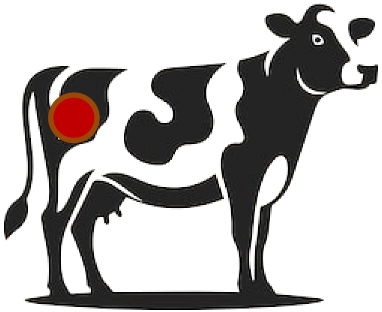
Vorgeburtliche Einflüsse auf die Nachkommen

Prof. Dr. Michael Hölker
Biotechnology & Reproduktion landwirtschaftlicher Nutztiere
Department für Nutztierwissenschaften
Georg-August-Universtität Göttingen

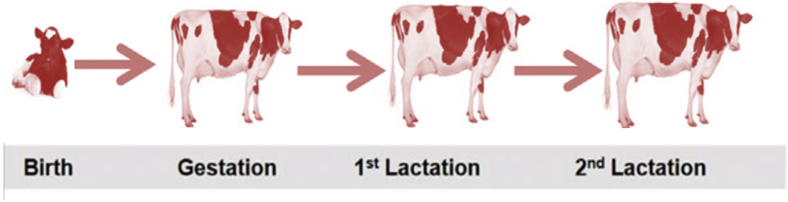
Vorgeburtliche Einflüsse

Maternale Faktoren

z.B. Genetik, Alter, Leistung



Vitalität & Leistung der Nachkommen



Vorgeburtliche Einflüsse

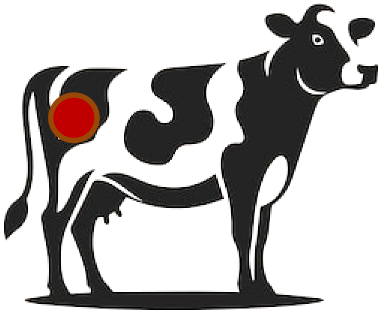
Umwelt

z.B. Klima, Management, Fütterung

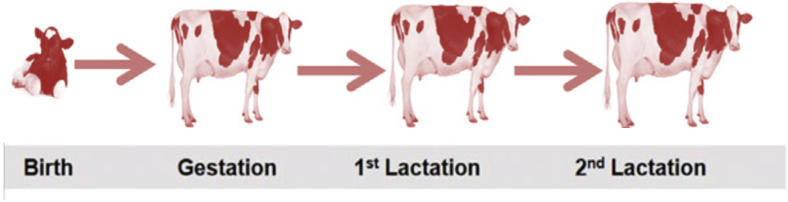
↓

Maternale Faktoren

z.B. Genetik, Alter, Leistung



Vitalität & Leistung der Nachkommen



Vorgeburtliche Einflüsse

Umwelt

z.B. Klima, Management, Fütterung

↓

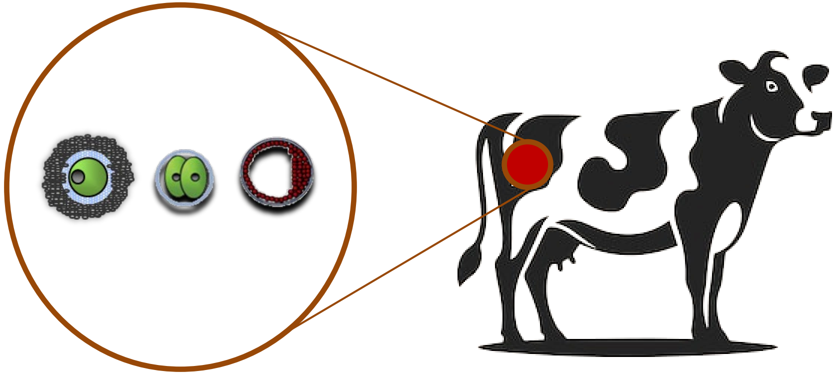
Embryonale Faktoren

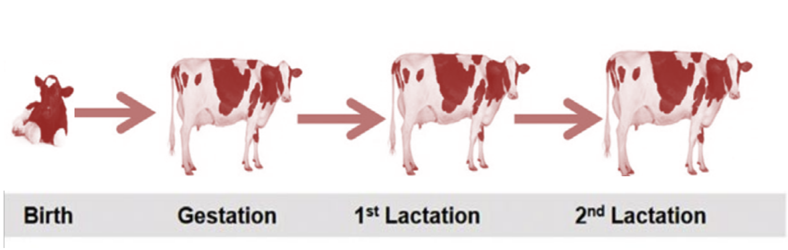
z.B. Genetik, Embryotypus

Maternale Faktoren

z.B. Genetik, Alter, Leistung

Vitalität & Leistung der Nachkommen





Einfluss von Hitzestress in der späten Trächtigkeitsphase

Trächtigkeitslänge (Tage)		Geburtsgewicht des Kalbes (Kilogramm)		Differenz (Prozent)	Literaturquelle*
HS	Kontr.	HS	Kontr.		
n.e.	n.e.	40,6	43,2	8	Wolfenson et al., 1988
n.e.	n.e.	33,7	37,9	11	Avendaño-Reyes et al., 2006
274	278	40,8	43,6	6	Adino et al., 2009
n.e.	n.e.	31,0	44,0	30	do Amaral et al., 2009
n.e.	n.e.	39,5	44,5	11	do Amaral et al., 2009
274	277	41,6	46,5	11	Tao et al., 2011
272	276	36,5	42,5	14	Tao et al., 2012

Hitzestress → Trächtigkeitsdauer ↓

Einfluss von Hitzestress in der späten Trächtigkeitsphase

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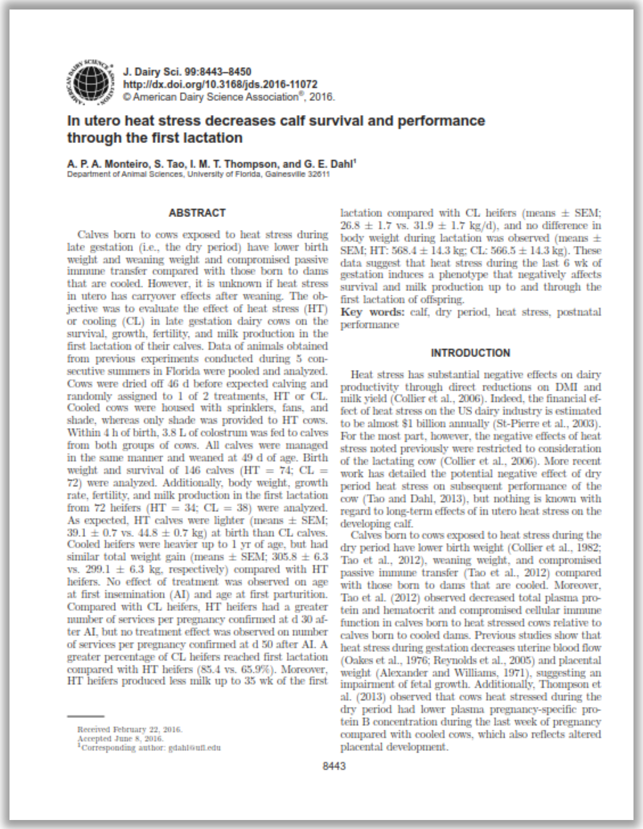
274	277	41,6	46,5	11	Tao et al., 2011
272	276	36,5	42,5	14	Tao et al., 2012

Hitzestress → Trächtigkeitsdauer ↓ und **Geburtsgewichte ↓**

Folgen von Hitzestress *In utero* während der Trockenstehzeit



J. Dairy Sci. 99:8443–8450
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In utero heat stress decreases calf survival and performance through the first lactation

A. P. A. Monteiro, S. Tao, I. M. T. Thompson, and G. E. Dahl[1]
Department of Animal Sciences, University of Florida, Gainesville 32611

ABSTRACT

Calves born to cows exposed to heat stress during late gestation (i.e., the dry period) have lower birth weight and weaning weight and compromised passive immune transfer compared with those born to dams that are cooled. However, it is unknown if heat stress in utero has carryover effects after weaning. The objective was to evaluate the effect of heat stress (HT) or cooling (CL) in late gestation dairy cows on the survival, growth, fertility, and milk production in the first lactation of their calves. Data of animals obtained from previous experiments conducted during 5 consecutive summers in Florida were pooled and analyzed. Cows were dried off 46 d before expected calving and randomly assigned to 1 of 2 treatments, HT or CL. Cooled cows were housed with sprinklers, fans, and shade, whereas only shade was provided to HT cows. Within 4 h of birth, 3.8 L of colostrum was fed to calves from both groups of cows. All calves were managed in the same manner and weaned at 49 d of age. Birth weight and survival of 146 calves (HT = 74; CL = 72) were analyzed. Additionally, body weight, growth rate, fertility, and milk production in the first lactation from 72 heifers (HT = 34; CL = 38) were analyzed. As expected, HT calves were lighter (means ± SEM; 39.1 ± 0.7 vs. 44.8 ± 0.7 kg) at birth than CL calves. Cooled heifers were heavier up to 1 yr of age, but had similar total weight gain (means ± SEM; 305.8 ± 6.3 vs. 299.1 ± 6.3 kg, respectively) compared with HT heifers. No effect of treatment was observed on age at first insemination (AI) and age at first parturition. Compared with CL heifers, HT heifers had a greater number of services per pregnancy confirmed at d 30 after AI, but no treatment effect was observed on number of services per pregnancy confirmed at d 50 after AI. A greater percentage of CL heifers reached first lactation compared with HT heifers (85.4 vs. 65.9%). Moreover, HT heifers produced less milk up to 35 wk of the first lactation compared with CL heifers (means ± SEM; 26.8 ± 1.7 vs. 31.9 ± 1.7 kg/d), and no difference in body weight during lactation was observed (means ± SEM; HT: 568.4 ± 14.3 kg; CL: 566.5 ± 14.3 kg). These data suggest that heat stress during the last 6 wk of gestation induces a phenotype that negatively affects survival and milk production up to and through the first lactation of offspring.

Key words: calf, dry period, heat stress, postnatal performance

INTRODUCTION

Heat stress has substantial negative effects on dairy productivity through direct reductions on DMI and milk yield (Collier et al., 2006). Indeed, the financial effect of heat stress on the US dairy industry is estimated to be almost $1 billion annually (St-Pierre et al., 2003). For the most part, however, the negative effects of heat stress noted previously were restricted to consideration of the lactating cow (Collier et al., 2006). More recent work has detailed the potential negative effect of dry period heat stress on subsequent performance of the cow (Tao and Dahl, 2013), but nothing is known with regard to long-term effects of in utero heat stress on the developing calf.

Calves born to cows exposed to heat stress during the dry period have lower birth weight (Collier et al., 1982; Tao et al., 2012), weaning weight, and compromised passive immune transfer (Tao et al., 2012) compared with those born to dams that are cooled. Moreover, Tao et al. (2012) observed decreased total plasma protein and hematocrit and compromised cellular immune function in calves born to heat stressed cows relative to calves born to cooled dams. Previous studies show that heat stress during gestation decreases uterine blood flow (Oakes et al., 1976; Reynolds et al., 2005) and placental weight (Alexander and Williams, 1971), suggesting an impairment of fetal growth. Additionally, Thompson et al. (2013) observed that cows heat stressed during the dry period had lower plasma pregnancy-specific protein B concentration during the last week of pregnancy compared with cooled cows, which also reflects altered placental development.

