

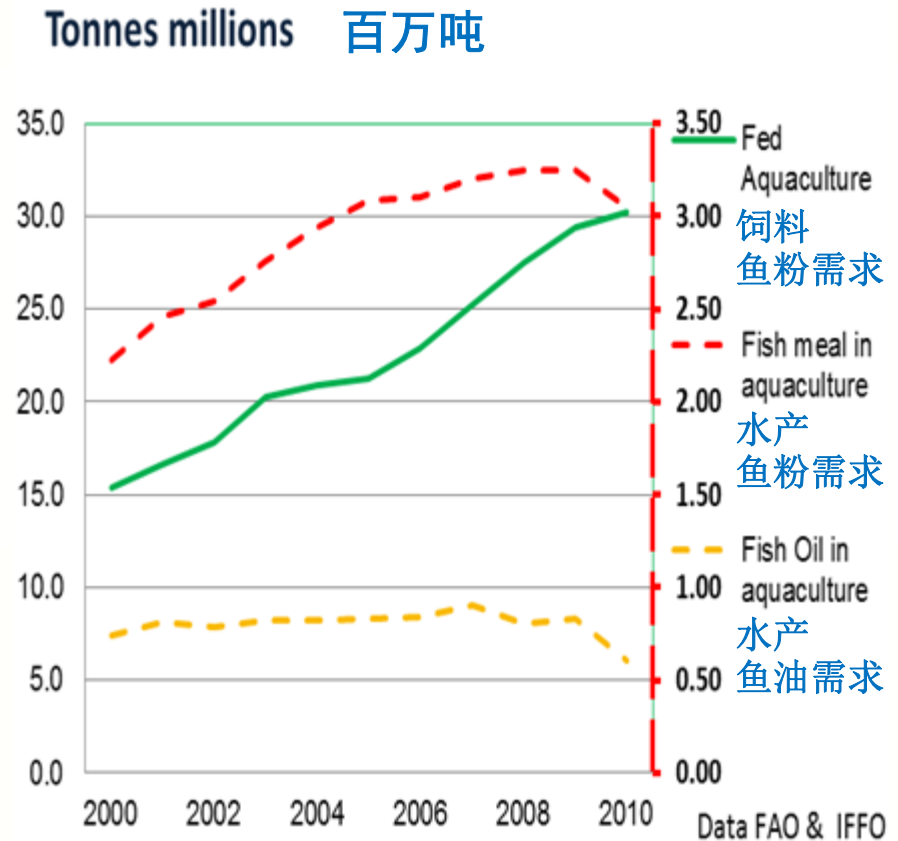


Sustainability of Fishmeal and Effective Alternative Sources Providing Health and Nutritional Benefits

G.S. Snyder, Ph. D
China Fishmeal & Fish Oil Association
Annual Conference 21-22 September, 2015
Qingdao, China

Fishmeal Supply is Flat

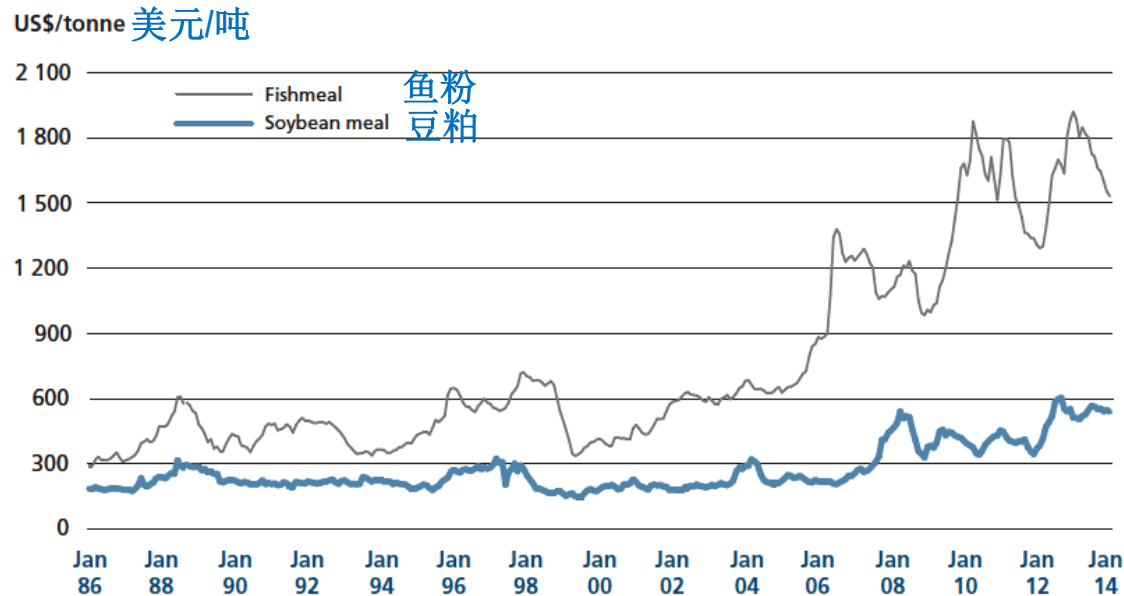
- World fishmeal supply is relatively stable at 6 MMT/year.
- Demand for fishmeal in Aquafeeds continues to escalate.
- From 2000 to 2010, aquaculture grew 97%, and it increased its consumption of the world fishmeal supply from 33% to 73%.



Fishmeal Prices Have Tripled

- Aquafeeds are outbidding other animal feeds (poultry, swine, cattle) to secure the needed fishmeal supply.

