OPTIMUM DIETARY LIPID LEVEL IN WHITELEG SHRIMP IN BIOFLOC SYSTEM

Hyeonho Yun[1], Inkwon Jang[2], Sukyong Kim[2] and Sungchul C. Bai[1*]

[1]Dept. of Marine Bio-materials and Aquaculture, Pukyong Nat'l University, Korea
[2]National Fisheries Research & Development Institute, Korea

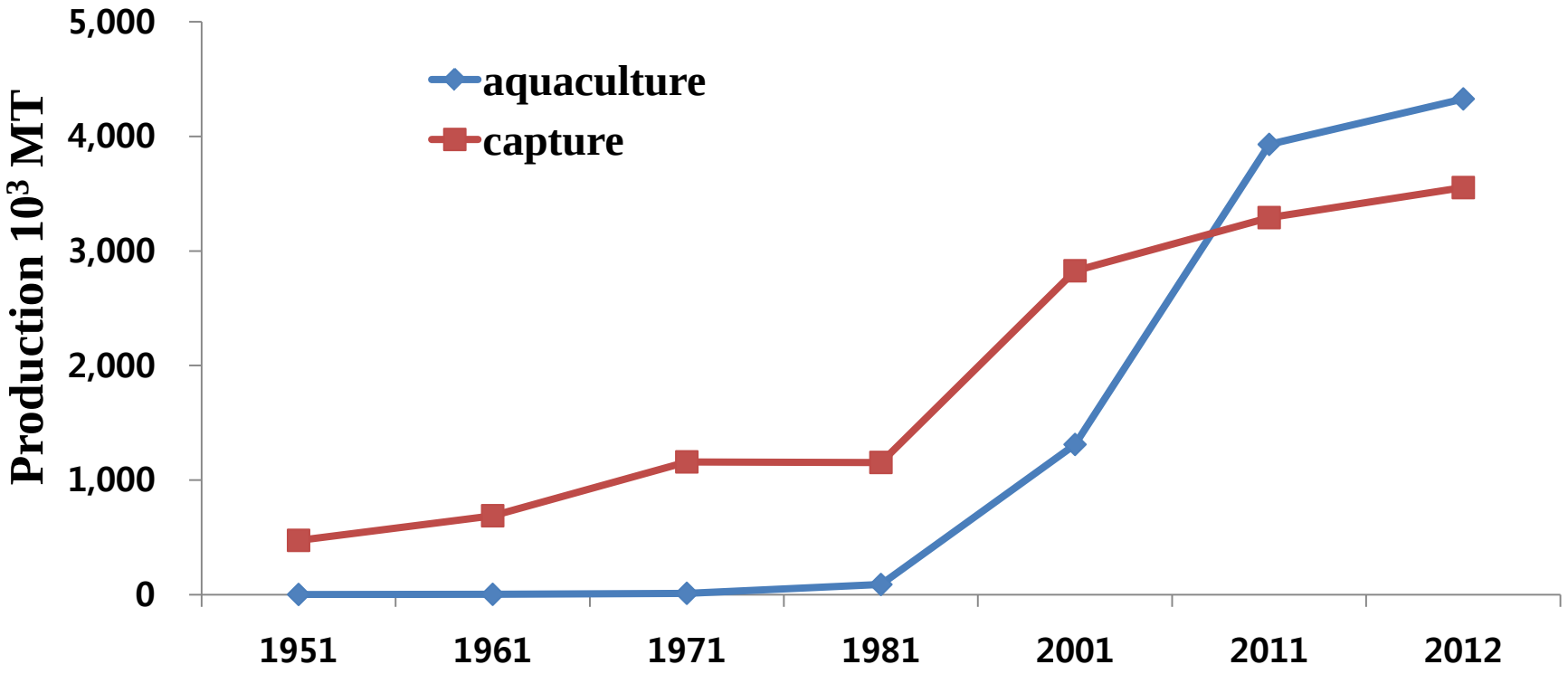
***Corresponding Author: scbai@pknu.ac.kr**