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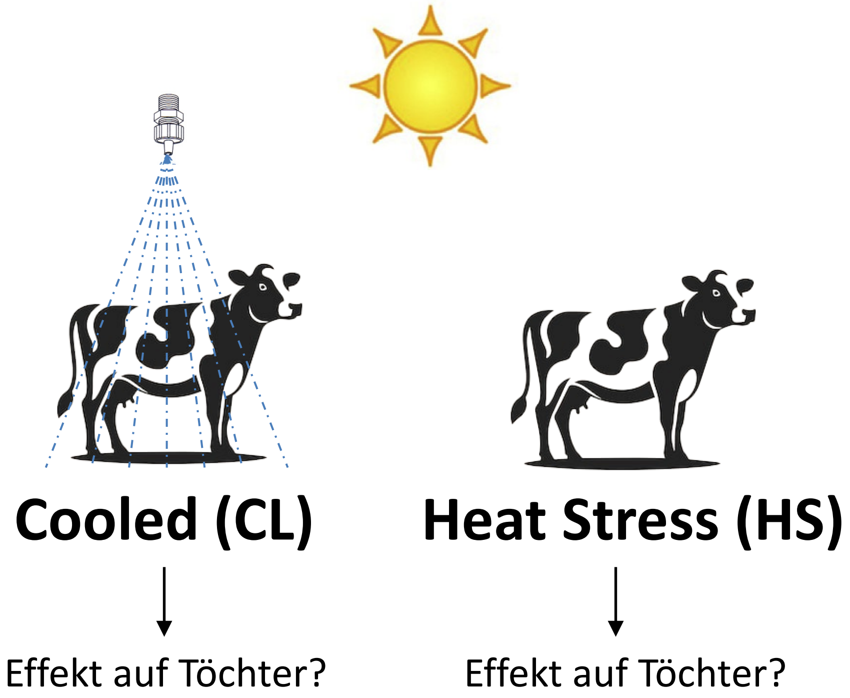
[1]Corresponding author: gdahl@ufl.edu



Monteiro et al. (2016), *J.Dairy Sci.* (99) 8443

Hitzestress *In utero* während der Trockenstehzeit

Effekt auf die Entwicklung der Töchter

	CL				HT				P-value
Item	AI	IVF[1]	Total	%[2]	AI	IVF	Total	%	Trt[3]
Bull calves (no.)	30	1	31	—	28	2	30	—	—
Heifer calves (no.)	29	12	41	—	29	15	44	—	—
Stillborn[4]	0	0	0	0.0	2	1	3	4.1	0.25
Bull calf mortality by 4 mo of age	1	0	1	3.2	3	0	3	10.0	0.35
Heifers leaving herd before puberty	1	4	5	12.2	3	7	10	22.7	0.26
due to sickness, malformation, or growth retardation	1	0	1	2.4	3	5	8	18.2	0.03
Heifers leaving herd after puberty, before first lactation	1	0	1	2.4	3	0	3	6.8	0.62
Heifers completing first lactation	27	8	35	85.4	22	7	29	65.9	0.05

Monteiro et al. (2016), *J. Dairy Sci.* (99) 8443

Hitzestress *In utero* während der Trockenstehzeit

… beinflusst die Fruchtbarkeit der Töchter

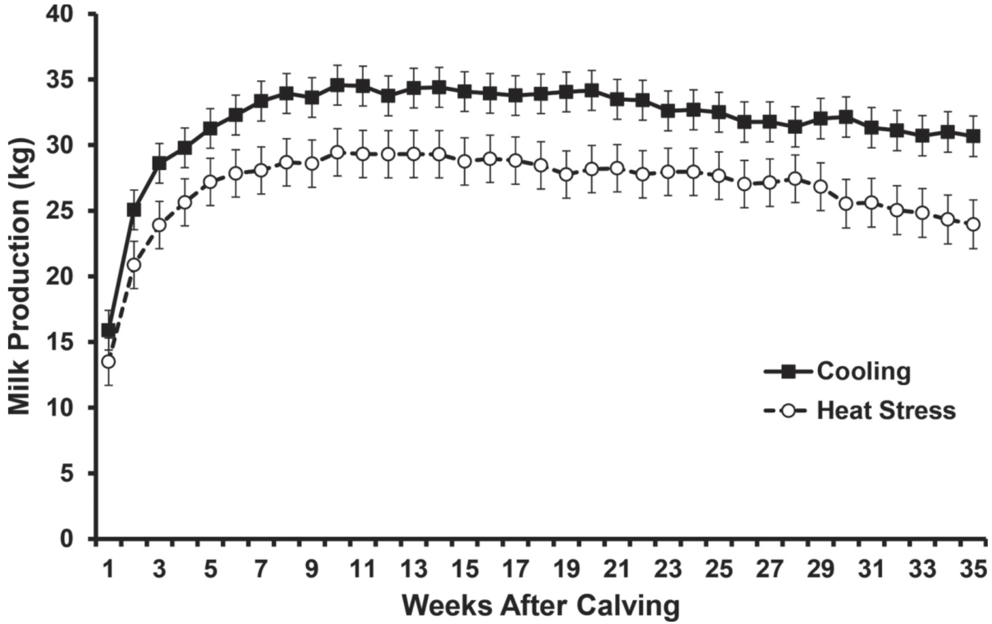
Item	CL	HT	SEM	*P*-value
Heifers (no.)	36	32	—	—
Age at first AI (mo)	13.6	13.8	0.2	0.32
Services per pregnancy d[1] 30	2.0	2.5	0.2	0.05
Age at pregnancy d[1] 30 (mo)	16.1	16.9	0.3	0.07
Services per pregnancy d[1] 50	2.3	2.6	0.2	0.32
Age at calving (mo)	24.8	25.0	0.4	0.72

[1]Days after insemination.

Monteiro et al. (2016), *J. Dairy Sci.* (99) 8443

Hitzestress *In utero* während der Trockenstehzeit

… beinflusst die Milchleistung der Töchter



Monteiro et al. (2016), *J.Dairy Sci.* (99) 8443

Hitzestress *In utero* während der Trockenstehzeit

… beinflusst die Nutzungsdauer Töchter

	CL				HT				*P*-value
Item	AI	IVF[1]	Total	%[2]	AI	IVF	Total	%	Trt[3]
Bull calves (no.)	30	1	31	—	28	2	30	—	—
Heifer calves (no.)	29	12	41	—	29	15	44	—	—
Stillborn[4]	0	0	0	0.0	2	1	3	4.1	0.25
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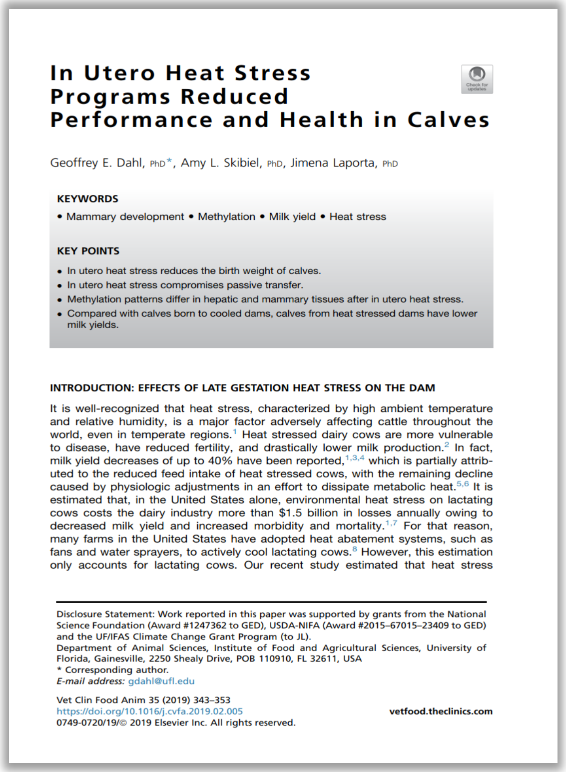
Folgen von Hitzestress *In utero* während der Trockenstehzeit



In Utero Heat Stress Programs Reduced Performance and Health in Calves

Geoffrey E. Dahl, PhD*, Amy L. Skibiel, PhD, Jimena Laporta, PhD

KEYWORDS

• Mammary development • Methylation • Milk yield • Heat stress

KEY POINTS

- In utero heat stress reduces the birth weight of calves.
- In utero heat stress compromises passive transfer.
- Methylation patterns differ in hepatic and mammary tissues after in utero heat stress.
- Compared with calves born to cooled dams, calves from heat stressed dams have lower milk yields.

INTRODUCTION: EFFECTS OF LATE GESTATION HEAT STRESS ON THE DAM

It is well-recognized that heat stress, characterized by high ambient temperature and relative humidity, is a major factor adversely affecting cattle throughout the world, even in temperate regions.[1] Heat stressed dairy cows are more vulnerable to disease, have reduced fertility, and drastically lower milk production.[2] In fact, milk yield decreases of up to 40% have been reported,[1,3,4] which is partially attributed to the reduced feed intake of heat stressed cows, with the remaining decline caused by physiologic adjustments in an effort to dissipate metabolic heat.[5,6] It is estimated that, in the United States alone, environmental heat stress on lactating cows costs the dairy industry more than $1.5 billion in losses annually owing to decreased milk yield and increased morbidity and mortality.[1,7] For that reason, many farms in the United States have adopted heat abatement systems, such as fans and water sprayers, to actively cool lactating cows.[8] However, this estimation only accounts for lactating cows. Our recent study estimated that heat stress

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Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 2250 Shealy Drive, POB 110910, FL 32611, USA
* Corresponding author.
E-mail address: gdahl@ufl.edu

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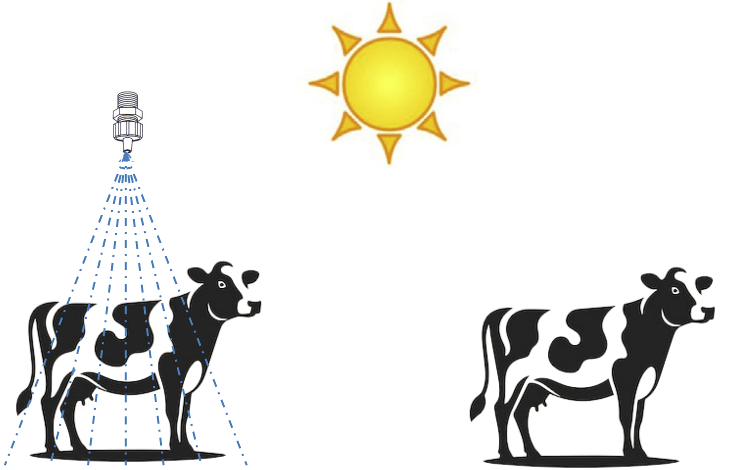
vetfood.theclinics.com



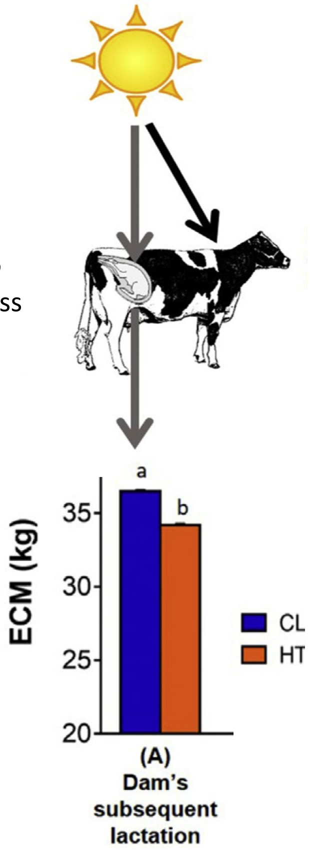
Cooled → Effekt auf Töchter?

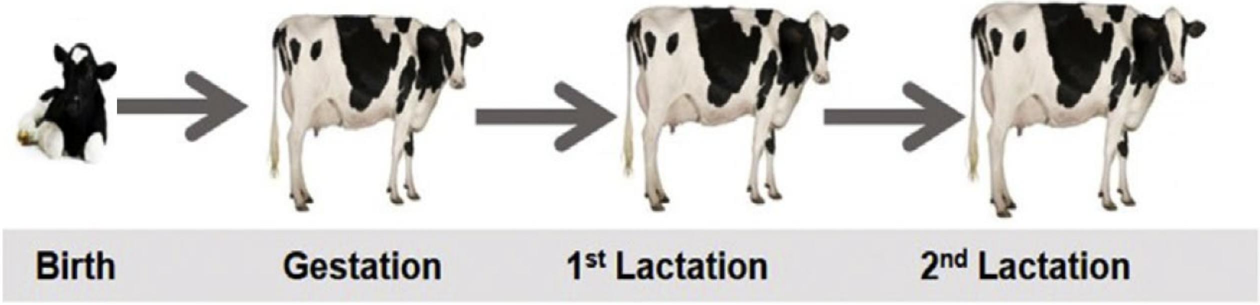
Heat Stress → Effekt auf Töchter?

