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Reducing the ω6 to ω3 ratio in milk replacer on growth and feeding behavior in calves fed ad libitum

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Milk replacer low fat and a different fat composition

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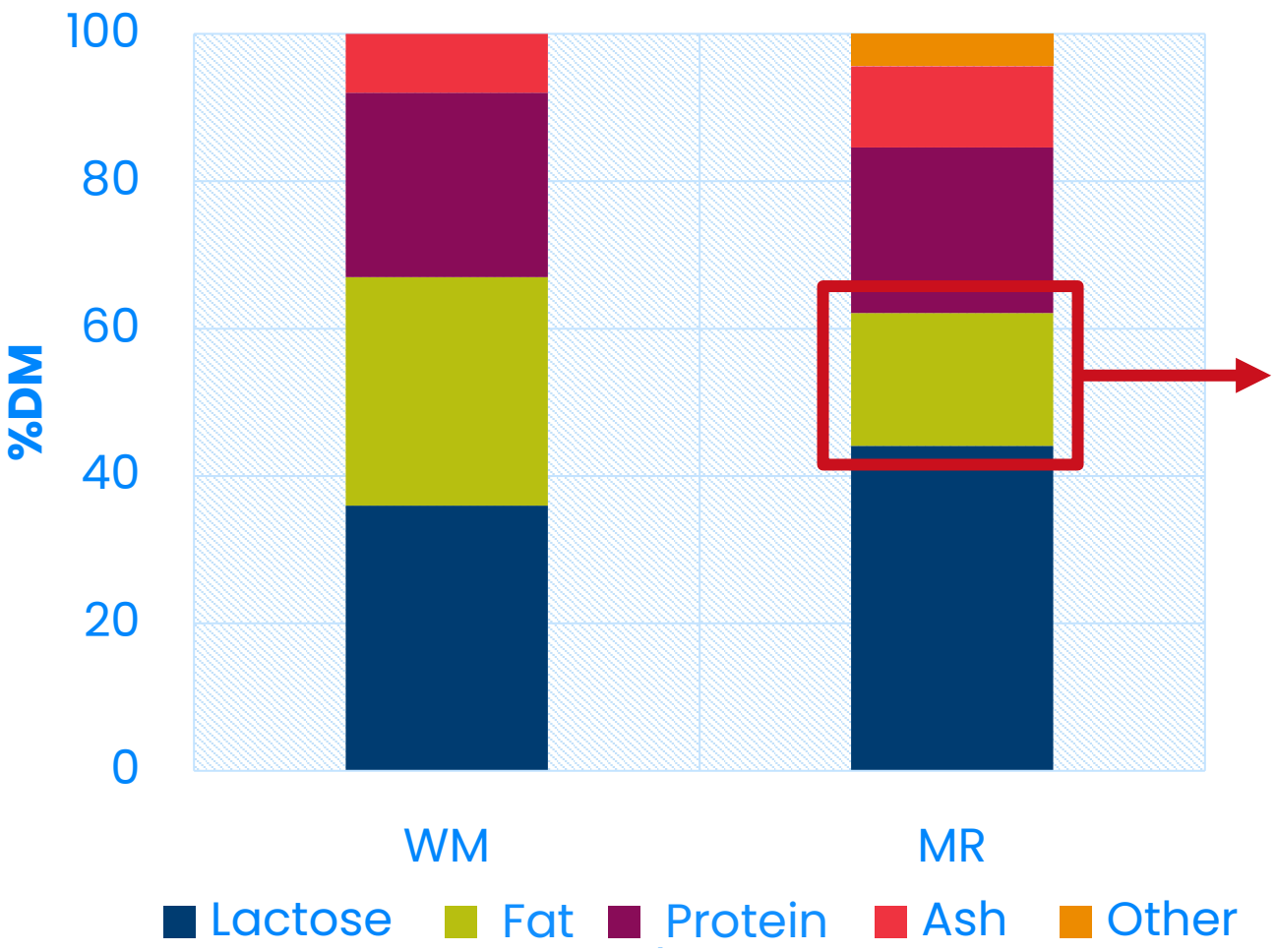
Macronutrient profile



Vegetable sources (Europe and other parts of the world)

Animal sources (mostly North America)

Huuskonen et al., 2005; Drackley, 2008; Echeverry-Munera et al., 2021; Welboren et al., 2023

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Different FA profile between MR and whole milk

