Agrar- und Ernährungswissenschaftliche Fakultät

Christian-Albrechts-Universität zu Kiel
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Early postnatal plane of nutrition affects subsequent milk production of Holstein calves

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Conventional rearing of calves

- during the last decades a restrictive provision of milk or milk replacer (MR) to newborn calves was (and is still) common practice on cattle farms

- concerns about delayed intake of concentrates / roughage, delayed rumen development, higher incidence of diarrhea and higher costs

- recently a re-evaluation of the restricted feeding protocol during the very first weeks of life has started

Direct effects of „accelerated early nutrition“, „enhanced nutrition“, „intensified nutrition“ or „biologically appropriate growth“ during the first weeks of life

better constitution

improved welfare

improved behaviour

comparable costs

improved feed efficiency

comparable incidence of diarrhea

comparable rumen development

higher weight of mammary parenchyma

comparable concentrate / roughage intake

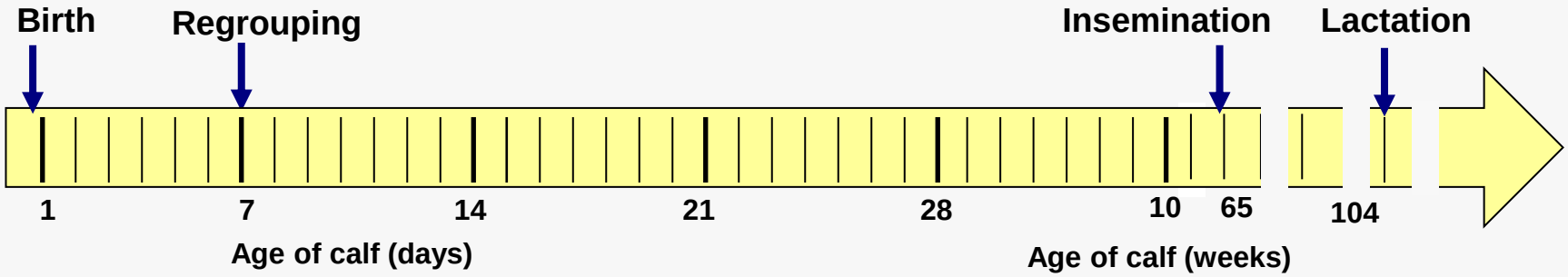
Hammon et al., 2002; Brown et al., 2005; Godden et al., 2005; Khan et al., 2007; von Keyserlingk et al., 2009; Khan et al., 2011; Maccari et al., 2014; Prokop et al., 2015

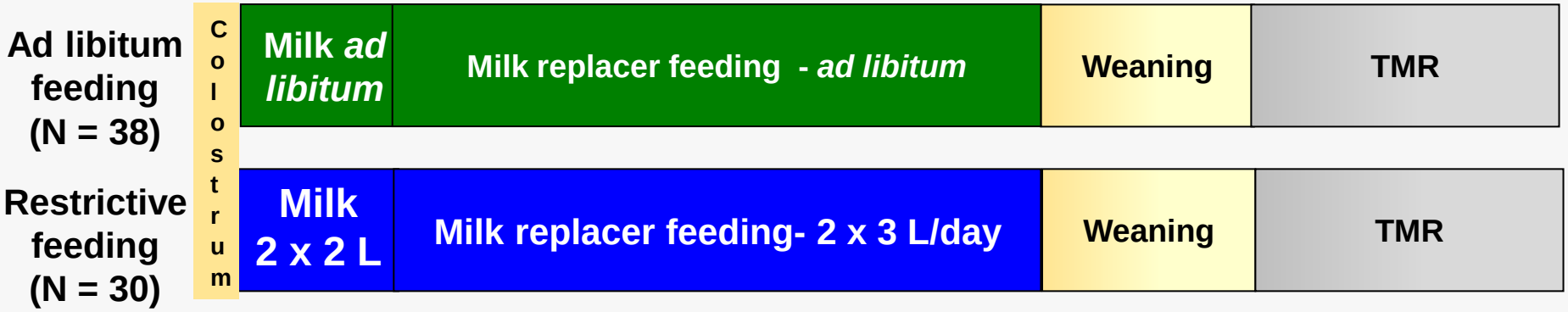
Effect of feeding intensity during early life on subsequent performance