FFNRC Pukyong National University
Feeds and Foods Nutrition Research Center

Introduction

The importance of shrimp research

- Shrimp consumption and production has increased steadily in the world



FAO 2014

Marine shrimp aquaculture in Korea

KOSTAT 2014

Trend in aquaculture

Past

Pond fed by naturally occurring

Present

Intensive cultivation

Need of nutrient requirement study

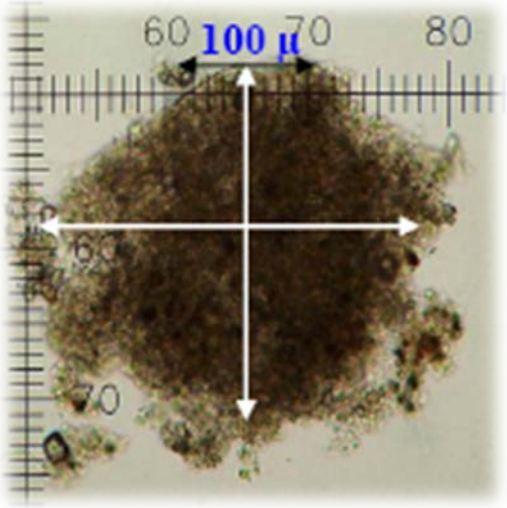
Pond culture

Biofloc system

The Biofloc

Defined as macroaggregates – diatoms, macroalgae, fecal pellets, exoskeleton, remains of dead organisms, bacteria, protest and invertebrates. (Decamp, O., et al 2002)

As Natural Feed (Filter feeders - Shrimp) : It is possible that microbial protein has a higher availability than feed protein (Yoram, 2005)



Floc communities and size

Avnimelech Y. 2012. Biofloc Technology

Basic concept of BFT

① **Limited water exchange**

② **Organic residues accumulation**

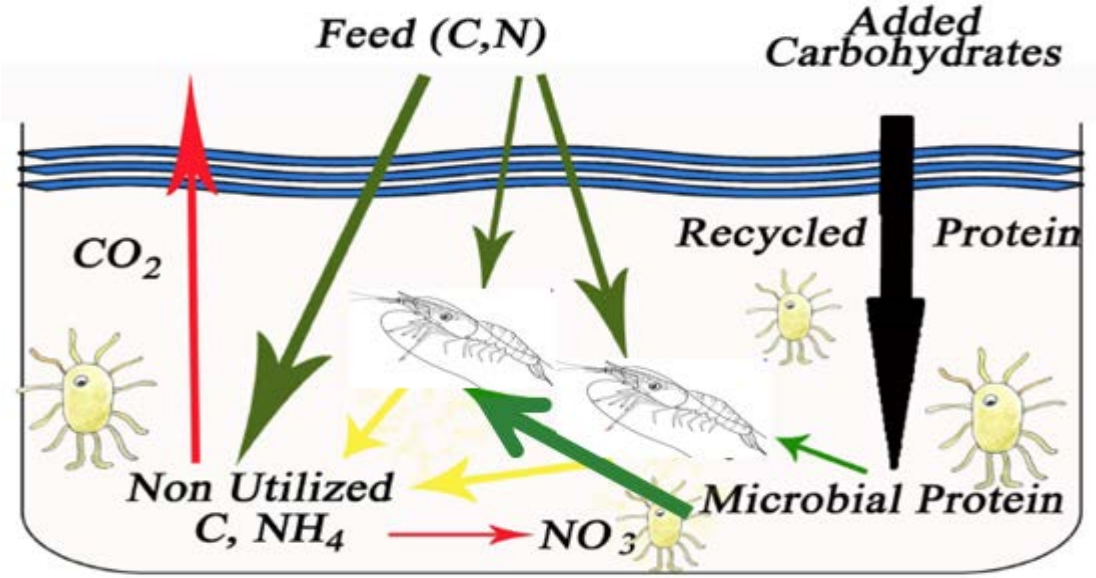
③ **Mix and aerate**

④ **Ideal environment by using bacteria**

⑤ **Bacteria control water quality**

⑥ **Shrimp feed bacteria**

⑦ **Feed is recycled**



Biofloc Technology, Yoram 2011

Functions of Lipids

① **Energy source and storage**
② **Structure of cell membranes**
③ **Important sources of essential fatty acids**
④ **Assist in the absorption of fat-soluble vitamins**
⑤ **Steroid hormones**