- Since 2004, fishmeal prices have risen from US \$600/MT to \$1,800/MT



Fishmeal Alternatives Are Needed

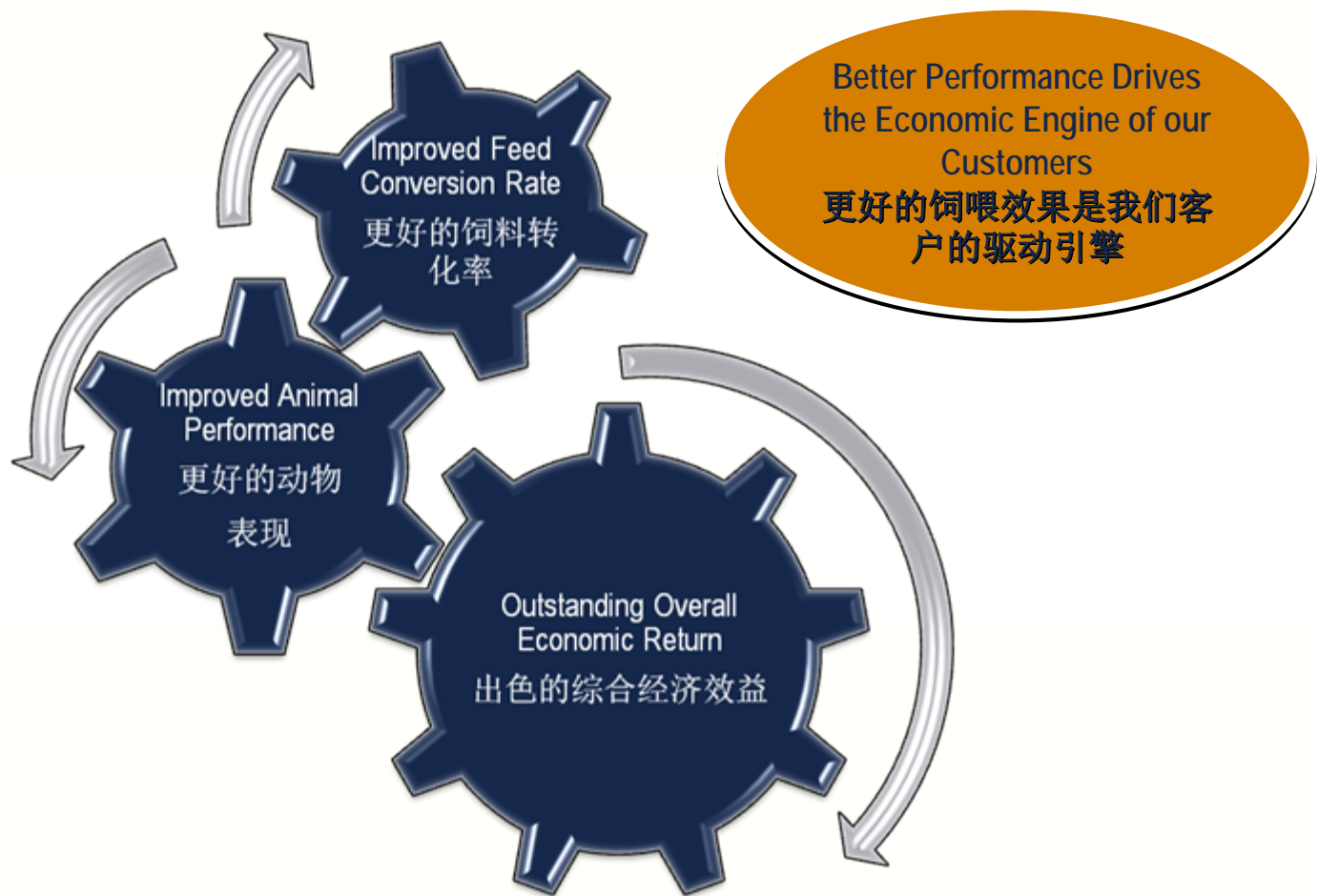
- As aquaculture continues to grow, it will outstrip the the world supply of fishmeal. Alternatives are needed.
- Additionally, public perception issues associated with concerns over wild fishery management and fishing industry labor treatment have heightened the importance of fishmeal alternatives.
- Potential protein alternatives include oil seed meals (such as soybean meal, canola meal, corn gluten meal), protein concentrates (soy protein concentrate and corn protein concentrate), rendered animal proteins (such as poultry byproduct meal, feather meal, blood meal, and meat and bone meal), and novel ingredients (such as insect meal and worm meal).

