Int.J.Curr.Microbiol.App.Sci (2019) *8*(2): 2993-3001

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 02 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.802.349

Growth Promoter Effect of Ginger, Garlic and Fenugreek on Pacific White Leg Shrimp (*Litopenaeus vannamei*)

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Keywords

Litopenaeus vannamei, Growth promotor, Supplemented diets ginger, Garlic and fenugreek

Article Info

Accepted:
22 January 2019
Available Online:
10 February 2019

A B S T R A C T

The present study was carried out to understand the dietary ginger, garlic and fenugreek on growth performance on *Litopenaeus vannamei L. Vannamei* was fed with three different herbal powder of ginger, garlic and fenugreek of varying levels of 1%, 2.5%, 5%, 2%, 4%, 6%, 0.5%, 1% and 1.5% of concentrations respectively to assess the optimal growth promoting potential. The feeding trial was continued for 63 days with triplicates in each treatment. The growth parameters (ABW, weight gain, SGR), feed efficiency parameters (FCR) and survival rate were significantly (P<0.01) higher in treatment diets fed *L. vannamei* compared to control diet. Highest weight gain was observed in Garlic powder 4% supplemented diet compared to all other garlic supplemented diets. Growth measured as specific growth rate was improved with the herbal supplementation in the basal diets. The elevation in the SGR is in the order of garlic > ginger > fenugreek > control. It was found that GP 4% supplementation in the diet was optimal level of inclusion in garlic supplementation for *L. vannamei* culture. The diet supplemented with GP 4% fed *L. vannamei* was showed best FCR with higher significance (P <0.01) compared to other treatments.

Introduction

Globally aquaculture production has become the rapid growing food production sector. It provides high-quality animal protein with total global production increasing from 63.6 million tonnes in 2011 to 66.63 million tonnes in 2012 (FAO). For high production people are started to incorporate antibiotic growth promoters in feed. But due to its negative impacts (residual accumulation in fish tissue, emergence of antibiotic resistant microbes) natural compounds are more acceptable to the public. The herbal immunostimulants which have been reported to enhance efficiency of feed utilization and animal productive performance (Levis *et al.*, 2008). The herbal plants have a wide variety of properties such as: antioxidant, antimicrobial, anticarcinogenic, analgesic, insecticidal, antiparasitic, anticoccidial, growth promoters, appetite enhancement, stimulant of secretion of bile and digestive enzyme activity, laxatives and antidiarrhea, hepatoprotection (Coutteau *et al.*, 2011).

Garlic, *Allium sativum* L., has been used for the treatment of many diseases since ancient times as reported in the Codex Ebers (1550 BC) where an Egyptian medical papyrus described several therapeutic formulas based on the garlic as a useful remedy for a variety of diseases such as heart problems, headache, bites, worms and tumors. Garlic (*Allium sativum*) has several beneficial effects for human and animals, exhibiting antimicrobial, antioxidant, and antihypertensive properties Sivam (2001). Garlic can help in the control of pathogens, especially bacteria and fungi, and increase the welfare of fish (Corzo, 2007).

Ginger (*Zingiber officinalis*) belongs to Zingiberaceae family. The part of the plant used is the rhizome, an important spice. The use of spices as food and feed additives has been practiced widely since ancient times. Till date, no study has been carried out on the shrimp with *Z. officinalis* as an herbal appetizer. Therefore, in the present study, *Z. officinalis* was chosen and the stimulatory effect verified. Various percentages of *Z. officinalis* was prepared and fed to postlarvae (PL-1–30) of *Penaeus monodon* through the live feed *Artemia franciscana*, because of its versatile characteristics, such as taste, high nutritive value, non selecting filter-feeding capability and non-contamination of the culture water. Ginger increases the pancreatic and intestine lipase (Platel and Srinivasan, 2000).

Fenugreek (*Trigonella foenumgraecum*) is an annual herb that belongs to the family Leguminosae widely grown in Pakistan, India, Egypt, and Middle Eastern countries (Alarcon-Aguilara *et al.,* 1998). Fenugreek has also been reported to exhibit pharmacological properties such as antitumor, antiviral, antimicrobial, anti-inflammatory, hypotensive and antioxidant activity (Cowan *et al.,* 1999 and Shetty *et al.,* 1997).

