Comparing the most preferred raw feed for Mud Spiny Lobster *Panulirus polyphagus* growth in pit culture at intertidal area of Akatariya (Mahuva) coast

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Abstract

In the present study, the fattening of mud spiny lobster *Panulirus polyphagus* in pit was carried out for 90 days at Aktariya village near Mahuva on the coast of Gujarat and find out the effect on growth and survival with feeding different types of fed material having uniform stocking density 20no/m^2 in all treatment. The data revealed significant (p<0.05) difference among the feed treatments, maximum growth was recorded in molluscan meat (MM) with weight gain of 128.9±6.08g followed by all mixed meat (AMM) 126.4±2.28, white meat (WM) 117.5±2.68 and low growth in red meat (RM) 115.3±4.63g. Significant difference was recorded in survival was higher in MM (90±5.00%) followed by AMM (83.3±5.77%), WM (78.3±2.89%) and low in RM (61.6±2.89%). Lower FCR was recorded in treatment MM (0.80±0.0.07) and AMM (0.85±0.07) followed by RM (0.96±0.0.05) and WM (1.14±0.0.08). The results of SGR was non-significant among all the treatment with highest SGR in MM (4.07±0.16) followed by AMM (4.00±0.16), WM (3.75±0.06) and low in RM (3.66±0.18). Water quality parameters were all conducive throughout the fattening period. Results of the present study revealed that most preferred food matter for fattening lobster is molluscan meat feeding given fast growth, high ADG and low FCR.

Keywords: Pit culture, Growth, Survival, Mud Spiny Lobster, FCR, and SGR.

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Introduction

Spiny Lobster (*Panulirus polyphagus*) culture is getting increasing attention in recent times due to the intense demand for live lobsters and lobster tails in the national and international market. Culture-based growout of tropical spiny lobster, is a emerging and unique industry that faces a number of challenges and opportunities Increasing global demand, a high market value, and concern for the sustainability of wild stocks have created significant interest in the development of spiny lobster aquaculture (Radford and Marsden, 2005; Simon and James, 2007).

Canada is the world's leading live lobster exporter with an annual export level of 20,400 mt (Kalidas and Salim, 2005). In 2004, countries in the Asia and the Pacific region accounted for 91.5% of the production quantity and 80.5 % of the value (Radhakrishnan, 2008). High value crustacean production in 2004 was 7.4% with 16.3 % of the total value (Syda-Rao, 2008). Production in the cage-reared *P. ornatus* industry is estimated to exceed 3000 tonnes annually at an export value of US$90 M (Williams, 2007). Annual landing of lobsters in India was 3000 t in 2005-06 (FAO, 2007) to which maximum landing of lobster were reported from Gujarat (43.7%) followed by Maharashtra (25.4%) (Kalidas and Salim, 2005). India has lost a substantial amount of foreign exchange by supplying juveniles to overseas countries for farming (Charles and Peter, 2003). Lobster fauna of India comprises 25 species (Radhakrishnan, 2008) from which three species are the most suitable for farming in India like *P. homarus* of southwest and southeast coast, *P. polyphagus* of North West coast and *P. ornatus* of southeast coast (Charles and Peter, 2003). Culture of the mud spiny lobster *Panulirus polyphagus*, based on the collection of early juveniles from the wild, has become a profitable and flourishing aquaculture industry (Srikrishnadhas and Rahman, 1995; Lovatelli, 1997; Tuan *et al.*,2000). Previous studies have shown that lobster above 60 g grows faster than the smaller ones. About one fourth of the commercial lobster's catches comprise juveniles of about 60-90 g size, which fetch hardly US$ 0.2 per individual or about US$ 2-3 per kg. If they are grown to a marketable size of about 200g, they will fetch US$ 3 per individual or about US$ 14- 15 per kg. To avoid targeted fishing of juvenile lobsters and to protect the breeding stock, the Ministry of Commerce, Government of India has banned export of undersized lobsters by a Gazette notification in July 2003 (Venkatesan, 2004). Lobster fattening is slowly getting commercialized in Kerala, Andhra Pradesh, and Tamil Nadu and now in Gujarat state. Fattening of young ones caught from wild requires only little inputs and technological application. However, recent awareness of profitability by fattening lobsters to marketable size is changing the trend of the exporting juveniles for fattening. Fish meal include white and red meat supplies the largest portion of dietary

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protein in fish diets (Biswas *et al*., 2007), high protein content and favorable amino acid profile, is consistently available and reported to be palatable to most species of fish (Lim and Akiyama, 1992).

