

USP

27º Congresso Brasileiro de Zootecnia
Congresso Veterinário Brasileiro
Pós-graduação e Pós-graduação Júnior
1995 - 2020 - 2021

100 - 1964 - 2020
Desenvolvimento da Produção Animal

"Impacto da nutrição fetal na reprodução de vacas de corte"

Guilherme Pugliesi
Professor Doutor
Departamento de Reprodução Animal
Faculdade de Medicina Veterinária e Zootecnia
Universidade de São Paulo

Pirassununga - SP
Nov - 2021

1

Aonde estamos?

Pirassununga

230km

São Paulo

USP

2

Tópicos

VETERINÁRIA
USP

Relação da Nutrição durante a gestação e Reprodução

Estratégias para alterar a nutrição fetal

Impactos na Reprodução da Vaca (mãe)

Impactos na Reprodução da Progenie (programação fetal)

Considerações Finais

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3



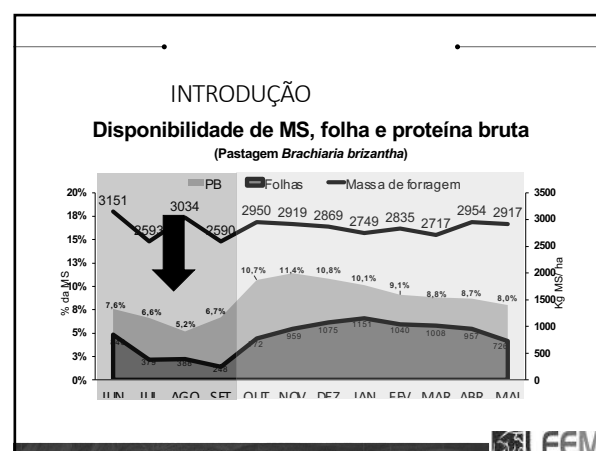
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Relação da Nutrição durante a gestação e a reprodução

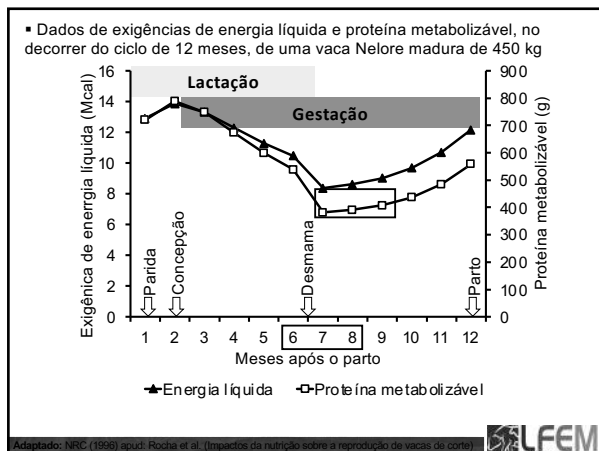
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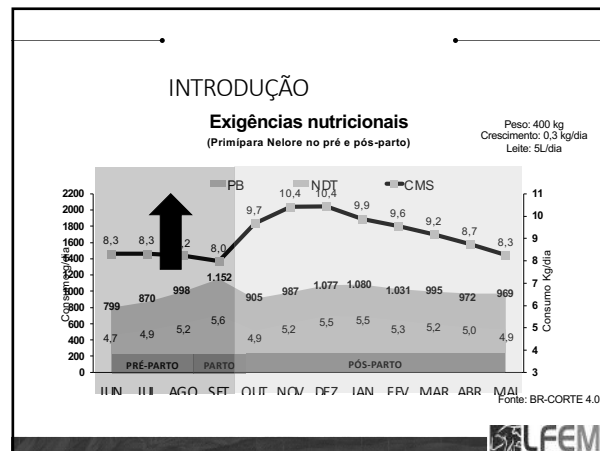
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Relação da Nutrição durante a gestação e a Reprodução

Nutrição Pré-parto

1. Período de maior ingestão de alimentos
2. Gestação como prioridade metabólica
3. Maior facilidade de aumento da condição corporal e acúmulo de gordura
4. Nutrição fetal

9

Relação da Nutrição durante a gestação e a Reprodução

10

Nutrição X Reprodução

11

Animal Reproduction Science 198 (2018) 27–36

Importance of body condition score and ovarian activity on determining the fertility in beef cows supplemented with long-acting progesterone after timed-AI

Thiago K. Nishimura^a, Thiago Martins^a, Maria Isabel da Silva^a, Bruna S. Ladeira^a, José Ricardo de Garbis Mano^a, Mario Rinaldi^b, Guilherme Pugliesi^b, Artur Saran Netto^a

Table 2
Mean $\pm$ SEM of body condition score (BCS), ovarian characteristics, and pregnancy and conception rates according to BCS (Low [2–2.5], Moderate [2.75–3.25] or High [3.5–5]; scale 1–5) in suckling beef cows submitted to a timed-AI (TAI) protocol, and supplemented or not supplemented with 150 mg of long-acting progesterone.

Test points	BCS			P value
	Low	Moderate	High	
BCS	2.47 $\pm$ 0.005 ^a	2.82 $\pm$ 0.004 ^b	3.84 $\pm$ 0.04 ^c	< 0.0001
Follicle diameter, mm	11.46 $\pm$ 0.10 ^a	11.26 $\pm$ 0.10 ^a	12.23 $\pm$ 0.24 ^b	0.0001
Estrus rate, % [†]	25.0 (20/80)	54.1 (140/258)	-	< 0.0001
Corpus luteum area, cm ²	3.21 $\pm$ 0.02 ^a	3.19 $\pm$ 0.02 ^a	1.54 $\pm$ 0.04 ^b	0.007
Ovulation rate, % (calculated)	82.4 ^a (350/426)	90.3 ^b (903/988)	94.8 ^b (110/116)	< 0.0001
Conception rate, % (P/calculated conc) [‡]	30.1 (177/585)	54.3 (490/903)	80.9 (87/108)	0.27
Pregnancy rate, % (P/TAI) [‡]	41.5 ^a (177/426)	49.1 ^b (490/998)	57.8 ^b (87/151)	0.04

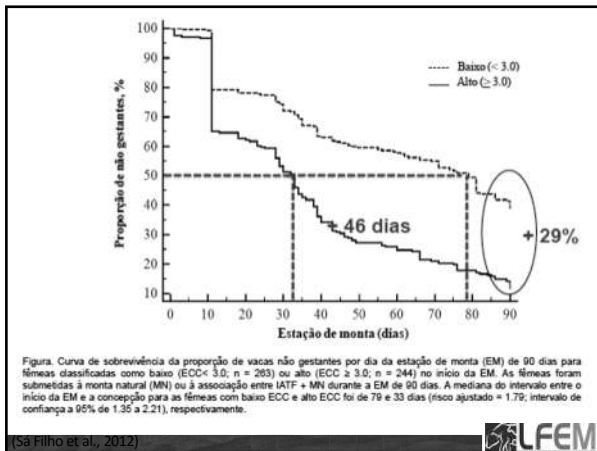
^{a,b,c} Different superscript letters in the same row indicate differences ($P < 0.05$) between groups by analysis of variance.

[†] For the category of BCS between 3.5–5, only one cow was detected in estrus, therefore, the data were excluded for this group.

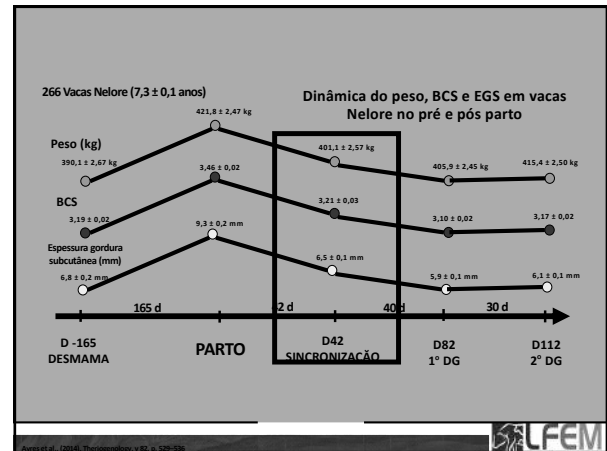
[‡] P/AI: number of pregnant cows divided by the total number of cows that had TAI.