Fishmeal Is A Complex Feed Ingredient

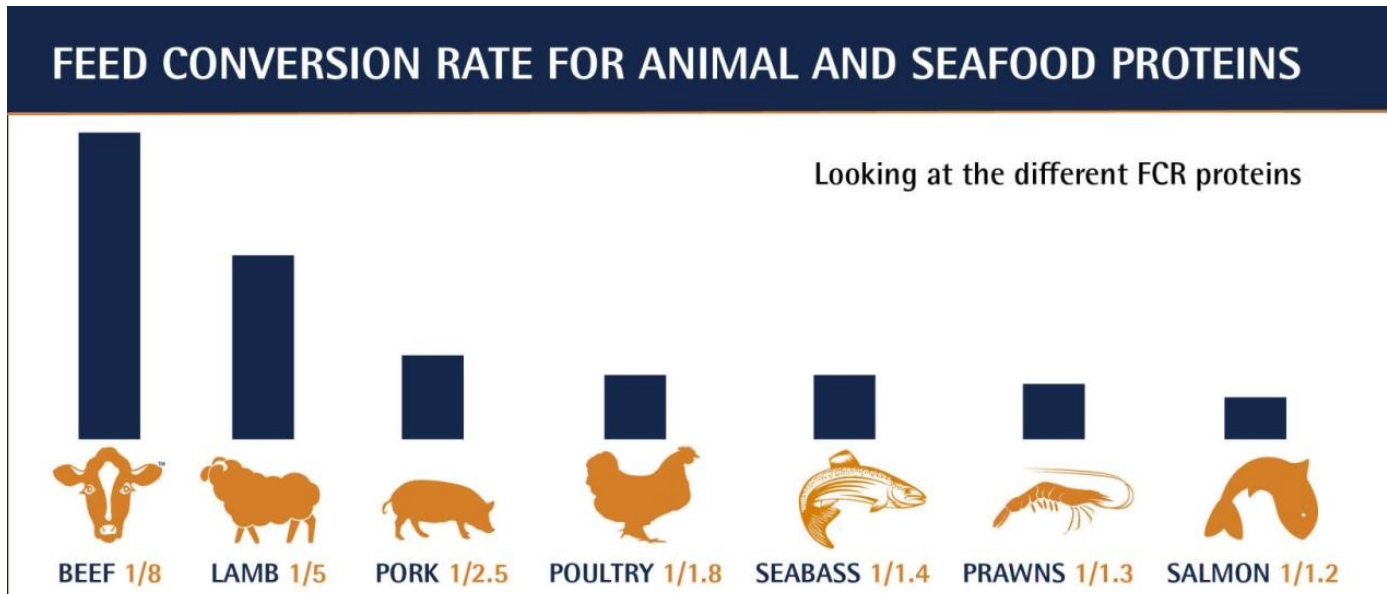
- Replacing fishmeal involves more than simply replacing crude protein.
- Fishmeal contains many nutrients
 - Balanced source of essential amino acids
 - Rich source of omega-3 polyunsaturated fatty acids
 - Phospholipids and cholesterol
 - Vitamins and trace minerals
 - Phosphorus
 - Attractants such as free amino acids, nucleotides, and quaternary ammonium compounds
 - Bioactive compounds such as testosterone and other hormones and growth promoters



*165 years of innovation to help
our customers feed the world*



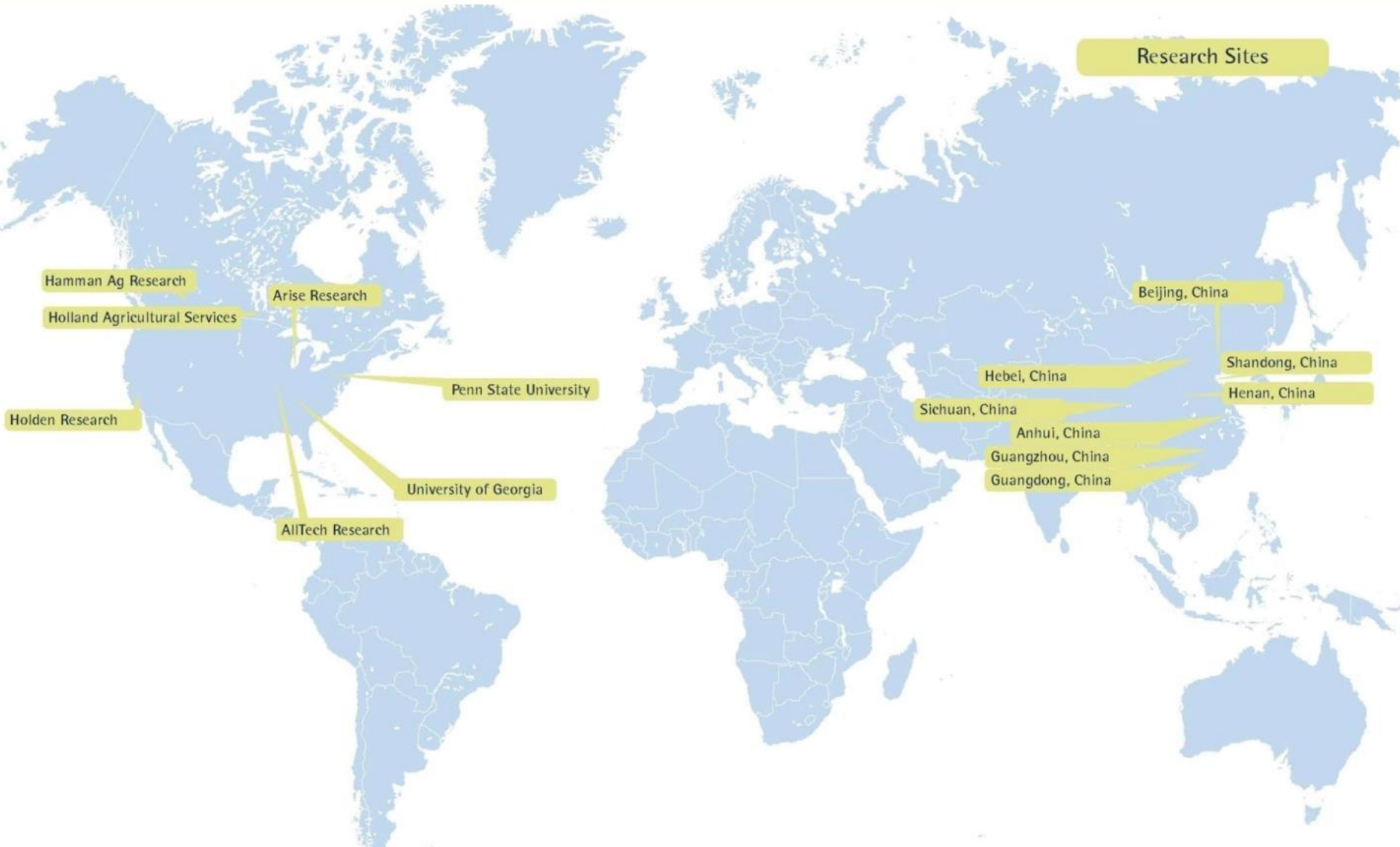
Feed conversion rates measure performance efficiency and returns on investment. H.J. Baker's highly sophisticated, safe, and efficient products provide an outstanding economic return.