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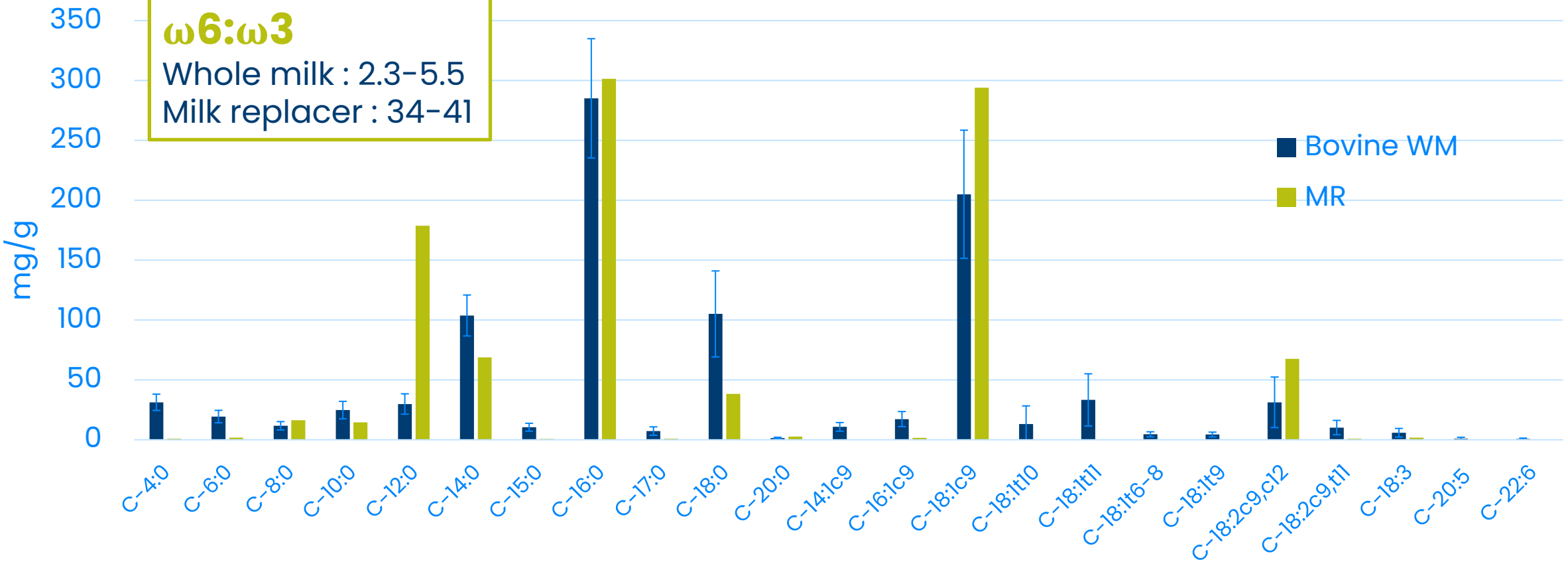
65% 35%

Fatty acid profile

ω6:ω3
Whole milk : 2.3-5.5
Milk replacer : 34-41



Moate et al., 2007; Peravian et al., 2022

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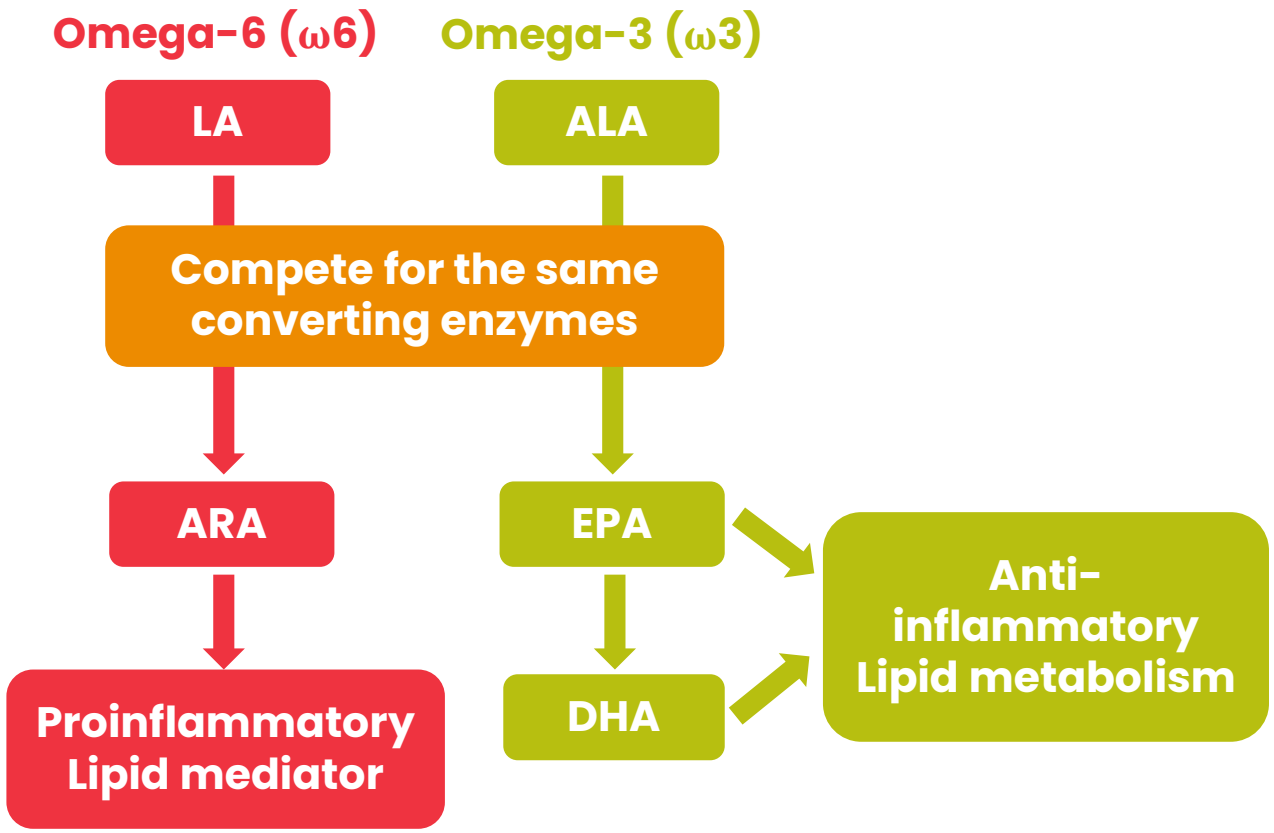
LA (linoleic, C18:2) and ALA (α-linolenic, C18:3)



