

Effect of *Foeniculum vulgare* Mingled Diet upon Growth, Reproduction and Spawning Performance of Guppy Fish

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Naturally breeding fish cannot meet the demand of humans. So induced breeding is essential to fulfill this demand. Induced breeding ensures a timely supply of fish seeds having desired characteristics and different techniques can be used for this purpose. In this perspective synthetic hormones, extracts of pituitary hormones, Gonadotropin-releasing hormones, and sometimes Human chronic gonadotropin are used as a spawning inducer for fishes. Plant extracts can also be used as it is a new technique which could be used in aquaculture. The basic aim of our study was to enhance the growth as well as to check the effect of the traditional herb *Foeniculum vulgare* on the reproductive performance of *Poecilia reticulata*.

Methodology: Samples were collected from a local fish shop in Sargodha. Ethanolic extract of *Foeniculum vulgare* seeds was prepared and mixed with different commercial feed. This feed was given to fish for 90 days to test the effect of *Foeniculum vulgare* seed extract on growth and reproduction performance. Water quality parameters were also maintained and recorded daily. Fecundity and Gonad somatic index were measured after dissection by removing the ovaries.

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Fecundity was calculated by counting the number of larvae and eggs seen with the naked eye. The hatching rate was measured by counting the number of hatching in each spawning.

Results: According to the growth results, different levels of fennel seed extract has a significant effect on weight gain, length gain and survival rates of the fish in different groups. Statistical analysis cleared that T₂ showed the highest weight and length gain. The feed Conversion Ratio decreased significantly. Results of reproduction parameters showed that the highest absolute fecundity (9.4 ± 0.19), GSI (8.69 ± 0.2) and spawning have increased in T₂ followed by T₁, T₃, and control respectively. The observation of present research shows that *Foeniculum vulgare* seed extract can act as an estrogenic compound and growth promoter in commercial aquaculture.

Keywords: *Foeniculum vulgare*; fecundity; spawning; gas chromatography mass spectroscopy; reproductive performance.

1. INTRODUCTION

The fisheries division plays a pivotal role in nourishment, dietary security, profit earning, and enhancing the national economy. Among fishes, some are edible and some are ornamental and might be perceived as decorative fishes.

They are likewise called “living jewels” due to their friendly behaviour, beautiful colour, and shape [1]. All over the world, the trade of aquatic animals and their products has increased in the last few years.

Ornamental fishkeeping is considered an interesting, easy, and relaxing hobby throughout the world. The worldwide exchange of aquatic organisms has been proposed as the wellspring business. Ornamental fishes are very attractive aquatic species in the world.

Ornamental fish is a key element of the aquatic environment and is considered an ecosystem maintainer in the aquatic environment [2]. *Poecilia reticulata* is a native species from North Brazil and South America [3].

Poecilia reticulata known as “Guppy fish” belongs to the family Poeciliidae, it is a small ornamental fish also called a livebearer, inhibited in a freshwater environment. *Poecilia reticulata* is a commercially important fish due to its attractive colours and variation in the tail which makes it the most trading ornamental aquarium fish in the world [4].

Poecilia reticulata start to breed from February till its peak in July. Female *Poecilia reticulata* are livebearers and give birth to live young. The rearing period of *Poecilia reticulata* in the Southeastern U. S. starts in May and finishes in September and October [5].

At the age of 10-12 weeks, females become mature while males mature at the age of 7 weeks. Female *Poecilia reticulata* show polyandry, females can mate with multiple males. Females can give birth to 20-200 young in a single spawn. The gestation period of *Poecilia reticulata* is about 4-6 weeks [6].

Seed availability is only possible by reproduction. Natural reproduction is not enough to meet the seed availability according to demand. Induce breeding is the best way to enhance reproduction, to produce seeds.

The availability of seeds can be possible by reproduction as well as artificially induced breeding in hatchery [7]. Due to the lack of proper environmental condition, the reproduction and growth of fishes is disturbed, and it is difficult to meet the demand for fish seed by natural resources. So, to fulfil this demand synthetic stimulators are used for fish breeding [8].

For egg development and spawning, females need an appropriate amount of lipids and protein. Diet plays a significant job in the development and reproduction of ornamental fish, and various feeds have been utilized for its raising.

Supplement feed, hormones, anti-infection agents, and numerous herbal products are used for enhancements of fecundity and gametes maturation of ornamental fish [9].

