

# Evaluation of Corn Dried Distillers Grains with Solubles (DDGS) as a Potential Alternative Ingredient for Shrimp Feeds

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**Addison L. Lawrence, Susmita Patnaik,  
Benjamart Pratoomthai, Kip Karges**

**Texas AgriLife Research Mariculture Laboratory  
Texas A&M System, 1300 Port Street, Port Aransas, Texas 78373  
POET Nutrition, 4506 N. Lewis Ave, Sioux Falls, South Dakota 57104**

# From Texas A&M University

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**HOWDY!!!!!!!!!!!!**





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A large, modern, tan-colored brick building with two white chimneys on the roof. The building is surrounded by landscaping including palm trees, small plants, and a red mulch bed. A sign in the foreground provides details about the facility.

**Texas AgriLife Research  
Mariculture Laboratory  
at Port Aransas**

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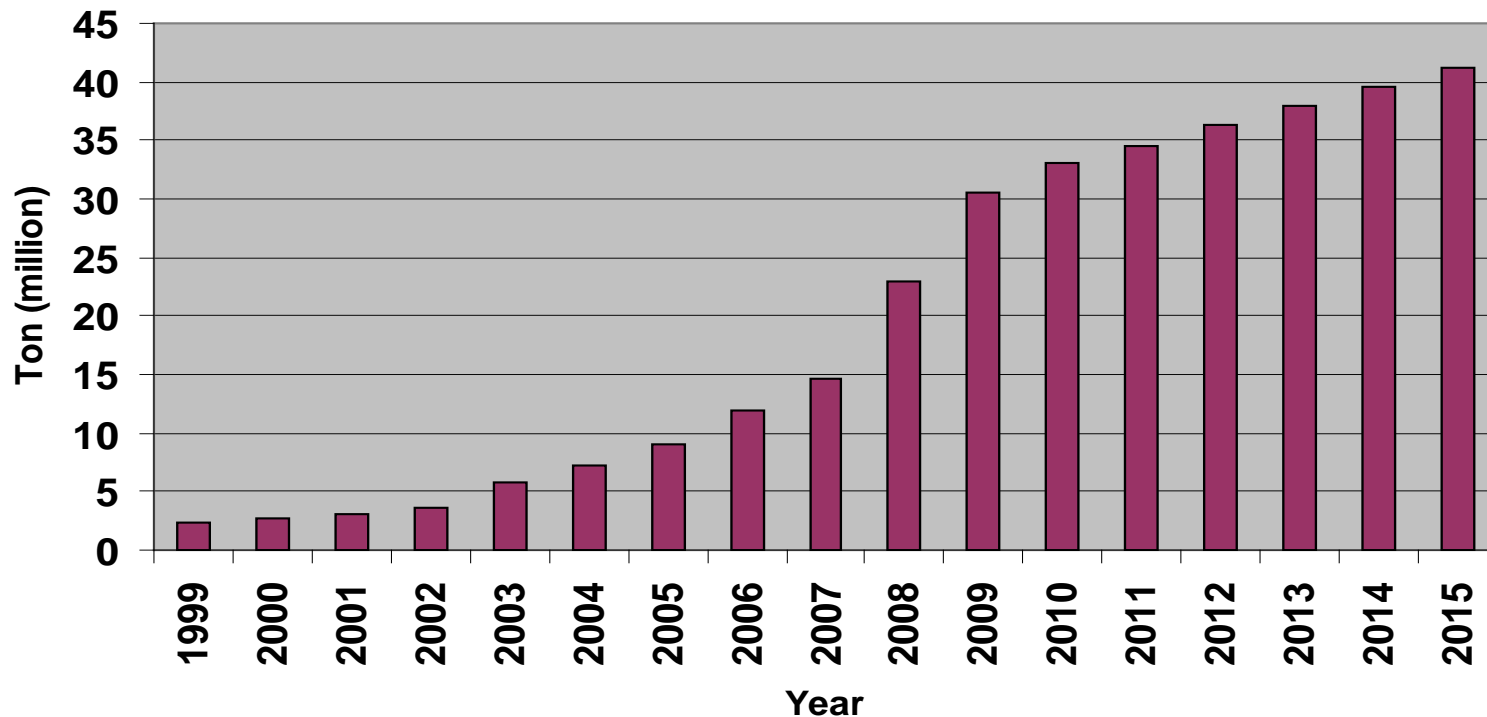
# Alternative Feed Ingredient Program