Protein saving effect but negative effect if given beyond optimum level

Objective

To evaluate the optimum dietary lipid level in whiteleg shrimp in biofloc system

Materials & Methods

Experimental design

- Initial body weight : 0.95 ± 0.03g
- Stocking density : 50 shrimp/200L FRP tank
- Temperature : 27.8± 1.0°C
- Feeding rate : 7% of BW, 4 times daily for 8 weeks
- Treatment: 5 diets, 3 replication

Crude lipid levels(%)				
4.5	6	9	12	15

Experimental diets

Ingredient	Diets				
	L4.5	L6.0	L9.0	L12.0	L15.0
Fish meal	25.1	25.1	25.1	25.1	25.1
Soybean meal	19.0	19.0	19.0	19.0	19.0
Dextrin	38.7	35.7	32.7	29.7	26.6
Wheat gluten meal	9.0	9.0	9.0	9.0	9.1
Corn oil	0.0	3.0	6.0	9.0	12.0
EPA+DHA	1.0	1.0	1.0	1.0	1.0
Others*	7.2	7.2	7.2	7.2	7.2
Total	100.0	100.0	100.0	100.0	100.0

* Lecithine, cholesterol, calcium phosphate, vitamin and mineral

Proximate composition of exp. diets

	Diets				
	L4.5	L6.0	L9.0	L12.0	L15.0
Moisture(%)	12.9	12.3	12.1	11.5	11.4
Crude ash(%)	8.5	8.6	8.5	8.5	8.7
Crude lipid(%)	4.6	6.2	9.2	12.0	14.9
Crude protein(%)	36.8	36.2	36.3	35.8	36.2

Parameters

- Growth performance
- Whole-body proximate composition
- Enzyme assay (SOD, TBARS, Lysozyme, Lipase, Amylase, Trypsin)
- Hemolymph analysis
- Water quality analysis
- Broken line analysis & Polynomial regression

