

Effects of a moderate exercise regimen on reproductive development of replacement beef heifers reared in drylots at a high stocking density

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Animal Science



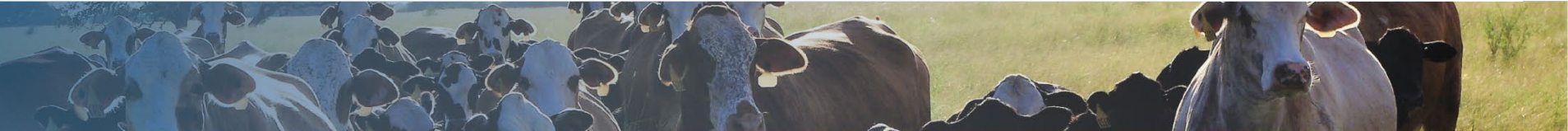


Cow-calf operations

- Represent 86% of beef operations and 84% beef cattle in the US
 - Most are extensive operations, based on grazing lands (≥ 1.0 ha/cow)



- Fall-weaned heifers – drylotted during winter/early spring for feeding
- Recent increase in drylot cow-calf systems (part of or all year – midwest US)



Cow-calf operations

- Heifer development programs – foundation of cow-calf systems
 - Pubertal by 12 mo | conceive by 15 mo | calve by 24 mo of age

JOURNAL ARTICLE

Effects of testosterone on reproduction in female beef heifers

R. F. Cooke, D. W. Rohrer, C. I. Francisco, R. S. Marques, C. I. Mueller, D. H. Keisler

JOURNAL ARTICLE

Effects of bovine somatotropin administration on growth, physiological, and reproductive responses of replacement beef heifers¹

R. F. Cooke, D. W. Rohrer, C. I. Francisco, R. S. Marques, C. I. Mueller, D. H. Keisler

Journal of Animal Science

JOURNAL ARTICLE

Supplementation based on protein or energy ingredients to beef cattle consuming low-quality cool-season forages: I. Forage disappearance

Creep-feeding to stimulate metabolic imprinting in nursing beef heifers: impacts on heifer growth, reproductive and physiological variables

Published online by Cambridge University Press: 20 May 2015

B. I. Cappellozza, M. M. Reis, R. F. Cooke, B. I. Cappellozza, R. S. Marques, T. A. Guarnieri Filho, M. C. Rodrigues, J. S. Bradley, C. J. Mueller, D. H. Keisler and S. E. Johnson ...Show all authors

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Article

Metrics





Cow-calf operations

- Heifer development programs – foundation of cow-calf systems
 - Pubertal by 12 mo | conceive by 15 mo | calve by 24 mo of age

Response	Pasture	Drylot	<i>P</i> =
Stocking rate, m ² /heifer	> 500	14	---
ADG, kg/d	0.56	0.75	< 0.01
% pubertal at breeding	50	15	< 0.01





Preliminary data (Shubach et al., 2017)

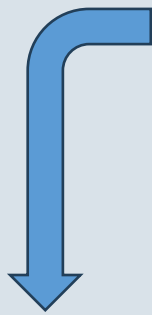
- Spring-born heifers raised on pasture
 - Drylot or pasture after weaning (late fall)
 - From weaning to first breeding season (182 days)
 - Same nutritional management (similar ADG)
 - Major change in management/environment
 - Confinement + lack of exercise
 - Physical, psychological, physiological stress
 - **Body and reproductive development?**





Preliminary data (Shubach et al., 2017)

Item	Pasture	Drylot	SEM	P =
Heifer growth				
Weaning BW, kg	211	212	3	0.82
Breeding BW, kg	356	358	5	0.84
ADG, kg/day	0.777	0.783	0.018	0.82
Heifer activity				
	Physical activity + gathering			
Steps/week	19,709	3,148	628	< 0.01
HSP72 mRNA	3.48	2.77	0.18	0.04
HSP70 mRNA	3.72	2.39	0.46	0.09