Reference	Groups	Duration of different feeding	Diff. Milk [kg]
Foldager / Krohn, 1994	suckling/restrictive	48 days	**+ 1.402**
Bar-Peled et al., 1998	suckling/MR	60 days	**+ 453**
Ballard et al., 2005	milk ad lib./conv. MR	35 days	**+ 1.250**
Rincker et al., 2006	intens. MR/conv. MR	42 days	**n.s.** **(60 DIM)**
Moallem et al., 2006	intens. MR/conv. MR	60 days	**1.134**
Drackley et al., 2007	intens. MR/conv. MR	35 days	**+ 921**
Rincker et al., 2011	intens. MR/conv. MR	42 days	**+ 291**
Kiezebrink et al., 2014	intens. milk/restr. milk	48 days	**n.s.**

MR=milk replacer

Effects of feeding intensity during the first 4 weeks on later life milk production
- Experimental setup -

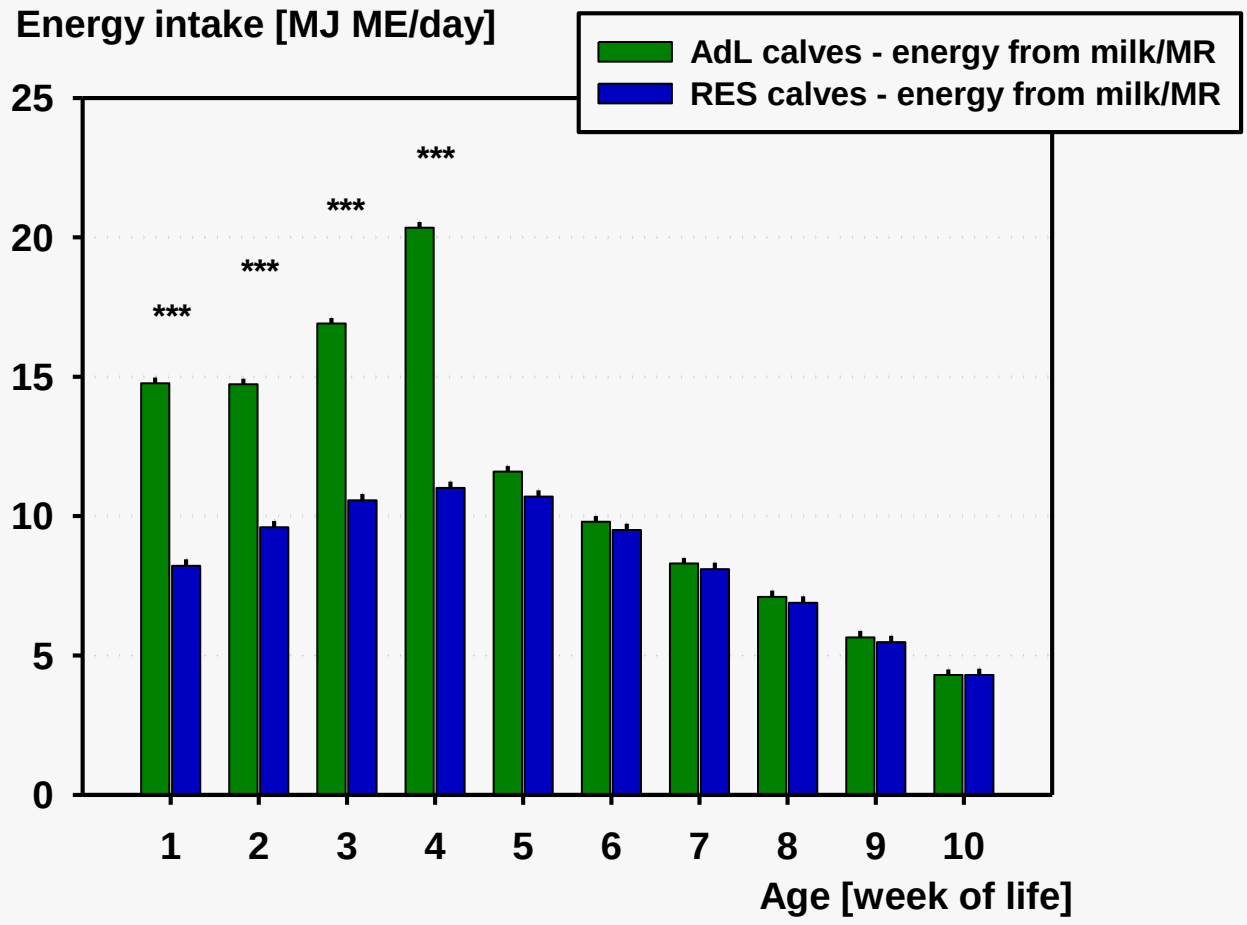




- ✓ feed intake during the first 10 wks of life and during first lactation (n=37)
- ✓ milk yield and milk composition during first lactation

