Defining the Role Nutrients Play in Beef Cows Reproduction – Ways to Improve Biological and Economic Efficiency

M.K. Petersen, J.T Mulliniks, R.C. Waterman

USDA-ARS Fort Keogh Livestock & Range Research Center

New Mexico State University

OUTLINE

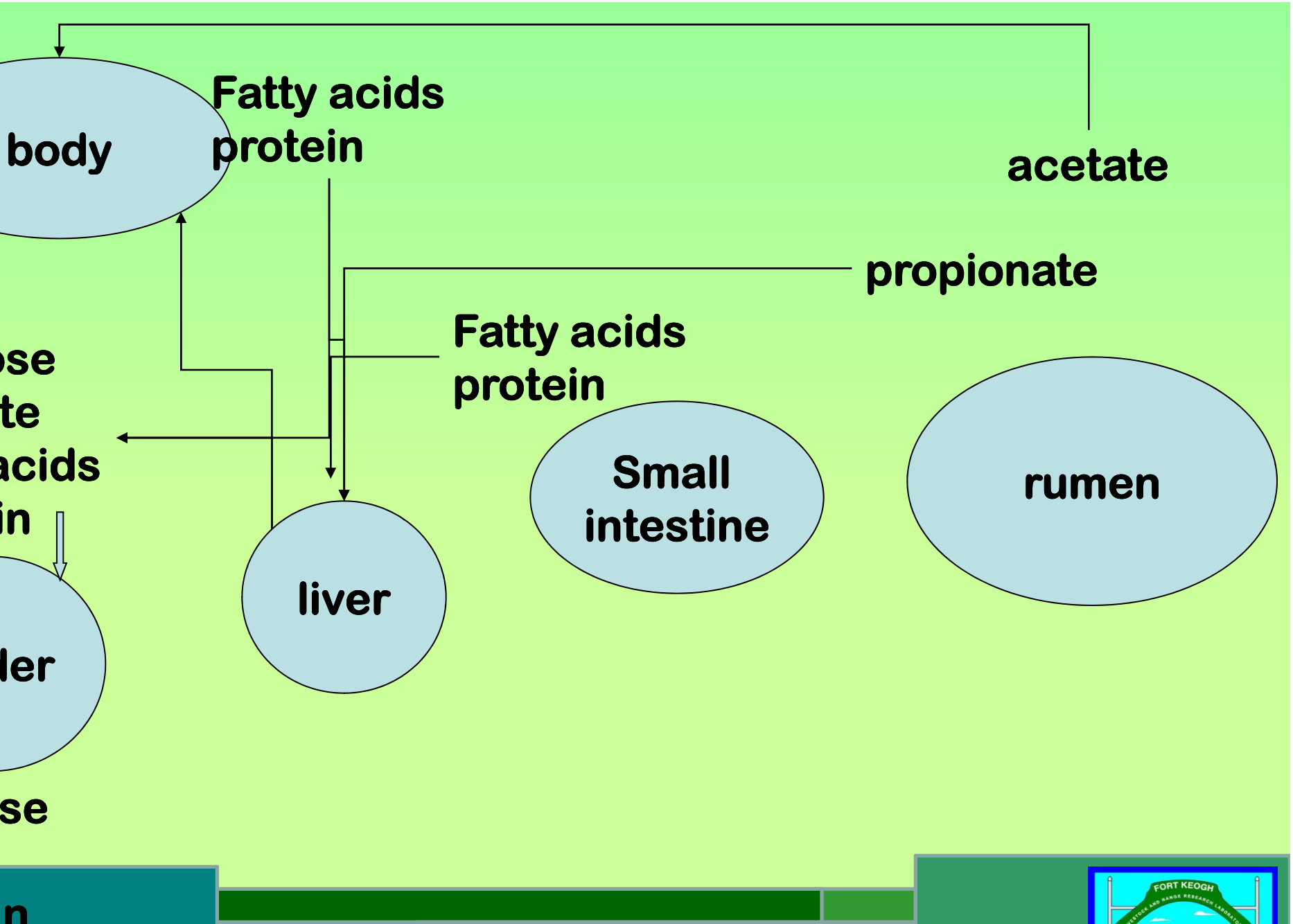
- Define problem
- Consequences of undernutrition
- Strategies to alleviate metabolic limits
- Responses to fat supplementation
- Responses to glucogenic precursors
- Summary
- Implications

UNDERNUTRITION

- Changing nutrient requirements
  - stress
- Requirements versus intake
  - low protein
  - inadequate glucose precursors
  - restricted intake
- Primarily acetate production
- Fat mobilization

UNDERNUTRITION

- Oxidative energy requirement
- Glucose requirement
  - acetate oxidation
  - fetus
  - milk production (lipid and lactose)
- Metabolism directed to gluconeogenesis
- Stimulating weight loss


body
Fatty acids
protein
acetate
propionate
Fatty acids
protein
Small
intestine
rumen
liver

NDERNUTRITION-lactating beef

w

ow's daily glucose

- 10g lactose
- 62g fat (58g glycerol)
- aily catabolism

ow glucose sources

- 4g N urine (213g prot)
- 60g (900g glucose)

- Glucose carbon

257 g

23 g

176 g

456 g C (1140 g)

96 g

360 g

456 g

NDERNUTRITION

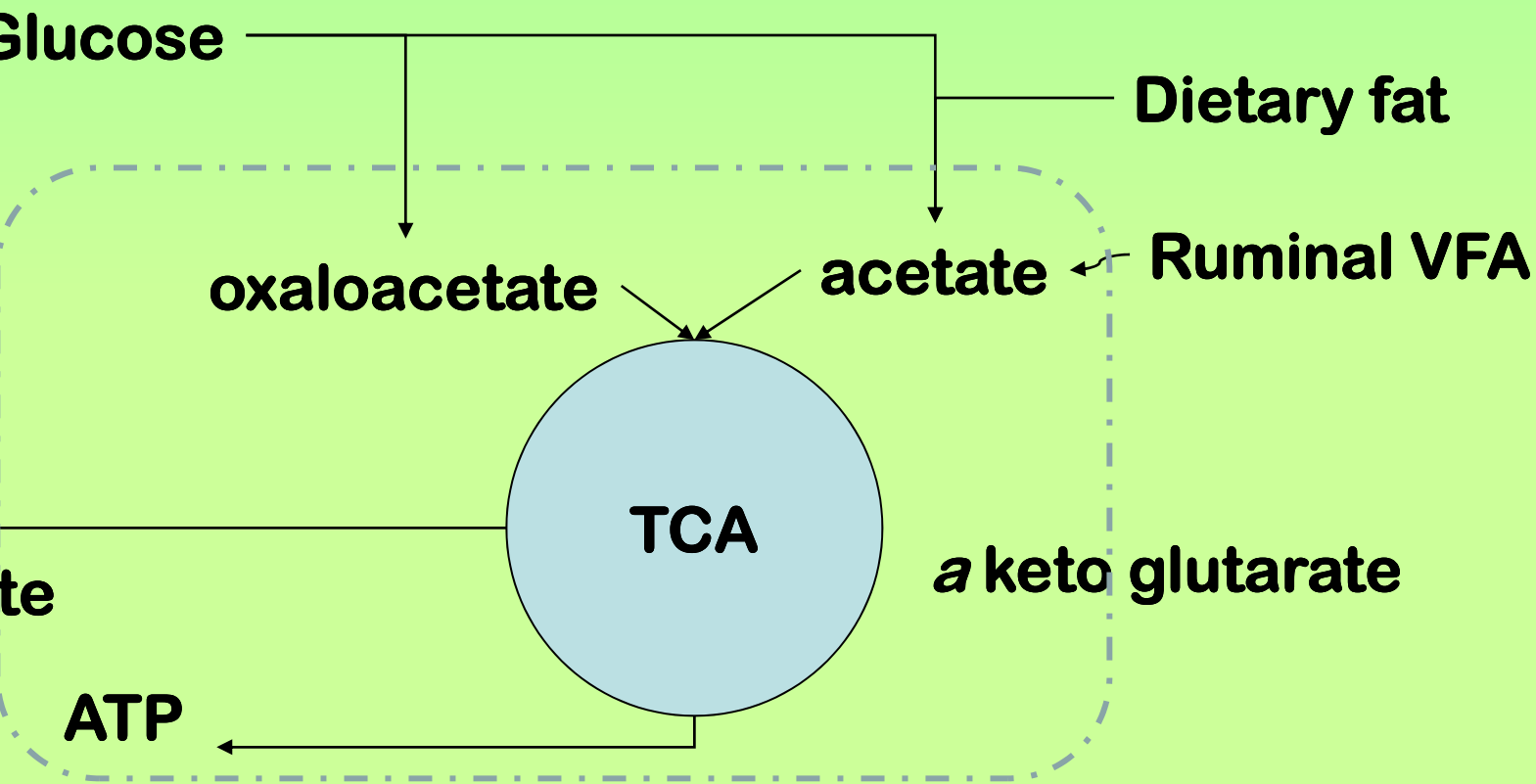
What are responses to declining glucose?

- gluconeogenesis from AA etc.
- glucocorticoids initiate mobilization of protein and lipids
- growth hormone promotes AA uptake

NDERNUTRITION-lactating beef or dairy cow

- cose requirement for lactose synthesis
- cose requirement milk fat synthesis
- cose precursors are required for energy etabolism (acetate for ATP production)

NDERNUTRITION-lactating beef or dairy cow



NDERNUTRITION-lactating beef or dairy cow

- glucose requirement for lactose synthesis
- glucose requirement milk fat synthesis
- lucose precursors are required for energy metabolism (acetate for ATP production)
- f inadequate glucose supply then protein is used or synthesis (dietary or body)

NDERNUTRITION-lactating beef or dairy cow

hat happens if we supply fat in the diet?

der requirement for fat synthesis is less

ares (increases) the glucose supply for lactose

reases milk production (lactose drives milk)

proves energy efficiency for acetate metabolism

FATS & THE POSTPARTUM COW

nt sources shorten the onset of luteal activity

lavera et al 1985, Wehrman et al 1991, Ryan et al 1992, & 95.

ybean oil (linoleic acid) increases;

nsulin and medium sized follicles

teal progesterone synthesis, secretion and licular growth

FATS & THE POSTPARTUM COW

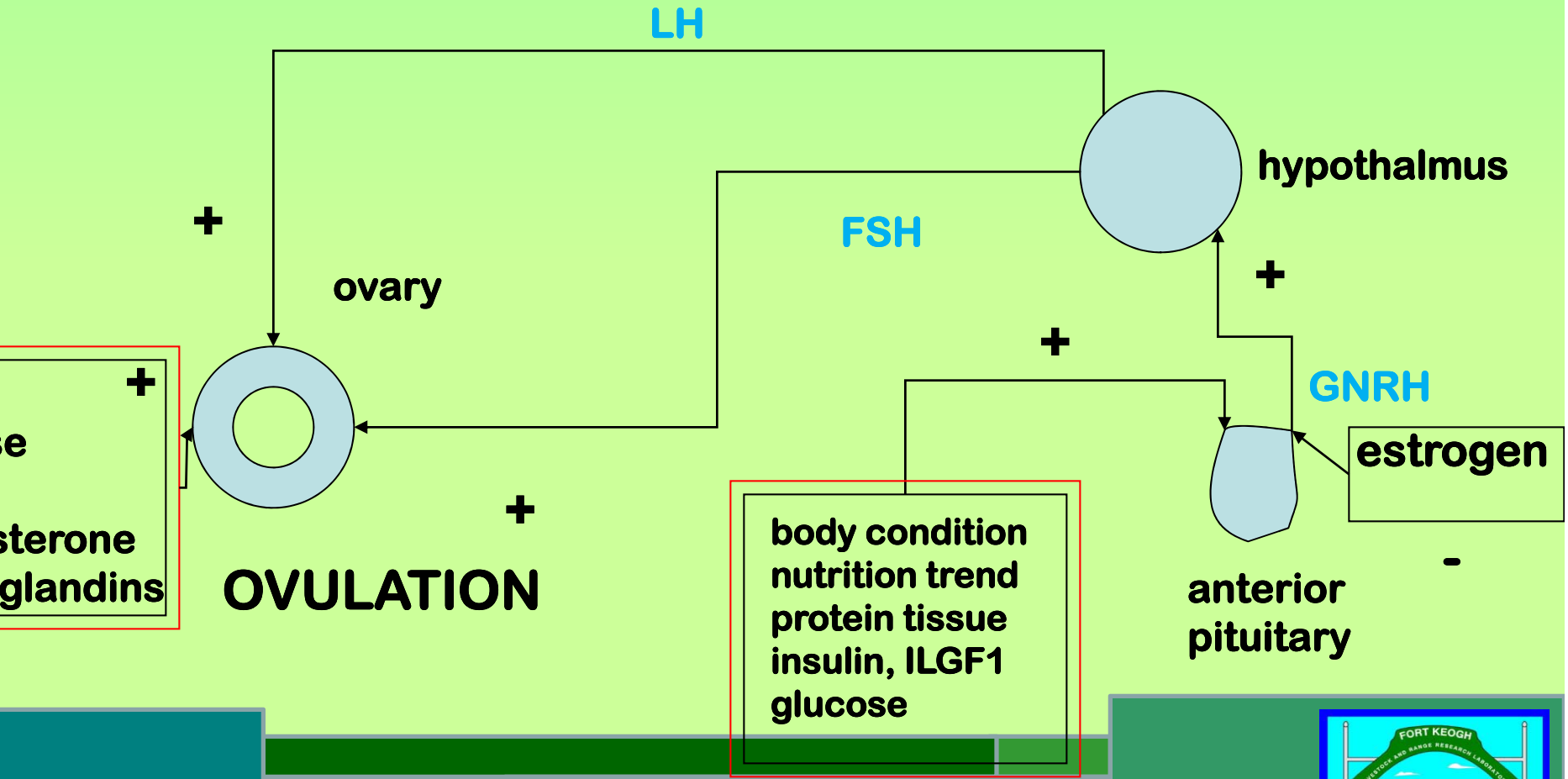
- Suggested rate 4% or greater to influence reproductive traits (Williams 1996 & 1997)
- Rice bran supplementation improved pregnancy rates (94 vs. 71%) DeFries et al 1998
- Fat containing supplements fed postpartum increase milk production and possibly weaning weights