Materials and Methods

Litopenaeus vannamei (1000 numbers) were obtained from CP Hatchery, Nellore. Shrimp seed were packed in double plastic bags filled with oxygen and water in the ratio of 3:1 in each bag and the density of shrimp was 300/bag. Post larvae (PL10) transported by road in plastic bags containing 15 ppt saline water. PL transferred to the same salinity water in cement tanks of the wet lab. Acclimatization was carried out over 10 days. During this period the seed were fed apparent satiation with control diet. The number of shrimp seed to be packed in oxygen inflated polythene bags was calculated as per the following formula (Jameson *et al.,* 1995). N = (DO – 2) X V/CH Where: DO: Dissolved oxygen content of water (mg/l), V: Volume of water used for transport (Lt), C: Rate of oxygen consumption of shrimp (ml/kg of shrimp), H: Duration of transport (Hours)

Experimental design

The aquarium tanks used for experiments were of size 60x30x30 cm (Plate 3). Thirty aquariums including control were stalked on iron racks. Aquariums were located in a secured place where there is no direct sunlight and covered all the sides with black paper to avoid algal growth in the tank. Water in the aquariums was aerated by using air stones connected to the air compressor. Filters are used for filtering the aquarium water. The underground water was taken into a tank and allowed to aerate for 48 hours and was used for filling the aquaria. Salinity was checked before taking the water into aquarium. The water is allowed to pass through biofilter filter for 24 hours before introducing the shrimps into the aquaria. In each aquarium 12 numbers of shrimps with initial average weights of 3.2±0.11gm were introduced and triplicates were maintained for each treatment. Regular water exchange of 25%

was done every day. Left over feed, excreta and other debris was siphoned off from the bottom of the tank without disturbing the shrimps at every 2 hours.

Experimental feed preparation and feeding

Garlic, ginger and fenugreeks were purchased in sufficient quantities from local market. The ingredients were sun dried for 2 weeks and powdered at required quantities before feed preparation. Ten experimental diets (Plate 8) were prepared by supplementing a basal formulated diet with different levels 0% (Control), 2%, 4%, 6%, 1%, 2.5%, 5%, 0.5%, 1% and 1.5% of garlic, ginger and fenugreek powders respectively. The growth parameters of all the shrimps of each aquarium were individually estimated by taking their total body length and weight at 7 days interval.

Weight gain

Weight increment was obtained by subtracting initial body weight from the final body weight. Weight gain (gm) = Final body weight (gm) – Initial body weight (gm).

Specific growth rate

Specific growth rate was calculated by the formula

$[(L_n \text{ FBW} - L_n \text{ IBW}) / \text{day}] \times 100$

FBW -- Final body weight
IBW -- Initial body weight
Ln -- Logarithm
Day -- duration of experiment (63 days)

Results and Discussion

Growth of *L. vannamei* fed with garlic powder (GP) supplementation

Observations on the growth during the first week (7th day) revealed that weight gain varied between 0.9±0.05g and 1.25±0.12g for treatment GP 2% and GP 4% respectively. Highest and lowest average weight values were observed in the treatments GP 4% (4.45±0.04g) and GP 2% (4.1±0.11g). On the 14th day highest weight gain of 1.22±0.07g and lowest weight gain of 0.8±0.03g were recorded for the GP 6% and control respectively. Highest average weight values (5.57±0.12g) and lowest average weight values (5.1±0.04g) were recorded for GP 4% and control respectively during the second sample (14th day). On the 21st day the highest and lowest weight gain observed were 0.92±0.06g and 0.51±0.10g for GP 4% and GP 6% respectively, while the highest and lowest average weight values observed were (6.49±0.04g and 5.67±0.02g) for GP 4% and GP 6% respectively. During the 28th day, the highest and lowest weight gain observed were 1.25g±0.11g and 0.95±0.11g for GP 4% and GP 6% respectively. The highest and lowest average weight values observed were (7.74±0.01g and 6.62±0.07g) for GP 4% and GP 6% respectively. On the 35th day of the experiment Highest and lowest weight gain observed were 0.8±0.04g and 0.2±0.01g for GP 6% and GP 4% respectively. The highest and lowest average weight values observed were (7.94±0.05g and 7.32±0.04g) for GP 4% and control respectively. GP 2% and GP 6% stood in second and third positions with weight of 7.85±0.01g and 7.42±0.11g respectively. On the 42nd day highest weight gain of 1.15±0.07g and lowest weight gain of 0.75±0.02g were recorded for the GP 4% and GP 6% respectively. Highest average weight values 9.09±0.08g and lowest average weight values 8.17±0.07g were recorded for GP 6% and control respectively (Fig. 1).