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- **Grain ingredients (e.g. dehulled defatted soybean meal, canola, lupin, pea meals, etc.)**
- **Grain concentrates (e.g. soybean concentrate, wheat gluten, corn gluten, etc.)**
- **Animal meals (e.g. poultry by-products, blood meal, meat and bone meal)**
- **Dried distiller grain with solubles (DDGS) by-product from brewery and biofuel industries**
- **Biofloc from aquaculture waste made by SBR's and MBR's**
- **Seafood processing by-products co-extruded with grain ingredients (e.g. soybean meal)**
- **Algae co-products (defatted algae)**

- **Distiller's Dried Grains with Solubles (DDGS) is a co-product produced in dry grind ethanol plants along with ethanol and carbon dioxide**
- **Global production of ethanol as car fuel and**
- **Co-products have increased rapidly in U.S. DDGS production is >33 million tons in 2010**

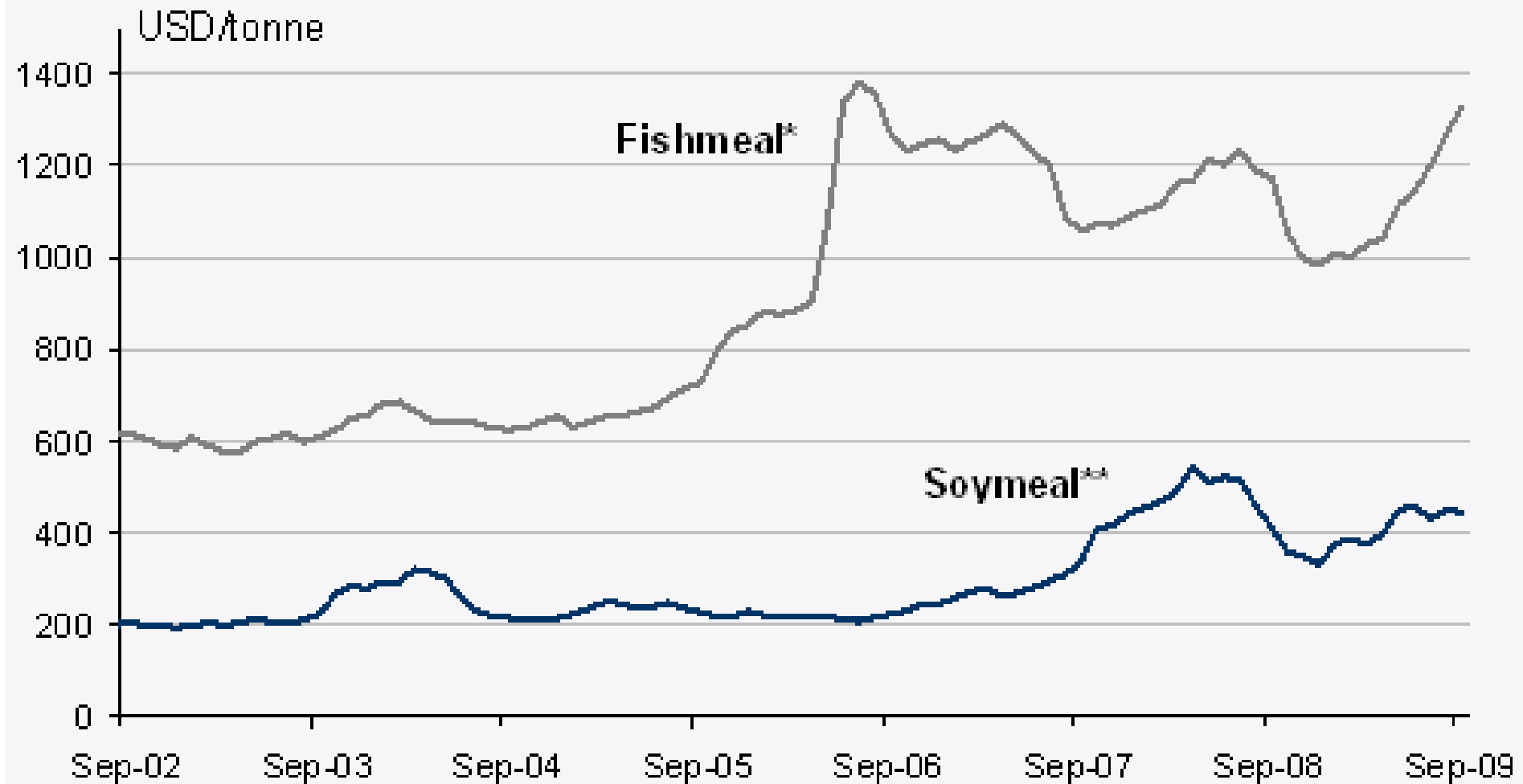
## U.S. Distillers Grain production





# Fish and Soybean Meals Prices

## Fishmeal and soymeal prices



# OBJECTIVE

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To evaluate the potential of using Corn Dried Distiller's Grain with Soluble (DDGS) as a potential alternative ingredient in feeds for the Pacific White Shrimp, *Litopenaeus vannamei*

DDGS type based on processing method

1. Standard
2. Dakota Gold BPX
3. Dakota Gold HP

Experimental approach: replacement of soybean isolated protein with DDGS on a protein bases



# METHODS

- **Recirculating indoor system (52.4 turns/tk/day) with 148%/day new filtered (0.5 $\mu$ ) sea water from Corpus Christi ship channel**
- **0.1 m<sup>2</sup> tanks,**
- **20 cm water depth**
- **Salinity: 31-38 ppt**
- **Temperature: 30 $\pm$ 1 $^{\circ}$ C**
- **Fed to slightly above satiation 15 times/day**
- **60 shrimp/m<sup>2</sup>(300/m<sup>3</sup>)**
- **Initial stocking size: 0.315  $\pm$  0.12 gms**