NDERNUTRITION and PRODUCTION

upplemental fat promotes

- prostaglandins synthesis (enhances luteal regression)
- ⇧ progesterone by ⇩ clearance
- ⇩estrogen ⇩negative feedback

NDERNUTRITION and REPRODUCTION

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GENERALIZED EFFECTS OF FEEDING FAT to BEEF COWS

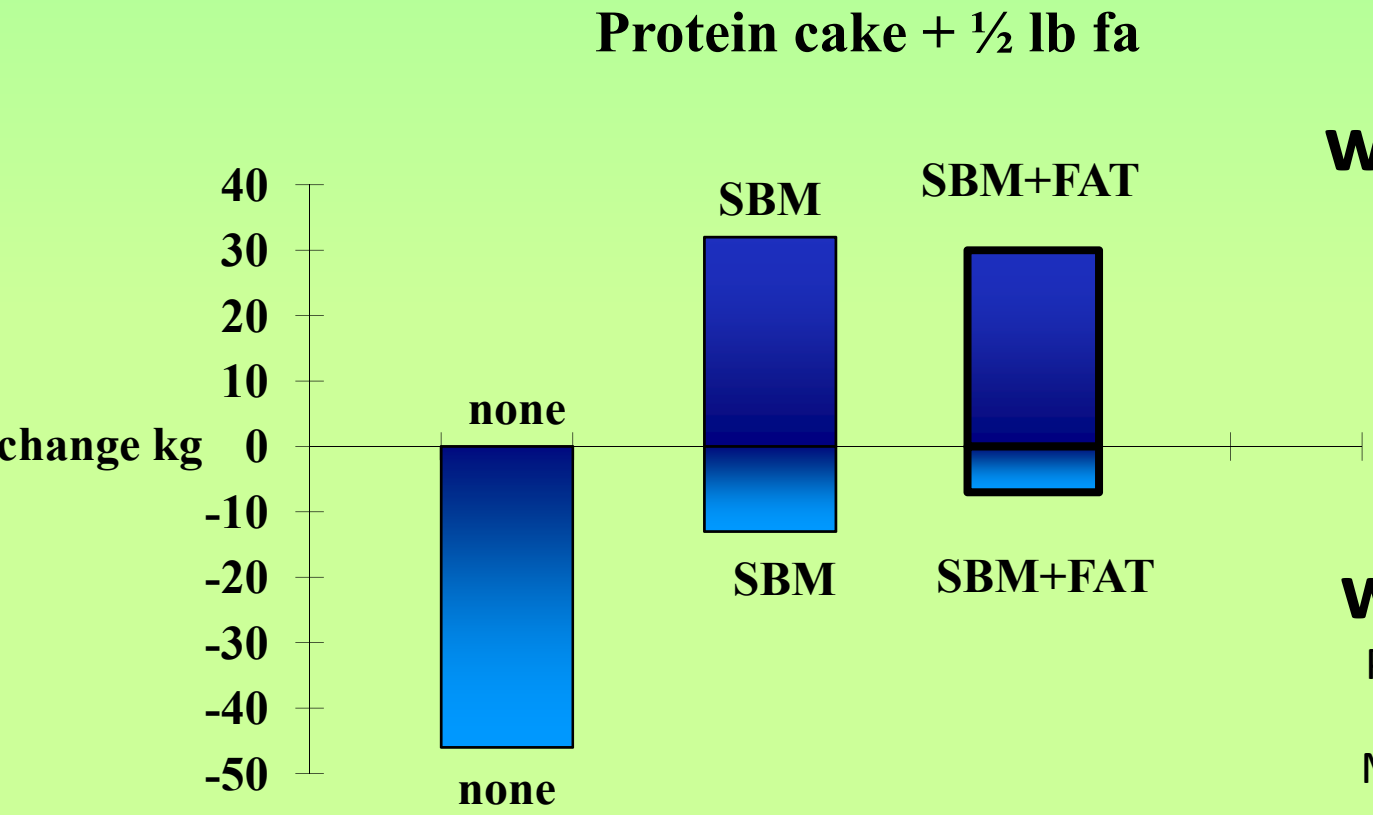
NERALIZED EFFECTS OF FEEDING FAT

- ered types of fat incorporated into milk
- proves milk production efficiency (reduction of fat nthesis)
- gher peak milk yield and extended lactation curve
- ecrease in milk protein
- ver services per conception
- effect on reproduction

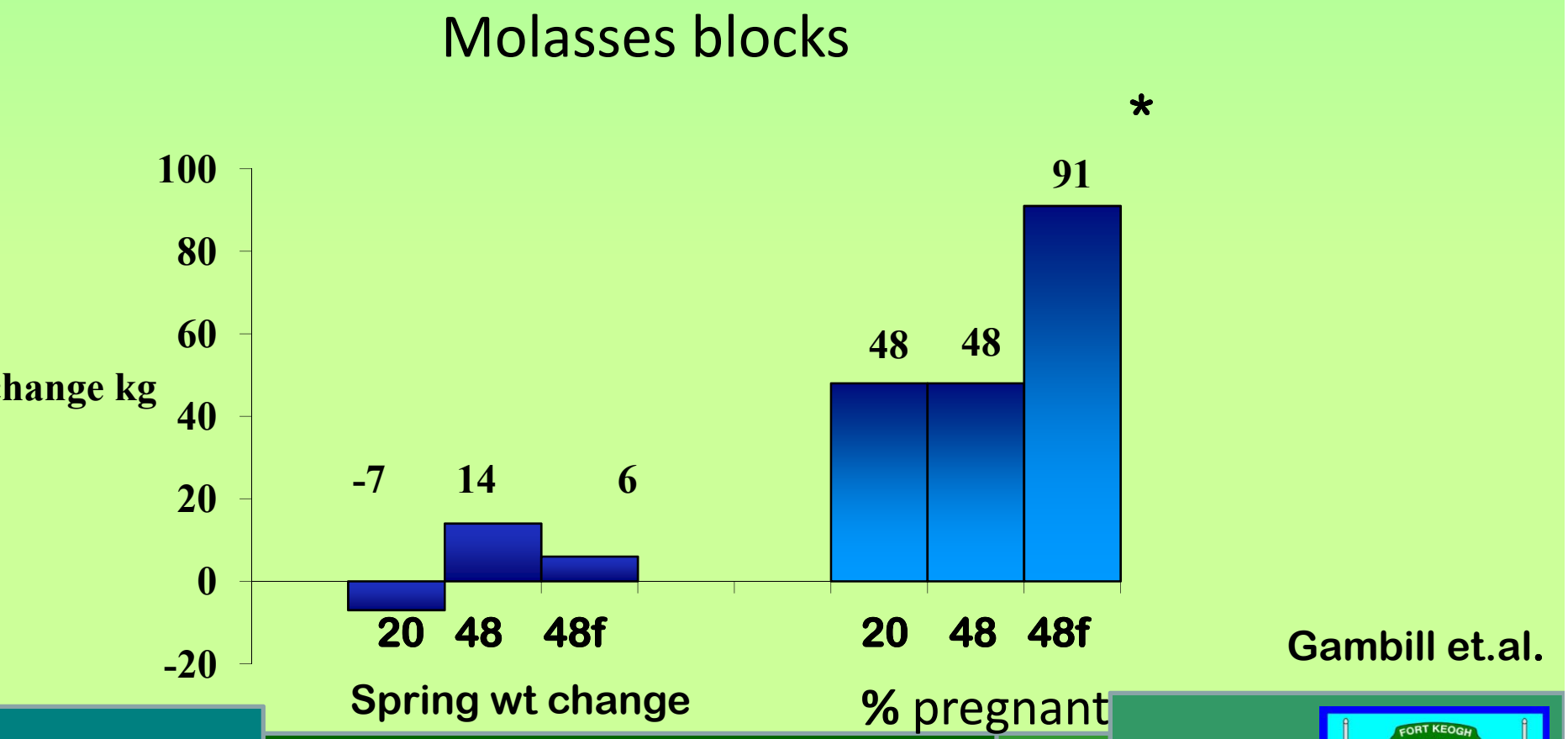
RESULTS OF FAT UPPLEMENTION TO RANGE COWS (1985 to 2000)

Corona Range & Livestock Research Center - NM

WINTER STRESS & SUPPLEMENTAL FAT

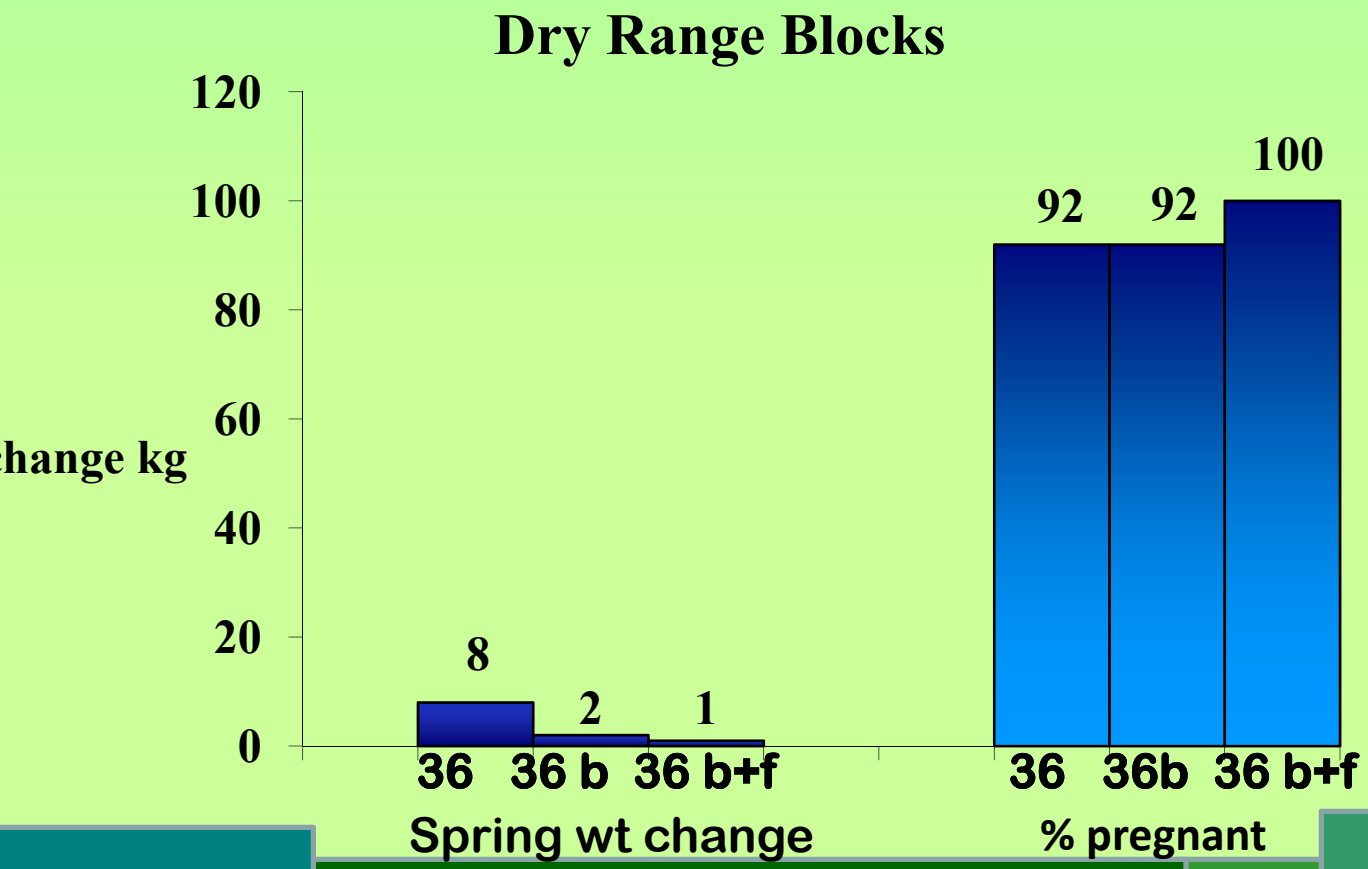


AFTER CALVING STRESS & SUPPLEMENTAL FAT (yr 2)



