EFFECT OF GARCINIA MANGOSTANA FRUIT PERICARP EXTRACTS AS A FEED ADDITIVE ON IMMUNOLOGICAL, BIOCHEMICAL AND GROWTH PARAMETERS OF CIRRHINUS MRIGALA AGAINST PATHOGENIC BACTERIA

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ABSTRACT

Aims: The present study was made to test the effect of Mangosteen (Garcinia mangostana Linn.) fruit pericarp extracts as a feed additive on immunity, biochemical and growth parameters of Indian major carp- (Cirrhinus mrigala Ham.) fingerlings. Methods: Sixty fingerlings were randomly introduced into each tub. Five treatment groups consist of three replicates. Five experimental diets were prepared: Controls, Petroleum ether, Toluene, Ethyl acetate and Methanol extract mixed feed respectively. The 0.10% of Mangosteen fruit pericarp various (petroleum ether, Toluene, Ethyl acetate and Methanol) extracts of mangosteen were included in the experimental diet. The fish were fed with experimental diets for sixty days. Result and conclusion: Results showed that oral administration of various mangosteen fruit pericarp extracts resulted in Superoxide anion production, Bactericidal activity, Lysozyme activity, Blood glucose, Total protein, Albumin, Globulin, SGOT, Total lipid, Cholesterol and Triglycerides Specific growth rate (SGR), Feed conversion ratio (FCR) and Histopathology of liver, kidney, gills, intestine of Cirrhinus mrigala showed the effect of experimental diets. Based on the results, the present study suggests that Mangosteen fruit pericarp extracts of different solvents especially 0.10%/Kg supplemented feed additive enhances the immunological, biochemical and growth parameters of Indian Major Carp Cirrhinus mrigala fingerlings against pathogenic bacteria Pseudomonas fluorescens.

KEY WORDS


INTRODUCTION

Aquaculture is considered as one of the most promptly developing food-producing field in the world. The increased expansion of fish culture has led to a vast number of disease outbreaks with an increasing range of organisms causing them. (Kirubakaran et al., 2010). Aquaculture has developed as one of the most hopeful business due to the increasing demand for animal proteins to serve nutritional and food safety. There are more than 200 species of fishes trained by aquaculture for economical reason, which has shown an increase in the acceptable economic enterprise in the developed as well as developing countries. In India, Catla catla, Labeo rohita, and Cirrhinus mrigala are the main freshwater
carp produced, which are essentially consumed as a source of helpful lipids and proteins. (Swapna et al., 2010; Dharmaraj et al., 2015).

Plant oriented medicinal treatments have antibacterial activity, and they are possibly suitable and substitute in the field of aquaculture (Abutbul et al., 2005). Plant materials, such as vegetables, fruits, leaves, spices, roots, and barks, have been widely evaluated as potential sources of natural antioxidants (Ellnain-Wojtaszek et al., 2002; Chyau et al., 2002; Picerno et al., 2003; Naczk et al., 2003). The plant extracts can be used as a substitute to control and avoid outbreaks of diseases mainly in fish forms. Since these substances are natural, their harmful possible is less when compared with other products. The outcomes show that the evaluated plants presented a high potential for substitute analysis of bacterial fish diseases (Castro et al., 2008).

Garcinia mangostana Linn. family Clusiaceae (Guttiferae) is a tree originate in Sri Lanka and other South East Asian countries, which is very popular due to its yummy fruits. Treatment of diarrhoea, skin infections, dysentery, and as an anti-inflammatory agent are some of the medicinal utilization of this plant. Xanthones, terpenoids and sugars have been reported from the fruit hulls and leaves of G. mangostana, and some of them have shown a variety of biological activities (Praveen et al., 1991; Suksamrarn et al., 2002). Among them, antibacterial activity against MRSA of a - mangosteen is significant (Linuma et al., 1996; Sakagami et al., 2005).