On the 49th day highest weight gain of 0.75±0.01g and lowest weight gain of 0.31±0.03g were recorded for GP 4% and control respectively. Highest average weight values 9.84±0.07g and lowest average weight

values 8.48±0.03g were recorded for GP 4% and control respectively. Highest average weight values of 11.97±0.07g from GP 4% and lowest average weight values of 9.55±0.07g from control were observed at the end of the experiment. An overall study indicated that the GP 4% recorded ABW of 11.97±0.07g in the 63 days' experimental period. This was followed by the GP 2% (10.68±0.04g), GP 6% (9.70±0.05g) and control (9.55±0.07g) they stood in second, third and fourth positions respectively.

The use of spices as dietary supplements has been practiced widely since time immemorial. Apart from enhancing the palatability of feed, herbal supplements have been widely believed to exert digestive stimulant action and growth promotion (venkataramalingam *et al.,* 2007).

The weight gain attained in GP 4% treatment diet fed *L. vannamei* was also significantly ($P < 0.01$) higher compared to other treatment diets. Poongodi *et al.,* (2012) were reported similar increase in weight gain of M. rosenbergii PL in the experimental diets over control. Similar results with garlic supplementation at 5% concentration were obtained by Rebecca and Bhavan (2014) in *M. rosenbergii*. Labrador *et al.,* (2016) were observed highest weight gain in *L. vannamei* fed with diet containing 6% garlic powder. The enhanced growth rate of the treatment groups may be attributed to the growth promoting substances present in the garlic powder. The growth data was subjected to analysis of variance (ANOVA) at 1% and 5% level of significance. The statistical analysis has shown that F- value is found to be significant among treatments. Since F- value is found to be significant, the pair wise comparison of any two Treatments could be done by computing RBD two way classification. The Treatment GP 4% is found to be significantly superior when compare to other Treatments. Treatment GP 4% has shown significantly different from all other Treatments. The second and third positions were occupied by GP 2% and GP 6% respectively. There was a significant difference between the culture periods also.

Highest weight gain in *L. vannamei* was noticed in the GP 4% herbal supplemented diets treatment compared to other treatments throughout experimental period performance related to progressive increase of garlic concentration was found to be significant ($P < 0.01$) among treatments. The growth promoting potential of several herbs on aquatic animals has been tested by many workers. The results were correlated with the observations in the present study (Chitrasu *et al.,* 2002).

Growth of *L. vannamei* fed with different concentrations of ginger powder supplementation

Observations on the growth during the first week (7^{th} day) revealed that weight gain varied between 0.91±0.06g and 1.24±0.11g for treatment ZP 1% and ZP 2.5% respectively. Highest and lowest average weight values were observed in the treatments ZP 2.5% (4.44±0.05g) and ZP 1% (4.11±0.10g). On the 14^{th} day highest weight gain of 1.12±0.10g and lowest weight gain of 0.7±0.07g were recorded for the ZP 1% and ZP 5% respectively. Highest average weight values (5.48±0.07g) and lowest average weight values (5.09±0.07g) were recorded for ZP 2.5% and ZP 5% respectively during the second sample (14^{th} day). On the 21^{st} day The highest and lowest weight gain observed were 0.94±0.04g and 0.42±0.02g for ZP 2.5% and ZP 1% respectively, while the highest and lowest average weight values observed were (6.42±0.10g and 5.65±0.04g) for ZP 2.5% and ZP 1% respectively. During the 28^{th} day, the highest weight gain observed were

1.15±0.12g in ZP 1% and control. The lowest weight gain observed were 0.65±0.01g for ZP 2.5%. The highest and lowest average weight values observed were (7.07±0.05g and 6.66±0.02g) for ZP 2.5% and ZP 5%respectively. On the 35th day of the experiment Highest and lowest weight gain observed were 1.14±0.10g and 0.41±0.04g for ZP 1% and control respectively. The highest and lowest average weight values observed were (8.02±0.02g and 7.32±0.04g) for ZP 2.5%% and control respectively. ZP 1% and ZP 5% stood in second and third positions with weight gain of 7.9±0.02g and 7.62±0.04g respectively.