[‡] Conception rate: number of pregnant cows divided by the number of cows detected with a corpus luteum 4 days after TAI.

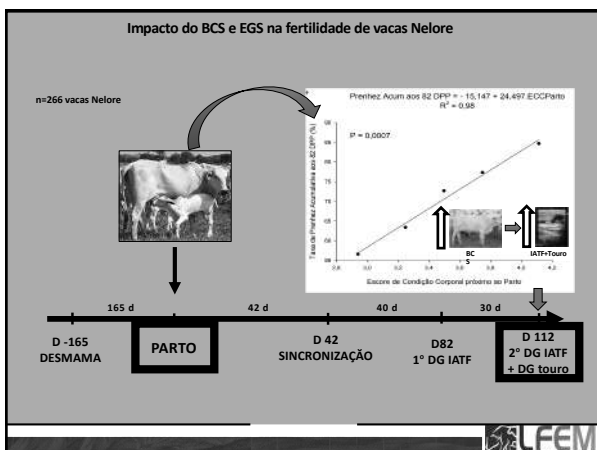
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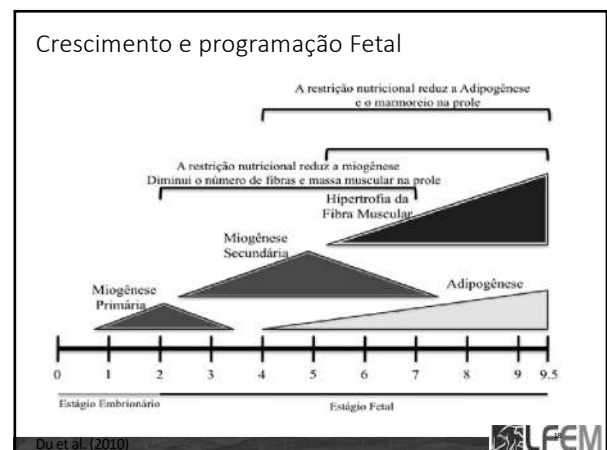
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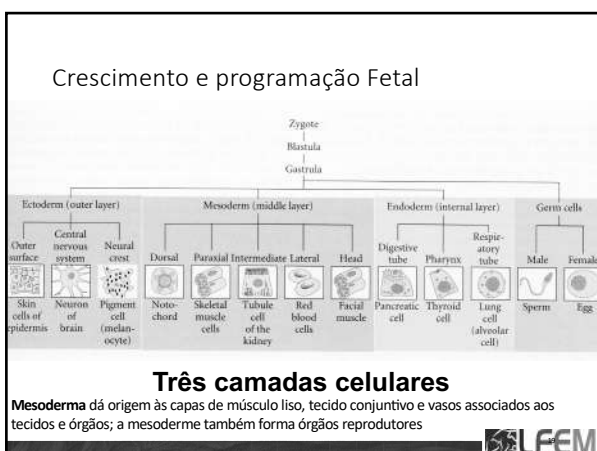
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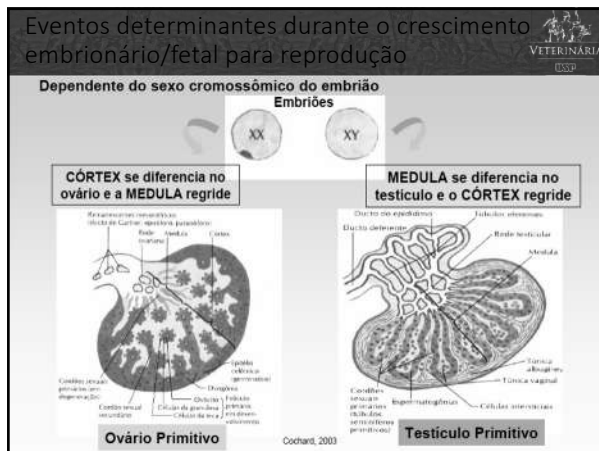
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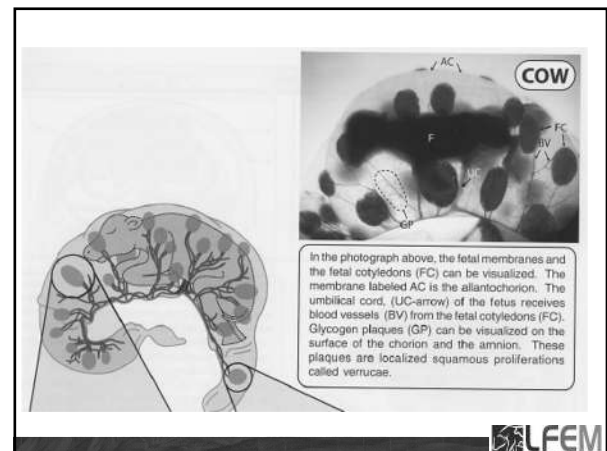
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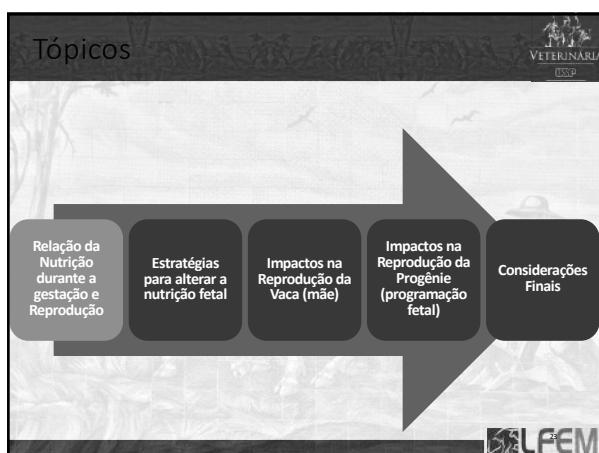
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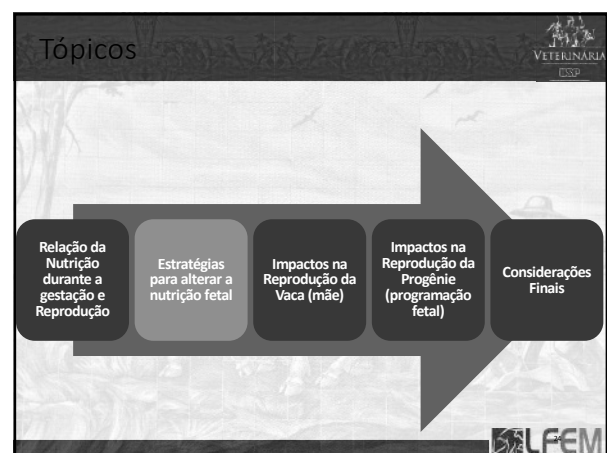
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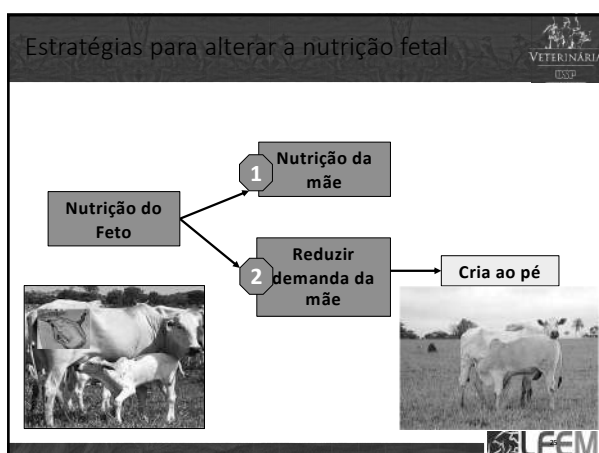
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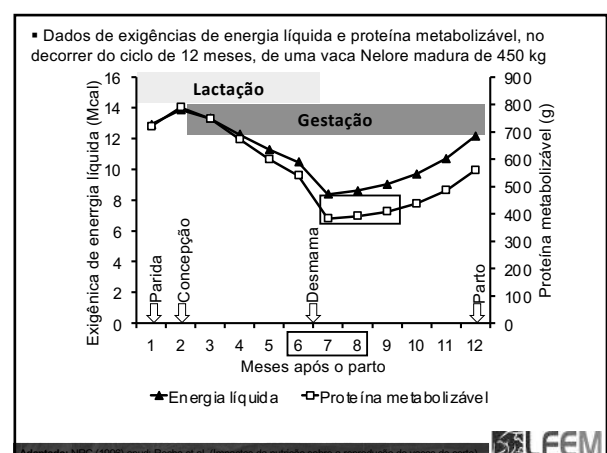
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24