Dahl et al. (2019), *Vet Clin Food Anim Practice*, 343

Folgen von Hitzestress *In utero* während der Trockenstehzeit

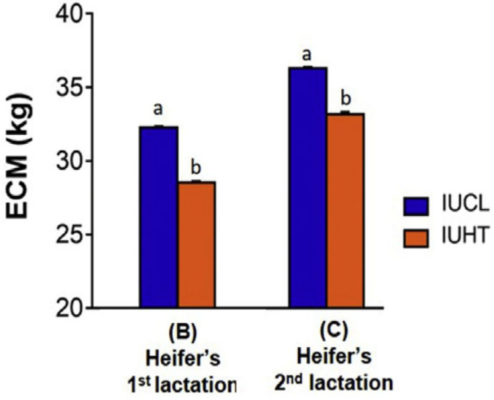
In utero
Heat Stress





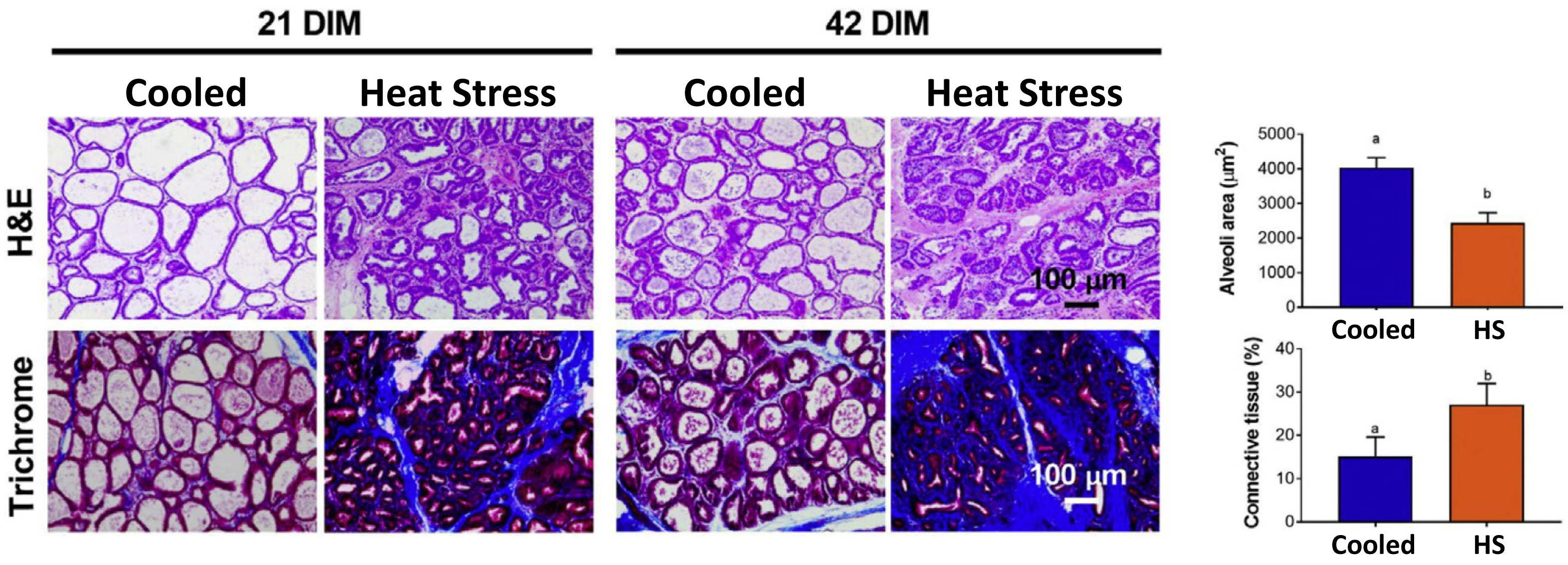
Tragezeit ↓
Geburtsgewicht ↓
Vitalität ↓

Heifer Vitality ↓
Heifer Fertility ↓



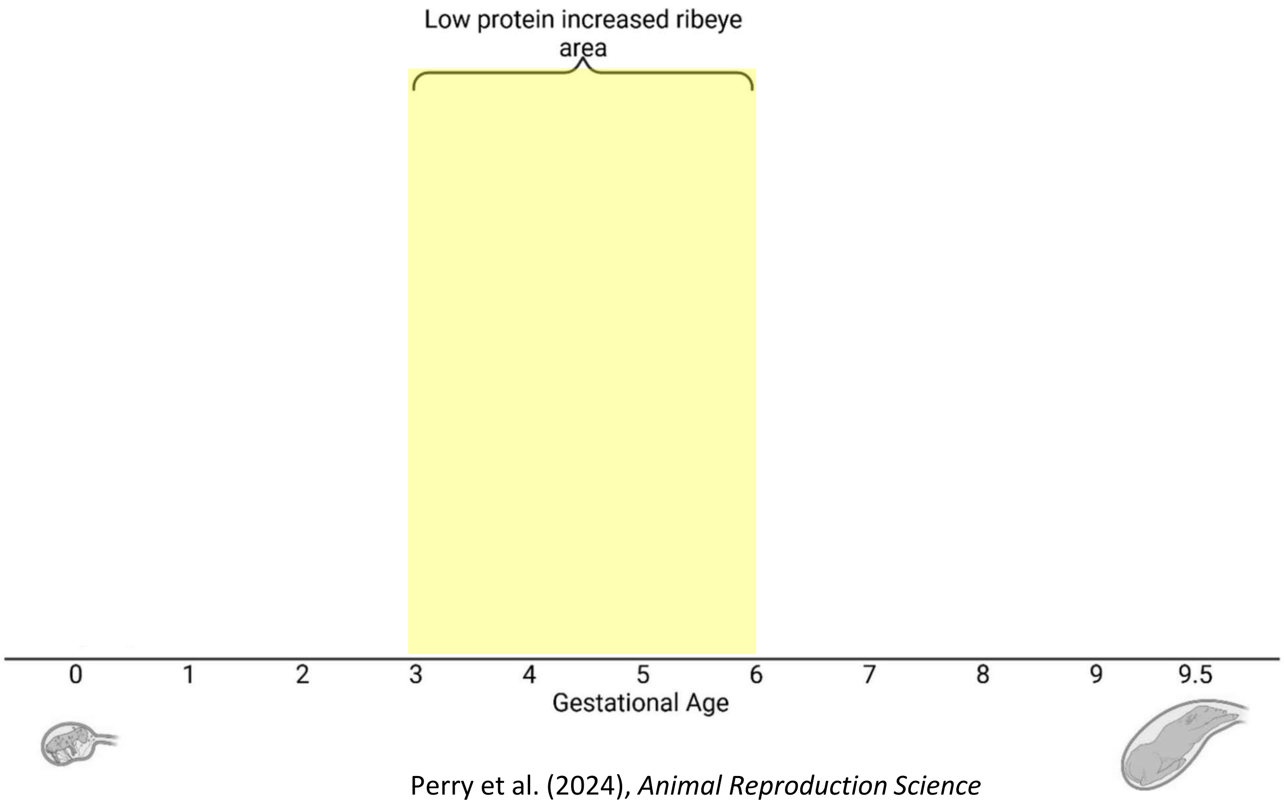
Folgen von Hitzestress *In utero* während der Trockenstehzeit

… beeinflussst den Euteraufbau der Töchter



Dahl et al. (2019), *Vet Clin Food Anim Practice*, 343

Bedeutung einer Restriktion des Futters zu spezifischen Trächtigkeits-zeitpunkten bei Fleischrindern



Perry et al. (2024), *Animal Reproduction Science*

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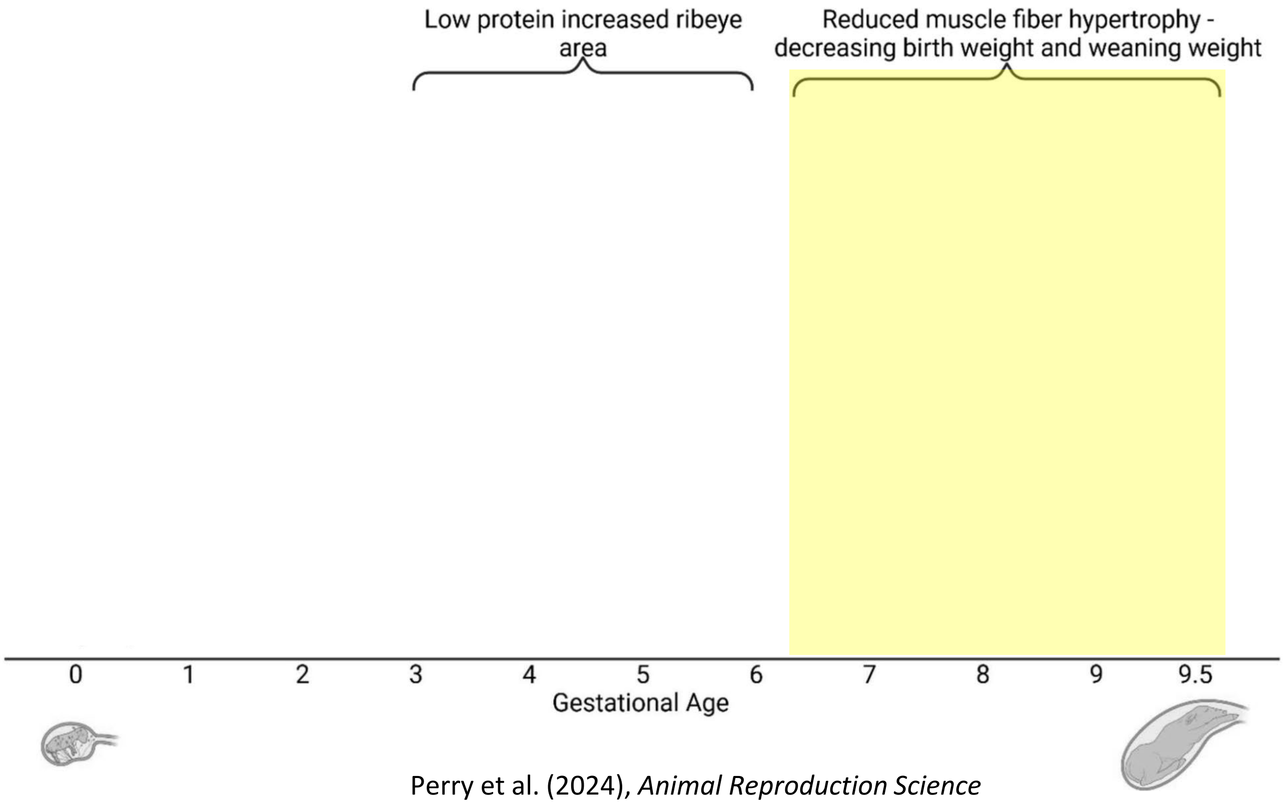

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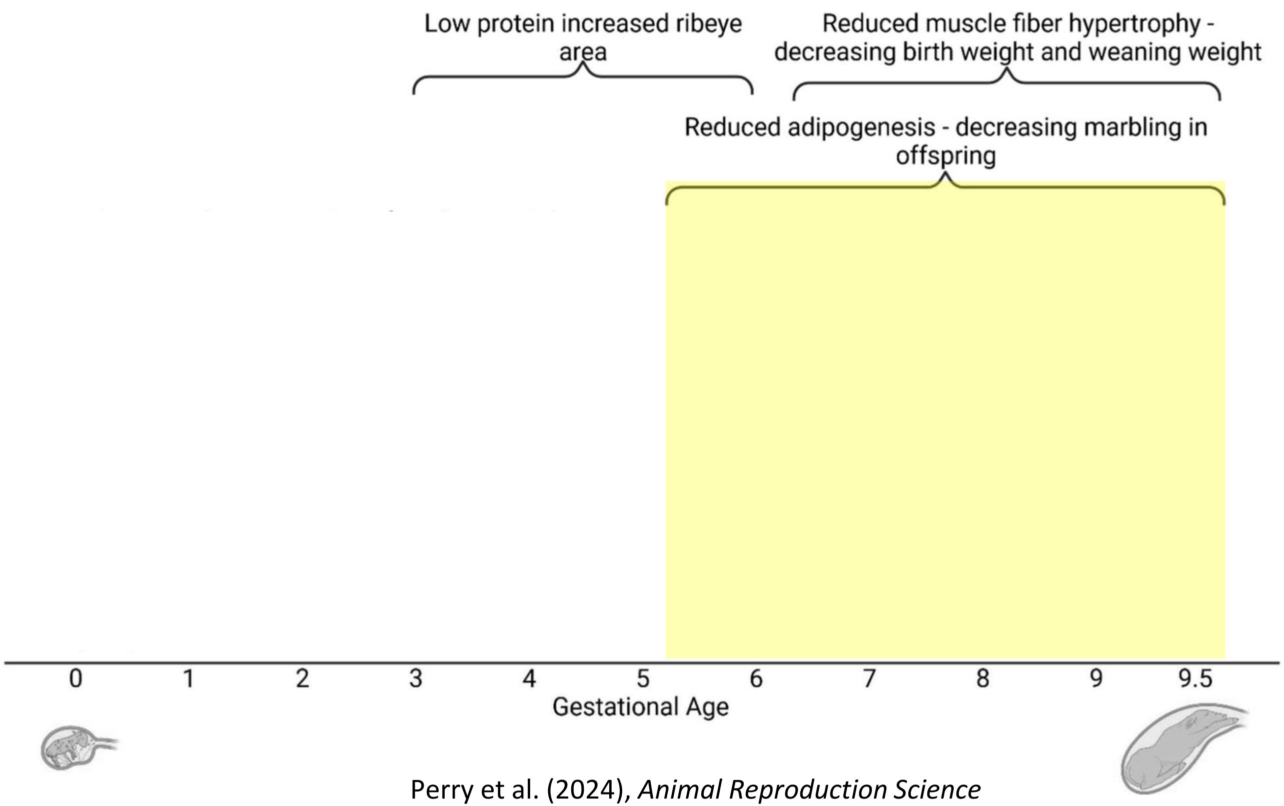