The fruits of G. mangostana are the most conserved part of this plant and are essential for the extraordinarily pleasant flavour. Therefore, G. Mangostana fruit was named as the ‘queen of tropical fruits’ (Lim, 1984; Ramage et al., 2004). Mangosteen fruits are a rich source of phenolic acids, xanthones, anthocyanins, and concised tannins (proanthocyanidins) (Pedraza-Chaverri et al., 2008; Zadernowski, Czaplicki, & Nacz, 2009). Phenolic acids detached from soluble esters are the predominant phenolic acids in the mangosteen fruits (Zadernowski et al., 2009). So far, fifty xanthones have been isolated and identified in the pericarp of mangosteen fruit (Jung et al., 2006; Naczk et al., 2011).

Various parts of G. mangostana, usually barks, roots and fruit hull, have been used for hundreds of years in Southeast Asia as a medicine for a great variety of medical conditions. In Thailand, China, India, and other parts of Asia dried and powdered fruit hull is used for the antiparasitic treatments in dysentery and antimicrobial agents. (Saralamp et al., 1996; Nakatani et al., 2002b; Moongkarndi et al., 2004b; Yu et al., 2007) as well as suppurations, chronic ulcers and externally for curative wounds (Farnsworth and Bunyapraphatsara, 1992).

The biting qualities of G. mangostana are also used for loss of needed nutrients from the gastrointestinal tract in case of diarrhoea and inhibiting dehydration. The fruit hulls of G. mangostana have been used for the treatment of painful skin infections and the break of diarrhoea in Thai folk medicine. (Suksamrarn et al., 2002, 2003; Jung et al., 2006). Several studies have demonstrated antiviral, antibacterial and antifungal properties of xanthones and extracts procured from G. Mangostana Linn. (Sakagami et al., 2005; Voravuthikunchai and Kitpipit 2005; Chomnawang et al., 2005; Rassameemaung et al., 2007). Bacteria are one of a chief productive agent of fish disease in both cultured and wild fish and are liable for severe economic losses. Many pathogens are present as skin infections especially vibrios, pseudomonads, aeromonads etc. The bacteria of genera pseudomonas are universal facultative parasites. These genera belong to the healthy bacterial flora of the hatcheries, aquaria, fish farms and bodies of water for domestic use. These bacteria show the presence of the colonization of in the fins, gills, skin, and the intestinal lumen of fish. Pseudomonas fluorescens has been related with ulcerative conditions and septicaemia in a wide range of fishes. It has been treated as a fish spoilage organism (Omparaksh et al., 2015). As well as a primary, but poor pathogen (Stoskopf et al., 1999). Pseudomonas fluorescens is normally found in soil, water, and on the body of fishes. With these findings in view, this work aimed to evaluate the effect of a various extract of G. Mangostana fruit pericarp supplemented diets on immunity and biochemical parameters against pathogenic bacterium Pseudomonas fluorescens in Cirrhinus mirgola during 60 days study.

MATERIALS AND METHODS

Acclimatisation of Fish

Healthy fingerlings of Mrigal carp (Cirrhinus mirgola) having an average weight of 8.5 ±1.0g and the total length of 9cm ± 1.0cm were procured from an Aliyar...
dam, Tamil Nadu Fisheries Corporation, India. (Located about 65 Km from Coimbatore). Initially, 300 fishes were introduced to the large cement tank containing dechlorinated tap water and kept for 30 days for acclimatization. The stock was fed on the control diet. After acclimatization, fishes were divided into five different groups (1-control, 2, 3, 4, 5-experimental group) of 60 fishes in each treatment. The water exchange rate was 50% of water volume daily.

