



THE ESSENTIAL FATTY ACIDS
**How Much Essential Fatty
Acids Can Escape
Biohydrogenation
in the Rumen?**

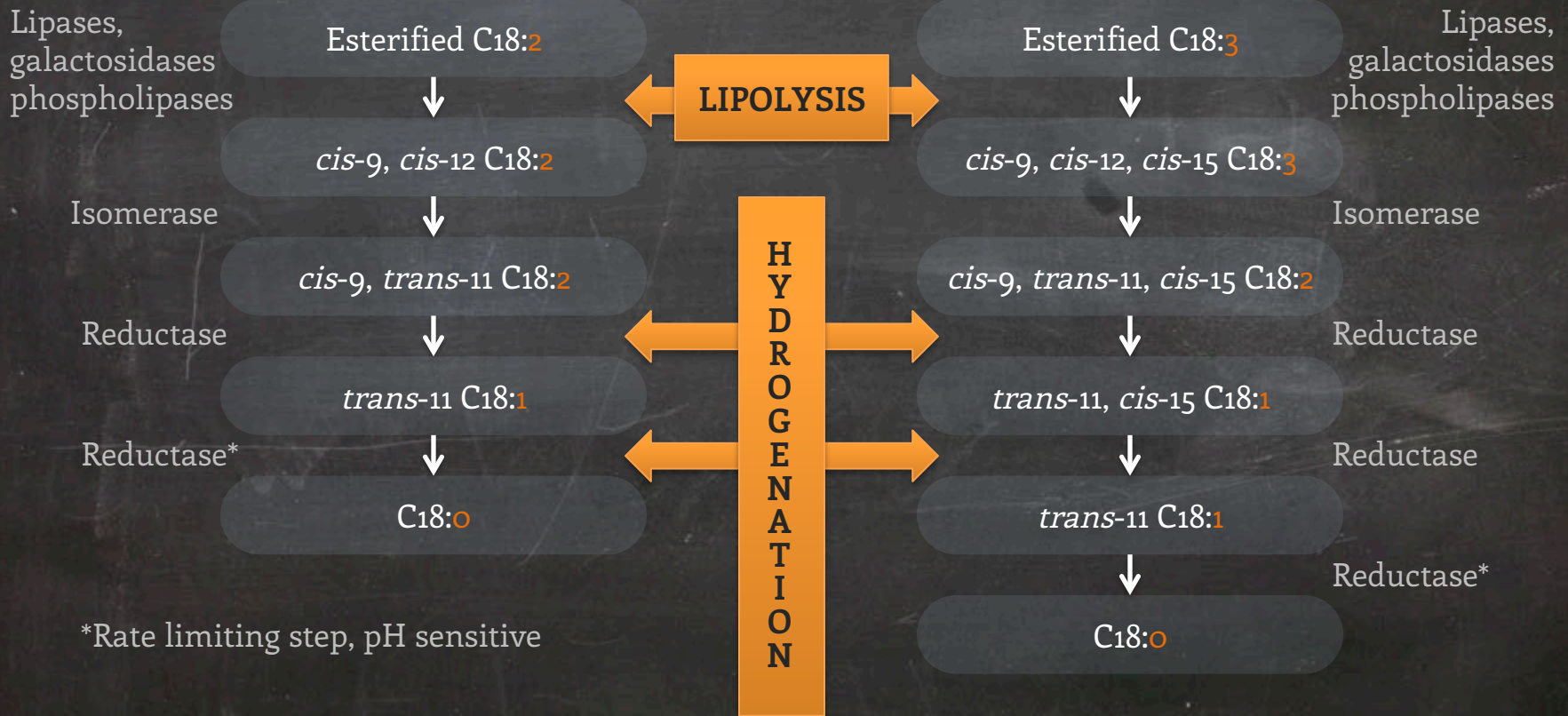
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FLORIDA
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THE ESSENTIAL FATTY ACIDS