- **Randomized block design**



# METHODS

- **Trial duration: 42 days**
- **Mash cold extruded at through dye on 3 mm meat chopper**
- **Feed crumbled to approximately 2.5 to 3.0 mm diameter**
- **Feed dried to 8% moisture**
- **Initial density: 60/m<sup>2</sup> or 300/m<sup>2</sup>**
- **All water quality parameters within desired range and not limiting**
- **Uneaten molts, feces, feed removed daily**
- **Statistics: one way ANOVA, *post-hoc* Turkey's HSD**





# Diet Formulation (g/100g)

Name	Base	Standard	Gold BPX	Gold HP
Ca Carbonate	2.60	2.90	3.00	2.50
Cellulose	2.40	0.70	0.50	0.20
Standard GGS		25.0		
Dakota Gold BPX			25.0	
Dakota Gold HP				25.0
Diatomaceous Earth	1.40	1.20	1.30	1.20
KCl	2.00	1.60	1.40	1.80
MgO	1.40	1.30	1.20	1.40
NaCl	0.20	0.30	0.30	0.30
Oil, Soybean	2.70	0.60	0.00	1.70
CaHPO <sub>4</sub>	2.30	1.80	1.60	2.30
Soybean 90%	19.7	12.5	11.8	8.1
Wheat Starch	32.7	19.5	21.3	22.9

All diets contained 0.5% vitamin/mineral premix, 1% NaHexametaPO<sub>4</sub>, 2% alginate, 5% poultry by-product, 15% menhaden fish meal, 0.1% L-methionine, 0.4% menhaden fish oil, 2.4% phospholipid, 6% squid meal, 0.2% cholesterol, 1% chromic oxide

# Determined Nutrient Profile of Diets with Standard DDGS

Nutrient	Base	Standard DDGS diets (%)				
Dry Wt Bases	0	5	10	15	20	25
Dry Matter (%)	91.5	92.0	92.5	92.2	92.0	91.7
Crude Protein(%)	36.8	37.5	38.3	37.2	37.6	37.0
Crude Fat (%)	8.62	8.49	8.34	8.65	8.66	9.22
Crude Fiber (%)	1.98	1.97	2.44	2.60	2.98	1.55
Ash (%)	16.1	15.8	15.9	16.0	15.9	15.9
Phosphorus (%)	1.79	1.81	1.83	1.80	1.85	1.89
Potassium (%)	1.27	1.32	1.34	1.32	1.35	1.35
Magnesium (%)	0.83	0.86	0.88	0.87	0.90	0.90
Calcium (%)	2.87	2.99	3.00	2.94	2.98	3.07
Sodium (%)	0.89	0.91	0.93	0.91	0.93	0.92
Iron (ppm)	203	204	213	210	213	216
Manganese (ppm)	34.0	35.0	35.0	36.0	35.0	36.0
Copper (ppm)	59.0	40.0	47.0	44.0	36.0	41.0
Zinc (ppm)	154	158	162	164	171	176