**Plant material**
Commercially available healthy fresh fruit of (*Garcinia mangostana* Linn.) that belongs to the family Guttiferae. *G. mangostana* were collected from local market of Nilgiris, Tamil Nadu, India. Confirmed by comparison with reference herbarium specimens. Initially, the aril or the white pulp of the fruit of *G. mangostana* was removed, and the pericarp was collected and washed cleanly in pure tap water, rinsed in double distilled water and shade dried for ten days in open air. After that, the dried pericarp was crushed using pestle and mortar reduced to powder using a laboratory mixer for few minutes at high speed and then sieved and saved in airtight closed containers before starting the experiment.

**Preparation of *G. Mangostana* fruit pericarp extract**

The powdered *G. mangostana* fruit pericarp was extracted separately to exhaustion in a Soxhlet apparatus using different organic solvents in the increasing polarity order. Twenty grams of powder was extracted in 450 ml of each solvent (Petroleum ether, Toluene-99.5%, Ethyl acetate-99%, Methanol-99%). The extract was collected carefully and then concentrated by using evaporating beaters at room temperature (27°-35°C) for 2–4 days till the final volume was reduced to one-fourth of the original volume of the solvent and stored at 4° to 6° C in airtight containers until further use. *G. mangostana* fruit pericarp extracts were tested against *Pseudomonas fluorescens* (gram negative rod or oval-shaped bacteria) through invivo method.

**Preparation of Experimental food**

1-Control normal balanced feed composed of Corn meal-10gm, Fish meal-15gm, Wheat meal-15gm, Soy bean meal-15gm, fish oil-2gm, Vitamin and mineral mix-2gm, Rice bra-15gm, Ground nut oil cake-20gm, starch-1gm, Egg white-5gm for 100gm feed preparation was used as the control diet. 2-Treatment diet was prepared by mixing of normally balanced feed composition and Petroleum ether extract of *G. Mangostana* fruit pericarp in ratio 10grams per kilogram of food. (i.e, 0.10 % *G. Mangostana* fruit pericarp petroleum ether extract). 3-Treatment diet was prepared by mixing of normally balanced feed composition and Toluene extract of *G. Mangostana* fruit pericarp in ratio 10grams per kilogram of food. (i.e, 0.10 % *G. Mangostana* fruit pericarp toluene extract). 4-Treatment diet was prepared by mixing of normally balanced feed composition and Ethyl acetate extract of *G. Mangostana* fruit pericarp in ratio 10grams per kilogram of food. (i.e, 0.10 % *G. Mangostana* fruit pericarp ethyl acetate extract). 5-Treatment diet was prepared by mixing of normally balanced feed composition and methanol extract of *G. Mangostana* fruit pericarp in ratio 10grams per kilogram of food. (i.e., 0.10 % *G. Mangostana* fruit pericarp methanol extract).

**Pathogen culture**

Bacteria cultures of *Pseudomonas fluorescens* (MTPC-103- Chandigarh) were obtained from Microbial biotechnology Department, Bharathiar University. The cultures were maintained on an agar plate at 4°C and activated at 25°C for 48hrs on an agar plate.

**Challenge study**

The bacterial cells were centrifuged at 600 rpm for 10 to 15 min and prepared in PBS. After 28th day of the experiment, fish in each group were injected through intraperitoneally with 0.1ml of suspension of the bacteria 1.6×107 cfu / fish in PBS. After that, Immunological, biochemical and growth parameters were tested against *Pseudomonas fluorescens*. Pathogenic effect and immune development of the fish were studied through the histopathology of Liver, Kidney, Gills and Intestines.

**Determination of immunological parameters**

1.Superoxide anion production of blood phagocytes challenged with *Pseudomonas fluorescens* was measured according to the method of Chung and Secombes 1988. 2. Lysozyme activity -turbidimetric assay was carried out followed by the method of Parry et al., 1965. 3. Bactericidal activity was done by the following procedure of Kajita et al., 1990.