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26

▪ Qual seria uma boa estratégia de suplementação visando recuperar ECC



ECC:2,50 ECC:3,00

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27

Importância da suplementação nutricional

- Suplementação proteica (animais em pastejo de baixa qualidade)
- Corrige deficiências nutricionais:
 - Melhora utilização da forragem (DelCurto et al., 2000)
 - ↑ Digestibilidade (Meteer et al., 2015)
 - ↑ Ingestão de matéria seca, proteína bruta e nutrientes (Kunkle et al., 2000)
 - ↑ Peso, ECC, metabolitos sanguíneos e performance reprodutiva (da Silva et al., 2017; Quintans et al., 2016; Wilson et al., 2016)

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28

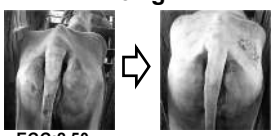
Nutrição ***

Suplemente as vacas de cria no momento certo

Adotar a prática após a desmama é ideal para a vaca recuperar a condição corporal e melhorar os índices de prenhez na estação seguinte



- Condição razoável da pastagem
- Suplementos minerais proteicos para estimular a ingestão de MS, e consequentemente o ganho de peso
- GPD: 600 g/d x 75d = 45 kg
- Vaca Nelore 400 kg
- 522 g de PM e 9,1 Mcal/dia



45 kg

ECC:2,50 ECC:3,00

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29

AMAMENTAÇÃO X REPRODUÇÃO



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30

Tópicos

VETERINÁRIA USP

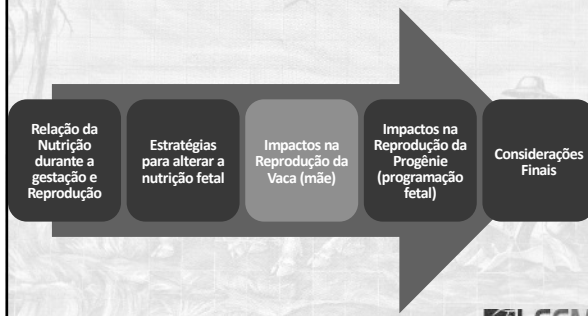


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31

Tópicos

VETERINÁRIA USP



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32

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 109 Vacas Angus x Simental, 495 kg
- Suplementação Pré e/ou Pós-parto (fatorial 2x2) – 1 kg/vaca/dia

Table 3. Effects of grazing winter range or corn residue and CP supplementation during the last trimester of gestation on cow performance and reproduction

Trait	Winter			Corn			Treatment P-value ¹		
	PS	NS	SEM	PS	NS	SEM	Supp	Supp x S	
Preweaning BW, kg	516 ^a	490 ^a	18	540 ^a	537 ^a	18	<0.001	0.00	
Preweaning BCS	5.13 ^a	4.77 ^a	0.07	5.29 ^a	5.24 ^a	0.07	<0.001	0.00	
Calving date, Feb 1 d, %	87 ^a	80 ^b	3	84 ^a	87 ^a	3	0.04	0.00	
Calving in the first 21 d, %	87 ^a	80 ^b	3	87 ^a	80 ^b	3	0.20	0.07	
Preweaning BW, kg	488 ^a	453 ^a	18	494 ^a	488 ^a	18	<0.001	0.00	
Preweaning BCS	5.29 ^a	5.02 ^a	0.06	5.41 ^a	5.27 ^a	0.06	0.004	0.00	
May 24 milk, kg	5.5 ^a	5.4 ^a	0.1	5.7 ^a	5.7 ^a	0.1	0.09	0.48	
Nov 24 milk, kg	7.3 ^a	7.3 ^a	0.3	7.3 ^a	7.3 ^a	0.3	0.000	0.85	
Nov weaning BW, kg	489 ^a	482 ^a	18	490 ^a	484 ^a	18	<0.001	0.00	
Nov weaning BCS	5.17 ^a	5.00 ^a	0.06	5.12 ^a	5.15 ^a	0.06	0.74	0.85	
Pregnancy rate, %	96	94	3	96	95	3	0.65	0.00	

¹ Within a row, means without a common superscript differ at $P < 0.05$.
² NS = dams supplemented 2 times per week with the equivalent of 0.45 kg/d of 28% CP cake (DSM basis) during gestation and grazed dormant winter range; PS = dams not supplemented with CP during gestation, grazed dormant winter range; CR = dams supplemented with the equivalent of 0.45 kg/d of 28% CP cake (DSM basis) during gestation and grazed corn residue between weaning and the subsequent calving.

33

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 106 Vacas Angus x Simental
- Controle vs. Suplem no terço final (125%)

Table 4. Body weight, BCS, and reproductive performance of cows fed 0 (No Supp) or 0.45 kg (Supp) supplement prepartum and allowed to graze subirrigated meadow or fed grass hay postpartum

Item	Supp		No Supp		SEM ¹	P-value ²		
	Meadow	Hay	Meadow	Hay		Pre	Post	Pre x Post
Cow BW, kg	490	487	493	496	4	0.16	0.95	0.52
December 1	489	491	457	475	6	0.001	0.13	0.20
February 28	447	449	433	447	5	0.14	0.13	0.22
May 30	466	453	457	451	5	0.24	0.06	0.32
October 8	486	476	476	481	5	0.81	0.55	0.23
Prepartum	-1	3	-17	-21	5	<0.001	0.06	0.25
Postpartum	19	4	24	3	3	0.52	<0.001	0.22
Cow BCS	5.3	5.6	5.3	5.3	0.08	0.11	0.67	0.81
December 1	5.1	5.2	4.5	4.8	0.30	<0.001	0.30	0.35
February 28	5.1	5.2	4.5	4.8	0.30	<0.001	0.30	0.35
May 30	5.2	4.9	5.1	4.8	0.06	0.01	<0.001	0.97
October 8	5.2	5.1	5.1	5.1	0.05	0.21	0.39	0.96
Prepartum	-0.1	-0.1	-0.8	-0.5	0.1	<0.001	0.22	0.29
Postpartum	0.4	0.1	0.2	0.3	0.2	0.05	<0.001	0.63
Pregnancy rate, %	94.9	93.5	89.2	91.3	3.9	0.46	0.88	0.48
Calving d of yr	87	88	84	85	1	0.01	0.18	0.80
Calving to conception, d	82	79	84	82	2	0.28	0.12	0.81
Conception first 21 d, %	68.7	71.3	76.2	66.3	5.4	0.97	0.38	0.17

¹ Pooled standard error of treatment means, n = 12 pastures per treatment.
² Pre = prepartum treatment main effect; Post = postpartum treatment main effect; Pre x Post = prepartum x postpartum treatment interaction.
³ Determined from subsequent calving date minus 285 d.