On the 42nd day highest weight gain 0.91±0.10g and lowest weight gain 0.35±0.01g were recorded for the ZP 2.5% and ZP 1% respectively. Highest average weight values 8.93±0.04g and lowest average weight values 8.17±0.07g were recorded for ZP 2.5% and control respectively. On the 49th day highest weight gain 0.9±0.08g and lowest weight gain 0.22±0.03g were recorded for ZP 2.5% and ZP 1% respectively. Highest average weight values 9.83±0.07g and lowest average weight values 8.48±0.03 were recorded for ZP 2.5% and control respectively. On the 56th day highest weight gain 1.11±0.11g and lowest weight gain of 0.82±0.06g were recorded for ZP 2.5% and control respectively.

Highest average weight values 10.94±0.08g and lowest average weight values 9.3±0.06g were recorded for ZP 2.5% and control respectively. Highest average weight values of 11.79±0.02g from ZP 2.5% and lowest average weight values of 9.55±0.07g from control were observed at the end of the experiment. An overall study indicated that the ZP 2.5% recorded ABW of 11.79±0.02g in the 63 days experimental period. This was followed by the ZP 5% (10.1±0.08g), ZP 1% (9.95±0.03g) and control (9.55±0.07g) they stood in second, third and fourth positions respectively.

The statistical analysis has shown that F-value is found to be significant among treatments. Since F- value is found to be significant, the pair wise comparison of any two Treatments could be done by computing RBD two way classification. The Treatment ZP 2.5% is found to be significantly superior when compare to other Treatments. Treatment ZP 2.5% has shown growth performance significantly different from all other Treatments. The second and third positions were occupied by ZP 5% and ZP 1% respectively. There was a significant difference between the culture periods also. Ginger place very important role in fat digestion and adsorption (Platel and Srinivasan, 2000). In the present study growth performance through elevation in the average weight and weight gain were showed fluctuating trends with the progression of experimental period. Highest average weight (11.79±0.02g) weight gain (1.24±0.11g) were observed in *L. vannamei* fed with the ZP 2.5% supplemented diets among all treatments. Ginger supplemented diets were demonstrated better growth performance compared to control throughout experimental period (Figure 2). It was noticed that ZP 2.5% supplemented diets performed highest significance ($P < 0.01$) in the elevation of growth in *L. vannamei* compared to all the treatments. The growth performance in *L. vannamei* fed with ginger supplemented diets may be attributed to the growth stimulants, enhanced digestive enzymes activity present in herbs and P. monodon post larvae when fed with pepain constituent of papaya leaf were showed increase in weight gain (Penaflorida, 1995). Kesavnath and Jayaram (2000) reported an improvement in the growth of *M. rosenbergii* with the supplementation of Nutripro-aqua, a soya based herbal product. Ginger (100%) enriched artemia fed *P.*

monodon PL was showed the highest weight gain (130.8±1.7mg) compared to non enriched artemia treatment (74.8±2.0mg) (Venkataramalingam *et al.,* 2007). Rebecca and Bhavan (2014) were also reported *Z.officinale* improved feed intake and promoted the growth in the PL of *M. rosenbergii*. El-Desouky *et al.,* (2012) were noticed similar results on the effect of *Z.officinale* on the growth of *M. rosenbergii*. (Chang *et al.,* 2012) were observed similar weight gain increase with the consequential increase of zingerione in *L. vannamei* juveniles. Similar growth performance in aquatic organism with the inclusion of ginger in the feed was reported by earlier workers (Poongodi *et al.,* 2012 and Rahimi *et al.,* 2015).