Aquaculture industry relies on feeding natural food items such as fresh fish, crustaceans and molluscs to the lobsters. The use of this type of feed results in significant wastage and hence poor feed conversion ratios and consequential environmental degradation (Tuan *et al.,* 2000). One of the obstacles to sustainable aquaculture of spiny lobsters is the lack of a preferred feed that will enable juveniles to be reared economically to a marketable size. In one of our previously experiments, the protein requirement of finfish account for about 70% of the diet and shellfish the remainder. The preferred fish, comprising 38% of all fish fed, was lizardfish (Tuan and Mao, 2004). The development of environment eco-friendly and cost effective feed has been recognized as one of the major constraints for large-scale culture of the spiny lobsters (Williams, 2007). At present, it is not possible to achieve the best growth and survival in spiny lobsters without the use of raw molluscan flesh (Johnston *et al.,* 2007; Simon and James, 2007). Food limitation induces nutrient deficiency and is an indicator of the utilization of nutrient reserves from body tissues (Sanchez-Paz *et al.,* 2006). Currently, almost all global lobster production is from capture fisheries, where stocks are either overexploited and in decline or at their maximum sustainable yield. Commercially viable hatchery technology is yet to be developed (Williams, 2007). The present study was carried out to compare the growth and survival of mud spiny lobster *Panulirus polyphagus* fattening by utilizing different types of raw feed in pit rearing at intertidal area of Akatariya (Mahuva) coast (Fig. 1).

Materials and methods

Experimental site

Experiments was carried out at Katpar fishing harbour (Lat. 21^0 2’ 43”N and Long. 71^0 48’ 12”E) near light house located 10 km away from Mahuva in Bhavnagar District, Gujarat, India (Fig. 2). Experiment was taken up for 90 days in the year 2018-19 in the month of September to December.

Pit specification

Pits are dug parallel to the coast line with hand tools as the bottom rock is soft in nature. After digging and leveling in the sides of the Pits, small holes of 0.15m were made so as to provide hiding spot for the moulting lobster. The pits were covered with nylon nets (20 mm) to prevent the lobsters from escape or being washed away by tidal waters. The nets are fastened on rock using reapers and nails (Fig. 3). Sea water enters the pit during high tide and hence water exchange takes place without any manual effort. Pits are reported to be varying in size from place to place, in general, two sizes have been found to be popular the

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"Virdas" or smaller Pits (Philipose, 1994). The "Virdas" must be located at lower levels where flushing with tidal waters occur twice a day. In some cases Pits are also partitioned using nylon nets, so as to stock separate size groups, avoiding competition for food and shelter. Pits ranging from 2x1x1m sizes were used for present experimental operation.