Strategic Partnerships



Investing in Customer Needs: Research



DAIRY 奶牛



MetaboLys®
MetaboMet®
PRO-LAK®
PRO-LAK® Custom

Maximize Milk
Production
Improve
Components

POULTRY 禽类



PRO-PLUS®
PRO-PAK® Poultry
Triple A

Enhance Meat
Quality

AQUA 水产



AQUA-PAK®
PRO-CISION®

Health Through
Nutrition
Functional
Feeds
Sustainable
Practices

SWINE 猪



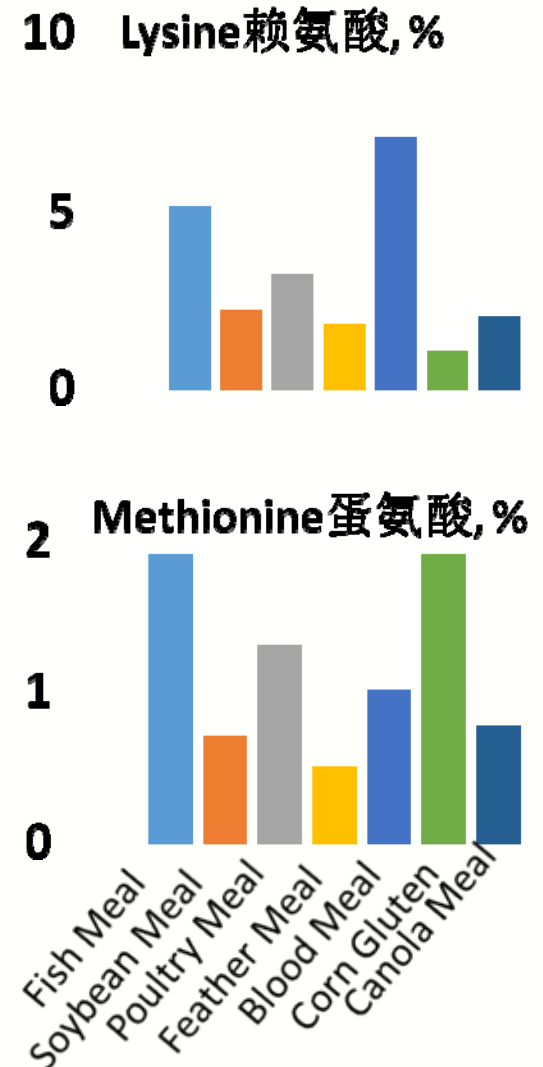
PRO-PAK® Swine

Enhance Meat
Quality

**Food safety, consistent quality, and increased
return on investment.**

Blending To Reduce Deficiencies

- Alternate proteins to reduce or replace fish meal vary in nutrient composition and digestibility.
- A combination can better match the nutrient requirements of the target species
- Proteins are comprised of 20 amino acids of which 10 are essential in the diet
- Fishmeal is rich in the essential amino acids, lysine and methionine, which are deficient in many alternate proteins.
 - Blood meal is rich in lysine, but deficient in methionine.
 - Corn protein is rich in methionine, but deficient in other amino acids.

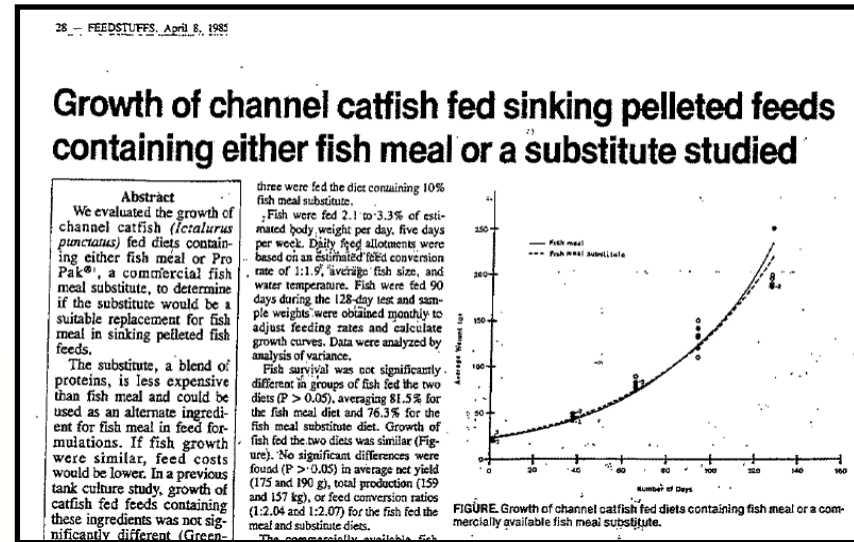


Historical Performance

Fish Farming Experimental Station, USA, 1985

I. *Punctatus*

- 100% Fishmeal Replacement.
- Significant Cost Reduction.