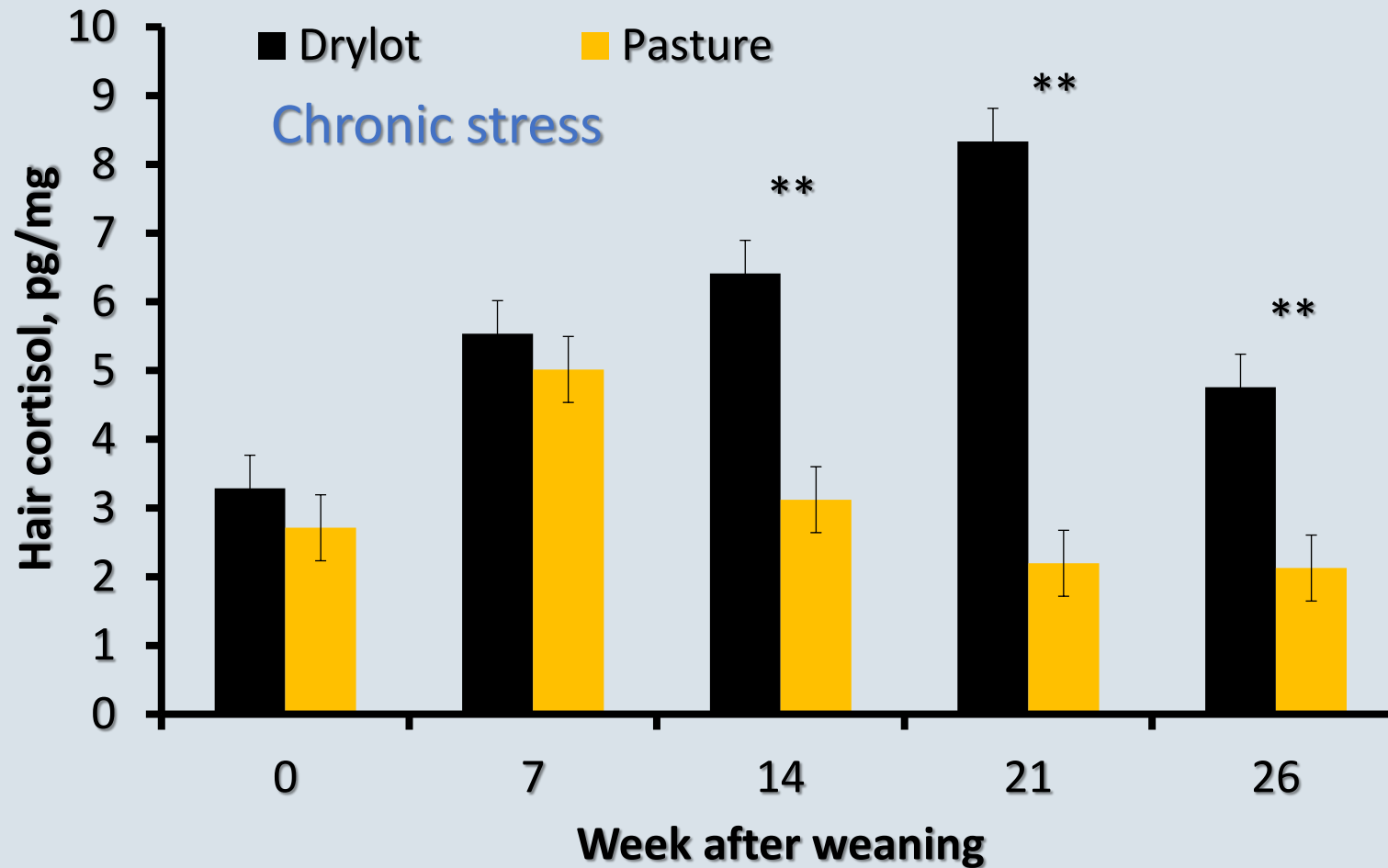
2.5 ha/heifer



14 m²/heifer



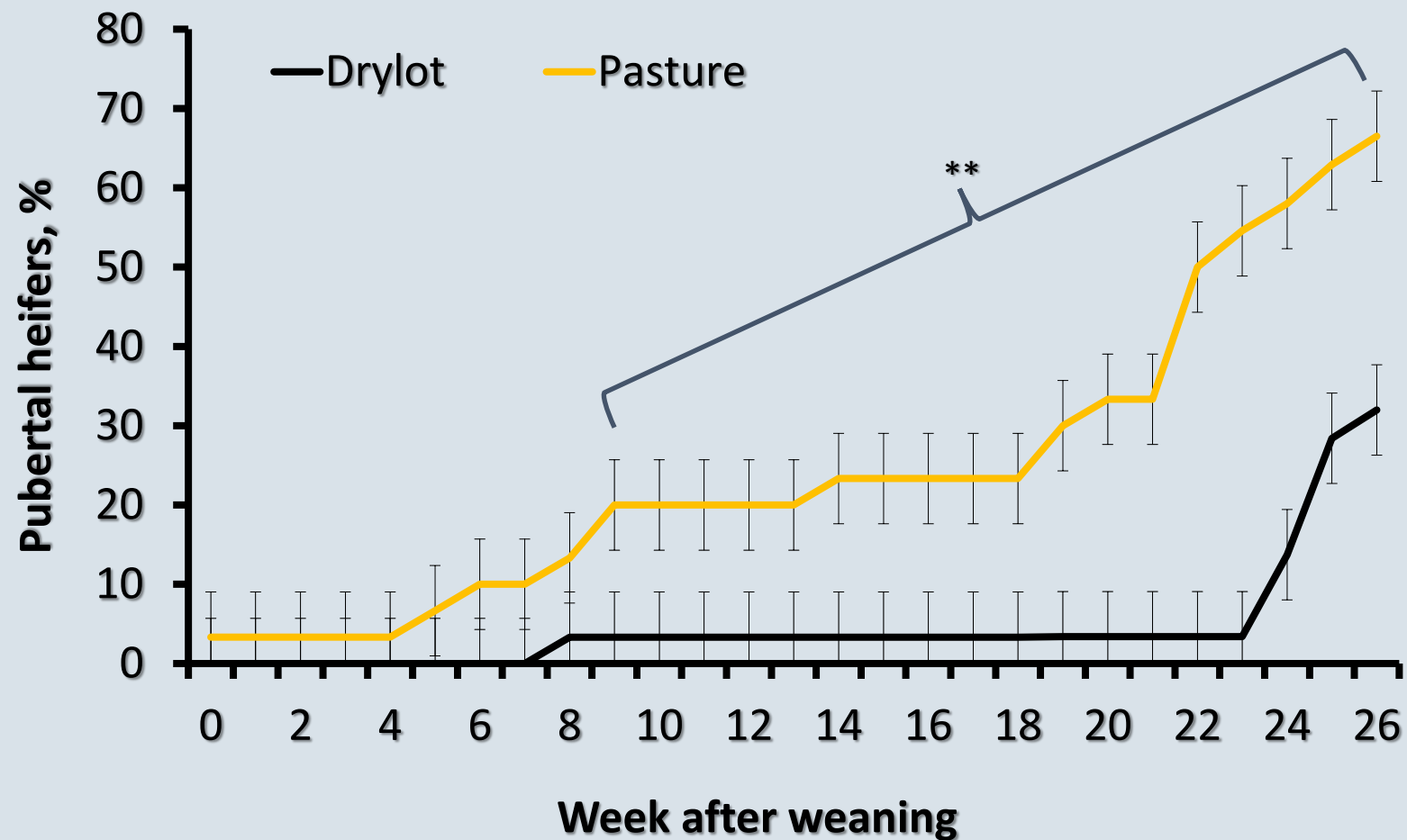
Preliminary data (Shubach et al., 2017)





Preliminary data (Schubach et al., 2017)

Puberty	Pasture	Drylot	SEM	P =
Age, d	331	354	12	0.04
BW, kg	324	372	9	0.01





Preliminary data (Shubach et al., 2017)

- Replacement heifers in drylots
 - Detrimental to puberty attainment
 - Despite similar and adequate BW development
 - **Stress of confinement**
 - Chronic stimulation of the HPA axis
 - **Lack of exercise**
 - Limited secretion of endogenous opioids
 - **Both impair** gonadotropin secretion and neuroendocrine sensitivity to estrogen
 - Harber and Sutton (1984) | Dobson and Smith (2000)