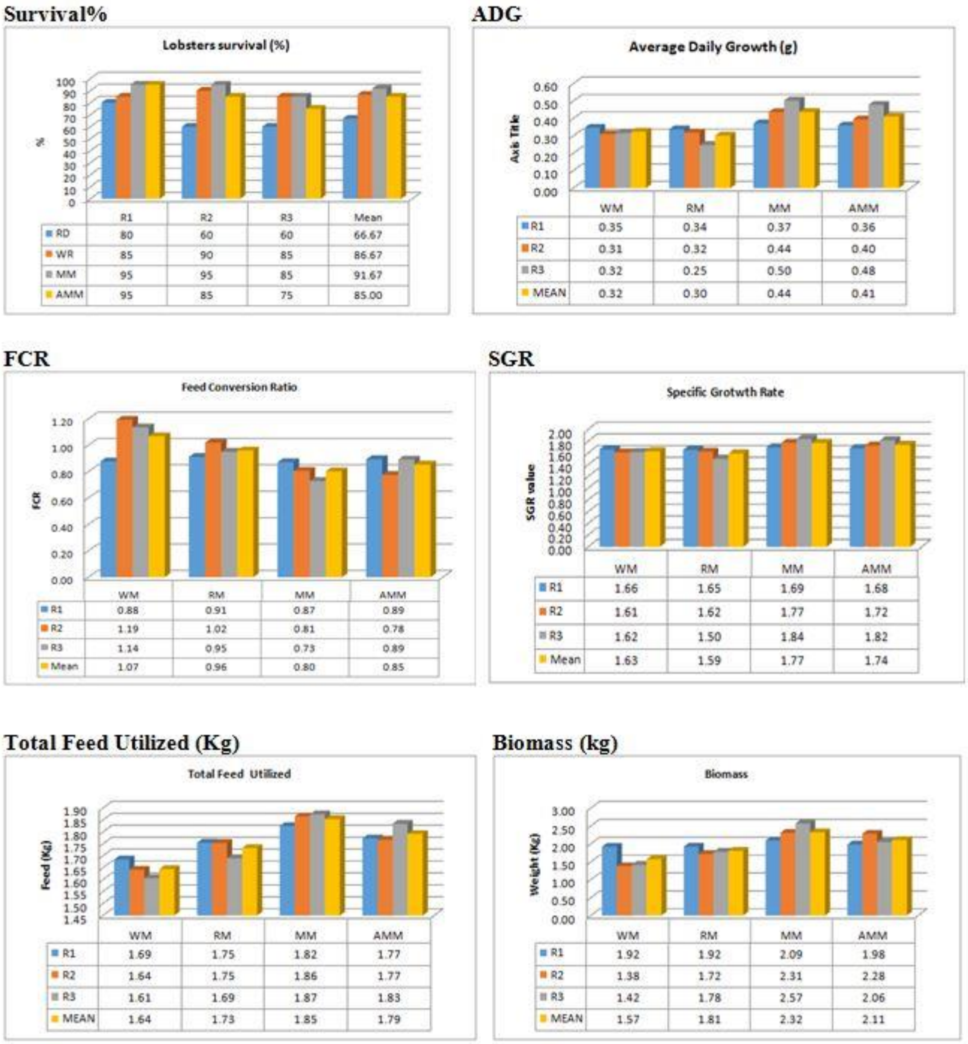

Figure 1: Growth performance of *P. polyphagus* lobsters in pit fed with different type of meat feeding for 90 days in pit.

Collection of lobsters and its acclimatization

The juveniles of spiny lobsters are available in abundance during the post monsoon months of August, September and October. Lobsters were either collected through lobster traps, doll net and "wada" (a similar technique to pen culture). The juveniles were collected from different potential sites along the Mahuva coast, the most promising among them are Khera-Patva,

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Chanchbundar, Uchha-Kotda, Datardi, Doliya, Setarda, Gujarda, Kuda, Visaliya and Siyalbet Bundar. Every day early morning during high tide period at 5:00 to 9:00, the highly skilled fishermen operate dragnet in and around lobster shoal. The collected lobster were of size around 70 to 110g juvenile lobsters, captured by tidal harvest through trawl catch and lobster traps. Collected lobsters were held in pit area for acclimatization, which after two months, were selected for pit fattening experiment. Lobsters which were physically good and healthy were randomly selected were placed in $2m^3$ pits with total 20 no. of juvenile lobsters/pit.

Figure 2: Map view of experimental area.

Figure 3: Pits covered with nets fixed on rock using reapers and nails.

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Experimental design and experimental site

A complete randomized design (CRD) was employed in the present investigation. Other details are as under: No. of replication: Three, No. of treatment: Four (Feed type).

Treatment detail

T1=Total 20 lobsters /m^2 were stocked in pit fed with white meat.

T2=Total 20 lobsters /m^2 were stocked in pit fed with red meat

T3=Total 20 lobsters /m^2 were stocked in pit fed with molluscan meat.

T4=Total 20 lobsters /m^2 were stocked in Pit fed with all the above feed each 33% (mixed type).

Each lobster was fed by four different types of diet (red meat type, white meat type, molluscan which include ((mussel and bivalve meat) and all the above (mixed types) was given on survival base at 5% of their body weight and feed treatment detail is as follows:

Red meat was collected from big eye tuna (*Thunus thunus*), skipjack tuna (*Katsuwonus pelamis*).

1. White meat was collected from Seer fish (*S. commersonii*, *S. guttatus*), Mullet (*Mugil cephalus*), Catfish (*Arius* spp.), lizardfish (*Saurida tumbil*) etc.
2. Bivalve and Mussels meat *Saccostrea cucullata, C. graphoides* and *Perna viridis* and squid meat (rarely).
3. Mixed meat: All the mixture T1+T2+T3 containing 30-33% daily fed @ 5% of the body wt. this bivalve were collected and stocked in the tank, which were selected and break open, meat was expel from the shell scar.