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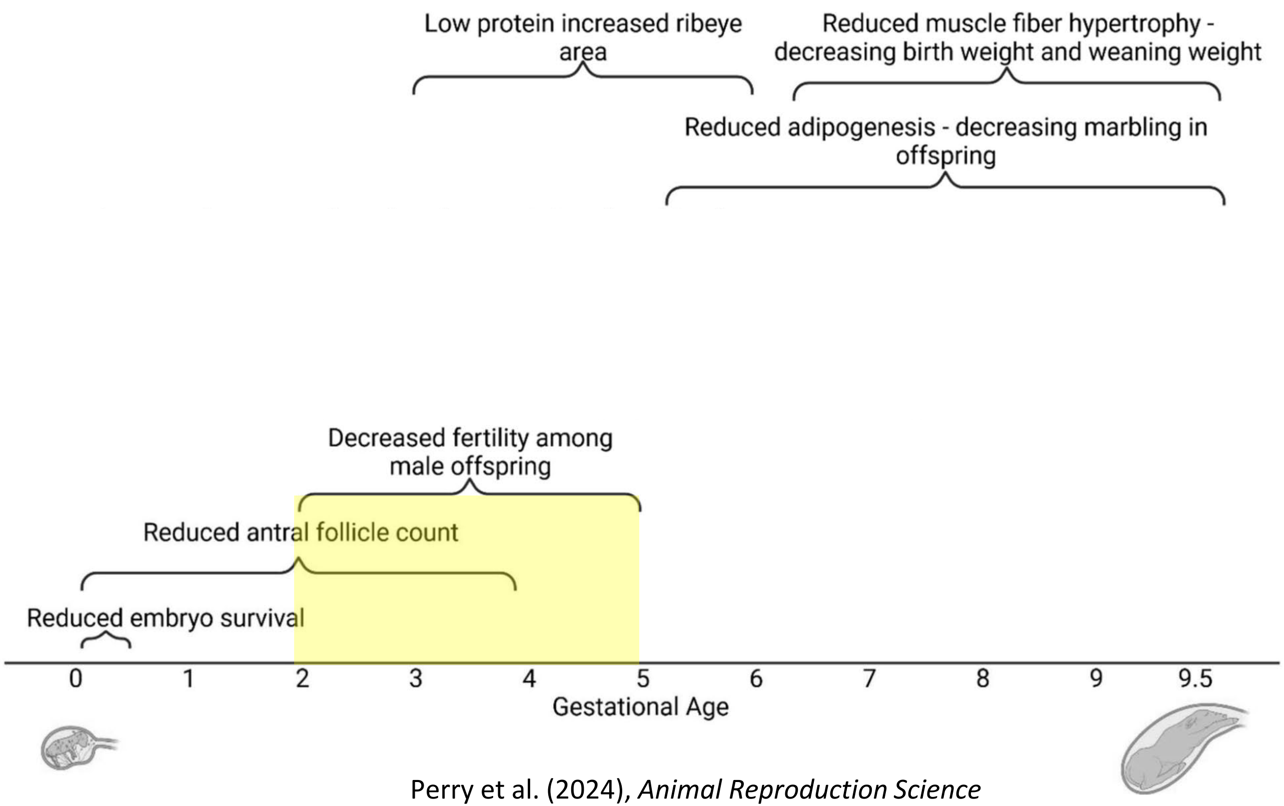

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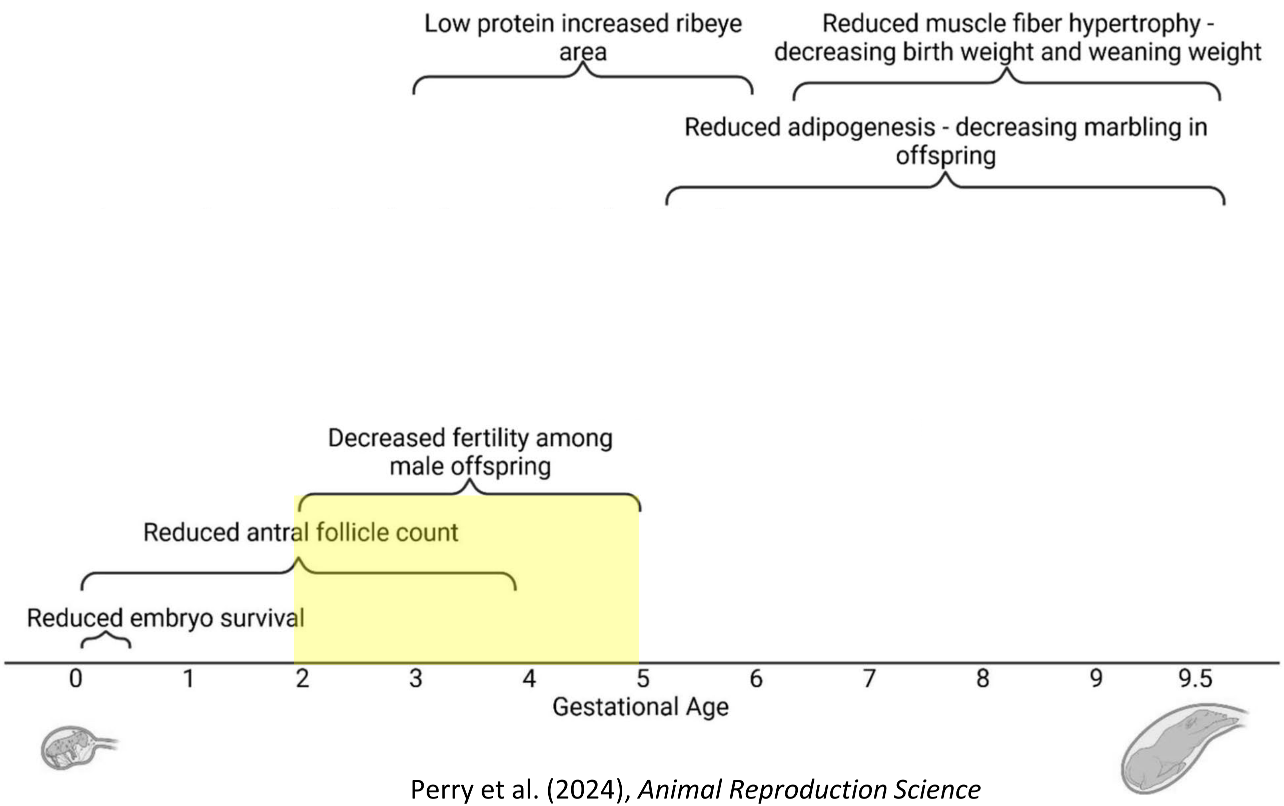

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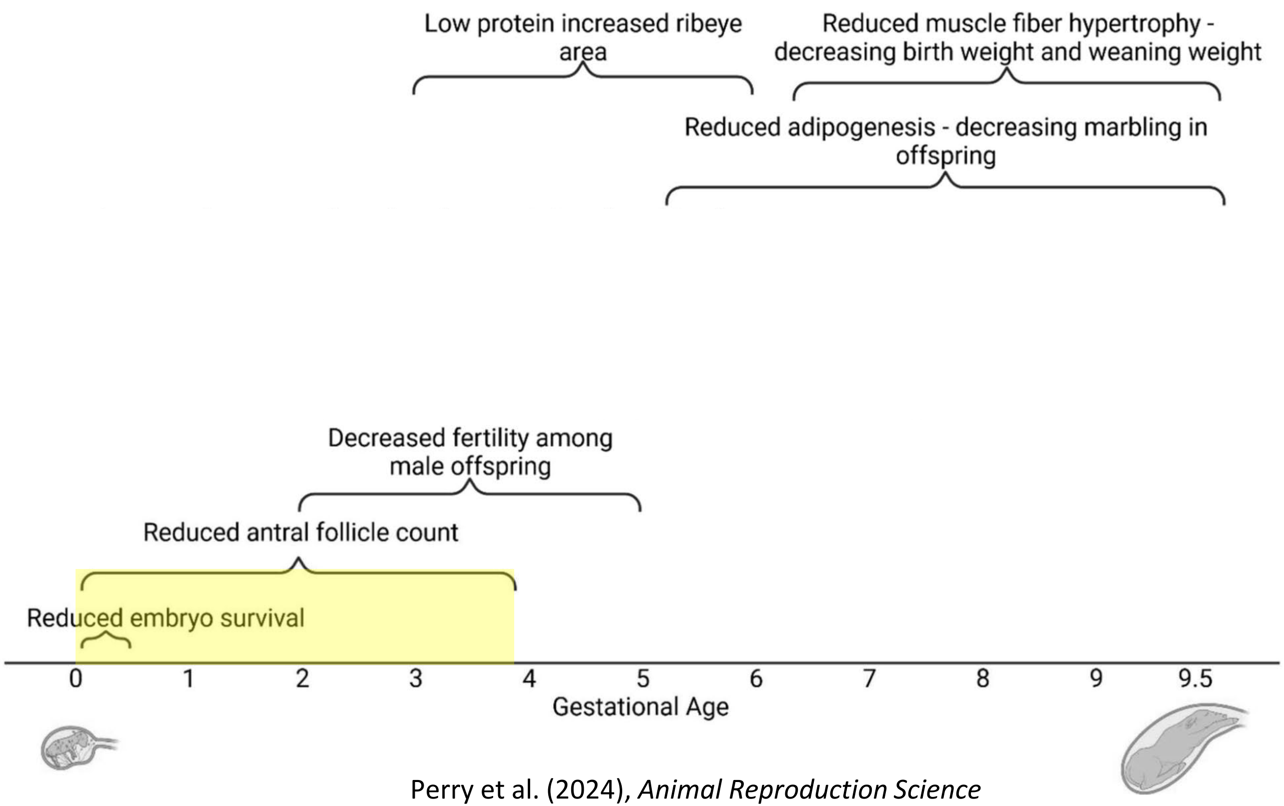

