THE EFFECTS OF PROTEIN BASED SURFACE COATINGS ON WATER-SOLUBLE NUTRIENT LEACHING AND PARTICLE STABILITY OF MICROPARTICULATE DIETS

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Introduction

- Marine finfish culturists face many challenges in rearing healthy young due to nutritional deficiencies
- Microparticulate diets are commonly used during the early life stages but must be palatable, digestible, water stable, and not lose their nutrients in water (referred to as nutrient leaching)
- Poor particle stability and rapid losses of water-soluble nutrients reduce payload delivery and may foul tanks and other components of rearing systems.
- Our solution utilizes protein-based surface coatings to protect particle payloads from water thereby reducing breakdown and nutrient loss.
- This study evaluates the effectiveness of this novel coating technology at increasing particle stability and reducing water-soluble nutrient leaching
- If successful, this technology may improve nutrient delivery to larval finfish and reduced impacts on RAS filtration systems.

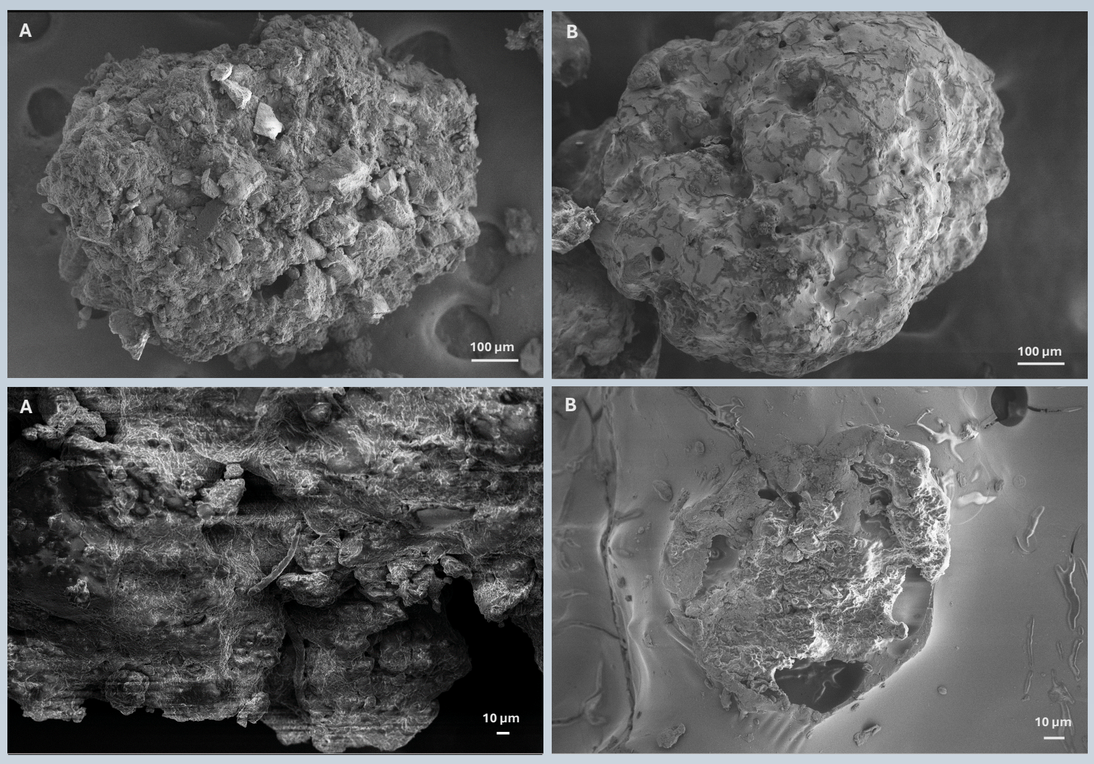

Figure 1. Images of raw and coated commercial microdiet particles taken on the NVision 40 scanning electron microscope. The upper row depicts entire microdiet particles while the lower row shows magnified cross section views of the same particles. (A) Uncoated particle at 100x (upper) and 275x (lower) magnification. (B) 5% Zein coating at 100x and 435x magnification.