- LA and ALA are essential FA influencing metabolic processes
- Long-chain PUFA are critical for **growth, organogenesis, regulation of inflammation, and neurodevelopment** in neonates.

Delplanque et al., 2015; Mendonca et al., 2017; Ronald, 2017.

Objective & Hypothesis

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Objective

Effect of reducing ω6: ω3 FA in milk replacer (MR) on growth, intakes, feeding behavior, and blood metabolites in calves fed ad libitum.

Hypothesis

Balacing the ω6 to ω3 ratio in MR may enhance metabolic health (reduction of inflammation) and growth in calves fed ad libitum.

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Experimental Animals & Feeding

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ORIGIN	Collaborating dairy farms
BREED / SEX	100% Holstein male calves
AGE	48 to 96 h after birth
COLOSTRUM QUALITY	≥ 22% BRIX
COLOSTRUM QUANTITY	3.0-4.0 L within the first 3 h after birth, followed by 2 feedings of 2.0 L

Week 1 to 6	Week 7 to 10	Week 11 & 12
GROUP HOUSED		
Ad libitum	Gradual weaning	Solids only
Weekly BW		
Blood sampling at Weeks : 1, 2, 3, 4, 6, 8, 10 and 12		

Calves blocked based on arrival sequence at the facility
Block entered the statistical model as fixed effect

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Experimental treatments

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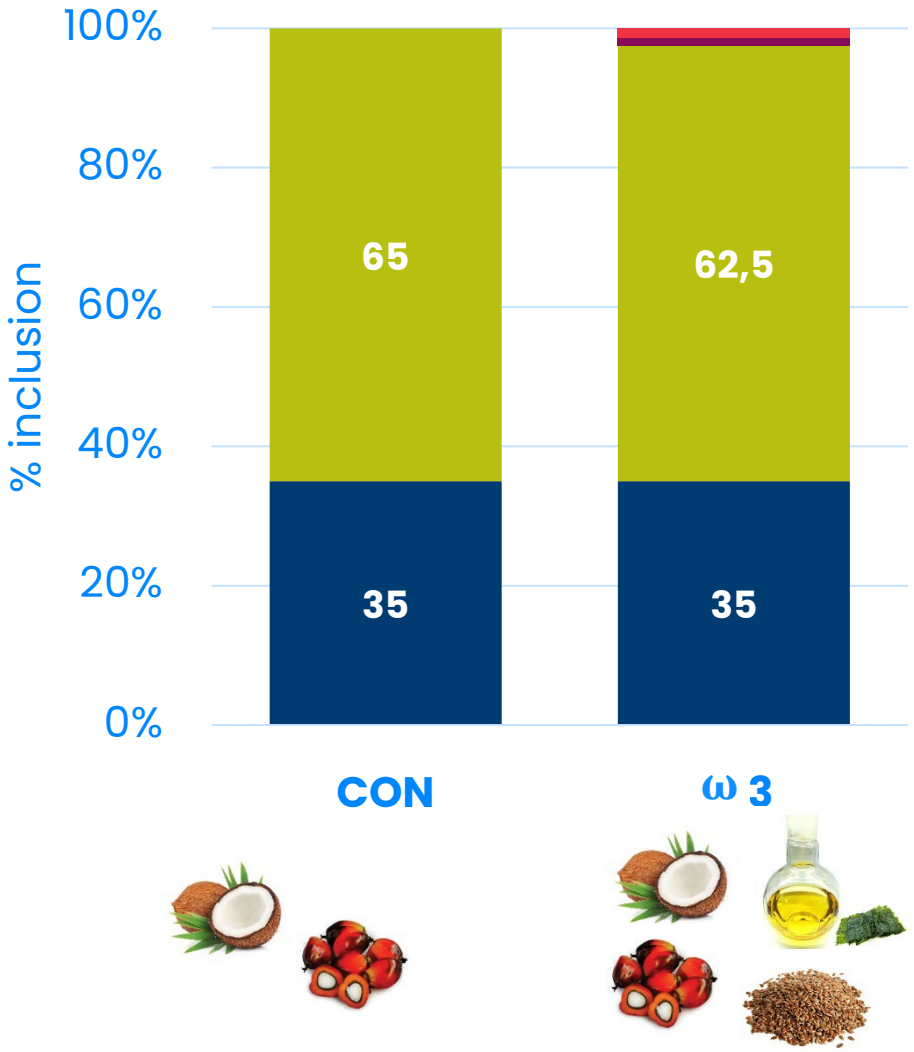
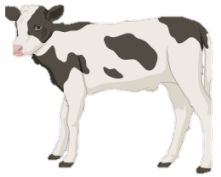
Fat blend composition