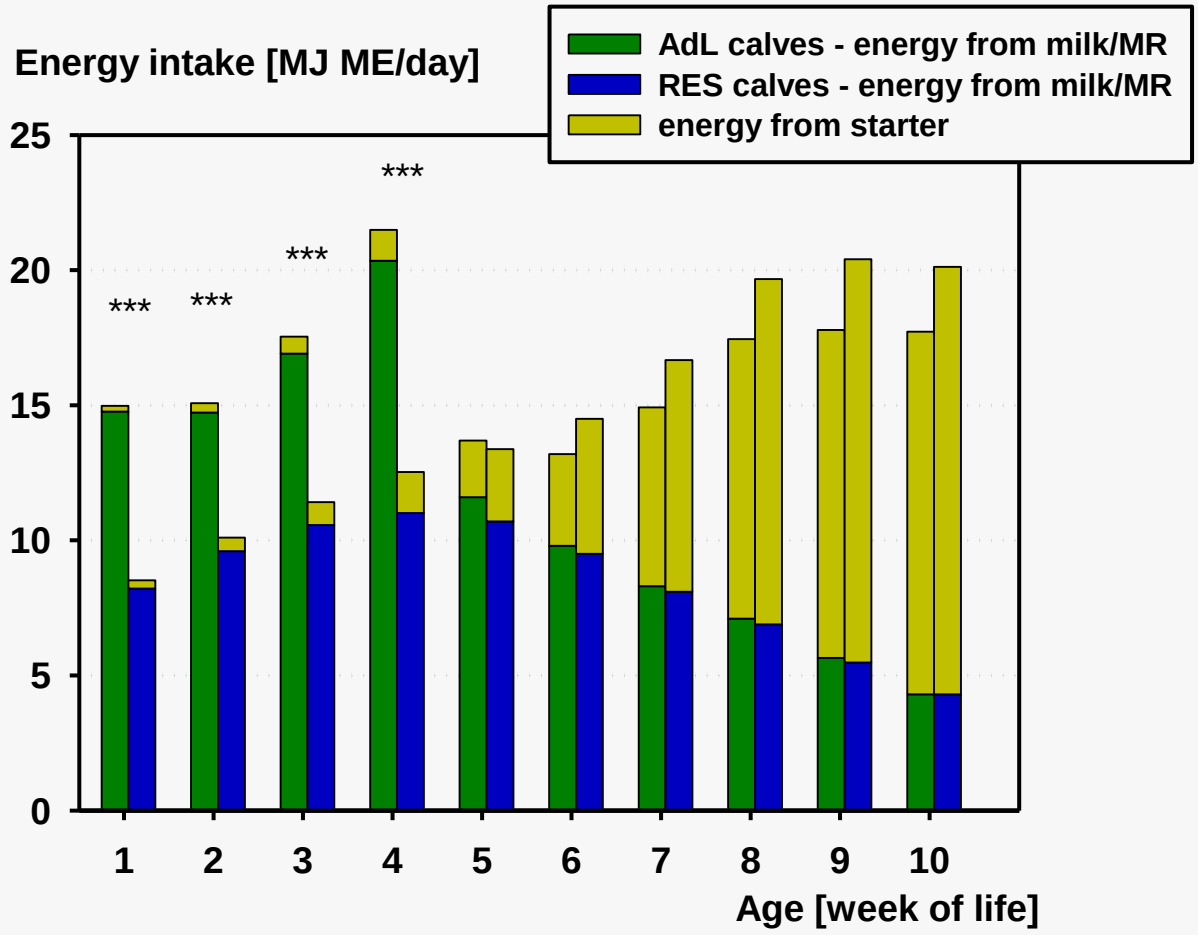
TMR = total mixed ration

Effects of feeding intensity during the first 4 weeks on later life milk production
- Energy intake from milk/MR -



An intensified feeding during the first four weeks of life resulted in higher energy intakes from milk.