Growth monitoring and sampling

Five lobsters were randomly selected from the Pits, for weighing and total length measurement (Fig. 4).

Figure 4: Length weight measurement of fattened lobster.

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Biometric observation P. polyphagus

The biometric observations were recorded from five randomly selected *P. polyphagus* from the three replicate pits of lobsters fattening.

Average wet weight gain (g)

Randomly five *P. polyphagus* were collected by scooping from Pit and then weighed by a physical balance, as per Kemp and Britz (2008). The observations were recorded weekly. Wet weight gain (g) was recorded using the formula given below.

Wet weight gain % ={Final weight (g) – Initial weight (g)} * 100/Initial wet weight (g).

Feed conversion ratio (FCR)

Weight of the feed fed to the animal divided by the weight of animal growth. *i.e.* Feed conversion ratio = weight of feed fed (g)/ fish weight gain.

Specific growth rate (SGR)

Growth rates were calculated as specific growth rate (SGR)% body weight per day was recorded by using formula as given below:

Specific Growth Rate (SGR)=100×(lnt. FBW- lnt. IBW)/D

Where, FBW is final body weight (g) (weight at the end of the time interval studied)

IBW is initial body weight (g) (weight at the beginning of the time interval studied),

D is number of days.

Survival (%)

Final survival of *P. polyphagus* was recorded on the 60th day of fattening of experiment with the formula given below:

Survival Rate%=No. of live *P. polyphagus* at harvest*100/ No of lobster at initial stocking.

Statistical analysis

All data presented are expressed as means ± standard deviation and was subjected to One Way Analysis of Variance (ANOVA). Significance difference between means was determined using Duncan's multiple-range test (DMRT). The level of significance was set up at $p \leq 0.05$.

Results

The surface net was made up of nylon (20mm), hooked by nail over pit was sealed from all sides, from where the lobsters can escape from the pit. The pit structure and side in the present study was found to be sturdy and secured.

Lobsters were fed white meat (WM), red meat (RM), molluscan meat (MM) and all above mixed meat, altogether having 30-33% proportion. The meat used for feeding the lobsters during fattening were categories like white meat, red meat, molluscan meat and mixed meat include fishes (Table 1). Most preferable feed type as per record is bivalve/ squid meat with compare to white and red meat whereas least eaten was red fish meat with compare to white meat.

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Table 1: Proximate composition of feed utilized for lobster feeding.

Feed Type	Moisture %	Fat %	Protein%	Ash%	Reference
Red meat (RM)					
Thunnus obsesus	72.89±0.63	2.06±0.57	23.72±0.16	1.77±0.33	Mahaliyana *et al*., 2015
K. pelamis	73.28±0.89	0.41±0.56	24.13±2.01	1.43±0.22	
White meat (WM)					
Upeneus vittatus	73.6±2.61	0.8 ± 0.45	12.48± 0.59	4.12 ± 0.43	
Sphyraena putnamae	70.6 ± 0.42	0.7 ± 0.27	26.61± 1.48	1.45 ± 0.18	Bijukumar *et al*., 2013
Arius tenuispinis	72.7 ± 0.99	1.1 ± 0.29	18.49 ± 1	5.69 ± 0.45	
Mugil cephalus	75.27±0.12	2.42±0.21	17.56±0.22	1.15±0.09	Kumaran *et al.*, 2012
Molluscan meat (MM)					
Saccostrea cucullata	75.87±0.81	8.51±1.51	9.69±1.60	2.02±0.82	Mitra *et al.*, 2008
Perna viridis	89.32±0.52	1.27±0.04	7.14±0.07	1.42±0.03	Chakraborty *et al.*, 2016
U. duvauceli	80.40±0.23	0.52±0.08	17.50±0.06	1.31±0.15	Remyakumari *et al.*, 2018
Mixed type (AMM)					
T1+T2+T3	All the above meat will be mixed @ 30-33% each and fed to lobsters under fattening				

RM were not significantly different (p<0.05).

Average wet weight gain (g)

Initial weight (g) of *P.polyphagus* lobsters were Non significant (p<0.05), after 90 days fattening, the result signifies among the treatment. There was significant difference among the treatments (p<0.05).