DM basis
Fat : 29.2%
Protein : 24.4%
Lactose : 34.1%

- Coconut
- Palm
- Linseed
- Algae



n = 17 calves per treatment

% total FA	CON	ω3
Saturated FA	63.7	62.6
Unsaturated FA	36.3	37.4
ω3	0.16	1.05
ω6	6.49	6.76
MUFA	29.7	29.6
PUFA	6.65	7.81
(ω6)LA	6.49	6.76
(ω3)ALA	0.16	0.69
LA:ALA	40.6	9.79
(ω3) EPA	**0.00**	**0.13**
(ω3) DHA	**0.00**	**0.23**
ω6:ω3	**40.6**	**6.43**

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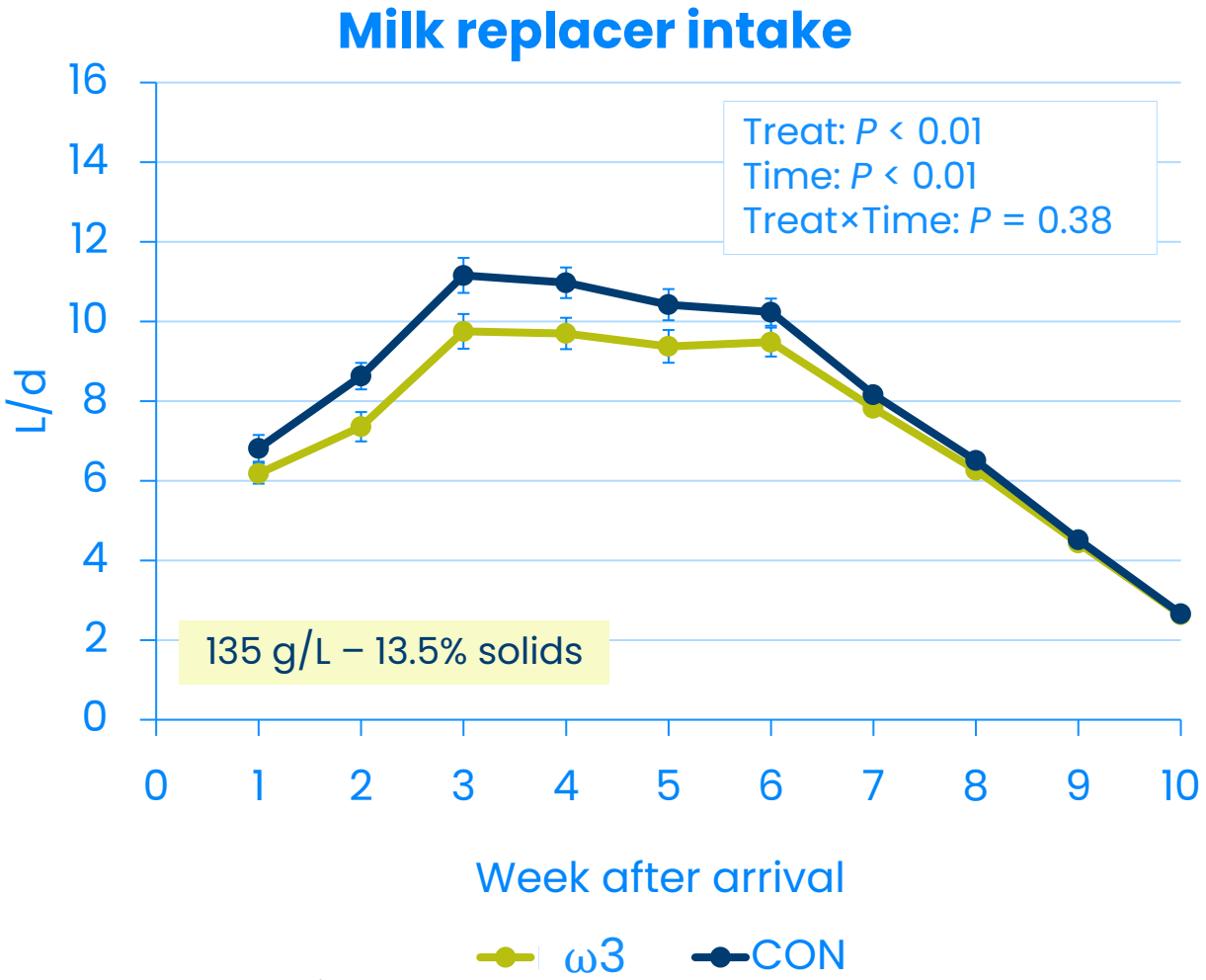
Higher milk replacer intake in calves fed CON



Reduction of MR intake in calves fed ω3 could be due to:

