



## Medium Chain Fatty Acids for Energy and Antimicrobial Activity

### What are Medium Chain Fatty Acids?

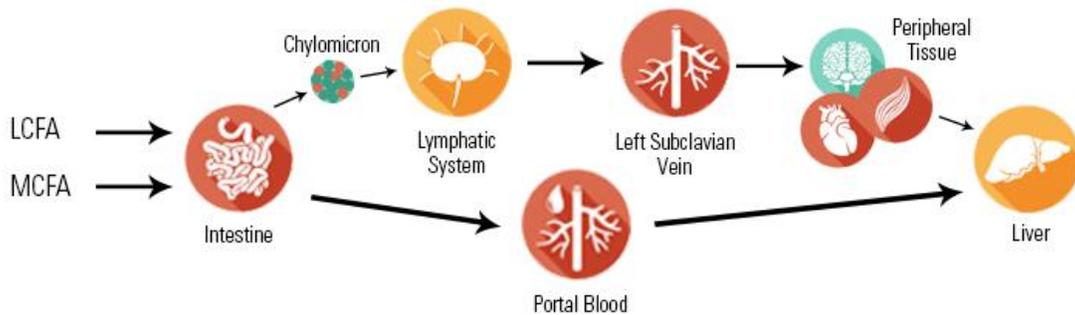
Medium chain fatty acids (MCFA) are saturated fatty acids having a carbon chain between 6 and 12 carbons in length. MCFA are naturally found in many animal and vegetable fats including coconut oil, palm kernel oil and dairy products. These molecules have been shown to have antimicrobial properties against gram (+) and gram (-) bacteria, as well as viruses.<sup>1,2,3</sup> MCFA have also been used as an energy source in various diets, including humans.<sup>4</sup>

**Table 1.** Types of Medium Chain Fatty Acids (MCFA).

<b>C6</b>	Caproic acid (or Hexanoic acid)
<b>C8</b>	Caprylic acid (or Octanoic acid)
<b>C10</b>	Capri acid (or Decanoic acid)
<b>C12</b>	Lauric acid (or Dodecanoic acid)

### Highly Available Energy Source

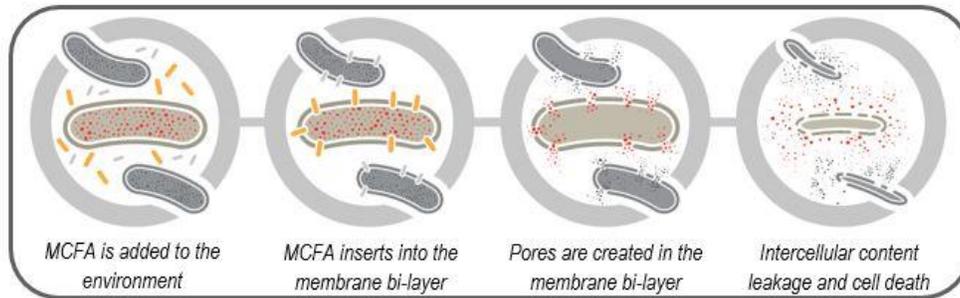
The length of a fatty acid's carbon chain directly impacts the digestibility and rate of metabolization of the specific fatty acid. Most fat sources included in today's animal diets, such as animal fats and vegetable oils, are comprised generally of long chain fatty acids (LCFA). LCFA, which have a carbon chain length >12, require bile acids for proper emulsification and lipases to break them down into smaller molecules which can then be absorbed by the small intestine. While LCFA provide valuable energy and essential fatty acids, they metabolize at a slower rate. MCFA, however, do not require the use of bile acids or lipases for absorption. Once in the intestine, the MCFA travel directly to the liver via the portal artery, making them a readily available energy source for the animal to efficiently utilize. Since MCFA are more efficiently converted into energy, they are less likely to be stored as fat.<sup>5</sup>



**Figure 1.** Absorption pathway for LCFA and MCFA.<sup>5</sup>

### MCFA Antimicrobial Mode of Action

Similar to their rate of metabolism, the fatty acid chain length plays a role in determining the antimicrobial mode of action. MCFA are amphipathic, having hydrophilic and hydrophobic characteristics, like the phospholipid bi-layer of the cell membrane.<sup>6</sup> Due to this similarity, they are able to insert themselves into the bi-layer of the membrane. This causes pores in the membrane to form, which disrupts the operations of the membrane and impacts cell permeability.<sup>7</sup> The pores allow for leakage of the intercellular content, which compromises the cell's integrity leading to lysis of the cell and eventual cell death.<sup>8</sup>



**Figure 2.** MCFA Mode of Action.

A growing number of research studies have demonstrated the vulnerability of feed and feed ingredients to contamination from bacterial and viral pathogens. Research conducted at Kansas State University illustrated MCFA ability to have both anti-bacterial and anti-viral characteristics against pathogens found in feed and feed ingredients.<sup>2,3</sup>

**Table 2.** Interaction of feed matrix and chemical mitigant on *Salmonella typhimurium* levels (CFU/g)<sup>2</sup>

Item	Control ( <i>Salmonella</i> +)	MCFA*	Commercial formaldehyde
Blood meal	3.28 <sup>A</sup>	0.54 <sup>GHI</sup>	0.72 <sup>GH</sup>
Feather meal	2.68 <sup>BC</sup>	0.21 <sup>I</sup>	0.32 <sup>H</sup>
Meat/bone meal	2.38 <sup>CD</sup>	0.54 <sup>GHI</sup>	0.82 <sup>G</sup>
Poultry by-product	1.90 <sup>EF</sup>	0.73 <sup>GH</sup>	0.73 <sup>GH</sup>

<sup>A-I</sup> Values in columns not sharing the same letter are significantly different ( $P \leq 0.05$ )

\*Medium chain fatty acid blend 1:1:1 caproic, caprylic, and capric acid applied at 2%.

**Table 3.** Effects of medium chain fatty acids and Sal CURB® on porcine epidemic diarrhea virus (PEDV) infectivity.<sup>3</sup>

Item	PEDV N-gene Real Time-PCR, cycle threshold (CT)						
	Feed CT	Fecal swabs					Cecum contents
		0 dpi*	2 dpi	4 dpi	6 dpi	7 dpi	7 dpi
<b>Day 1</b>							
PEDV positive	29.7	---	+++	+++	+++	+++	20.9
Sal CURB	33.0	---	---	---	---	---	> 45.0
1% MCFA**	38.3	---	---	---	---	---	> 45.0

\*Days post inoculation. \*\*Medium chain fatty acid blend 1:1:1 caproic, caprylic, and capric acid.

Serving as both an antimicrobial agent and a highly available energy source, MCFA may be an effective feed antimicrobial solution.

## References

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