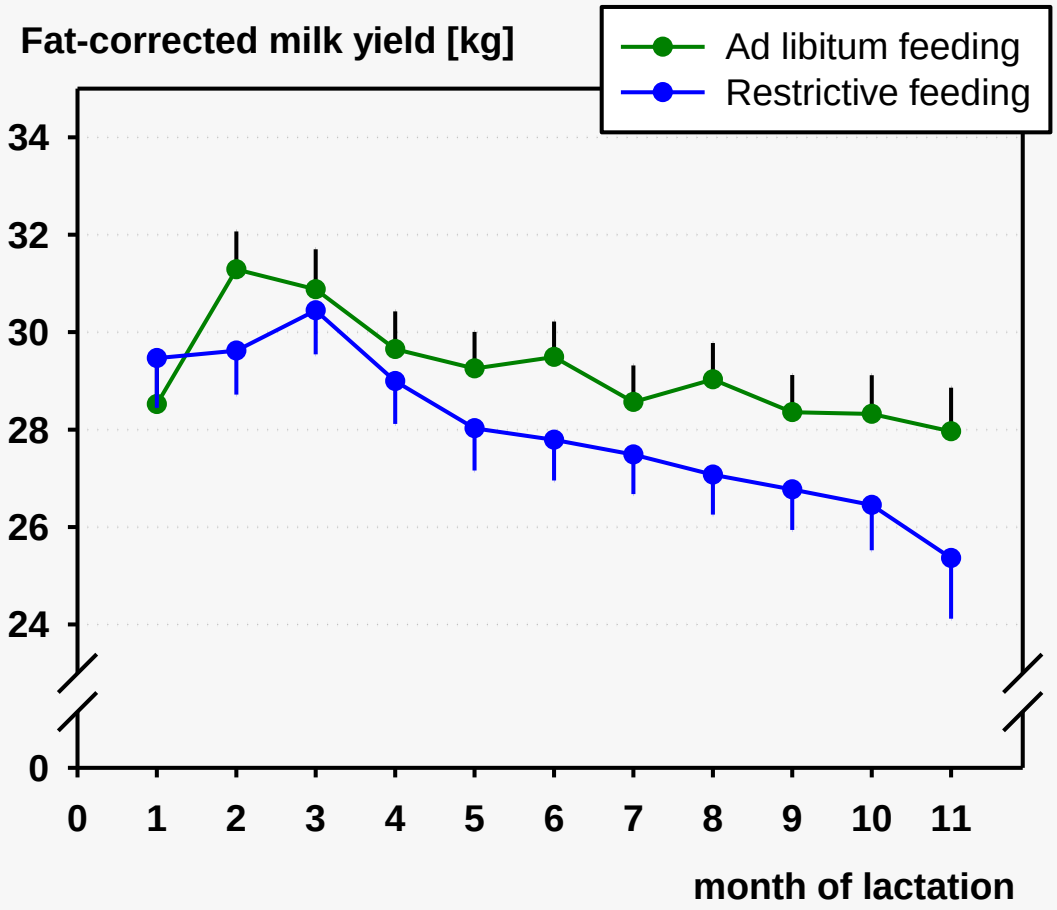
Effects of feeding intensity during the first 4 weeks on later life milk production
- Total energy intake -



During the first weeks of life no significant concentrate intake was observed in both groups.

Effects of feeding intensity during the first 4 weeks on later life milk production
- Milk yield -

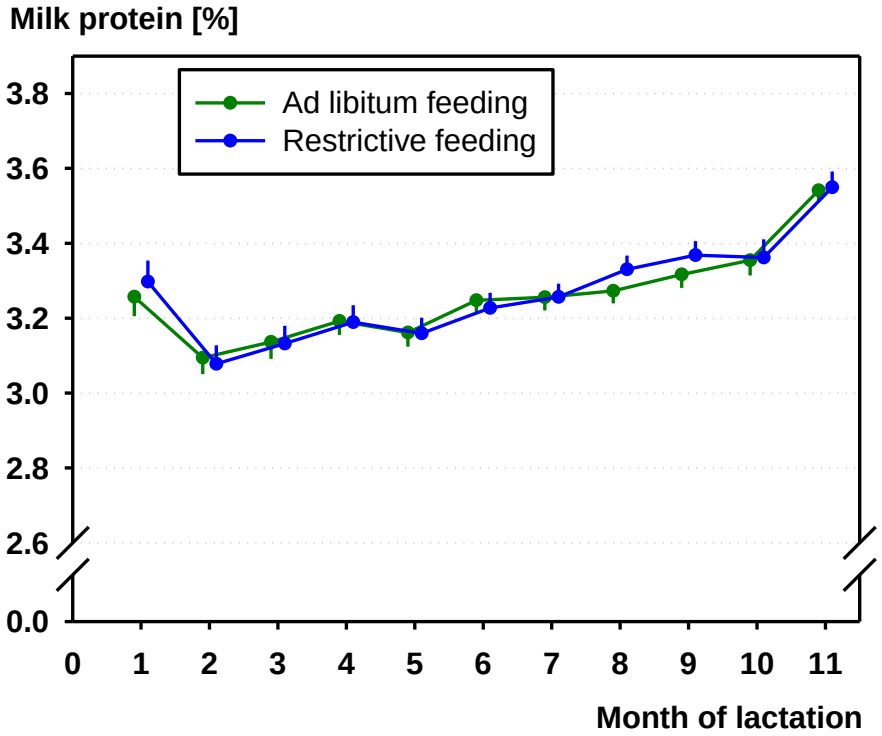
✓ **no differences in first calving age between groups**