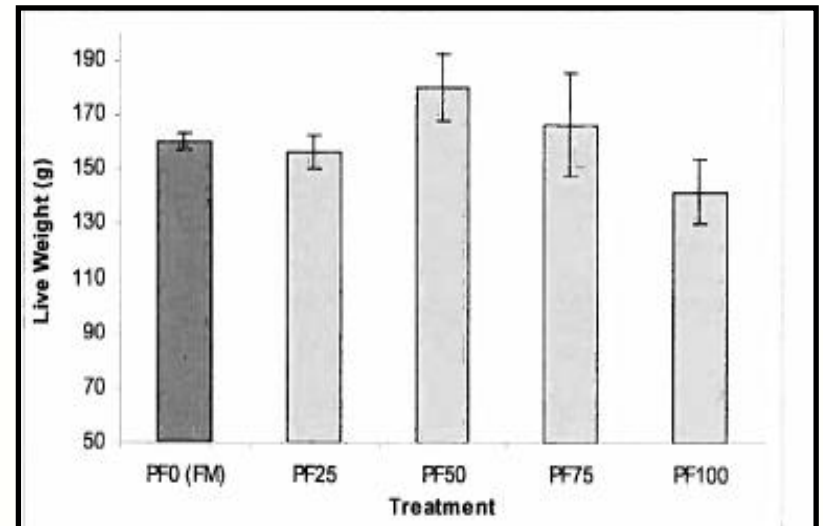


Historical Performance

Can Tho University, Viet Nam, 2007

P. Hypophthalmus

- 100% Fishmeal Replacement With No Performance Reduction.
- FM-PRO-PAK® Combination Improved Performance.



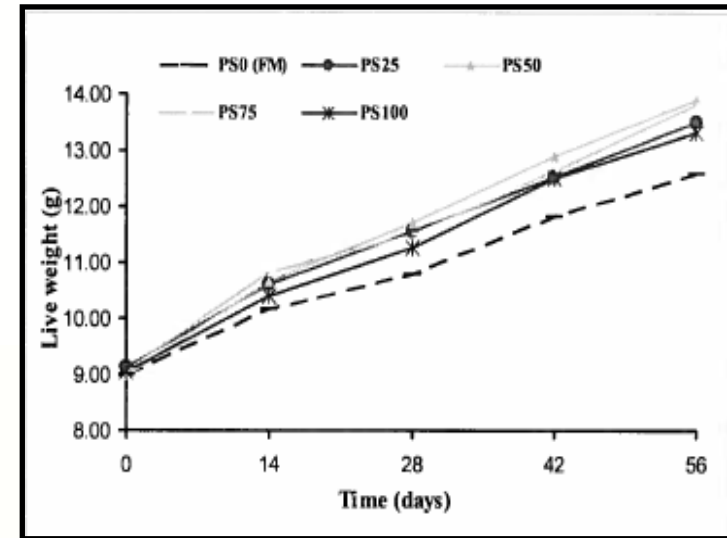
Historical Performance

历史实验数据

Can Tho University, Viet Nam, 2007

P. Monodon

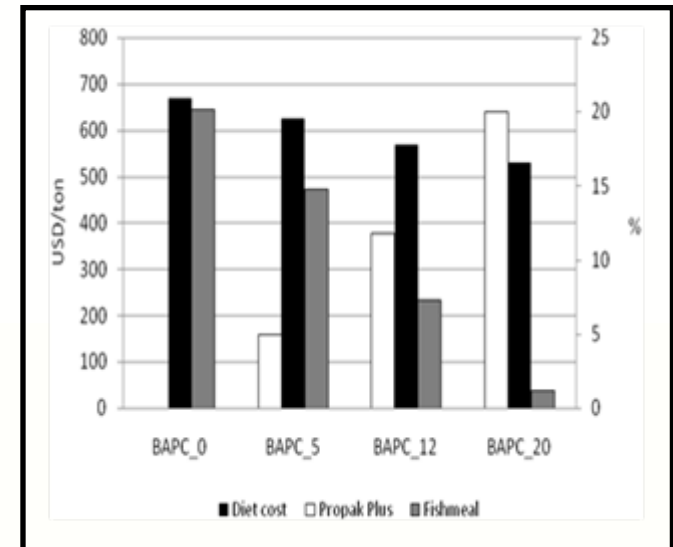
- **100% Fishmeal Replacement With No Performance Reduction.**
- **FM-PRO-PAK[®] Combination Improved Performance.**



LABOMAR Brazil, 2007

L. Vannamei

- 100% Fishmeal Replacement With No Performance Reduction.
- 5-10% PRO-PAK[®] Inclusion Allowed 30-50% Fishmeal Reduction in Formulation.





AQUA-PAK® PRO-CISION™ was developed to address many of the issues associated with fishmeal replacement.

AQUA-PAK® PRO-CISION™ includes a variety of nutritional components to compensate for those normally provided by fishmeal.

Ongoing research is illustrating that AQUA-PAK® PRO-CISION™ can effectively replace most or all of fishmeal in shrimp diets.



- **AQUA-PAK® PRO-CISION™ includes:**
 - Highly digestible protein sources
 - High fat/lipid levels
 - Protected amino acids (lysine, methionine, threonine) to reduce leaching/loss from shrimp diets.
 - Added components for reduction of Early Mortality Syndrome (EMS) in shrimp.
 - Attractants to increase the ability of shrimp to locate feed pellets.