# Determined Nutrient Profile of diets with Dakota Gold BPX

Nutrient (dry wt basis)	Base	Dakota Gold BPX Diets (%)				
	0	5	10	15	20	25
Dry Matter (%)	91.5	91.8	92.3	91.9	92.1	92.2
Crude Protein (%)	36.8	37.1	37.4	36.4	36.8	37.4
Crude Fat (%)	8.62	8.56	8.69	9.04	9.01	8.65
Crude Fiber (%)	1.98	2.51	3.25	3.56	1.76	3.82
Ash (%)	16.1	16.0	15.9	16.1	15.7	15.6
Phosphorus (%)	1.79	1.81	1.82	1.86	1.79	1.79
Potassium (%)	1.27	1.31	1.31	1.33	1.24	1.26
Magnesium (%)	0.83	0.85	0.87	0.88	0.82	0.83
Calcium (%)	2.87	2.99	2.97	2.97	2.94	2.93
Sodium (%)	0.89	0.92	0.92	0.94	0.87	0.88
Iron (ppm)	203	201	210	214	202	206
Manganese (ppm)	34.0	33.0	34.0	35.0	34.0	35.0
Copper (ppm)	59.0	48.0	53.0	41.0	40.0	40.0
Zinc (ppm)	154	156	158	164	158	164

# Determined Nutrient Profile of diets with Dakota Gold HP

Nutrient	Dakota Gold HP Diets (%)					
	0	5	10	15	20	25
(dry wt basis)						
Dry Matter (%)	91.5	91.5	91.4	91.5	91.5	91.6
Crude Protein (%)	36.8	37.2	37.5	37.0	37.1	36.9
Crude Fat (%)	8.62	8.45	8.63	8.81	8.74	8.77
Crude Fiber (%)	1.98	2.25	2.27	3.45	3.80	3.30
Ash (%)	16.1	15.8	16.2	16.5	15.8	16.2
Phosphorus (%)	1.79	1.81	1.91	1.86	1.87	1.91
Potassium (%)	1.27	1.31	1.31	1.29	1.35	1.29
Magnesium (%)	0.83	0.87	0.9	0.89	0.92	0.92
Calcium (%)	2.87	2.98	3.11	3.02	3.02	3.07
Sodium (%)	0.89	0.92	0.91	0.88	0.9	0.84
Iron (ppm)	203	200	206	211	210	210
Manganese (ppm)	34	33	34	35	34	34
Copper (ppm)	59	42	43	40	38	41
Zinc (ppm)	154	160	165	170	179	179