Growth of *L. vannamei* fed with different concentrations of fenugreek powder supplementation

Observations on the growth during the first week (7th day) revealed that weight gain varied between 1.18±0.12g and 0.82±0.04g for treatment FP 1% and FP 0.5% respectively. Highest and lowest average weight values were observed in the treatments FP 1% (4.38±0.04g) and FP 0.5% (4.02±0.07g). On the 14th day highest weight gain of 1.35±0.12g and lowest weight gain of 0.8±0.03g were recorded for the FP 1.5% and control respectively. Highest average weight values (5.6±0.02g) and lowest average weight values (5.10±0.11g) were recorded for FP 1% and control respectively during the second sample (14th day). On the 21st day The highest and lowest weight gain observed were 1.1±0.10g and 0.52±0.02g for FP 1% and FP 0.5% respectively, while the highest and lowest average weight values observed were (6.7±0.08g and 5.76±0.05g) for FP 1% and control respectively. During the 28th day, the highest and lowest weight gains observed were 1.15±0.12g and 0.42±0.02g for control and FP 1% respectively. The highest and lowest average weight values observed were (7.12±0.01g and 6.64±0.07g) for FP 1% and FP 0.5% respectively. On the 35th day of the experiment Highest and lowest weight gain observed were 1.26±0.12g and 0.41±0.04g for FP 0.5% and control respectively. The highest and lowest average weight values observed were (8.2±0.04g and 7.32±0.04g) for FP 1% and FP 0.5% respectively (Fig. 3).

On the 42nd day highest weight gain 0.85±0.01g and lowest weight gain 0.45±0.01g were recorded for the control and FP 1.5% respectively. Highest average weight values 8.85±0.07g and lowest average weight values 8.16±0.05g were recorded for FP 1% and FP 1.5% respectively. On the 49th day highest weight gain 1.13±0.14g and lowest weight gain of 0.31±0.03g were recorded for FP 1% and control respectively.

Highest average weight values 9.98±0.12g and lowest average weight values 8.48±0.03g were recorded for FP 1% and control respectively. On the 56th day highest weight gain 0.92±0.10g and lowest weight gain of 0.75±0.12g were recorded for FP 1.5% and FP 0.5% respectively. Highest average weight values 10.86±0.02g and lowest average weight values 9.3±0.06g were recorded for FP 1% and control respectively. Highest average weight values of 11.35±0.03g from FP 1% and lowest average weight values of 9.55±0.07g from control were observed at the end of the experiment. An overall study indicated that the FP 1% recorded ABW of 11.35±0.03g in the 63 days experimental period. This was followed by the FP 1.5 % (11.07±0.08g), FP 0.5 % (10.05±0.02g) and control (9.55±0.07g) they stood in second, third and fourth positions respectively.

Fig.1 Growth of *L. vannamei* fed with different concentrations of garlic powder supplementation

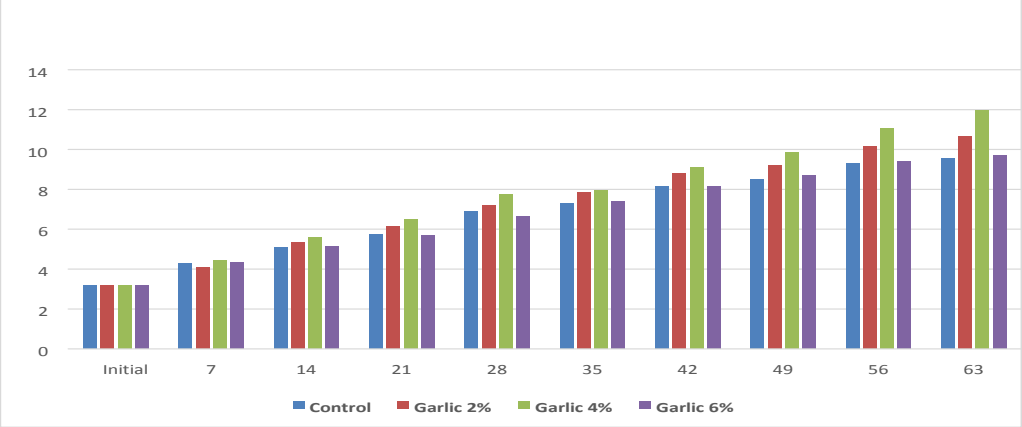


Fig.2 Growth of *L. vannamei* fed with different concentrations of ginger powder supplementation