**Determination of blood biochemical parameters**

1. Blood glucose was measured by adopting the Enzymatic – colorimetric- End point method described by (Trinder et al., 1972).2. Total protein content was determined via the method described by Lowry et al., 1957.3. Albumin content from blood was estimated by following Doumas et al. 1971.4. Globulin content was
measured using a standard albumin estimation kit, and
the globulin content was estimated by subtracting
albumin from total protein.5. AST or SGOT levels were
estimated by adopting the procedure of Reitman and
frankel 1957.6. Cholesterol level was determined by the
method described by Folch et al., 1957. 7. Triglycerides
level was determined by the method described by Folch
et al., 1957.

**Determination of Growth parameters**

Weight gain percentage, Specific growth Rate, Feed
Conversion Ratio of each group was determined by the

**RESULTS AND DISCUSSION**

**Immunological parameters**

Superoxide anion production from the *Cirrhinus mirigala*
was reported the highest level (2.80 ± 0.5091)
significantly on the 45th day in *G. Mangostana* methanol
extract treated group, and it was low level (1.96 ±
0.5657) on the 60th day of the experiment. (Fig-1) When
compared with other groups. Lysozyme activity was
increased in the *G. Mangostana* methanol extract
treated group (368 ± 0.9899), control group (99 ±
0.7071) on the 45th day and significantly decreased on the
60th day (280 ± 0.0000). When compared with the
control group. (76 ± 0.4243) (Fig-2) Bactericidal activity
was increased in *G. Mangostana* methanol extract
group (192 ± 0.4619) on the 45th day of the experiment.
At the same time, it was significantly decreased (96 ±
0.3464) on the 60th day of the experiment. When
compared with control, petroleum ether, toluene, ethyl
acetaate groups. (Fig-3).

**Biochemical parameters**

Blood glucose was increased in the ethyl acetate extract
group (124 ± 0.2121) and *G. Mangostana* methanol
extract treated group (248 ± 0.0000) on the 30th day of
the experiment. It was significantly decreased in the
ethyl acetate extract group (96 ± 0.5657) and *G.
Mangostana* Methanol extract treated group (212 ±
0.7071) on the 45th day of the experiment. When
compared with control and other groups. (Fig-4) Total
protein was significantly decreased in ethyl acetate
extract group (7.90 ± 0.7071) and *G. Mangostana*
methanol extract treated group (10.60 ± 0.2887) on 45th
day then it was significantly increased in ethyl acetate
extract group (11.40 ± 0.1155). Moreover, *G.
Mangostana* methanol extract treated group. (13.20 ±
0.7071) on the 60th day when compared with other
groups. (Fig-5) Albumin level was increased (4.70 ±
0.1155) in *G. Mangostana* methanol extract treated
group on the 60th day of the experiment. When
compared with control (3.40 ± 0.0000) and other
experimental groups. (Fig-6) Globulin level was
significantly decreased (6.50 ± 0.0577) in *G.
Mangostana* methanol extract treated group on the 45th
day of the experiment. Then it was significantly
increased (8.50 ± 0.0346) on the 60th day of the
experiment. (Fig-7) AST (aspartate transaminase) was
significantly increased in ethyl acetate extract group (82.4 ± 0.0173) and *G.
Mangostana* methanol extract treated group (84.4 ±
0.1155) on the 60th day when compared with a 15th and
30th day of the experiment of the same groups as well as
other groups. (Fig-8) Cholesterol was significantly increased in
ehtyl acetate extract group (82.4 ± 0.0173) and *G.
Mangostana* methanol extract treated group (84.4 ±
0.1155) on the 60th day when compared with a 15th and
30th day of the experiment of the same groups as well as
other groups. (Fig-9) Triglycerides were also increased in
ehtyl acetate extract group (64.4 ± 0.0283) and *G.
Mangostana* methanol extract treated group (71.4 ±
0.0424) on the 60th day of the experiment when
compared with 15th, 30th, 45th day of the same
experimental groups as well as control, petroleum ether
and toluene group. (Fig-10).