Heifer development systems

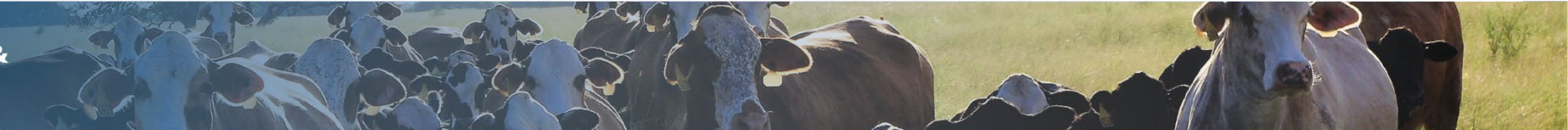


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- Questions to be addressed

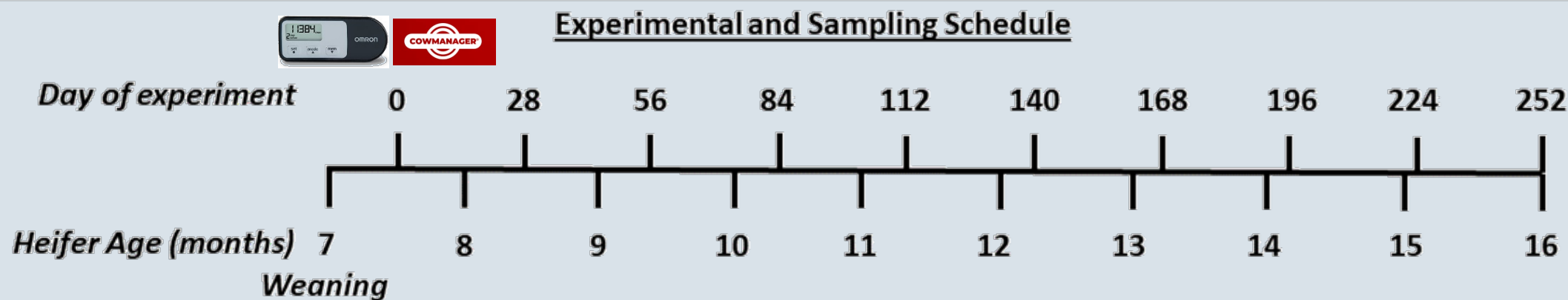
- Lack of exercise vs. stress of confinement?
 - Frequent but moderated exercise hastened puberty in heifers (Cooke et al., 2009; Cooke et al., 2012)
 - *Limited physical activity contributes to the delayed puberty attainment in drylot heifers*
 - *Moderate exercise regimen will alleviate the negative reproductive effects of confinement*
- Different stocking densities
 - Lack of guidelines for replacement heifers (1987 feedlot guidelines, **min 14 m²/heifer**)
 - *Reducing stocking density (14 m², 28 m², 42 m²) will improve heifer reproductive development*
- Different group × pen sizes
 - Physical activity and space use increases in larger pens with same stocking density (Telezhenko et al., 2012)
 - *increasing pen and group size will alleviate the negative reproductive effects of confinement*





Heifer development systems

- Spring-born heifers raised on pasture (McGregor, TX)
 - 2-year study (2021, 2022) – 90 Angus x *B. indicus* heifers/year
 - From 21 d after weaning to first breeding season (224 days)
 - Same nutritional management (similar ADG)



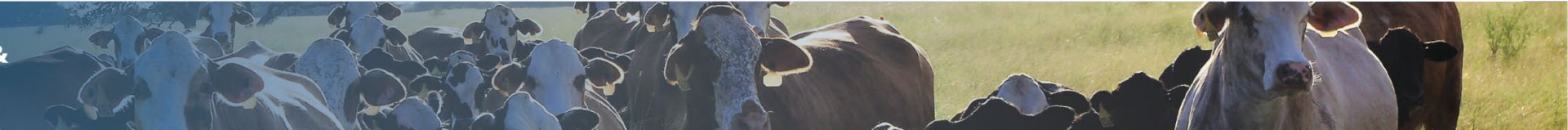
- *Start, middle, end of trial*: Temperament, shrunk BW
 - *Weekly*: BW, puberty, physical activity, behavior

- *14- intervals*: Plasma cortisol
- *28-d intervals*: Hair cortisol, blood biomarkers (mRNA)