There are many ways to stimulate the reproduction of fish. Reproduction of fish can be provoked by using one of these products in ornamental fish, Ovaprim a liquid form injection which is a mixture of GnRH and domperidone in the liquid of propylene glycol.

Ovaprim is used as a spawning abet to induce evolution [10]. The gonadosomatic index (GSI) is

the ratio between body weight and gonads weight of fish.

The gonadosomatic index involves identifying the spawning season of fish. Fecundity is the relation between the numbers of eggs produced in each spawn and the body weight of fish. It is the most important parameter used in the study of the reproduction of fish [11].

Gonadosomatic index and fecundity measures are helpful in measuring population dynamics, population carrying capacity and productivity. It evaluates the reproductive system of a fish by calculating the total body size. It is considered the most important parameter of fish reproductive biology, and provides us with a comprehensive view of fish breeding and the reproductive status of related species, especially in finding the fish breeding seasons. Fertility and effectiveness are estimated by the Gonadosomatic Index and fecundity [12].

To check the effect of the traditional herb *Foeniculum vulgare* on growth rate, and reproductive performance of *Poecilia reticulata*.

To evaluate the influence of *Foeniculum vulgare* on the spawning of female *Poecilia reticulata*.

2. MATERIALS AND METHODS

(Complete Random Design (CRD) was used for sampling purposes to evaluate the variable of growth (weight gain, length gain, FCR, and survival rate) and Reproduction (Fecundity, GSI, Hatching rate, and spawning).

The present study was conducted in the Laboratory, Department of Zoology, The University of Lahore, Sargodha Campus. *Poecilia reticulata* stock of 120 was kept in the 12-glass aquarium of size 12×12×18. Juvenile *Poecilia reticulata* having a size range of 0.19 ± 0.02 were divided into four experimental groups. Each glass aquarium for experimental treatment contains 10 juvenile guppies (30 in triplicate). The fish feed used during the experiment was commercial.

2.1 Sample Size

The present experiment was performed for 3 months (90 days) after being acclimatized in laboratory conditions for two weeks. Initial stocks of 120 juvenile *Poecilia reticulata* having an average weight of 0.19 ± 0.007 were purchased from a commercial fish shop in Sargodha.

Fish were identified by following the Coad, [6]. Guppies were kept in the four aquariums to make them acclimatized to the laboratory condition for two weeks before the research. After two weeks, fingerlings were divided into four Aquarium manually @ ten fish per aquarium.

During this period juveniles were observed and diseased juveniles were separated from the healthy fishes, then remaining stocks were divided into four treatments having an average weight of 0.18 ± 0.01 g (T₁), 0.19 ± 0.01 g (T₂), 0.19 ± 0.01 g (T₃), and 0.19 ± 0.01 g (T₄).

Poecilia reticulata were provided with a feed named "INCH GOLD" a commercial feed of 3% of body weight twice a day i.e. 8:00 am and 6:00 pm. Aquarium water was changed weekly to maintain a healthy and clean water environment.

2.2 *Foeniculum vulgare* Seeds Extract Preparation

Foeniculum vulgare seeds were purchased from the herbal shop in Sargodha, Pakistan. *Foeniculum vulgare* seeds were identified by the Department of Botany, Lahore University, Sargodha Campus. *Foeniculum vulgare* seeds were ground with a blender to get a fine powder.

To get *Foeniculum vulgare* seed extract, *Foeniculum vulgare* seed powder (50 g) was taken and 96% ethanol was mixed with a ratio of 1: 1. The extract was kept at room temperature for 24 hours with continuous stirring.

What-man filter paper No.1 was used to filter the extract. The obtained extract was diluted with distilled water to obtain the final solution [13].

2.3 Treatment Feed Preparation

Feed was prepared by the following (Haghighi et al, 2014). Commercial feed which is "Inch gold" used in feed and mixed with *Foeniculum vulgare* seeds extract in a Petri dish. Four treatment diets with different *Foeniculum vulgare* seed extract concentrations were prepared i.e. 50, 100, and 150µl/g while the fourth diet was controlled by having 0µl *Foeniculum vulgare* extract.

These diets were termed as D₀, D₁, D₂, and D₃. Feed pellets were dry at room temperature. The pellets were air-dried and stored in airtight container at room temperature until fed. This feed was fed to fish, twice a day, at 3% of body weight, for 90 days. From all groups required

parameter evaluation was checked after fifteen days.