# Determined Essential Amino Acid Profile for Diets

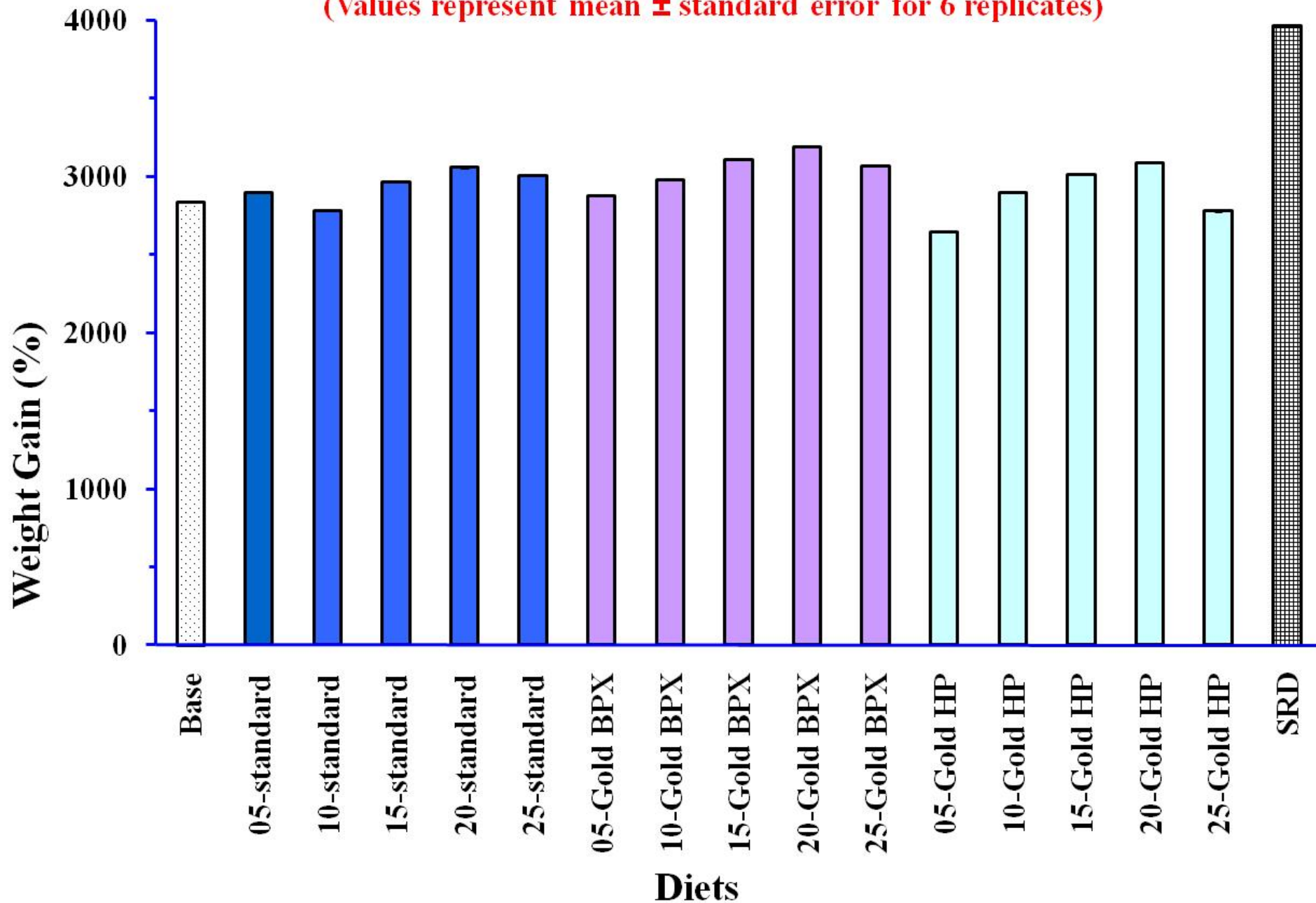
(values in % on an "as fed" bases)

Amino Acid	Base	Standard DDGS diets					Dakota Gold BPX Diets					Dakota Gold HP Diets				
		0	5	10	15	20	25	5	10	15	20	25	5	10	15	20
Arginine	3.2	2.3	2.3	2.1	2.3	2.7	2.2	2.3	2.0	1.8	2.0	2.2	1.7	2.1	1.8	1.8
Cystine	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3
Histidine	1.3	1.0	1.1	1.2	1.2	1.0	0.8	0.9	1.1	1.6	1.0	1.4	1.0	1.0	0.9	1.2
Isoleucine	1.8	1.6	1.6	1.8	1.6	1.8	1.8	1.8	1.7	1.6	1.7	1.7	1.5	1.4	1.6	1.5
Leucine	2.9	2.7	3.0	3.0	3.1	3.1	3.0	3.3	3.0	2.7	2.9	2.9	2.9	2.9	3.0	2.9
Lysine	2.8	2.5	2.8	2.4	2.4	2.3	2.4	2.6	2.6	2.5	2.3	2.4	2.3	2.0	2.0	2.0
Methionine	0.7	0.7	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.7
Phenylalanine	1.9	1.8	2.0	1.8	1.8	1.9	1.9	2.0	1.7	1.8	1.9	1.7	1.7	1.8	1.9	1.6
Threonine	2.0	1.5	1.6	1.6	1.8	1.9	1.5	1.6	1.6	1.4	1.6	1.5	1.7	1.4	1.4	1.3
Tyrosine	1.3	1.5	1.4	1.5	1.4	1.7	1.3	1.6	1.4	1.5	1.5	1.3	1.3	1.2	1.2	1.2
Tryptophan	0.4	0.5	0.3	0.4	0.4	0.3	0.4	0.4	0.5	0.3	0.3	0.4	0.5	0.3	0.4	0.3
Valine	2.2	1.9	2.1	2.1	2.0	1.9	2.3	2.6	2.1	1.9	1.8	1.7	1.8	2.0	2.0	2.0