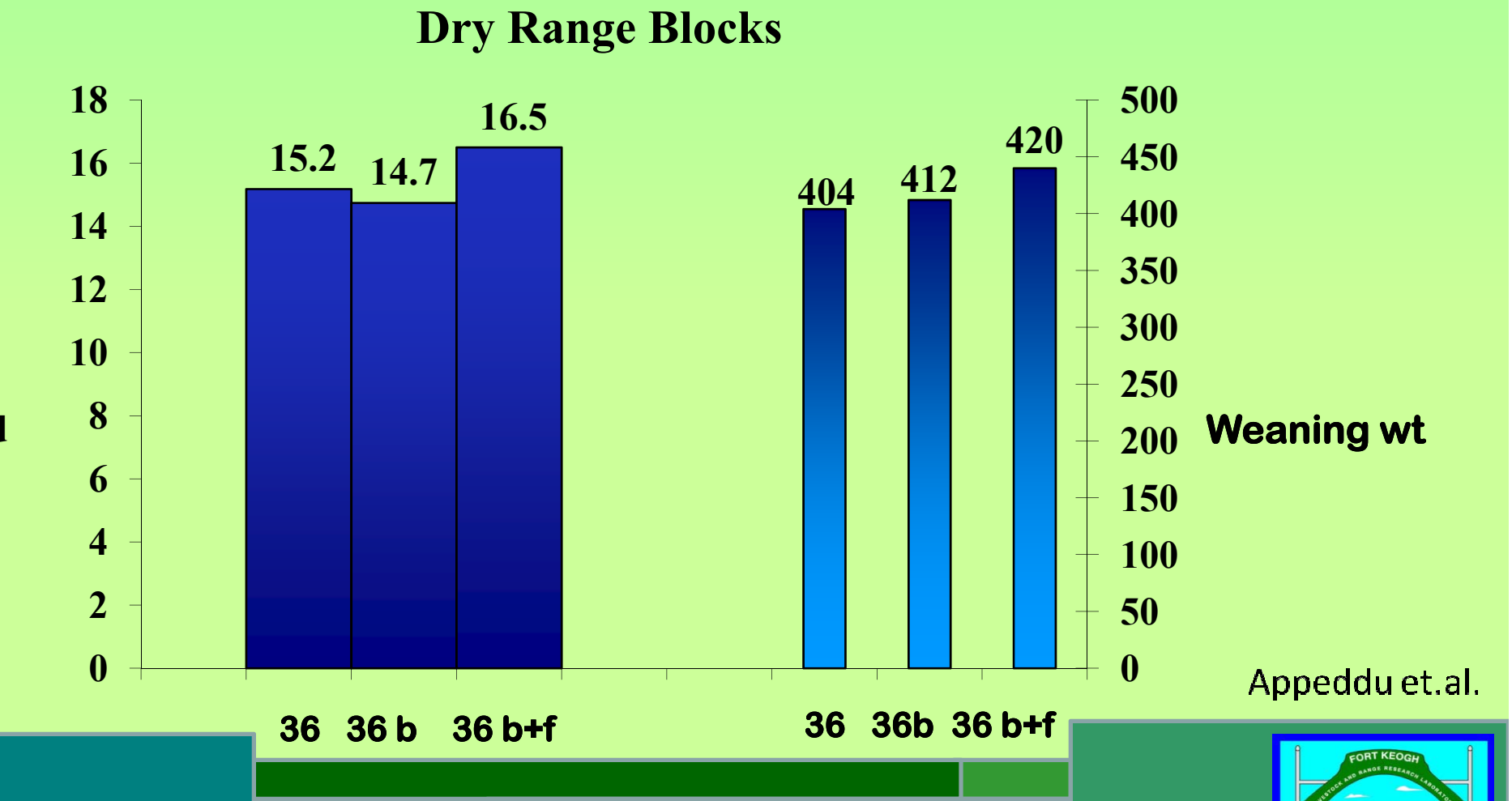
Gambill et.al.

AFTER CALVING STRESS & SUPPLEMENTAL FAT

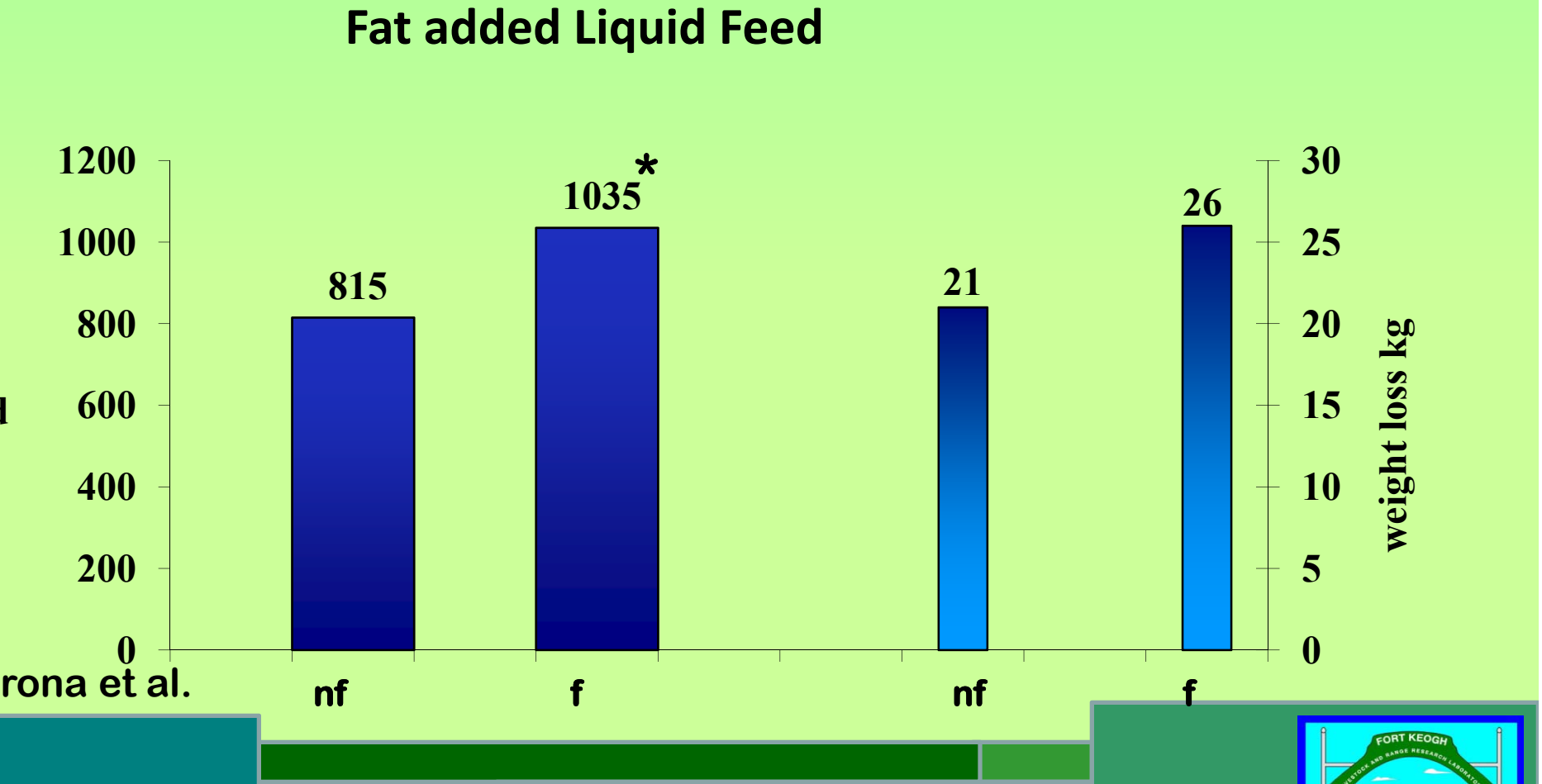


Appeddu et.al.

AFTER CALVING STRESS & SUPPLEMENTAL FAT



MID LACTATION RANGE COWS FED IQUID FEED + FAT



rona et al.

Post Calving Fat Supplementation

determine the effects of supplementing fat to range
vs on:

- Nutritional status.
- Lactational performance.
- Serum constituents.
- Reproductive performance.
- Calf growth.

terials & Methods Experiment *I*

imals, Treatments, & Pastures:

One hundred forty three English cross or English-Simmental cross cows were stratified by weight and assigned to treatments .

All cows had been verified pregnant the previous fall by rectal palpation.

Materials & Methods Experiment I

imals, Treatments, & Pastures.

Treatments were:

- 1) negative control, no supplement (NC),
- 2) liquid supplement w/ urea (U),
- 3) supplement 2 plus 12% fat (UF),

Materials & Methods Experiment I

Supplementation began one week before the expected start of calving (2/11/98: d 1).

Materials & Methods Experiment I

- mals, treatments, & pastures.
- Calves were branded, castrated, vaccinated, and implanted with Synovex S at the time of pasture rotation.
- Two bulls were placed in each pasture on May 5, 1998.
- Supplementation ended and cattle were placed in a common pasture on June 5, 1998 (d 114).

PLEMENT INTAKE

erage supplement intake d 1 - d 114:

U 1.2 lb/hd/d.

UF 1.6 lb/hd/d.

t of fat in liquid supplements fed to cows
ng native range on Body Weight.

	Treatments				Contrast,	
	NC	U	UF	SEM[b]	1	2
	23	25	22			
nge, kg						
d 114	-81	-18	-50	15.0	.01	.01

ved significance level for contrasts: 1 = NC vs supplement,
at vs no fat .

rd error

ct of fat in liquid supplements fed to cows ing native range on Body Condition.

	Treatments				Contrast,	
	NC	U	UF	SEM[b]	1	2
	23	25	22			
CS	3.6	3.8	3.7	.11	.53	.28
ange						
d 114	-.67	-.19	-.18	.13	.01	.15

served significance level: 1 = NC vs supplement,2 = fat vs no fat .

error of the least squares mean.

ect of fat in liquid supplements fed to cows zing native range on Calf Weight .

	Treatments				Contrast,	
	NC	U	UF	SEM[b]	1	2
	23	25	22			
g wt						
	216	226	239		4.6	.01 .56

d significance level for contrasts: 1 = NC vs supplement, 2 = fat vs no fat .

error of the least squares mean.

ect of fat in liquid supplements fed to cows
zing native range on Reproduction

	Treatments				Contrast,	
	NC	U	UF	SEM[b]	1	2
	23	25	22			
ncy %	87	87	91		.59	.98
g interval						
	371	360	353	5.2	.06	.01

d significance level for contrasts: 1 = NC vs supplement, 2 = fat vs no fat .

error of the least squares mean.

Conclusions Experiment I

ea based supplements:

ncreased the plane of nutrition compared to unsupplemented cows.

ncreased reproductive efficiency

pplemental fat resulted in nutrients being ected toward lactation.

Resulting in improved calf growth..

lications

ea based supplements are effective for mature cows
zing native range.

supplements can improve lactational performance.

- Leading to heavier calves at weaning.
- This could lead to an improvement in profitability of cow/calf production.

plications

onomics experiment I:

e value of the calves at weaning minus the supplemental
d cost was.

NC $334

U $341

UF $346

What is our nutritional management strategy?

ow can easily eat all she wants every day

hat is our supplement management strategy?

ew Mexico limiting nutrients include;

Vitamin A & Phosphorous - Knox 1966

Protein - Wallace 1991

pproach to strategic supplementation

- v labor (minimize delivery costs)
- logically potent formulation
- pply when needed
- cient response to supplemental nutrients
- proves unit cost of production (UCOP)

proaches to strategic supplementation

als for cow herd:

30% calving in 30 days

Budget $50 per cow per year purchased feed
spend less)

Have positive cash flow (all segments of beef
cycle)

Low UCOP evaluated through SPA

Goal = Nutritional Management

prove livestock efficiency and profitability with no
reased costs!

Developing strategy: Protein

et – brown/dormant less than 7% CP

pected responses to protein supplement

Increase digestibility

Increase intake

When should we supplement?