Methods

- Produced commercial-type microdiets in lab, then coated them with protein-based shells using a fluidized-bed top coater
- Coated feeds were imaged using SEM (Figure 1)
- Particle stability was evaluated my measuring particle size of microparticles suspended in water over time
- Leach trials were conducted to measure the water-soluble nutrient loss (taurine and sodium fluorescein) from microparticles over time

Results

- Taurine and sodium fluorescein retention after 2 and 5 minutes of suspension was significantly higher in coated feeds when compared to uncoated feeds. After two minutes, coated diets (33.1% retention) showed nearly two times the taurine retention than the uncoated hydrolyzed casein MEM (18.1%; (Figure 2).
- The coated microdiet demonstrated significantly higher particle size retention over time than their uncoated equivalent (Figure 3). We found the mean residual particle size (%) for our coated MEM to be roughly 13 percent greater than Otohime, 26 percent greater than our uncoated intact casein MEM, and 34 percent greater than the uncoated hydrolyzed casein MEM after 15 minutes.

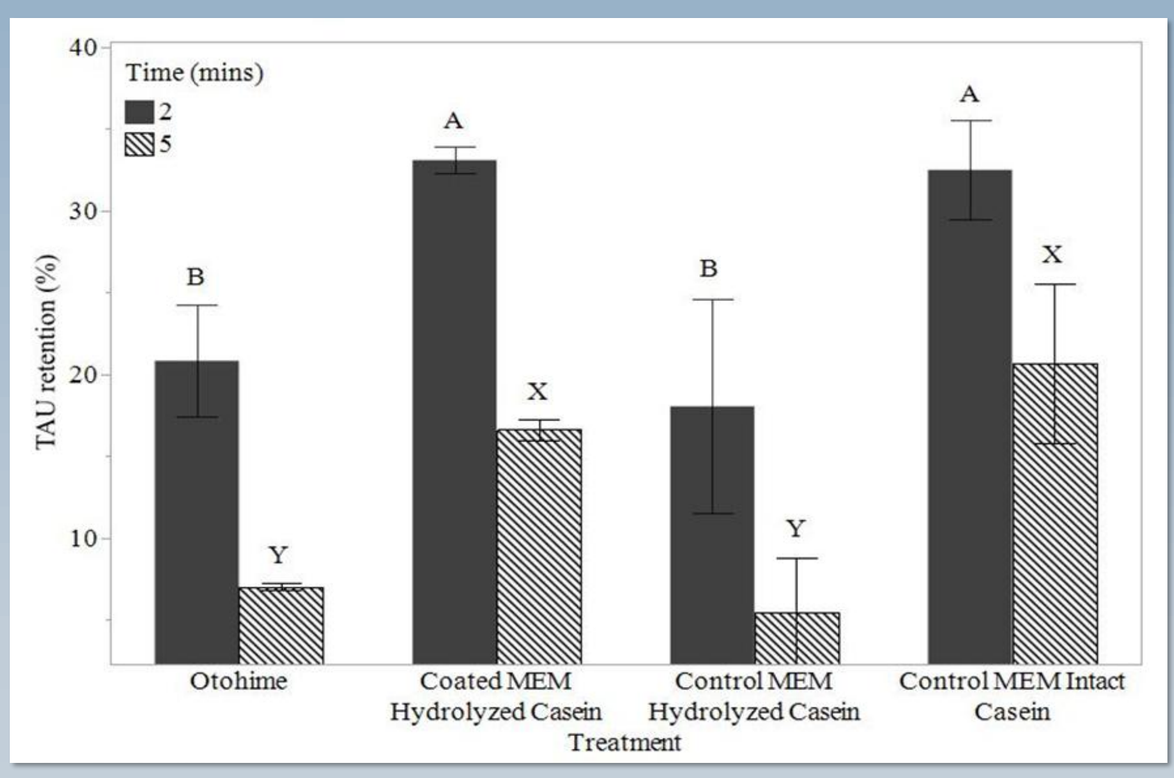

Figure 2. Taurine retention (TAU retention [%]) levels after 2 and 5 minutes of suspension. Treatments not connected by the same letter were significantly different (Tukey's HSD, significance threshold p = 0.05).

