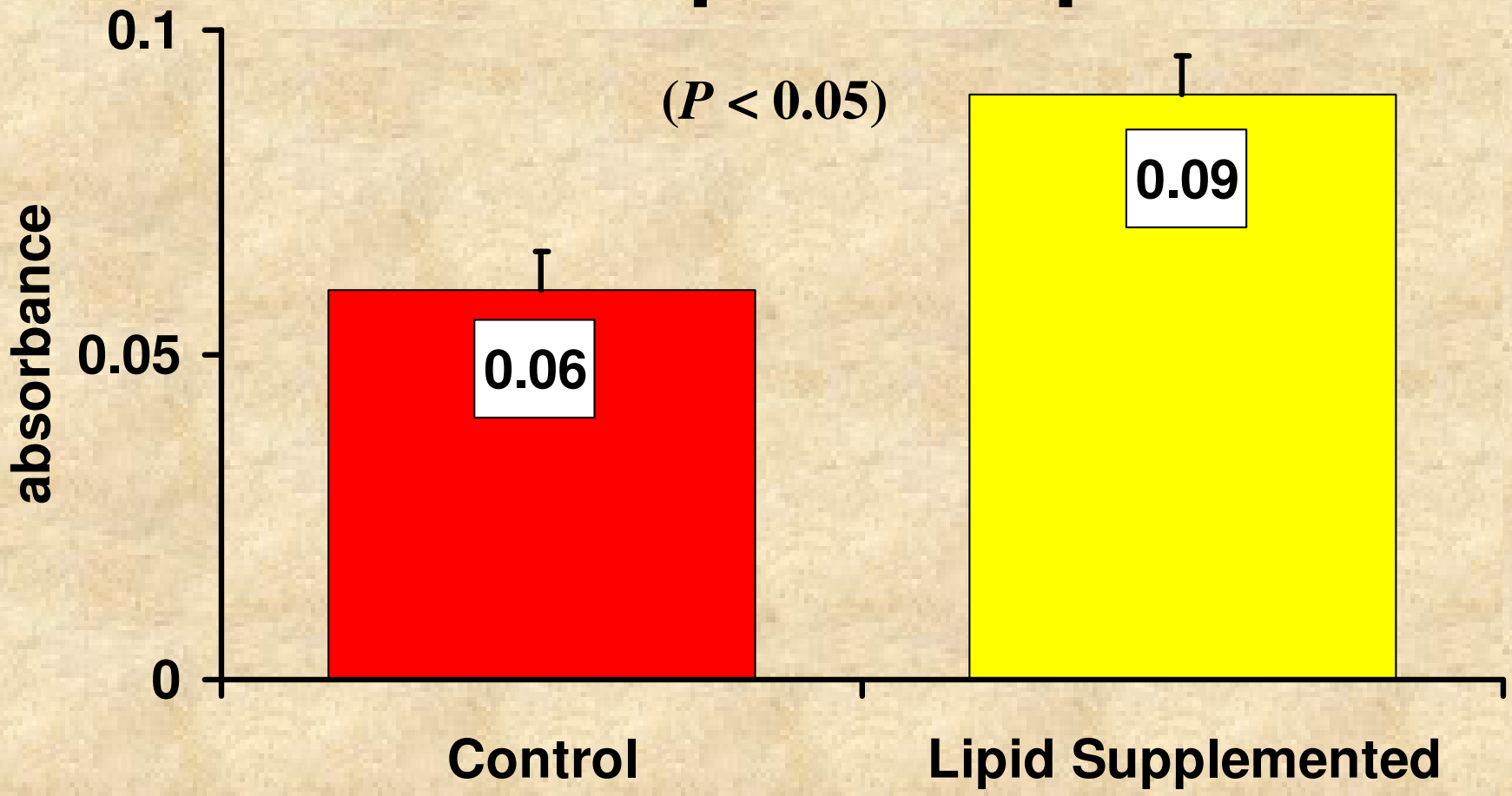
Alexander et al. (2002)