- Strong algae taste and smell
- Metabolic changes affecting satiety related to :
  - Degree of saturation of dietary fats
  - Increased dietary ALA, EPA, and DHA that can enhance CCK, GLP-1, and leptin concentrations

Lawton et al., 2000; Maljaars et al., 2008; Parra et al., 2008; Kozimor et al., 2013; Guldemir et al., 2023

Larger meal size in calves fed CON

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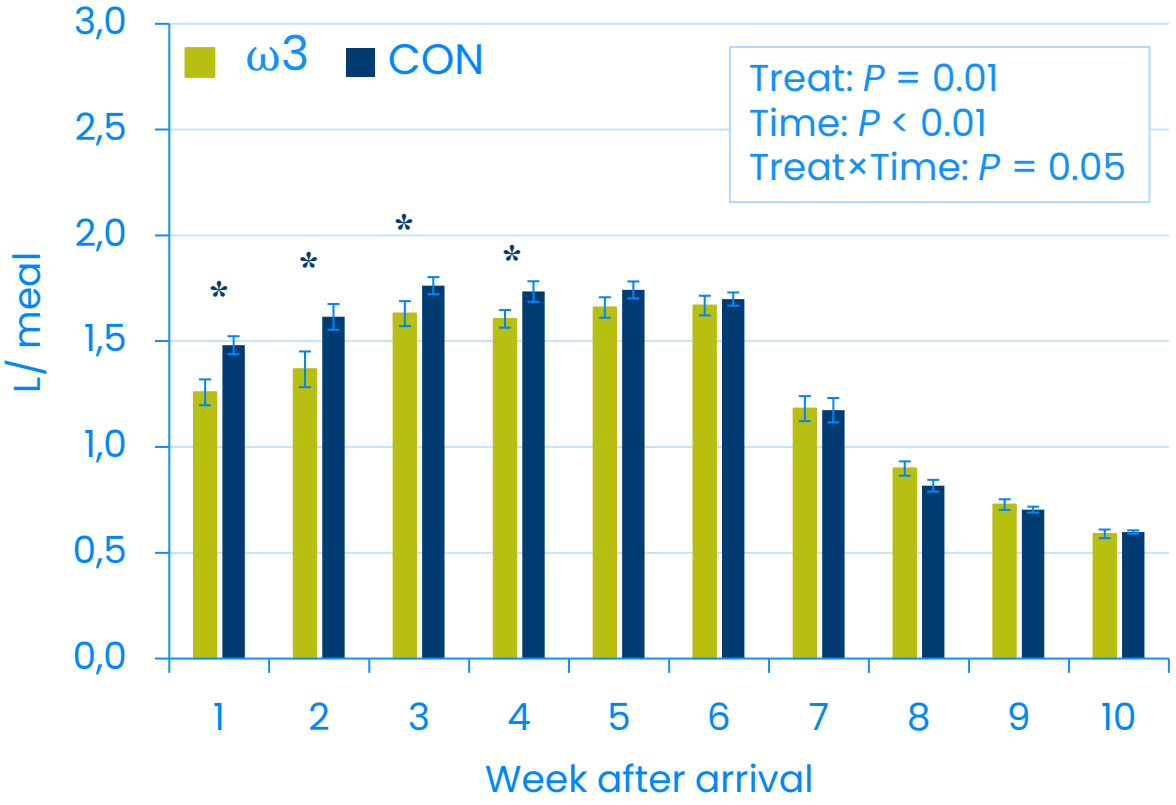
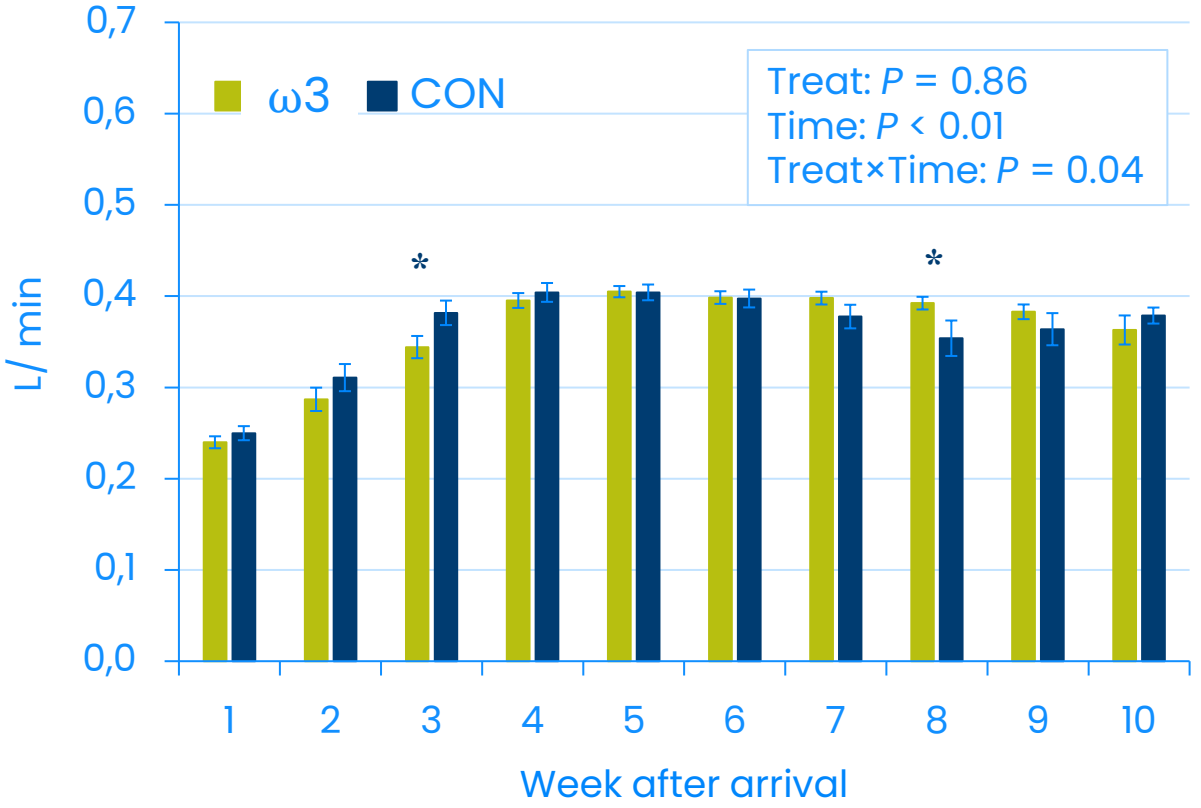
Meal size per visit