Ruminal Biohydrogenation of C18:2 & C18:3

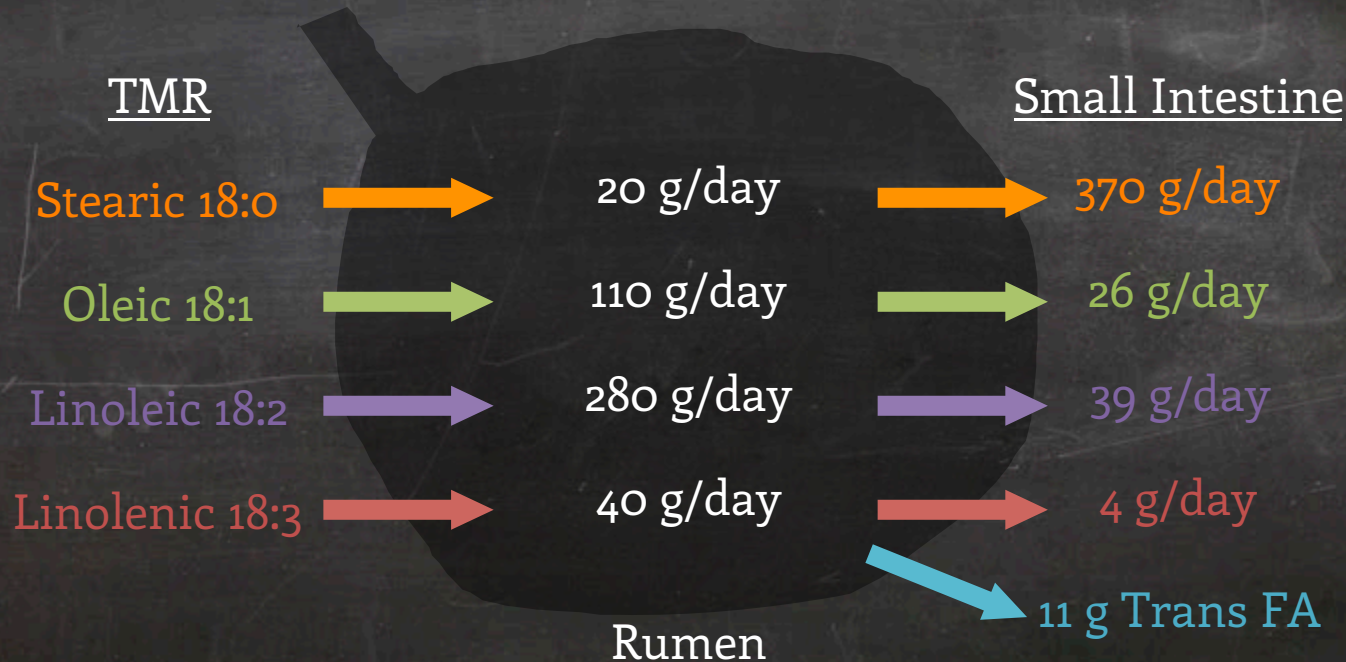




THE ESSENTIAL FATTY ACIDS

Ruminal Bacteria Change Dietary Unsaturated Fatty Acids Into Trans & Saturated Fatty Acids

Ruminal Bacteria Change Dietary Unsaturated Fatty Acids Into Trans & Saturated Fatty Acids





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Some Factors Influencing Ruminal Biohydrogenation (BH) of Essential Fatty Acids

- Number of double bonds in the essential fatty acid
 - Extent of BH of C18:2 (linoleic acid) is from 70 to 90%
 - Extent of BH of C18:3 (linolenic acid) is from 85 to 100%