Plasma 18:2 of Calves from Cows Fed Lipids Prepartum



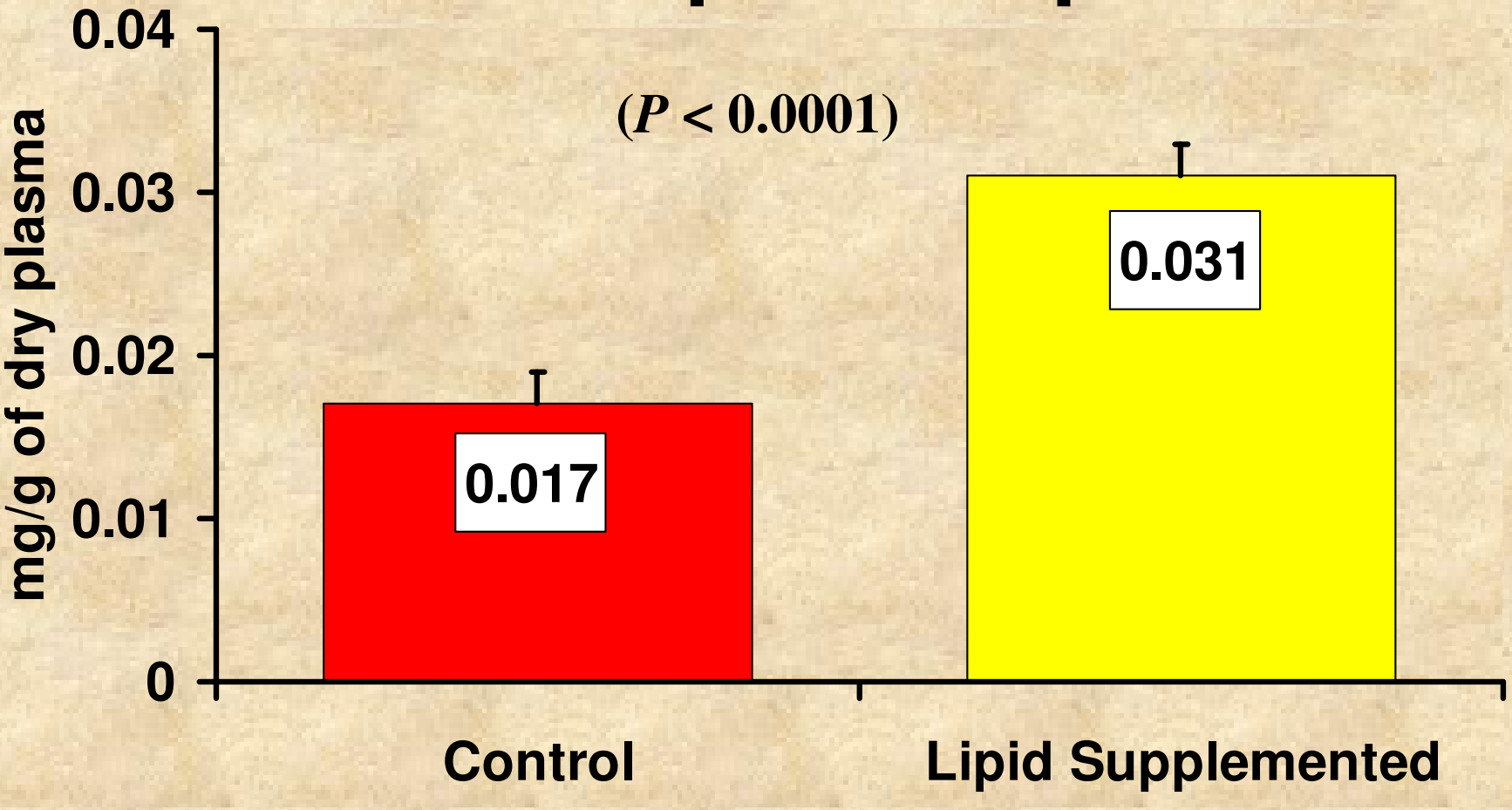
Small et al. (2004)

Immune Response of Calves from Cows Fed Lipids Prepartum



Small et al. (2004)