**Growth parameters**

Weight gain percentage was *G. Mangostana* methanol
extract treated group (32.91 ± 0.0283) and the very
lowest range in the control group (15.197 ± 0.0113)
when compared with other groups. (Fig-11) Specific
growth Rate was significantly increased in *G.
Mangostana* methanol extract treated group (2.96 ±
0.4808) but very low in the control group (0.307 ±
0.0066). (Fig-12) Feed Conversion Ratio was the highest
range in *G. Mangostana* methanol extract treated group
(19.28 ± 0.1703) and very low in the control group
(6.920 ± 0.0424) when compared with other groups.
(Fig-13).
FIGURE 1. SUPER OXIDE ANION PRODUCTION (O. D).

FIGURE 2. LYSOZYME ACTIVITY (U / ML).

FIGURE 3. BACTERICIDAL ACTIVITY % (CFU)
FIGURE 4. BLOOD GLUCOSE (MG L⁻¹).

FIGURE 5. TOTAL PROTEIN (G / DL).

FIGURE 6. ALBUMIN (G / DL).
FIGURE 7. GLOBULIN (G/DL).

FIGURE 8. ASPARTATE TRANSMINASE (U/ML).

FIGURE 9. CHOLESTEROL (MG/DL).
FIGURE 10. TRIGLYCERIDES (MG / DL).

FIGURE 11. WEIGHT GAIN (%)

FIGURE 12. SPECIFIC GROWTH RATE (%)
FIGURE 13. FEED CONVERSION RATIO (%)

FIGURE 14. CULTURE OF PSEUDOMONAS FLUORESCENS.

FIGURE 15. MICROSCOPIC VIEW OF PSEUDOMONAS FLUORESCENS (100X).
FIGURE.16. FISH AFFECTED BY PSEUDOMONAS FLUORESCENS.

HISTOPATHOLOGY

FIGURE-17. HISTOPATHOLOGY OF LIVER OF CIRRHINUS MRIGALA FINGERLINGS.

FIGURE 18. HISTOPATHOLOGY OF KIDNEY OF *CIRRHINUS MRIGALA* FINGERLINGS.

A] Normal Kidney- Section shows kidney tissue with congested glomeruli, 1- Normal proximal convoluted tubules and 2-Distal convolutes tubules - (40X).

B] Control group- Section shows 1-Denature of renal tubules architecture, 2-Damaged glomerulous- (40X).

C] *G. Mangostana* fruit pericarp petroleum ether extract treated group- Section shows 1- Cracked glomerulus as well as cytoplasm, 2- Vacuolated cytoplasm - (40X).

D] *G. Mangostana* fruit pericarp toluene extract treated group- Section shows 1- Affected melano macrophagus aggregation close to a vessel, 2- Vacuolated lumen tubule - (40X).

E] *G. Mangostana* fruit pericarp ethyl acetate extract treated group – Section shows 1- Affected cytoplasm, 2-Affected glomerulus, 3- Enlarged size of renal tubules - (40X).

F] *G. Mangostana* fruit pericarp methanol extract treated group- Section shows 1- Convoluted tubules are normal and 2- Distal convolutes tubules are also normal structure - (40X).

FIGURE 19. HISTOPATHOLOGY OF GILLS OF *CIRRHINUS MRIGALA* FINGERLINGS.

A] Normal Gills- Section shows Gill tissue with 1-Prominent primary lamellae and 2-Secondary lamellae, 3-Gill arch-(10X).

B] Control group- Section shows1-Loss of Structural integrity of lamellae, 2-Separation and breakdown of primary gill lamellae-(10X).

C] *G. Mangostana* fruit pericarp petroleum ether extract treated group- Section shows Breakdown of Secondary gill lamellae-(10X).