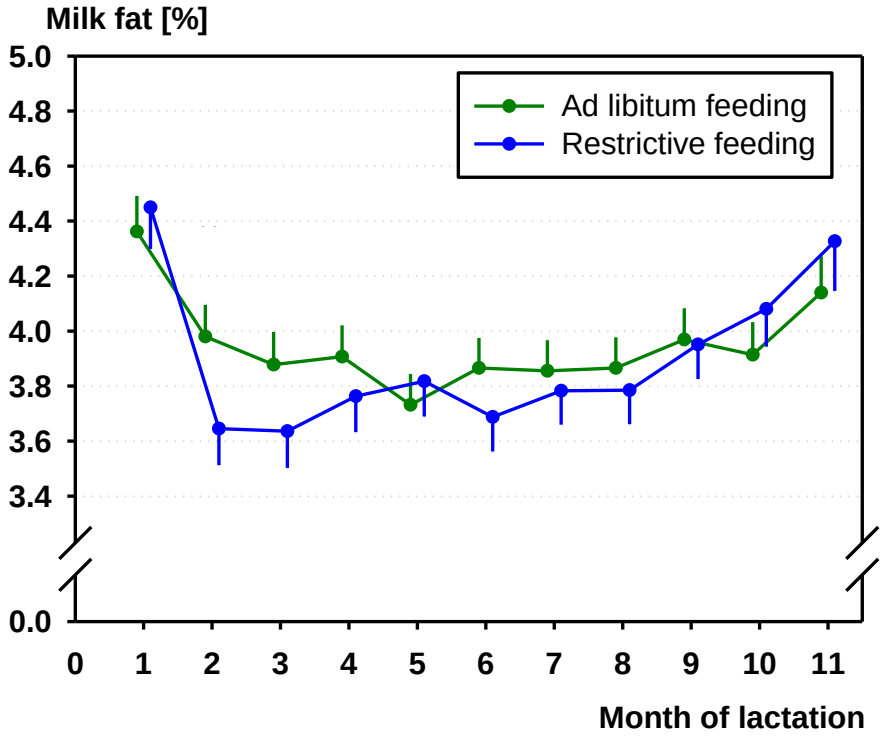


FCM ($p<0.05$):
Ad libitum feeding: 29.2 ± 0.4 kg/d
Restrictive feeding:28.0 ± 0.4 kg/d

An intensified feeding during the first four weeks of life resulted in an increased FCM.

Effects of feeding intensity during the first 4 weeks on later life milk production
- Milk composition -





Protein concentration (p=0.59):

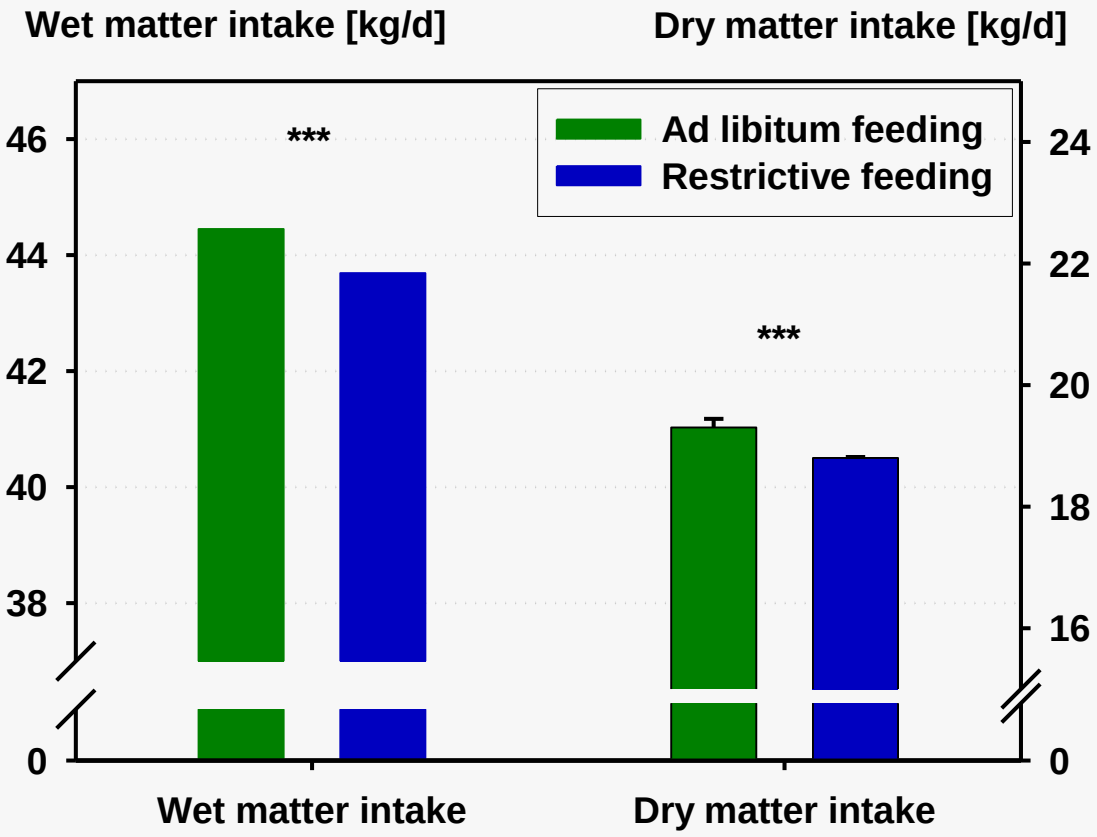
Ad libitum feeding (N=36): 3.30 ± 0.03 %
Restrictive feeding (N=31): 3.28 ± 0.03 %