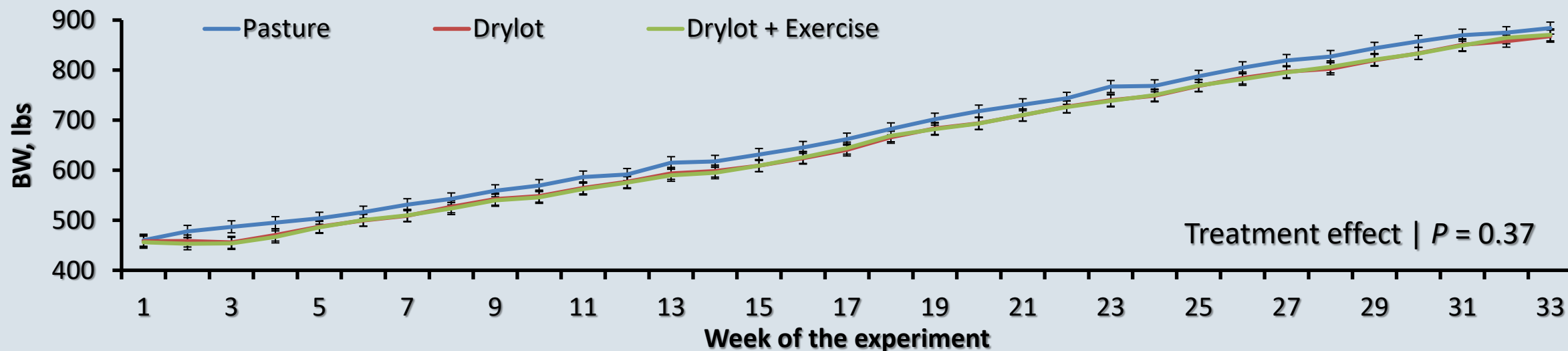
Heifer development systems

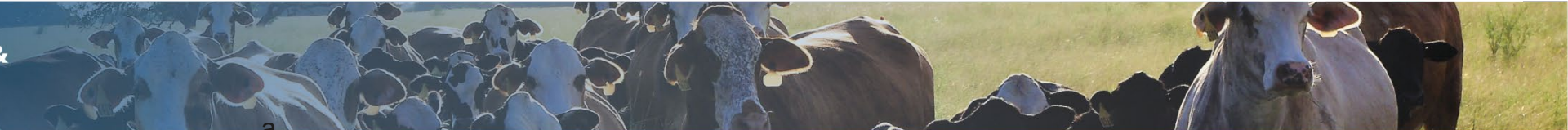
Item	Pasture	Drylot	Drylot + Exercise	SEM	<i>P</i> =
Steps/week 	23,973 ^a	6,706 ^c	12,354 ^b	1,247	< 0,01
Time spent, % 					
Active	19.9 ^a	16.9 ^b	17.5 ^b	0.4	< 0.01
Eating	14.8 ^a	5.40 ^b	5.23 ^b	0.37	< 0.01
Highly active	18.2	17.5	16.7	0.5	0.11
Not active	37.3 ^b	52.2 ^a	53.3 ^a	0.8	< 0.01
Ruminating	9.60	7.99	7.26	0.80	0.14



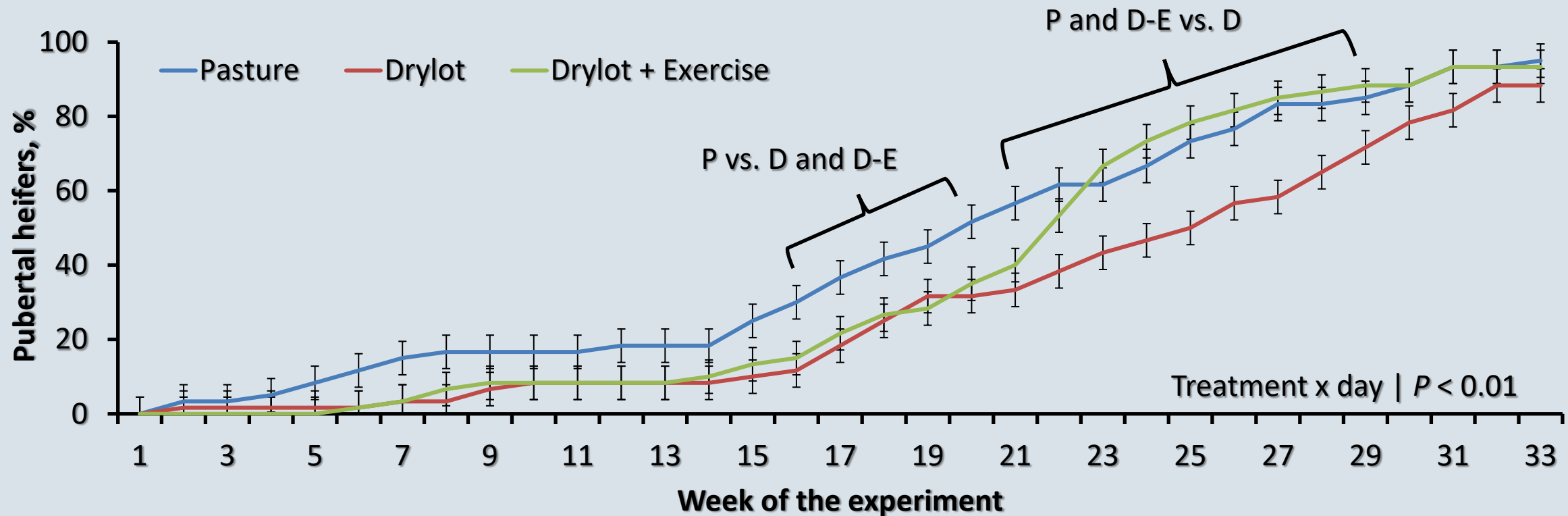
Heifer development systems

Item	Pasture	Drylot	Drylot + Exercise	SEM	<i>P</i> =
Age (d 0)	264	264	265	3	0.99
Heifer growth					
Initial BW, kg	200	200	200	7	0.99
Final BW, kg	387	386	387	8	0.99
ADG, kg/day	0.820	0.815	0.824	0.016	0.91