Statistical analysis

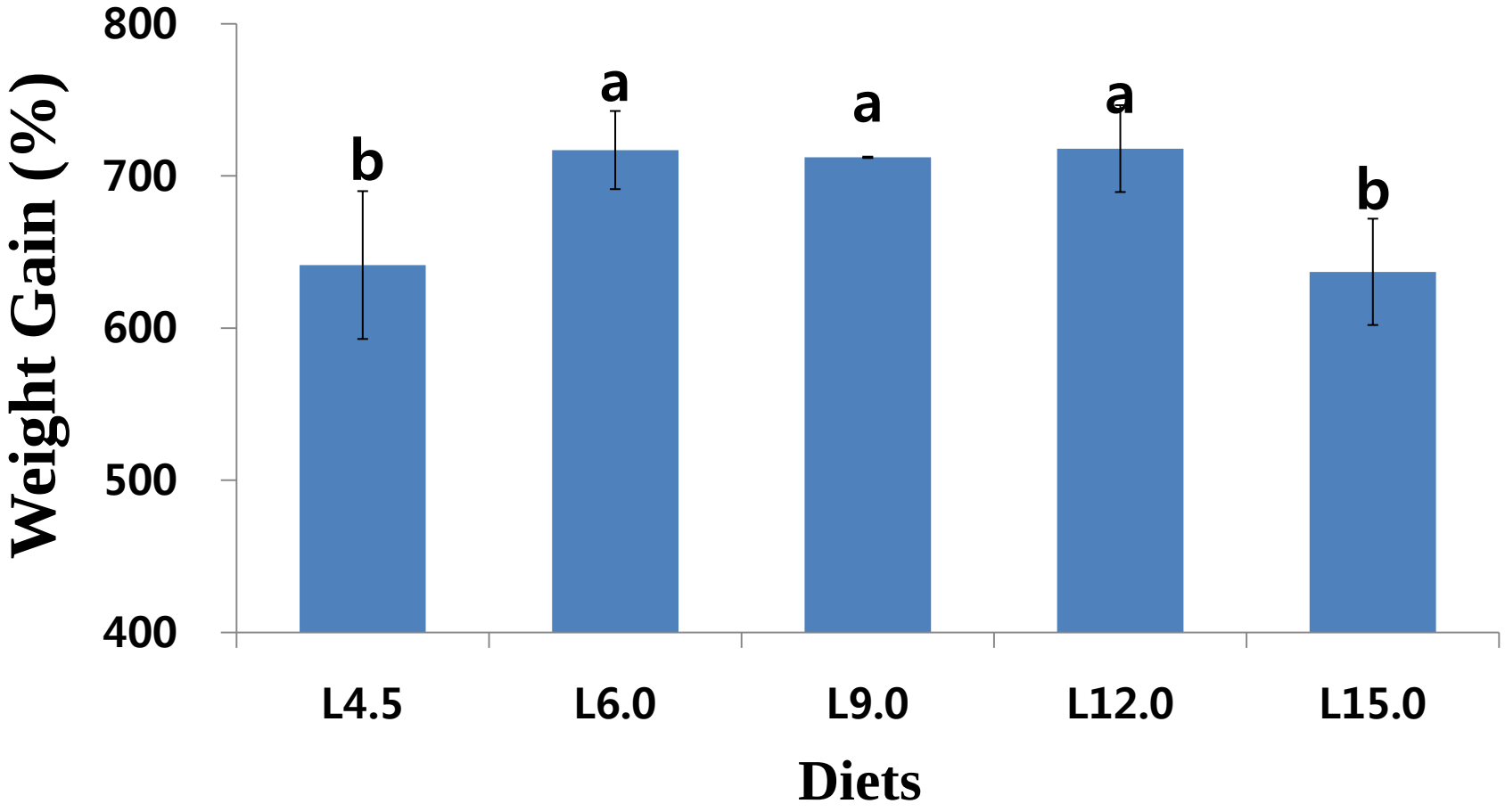
- SAS (version 9.1 for window)
- ANOVA (Analysis of variance) test
- LSD: (Least Significant Difference)