# Corn DDGS levels vs *L. vannamei* Percent Weight gain

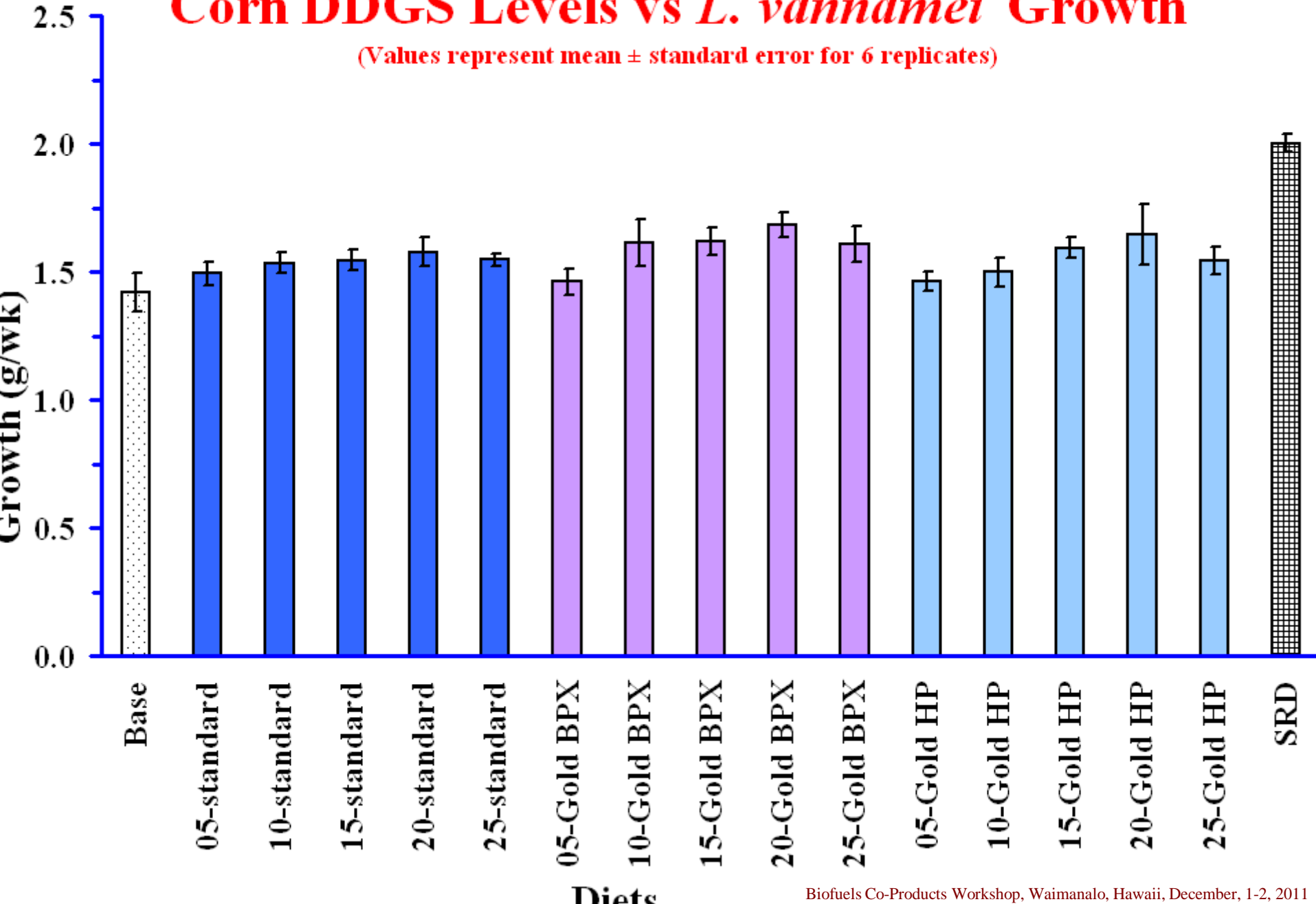
(Values represent mean  $\pm$  standard error for 6 replicates)





# Corn DDGS Levels vs *L. vannamei* Growth

(Values represent mean  $\pm$  standard error for 6 replicates)



**Survival, Final Weight, Growth Rate, Weight Gain and FCR of  
*Litopenaeus vannamei* in a 42-day trial (initial weight: 0.315 ± 0.12)**