Developing strategy: Protein

se supplement when it will critically change
imal performance (strategic)

- **Hand held ketone meter – promising (0.5mg/dL)**

ey performance criteria :

- **Calf wt weaned per cow exposed**
- **Days to first estrus**
- **Pregnancy rate**

Developing strategy: Protein

ntinually assess:

Cow body condition

Forage conditions

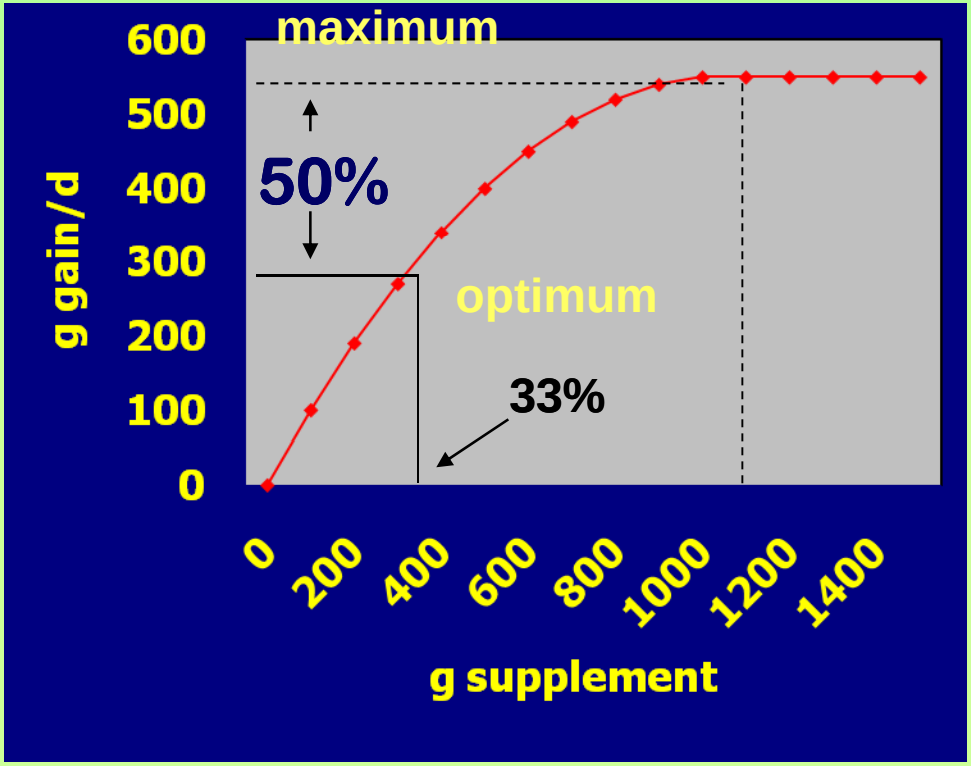
Developing strategy: Protein

se concept

minishing returns
conomic)

se/response (nutritional
quirements)

50% response from
33% feed



Key findings leading to development of nutritional management scheme

ent post ruminal protein supply

nt sources varied insulin
ation

showed insulin influence
on

lian and UK researchers
ed bypass protein ↑or ↓ milk
ction

Key findings leading to development of nutritional management scheme

ars interacted to influence insulin resistance

Dry winters and springs

- Higher insulin resistance
- Higher milk production (especially fat)

Wetter winters and springs

- Higher insulin sensitivity
- Lower milk production

Followed the data

Key findings leading to development of nutritional management scheme

pothesized

Alter metabolism: ↑insulin, insulin sensitivity

- **Reduce milk production**
- **Decrease days & magnitude of body wt nadir**
- **Positive influence reproductive axis**

Key findings leading to development of nutritional management scheme

pothesized

mproved productivity

- ↓ days to first estrus
- ↑ pregnancy rate
- Heavier calves next year

mproved efficiency, lower osts and more profitable

Key findings leading to development of nutritional management scheme

be effective needed more flexibility

More than 20% vs 36% or

natural protein vs npn

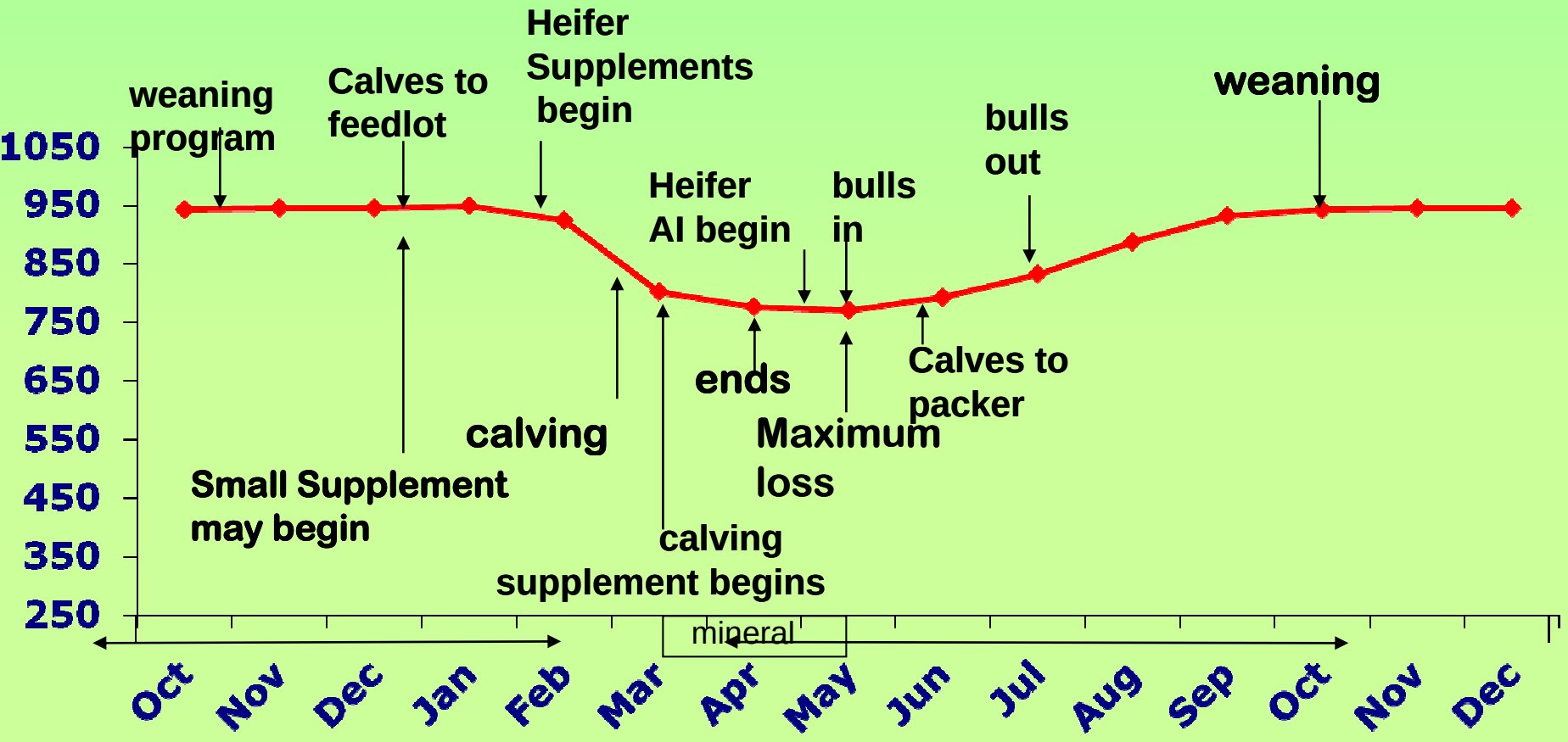
Developing strategy - Protein

OW MUCH PROTEIN TO FEED?

quantities Strategic: minimal protein
pplementation schemes

- **Minute – 4 oz/d (self fed – Small supplement)**
- **Minimum – ½ lb/d (fed 1 time/wk at 3.5 lb/ hd)**
- **Moderate – 1 lb/d (fed 2 to 3 times/wk)***
- **Maximum – 2 lb/d (fed 2 to 3 times/wk)**
- **Super Maximum – Max + propionate salt**

t Effective Supplementation in a management year as practiced at CRLRC



Developing strategy: Protein

INUTE (NMSU Small supplement)

50% Corona Ranch Mineral

50% high bypass protein (mixed 50:50)

- **Feather, blood or fish meals**
- **Not corn gluten meal**

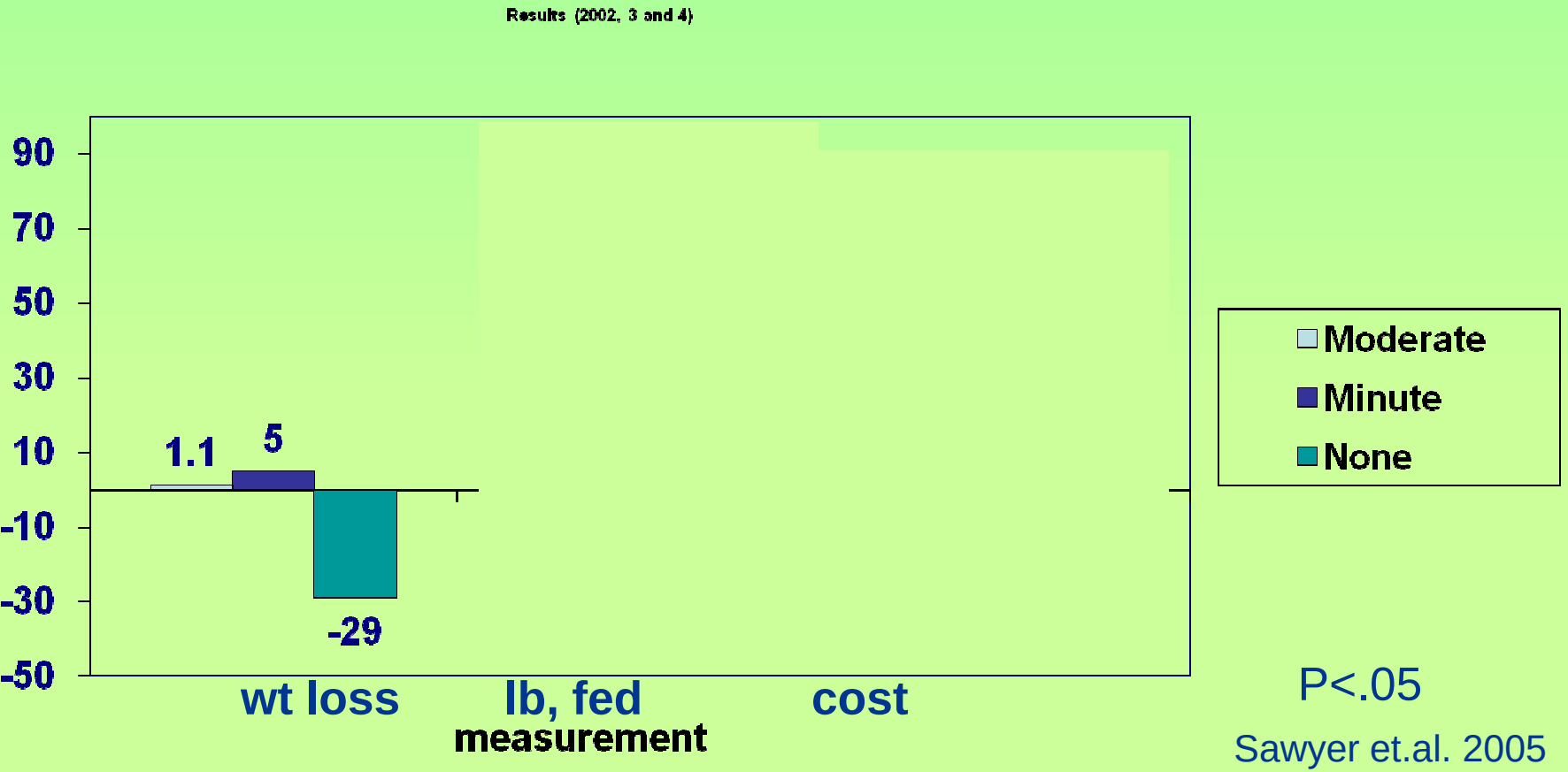
Self fed, target 4 oz per day

- **Maximum allowable intake 9 oz**

Low labor, low nutritional stress

Very efficient **costs $0.04 /d**

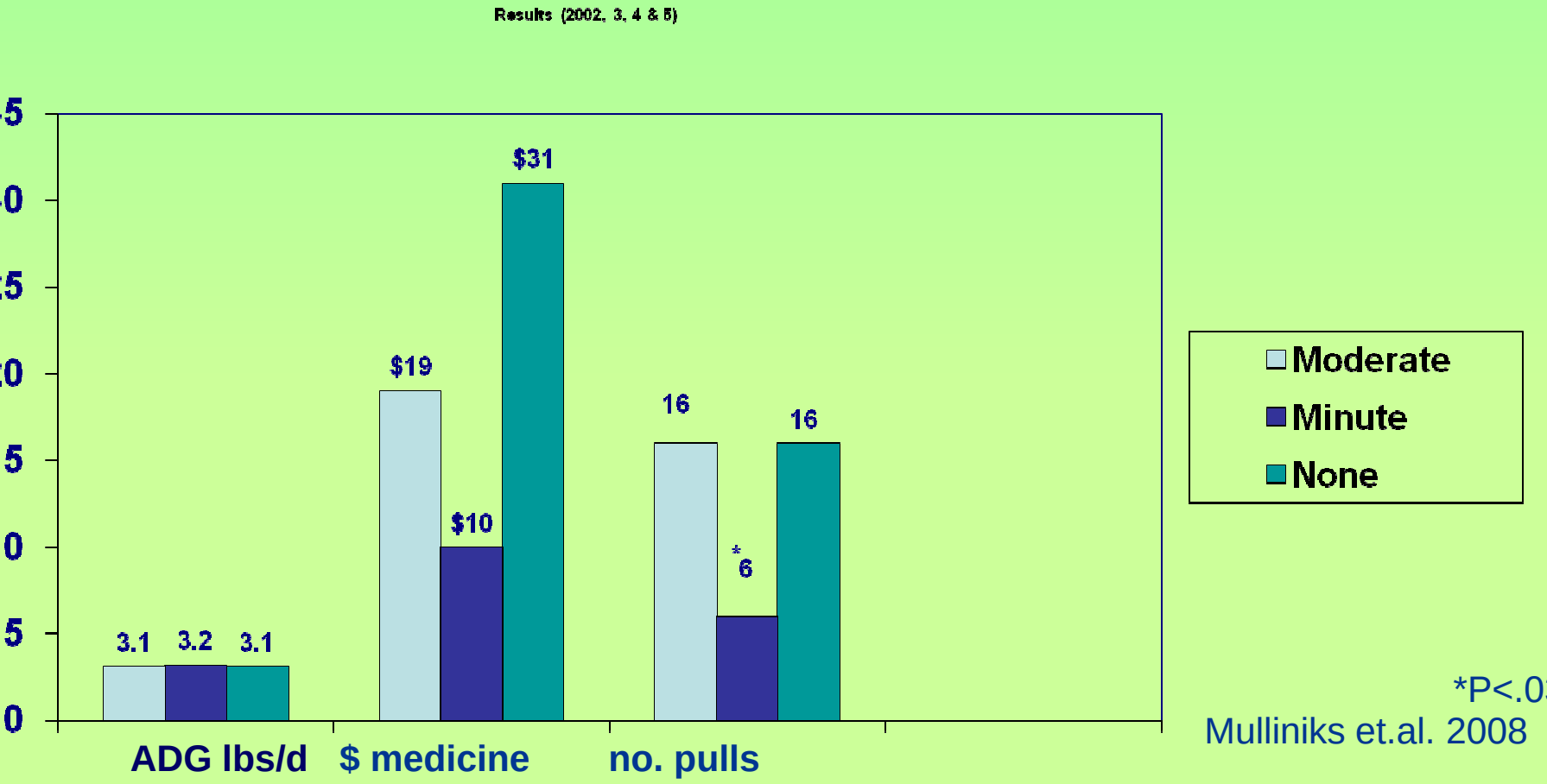
asumption, weight loss & cost in range cows fed Minute Supplement