Results

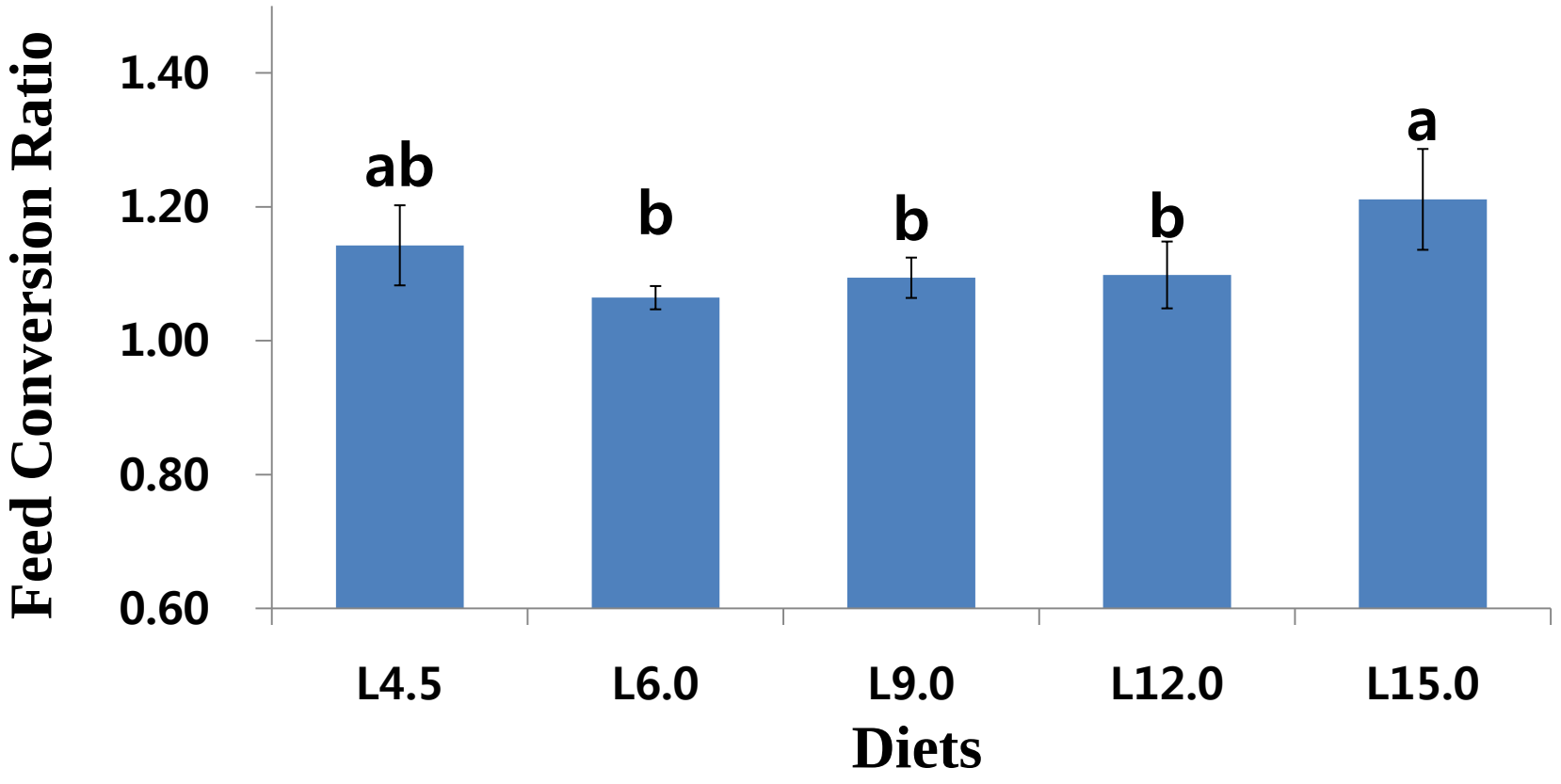
Growth performance

	WG(%)	SGR(%)	FCR	PER	Survival (%)
L4.5	641^{b}	6.67^{b}	1.14^{ab}	2.38^{bc}	88.7
L6.0	717^{a}	7.00^{a}	1.06^{b}	2.59^{a}	90.0
L9.0	712^{a}	6.98^{a}	1.09^{b}	2.52^{ab}	88.0
L12.0	718^{a}	7.00^{a}	1.10^{b}	2.54^{ab}	79.3
L15.0	637^{b}	6.66^{b}	1.21^{a}	2.29^{c}	78.7
Pooled SEM	12.2	0.05	0.02	0.04	1.99

Weight Gain (%)


Weight Gain (%)
800
700
600
500
400
b
a
a
a
b
L4.5
L6.0
L9.0
L12.0
L15.0
Diets

Feed Conversion Ratio



Whole-body proximate composition

%, DM basis

Diets	Moisture	Crude lipid	Crude protein	Crude ash
L4.5	73.3	1.27^{d}	74.1^{b}	13.2
L6.0	73.1	1.89^{d}	76.3^{a}	12.8
L9.0	73.6	3.75^{c}	76.0^{a}	12.3
L12.0	73.4	4.93^{b}	75.8^{a}	12.5
L15.0	73.5	6.09^{a}	75.8^{a}	12.6
Pooled SEM	0.10	0.50	0.27	0.14