Plasma CLA of Calves from Cows Fed Lipids Prepartum

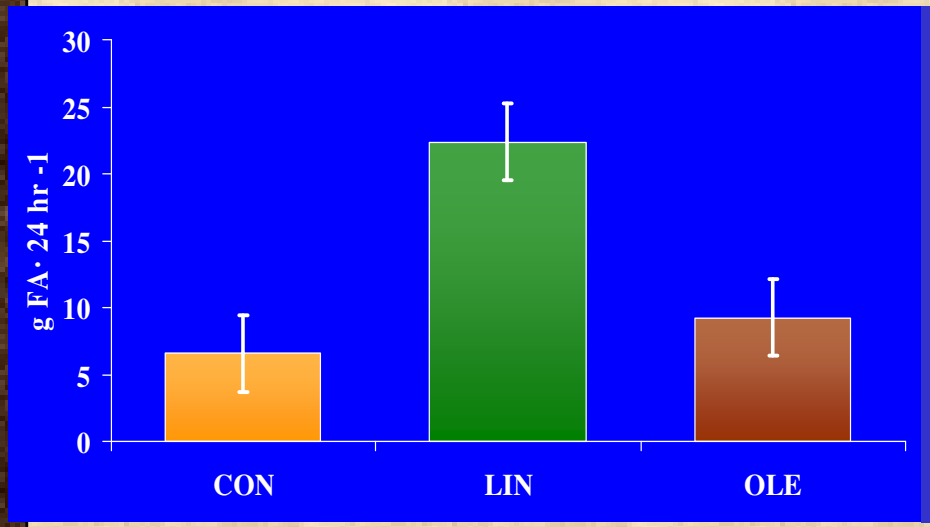


Small et al. 2004


PEARSON

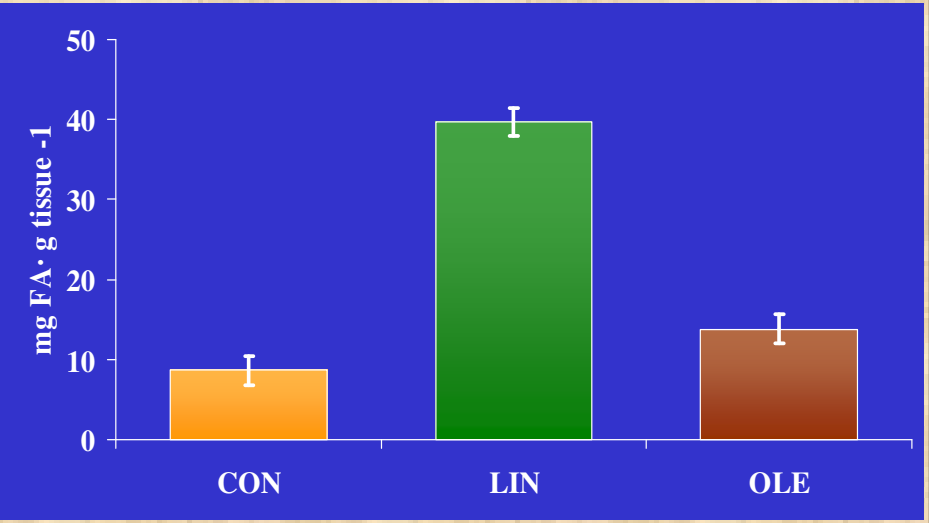
Relationship Between Milk TVA and Calf Adipose TVA