THE ESSENTIAL FATTY ACIDS

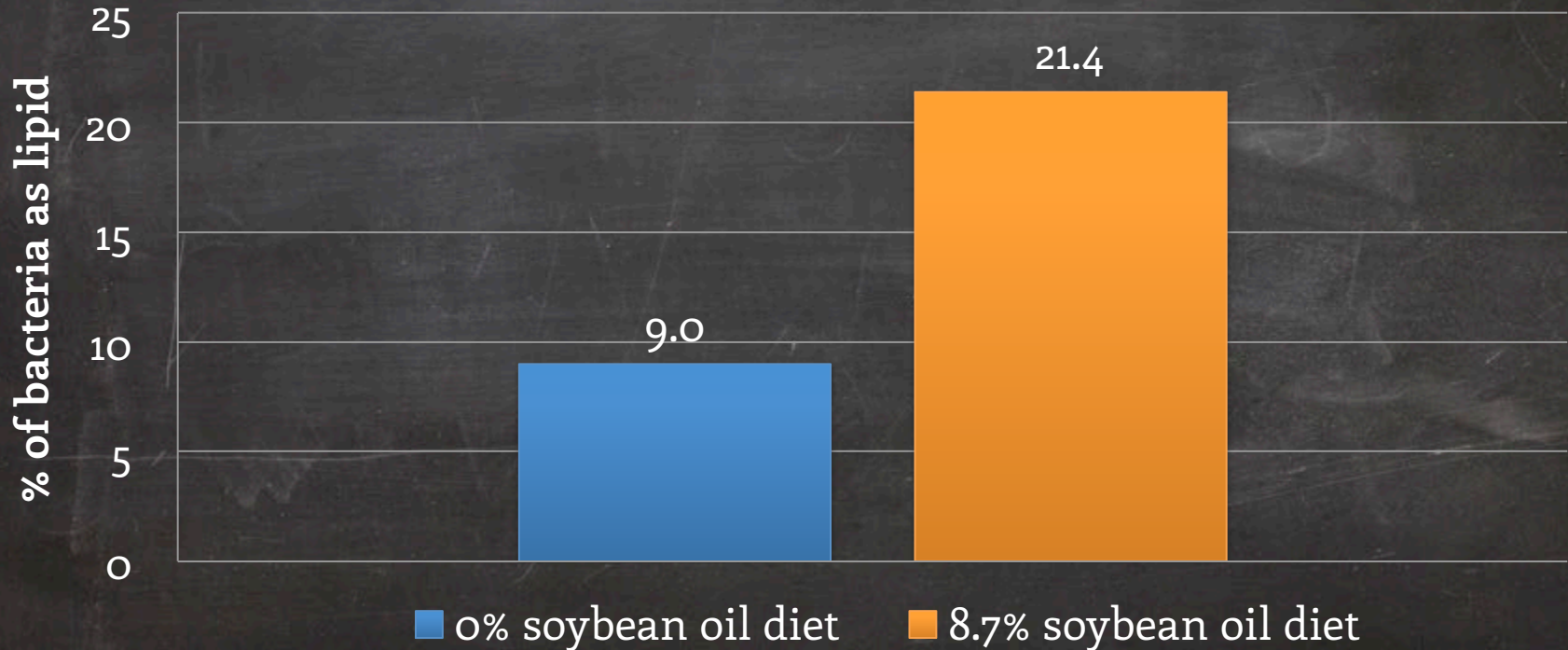
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- Number of double bonds in the essential fatty acid
 - Extent of BH of C18:2 (linoleic acid) is from 70 to 95%
 - Extent of BH of C18:3 (linolenic acid) is from 85 to 100%
- Ruminal bacteria incorporate unsaturated FA into their cells