34

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 228 Vacas
- Fatorial 2x2 (ECC e Suplementação no terço final)
- 0,9 kg/dia no terço final

Table 2. Body weight, BCS and reproductive performance of cows managed to enter the last trimester of gestation in low BCS (LBCS; approximately 4) or high BCS (HBCS; approximately 6) and offered 0.0 (No) or 0.9 kg/d (Yes) of dried distillers grains plus solubles during the last trimester of gestation¹

Item	BCS			SEM	P-value	Supplementation			P-value
	LBCS	HBCS	Yes			No	Yes	No	
Initial BW, kg	503	565	14.7	<0.001	510	590	13.2	0.001	
Calving BW, kg	513	544	13.2	<0.001	510	590	13.2	0.001	
Weaning BW, kg	518	547	27.6	<0.001	528	579	27.8	0.20	
Initial BCS	4.4	5.7	0.13	<0.001	5.1	5.9	0.13	0.41	
Calving BCS	4.4	5.3	0.06	<0.001	4.8	5.0	0.06	0.003	
Weaning BCS	4.7	5.2	0.15	<0.001	4.9	5.0	0.15	0.08	
Pregnancy rate, %	79.3	91.6	4.14	0.05	87.2	87.6	4.14	0.94	

¹ Initial BCS and BW was determined at study initiation, approximately 90 d prior to calving.

35

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 106 Vacas Angus x Simental
- Controle vs. Suplem no terço final (125%)

Table 4. Influence of prepartum dietary energy on cow BW, BCS, calving, milk production, and subsequent reproduction

Item	Treatment ¹		SEM	P-value
	0.0	0.9		
BW, kg				
Initial	486	480	7	0.65
Post-calving	413	408	8	0.51
Prepartum	415	408	8	0.65
Calving date, Feb 1 d, %	87	80	3	0.07
Calving to conception, d	82	79	2	0.07
Conception first 21 d, %	68.7	71.3	5.4	0.97

¹ 0.0 = feed lot to provide 3000 TDM; 0.9 = feed lot to provide 1250 TDM.
² Cow performance reported for 67 cows (0.0; n=40; 0.9; n=41); 6 pens per treatment.
³ Subsequent reproduction reported for 62 cows (0.0; n=40; 0.9; n=38); 6 pens per treatment.

36

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 80 Vacas Nelore com 6 meses de gestação, 516 kg
- Suplementação Pré e/ou Pós-parto (fatorial 2x2) – 1 kg/vaca/dia

Table 1. Nutrient content of dietary supplement offered and pasture available to cows during the pre- and postpartum intervals

Item	Supplement	Pastures (dry relative to calving)					
		-75	-45	-15	+15	+45	+75
DM	887	455	588	469	356	275	252
Crude protein ^a	919	515	515	506	515	501	524
Crude protein ^b	286	86	62	70	87	86	109
Crude protein ^c	319	294	194	204	280	262	328
Crude protein ^d	25	9	8	11	12	12	12
Crude protein ^e	196	613	612	617	622	629	617
Crude protein ^f	452	218	191	211	199	201	216
Crude protein ^g	38	171	402	342	251	214	144
Crude protein ^h	14	—	—	—	—	—	—

^a kg of DM.
^b kg of total nitrogen.
^c MJ of DM.

37

Efeitos da nutrição pré-parto na reprodução da vaca

Suplementação no terço final

- 80 Vacas Nelore com 6 meses de gestação, 516 kg
- Suplementação Pré e/ou Pós-parto (fatorial 2x2) – 1 kg/vaca/dia

Table 2. Performance and body condition score of Nelore cows supplemented or not supplemented during the prepartum period

Item	Supplementation (90 days prepartum)		S.E.M.	P-value
	Minus	Plus		
Initial bodyweight (kg)	516	515	1.80	0.887
Final bodyweight (kg)	499	528	2.20	0.001
Average daily gain (g/day)	-182	149	24.03	0.001
BCS at calving	4.3	5.1	0.04	0.001
Calf birthweight (kg)	30.6	34.3	0.75	0.001

38

VETERINÁRIA
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Item	Supplementation strategy						F-value ^a			
	M:M	F:M	M:P	P:P	Pre	Post	Pre × Post	Pre × Day	Post × Day	Pre × Post × Day
Serum urea N (mmol/L)	3.29	3.18	3.20	3.25	0.380	0.412	0.001	0.113	0.001	0.956
Urea (mmol/L)	2.42	2.44	2.49	2.46	0.001	0.272 ^b	0.003	0.106	0.010	0.871
Urea N (mmol/L)	0.65	0.58	0.31	0.21	0.021	0.001	0.001	0.049	0.017	0.719
Urea N (mmol/L)	0.62	0.57	0.31 ^b	0.21 ^b	0.001	0.001	0.001	0.001	0.001	0.001
Proteinuria (mg/dL)	1.51	2.26	3.76	3.67	0.277	0.110	0.001	0.658	0.001	0.762
Proteinuria (mg/dL)	1.51	2.26	3.76	3.67	0.277	0.110	0.001	0.658	0.001	0.762
Concentration ratio (%)	10	8.3	8.4	8.5	—	0.007	0.005	0.494	—	—

NAME

100
90
80
70
60

45
4
420
200
41.5

only complementing day 0–black
cell day
male protein: NPS = non protein



LFEM

LFEM

VETERINÁRIA
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100



LFEM

LFEM

score (1–5 point)

Pré vs. Pós

25	<0.01
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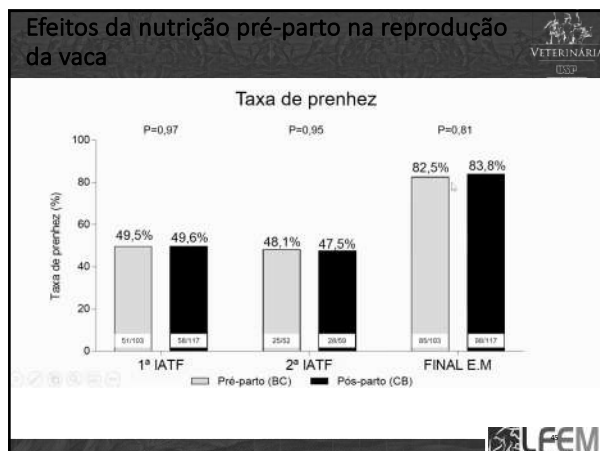
25	<0.01
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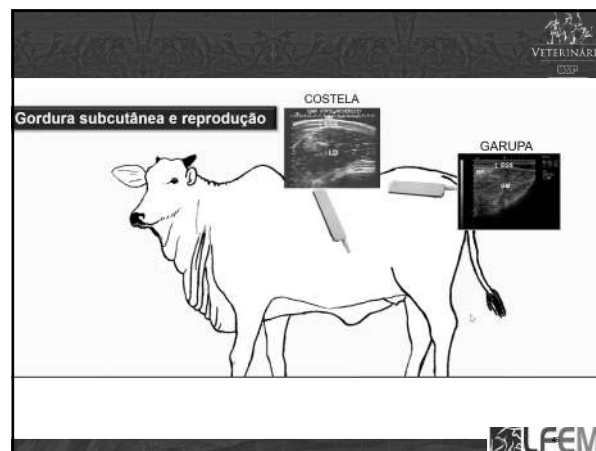
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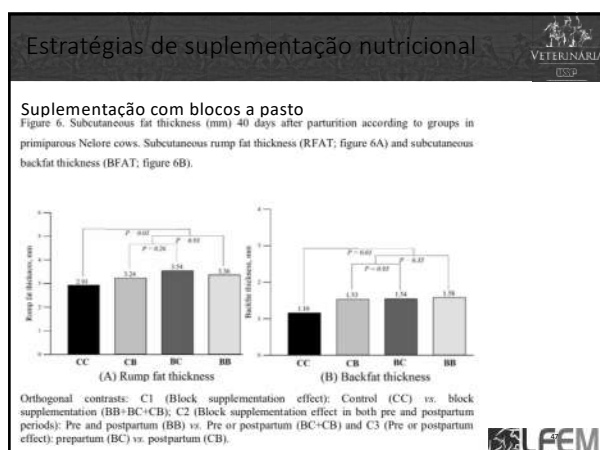
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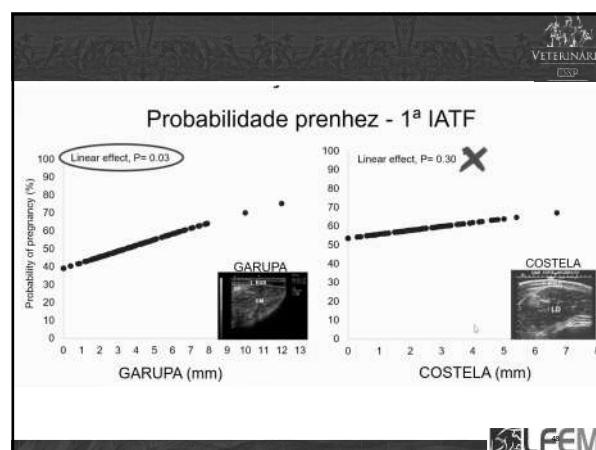
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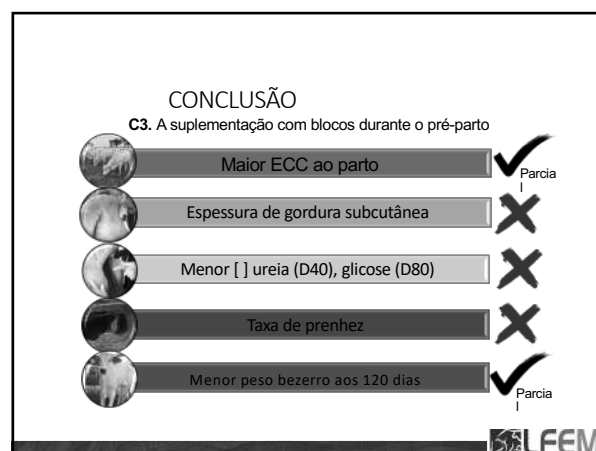
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48