P<.05

Sawyer et.al. 2005

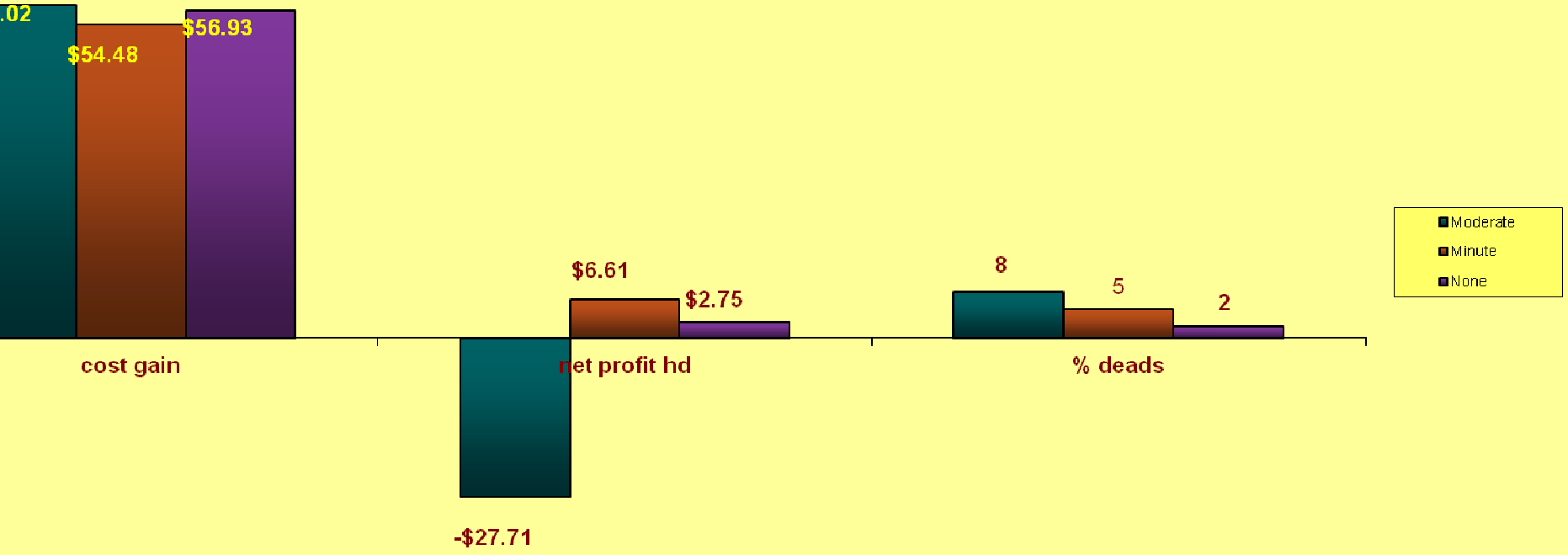
lf feedlot gain, pull rate & net profit from range cows fed Minute Supplement



*P<.03

Mulliniks et.al. 2008

st/cwt gain, net profit/head,% deads from range cows fed Minute Supplement



Mulliniks et.al. 2008

Developing strategy: Protein

inimum

36% crude protein (CP) supplement

- **65% rumen degradable**
- **Oil seed meal base**
- **6% CP equivalents from urea**

Hand fed, (cubes) target 0.5 lb per day

- **3.5 lbs/hd 1X per week**

Lower labor, low nutritional stress

Efficient, costs $0.08/d

Developing strategy: Protein

ODERATE (typical high protein)

36% crude protein (CP) supplement

- **65% rumen degradable**
- **Oil seed meal base**
- **6% CP equivalents from urea**

Hand fed, (cubes or cake) target 1.0 to 2.0 lbs/d,

– costs $0.16 to 0.30 /d

- **Fed every other day, 3X or 2X per week**

Developing strategy - Protein

ODERATE

Effective during;

- **pregnancy**
- **stressful climatic conditions**

Most often used

Developing strategy - Protein

AXIMUM

36% crude protein (CP) supplement

- **50% rumen degradable**
- **Oil seed meal plus high ruminally undegradable**
- **6% CP equivalents from urea**

Target up to 2.0 lbs/hd/d

- **Fed every other day, 3X or 2X/wk**
- **costs $0.50/d**

Most effective during rapid body weight loss

- **After calving**

Developing strategy - Protein

AXIMUM – bypass protein sources

Fish meal

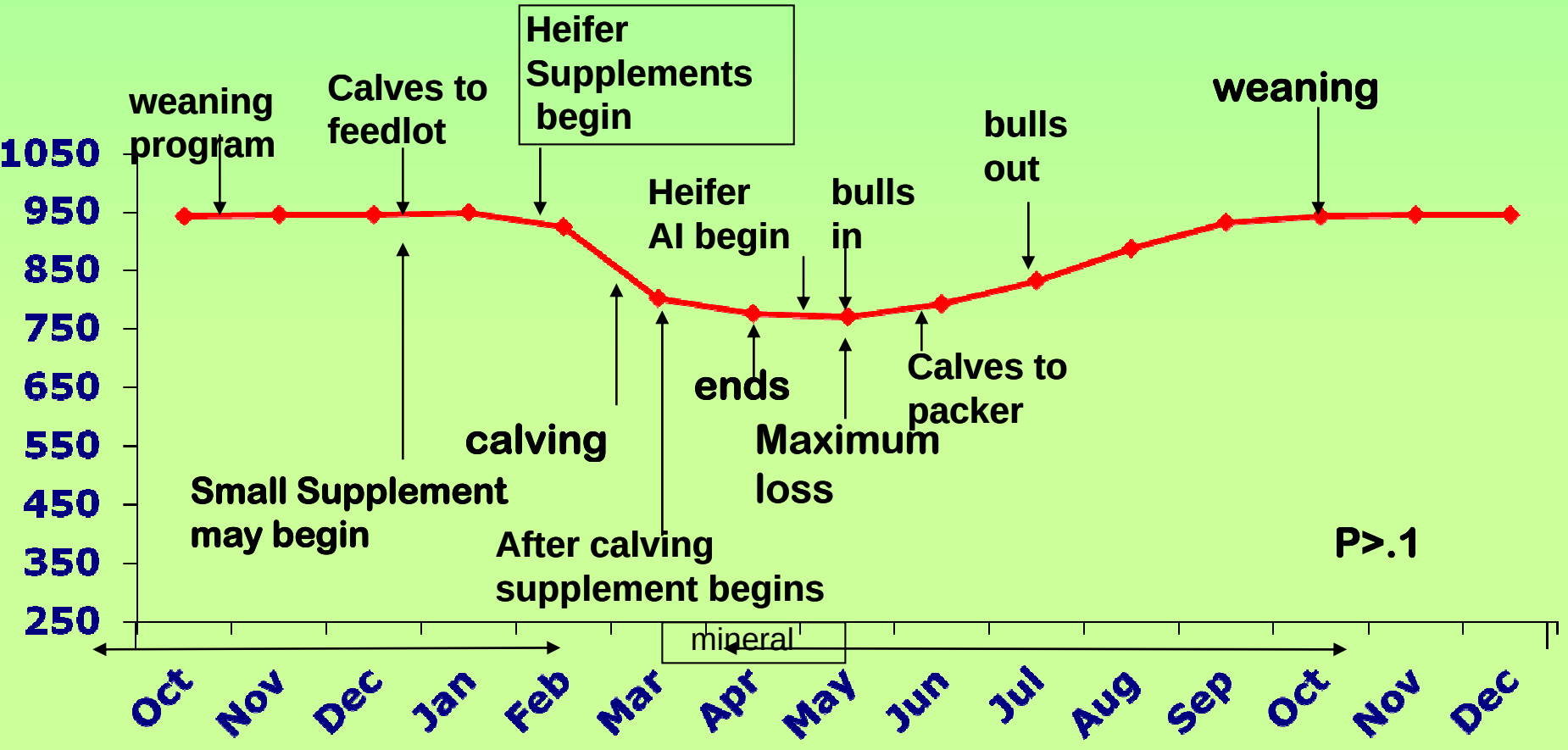
Corn Gluten meal

Distillers dried grains

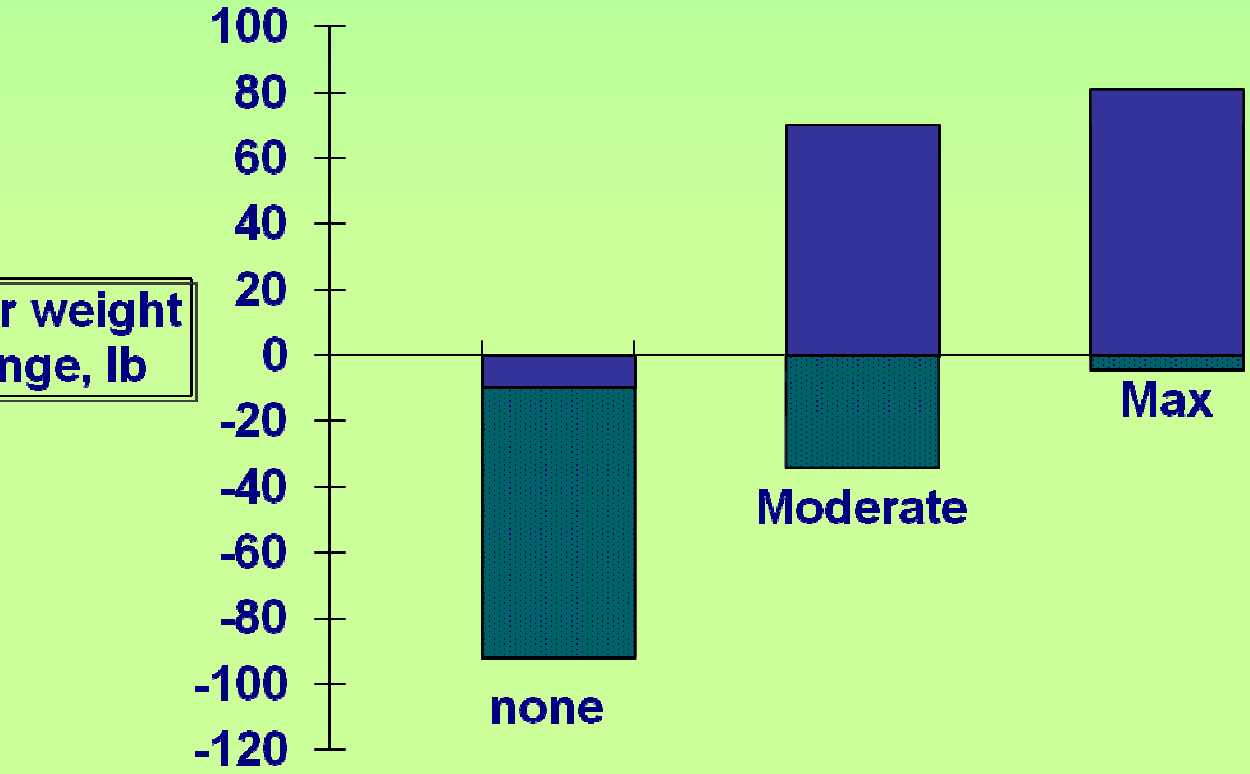
Feather meal

Pig blood meal

t Effective Supplementation in a management year as practiced at CRLRC



/inter stress-pregnancy: senior cows protein pplementation (1# SBM+1/3 lb blood meal/d)