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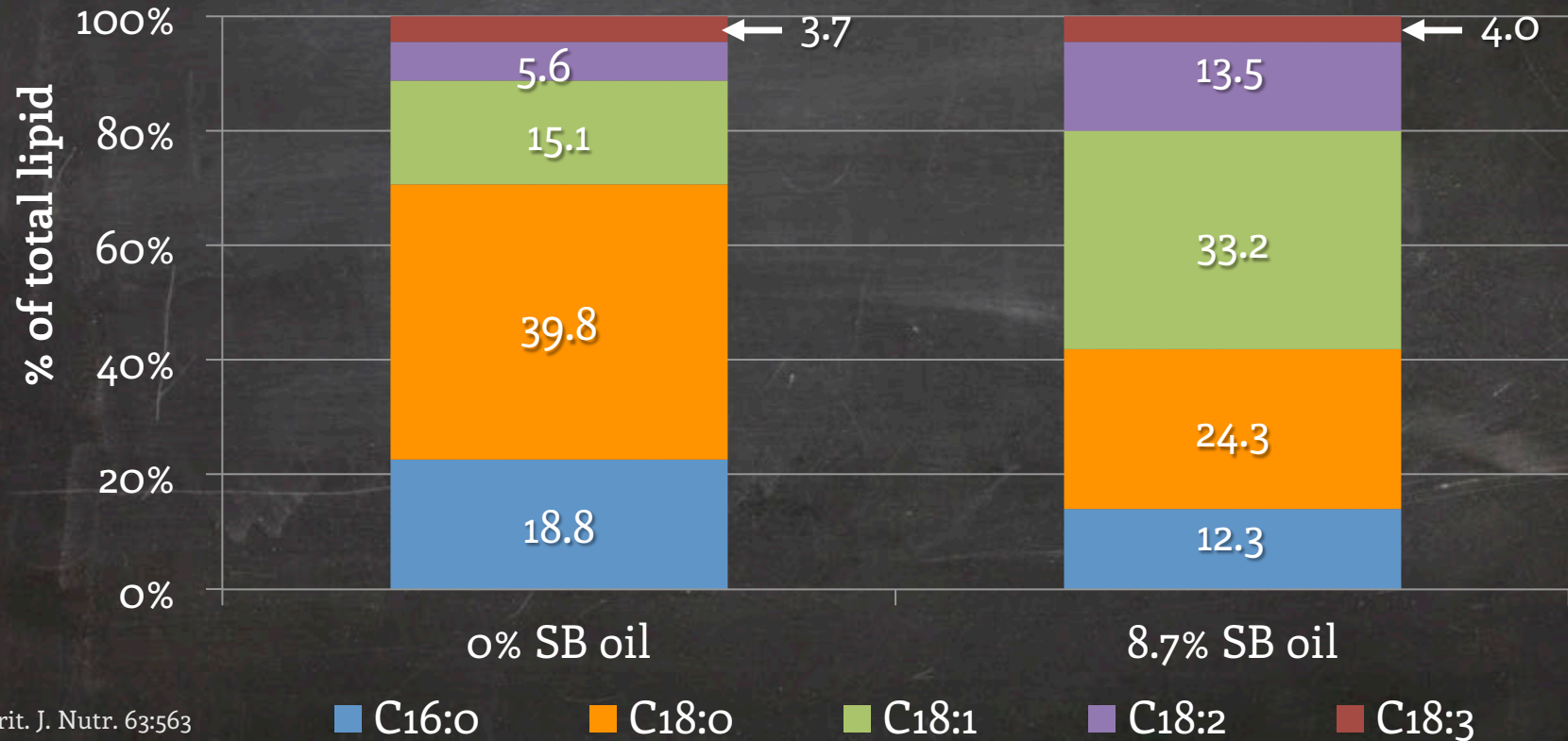
Feeding Soybean Oil to Dairy Cows Increased Total Lipid Content of Ruminal Bacteria





THE ESSENTIAL FATTY ACIDS

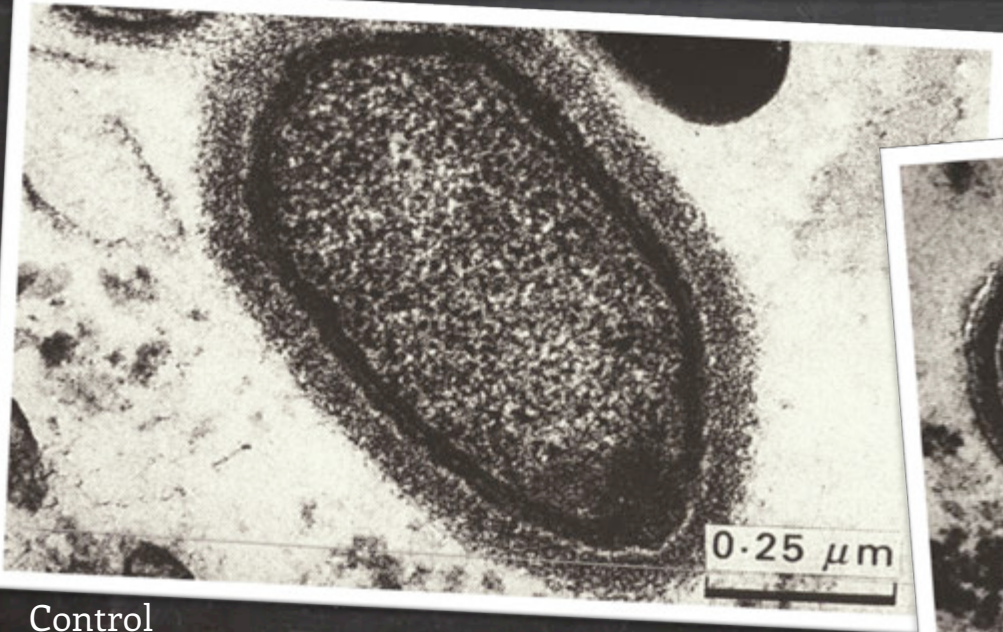
Fatty Acid Profile of Ruminal Bacteria From Dairy Cows Fed Diets of 0 or 8.7% Soybean Oil