$P = 0.001$



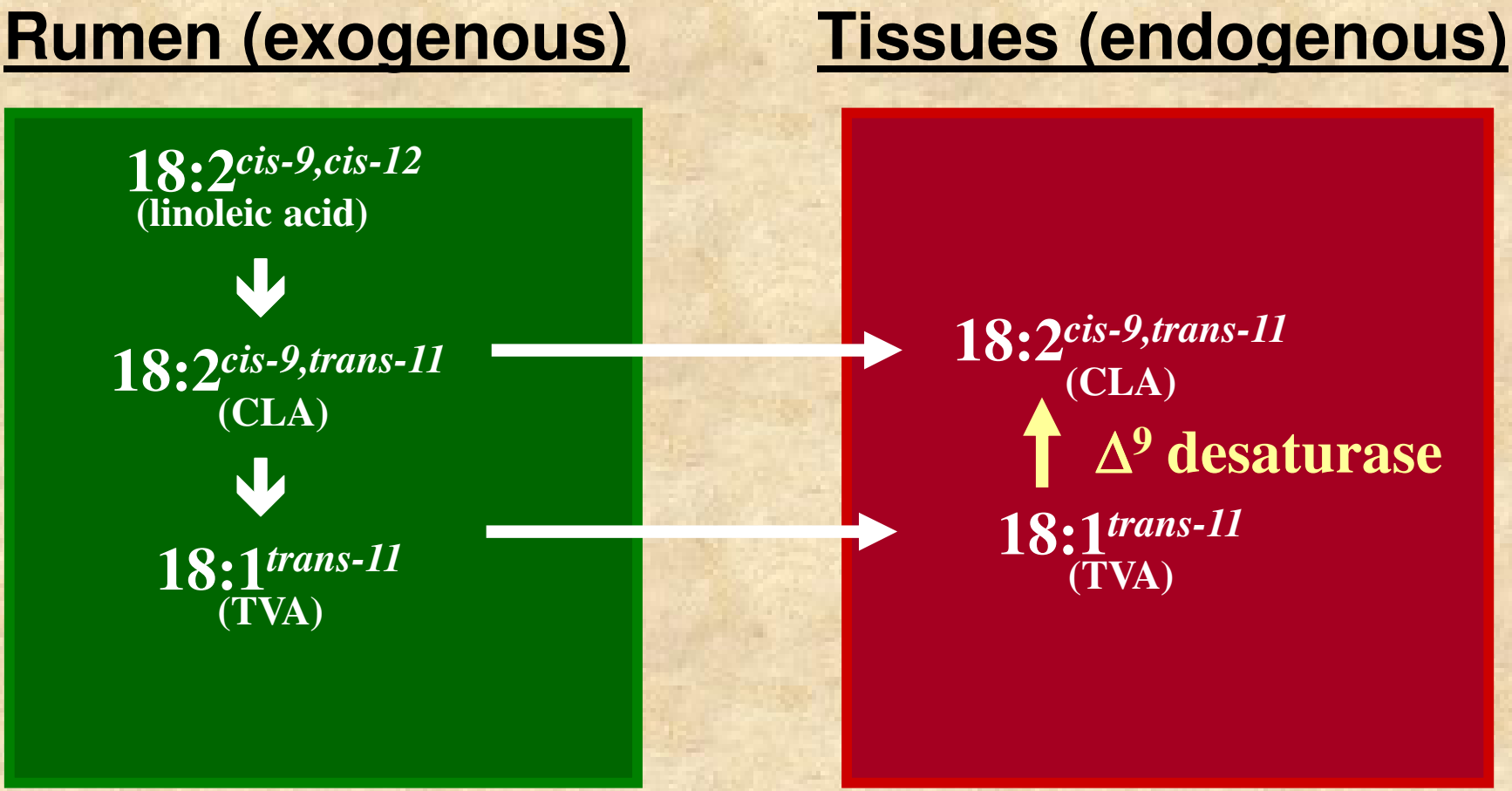
Milk

$P < 0.0001$



Calf

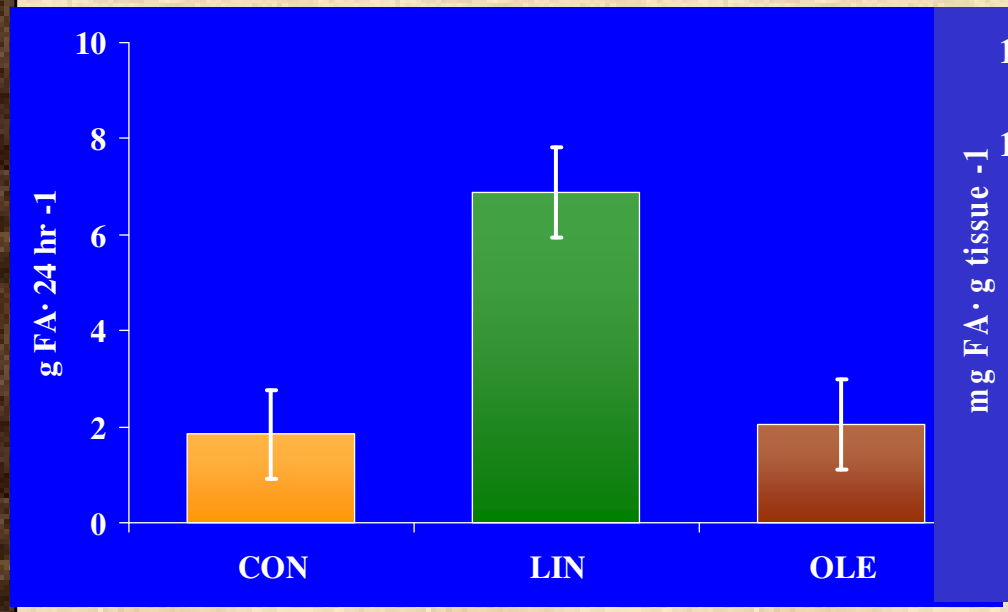
Pathways of CLA Biosynthesis