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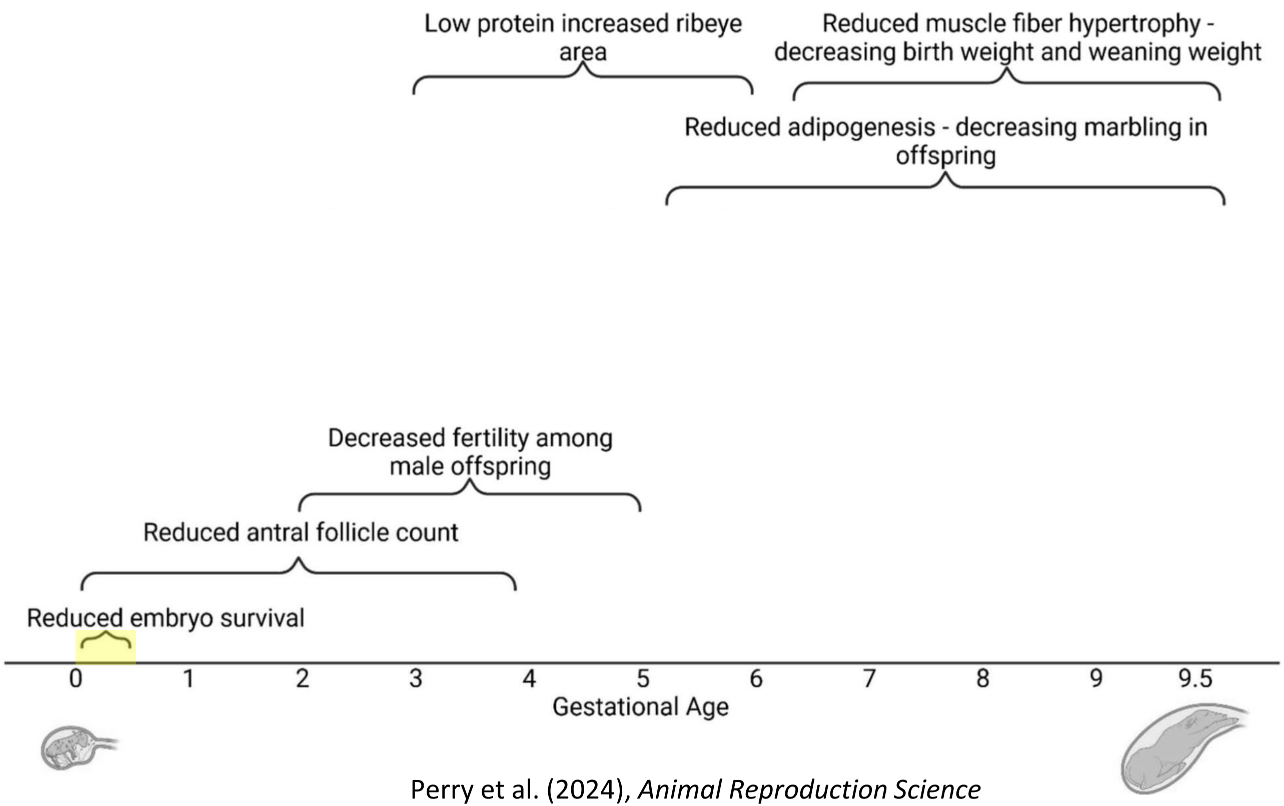
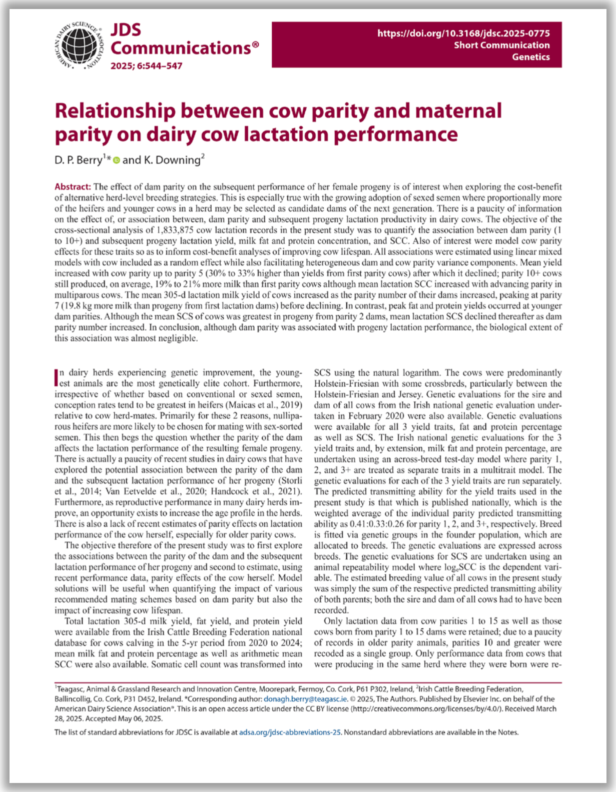


Perry et al. (2024), *Animal Reproduction Science*

Parität der Mutter & Milchleistung der Töchter



JDS Communications®
2025; 6:544–547

https://doi.org/10.3168/jdsc.2025-0775
Short Communication
Genetics

Relationship between cow parity and maternal parity on dairy cow lactation performance

D. P. Berry[1]* and K. Downing[2]

Abstract: The effect of dam parity on the subsequent performance of her female progeny is of interest when exploring the cost-benefit of alternative herd-level breeding strategies. This is especially true with the growing adoption of sexed semen where proportionally more of the heifers and younger cows in a herd may be selected as candidate dams of the next generation. There is a paucity of information on the effect of, or association between, dam parity and subsequent progeny lactation productivity in dairy cows. The objective of the cross-sectional analysis of 1,833,875 cow lactation records in the present study was to quantify the association between dam parity (1 to 10+) and subsequent progeny lactation yield, milk fat and protein concentration, and SCC. Also of interest were model cow parity effects for these traits so as to inform cost-benefit analyses of improving cow lifespan. All associations were estimated using linear mixed models with cow included as a random effect while also facilitating heterogeneous dam and cow parity variance components. Mean yield increased with cow parity up to parity 5 (30% to 33% higher than yields from first parity cows) after which it declined; parity 10+ cows still produced, on average, 19% to 21% more milk than first parity cows although mean lactation SCC increased with advancing parity in multiparous cows. The mean 305-d lactation milk yield of cows increased as the parity number of their dams increased, peaking at parity 7 (19.8 kg more milk than progeny from first lactation dams) before declining. In contrast, peak fat and protein yields occurred at younger dam parities. Although the mean SCS of cows was greatest in progeny from parity 2 dams, mean lactation SCS declined thereafter as dam parity number increased. In conclusion, although dam parity was associated with progeny lactation performance, the biological extent of this association was almost negligible.

In dairy herds experiencing genetic improvement, the youngest animals are the most genetically elite cohort. Furthermore, irrespective of whether based on conventional or sexed semen, conception rates tend to be greatest in heifers (Maicas et al., 2019) relative to cow herd-mates. Primarily for these 2 reasons, nulliparous heifers are more likely to be chosen for mating with sex-sorted semen. This then begs the question whether the parity of the dam affects the lactation performance of the resulting female progeny. There is actually a paucity of recent studies in dairy cows that have explored the potential association between the parity of the dam and the subsequent lactation performance of her progeny (Storli et al., 2014; Van Eetvelde et al., 2020; Handcock et al., 2021). Furthermore, as reproductive performance in many dairy herds improve, an opportunity exists to increase the age profile in the herds. There is also a lack of recent estimates of parity effects on lactation performance of the cow herself, especially for older parity cows.

The objective therefore of the present study was to first explore the associations between the parity of the dam and the subsequent lactation performance of her progeny and second to estimate, using recent performance data, parity effects of the cow herself. Model solutions will be useful when quantifying the impact of various recommended mating schemes based on dam parity but also the impact of increasing cow lifespan.

Total lactation 305-d milk yield, fat yield, and protein yield were available from the Irish Cattle Breeding Federation national database for cows calving in the 5-yr period from 2020 to 2024; mean milk fat and protein percentage as well as arithmetic mean SCC were also available. Somatic cell count was transformed into SCS using the natural logarithm. The cows were predominantly Holstein-Friesian with some crossbreds, particularly between the Holstein-Friesian and Jersey. Genetic evaluations for the sire and dam of all cows from the Irish national genetic evaluation undertaken in February 2020 were also available. Genetic evaluations were available for all 3 yield traits, fat and protein percentage as well as SCS. The Irish national genetic evaluations for the 3 yield traits and, by extension, milk fat and protein percentage, are undertaken using an across-breed test-day model where parity 1, 2, and 3+ are treated as separate traits in a multitrait model. The genetic evaluations for each of the 3 yield traits are run separately. The predicted transmitting ability for the yield traits used in the present study is that which is published nationally, which is the weighted average of the individual parity predicted transmitting ability as 0.41:0.33:0.26 for parity 1, 2, and 3+, respectively. Breed is fitted via genetic groups in the founder population, which are allocated to breeds. The genetic evaluations are expressed across breeds. The genetic evaluations for SCS are undertaken using an animal repeatability model where $\log_e$SCC is the dependent variable. The estimated breeding value of all cows in the present study was simply the sum of the respective predicted transmitting ability of both parents; both the sire and dam of all cows had to have been recorded.

Only lactation data from cow parities 1 to 15 as well as those cows born from parity 1 to 15 dams were retained; due to a paucity of records in older parity animals, parities 10 and greater were recoded as a single group. Only performance data from cows that were producing in the same herd where they were born were re-

[1]Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork, P61 P302, Ireland, [2]Irish Cattle Breeding Federation, Ballincollig, Co. Cork, P31 D452, Ireland. *Corresponding author: donagh.berry@teagasc.ie. Received March 28, 2025. Accepted May 06, 2025.

The list of standard abbreviations for JDSC is available at adsa.org/jdsc-abbreviations-25. Nonstandard abbreviations are available in the Notes.

Nationale Datenbasis Irish Cattle Breeding Federation (2020-2024) 1,8 Mio Laktationen

LaktationsNr. während der Trächtigkeit

↓

Töchterleistung ?

- Milchleistung ?
- Gesamtprotein ?
- Gesamtfett ?
- Somatische Zellzahl ?

Berry et al. (2025), *JDS Communications* 6:544-547

Parität der Mutter & Milchleistung der Töchter

Parity	N	Yield (kg) Milk	Yield (kg) Fat	Yield (kg) Protein	Composition (%) Fat	Composition (%) Protein	SCS (log_e units)
1	429,201	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]
2	423,085	6.3 (2.17)[b]	1.4 (0.09)[b]	0.2 (0.07)[bc]	0.02 (0.001)[b]	−0.002 (0.0005)[b]	0.006 (0.0022)[b]
3	317,985	9.9 (2.35)[bc]	1.4 (0.09)[b]	0.3 (0.08)[b]	0.02 (0.001)[b]	0.000 (0.0006)[a]	−0.005 (0.0023)[c]
4	239,098	15.7 (2.56)[cd]	1.2 (0.10)[bd]	0.4 (0.08)[b]	0.01 (0.001)[b]	0.000 (0.0006)[ad]	−0.011 (0.0025)[cd]
5	169,980	16.1 (2.86)[c]	1.4 (0.11)[b]	0.4 (0.09)[b]	0.02 (0.002)[b]	0.002 (0.0007)[cd]	−0.012 (0.0029)[de]
6	111,244	14.2 (3.34)[c]	1.1 (0.13)[bc]	0.3 (0.11)[b]	0.02 (0.002)[b]	0.002 (0.0008)[ce]	−0.013 (0.0033)[de]
7	68,578	19.8 (4.06)[d]	1.0 (0.16)[cd]	0.4 (0.13)[b]	0.01 (0.002)[b]	0.001 (0.0010)[ac]	−0.016 (0.0040)[de]
8	38,262	9.7 (5.23)[abcd]	0.7 (0.21)[c]	0.2 (0.17)[ab]	0.02 (0.003)[b]	0.005 (0.0013)[e]	−0.013 (0.0052)[cde]
9	20,120	13.0 (7.06)[abcd]	0.5 (0.28)[c]	0.1 (0.23)[ab]	0.02 (0.004)[b]	0.004 (0.0017)[ce]	−0.027 (0.0070)[e]
10	16,322	7.1 (7.88)[abcd]	−0.3 (0.32)[a]	−0.2 (0.26)[ac]	0.01 (0.004)[b]	0.005 (0.0019)[e]	−0.027 (0.0078)[de]

[a–e]Different superscripts within columns denote differences ($P < 0.05$) between solutions without adjustment for multiple testing.

→ Höhere Milchleistung obwohl Genetik der älteren Mütter geringer !

Berry et al. (2025), *JDS Communications* 6:544-547

Parität der Mutter & Milchleistung der Töchter


J. Dairy Sci. 100:5899–5908
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Postnatal phenotype of dairy cows is altered by in vitro embryo production using reverse X-sorted semen

Luiz G. B. Siqueira,*† Serdal Dikmen,‡ M. Sofia Ortega,* and Peter J. Hansen*[1]
*Department of Animal Sciences, D.H. Barron Reproductive and Perinatal Biology Research Program, and Genetics Institute, University of Florida, Gainesville 32611-0910
†Embrapa Gado de Leite, Juiz de Fora, MG, Brazil 36035-330
‡Department of Animal Sciences, Faculty of Veterinary Medicine, Uludag University, Bursa, 16059, Turkey

ABSTRACT

Abnormal fetuses, neonates, and adult offspring derived by assisted reproductive technologies have been reported in humans and mice and have been associated with increased likelihood of certain adult diseases. To test the hypothesis that bovine females derived by assisted reproductive technologies have altered postnatal growth and adult function, a retrospective cohort study evaluated survival, growth, and production traits of offspring derived by in vitro embryo production (IVP) with conventional (IVP-conv) or reverse X-sorted semen (IVP-sexed), multiple ovulation and embryo transfer, and artificial insemination (AI) in a large dairy herd. Live calves produced by IVP were born slightly heavier compared with AI calves. In addition, IVP-sexed calves had a higher cumulative mortality from 90 to 180 d of age compared with AI offspring. Mortality of IVP-conv and multiple ovulation and embryo transfer offspring was intermediate and not different from AI or IVP-sexed offspring. The altered phenotype of offspring from IVP-sexed extended to adult milk production. Cows derived by IVP-sexed produced less milk, fat, and protein in their first lactation compared with dairy cows derived by AI. Additionally, females born to nulliparous dams had a distinct postnatal phenotype compared with offspring from parous dams even when data were restricted to offspring of surrogate females. In conclusion, procedures associated with in vitro production of embryos involving use of reverse-sorted spermatozoa for fertilization result in an alteration of embryonic programming that persists postnatally and causes an effect on milk production in adulthood. Thus, some benefits of reverse-sorted semen for genetic improvement may be offset by adverse programming events.