The highest weight gain was found in molluscan meat (MM) (128.9±6.08) followed by (126.4±2.28), (117.5±2.68) and low growth (g) was with (115.3±4.63) in the treatment all mixed meat (AMM), red meat (RM) and white meat (WM) respectively (Table 2). With respect to avg. wet weight gain(g), WM was significantly differed from MM, whereas AMM and RM were not significantly different (p<0.05) among the treatment. Avg. wet weight gain (g) as observed in the respective treatment is shown graphically in Figure 1.

The highest SGR and ADG was recorded in treatment MM (1.77±0.07), (0.44±0.07) and lowest was recorded in treatment WM (1.59±0.08), (0.32±0.02) during the fattening. Statistical analysis revealed that all treatment was Non-significant (p<0.05). The lobsters fed with molluscan meat (MM) has SGR and ADG (g/day) in pit was higher than all other treatment. The highest avg. growth (g) increment was recorded in molluscan meat (MM) with 39.37±5.93 followed by 37.01±5.46, 29.21±1.79 and 27.17±1.79 in all mixed meat (AMM), white meat (WM) and red meat (RM) respectively at 90 days of fattening.

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Table 2: Mean weight gain of *P. polyphagus* lobsters (g) ±S.E in pit fed with different feeding matter.

DOC	Type of feed fed to lobsters			
	White meat	**Red meat**	**Molluscan meat**	**All mixed meat**
0	88.36±1.39^{a}	88.18±2.03^{a}	89.56±0.45^{a}	89.40±3.37^{a}
15	91.78±1.57^{a}	92.45±2.24^{a}	96.3±0.43^{a}	95.14±3.72^{a}
30	89.75±5.77^{a}	98.48±3.97^{a}	100.1±2.63^{a}	99.04±7.02^{a}
45	98.73±9.62^{a}	105.9±1.47^{a}	110.6±5.62^{a}	105.3±7.97^{a}
60	106.9±9.01^{a}	111.09±1.40^{a}	114.9±6.86^{a}	116.1±2.14^{a}
75	83.12±8.37^{b}	116.6±2.04^{ab}	123.2±5.74^{a}	119.1±4.11^{a}
90	117.5±2.68^{ab}	115.3±4.63^{b}	128.9±6.08^{a}	126.4±2.28^{ab}

(Within Mean±SE column with different superscript letters in all treatments are statistically significant (One way ANOVA; p<0.05 and subsequently Post Hoc Test)

Biomass (kg)

Maximum lobsters biomass (kg) obtained after 90 days of pit fattening was in molluscan meat (MM) (2.32±0.23) followed by AMM (2.11±0.15), RM (1.81± In the treatment MM was significantly differed from WM, whereas AMM and 0.10) and low in WM (1.57±0.34) (Table 3).

Table 3: Effect of different feed on growth and survival performance of lobster (*P. polyphagus*) fattened in pit with feeding different types for 90 days (±SD).

Parameters n=5	Type of feed fed to lobsters			
	White meat	**Red meat**	**Molluscan meat**	**All mixed meat**
Initial weight (g)	88.36±1.39^{a}	88.18±2.03^{a}	89.56±0.45^{a}	89.4±3.37^{a}
Final weight (g)	117.5±2.68^{ab}	115.3±4.63^{b}	128.9±6.08^{a}	126.4±2.28^{ab}
Net weight gain (g)	29.21±1.79^{a}	27.17±4.27^{a}	39.37±5.93^{a}	37.02±5.46^{a}
SGR	1.63±0.03^{a}	1.59±0.08^{a}	1.77±0.07^{a}	1.74±0.07^{a}
ADG	0.32±0.02^{a}	0.30±0.05^{a}	0.44±0.07^{a}	0.41±0.06^{a}
FCR	1.06±0.17^{b}	0.96±0.05^{ab}	0.80±0.0.07^{a}	0.85±0.07^{ab}
Survival (%)	66.66±11.5^{b}	86.66±2.89^{ab}	91.66±5.77^{a}	85.0±10.0^{ab}
Biomass(Kg)	1.57±0.34^{b}	1.81±0.10^{ab}	2.32±0.23^{a}	2.11±0.15^{ab}

(Within Mean±SE column with different superscript letters in all treatments are statistically significant (One way ANOVA; p<0.05 and subsequently Post Hoc Test).