Adapted from Griinari and Bauman (1999)

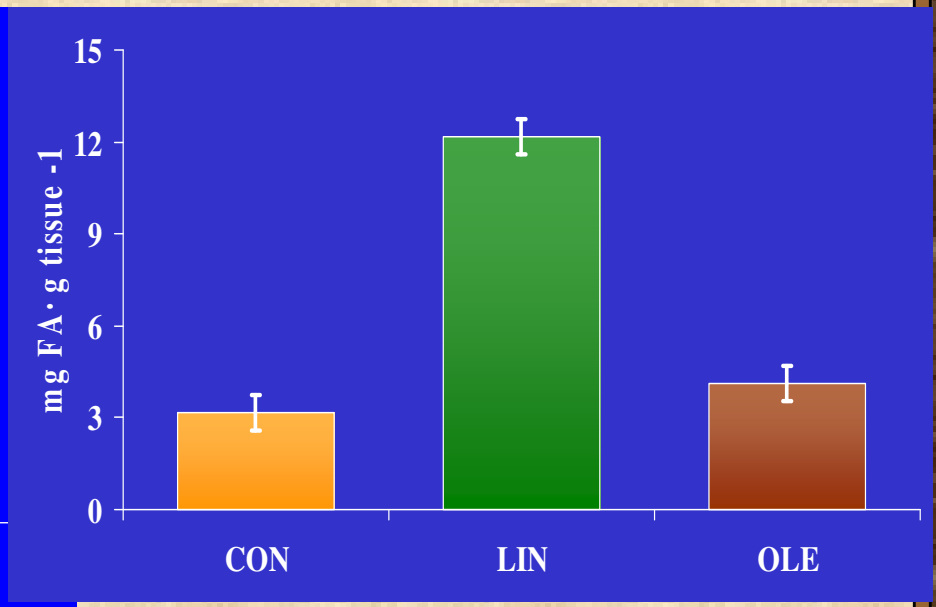
Relationship Between Milk TVA and Calf Adipose CLA