Fat concentration (p=0.64):

Ad libitum feeding (N=36): 3.95 ± 0.07 %
Restrictive feeding (N=31): 3.90 ± 0.08 %

An intensified feeding during the first four weeks of life did not change milk composition over the whole lactation period.

Effects of feeding intensity during the first 4 weeks on later life milk production
- Feed intake during first lactation -



An intensified feeding during the first four weeks of life resulted in higher roughage intakes during first lactation.

Conclusions

Ad libitum feeding during the first four weeks of life:

- ✓ **resulted in higher feed intakes during the milk feeding period and during first lactation**
- ✓ **did not result in an earlier calving age**
- ✓ **programmed animals to produce more milk during first lactation**
- ✓ **further studies are needed to understand the underlying physiological mechanisms**

Kühl, 2011

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Thank you for your attention!

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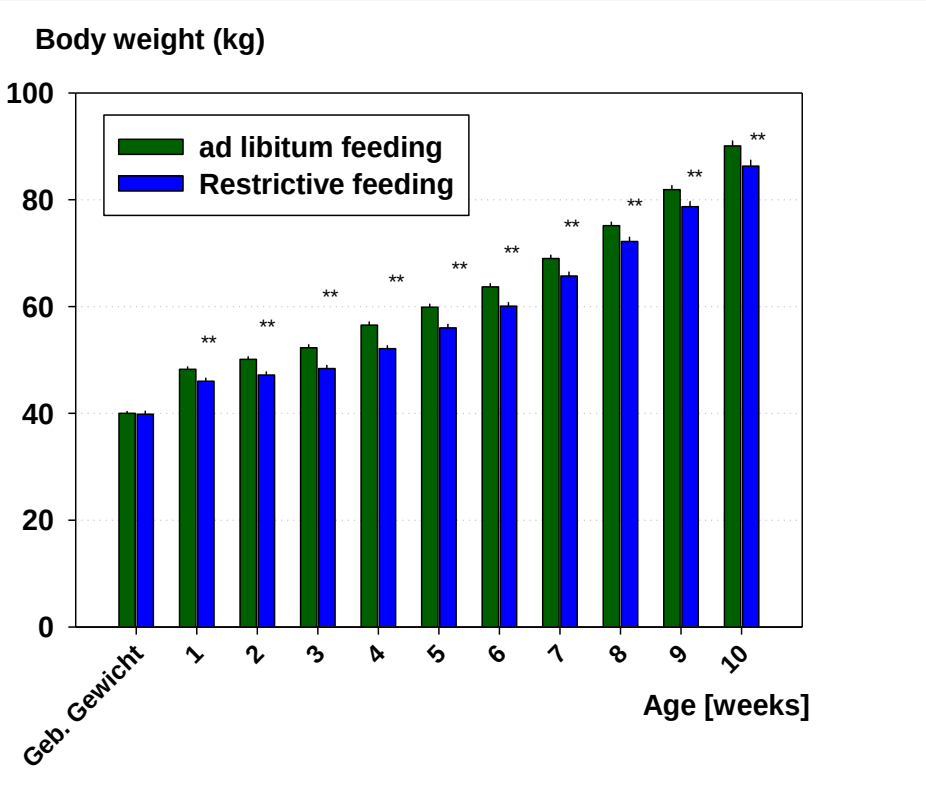
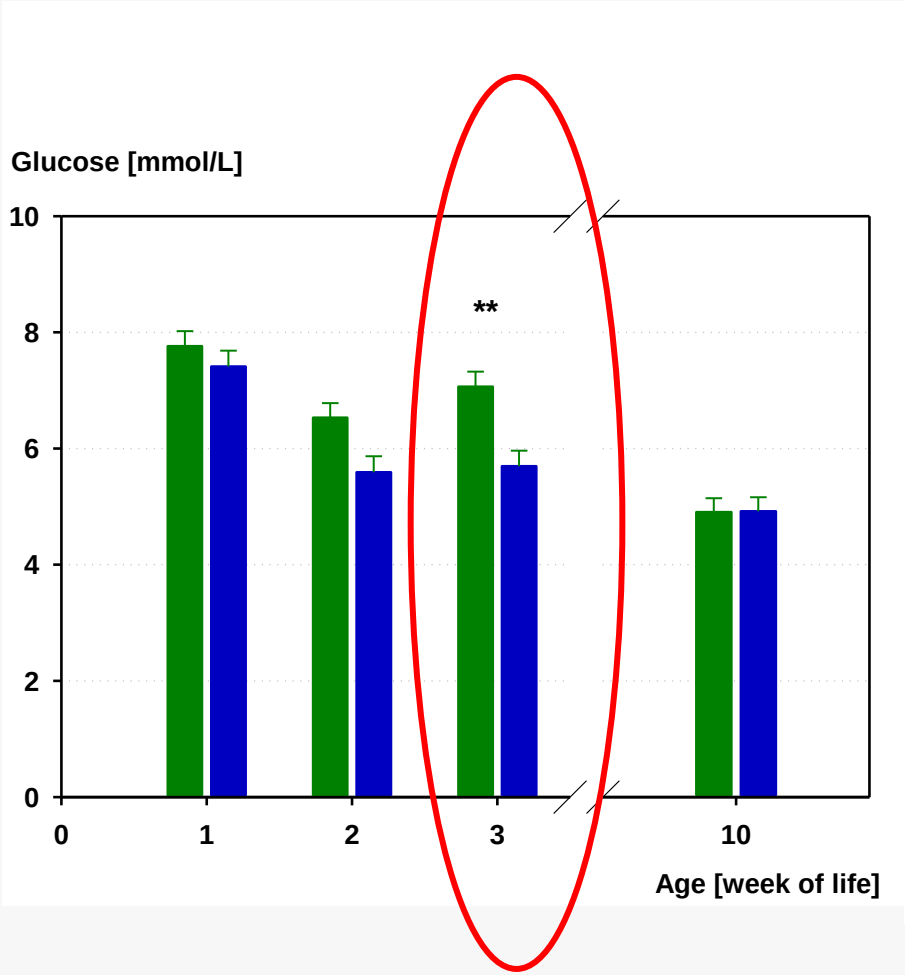
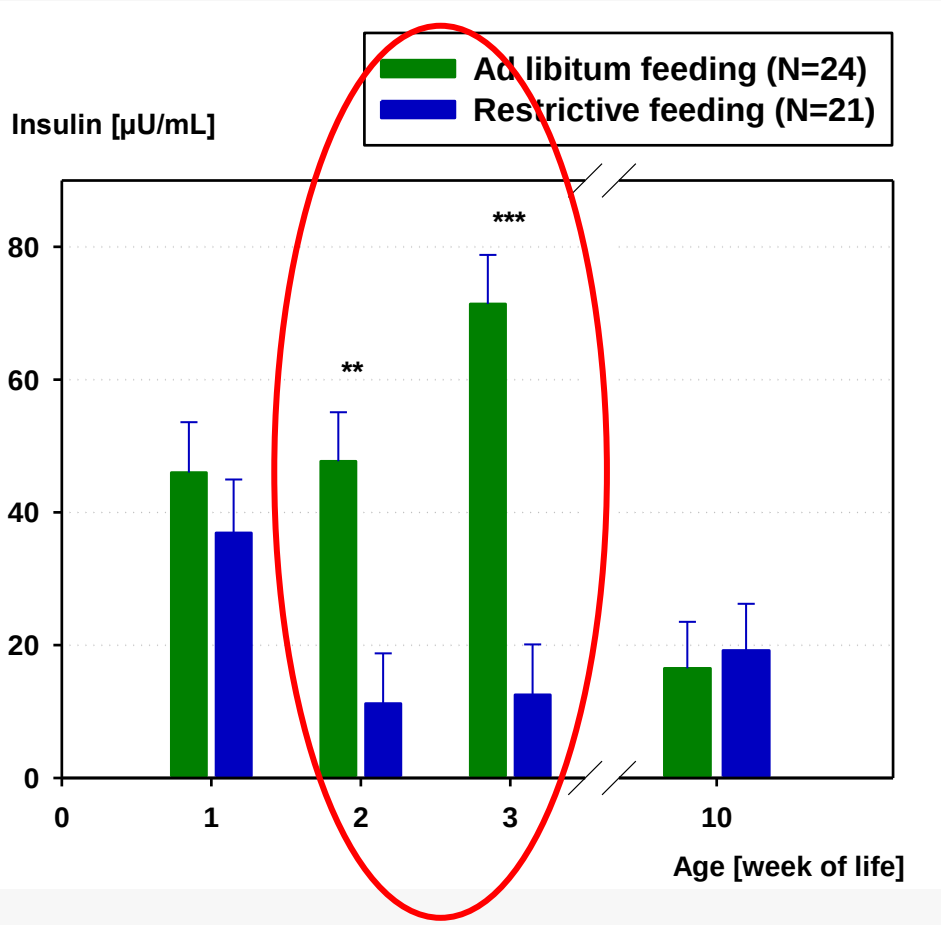
Nutrient supply in early life
- Effects of feeding intensity during the first 3 weeks -