Survival%

The data for survival of *P.polyphagus* lobsters in the respective treatment are detailed (Table 3). The highest survival rate was found in MM (91.6±5.77%) followed by (86.6±2.89%), (85.00±10.0%) and low with (66.6±11.55%), in the treatment RM, AMM and WM respectively. Statistical analysis of survival (%) was carried at the end of fattening. There was significant difference among the treatments (p<0.05).

FCR

Maximum feed intake and higher FCR by lobsters were in the Pits fed with molluscan meat (MM) (2.53±0.16), (0.80±0.07) followed by all mixed meat (AMM) (2.46±0.06), (0.85±0.07), Red meat (RM) (2.34±0.18), (0.96±0.05) and low in white meat (WM)

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(2.30±0.18), (1.06±0.17). The data revealed that higher FCR was in the treatments MM significantly differed from WM, whereas AMM and RM were not significantly different (P<0.05).

Discussion

Acceptance of feed matter by lobsters during captivity condition depends upon many intrinsic and extrinsic factors. *P. polyphagus* lobsters appetite revival was studied by (Loya-Javellana *et al.,* 1995). Several factors are known to affect appetite in fish including stomach fullness and rates of gastric evacuation (Colgan, 1973; Grove *et al*.,1978; Vahl,1979), temperature (Elliot, 1975), animal size (Grove *et al*.,1978), stocking density (Solanki *et al.,* 2018), respiratory rate (Muir and Niimi,1972), dietary energy content (Bromley, 1987), circulating metabolites and glucose metabolism.

According to (Radhakrishnan, 2008) in Gujarat state, juveniles of *P. polyphagus* (30-50g) were stocked in intertidal pits ($21x7x1m^3$) at 20 no/m^2 attained 100-125g within 90days of fattening, the present study is agreement with the above result with weight whereas (Solanki *et al.,* 2012) stated that rearing juvenile lobster with stocking density of 20 lobster/ cage ($2x1x1m^3$) resulted with weight gain of 48.95%, Protein turnover can be divided into its constituent processes, protein synthesis, protein growth and protein degradation. Water parameters like temperature (Tong *et al*., 1997) and dissolved oxygen (DO) consumption of juvenile lobsters showed to increase exponentially with a wide range of temperatures (5°C–21°C) (Crear and Forteath, 2002). Growth of crustacean is directly affected with dissolved oxygen level in the culture medium. There are many factors that have been found to affect the rate of oxygen consumption in spiny lobsters such as body weight, dissolved oxygen level, salinity, temperature, activity, handling, diurnal rhythm and feeding, such studies have been conducted only for few species (Buesa, 1979; Crear and Forteath, 2002; Díaz-Iglesias *et al.,* 2002 ; Perera *et al.,* 2005). Deposition of waste material from pit culture results in organic accumulation and bacteria in sediment causing increased sediment oxygen consumption. In some cases, this has led to anoxic bottoms, with increased risk of generating comprehensive negative ecological changes (species shift, ecosystem functional changes etc).

Lobsters have generally shown to tolerate high dietary levels of lipid (Tolomei *et al.,* 2003; Barclay *et al.* 2006). Also, feeding of raw molluscan meat has been associated with higher lipid content in the hepatopancreas (Ward and Carter 2009). According to (Cox and Davis, 2006) feeding *P. argus* juveniles spiny lobster rations of frozen clams, shrimp, squid and oysters at 100% of their body weight once daily at the onset of dusk resulted in significantly better growth than those fed 50% of their body weight twice daily. The fish meal digestibility is lower for *J. edwardsii* (Ward *et al.*, 2003) than the growth of lobsters fed fresh mussels (Crear *et al.,* 2002; Ward *et al.,* 2003), This statement is in agreement with the present study with molluscan meat total biomass (g) 2.32±0.23 with lower FCR 0.80±0.07 with compare to all other treatment.

Williams *et al.* (2004) stated that in the laboratory with *P. ornatus* (and for other crustaceans (Mackie, 1973; Derby, 1984; Carr and Derby, 1986), small soluble peptides and free amino acids are potent feed attractants that induce strong feeding behavior in crustaceans. Bivalve meat is rich in amino acid, Feeding fresh bivalve indicates that more amino acids are available for protein synthesis. Since the hepatopancreas is an organ exhibiting high protein synthesis and degradation (Mente, 2002), the higher free amino acid content in the clam fed group is an indication of a physiologically active hepatopancreas and a healthy animal condition. This statement is in agreement with the present study, all moluscan meat fed lobster obtain higher survival and healthy lobsters at harvest whereas (Smith *et al.,* 2003) reported that juvenile *P. ornatus* lobsters growth rate and survival were low with the mussel diet with 0.42 g/wk and 41±4.5%, respectively.