D] *G. Mangostana* fruit pericarp toluene extract treated group- Section shows Ball like appearance of inter
lamellar cells–(40X). E] G. Mangostana fruit pericarp ethyl acetate extract treated group – Section shows 1- Bulging of primary gill lamellae, 2- Haemorrhage in the central gill arch, 3-Breakdown of primary gill filament, 4-Desquamation of epithelial cells and pillar cells of secondary gill lamellae -(10X). F] G. Mangostana fruit pericarp methanol extract treated group- Section shows 1- Fusion in normal prominent primary lamellae, 2- Fusion in normal secondary lamellae and 3- Gill arch - (40X).

**FIGURE- 20. HISTOPATHOLOGY OF INTESTINE OF CIRRhinUS MRIGALA FINGERLINGS.**

A] Normal Intestine- Section shows cut section of intestine lined by tall columnar cells arranged in 1- Short villi, 2- Lumen contains undigested matters - (10X), B] Control group- Section shows 1- Vculolization of epithelial cells inside the villi, 2- Lumen content separated and moved into the corner - (10X). C] G. Mangostana fruit pericarp petroleum ether extract treated group- Section shows 1- Serosa, longitudinal and circular muscle layer broken and inner lumen content released outside, 2- Denature of lumen content and accumulation of mucus - (10X). D] G. Mangostana fruit pericarp toluene extract treated group- Section shows 1- Broken serosa and epithelium, 2- Dissolved and denatured lumen content - (10X). E] G. Mangostana fruit pericarp ethyl acetate extract treated group – Section shows 1- Cracked clay appearance of epithelial cells of villi, 2- Cornered inner lumen content - (10X). F] G. Mangostana fruit pericarp methanol extract treated group- Section shows 1- Tip damaged villi, 2- Seperated lumen content - (10X).

Application of immunostimulators, especially herbal immunostimulants in the aquaculture industry, can be considered a notable advantage because of their safety and the fact that they are treated environmentally friendly (Dugenci et al., 2003; Jian and Wu, 2004). Yoshikawa et al., 1994 found that the methanolic extracts of G. Mangostana hulls showed DPPH radical scavenging activity. α and γ mangostins showed antioxidant activity using the ferric thiocyanate method. In the present study, food additive with G. mangostana (Garcinia mangostana Linn.) fruit pericarp of methanol extract treated group exhibit significantly highest level on the 45th day. The present findings are in according to the findings of Chomnawang et al., 2007.

Lysozyme activity was increased significantly in the G. Mangostana. Methanol extract treated group. When compared with the control group. Similar study where conducted by Swain et al., 2006. Furthermore, this lysozyme is known to generate an opsonin of the complement system and phagocyte cells (Magnadottir, 2006). Bactericidal activity was significantly increased in G. Mangostana methanol extract group on the 45th day of the experiment. When compared with the other group, similar studies were executed by Divyagnaneswari et al., 2007. Blood is a good indicator in deciding the wealth of an organism (Joshi et al., 2002). Certain herbal immunostimulants have been reported to increase total protein as well as total globulin in fish (Vasudeva et al.,
In this study, Biochemical parameters such as Blood glucose, Total protein, Albumin, Globulin, AST (aspartate transaminase) Similar studies were recorded by (Devi Sampath and Vijayaraghavan, 2007), Cholesterol and Triglycerides were also significantly increased in G. Mangostana methanol extract treated group when compared with the other group and other treatment groups.

In the present study, the growth parameters such as weight gain percentage, specific growth rate and feed conversion ratio were the highest range in G. Mangostan methanol extract treated group when compared with the other group. The present observation agrees with the report of (Choudhury et al. 2005). Therefore, the above results demonstrated that 0.10% of (Garcinia mangostana Linn.) fruit pericarp extracts of different solvents as a feed supplement on immunological and biochemical parameters of Cirrhinus mirgala Ham. Fingerlings against harmful bacteria. Histopathology of kidney appeared a normal structure in the fingerlings fed with enrich foods. Whereas, control affected fingerlings appeared dark granule aggregation in tubular cells, vacuole formation in kidney tubules and lethality. Water contamination first affects the kidney of the fish. (Thophon et al., 2003).