P = 0.001



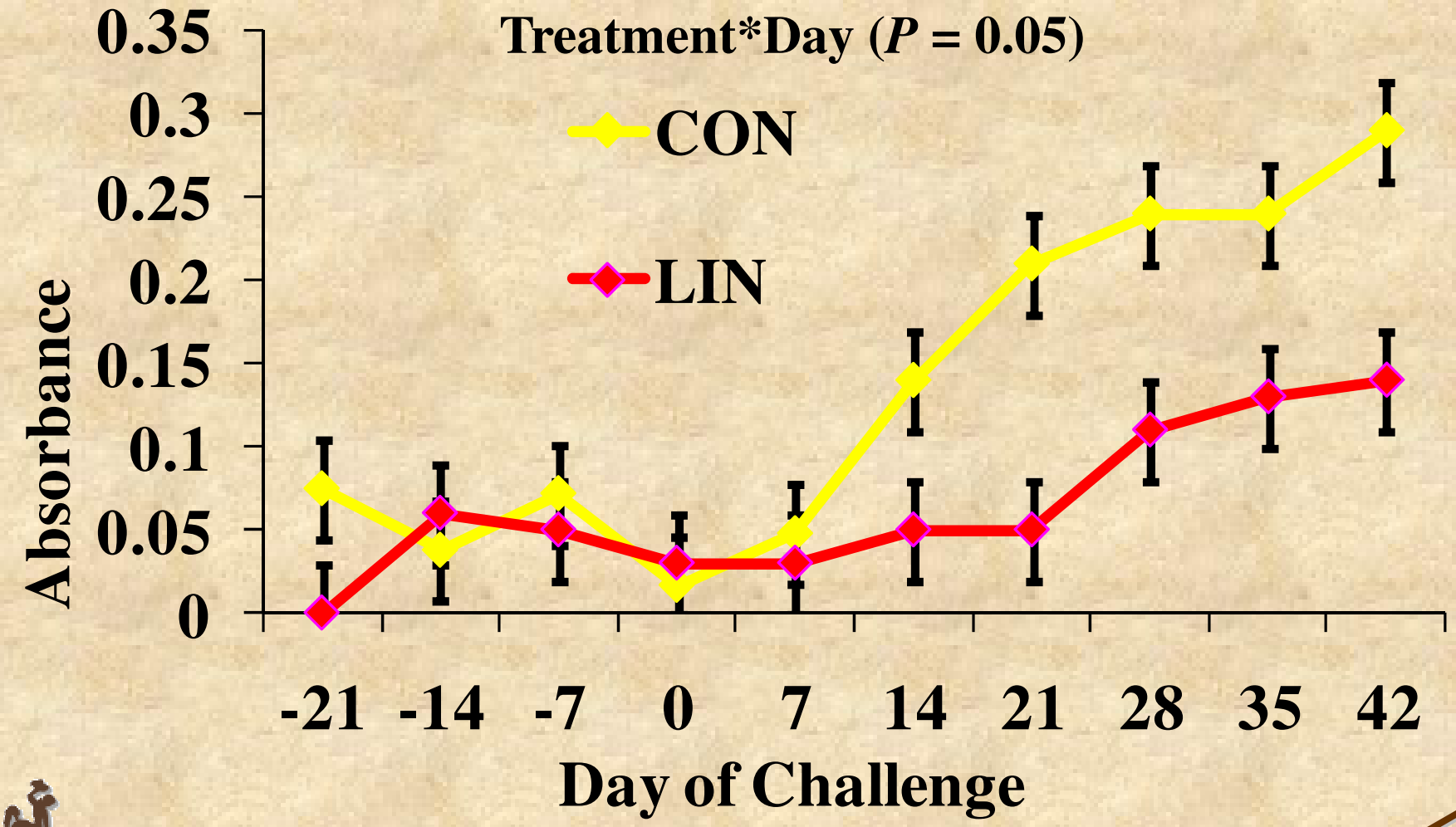
Milk

P < 0.0001



Calf

Antigen Response



Lake et al. (2006b)

Summary

Supplementing fat can be an effective strategy to increase energy density of the diet, but not in excess of 4% of DM intake.

Limiting supplemental fat to 2% of dietary DM will help prevent negative associative effects.

Extensive ruminal biohydrogenation of dietary C18 unsaturated fatty acids does not preclude the ability to alter unsaturated fatty acid status, including biohydrogenation intermediates.