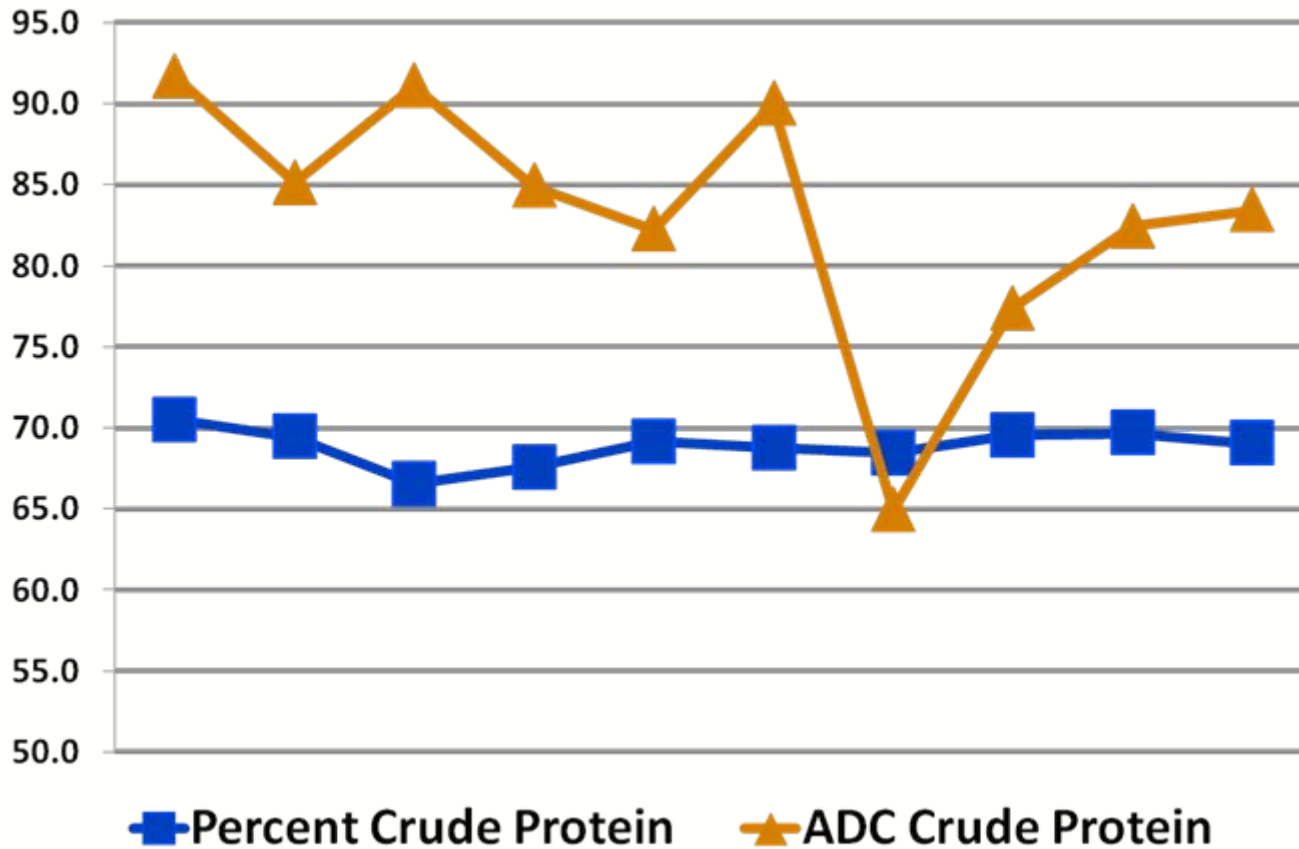
- AQUA-PAK® PRO-CISION™ is an effective replacement for fishmeal in shrimp and other aqua species diets.
- AQUA-PAK® PRO-CISION™ is very consistent with exceptional quality control applied to the formulation and manufacturing process.
- AQUA-PAK® PRO-CISION™ is precision formulated to ensure optimal efficiency and performance.

A significant problem with fishmeal is consistency. Sources of fishmeal within the market can vary greatly and this leads to variation in shrimp performance.

- Variation in fishmeal includes:

- Nutrient content and digestibility
- Contaminants
- Presence of pathogens (salmonella, e. coli, etc.)
- Overall physical appearance and olfactory variation.

Fishmeal Inconsistency



Nutrient Comparison – Fishmeal (typical) and AquaPak (actual)



Nutrient	Fishmeal	
Dry Matter (%)	92.0	96.0
Crude Protein(%)	62-64	70.0
Crude Fat (%)	9.0	10.5
Crude Fiber(%)	1.0	1.6
Ash (%)	19.5	10.25
Calcium (%)	4–5	2.95
Phosphorus (%)	2.5	1.6
Lysine (%)	5.0	8.2
Methionine (%)	2.2	1.8
Threonine (%)	2.7	3.0