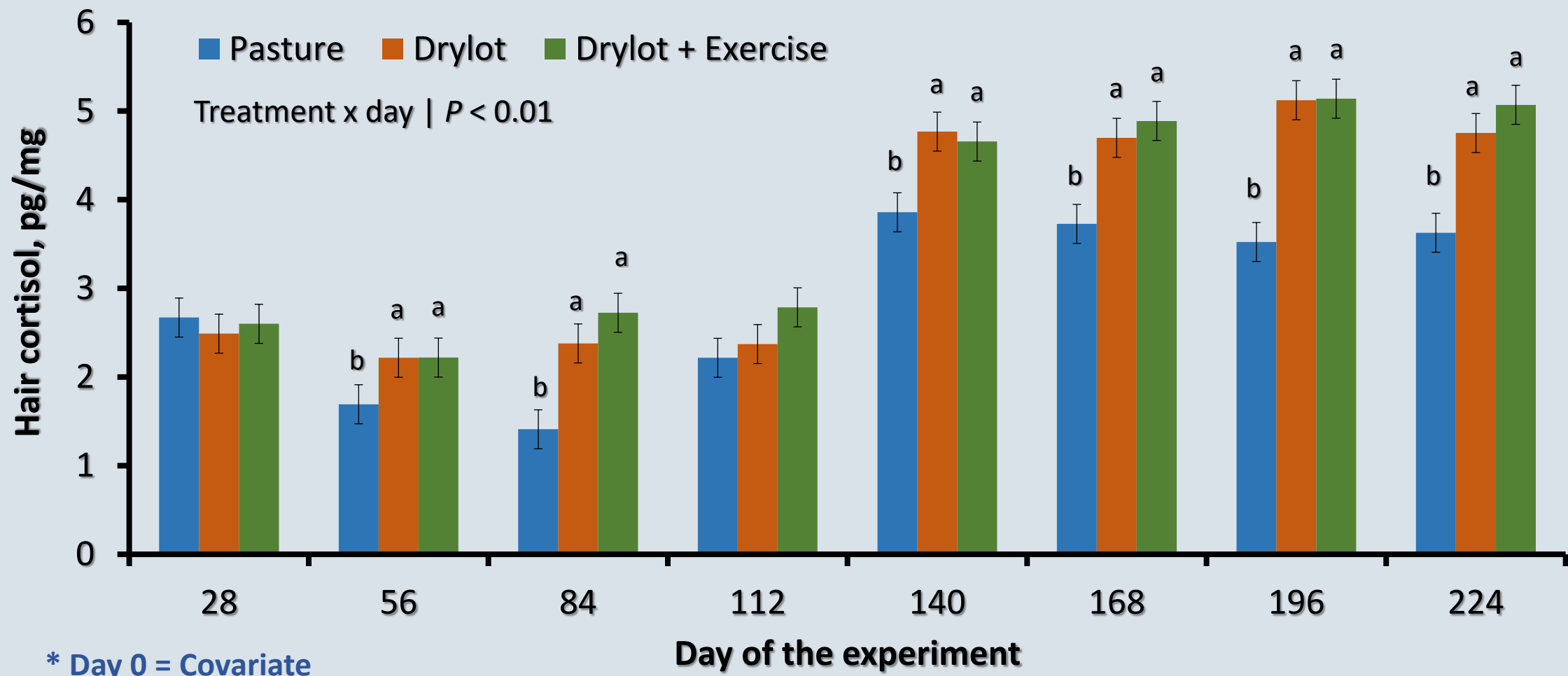
Heifer development systems



Item	Pasture	Drylot	Drylot + Exercise	SEM	P =
Age at puberty, d	391 ^b	417 ^a	404 ^{ab}	7	0.04
BW at puberty, kg	320	336	326	6	0.17