49



50

Efeitos da nutrição pré-parto na reprodução da progênie

Subnutrição

- Reduz fluxo sanguíneo para placenta
- Aumenta vilosidade dos placentônios
- Reduz Peso ao nascimento
- Menor CFA (primeiro trimestre)

Excesso de nutrição

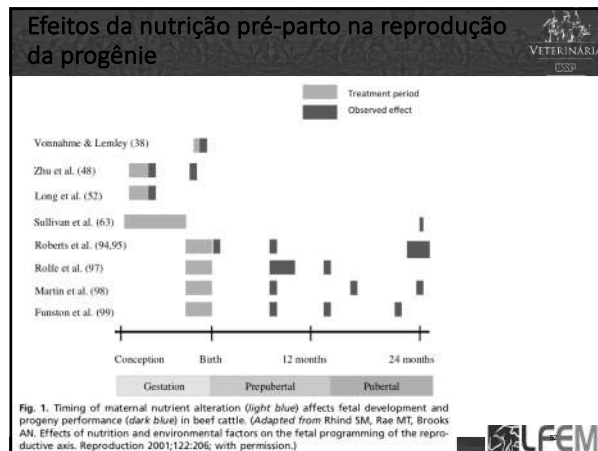
- Alta PB reduz CFA
- Aumenta Peso e esqueleto
- Reduz produção de leite e longevidade
- Menor performance reprodutiva

Suplementação

- Pode aumentar o desenvolvimento na recria
- Antecipar puberdade
- Antecipar a prenhez
- Aumentar a taxa de concepção
- Maior desenvolvimento folicular

(Funston et al., 2013)

51



52

Efeitos da nutrição pré-parto na reprodução da progênie

Effect of Prenatal Programming on Heifer Development

Richard N. Funston, ms¹, Adam F. Summers, ms²

Subnutrição

Heifer Development and Treatment ^a	Level of Winter Supplement to Dam ^a			
	Marginal		Adequate	
	Restricted	Control	Restricted	Control
Frontal BW ^b , kg	515	520	490	505
BCS at 5 y ^b	4.9	5.1	4.7*	5.0
Retention at 5 y, %	49	46	39	49
Calving birth weight, kg	33.6*	35	35	35
Calving weaning weight ^c , kg	196*	201	202	204

^a Level of supplementation provided to cows from December to March. Marginal = equivalent of 1.1 kg/d; Adequate = equivalent of 1.8 kg/d.
^b Dietary level offered to heifers during 140-day postweaning development period. Restricted = 80% of feed provided to control and 1.1 kg/d supplement each subsequent winter. Control = fed ad libitum during postweaning and 1.8 kg/d supplement each winter.
^c P<0.1 for effect of dam treatment and heifer development treatment.
^d P<0.01 for interaction of dam treatment and heifer development treatment.
^e Differs from others in same row.
 Data from Roberts AJ, Grings EL, MacNeil MD, et al. Implications of going against the dogma of feed them to breed them. WSA Sect Anim Sci Proc 2009;60:87-8; and Roberts AJ, Funston R, Mullins T, et al. Feed efficiency—how should it be used for the cow herd? Presented at Range Beef Cow Symposium XXII, Mitchell, November 30, 2011.

(Funston et al., 2013)

53

Efeitos da nutrição pré-parto na reprodução da progênie

Subnutrição no terço inicial da gestação

INFLUENCE OF PREPARTUM NUTRITION ON THE REPRODUCTIVE PERFORMANCE OF BEEF FEMALES AND THE PERFORMANCE OF THEIR PROGENY^{1,2}

L. B. Gosh³, T. G. Doss³ and C. C. Kalerbach⁴
 University of Wyoming, Laramie W2071

- 59 Novilhas Hereford
- Controle vs. Restrição (65% da demanda)
- 100 dias pré-parto

Item	High Energy level			Low Energy level		
	No.	Mean	SE	No.	Mean	SE
Calves alive at birth (%)	30	92	3	29	90	3
Weaning weight (kg)	26	160.6 ^a	4.2	25	147.6 ^b	4.2
Milk production (kg/day)	28	4.8	0.2	28	5.0	0.4
Interval to first estrus (days)	28	51	6	28	52	5
Percent showing estrus by 40 days postpartum	28	41	4	28	26	4
Age at puberty of F ₁ heifer calves (days)	12	318	6	12	337	11

^{a,b} Values with different superscripts are significantly different (P<0.05).

(Corrah et al., 1978)

54

Efeitos da nutrição pré-parto na reprodução da progênie

Subnutrição até o terço médio da gestação

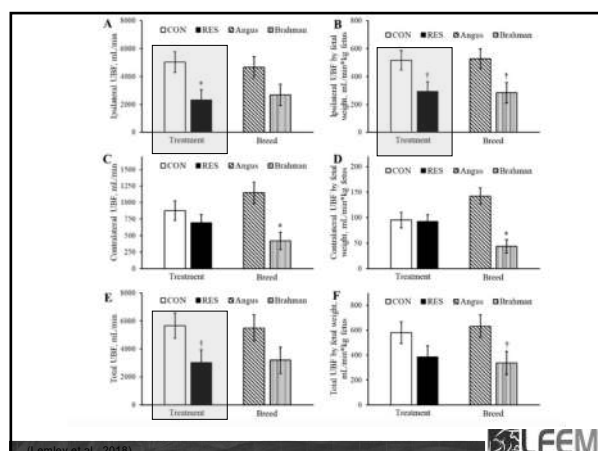
Maternal nutrient restriction alters uterine artery hemodynamics and placental vascular density in *Bos indicus* and *Bos taurus*¹

Caleb O. Lemley,^{1,2} Caitlin G. Hart,¹ Rachael L. Lemley,¹ E. Heath King,¹ Richard M. Hopper,¹ Seung B. Park,¹ Brian J. Rude,¹ and Dennis D. Burnett¹