winter 1

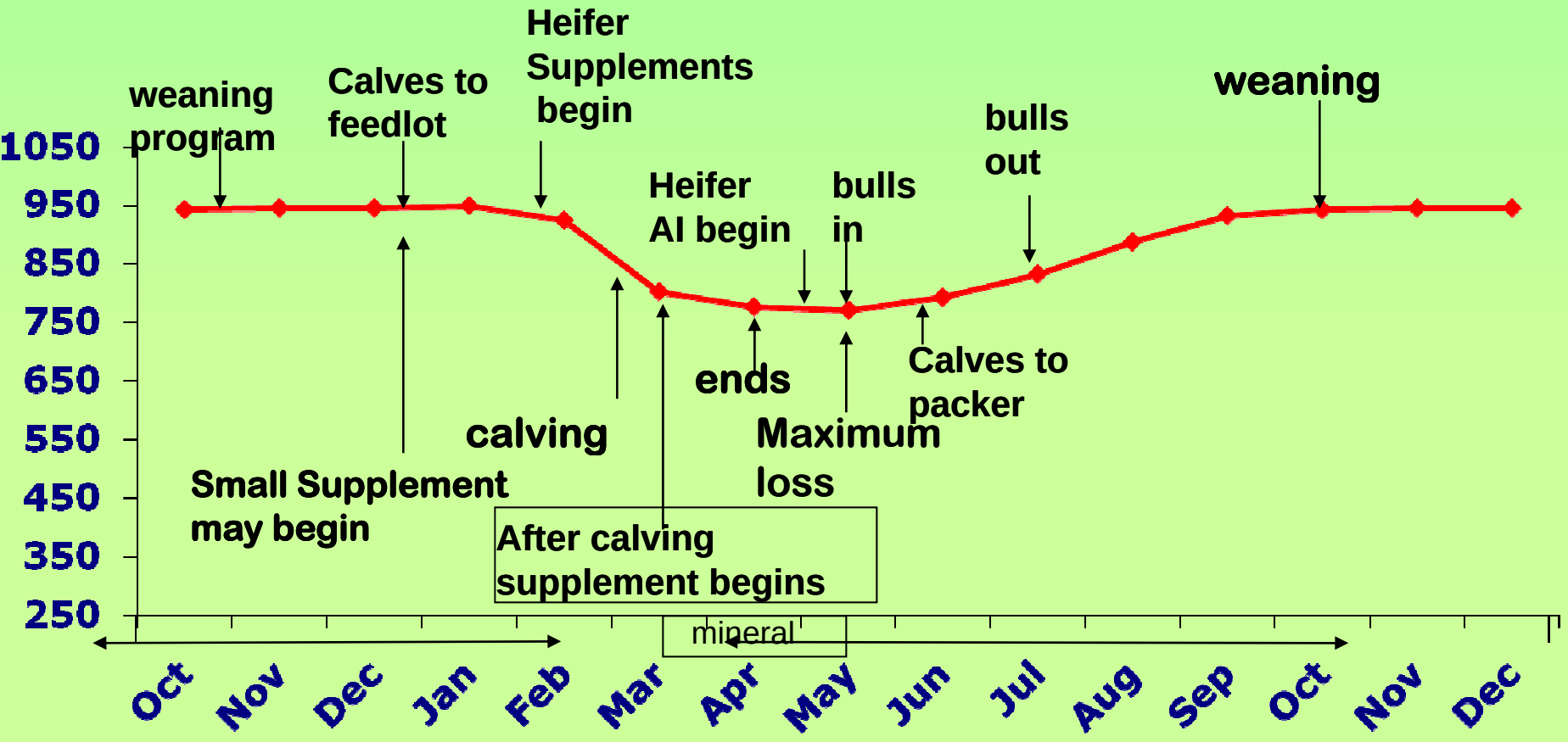
winter 2

*P<.05

Effects of bypass protein on utilization of weight loss diets in lambs

	No supp	0.25lb/d bypass
l wt lb	98	95
wt lb	98	108
(lb/d)	0	0.15
e, lb		
eat straw	1.95	1.70
meal	0	0.25
ge in carcass osition		
tein (lb)	-0.31	+1.95
(lb)	-3.10	- 2.05

t Effective Supplementation in a management year as practiced at CRLRC



Developing strategy - Protein

- eight loss occurs energy mands exceed nutrient intake
- eight loss can be planned
- eight loss antagonistic to production!
- anage weight loss to manage SK

Developing strategy: Protein

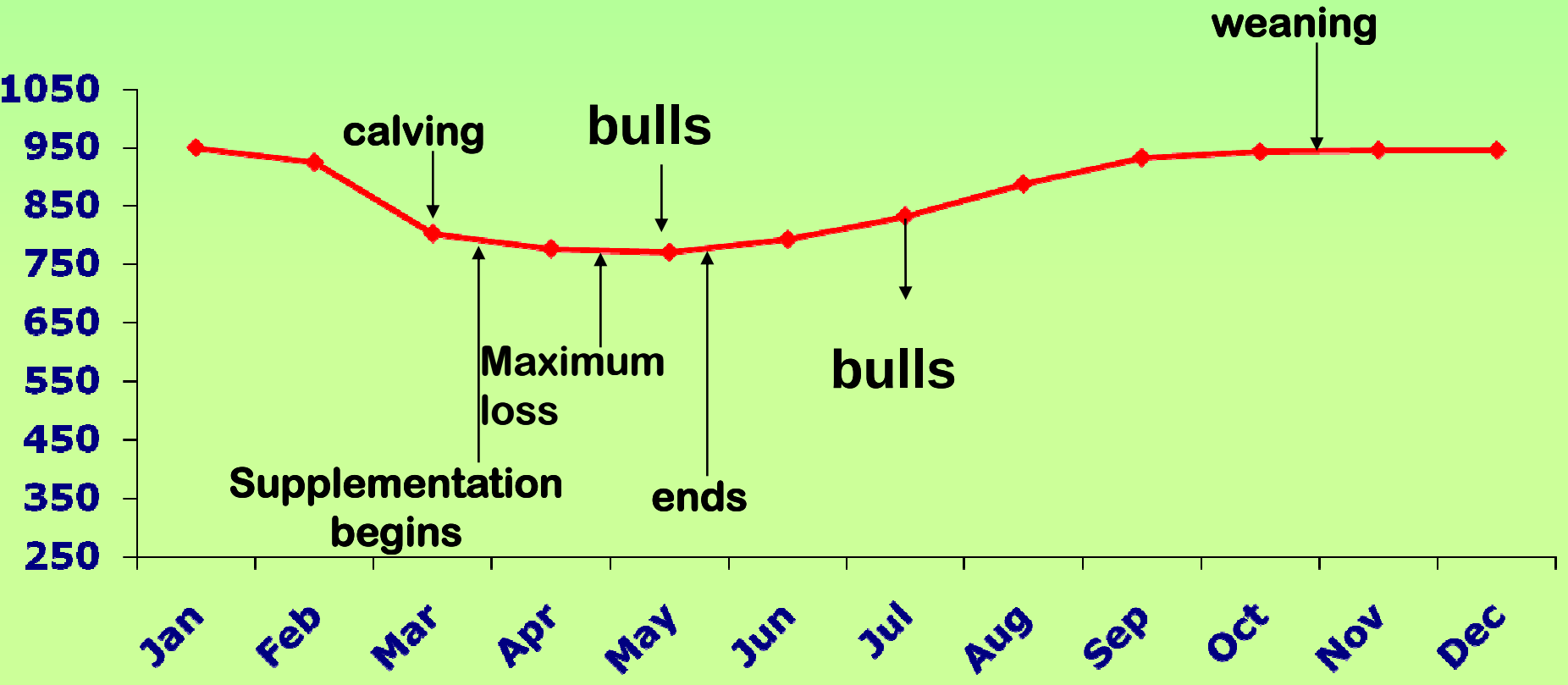
What does this mean for range supplementation during weight loss?

- Use bypass protein to minimize body protein weight loss

rategically supplementing young cows after calving

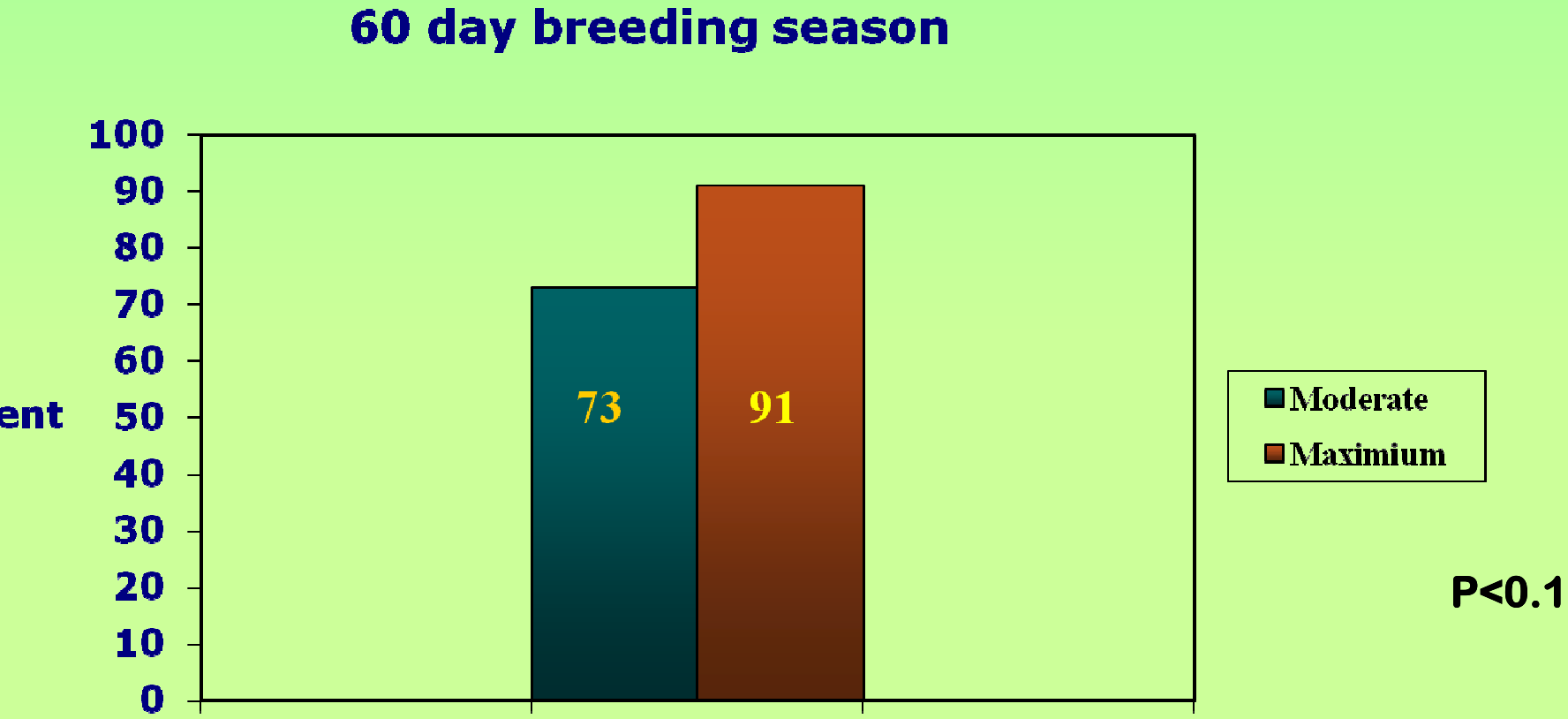
ow do the Moderate and Maximum pplements compare during lactation?

er Calving Body Weight Change: MOD vs Max weight loss was similar



Cows fed MAX – higher fall pregnancy

(2# 36% with csm vs 2# 36% with csm+fm+bm)