2.4 Seed Analysis

Foeniculum vulgare seed extract was analyzed through a gas chromatography-mass spectroscopy system (Hammouda et al., 2014).

GC-MS system contains an auto-sampler unit, injector use, and a gas chromatograph with a mass spectrometer. With a ratio of 1: 100, approximately 2 μ l samples were inserted into split mode. Helium gas was used as the carrier with a pressure of (65.2 kPa).

The ionization energy used to identify the compounds by GC-MS was 70 eV. The temperature in the Column oven was 80°C to 220°C. The flow rate of helium gas was used as 1.5 l ml/min as a carrier gas.

The average temperature range for the injector and MS transfer line was 220°C to 290°C. The total time required for separation was 65 minutes. The MS capillary column extracted the *Foeniculum vulgare* seed extract compounds [14].

2.5 *Foeniculum vulgare* Seed Extract Composition (%) by GC-MS

Shows the chemical component of fennel seed extract. With the aid of GC-MS, 18 compounds were described. Trans-anethole (64.49 per cent), Fenchone (11.68 per cent), and Benzaldehyde-4-methoxy (10.01) were the main constituents of the ethanolic extract of fennel seed. Furthermore,

the fennel seed contained significant amounts of different minor constituents, with a contribution of less than 10%.

Chemical compound	%
4-Hexen-2-one	0.20
3-Hydroxytetrahydropyran	0.65
Acetic acid	0.10
Fenchone	11.68
Delta-3-carene	0.52
Camphor	Trace
Tetradecane	0.90
Benzaldehyde-4-methoxy	10.01
L-Histidine	Trace
Benzene -1- methoxy-4- (2-propene)	2.52
Fenchyl acetate	0.11
Cyclohexane	0.41
1-Methyl-2-methylene-4-isopropyl	Trace
Trans-anethole	64.49
1-Tetradecene	0.74
1-Methoxy-3-(ethenylcarbonyl)B	0.81
Hexatriacontane	1.54
10-Nonadecanone	3.17

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Weight gain and length gain

Calculated results for weight gain and length gain are presented in Table 2. Statistical analysis shows that maximum weight gain was observed in T₂ while minimum growth rate was recorded in T₀ (Control group) respectively.

Table 1. Growth data of *Poecilia reticulata* record after 14 days Trail

Treatments	Difference between Initial reading and after 14 days reading of samples					
	Initial Wt(g)	Final Wt(g)	weight gain (W _f - W _i)	Initial Length (cm)	Final Length (cm)	length gain L _f -L _i
T ₀	0.17	0.21	0.04	1.93	2.2	0.27
T ₁	0.19	0.24	0.05	1.95	2.4	0.45
T ₂	0.19	0.27	0.08	1.97	2.7	0.73
T ₃	0.18	0.24	0.06	1.92	2.5	0.58

Table 2. Growth data of *Poecilia reticulata* record during trial

Sr. No	Treatment	Total Weight gain and length gain during the experiment (90 days)					
		Initial Wt(g)	Final Wt (g)	weight gain (W _f - W _i)	Initial Length (cm)	Final Length (cm)	Net length gain L _f -L _i
1	T ₀	0.17	0.31	0.12	1.93	3.07	1.41
2	T ₁	0.19	0.38	0.19	1.95	3.73	1.78
3	T ₂	0.19	0.44	0.25	1.97	4.09	2.12
4	T ₃	0.18	0.39	0.21	1.92	3.66	1.74