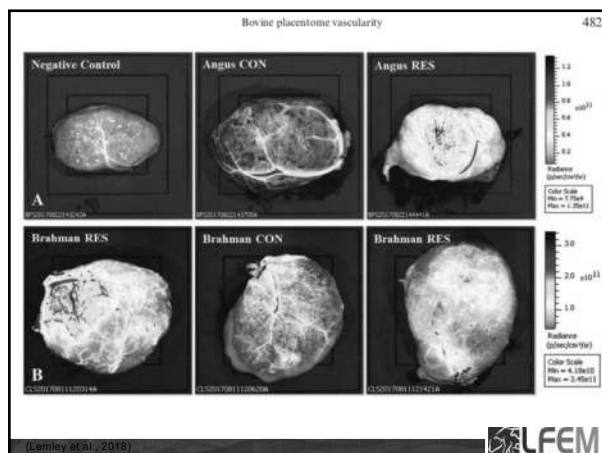
- Novilhas Angus e Brahman
- Controle vs. Restrição (60% da EM)
- restrição do dia 50 ao 175 da gestação

(Lemley et al., 2015)

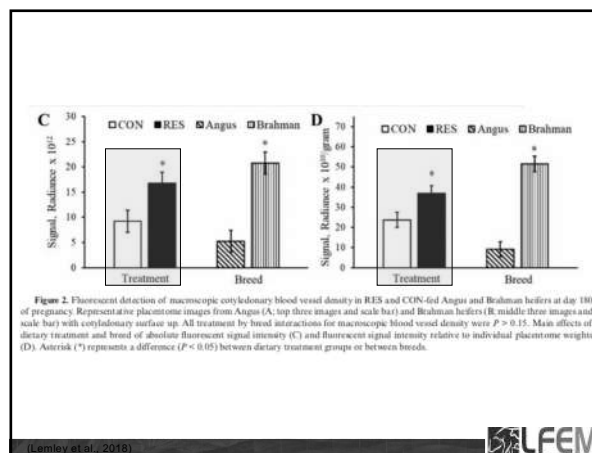
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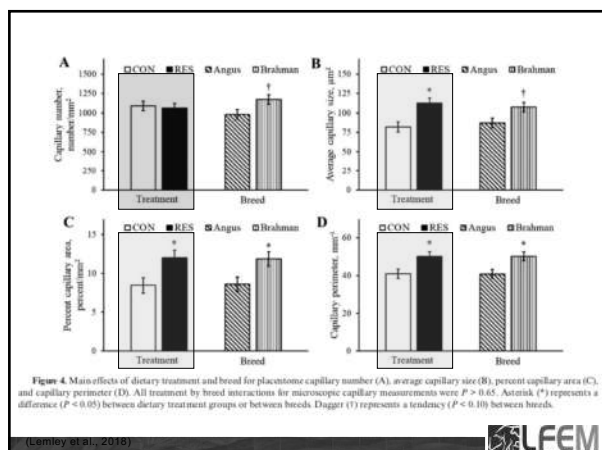
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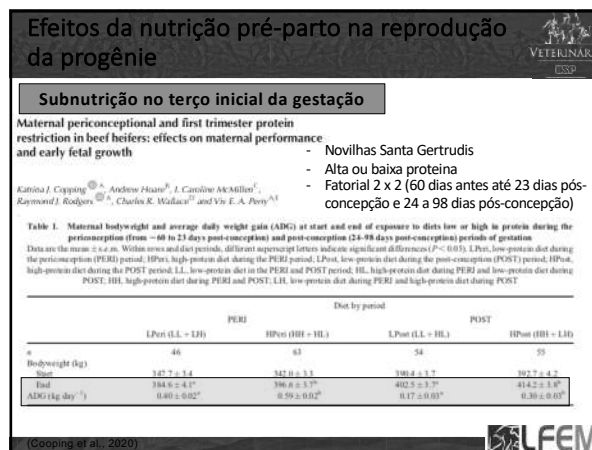
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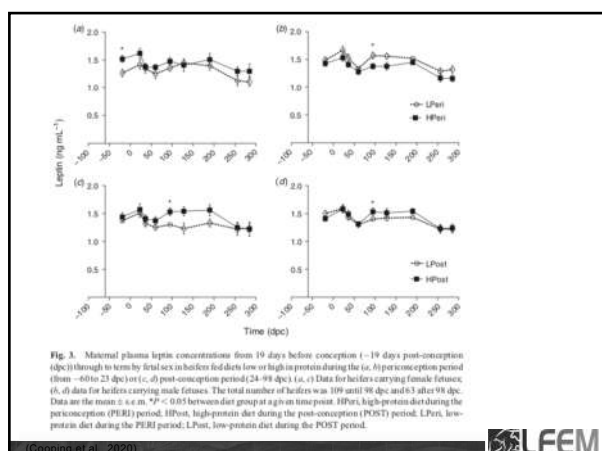
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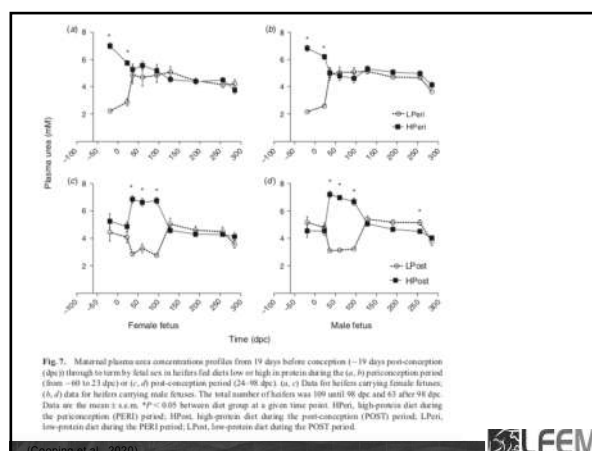
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60



61



62

Table 2. Ultrasound measurements at 60 and 95 days post-conception (dpc) of fetuses exposed to maternal diets low or high in protein during the periconception (from ~60 to 23 dpc) or post-conception (24–95 dpc) periods of gestation.
Data are the mean $\pm$ s.e.m. AD, abdominal diameter; CNL, crown–nose length; ED, eye socket diameter; HPen, high-protein diet during the periconception (PERI) period; HPPost, high-protein diet during the post-conception (POST) period; LPen, low-protein diet during the PERI period; LPPost, low-protein diet during the POST period; n, number of fetuses measured at each ultrasound time point for each measurement taken; U/D, umbilical cord diameter.

	Treatment				P-value ^b		
	LPen	HPen	LPPost	HPPost	Sex	PERI	POST
60 dpc							
AD (cm)	1.73 $\pm$ 0.03	1.73 $\pm$ 0.02	1.72 $\pm$ 0.02	1.67 $\pm$ 0.02	0.033	0.142	0.320
n	21	25	33	30			
CNL (cm)	2.53 $\pm$ 0.03	2.50 $\pm$ 0.04	2.30 $\pm$ 0.03	2.49 $\pm$ 0.03	0.073	0.558	0.686
n	21	24	33	28			
95 dpc							
AD (cm)	4.51 $\pm$ 0.06	4.40 $\pm$ 0.06	4.46 $\pm$ 0.06	4.57 $\pm$ 0.06	0.273	0.510	0.770
n	21	25	33	30			
CNL (cm)	5.57 $\pm$ 0.06	5.64 $\pm$ 0.05	5.66 $\pm$ 0.07	5.58 $\pm$ 0.05	0.364	0.537	0.901
n	21	24	33	26			
ED (cm)	1.11 $\pm$ 0.02	1.12 $\pm$ 0.01	1.11 $\pm$ 0.01	1.12 $\pm$ 0.02	0.534	0.8362	0.385
n	21	25	33	29			
U/D (mm)	1.04 $\pm$ 0.02	1.03 $\pm$ 0.02	1.03 $\pm$ 0.02	1.07 $\pm$ 0.02	0.445	0.573	0.497
n	21	24	33	30			

^aOverall difference between fetal sexes ($P < 0.05$).
^bThe full model analysis was PERI $\times$ POST $\times$ SEX. The P-value for main effects and the PERI $\times$ POST interaction is shown for all variables. All other interactions were not significant ($P > 0.05$), unless expressly stated.