Trials



Trial with Pacific White Shrimp *Litopenaeus vannamei*

Trial Details

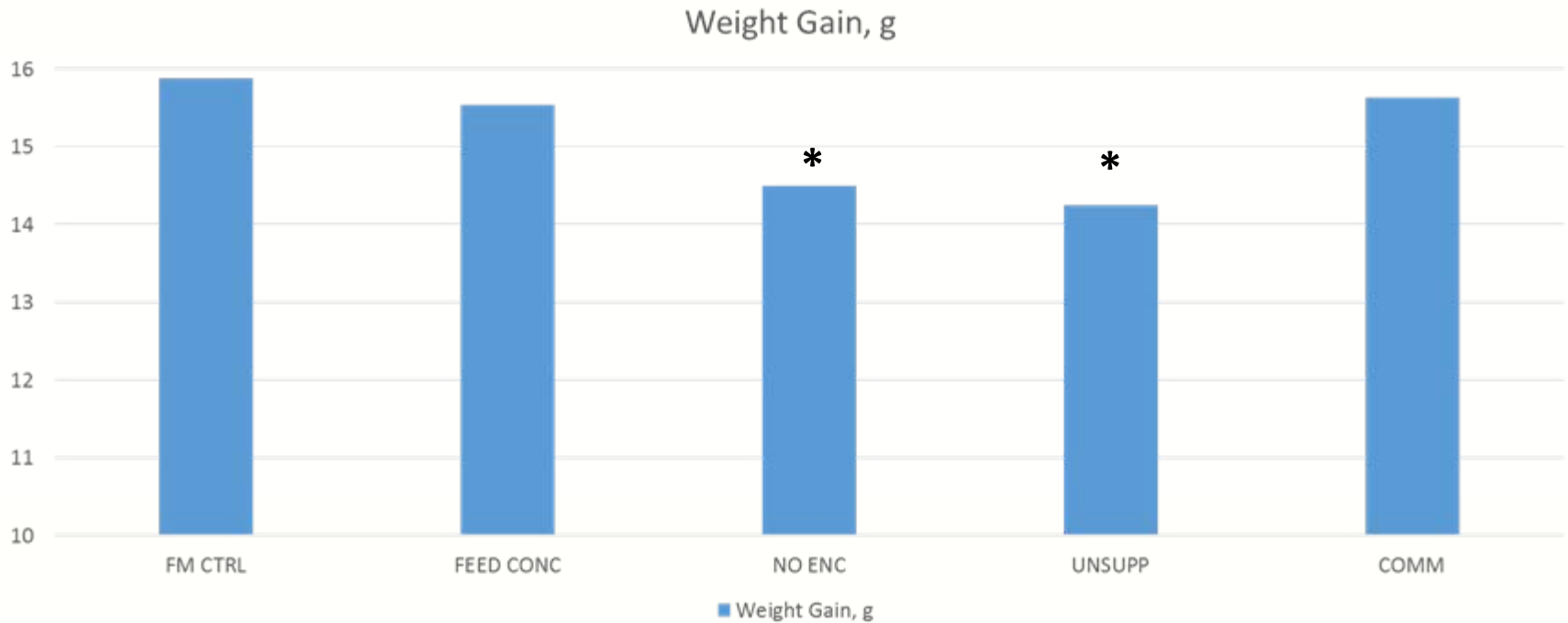
- Conducted at iAqua Shrimp Nutrition facility in Kauai
- 6 week trial
- Water Temp – 27 °C
- 37% CP, 4.5% Fat Diets; Commercial Diet similar composition; diets formulated to meet nutritional requirements of species
- Diets consisted of fishmeal, soybean meal and wheat as primary protein sources in the control; fishmeal was replaced by feed concentrate in treatment diets
- Feed Concentrate (AQUA-PAK® PRO-CISION™) consisted of Poultry Meal (petfood grade), Poultry (Avian) Blood Meal; Hydrolyzed feather meal and protected amino acid premix

Trial Diets - 实验方案

Diets	
FM CTRL	Fish Meal Control; 25% Fish Meal
FEED CONC	Fish Meal Free; Protein Concentrate with encapsulated premix
NO ENC	Fish Meal Free; Protein Concentrate – non-encapsulated premix
UNSUPP	Fish Meal Free; Protein Concentrate – unsupplemented – no premix
COMM	Commercial shrimp feed