Developing strategy – Protein + glucose

<u>per MAX (protein same as MAX)</u>

36% crude protein (CP) supplement

- **50% rumen degradable**
- **6% CP equivalents from urea**

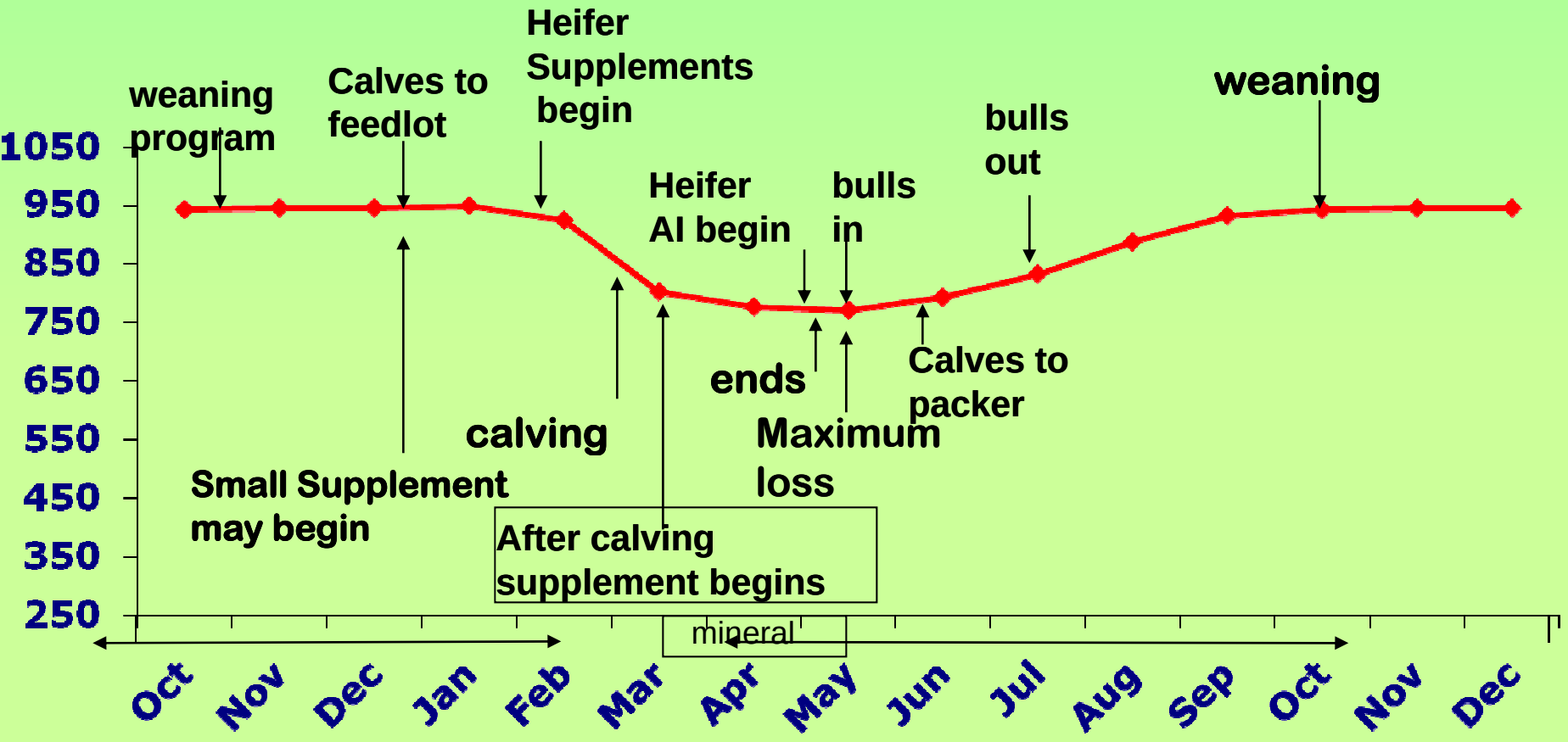
❖**40 to 100 g/d propionate salt**

Hand fed, (cubes) target 900 g per day

- **Fed every other day, 3X or 2X per week**

Effective during body weight loss (lactation or environmental stress)

t Effective Supplementation in a management year as practiced at CRLRC



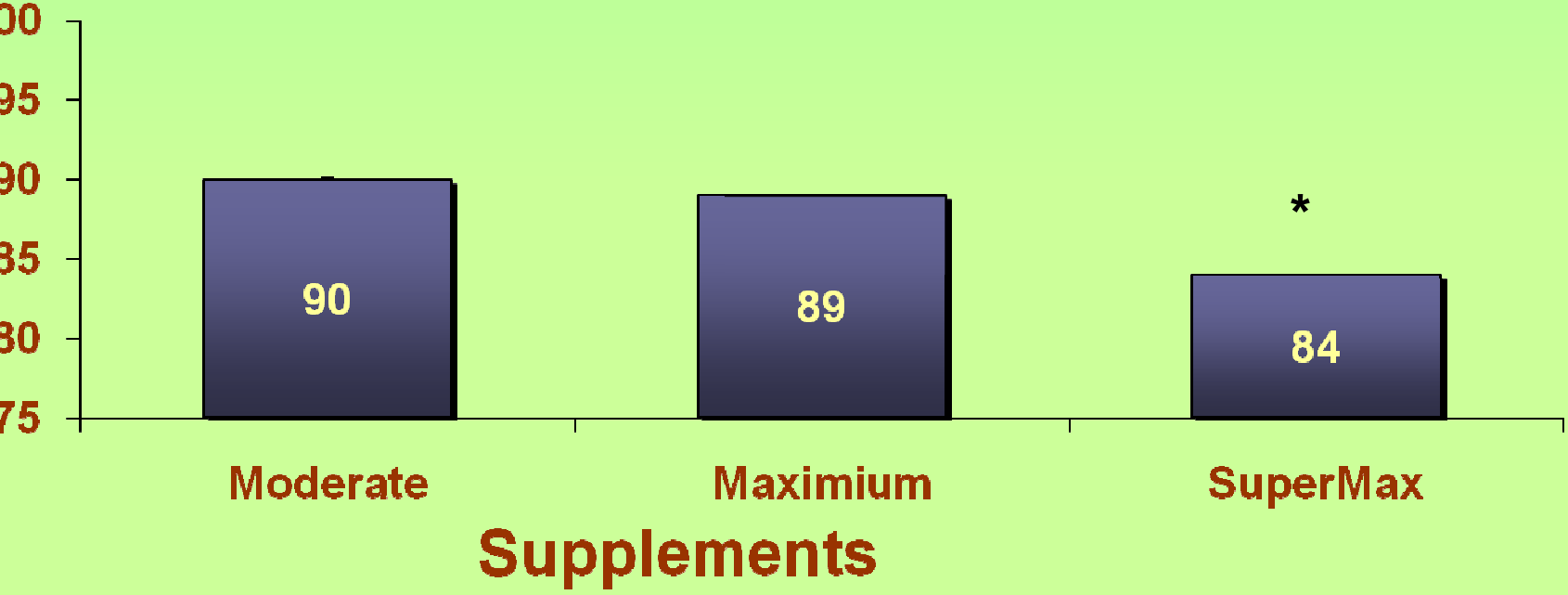
Developing strategy - Protein

hat does this mean for range supplements ter calving:

- **Ruminal degradable to improve ruminal microbial activity**
- **Ruminal undegradable protein to minimize weight loss**
- **Propionate salt to improve glucose availability and energy metabolism**

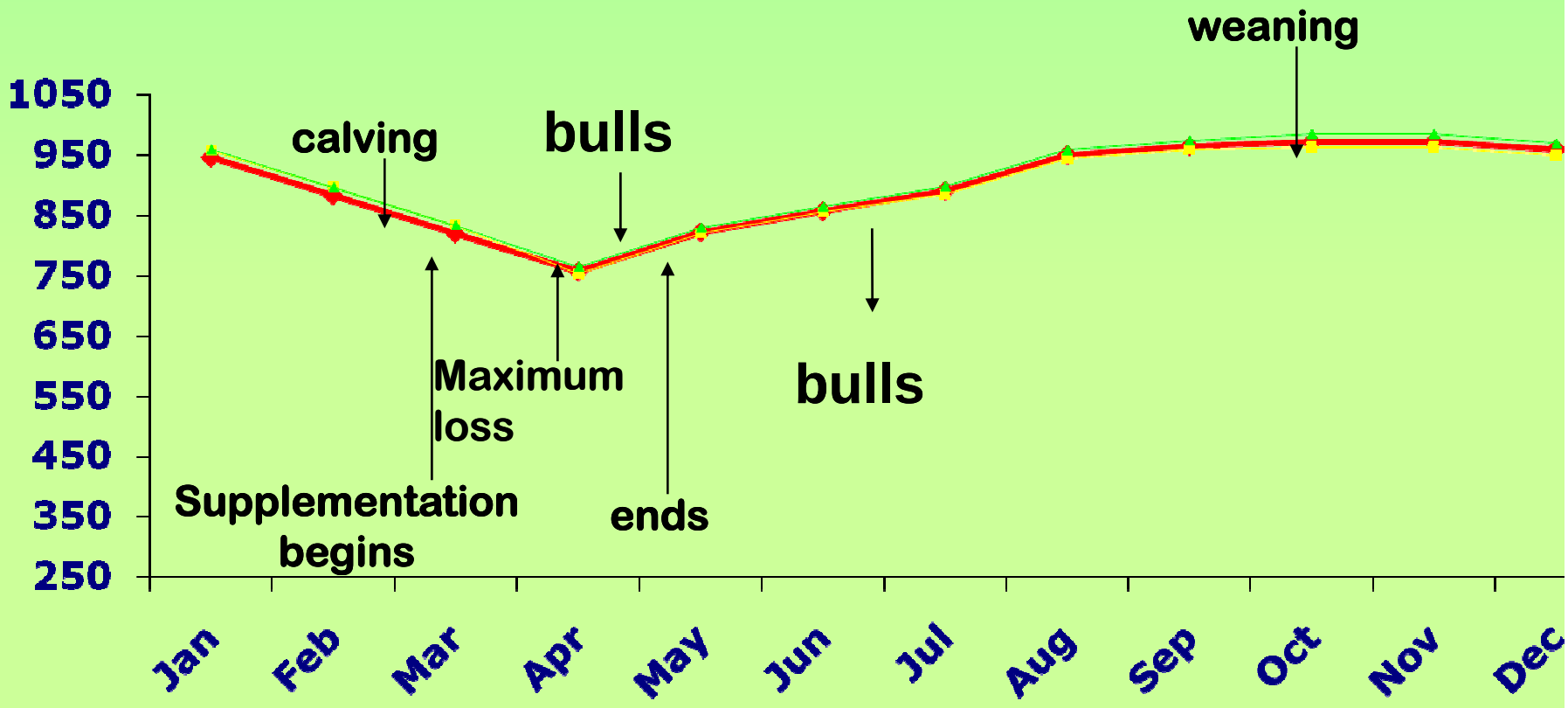
ys to first estrus: less with greater glucose potential

7 years 2000 to 2007
2 & 3 year old cows



Linear P<.01

er Calving Body Weight Change: MOD vs Max weight loss was similar



ncy rate, return to estrus, milk production, and calf ning weight of for young cows fed three different postpartum supplements (2000 to 2007)

	Supplement		
	Moderate	Maximum	SupMax
cy rate, %	84	88	95
o estrus, days	90	89	84
duction, lbs/d	13.4	15.1	13.8

Economic comparison of three postpartum supplements fed to 100, 2 & 3 yr old cows.

YEAR 1

	Moderate	Maximum	SupMax
ment cost/ton	318	385	474
st/cow	22.26	26.95	33.18
aning wt, lb	460	480	473
alves	$570	$595	$586
inus feed	546	569	553
	21	6	

difference

Economic comparison of three postpartum supplements fed to 100, 2 & 3 yr old cows.

YEAR 1

	Moderate	Maximum	SupMax
cy, %	85	88	95

YEAR 2

s/exposed			
w,%	2.8	2.8	2.8
p/exposed			
w, %	82.6	85.2	92.3

Economic comparison of three postpartum supplements fed to 100, 2 & 3 yr old cows.

YEAR 2

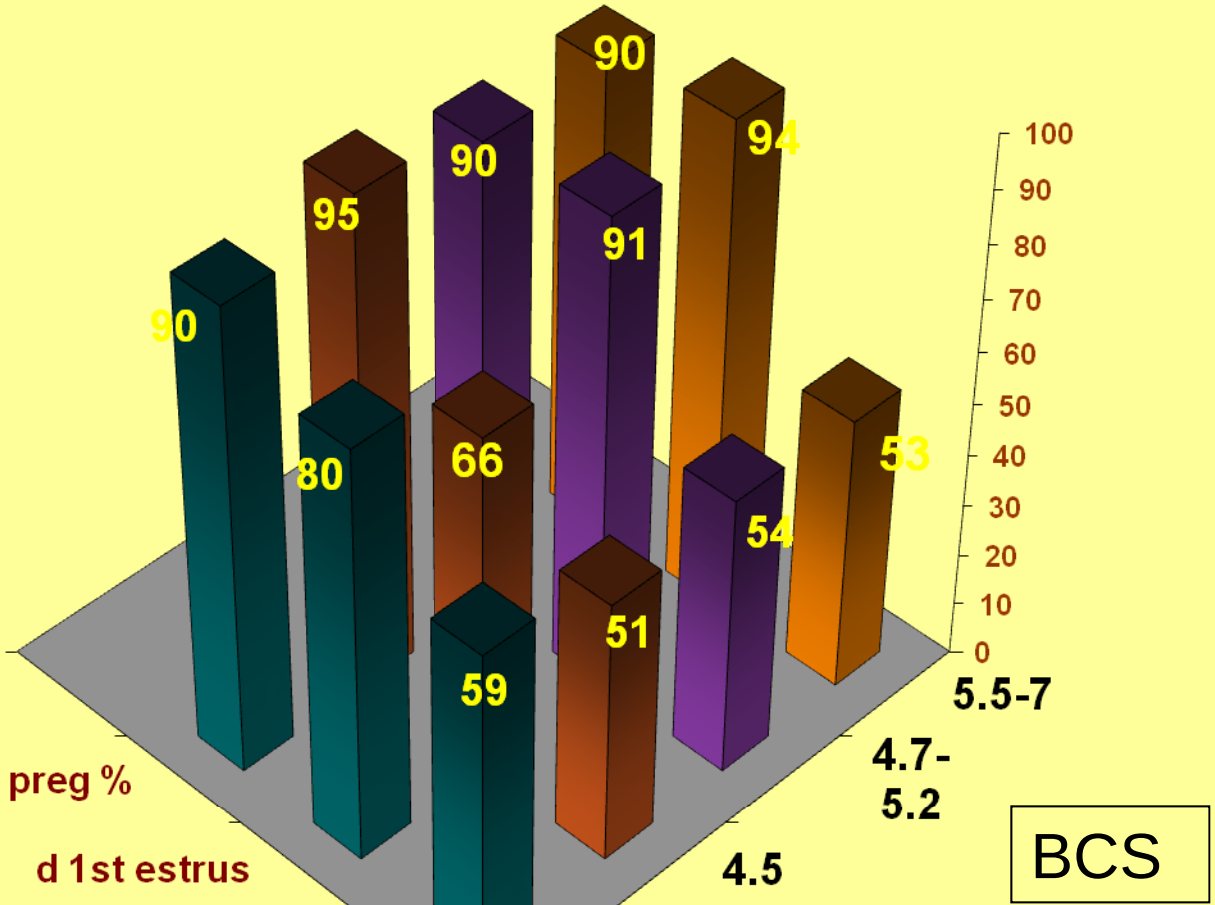
	Moderate	Maximum	SupMax
ows	82	85	92
l calf			
eaning wt, lb	459	482	485
lves	$570	$597	$601
venue,$	44845	48512	52276
fference	---	3666	7430

rategically supplementing young cows after calving

w important is body condition?