(Copping et al., 2020)

63

Maternal periconceptional and first trimester protein restriction in beef heifers: effects on placental parameters and fetal and neonatal calf development

K. J. Copping^a, J. Hernandez-Medrano^a, A. Hazeel^a, K. Hammittsch^b, L. C. McMillen^a, L. L. Morrison^a, R. J. Rodgers^a and V. E. A. Perry^a*

Table 2. Measurements and absolute organ weights of fetuses at 95 days post-conception (dpc) following exposure to maternal diets low or high in protein during the periconception (PERI; ~60 to 23 dpc) and post-conception (POST; 24 to 95 dpc) periods.
Values are given as the unadjusted mean $\pm$ s.e.m. Within rows, values with different superscript letters differ significantly ($P < 0.05$). AC, abdominal circumference.

PERI POST	Treatment				P-value		
	Low	Low	High	Low	High	Sex	PERI POST
n, fetuses	9	10	15	12			
Gravid uterus (kg)	2.71 $\pm$ 0.06	2.87 $\pm$ 0.11	2.71 $\pm$ 0.09	2.83 $\pm$ 0.09	0.394	0.768	0.132
AC (cm)	14.39 $\pm$ 0.22	14.80 $\pm$ 0.23	14.48 $\pm$ 0.26	14.92 $\pm$ 0.10	0.007	0.862	0.036
Left ventricle (g)	0.50 $\pm$ 0.03	0.53 $\pm$ 0.03	0.51 $\pm$ 0.02	0.59 $\pm$ 0.03	0.073	0.326	0.040
Right ventricle (g)	0.39 $\pm$ 0.02	0.49 $\pm$ 0.02	0.44 $\pm$ 0.02	0.47 $\pm$ 0.03	0.340	0.532	0.016
Septum (g)	0.50 $\pm$ 0.03	0.58 $\pm$ 0.02	0.54 $\pm$ 0.03	0.58 $\pm$ 0.02	0.202	0.620	0.037
Atrial sept ^a (g)	0.61 $\pm$ 0.04 ^a	0.75 $\pm$ 0.05 ^b	0.69 $\pm$ 0.03 ^{ab}	0.65 $\pm$ 0.02 ^{ab}	0.007	0.539	0.115
Brain (g)	0.62 $\pm$ 0.12	0.32 $\pm$ 0.24	0.59 $\pm$ 0.16	0.51 $\pm$ 0.23	0.065	0.088	0.502
Left kidney (g)	1.17 $\pm$ 0.08	1.19 $\pm$ 0.06	1.21 $\pm$ 0.06	1.24 $\pm$ 0.07	0.007	0.637	0.673
Long (g)	8.90 $\pm$ 0.16	9.26 $\pm$ 0.41	9.23 $\pm$ 0.33	10.06 $\pm$ 0.31	0.002	0.150	0.040
Pancreas (g)	0.17 $\pm$ 0.02	0.20 $\pm$ 0.02	0.19 $\pm$ 0.01	0.21 $\pm$ 0.01	0.047	0.640	0.044
Liver (g)	10.43 $\pm$ 0.68	11.44 $\pm$ 0.51	11.32 $\pm$ 0.39	11.47 $\pm$ 0.34	0.006	0.478	0.182
No. placentomes	47.44 $\pm$ 3.79	46.50 $\pm$ 4.57	27.47 $\pm$ 5.87	65.00 $\pm$ 7.60	0.005	0.027	0.653
Placentome weight (g)	153.96 $\pm$ 3.38	115.13 $\pm$ 3.11	164.93 $\pm$ 4.61	91.97 $\pm$ 13.20	0.909	0.536	0.075
Placentome volume (mL)	140.33 $\pm$ 7.34	151.10 $\pm$ 9.12	149.13 $\pm$ 7.39	163.42 $\pm$ 8.38	0.746	0.062	0.010

*Significant PERI $\times$ POST interaction ($P < 0.05$).

64

Efeitos da nutrição pré-parto na reprodução da prole

Subnutrição no terço inicial da gestação

Figure 1. Experimental design. * month; CONTROL, cows fed 100% of their nutritional requirements during the first third of pregnancy; SUBNUT, cows fed 65% of their nutritional requirements during the first third of pregnancy; AI, artificial insemination.

Table 1. Chemical composition of feedstuffs used in the experiment (on an as-fed basis).

Chemical Composition	Total Mixed Ration ¹	Concentrate ¹	Meadow Hay ²	Barley Straw ³
DW (g/kg)	400	307	106	902
CP (g/kg DM)	124	152	154	40
ADF (g/kg DM)	466	262	569	786
ADL (g/kg DM)	203	62	320	450
ADL (g/kg DM)	40	8	58	34
Ash (g/kg DM)	113	60	88	65
ME (MJ/kg DM)	11.0	14.4	9.8	7.9

¹ Diet used during early pregnancy (maternal nutrition treatment) and lactation and heifer lactation; ² Diet used during heifer rearing; ³ Diet used during the last third of heifer pregnancy; DM, dry matter; CP, crude protein; ADF, neutral detergent fibre; ADL, acid detergent fibre; ME, metabolizable energy.

(Noya et al., 2019)

65

Efeitos da nutrição pré-parto na reprodução da prole

Subnutrição no terço inicial da gestação

Table 3. Reproductive performance of heifers during rearing according to maternal nutrition and breed.

Items	Maternal Nutrition		Breed		RSD	p-Value	
	CONTROL	SUBNUT	Parda	Pirenaica		Maternal Nutrition	Breed
Age at puberty (months)	12.0	12.1	11.6	12.6	1.58	0.905	0.169
LW at puberty (kg)	341	336	350	327	23.8	0.659	0.076
Mature LW at puberty (%) [†]	59	58	61	56	4.8	0.723	0.055
Puberty reached by 12 months (%) [†]	63	50	63	60	-	0.210	0.272
Puberty reached by 16 months (%)	94	89	95	87	-	0.409	0.333
Fertility to a single AI (%)	78.6	81.3	82.4	76.9	-	0.343	0.328

[†] 500 kg of expected mature LW for both breeds; 1% of animals that reached puberty before the mean age at puberty reported in each group; CONTROL, heifers from cows fed 100% of their requirements in early pregnancy; SUBNUT, heifers from cows fed 65% of their requirements in early pregnancy; RSD, residual standard deviation; AI, artificial insemination.

(Noya et al., 2019)

66

Efeitos da nutrição pré-parto na reprodução da prole

Subnutrição no terço inicial da gestação

Table 4. Follicle population, corpus luteum, and ovary size of heifers during rearing according to maternal nutrition and breed.

Items	Maternal Nutrition		Breed		RSD	p-Value	
	CONTROL	SUBNUT	Parda	Pirenaica		Maternal Nutrition	Breed
Small follicles (<5 mm)							
At 9.5 months (n)	8	9	10	7	4.4	0.365	0.217
At 13 months (n)	10	10	9	11	4.1	0.964	0.432
At 15.5 months (n)	16 ^a	11 ^b	33	14	4.5	0.011	0.418
Medium follicles (5 < s < 10 mm)							
At 9.5 months (n)	0.8 ^b	2.5 ^a	1.8	1.4	1.85	0.019	0.524
At 13 months (n)	0.9	1.9	2.1	0.7	1.79	0.234	0.100
At 15.5 months (n)	1.4	0.8	0.9	1.3	1.40	0.364	0.637
Large follicles (>10 mm)							
At 9.5 months (n)	0.8	0.4	0.8 ^a	0.4 ^b	0.49	0.108	0.044
At 13 months (n)	0.9 ^a	0.4 ^b	0.5	0.8	0.57	0.041	0.367
At 15.5 months (n)	0.4 ^b	0.9 ^a	0.9	0.4	0.51	0.032	0.056
Dominant follicle diameter							
At 9.5 months (mm)	11.2	9.5	10.9	9.8	1.69	0.054	0.227
At 13 months (mm)	11.1	10.2	10.9	10.5	3.19	0.544	0.807
At 15.5 months (mm)	10.5	11.4	12.4 ^a	9.5 ^b	2.31	0.451	0.017