THE ESSENTIAL FATTY ACIDS

Lipid Droplets Inside Bacteria of Dairy Cows Fed Oil



Control



Oil-fed



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- Ruminal bacteria incorporate unsaturated FA into their cells
- Changing pH of ruminal fluid



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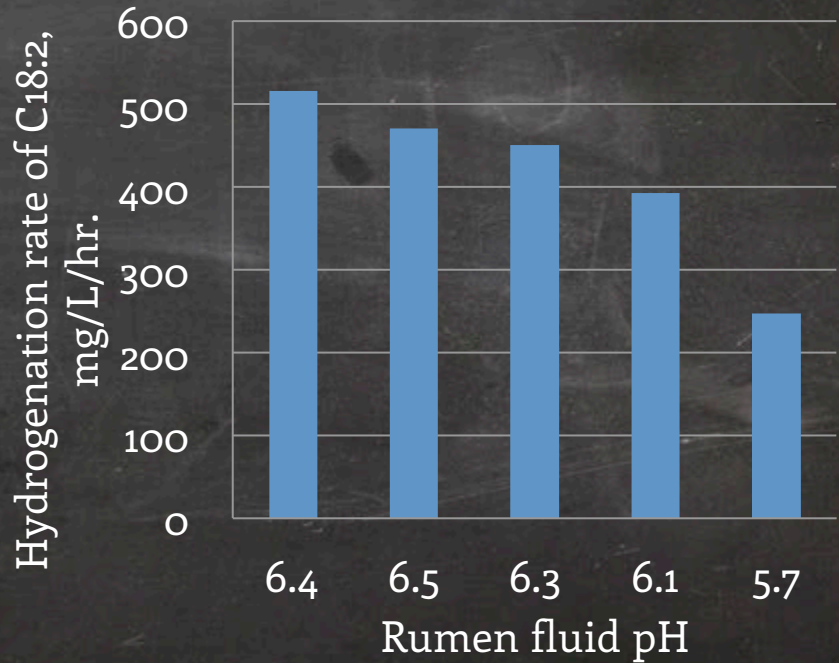
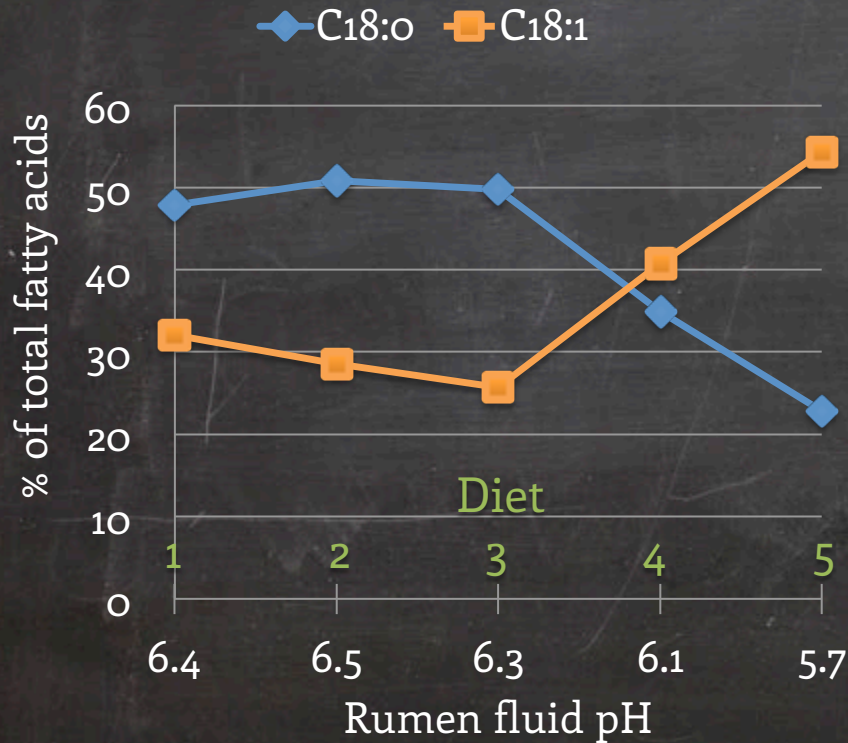
Effects of Forage to Concentrate Ratio on Ruminal pH & in Vitro Rates of Microbial BH of FA