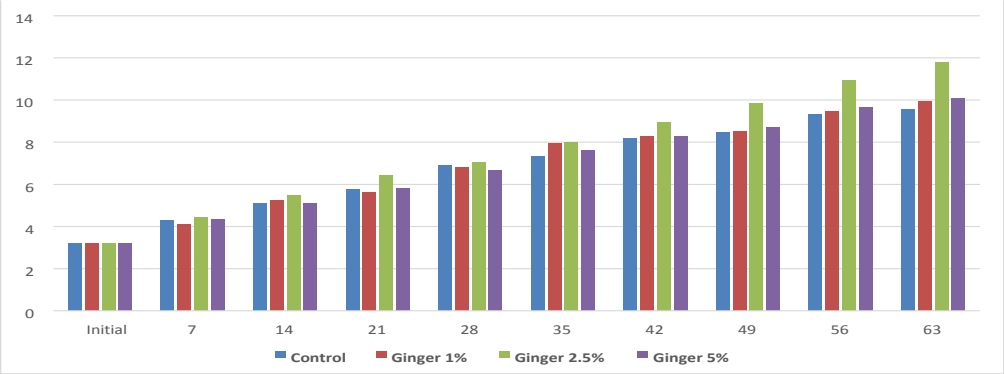
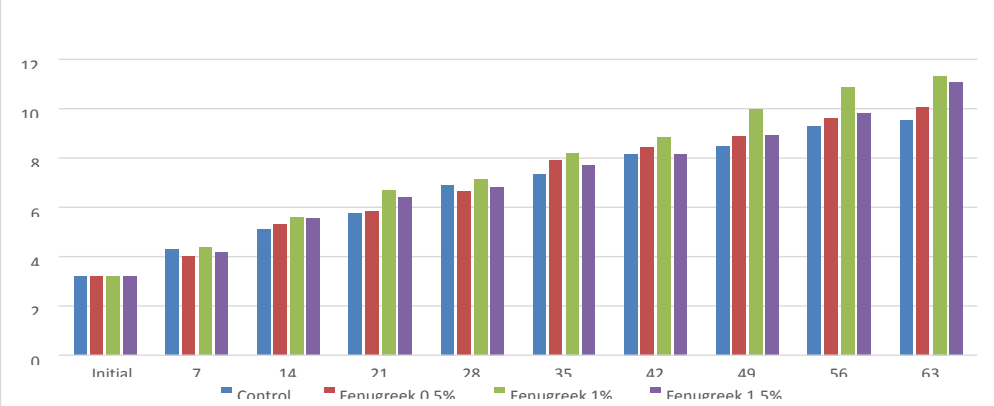


Fig.3 Growth of *L. vannamei* fed with different concentrations of fenugreek powder supplementation



The growth data was subjected to analysis of variance (ANOVA) at 1% and 5% level of

significance. The statistical analysis has shown that F- value is found to be significant among treatments. Since F- value is found to be significant, the pair wise comparison of any two Treatments could be done by computing RBD two-way classification. The Treatment FP 1% is found to be significantly superior when compare to other Treatments. Treatment FP 1% has shown significantly different from all other Treatments. The second and third positions were occupied by FP 1.5% and FP 0.5% respectively. There was a significant difference between the culture periods also. Growth performance of *L. vannamei* fed with different concentration of fenugreek powder supplementation. The results in the present study were correlated with the earlier observations in *M. rosenbergii* (Poongodi *et al.,* 2012), in *Cyprinus carpio* (Roohi *et al.,* 2015). Growth stimulants, antioxidants, vitamins and minerals present in fenugreek may have contributed for the increase in weight gain of *L. vannamei* fed with herbal supplemented diets. Growth performance came to stand still or reduction from the 1% FP inclusion level in the diet may be due to reduction in palatability of the feed.

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How to cite this article:

Mahesh Kumar, R., A. Chandra Sekhara Rao, Narshivudu Daggula, Ganesh Guguloth, B. Yesu Das and Ashok indhuri. 2019. Growth Promoter Effect of Ginger, Garlic and Fenugreek on Pacific White Leg Shrimp (*Litopenaeus vannamei)*. *Int.J.Curr.Microbiol.App.Sci.* 8(02): 2993-3001. doi: https://doi.org/10.20546/ijcmas.2019.802.349