Summary
Experimental studies have shown that MERA™ Cid is effective in improving growth rate and survivability and actively mediates bacterial infection in aquatic species.

MERA Cid is a special blend of organic acids for inclusion in aquaculture feeds which is able to resist the extreme temperatures under which aquatic feeds are produced. It is a micro-granulated feed acidifier based on formic acid, propionic acid, ammonium formate and ammonium propionate adsorbed to a silica carrier.

Background
The use of AGPs (antibiotic growth promoters) as an in-feed additive for the diets of fish and shrimp may promote growth and improve FCR (feed conversion ratio), as well as improve survival rates. However, public concerns on the development of bacterial resistance to the antibiotics and possibilities of human cross-resistance have led to reduction or elimination of such substances in aquaculture. Consequently, there has been an ongoing search for other additives in order to maintain performance parameters and high survival rates. Among the different additives tested, organic acids have shown to have similar effects to AGP without the risks associated with the use of antibiotics.

Organic acids are chemical compounds that contain a carboxylic group. Both individual organic acids, such as formic, propionic, or citric acid, and blends of two or more of these compounds have been used successfully in aquatic species. The inclusion of organic acids in fish and shrimp feeds results in the stabilization of the gastro-intestinal microflora and an improvement in feed hygiene by destruction of Gram-negative bacteria such as Vibrio spp. Furthermore, organic acids also improve digestion of proteins by lowering the pH-enhanced enzyme activation and acid-binding capacity in the feed.

Materials and Methods
Conducted at Kasetsart University, Thailand, in 2009 this study aimed to evaluate the effect of MERA Cid on shrimp growth performance and survival rate when the shrimp were challenged with different concentrations of the pathogenic bacteria Vibrio harveyi. In a first trial, 12-day (PL12) Pacific white shrimp (Litopenaeus vannamei) postlarvae were stocked into ten 500-L fiberglass tanks at the density of 50 PL/tank at 29°C. Shrimp in 5 tanks received feed which did not contain MERA Cid (control). The remaining 5 tanks were fed a feed containing 1 percent MERA Cid. At the end of a 60-day period shrimp fed 1 percent MERA Cid had an average body weight of 15 g, compared to 10 g for controls.

Key Findings
MERA Cid is a proprietary blend of GEMs (gut environment modifiers) designed to improve feed quality and to help optimize efficient nutrient uptake resulting in improved nutritional performance.

- MERA Cid at 1 percent inclusion rate significantly improved shrimp growth compared to controls.
- MERA Cid at 1 percent inclusion rate reduced total bacteria counts and Vibrio spp. populations in the shrimp gut.
- MERA Cid at 0.5 percent inclusion rate increased survival from 0 percent in controls to 80 percent following challenges with Vibrio harveyi at 105 CFU/mL.
significantly higher (P<0.05) than the control group (Table 1). The use of MERA Cid in this trial also significantly reduced the total bacteria and Vibrio spp. populations in the shrimp intestine (Table 2).

A second trial tested the effects of MERA Cid on mediating V. harveyi infections in Pacific white shrimp (3-4 g). The test was carried out in two treatments, control and MERA Cid 0.5%, with eight replicates per treatment. Each replicate consisted of 50 shrimp in 500-L tanks. After 7 days of acclimation, V. harveyi were added to final concentration of 10^3, 10^4 and 10^5 CFU/mL (4 tanks per treatment). Total Vibrio count at days 10, 20 and 30 (after challenging with the bacteria for the 10^3, 10^4 CFU/mL treatments) were significantly lower in the gut of shrimp fed the diet containing MERA Cid in contrast with those fed with a diet not containing MERA Cid. The treatment receiving a lethal dose of 10^5 CFU/mL V. harveyi showed 100% mortality in controls while shrimp fed with MERA Cid 0.5% had a survival rate of 80% (Table 3, Figure 1). The present study indicated that oral administration of MERA Cid can increase growth and survival of Pacific white shrimp by preventing V. harveyi in rearing conditions.

Results

TABLE 1.
Average Body Weight and Percentage Survival Rate of L. vannamei after 60 Days of Feeding Diets with 0% and 1% MERA Cid (n=100)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Body Weight (g)</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERA Cid 0% (control)</td>
<td>2.77^b</td>
<td>92.8^a</td>
</tr>
<tr>
<td>MERA Cid 1%</td>
<td>3.14^a</td>
<td>93.6^a</td>
</tr>
</tbody>
</table>

(P<0.05)

TABLE 2.
The Number of Total Bacteria and Vibrio spp. in L. vannamei Intestine after 60 Days of Feeding Diets with 0 and 1% MERA Cid (n=50)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Total Bacteria (CFU/g)</th>
<th>Number of Vibrio spp. (CFU/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERA Cid 0% (control)</td>
<td>1.52 x 10^7^</td>
<td>1.15 x 10^4</td>
</tr>
<tr>
<td>MERA Cid 1%</td>
<td>3.06 x 10^8^</td>
<td>7.74 x 10^4</td>
</tr>
</tbody>
</table>

(P<0.05)

Conclusion

MERA Cid demonstrates several benefits, including significant improvement in shrimp growth, reduction of total bacteria and Vibrio spp. counts in the gut, and increased rates of survivability of bacterial infection, such as Vibrio harveyi.

The proprietary blend of GEMs in MERA Cid is designed to improve feed quality and to help optimize efficient nutrient uptake, resulting in improved nutritional performance.