	Diets fed to sheep				
	1	2	3	4	5
Alfalfa Meal	96	66	48	30	—
Soybean Meal	—	10	16	16	32
Dehusked Barley	—	20	32	50	64
Corn Oil	2	2	2	2	2
Mineral	2	2	2	2	2
NDF, % of diet DM	42.8	39.0	32.5	27.6	19.5
Starch + sugars, % diet	12.2	18.7	25.9	31.2	35.7



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Effect of Decreasing Dietary Forage on Biohydrogenation of Unsaturated Fatty Acids





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- Ruminal bacteria incorporate unsaturated FA into their cells
- Changing pH of ruminal fluid
- Feeding ionophores

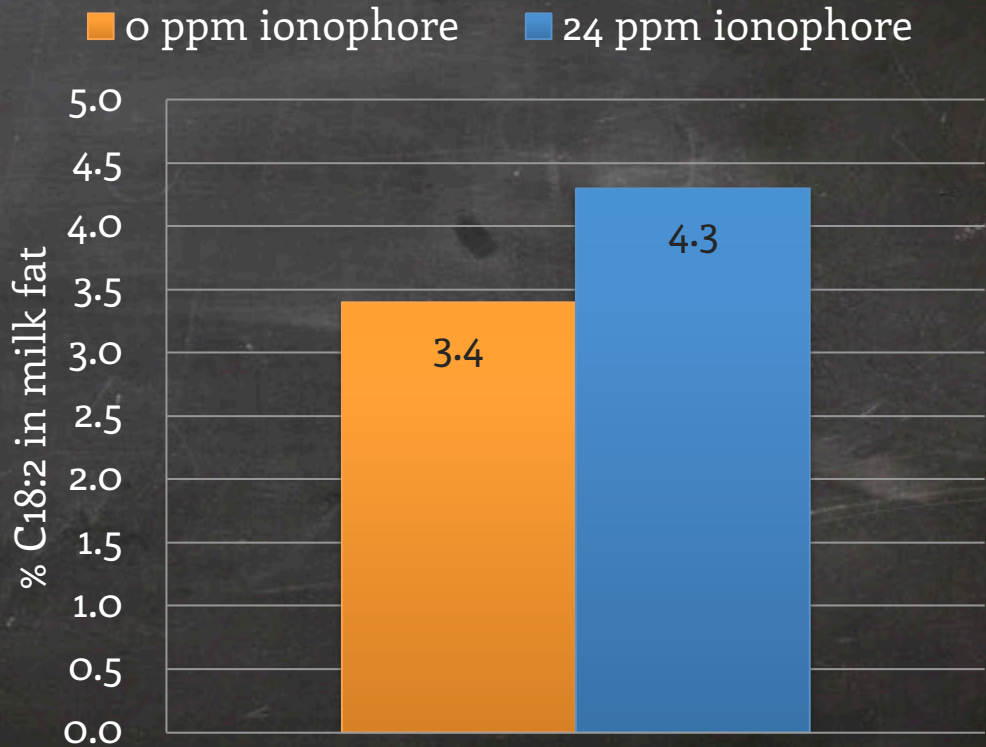


THE ESSENTIAL FATTY ACIDS

Antimicrobials Reduce Bacterial Metabolism of C18:2 and Increase % C18:2 in Milk Fat

Ionophore	Lipolysis	Hydrogenation
—% inhibition—		
Lasalocid Na	18.5 ^a	8.6 ^a
Monensin	15.0 ^a	2.1 ^a

^a $P < 0.10$



Soybean oil in vitro (J. Dairy Sci. 78:2797)

Sauer et al., J. Animal Sci. 76:906



THE ESSENTIAL FATTY ACIDS

Some Factors Influencing Ruminant Biohydrogenation (BH) of Essential Fatty Acids

- Number of double bonds in the essential fatty acid
 - Extent of BH of C18:2 (linoleic acid) is from 70 to 95%
 - Extent of BH of C18:3 (linolenic acid) is from 85 to 100%
- Ruminant bacteria incorporate unsaturated FA into their cells
- Changing pH of ruminal fluid
- Feeding ionophores
- Feeding roasted vs. unroasted whole oil seeds