Condition at calving on reproduction in 2 & 3 yr olds cow (7 yrs 2001-08)

Uncoupled relationship BCS and reproduction



How does this fit into a management scheme?

rona Range Livestock Research Center has a itten management plan

e objective has been to strategically supplement

SUMMARY
Strategic Supplementation

- aintain forage and animal balance
- round nutrition management with effective ineral program
- dvantageous through optimization
- now unit costs and net revenue

SUMMARY
Cost Effective Supplementation

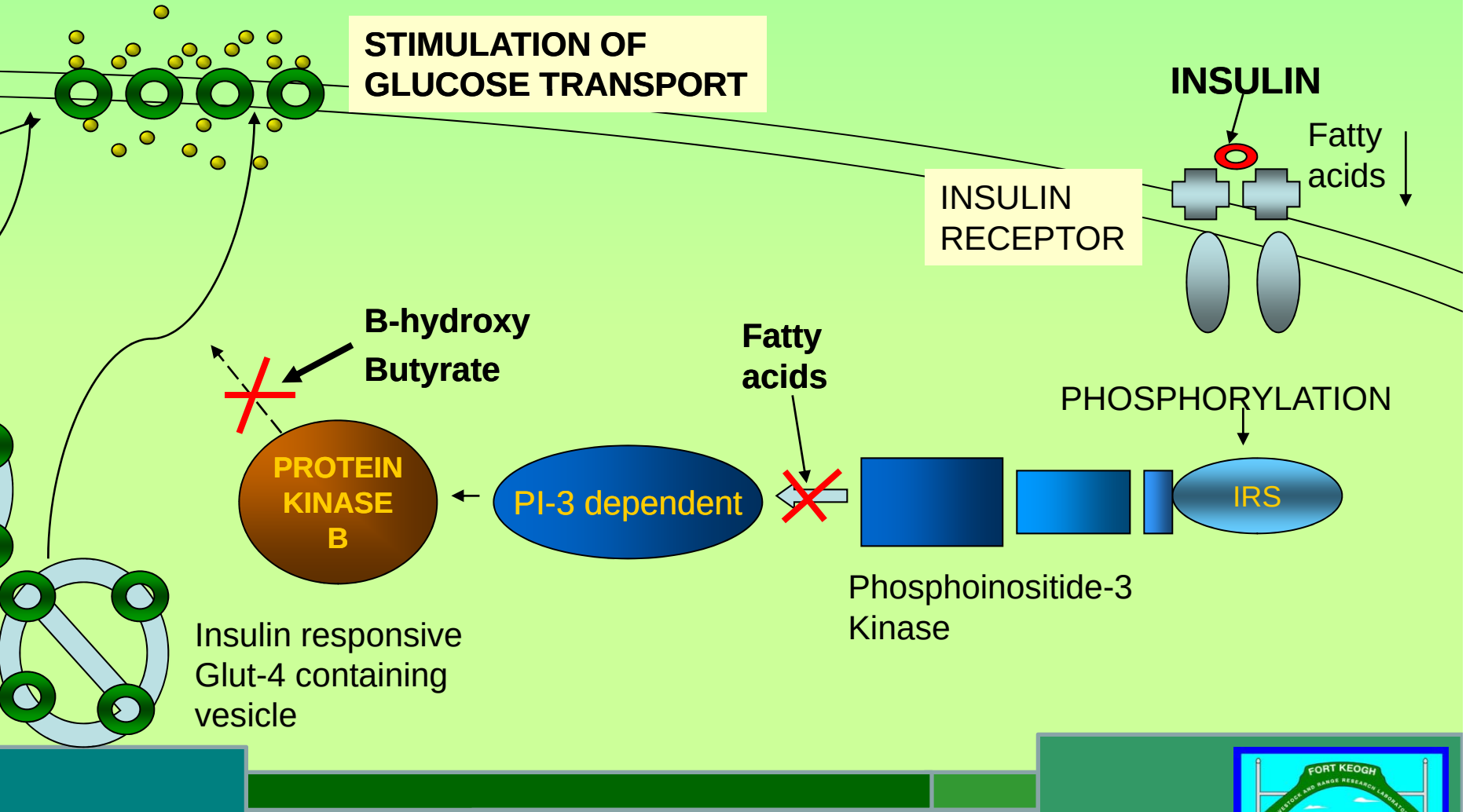
rona Strategic Cost Effective Supplementation ogram

- 5 protein supplements
- Range from 4oz to 2 lb/d
- Flexibility
- Fed minimum
- Goal $50 purchased feed

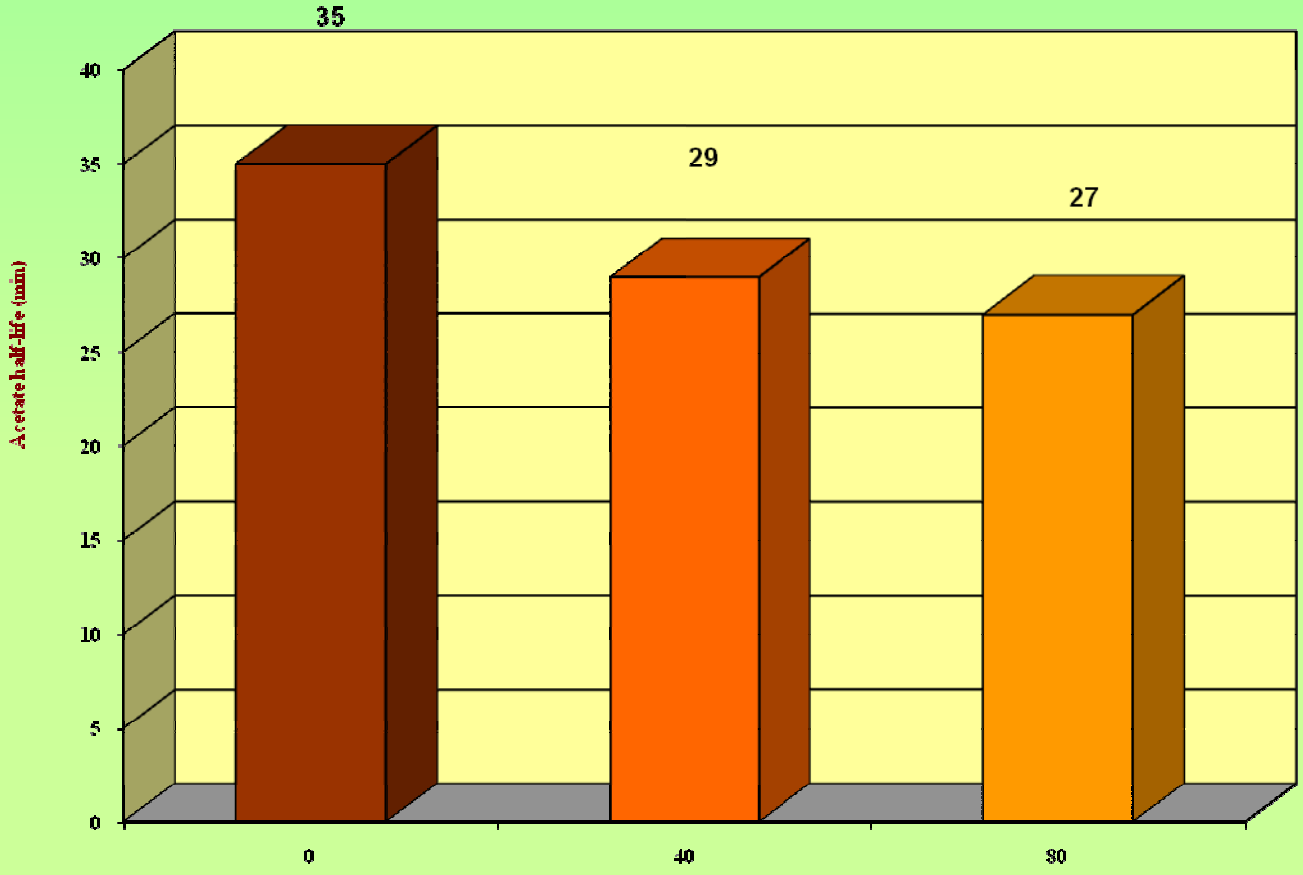
FORT KEOGH

Thanks

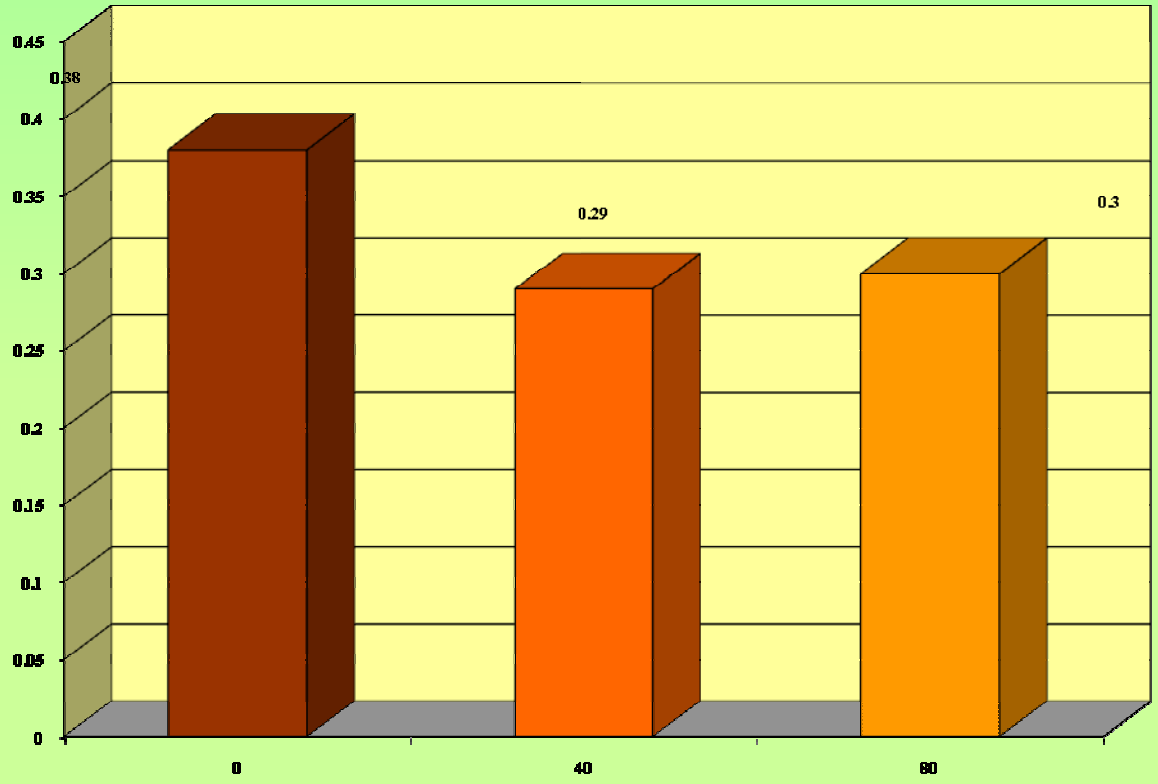
OPOSED CAUSE OF INSULIN RESISTANCE RANGE COWS



ffect of Supplement on Acetate olerance Test



ects of Supplement on Blood tone Concentrations



ects of bypass protein on utilization of weight loss diets

	No supp	0.11kg/d bypass
l wt kg	45	43
wt kg	45	49
(kg/d)	0	0.07
e, kg		
eat straw	0.86	0.77
meal	0	0.11
ge in carcass osition		
tein (kg)	-0.14	+0.86
(kg)	-1.40	- 0.91

etabolizable glucose & protein limit feed efficiency

meal (% diet)	0	6	0	6
ose infused /d)	0	0	80	80

ke (oat chaff) kg/d)	0.91	1.1	0.77	1.09
G kg/d)	0.1	0.2	0.13	0.26
conversion (kg/kg)		8.9	5.7	5.9	4.1