UW

Summary

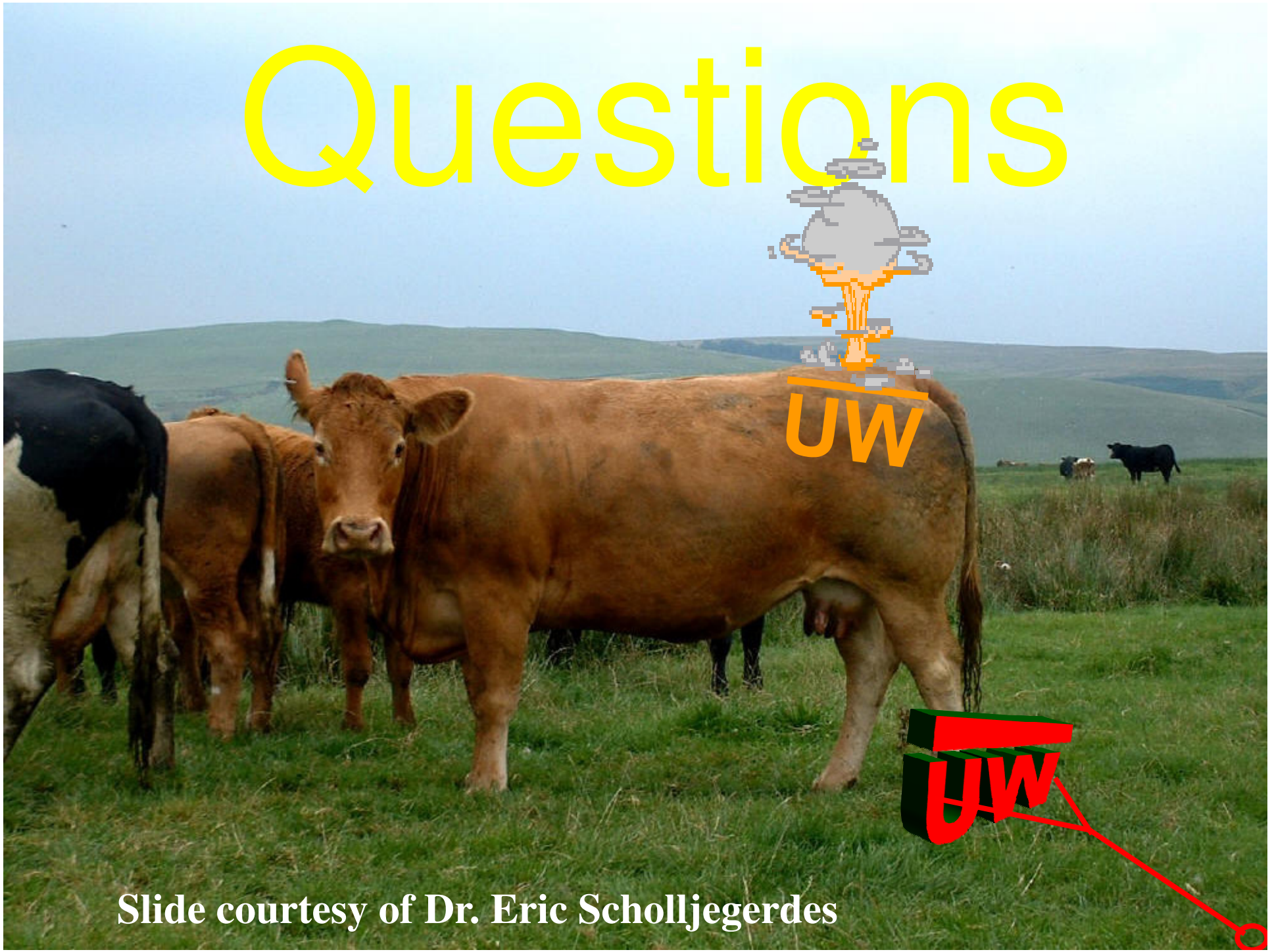
Positive effects on reproductive processes in beef cattle fed fat have been attributed to changes in unsaturated fatty acid status.

Developing replacement heifers should be fed supplemental fat for 60 to 90 d before the breeding season.

Although feeding fat prepartum seems beneficial, provision postpartum results in an equivocal response on pregnancy rate

- not 16 to 18 g/d of 18:2.

Questions



Slide courtesy of Dr. Eric Scholljegerdes