THE ESSENTIAL FATTY ACIDS

Feeding Roasted Soybeans Can Increase Ruminal Escape of Linoleic Acid

Reference	Raw Soybeans	Roasted Soybeans
	————— % biohydrogenation of C18:2 —————	
Reddy et al., JDS 77:3410	80 ^a	58 ^b
	————— % C18:2 in milk fat —————	
Tice et al., JDS 77:166	5.5 ^a	6.7 ^b

^{a,b} $P < 0.10$



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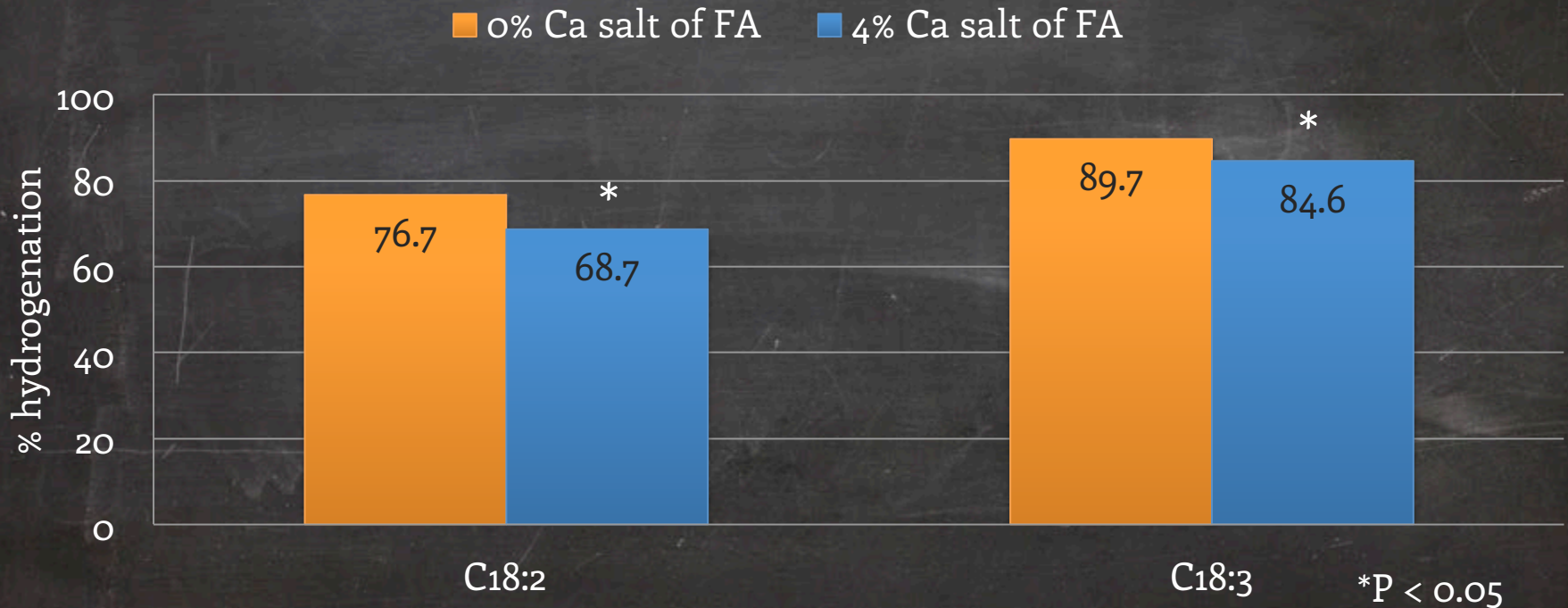
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- Ruminal bacteria incorporate unsaturated FA into their cells
- Changing pH of ruminal fluid
- Feeding ionophores
- Feeding roasted vs. unroasted whole oil seeds
- Feeding calcium salts of fatty acids



THE ESSENTIAL FATTY ACIDS

Extent of Feeding Ca Salts of FA to Lactating Dairy Cows on Biohydrogenation of Essential FA





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How Much Essential Fatty Acids Can Escape Biohydrogenation in the Rumen?

Summary

- In general, only ~10 to 30% of essential fatty acids in the diet reach the small intestine of lactating dairy cows because of the extensive hydrogenation by ruminal microorganisms
- This can be increased somewhat when diets contain
 - more concentrates and less forage
 - an ionophore
 - roasted vs. raw soybeans
 - Ca salts of essential fatty acids