Drinking speed



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Higher unrewarded visits during weaning in calves fed CON

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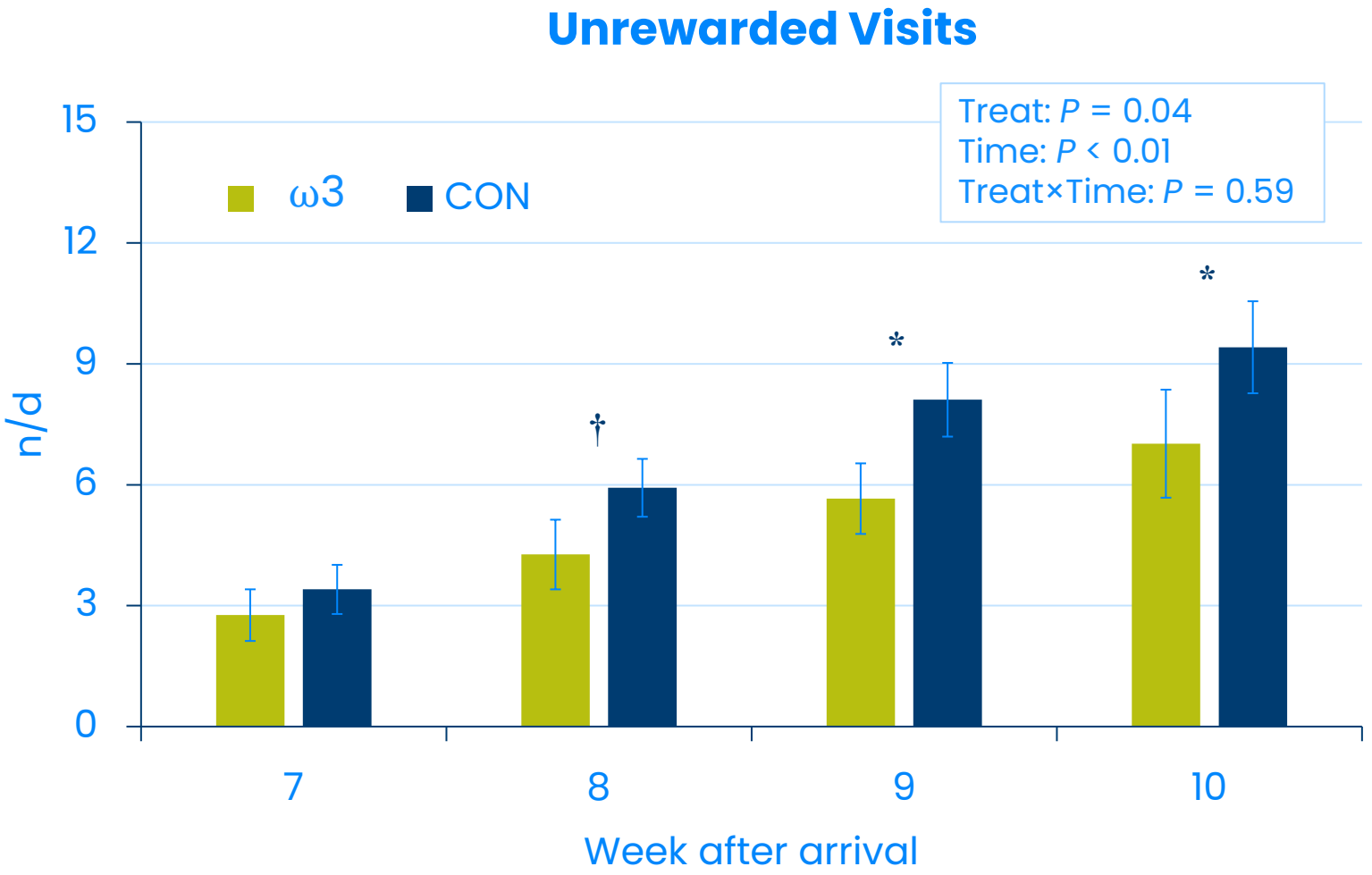