Key words: in vitro fertilization, reverse-sorted semen, developmental programming, milk yield, bovine

INTRODUCTION

The theory that maternal environment during gestation modulates offspring health and disease has been repeatedly demonstrated (Wadhwa et al., 2009; Schulz, 2010). Programming of adult phenotype can occur at the earliest stages of embryonic development, during the preimplantation period [see Fleming et al. (2015) and Hansen et al. (2016) for review]. Furthermore, epigenetic changes in male gametes can also play a role in programming offspring phenotype [see (Rando and Simmons, 2015) and (Schagdarsurengin and Steger, 2016) for review].

Perhaps the most extreme perturbation in the environment of the preimplantation embryo occurs when the embryo is produced in vitro. In this situation, nutrients, regulatory molecules, ions, dissolved gases, the substratum, and other molecules in the reproductive tract are replaced by artificial culture media. The result can be alterations in embryonic gene expression, DNA methylation, metabolome, cell allocation into inner cell mass and trophectoderm lineages, and competence to establish pregnancy after transfer to recipient females (Thompson, 1997; Lonergan et al., 2006; Urrego et al., 2014). Even an assisted reproductive technology (**ART**) such as multiple ovulation and embryo transfer (**MOET**), where embryonic development occurs in vivo, can perturb embryonic function due to changes in the reproductive tract or characteristics of the oocytes from which embryos are derived (Market-Velker et al., 2010; Gad et al., 2011; Mainigi et al., 2014).

Conceptuses generated from MOET or in vitro production of embryos (**IVP**) have altered placental growth and function (Miles, 2004; de Waal et al., 2014; Mainigi et al., 2014). In addition, IVP has been associated with abnormal fetal development in sheep, cattle, mice, and humans (Young et al., 1998; Farin et al., 2010; Bloise

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[1]Corresponding author: hansen@animal.ufl.edu

Ein Betrieb (Florida, 4000 Milchkühe/d)

1252 Kälber aus ET → 831 Laktierende Tiere
3465 Kälber aus KB → 2037 Laktierende Tiere

LaktationsNr. während der Trächtigkeit

↓

Töchterleistung ?
- Milchleistung ?
- Gesamtprotein ?
- Gesamtfett ?

Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Parität des Muttertieres (Kuh vs. Rind)

… beeinflusst die Entwicklung & die Milchleistung der Töchter

Endpoint	Dam parity: Nulliparous (parity = 0)	Dam parity: Parous (parity ≥1)	P-value: Dam parity	P-value: Dam parity by technique interaction
Growth trait				
Gestation length (d)	274.8 ± 0.2	277.5 ± 0.21	<0.0001	0.154
Birth weight (kg)	36.9 ± 0.2	40.9 ± 0.2	<0.0001	0.13
Weaning weight (kg)	82.9 ± 1.3	93.6 ± 1.0	<0.0001	0.028[1]
Weight at first breeding (kg)	345.7 ± 1.7	352.8 ± 1.6	0.0025	0.87
ADG, birth to weaning (kg/d)	0.66 ± 0.03	0.70 ± 0.02	0.22	0.49
ADG, weaning to breeding (kg/d)	0.86 ± 0.009	0.87 ± 0.007	0.39	0.60
Reproduction trait				
Age at first calving (mo)	23.3 ± 0.2	23.6 ± 0.2	0.29	0.16
Days open, first lactation	96.0 ± 4.2	103.3 ± 3.2	0.15	0.36
Production trait				
Projected actual milk yield, 305 d (kg)	10,761 ± 70	11,035 ± 62	0.0019	0.37
Projected actual fat yield, 305 d (kg)	377.0 ± 2.7	390.7 ± 2.4	<0.0001	0.17
Projected actual protein yield, 305 d (kg)	327.5 ± 2.3	337.2 ± 2.0	0.0007	0.22

Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Embryotypus & Milchleistung der Töchter

J. Dairy Sci. 100:5899–5908
https://doi.org/10.3168/jds.2016-12539

Postnatal phenotype of dairy cows is altered by in vitro embryo production using reverse X-sorted semen

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Conceptuses generated from MOET or in vitro production of embryos (**IVP**) have altered placental growth and function (Miles, 2004; de Waal et al., 2014; Mainigi et al., 2014). In addition, IVP has been associated with abnormal fetal development in sheep, cattle, mice, and humans (Young et al., 1998; Farin et al., 2010; Bloise

Ein Betrieb (Florida, 4000 Milchkühe/d)

1252 Kälber aus ET → 831 Laktierende Tiere
3465 Kälber aus KB → 2037 Laktierende Tiere

Embryotypus (KB, IVP, IVP sexed semen)

↓

Töchterleistung ?
- Milchleistung ?
- Gesamtprotein ?
- Gesamtfett ?

Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Embryotypus & Milchleistung der Töchter

Table 1. Effects of technique used to produce a pregnancy on characteristics of the resultant offspring[1]

Endpoint	AI	IVP-conv	IVP-sexed	MOET	*P*-value[2]
Growth trait					
Gestation length (d)	276.3 ± 0.1	276.5 ± 0.4	276.2 ± 0.3	275.5 ± 0.5	0.7222
Birth weight (kg)	38.5 ± 0.1[a]	39.4 ± 0.3[b]	39.0 ± 0.2[b]	38.7 ± 0.4[ab]	0.0280
Weaning weight (kg)	88.2 ± 0.6	88.3 ± 1.7	89.4 ± 1.2	87.0 ± 2.4	0.7718
Weight at first breeding (kg)	344.3 ± 0.8[a]	351.0 ± 2.8[bc]	355.3 ± 2.0[c]	346.5 ± 3.2[ab]	<0.0001
ADG, birth to weaning (kg/d)	0.69 ± 0.01	0.68 ± 0.03	0.70 ± 0.03	0.66 ± 0.05	0.8925
ADG, weaning to breeding (kg/d)	0.85 ± 0.004[a]	0.87 ± 0.01[ab]	0.89 ± 0.01[b]	0.87 ± 0.02[ab]	0.0015
Reproduction trait					
Age at first calving (mo)	23.5 ± 0.1	23.8 ± 0.3	23.2 ± 0.2	23.3 ± 0.3	0.4520
Days open, first lactation (d)	100.0 ± 2.1	108.3 ± 5.5	102.7 ± 3.9	87.5 ± 7.6	0.1479
Production trait					
Projected actual milk yield, 305 d (kg)	11,038 ± 31[a]	10,946 ± 100[ab]	10,717 ± 76[b]	10,891 ± 149[ab]	0.0014
Projected actual fat yield, 305 d (kg)	388.3 ± 1.2[a]	385.6 ± 3.9[ab]	377.1 ± 3.0[b]	384.7 ± 5.8[ab]	0.0072
Projected actual protein yield, 305 d (kg)	334.6 ± 1.0[a]	336.5 ± 3.3[a]	327.1 ± 2.5[b]	331.2 ± 4.8[ab]	0.0318
Genetic trait					
Genomic PTA for milk (kg)	203.2 ± 5.4[a]	290.2 ± 16.6[b]	284.2 ± 12.0[b]	234.7 ± 18.3[ab]	<0.0001
Genomic PTA for fat (kg)	8.9 ± 0.2[a]	14.8 ± 0.7[b]	14.3 ± 0.5[b]	14.6 ± 0.7[b]	<0.0001
Genomic PTA for protein (kg)	7.3 ± 0.1[a]	11.1 ± 0.4[b]	10.6 ± 0.3[b]	9.6 ± 0.4[b]	<0.0001
Dam PTA for milk (kg)	68.9 ± 6.1[a]	216.9 ± 33.2[b]	182.2 ± 27.9[b]	20.6 ± 30.2[a]	<0.0001
Sire PTA for milk (kg)	330.4 ± 6.2[a]	346.5 ± 18.8[a]	461.3 ± 13.3[b]	366.7 ± 20.8[a]	<0.0001
Net merit ($)	321.0 ± 2.9[a]	455.7 ± 9.0[b]	463.6 ± 6.5[b]	420.2 ± 9.9[c]	<0.0001
Genomic PTA for DPR	1.9 ± 0.03[a]	2.0 ± 0.09[a]	2.4 ± 0.06[b]	2.1 ± 0.1[ab]	<0.0001

Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Embryotypus & Milchleistung der Töchter

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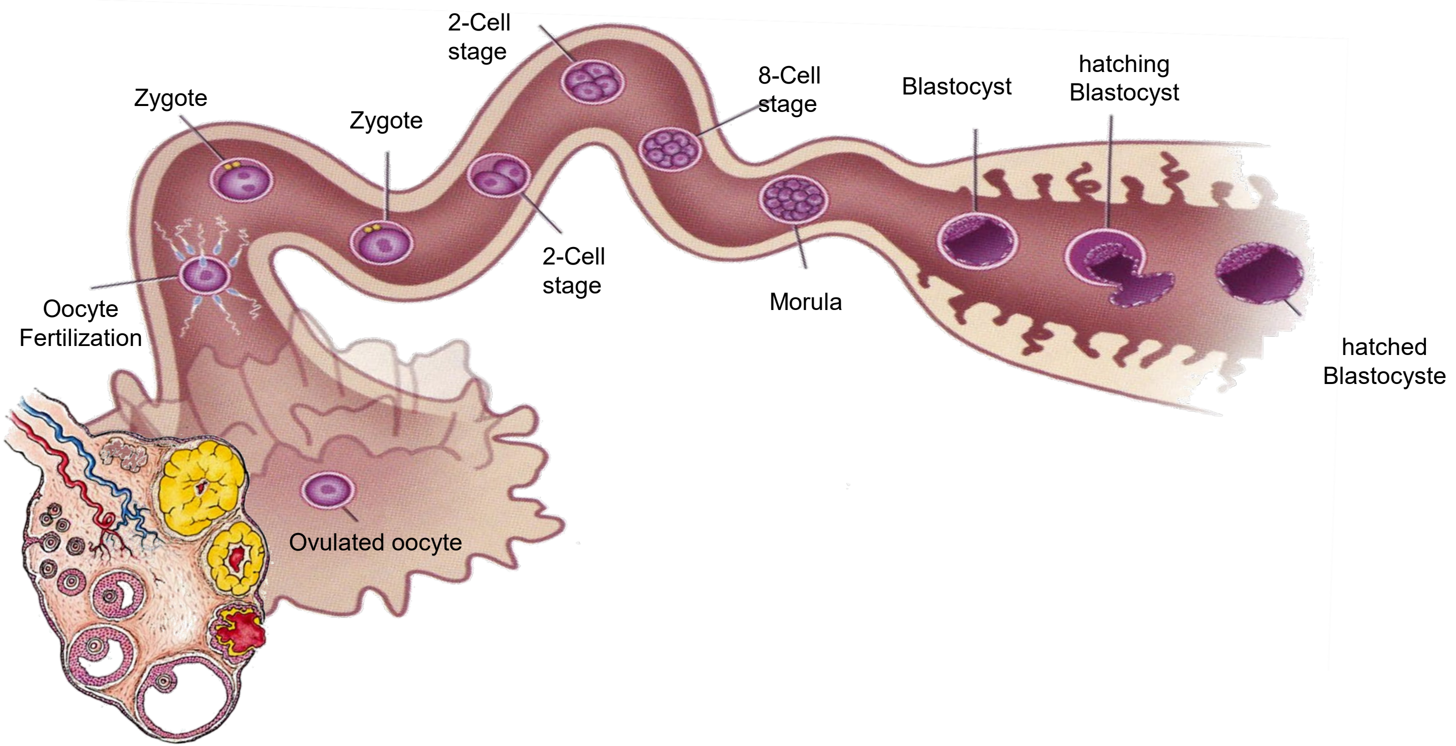
Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Einfluss der Frühembryonalen Entwicklungsumgebung