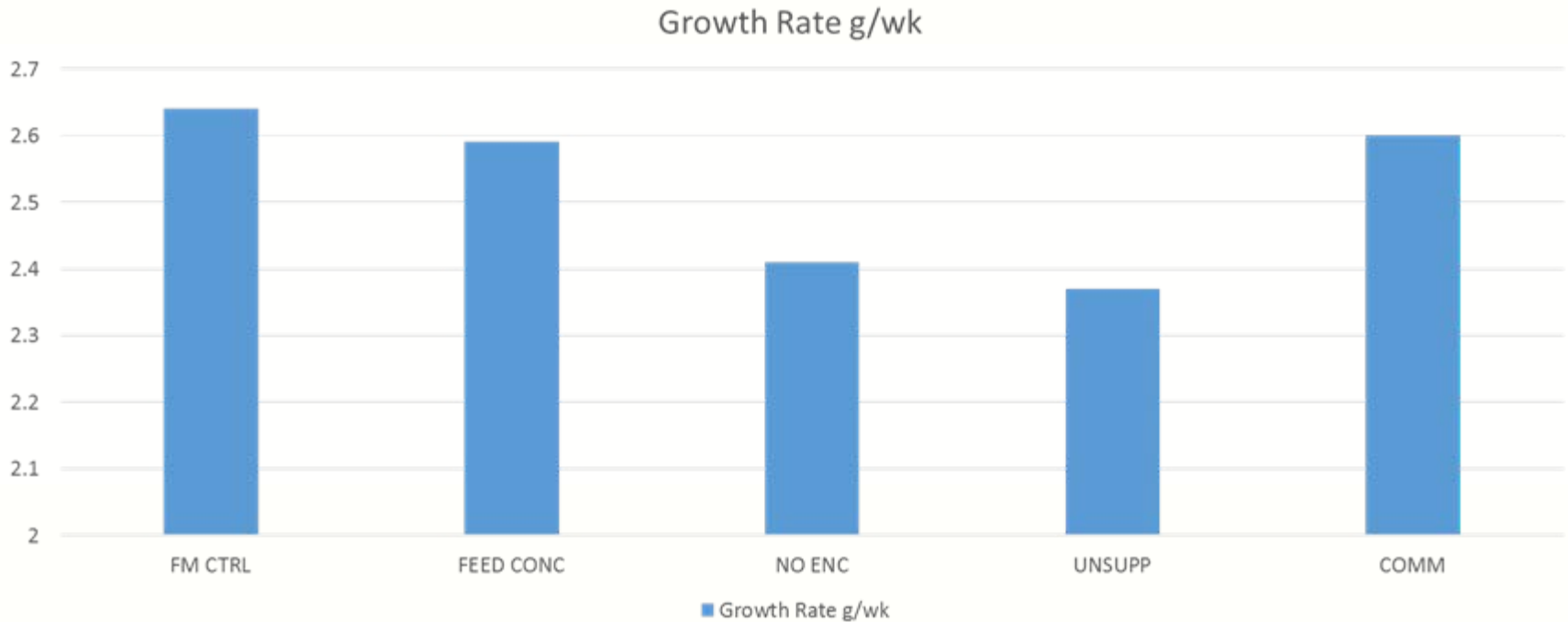
处理	
FM CTRL 鱼粉对照	鱼粉对照组：25%鱼粉
FEED CONC 浓缩蛋白料	不含鱼粉；浓缩蛋白料，加包被预混氨基酸
NO ENC 非包被	不含鱼粉；浓缩蛋白料，加未包被预混氨基酸
UNSUPP 不添加氨基酸	不含鱼粉；浓缩蛋白料，不加预混氨基酸
COMM 商业虾饲料对照	普通商业虾饲料

Results – Weight Gain



- Significant $p < 0.05$, Duncan's Test

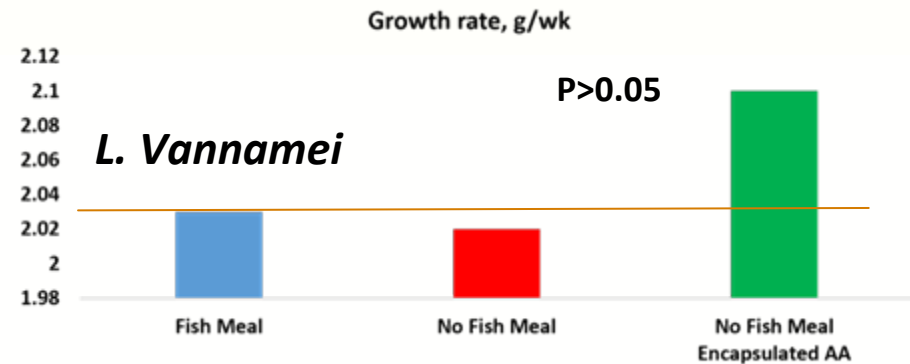
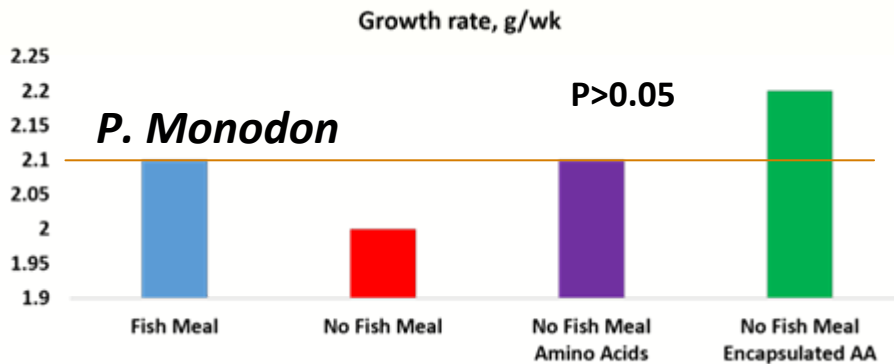
Results – Growth Rate





Trial Summary with Black Tiger Shrimp *Penaeus monodon* and Pacific White Shrimp *L. vannamei*

Improved Performance in Low Fishmeal Diets



N=5; 8 week trials; Microcosm Tanks; Green Water

- Supplementation of amino acids to low fishmeal or fish meal free diets improves performance
- Supplementation with encapsulated amino acids further improves performance

Trial Summary Comments

- In the trials shown the AQUA-PAK[®] PRO-CISION[™] treatments either equaled or surpassed the performance of shrimp on diets including fishmeal at full or partial inclusion rates.
- Additional trials are planned to further investigate these effects on a larger scale.



- Fishmeal is insufficient in supply to meet the needs of the rapidly growing aquaculture feed sector. Alternatives are needed to extend the fishmeal supply.
- Many alternative protein and lipid sources are available, but each is rich in certain nutrients and deficient in others.
- Effective substitution of fish meal in dietary formulations requires a multi-faceted approach. AQUA-PAK® PRO-CISION™ provides digestible nutrient requirements, reduced leaching losses, attractants, and health additives.
- HJ Baker has a 50-year history of offering feed concentrates for animal production and is looking forward to continued evolution of feed concentrate products for aquaculture.



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