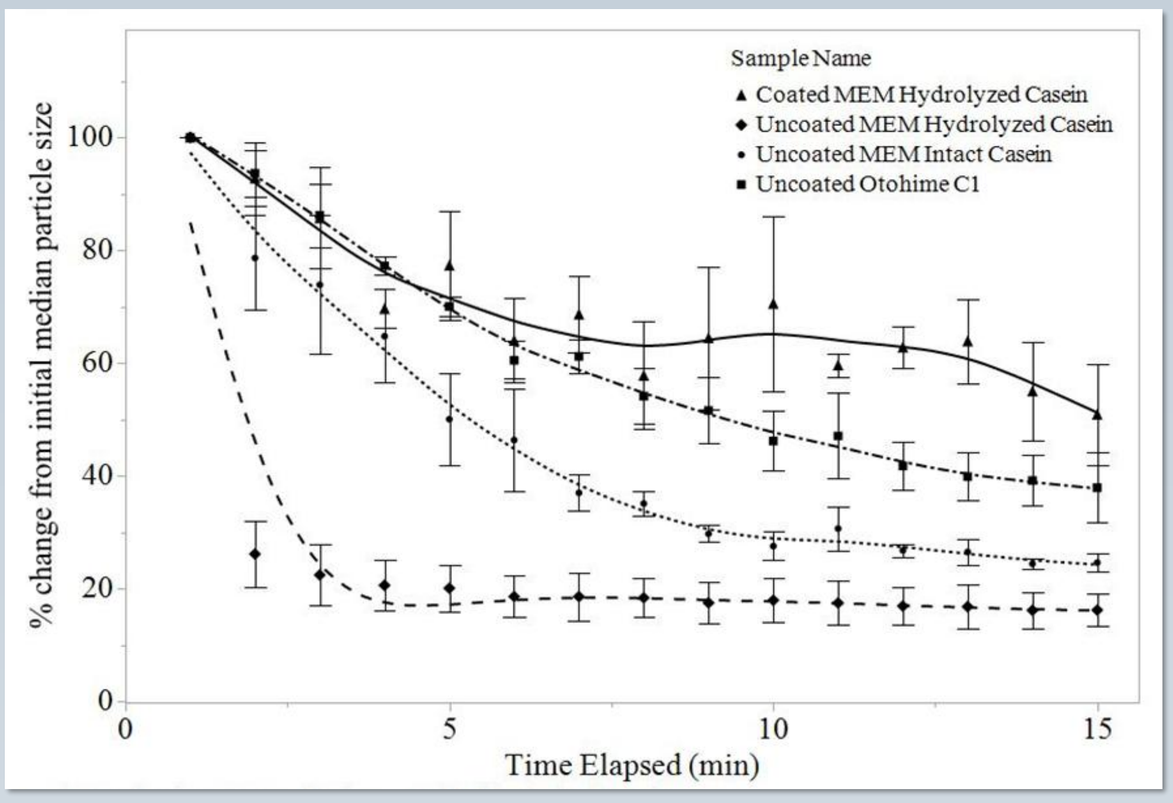

Figure 3. Percent change (mean ±1SD) from initial median particle size of experimental microparticles following suspension in water for 15 minutes.

Conclusions

- Coatings significantly reduce leaching of water-soluble nutrients
- Coatings significantly improve the structural integrity of microparticle diets
- These benefits should improve nutrient delivery and reduce filtration costs for RAS growers
- This technology is commercially viable and scalable for industry