Majority of the ordinary modifications present in the kidney of fishes opened to water pollution are degeneration of tubule (droplets of hyaline and swelling of cloudiness) and corpuscle structure changes, such as capillaries dilation of glomerulus and Bowman’s space reduction (Takashima and Hibiya, 1995; John devadoss and Ravichandran 2014). Similar conclusions were recorded by Anitha Kumari and Ram Kumar 1997a; Prashanth and David 2011. In Channa striatus and Heteropleustes skeleton is exhibited to contaminated water of Hussainsagar lake. Liver fibrosis is not frequently, but it is usual to see a cirrhotic reflection caused by toxic agents or inflammation (Wolf and Wolfe 2005). Gill histology may be symbolic of normal stress from exposure to different xenobiotics, organic pollutants, metals, suspended solids and toxic algae (Rendon von Osten and Uso de., 2005; Ruiz-Picos and Lopez-Lopez, 2012).

Herbal based immune system stimulants are biodegradable, biocompatible, and safe for the human health and environment. Hence, this study studied the response of various plant parts of G. mangostana extract as an immune development additive in fingerlings of African catfish. Certain plants and general components were proved for their growth improving activities in animals of aquatic ecosystem (Citarasu et al., 2002; Sivaram et al., 2004; Soosean et al., 2010). The latest results were in verification with a few statements in which the Garcinia species contain generally appearing phytochemical compounds which have a very powerful antimicrobial ability against Staphylococcus aureus (Sundaram et al., 1983). Recently, number of researches declared that the G. mangostana pericarp is the major source of phytoneutrients, such as xanthones oligometric proanthocyanins and anthocyanins (Kondo et al., 2009; Zhou et al., 2011) and properties of antimicrobial (Lacombe et al., 2010).

With hints to different diagnosis that advantage to the description of medicinal properties of G. mangostana, number of studies are being achieved to identify the probable benefit of this compound. These results have been achieved using synthetic derivatives as well as natural extracts. They have demonstrated to show steady pharmacological and antimicrobial activities. (Valdir et al., 2000; Saraswathi et al., 2010).

The freeze-dried pericarp ethyl acetate extract of G. mangostana fruit sustained three types of xanthones by silica gel chromatography (Karla Divina et al., 2010). The effective phyto chemical compounds that are found in medicinal herbs like G. mangostana were liable for its anti-microbial ability (Priscila Ikeda et al., 2007). Among xanthone by-products from extract of G. mangostana, α-mangostin has been known to use the most powerful antimicrobial ability (Suksamrarn et al., 2003; Sakagami et al., 2005; Chomnawang et al., 2005). Kitti Torrungruang (2007) exposed the antibacterial ability of G. mangostana pericarp extract against cariogenic chiefly Streptococcus mutans (Kitti Torrungruang et al., 2007; Vishnu priya et al., 2010).

**Statistical Analysis**

Values were presented as (n = 3) arithmetic mean ± Standard Error (SE). The data were statistically evaluated by One-Way Analysis of variance (ANOVA) followed by Post Hoc multiple comparison tests using SPSS software (version-16). The levels of significance P < 0.05 was considered as statistically significant and P < 0.01 as highly significant.

**CONCLUSION**

In the present study food supplement of Garcinia mangostana Linn. fruit pericarp extract holds significant
antibacterial activity against pathogenic bacteria \textit{Pseudomonas fluorescens}. This appears to be achieved by improvement of good immunological, biochemical and growth parameters. Therefore, the data reported in this study showed that 0.10% of \textit{G. mangostana} fruit pericarp extract supplementation with a feed could increase the resistance and also improve the survival rate. Further analysis is needed for the isolation and identification of active principles present in the extracts which could be exploited for fish feed formulation use and also the infection prevention method through feed in the fresh water aquaculture ecosystem.

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