Hemolymph analysis

	GOT (U/I)	GPT (U/I)	Glucose (mg/dl)	T-P (g/dl)	T-G (mg/dl)	T-CHO (mg/dl)
L4.5	41.3^{ab}	89.3	25.3	1.93	25.0^{b}	23.3^{b}
L6.0	38.3^{ab}	86.7	21.7	1.77	39.7^{ab}	30.0^{ab}
L9.0	48.0^{a}	94.7	23.0	1.93	45.3^{a}	35.3^{a}
L12.0	48.7^{a}	115.0	24.7	2.10	42.0^{ab}	31.0^{ab}
L15.0	27.3^{b}	86.7	16.3	1.43	40.7^{ab}	29.3^{ab}
Pooled SEM	2.76	4.90	1.59	0.10	2.85	1.49

Enzyme assay

	TBARS (nmol/mg)	SOD (% inhibition)	Lysozyme (unit/ml)
L4.5	5.77	72.5	0.22^{ab}
L6.0	5.60	73.0	0.24^{ab}
L9.0	5.84	70.4	0.26^{a}
L12.0	5.89	73.5	0.25^{ab}
L15.0	6.51	70.7	0.20^{b}
Pooled SEM	0.23	0.66	0.01

Digestive enzyme activities in hepatopancreas

mU/mL

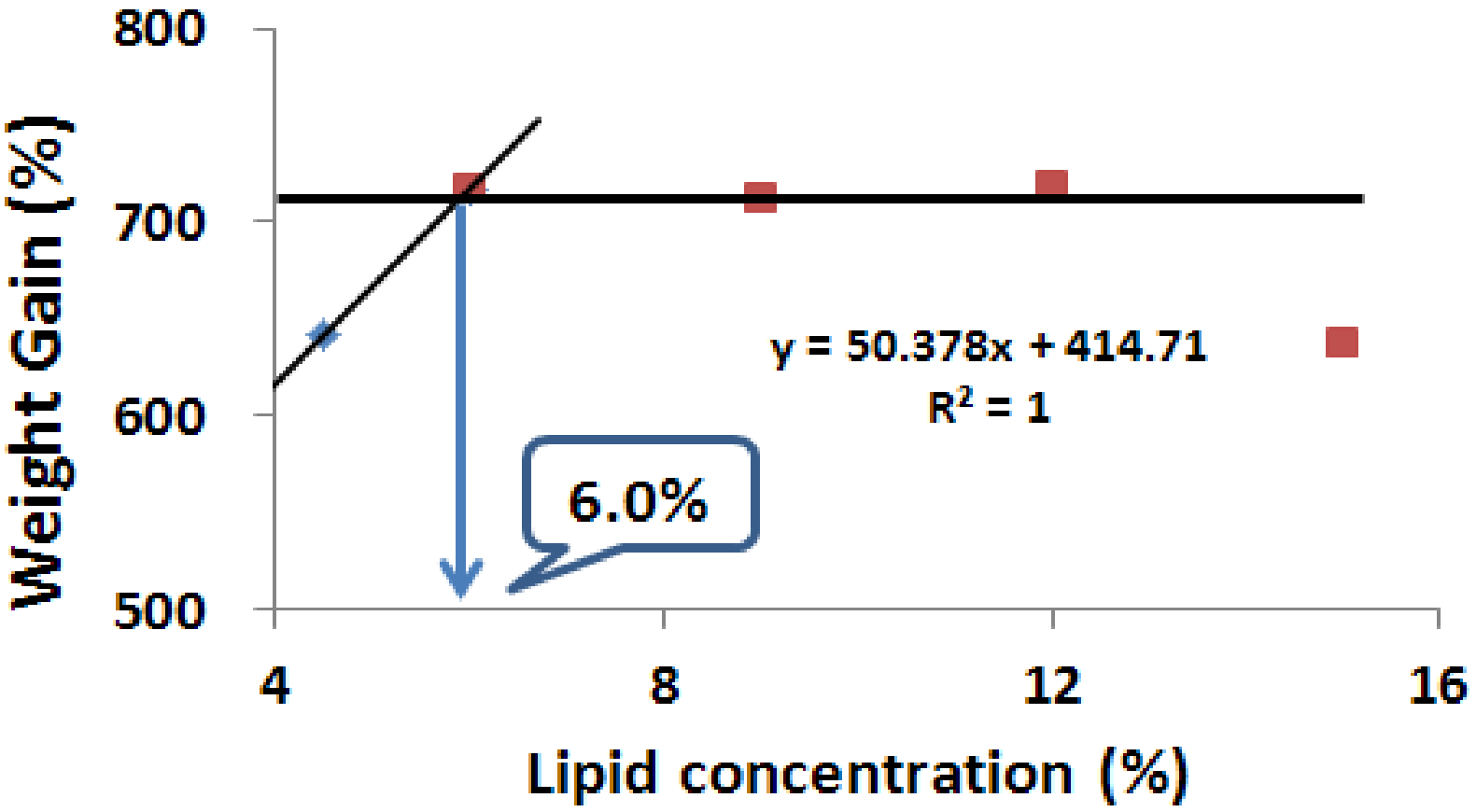
Diets	Lipase activity	Amylase activity	Trypsin activity
L4.5	0.11^{b}	1.93^{c}	0.20
L6.0	0.14^{ab}	2.19^{b}	0.19
L9.0	0.15^{a}	2.52^{a}	0.21
L12.0	0.16^{a}	2.57^{a}	0.21
L15.0	0.11^{b}	2.30^{b}	0.20
Pooled SEM	0.01	0.07	0.01