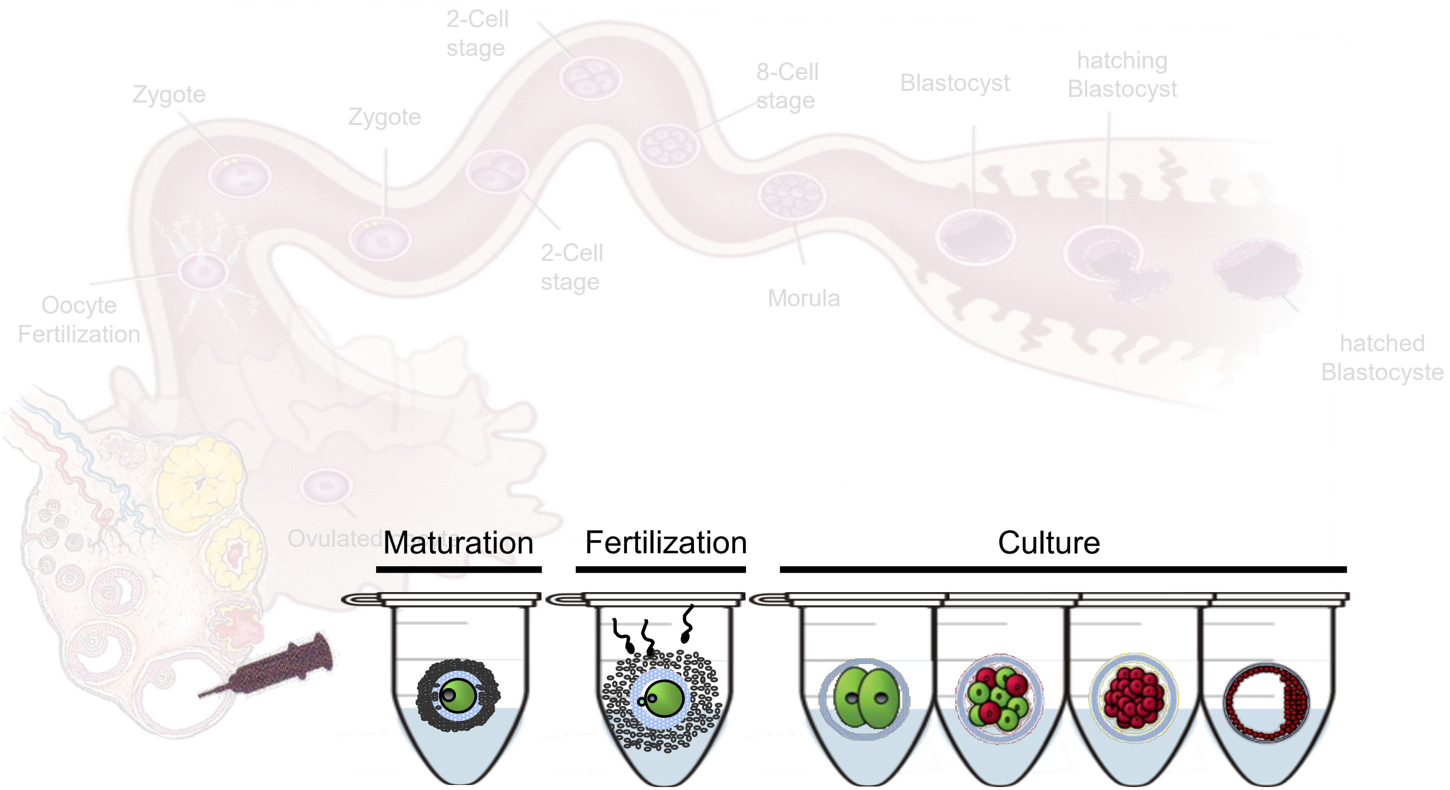
AI



Senger (2003), modifiziert

Einfluss der Frühembryonalen Entwicklungsumgebung

IVP



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Embryotypus & Milchleistung der Töchter

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Siquera et al. (2017), *J. Dairy Sci.* 100:5899-5908

Einfluss des Embryonentypus (IVP) auf das Geburtsgewicht

THERIOGENOLOGY

THE VIABILITY OF LATE MORULAE AND BLASTOCYSTS PRODUCED BY NUCLEAR TRANSPLANTATION IN CATTLE

S.M.Willadsen, R.E.Janzen, R.J.McAlister, B.F.Shea,
G.Hamilton and D.McDermand
ALTA GENETICS INC.
box 12, site 12,RR #4, Calgary
Alberta, CANADA T2M 4L4

ABSTRACT

Late morulae and blastocysts, produced by fusion of blastomeres from parent embryos of between eight and 64 cells and enucleated recently ovulated eggs, were transferred to cow and heifer recipients. Of the 302 recipients, 128(42.4 %) were pregnant at Day 35. Fourteen (4.6 %) had aborted by Day 90, another four(1.3 %) aborted when between 6 1/2 and 8 months pregnant. Of the remaining 110(36.4 %) pregnant recipients, ten died due to unrelated circumstances. One hundred(33.1 %) survived to term and produced calves.
Embryos of excellent and good quality gave pregnancy rates of close to sixty percent and calving rates near fifty percent. The corresponding results for poorer quality embryos were about twenty percent and slightly below twenty percent, respectively.
Congenital malformations were observed in four calves. The rest appeared normal, although some were very large, weighing up to 155 lbs.

→ **100 ET Kälber geboren**

→ **4 Kälber zeigten Congenitale Malformationen**

→ **Einige sehr schwer (bis zu 70 kg !)**

Willadsen et al. (1991), *Theriogenology* 35 (I)

Übergroße Kälber nach Transfer von IVP-Embryonen

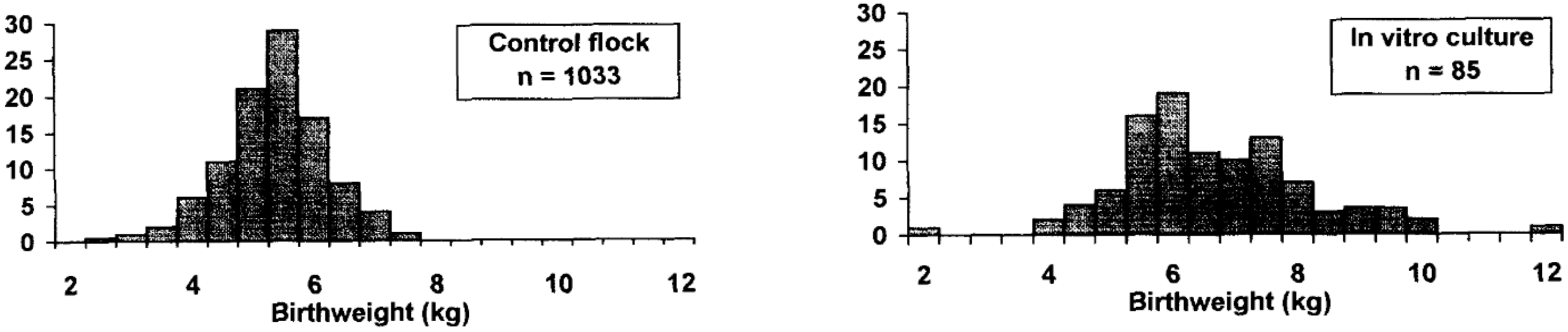
Table 1. Gestation period, birth weight and sex of calves from embryos that developed in vivo or in vitro after in vitro maturation and fertilization procedures

Treatment	Number of calves	Gestation period (d)	Sex male/female	Singles/Twin sets	Birth weight (kg) $\bar{X} \pm$ SEM	Range[c]
AI	74	277 ± 1.2^a	43/31	68/3	36 ± 1.4^a	25-55
In vivo (sheep oviduct)	8	271 ± 2.3^a	4/4	6/1	36 ± 2.5^a	32-64
In vitro (co-culture)	8	271 ± 2.4^a	8/0	4/2	51 ± 2.2^b	61-74

[a,b]Least square means ± SEM in the same column with different superscripts differ ($P < 0.001$). [c]Range in birth weights are actual weights and given for single calves only.

Behboodi et al. (1994), *Theriogenology*

Large Offspring (LOS) nach Transfer von IVP-Embryonen beim Schaf



Walker et al. (1996), *Theriogenology* 45 (I), 111-120

Übergroße Kälber (LOS) durch Kulturbedingungen nach IVF

Gruppe	Anzah Kälber [n]	Geburts-gewichte [kg]	>50 kg [%]	>60 kg [%]
In vitro (SOF+BSA)	23	**52,8 ± 9,4[a]**	13 (59,1%[a])	5 (22,7%[a])
In vitro (SOF+Serum)	10	**56,7 ± 12,1[a]**	5 (50,0%[a])	5 (50,0%[a])
Eileiter (Schaf)	34	**44,1 ± 5,5[b]**	4 (11,8%[b])	1 (2,9%[b])
In vivo (MOET)	63	**41,1 ± 3,0[b]**	1 (1,6%[c])	0
In vivo (KB)	24	**43,4 ± 4,3[b]**	0	0

a:b:c $p \leq 0.05$

Lazzari et al. 2002

Übergroße Kälber (LOS) durch Kulturbedingungen nach IVF

Gruppe	Anzah Kälber [n]	Geburts-gewichte [kg]	>50 kg [%]	>60 kg [%]
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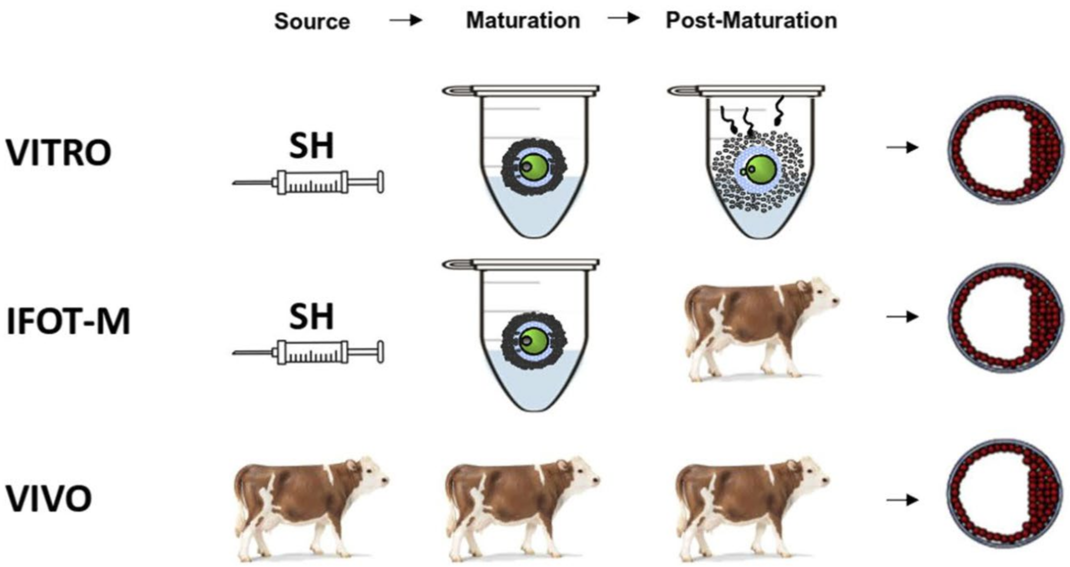
Lazzari et al. 2002

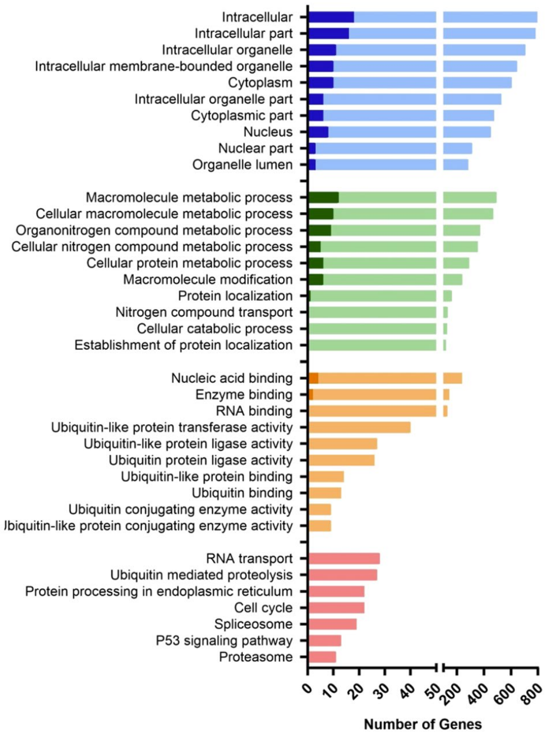
Einfluss der Entwicklungsumgebung auf das globale embryonale Genexpressionsprofil