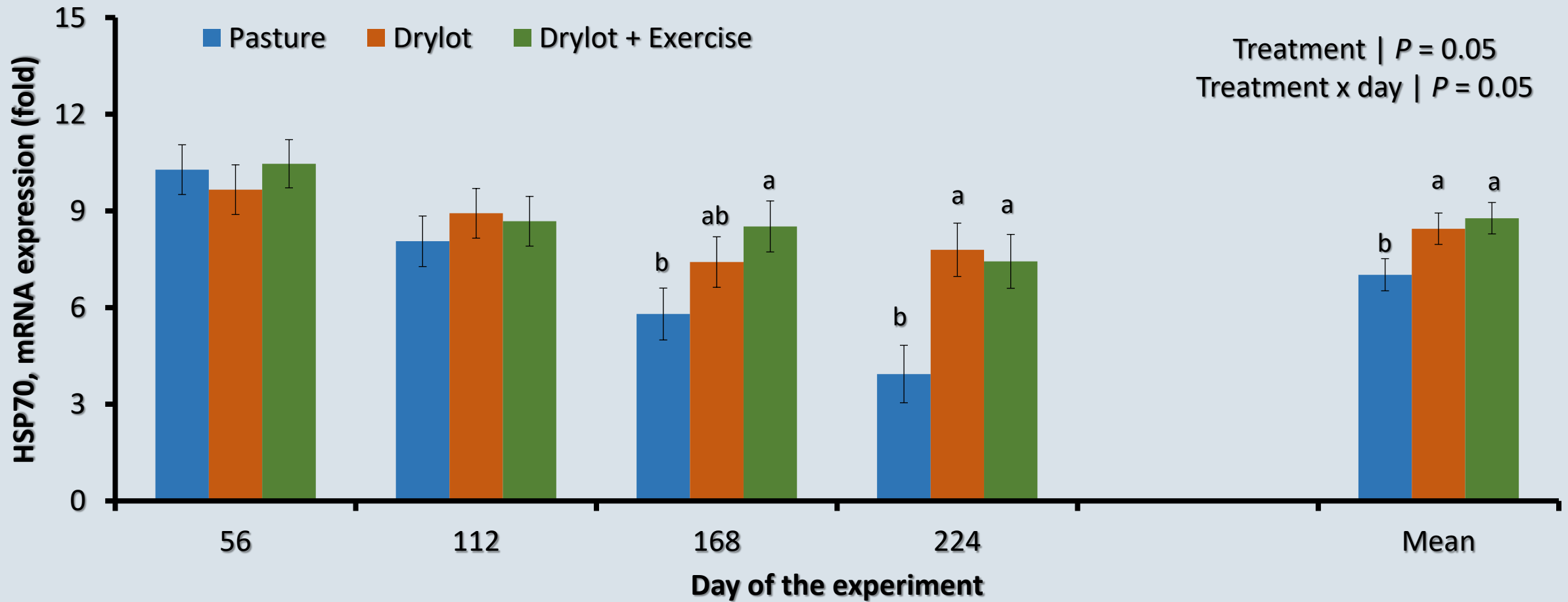


Heifer development systems





Heifer development systems

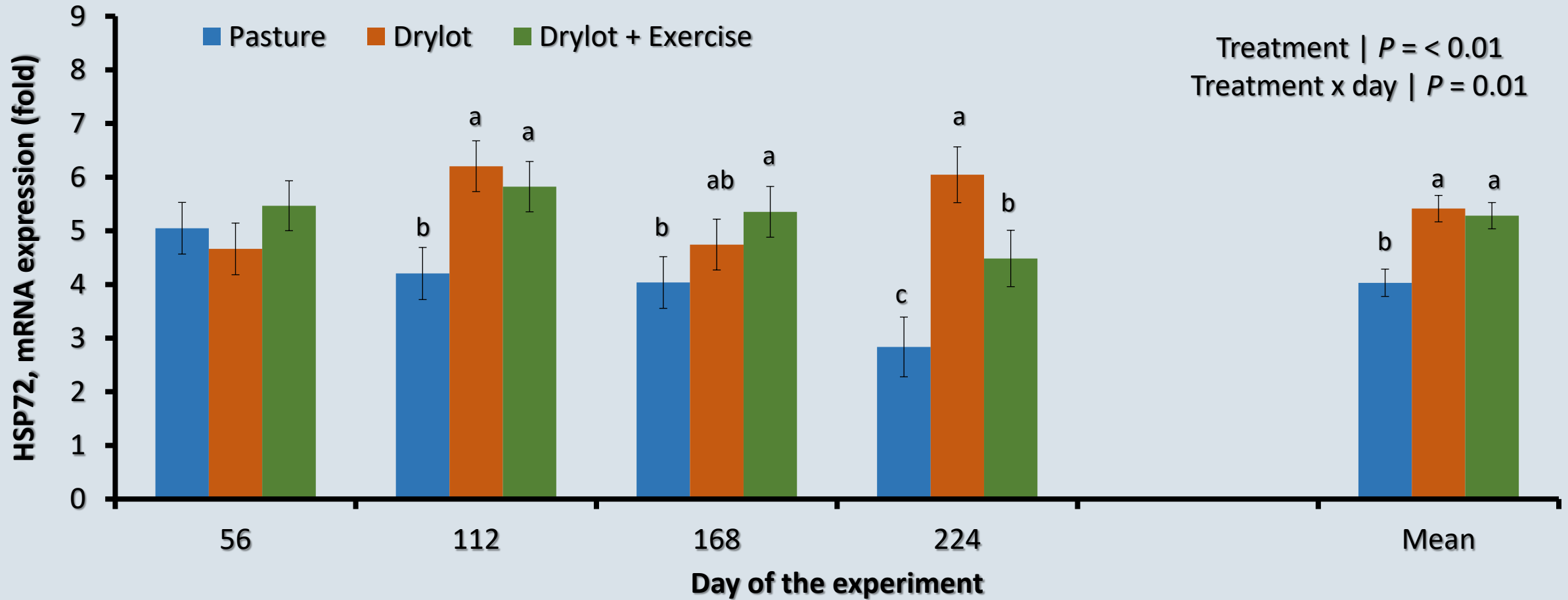


* Day 0 = Covariate

HSP70 = upregulated in stress conditions

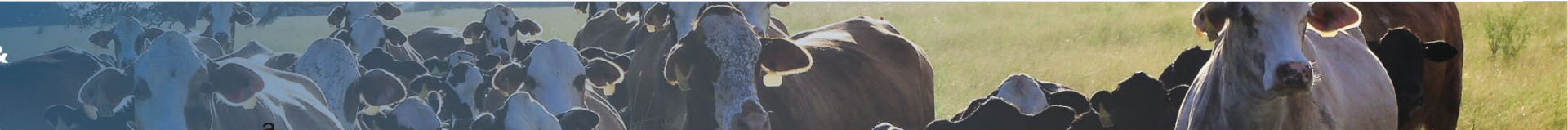


Heifer development systems

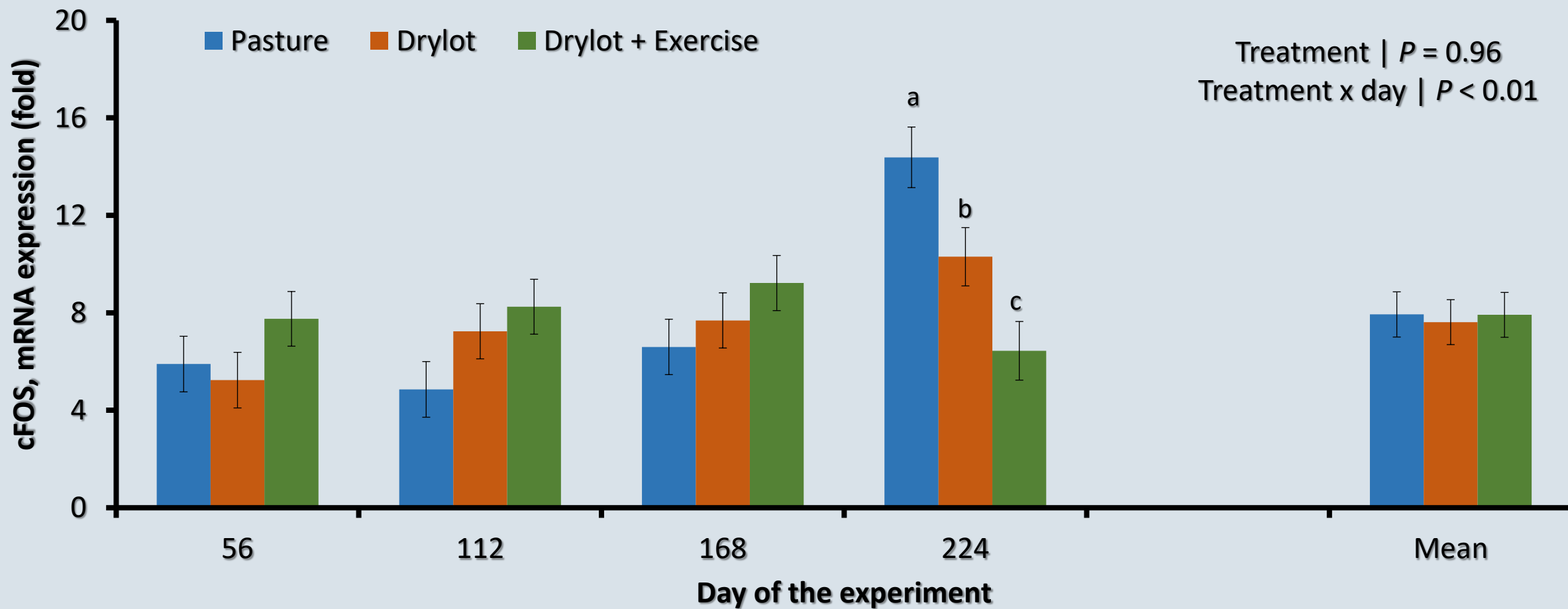


* Day 0 = Covariate

HSP72 = upregulated in stress conditions

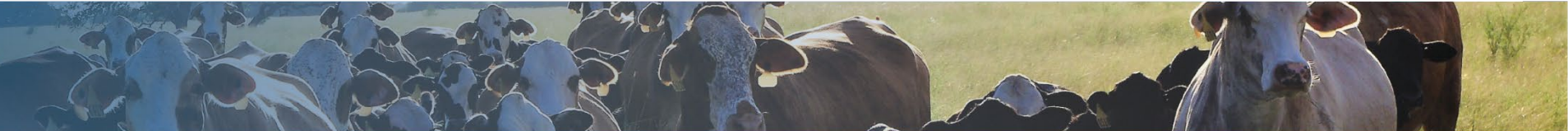


Heifer development systems



* Day 0 = Covariate

cFOS = downregulated in anxiety conditions



Heifer development systems



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Thank you for your attention



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