Water quality

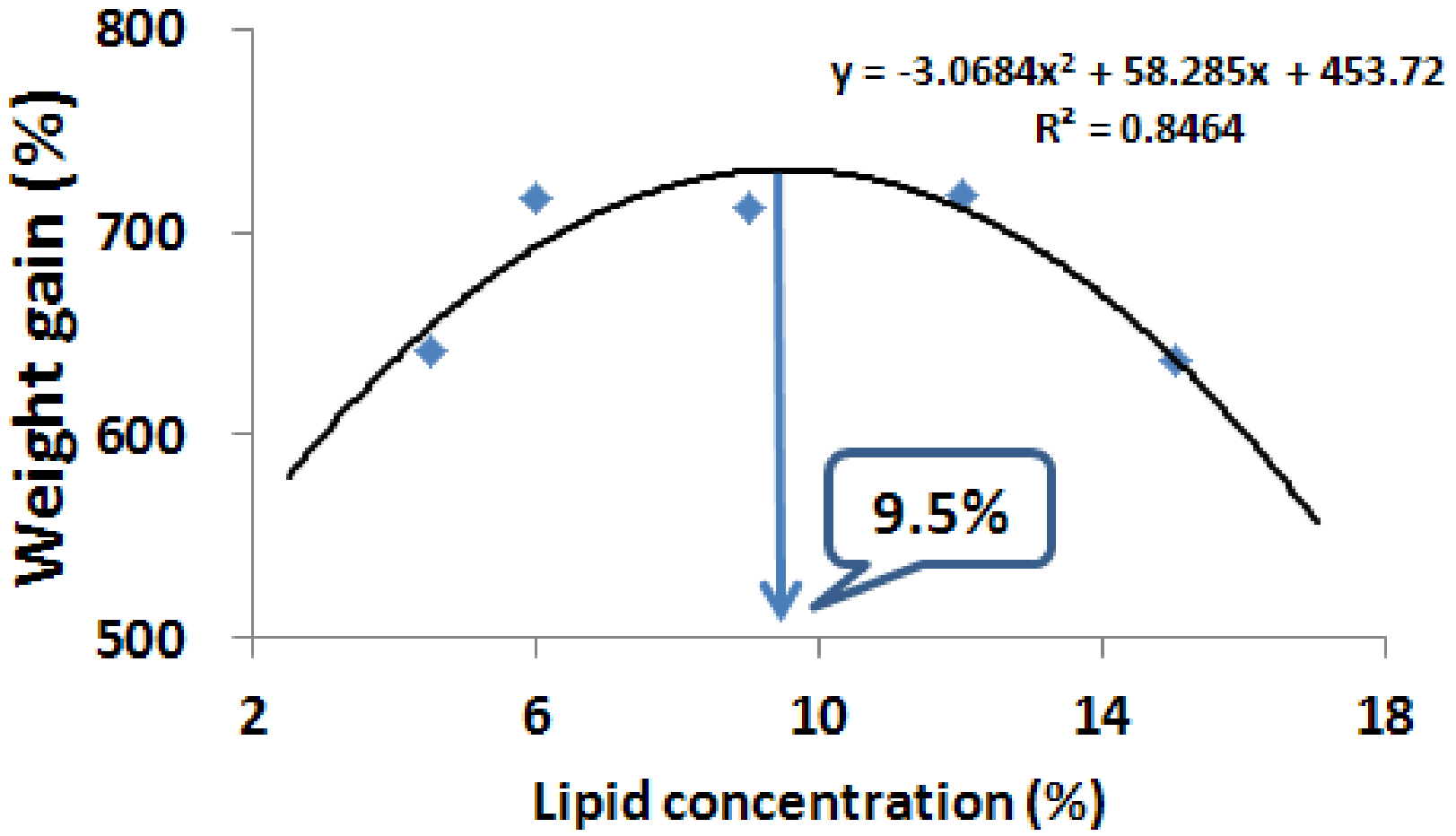
mg/L

Diets	NO_2	NO_3	NH_4	TSS
L4.5	0.15±0.16	268±24	0.80±0.68	294±42.4
L6.0	0.21±0.17	269±6.0	0.85±0.33	376±115
L9.0	0.21±0.17	264±13	0.76±0.35	381±64.8
L12.0	0.18±0.16	267±13	0.95±0.61	368±102
L15.0	0.19±0.17	292±67	0.78±0.37	361±80.3

Broken line analysis



Polynomial regression



Discussion & Conclusion

WG & SGR of shrimp fed L6.0, L9.0 and L12.0 diets were significantly higher than those of shrimp fed L4.5 and L15.0

Similarly, other nutritional studies with shrimps indicated that the optimal dietary lipid level ranges from 5 to 14% (Glencross et al., 2002; Tzeng et al., 2004, Beseres et al., 2005, Goda 2008)

Insufficient and excessive amount of dietary lipids have negative effects for various fishes such as flounder, yellow puffer, tilapia and other species (Kanazawa et al., 1980; Lee et al., 2005; Cho et al., 2008; El-Kachief et al., 2011)

Lysozyme activity of shrimp fed L9.0 diet was significantly higher than those of shrimp fed L15.0 diet. Zhang et al., 2013 reported immune related enzymes such as CAT, GPx, AKP and SOD increased with dietary lipid level from 10% to 14%

Lipid content of whole-body has increased with the dietary lipid level. Other studies also showed similar trend (Catacutan 2002; Gonza´ lez-Fe´ lix 2002; Ai et al. 2004; Peng et al. 2005).

Digestive enzyme activities of lipase and amylase in hepatopancreas of shrimp fed L9.0 and L12.0 was significantly higher than those of shrimp fed L4.5 and L15.0

This maybe because of suitable protein to energy ratio of diets containing 9% to 12% with 36% protein and digestive stimulating effect for lipid and carbohydrate

Conclusion

Optimum lipid level (0.9g)
6.0% ≤ Requirement< 9.5%

FFNRC Pukyong National University
Feeds and Foods Nutrition Research Center

NFRDI National Fisheries Research & Development Institute

Thank You

C U @ WA 2015 Jeju

May 26-30, 2015, Jeju ICC, Jeju, Rep. of Korea