- High unrewarded visits during weaning is a sign of hunger
- Calves fed CON eager to drink more milk during weaning
- This may indicate calves fed ω3 had a better satiety

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No effect of dietary treatments on solid feed intake

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Starter feed intake

Treat: $P = 0.65$
Time: $P < 0.01$
Treat×Time: $P = 0.49$

Chopped straw intake

Treat: $P = 0.10$
Time: $P < 0.01$
Treat×Time: $P = 0.21$

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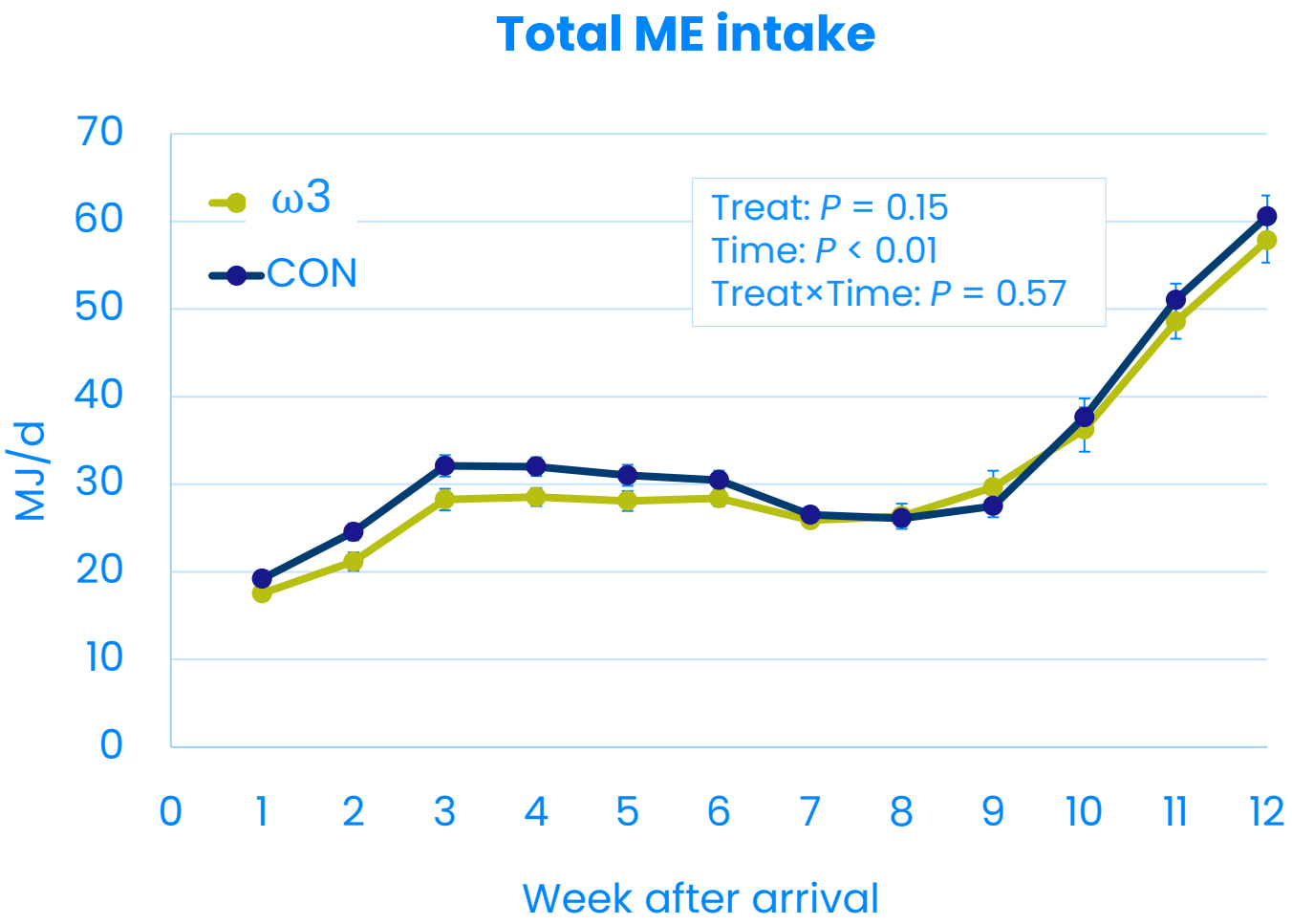
Trend for higher total ME intake in calves fed CON



- Total ME intake includes ME from starter feed and MR
- Higher total ME intake in calves fed CON ($P = 0.01$) during the preweaning phase due to the higher MR intake