Guillaume (1997) has suggested that the protein requirement of crustaceans spp can be met with diets providing from 25–55% DM protein. (Chinh *et al.* 1997) reported that the protein content of mussel was about 5.5– 7.5% of wet weight, while lipid was quite low at 0.2–0.8% of wet weight. In the present study, protein content of molluscan meat range between 7.14±0.07 to 17.5±0.06%, lipid with 0.52±0.08 to 8.51±1.51%. The protein content of mussel is much lower than fish with white and red meat, this experiment has demonstrated that co-feeding of mussel and fish by-catch results in superior lobster growth than feeding fish meat alone.

Du *et al.*, (2004) reported that the organic matter at bottom layer of water and sediment in lobster cages with mussel co-culture was significantly lower than mussel co-culture, this is an agreement with present study, During harvesting the lobsters pit altogether were loaded with 6 to 8 inch thick layer of organic matter and clay, this may be due to incoming turbid tidal water due to port of pipava and alang shipyard, other than this incoming tidal fish, molluscan and crustacean larvae or juveniles enters the pits and get settled, which could have being consumed and so low FCR. Pits are prepared in porous rock, in which lobster were reared for 90 days, it is because this coastal belt has porous rock all around. Porous rock provide shelter to many type of infauna organisms as feed matter. The substratum is mainly formed of rocks of miliolite and laterite stone providing altogether a different habitat to the intertidal population (Sarvaiya, 1977). Mare (1942) stated that infauna are animals that live entirely within the sediment. Meiofauna are infaunal

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organisms that pass through a 500 pm sieve, but are retained in a 63 pm sieve. Solanki *et al.* (2016) reported that the intertidal marine fauna at Bhavnagar coastal like bivalve, gastropods, sponges, polychaetes, worms small crustacean larvae and seaweed etc, which would be the best preferred feed, on which lobsters survive and hence FCR was recorded lowest in all the treatment.

The major factor affecting the live trading of lobster is the coloration. The ability to maintain and improve coloration is an important consideration in live-holding of lobsters. Change of color over time in the exoskeleton of captive decapod crustaceans has been reported on several occasions (Howell and Matthews, 1991; Menasveta *et al*., 1993). The change in pigmentation is usually due to lack of carotenoids level in the diet as carotenoids are essential for the pigmentation of the exoskeleton. In the present study, lobsters maintained their coloration, possibly by deriving carotenoids through consumption of live dissected molluscan meat or pits side where infaunal organisms survive within the crevices and interstitial space within the rock.

Abraham *et al.* (1996) reported that external infestations with fouling organisms were common. Usually elevation of seawater temperatures in pit, and uneven tidal water flow leading to locally poor water quality, with lower dissolved oxygen concentration and ammonia buildup, ultimately caused bacterial diseases or mortality. Wastage of feed matter within the pit, resultant environmental pollution with organic matter cause stress on cultured stock potentiates the outbreak and spread of infectious disease (Evans and Brock, 1994; Aguado and Bashirullah, 1996) associated with increased susceptibility to infection (Takahashi *et al.*, 1995), this statement is in agreement with present study in White meat and red meat fed treatment pit has lower growth and high mortality, may be due to fat rancidity and feed wastage lead to malodorous water.

Conclusion

From the experiments, it indicate that the most preferable feed for rearing mud spiny lobsters in pits is molluscan meat with compare to all mixed meat, red meat and white meat feed. Lobsters survival and growth was recorded higher in the pit were lobsters were fed molluscan meat compare to all mixed meat, red meat and white meat feed. The highest lobsters mortality was seen in white meat treatment compare to red meat fed pit, all mixed type meat and low in molluscan meat feed. Fatty fish usually decomposed lead to rancidity, which affect the lobsters and hence low survival and growth. Lobsters growth get suppress, when any lobsters die within the pit, directly affecting the other lobster stock of the pit. It is advisable to carryout lobster fattening in pit by feeding molluscan meat. Whereas, experiment of lobster culture can be taken up in Pit rather than cage

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which may show less expensive, good growth and survival in the same.

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