Diet	DDGS Level	Survival (%)	Final Wt (g)	Gth Rate (g/wk)	Wt Gain (%)	FCR
Base	0	91 <sup>a</sup>	8.8 <sup>a</sup>	1.42 <sup>a</sup>	2838	2.08 <sup>a</sup>
Standard DDGS	5	100 <sup>a</sup>	9.3 <sup>a</sup>	1.49 <sup>a</sup>	2899	1.77 <sup>b</sup>
Standard DDGS	10	100 <sup>a</sup>	9.5 <sup>a</sup>	1.53 <sup>a</sup>	2784	1.72 <sup>b</sup>
Standard DDGS	15	100 <sup>a</sup>	9.6 <sup>a</sup>	1.54 <sup>a</sup>	2962	1.71 <sup>b</sup>
Standard DDGS	20	97 <sup>a</sup>	9.8 <sup>a</sup>	1.58 <sup>a</sup>	3060	1.73 <sup>b</sup>
Standard DDGS	25	97 <sup>a</sup>	9.6 <sup>a</sup>	1.55 <sup>a</sup>	3003	1.76 <sup>b</sup>
Dakota Gold BPX	5	97 <sup>a</sup>	9.1 <sup>a</sup>	1.46 <sup>a</sup>	2873	1.87 <sup>b</sup>
Dakota Gold BPX	10	93 <sup>a</sup>	10.0 <sup>a</sup>	1.60 <sup>a</sup>	2977	1.78 <sup>b</sup>
Dakota Gold BPX	15	100 <sup>a</sup>	10.0 <sup>a</sup>	1.62 <sup>a</sup>	3111	1.64 <sup>b</sup>
Dakota Gold BPX	20	96 <sup>a</sup>	10.4 <sup>a</sup>	1.68 <sup>a</sup>	3187	1.63 <sup>b</sup>
Dakota Gold BPX	25	100 <sup>a</sup>	9.9 <sup>a</sup>	1.61 <sup>a</sup>	3066	1.65 <sup>b</sup>
Dakota Gold HP	5	100 <sup>a</sup>	9.1 <sup>a</sup>	1.46 <sup>a</sup>	2646	1.81 <sup>b</sup>
Dakota Gold HP	10	100 <sup>a</sup>	9.3 <sup>a</sup>	1.50 <sup>a</sup>	2894	1.77 <sup>b</sup>
Dakota Gold HP	15	100 <sup>a</sup>	9.9 <sup>a</sup>	1.59 <sup>a</sup>	3016	1.66 <sup>b</sup>
Dakota Gold HP	20	97 <sup>a</sup>	10.2 <sup>a</sup>	1.65 <sup>a</sup>	3089	1.68 <sup>b</sup>
Dakota Gold HP	25	100 <sup>a</sup>	9.6 <sup>a</sup>	1.54 <sup>a</sup>	2781	1.71 <sup>b</sup>
Control	0	100 <sup>a</sup>	12.3 <sup>b</sup>	2.00 <sup>b</sup>	3969	1.32

# SUMMARY

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- **All DDGS diets performed the same or better in terms of shrimp growth and survival when compared with the diet without DDGS.**
- **FCR's for all diets containing DDGS lower than the FCR for diet not containing DDGS.**
- **All FCR's ranging from 1.62 to 1.87 for the DDGS diets is indicative of feeding slightly above satiation for the conditions of experiment.**
- **As high as 20 to 25% of POET DDGS can be included in the shrimp diets if soybean meal is replaced for the conditions of this trial.**



# SUMMARY

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- **Equal or greater growth of shrimp fed DDGS diets are not due to crude protein, crude fat, crude fiber, total ash, total ash, P, K, Mg, Ca, Na, Fe, Mn, Cu, Zn and essential fatty acids and amino acids.**
- **But could be due to unknown growth factors such as dipeptides, oligopeptides, prebiotics, nucleotides, chemoattractants, etc.**
- **Similarity to “BIOFLOC” ??????????????**
- **Research using higher inclusion levels of DDGS in shrimp diets is justified.**





# Acknowledgements

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- **Special thanks to POET, Sioux Falls, SD for providing the DDGS and partial funding for this project.**
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- **Employees and students of Texas AgriLife Research, Shrimp Mariculture Lab, Texas A&M University System.**

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# Thank You!!!!