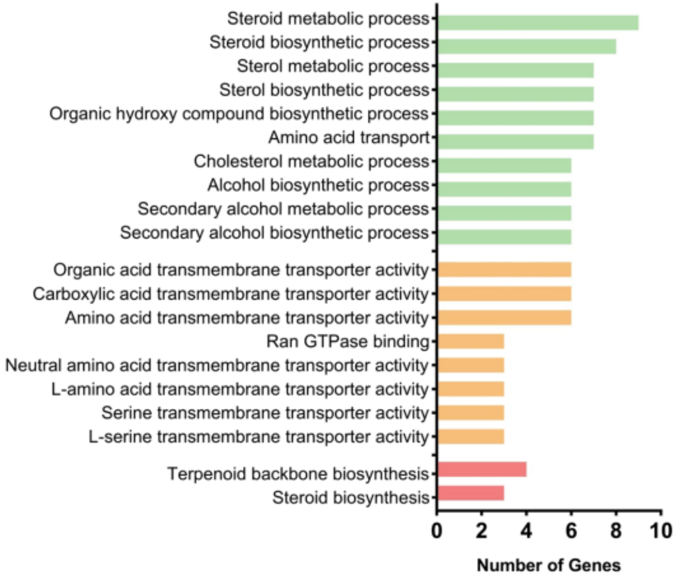
Rahman et al. (2025), *BMC Genomics* (26) 673

Einfluss der Entwicklungsumgebung auf das globale embryonale Genexpressionsprofil

Follikelphase & Eileiterphase (vivo vs. vitro)

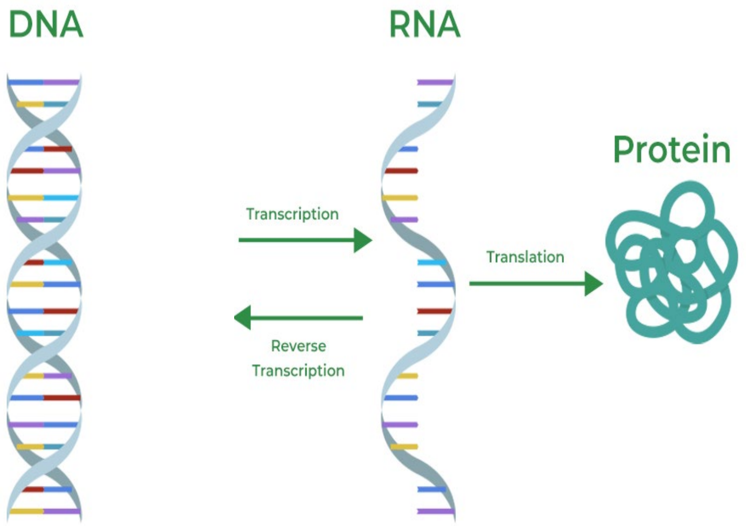


Follikelphase (vivo vs. vitro)

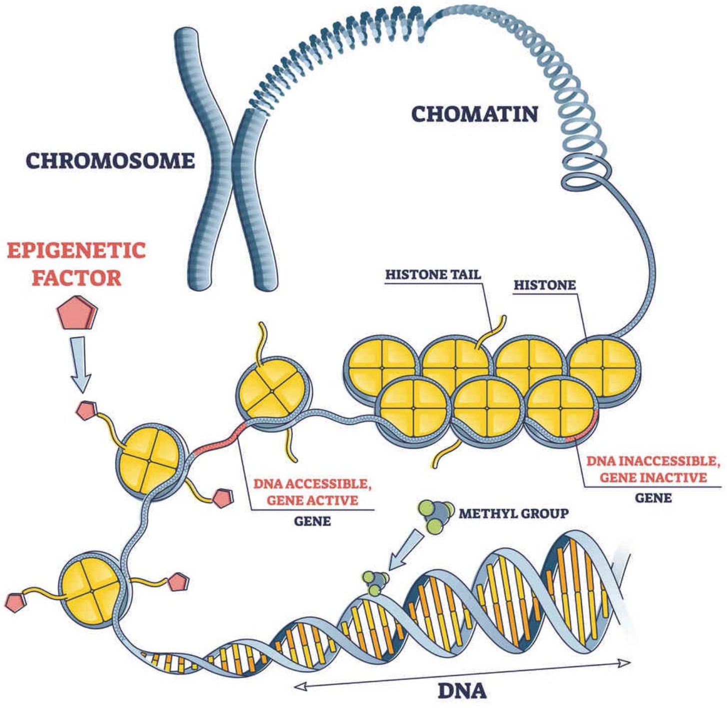


Rahman et al. (2025), *BMC Genomics* (26) 673

Zentrales Dogma der Molekularbiologie nach Francis Crick (1958)



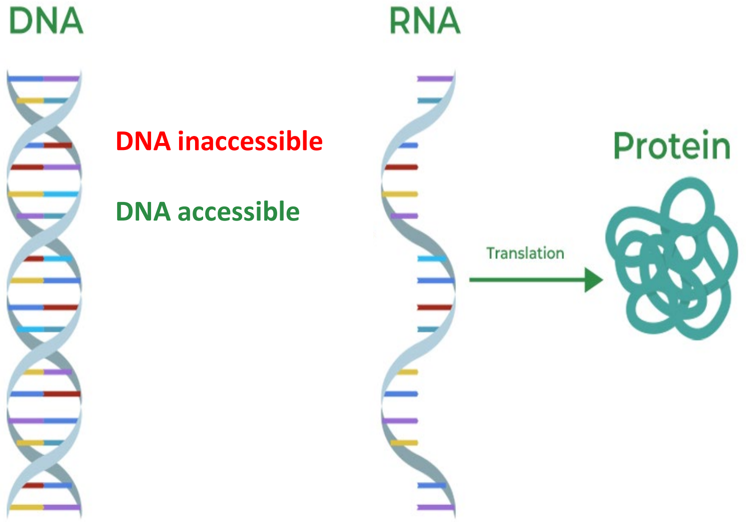
Epigenetische Modifikationen → Regulation der Genexpression



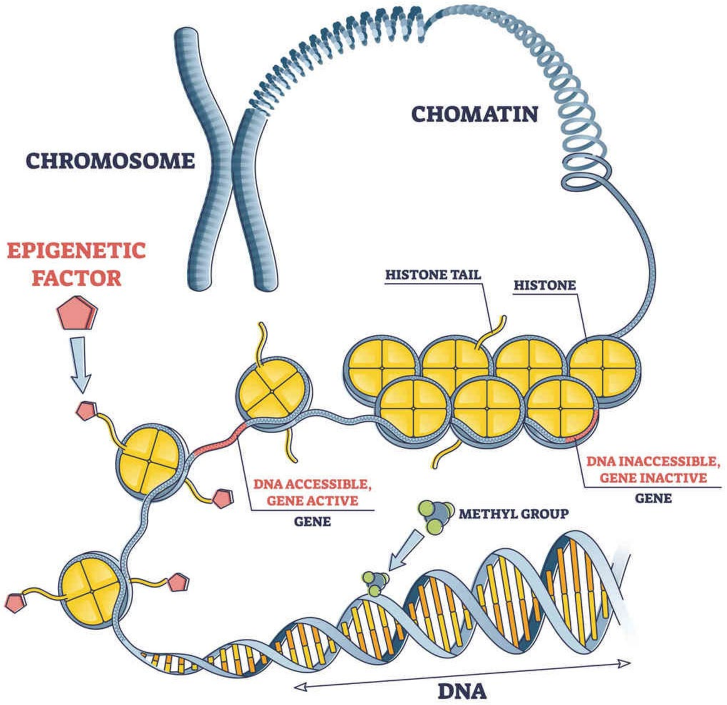
Histon Modification

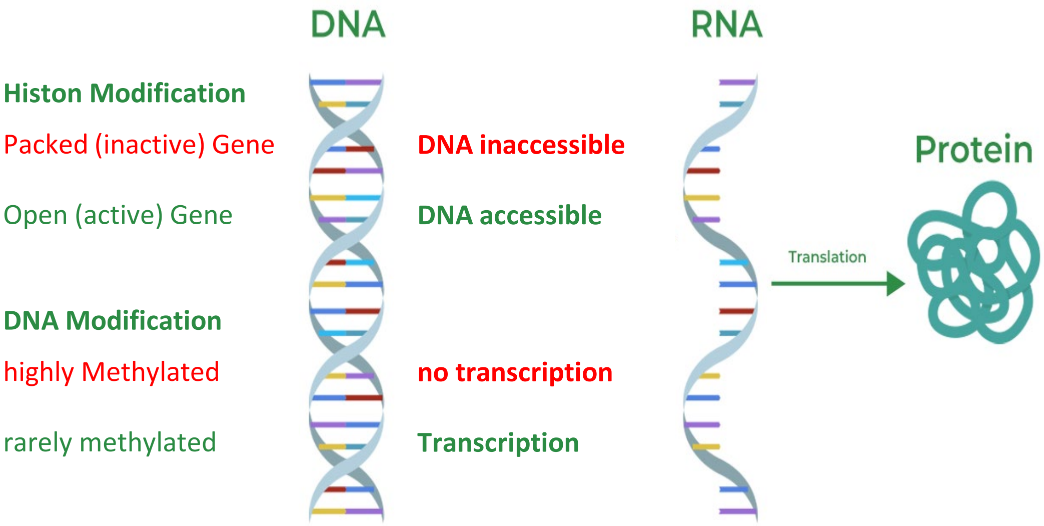
Packed (inactive) Gene — **DNA inaccessible**

Open (active) Gene — **DNA accessible**

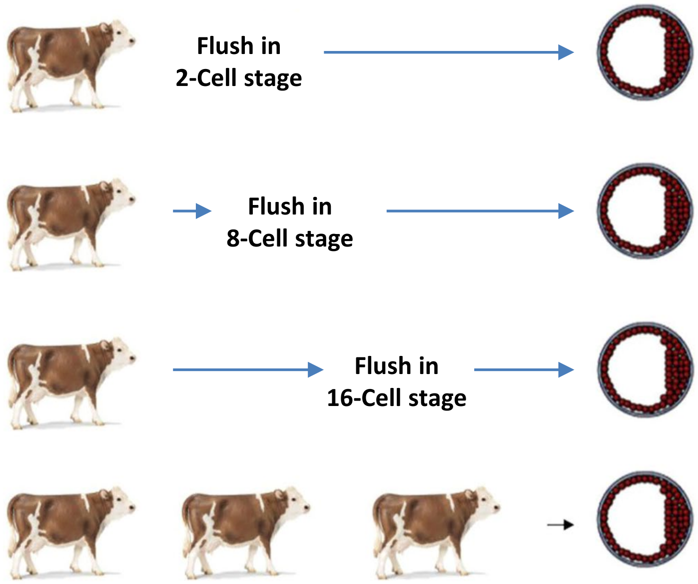


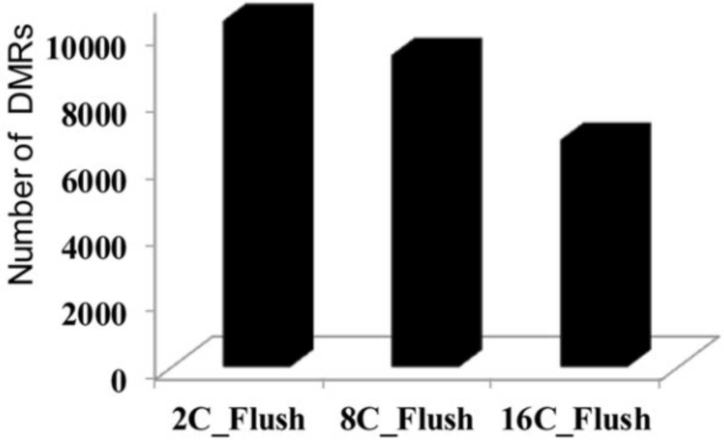
Epigenetische Modifikationen – Regulation der Genexpression





Einfluss der Entwicklungsumgebung auf das globale embryonale Methylierungsmuster





Salilew-Wondim et al. (2018), *BMC Genomics* (19) 424

Vielen Dank für Ihre Aufmerksamkeit !