(Noya et al., 2019)

67

Efeitos da nutrição pré-parto na reprodução da prole

Subnutrição no terço inicial da gestação

Items	Maternal Nutrition		Breed		RSD	p-Value	
	CONTROL	SUBNUT	Parda	Pirenaica		Maternal Nutrition	Breed
Corpus luteum							
Heifers with CL at 13 months (%)	88	72	84	73	-	0.191	0.246
CL diameter at 13 months (mm)	19.2	17.9	18.6	18.5	4.25	0.601	0.968
Heifers with CL at 15.5 months (%)	94	83	95	80	-	0.282	0.186
CL diameter at 15.5 months (mm)	13.2	17.2	16.6	13.8	4.13	0.119	0.265
Ovary diameter							
At 9.5 months (mm)	14.0	14.4	15.5 ^a	12.9 ^b	1.41	0.639	0.009
At 13 months (mm)	18.6	17.5	18.3	17.7	2.02	0.325	0.608
At 15.5 months (mm)	17.8	18.8	19.3 ^a	16.7 ^b	1.73	0.292	0.003

(Noya et al., 2019)

68

(Cracco et al., Accepted manuscript)



VETERINÁRIA
USP

TABLE 1

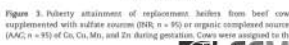
(Cracco et al., Accepted manuscript)

VETERINARIYA
ITSSP

(Harvey et al., 2021)

VETERINARIA
ANVI

(Harvey et al., 2021)



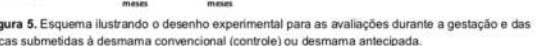
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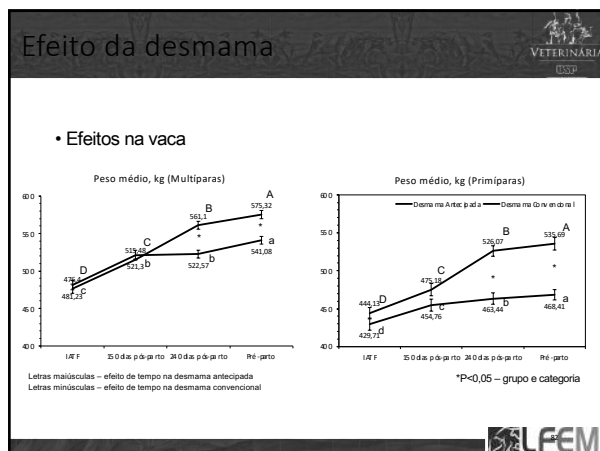
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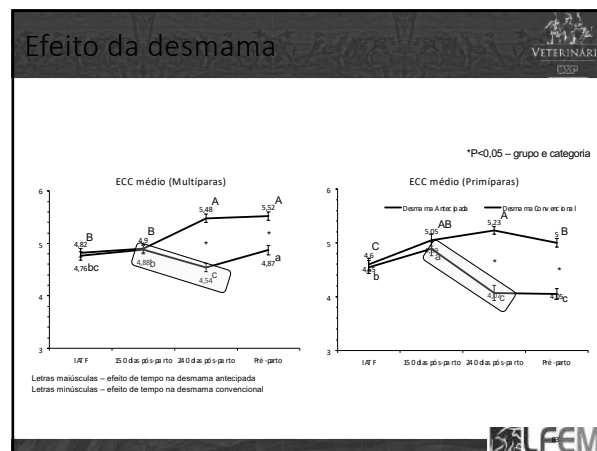
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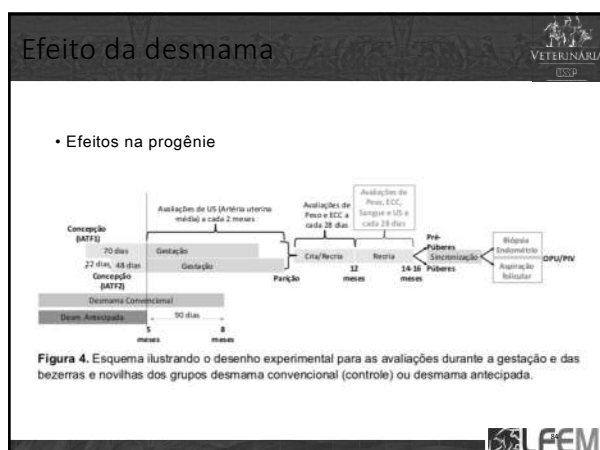
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82



83



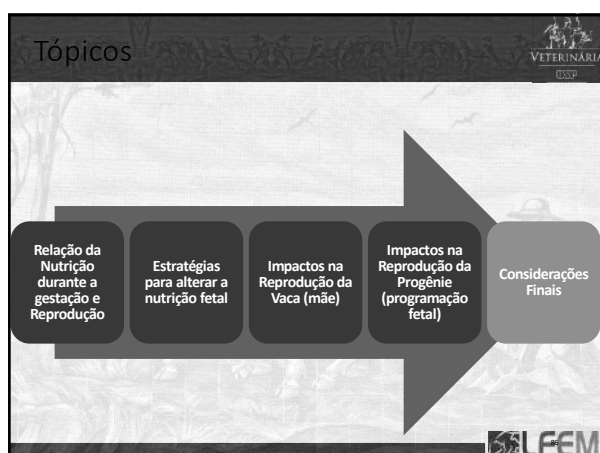
84

Efeito da desmama

Efeitos na vaca/progênie → Perfusão sanguínea na artéria Uterina média (5,5 gestação)

	Primiparas		Multiparas		Valor de P		
	Antecipado (n=12)	Convencional (n=13)	Antecipado (n=13)	Convencional (n=12)	CAT	TRAT	CAT*TRAT
Diâmetro Ipsi (mm)	7.65 ± 0.42	7.76 ± 0.39	7.50 ± 0.30	7.66 ± 0.31	0.10	0.76	0.32
Diâmetro Contra (mm)	4.43 ± 0.31	4.17 ± 0.25	4.88 ± 0.45	4.92 ± 0.45	0.02	0.21	0.11
IR Ipsi	0.50 ± 0.02	0.49 ± 0.02	0.50 ± 0.02	0.50 ± 0.02	0.91	0.79	0.91
IR Contra	0.57 ± 0.02	0.56 ± 0.02	0.57 ± 0.02	0.58 ± 0.71	0.71	0.83	0.63
TAMV Ipsi (cm/s)	112.7 ± 8.61	112.9 ± 8.22	107.7 ± 5.53	107.5 ± 0.05	0.05	0.37	0.97
TAMV Contra (cm/s)	43.4 ± 5.51	47.6 ± 5.00	49.7 ± 6.15	47.8 ± 0.86	0.86	0.38	0.59
Volume Ipsi (L/min)	3.20 ± 0.40	3.29 ± 0.38	2.89 ± 0.28	3.00 ± 0.89	0.89	0.37	0.36
Volume Contra (L/min)	0.45 ± 0.10	0.44 ± 0.08	0.63 ± 0.13	0.60 ± 0.12	0.12	0.15	0.14

85



86

Considerações Finais

Desempenho Reprodutivo da vaca	Desempenho Reprodutivo da progênie
- Restrição ou Suplementação: - Peso e ECC - Metabólitos - Gordura subcutânea - Potencial para impactar na Reprodução - Terço Final da gestação - Primiparas	- Maiores alterações em casos de restrição (Subnutrição) - Menor desenvolvimento da placenta - Menor peso ao nascimento e desmama - Crescimento e carcaça - Saúde na cria e recria - Atraso na puberdade e prenhez - Suplementação - Resultados inconsistentes - Estratégica

Evitar Subnutrição !!

87



88



89