An intensified feeding during the first three weeks of life resulted in higher weight gains.

Feeding intensity during the first three weeks of life affects glucose metabolism (male calves)



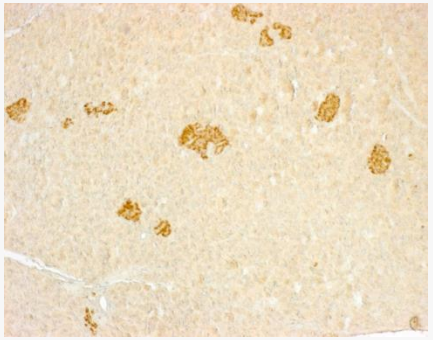


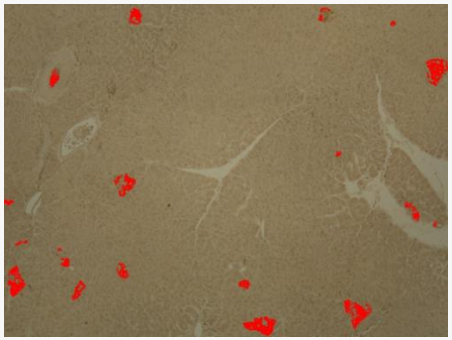
MACCARI ET AL., 2014; PROKOP ET AL., IN REVISION

Feeding intensity during the first three weeks of life affects morphology of the pancreas

- during the fetal and the early postnatal period highest rate of replication and regeneration of β-cells from the ductal pancreatic epithelium
- nutrition influences the balance between β-cell proliferation and β-cell death

	Ad libitum	Control	P-value
Calves	21	21	
Number of islets	9.1 ± 0.3	7.8 ± 0.3	<0.01
Area of insulin stained cells (µm²)	107,180 ± 4,987	84,249 ± 4963	<0.01





PROKOP ET AL., IN REVISION

And the costs?

(Rincker, Journal of Dairy Science, 2011)

- ✓ rearing until **day 152 pp** of the first lactation
- ✓ calculation of income and profits for US standards
- ✓ slight differences in the costs, but higher income in milk expected after the 152th day of lactation

Table 11. Effect of preweaning diet on costs, revenues, and net returns[1]

Item	Preweaning diet		Change with intensive diet	*P*-value
	Conventional	Intensive[2]		
Milk replacer cost	55	111	56	<0.01
Starter cost	7	3	−3	<0.01
Total feed cost, preweaning	62	114	52	<0.01
Total feed cost, precalving[3]	849	880	31	0.02
Heifer feed costs to 152 DIM[3,4]	971	1,011	40	0.01
Non-feed calf costs[5]	408	408		
Breeding and veterinary costs	53	53		
Other postweaning costs[7]	525	513	−12	0.11
Heifer non-feed costs to 152 DIM[3]	1,175	1,158	−17	0.11
Total heifer costs to 152 DIM[3]	2,148	2,168	23	0.33
Milk income[8]	3,450	3,552	103	0.27
Feed cost, lactation[9]	1,203	1,230	27	0.22
Milk return to lactation feed costs[10]	2,247	2,322	75	0.28
Milk return to heifer and lactation feed cost[11]	101	154	53	0.51
Return using PA-corrected milk[12]	83	170	87	0.24