Higher postweaning growth in calves fed CON

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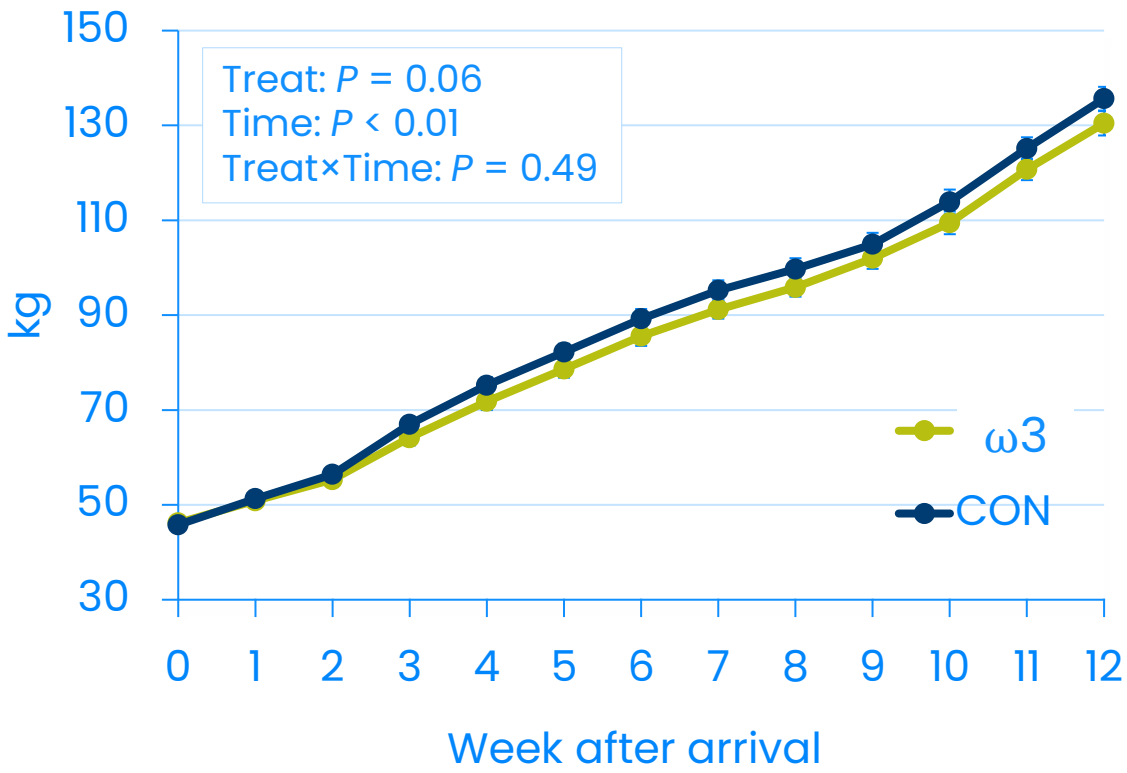
12 wk rearing period
CON: 1.07 ± 0.026 kg/d
ω3: 1.00 ± 0.026 kg/d

Body weight



ADG

- Trend for higher overall experimental BW in calves fed CON than in calves fed ω3 (P = 0.06)
- Higher postweaning BW in calves fed CON than in calves fed ω3 (P = 0.03)
- Trend for higher overall experimental and preweaning ADG in calves fed CON than in calves fed ω3 (P = 0.08)

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No difference in metabolic profiles

Blood parameters	Treatment		Pooled SEM	*P*-value		
	CON	ω3		Treatment (Trt)	Time	Trt × T
Oxidative metabolism						
TBARS *	341	351	0.02	0.37	< 0.01	0.88
dROM	75.4	71.1	4.26	0.49	< 0.01	0.88
FRAP	253	251	3.44	0.63	< 0.01	0.92
GSH-Px	0.18	0.18	0.024	0.84	0.186	0.87
Markers of inflammation						
Fibrinogen *	0.96	1.05	0.038	0.87	< 0.01	0.47
Haptoglobin *	76.6	85.9	0.07	0.22	0.05	0.41
Serum amyloid A *	2590	2443	0.14	0.77	< 0.01	0.73
Hormones						
Adiponectin	12.9	13.9	0.48	0.13	< 0.01	0.97
Leptin	3.2	3.1	0.08	0.48	< 0.01	0.23
IGF-I	214	200	7.13	0.18	< 0.01	0.88

TBARS =Thiobarbituric acid reactive substances
dROM = diacron of reactive oxygen metabolites
FRAP = Ferric-reducing ability of plasma
GSH-Px = selenium-dependent antioxidant selenoenzyme glutathione peroxidase
IGF-I = insulin-like growth factor I

* Expressed as log(SEM)

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Conclusions

GROWTH	Enhanced growth in calves fed CON.
MILK REPLACER INTAKE	Reduced MR intakes in calves fed ω3 may be due to modulation of hormonal mechanisms regulating satiety or to alteration of palatability.
BLOOD	Differences in voluntary intake may have modulated blood parameters, thus it is difficult to isolate the treatment effect.

Acknowledgments

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Thank you

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