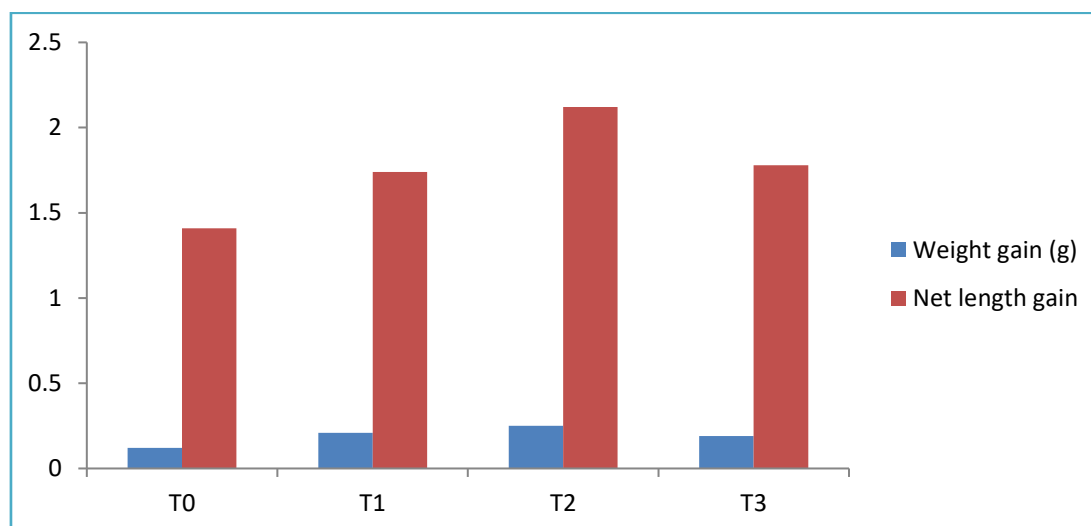


Fig. 1. Increase growth rate observation fed with *Foeniculum vulgare* concentrations

The increase in length was also observed during the experiment to check the effect of *Foeniculum vulgare* extract on total length gain. Length increase is presented in Table 2. Analysis of the increase in length presented in graph (Fig. 1) shows that the maximum length was attained by Treatment T₂ and T₀ achieved minimum length.

Growth performance results showed that a concentration of 100µl of *Foeniculum vulgare* seed extract containing has a positive effect ($P < 0.05$) on the growth parameters of *Poecilia reticulata*.

Weight gain, height increase, survival rate, and feed conversion ratio were recorded in (Table 3). Growth parameters were recorded after fifteen days. The statistically analyzed data showed that as the concentration of *Foeniculum vulgare* increases the weight and length also increase significantly ($p < 0.05$).

3.1.2 Feed conversion ratio

According to the results, data presented in Table 3, different concentrations of fennel extract have a positive effect on the FCR of feed fed by *Poecilia reticulata* in experimental treatments. FCR values were recorded as in T₀ (3.11 ± 0.8), T₁ (2.52 ± 0.4), T₂ (2.24 ± 0.1), and T₃ (2.93 ± 0.2), respectively. A significant decrease in the FCR value of T₂ is observed when compared with other groups in the experiment. Fennel seed extract contains anethole which is a digestive stimulator, a reason for the decrease in FCR. Graphical presentation (Fig. 2) of the Feed

Conversion Ratio shows that highest in T₀ while it was lowest in T₂. The results indicate that T₂ has significantly differed from T₁, T₃, and T₀. The results of FCR showed that *Foeniculum vulgare* reduces the Feed conversion ratio.

3.1.3 Survival rate

Graphical presentation of the survival rate (Fig. 3) showed that fennel extract did not negatively affect the Survival rate of *Poecilia reticulata* in every experimental group. The survival rates in all experimental and control were consistently high ($P > 0.05$). The survival rate of all treatments is recorded as 100%. It is inferred that *F. vulgare* seed extract has no adverse effect on the Survival rate of *Poecilia reticulata*.

3.2 Reproduction Parameters

3.2.1 Gonadosomatic index

Final data of reproduction parameters are described in Table 4. The gonadosomatic index was measured by the weight of the fish and the gonad's weight of the fish. Gonad's weight gain at maturity is shown in Fig. 4. The highest Gonadosomatic index was observed in T₂ followed by T₁, T₃, and T₀ separately. In the groups that contain *F. vulgare* seed extract, the gonadosomatic index (GSI) is significantly high ($P < 0.05$). The highest GSI was observed in T₂ (8.69 ± 0.2) and the lowest GSI was found in T₀ (6.07 ± 0.2) respectively.

Table 3. Growth parameters of *Poecilia reticulata* fed diets containing different concentrations of *Foeniculum vulgare* for 90 days

Growth parameters	T ₀ (0 µl)	T ₁ (50 µl)	T ₂ (100 µl)	T ₃ (150 µl)
Initial weight (g)	0.17±0.008 ^a	0.18±0.01 ^a	0.19±0.008 ^a	0.19±0.007 ^a
Final weight (g)	0.31±0.03 ^c	0.38±0.01 ^b	0.44±0.03 ^a	0.39±0.03 ^b
Weight gain (g)	0.12 ^c	0.21 ^b	0.25 ^a	0.19 ^b
Initial Length(cm)	1.93±0.13 ^a	1.95±0.16 ^a	1.97±0.1 ^a	1.92±0.14 ^a
Final Length (cm)	3.07±0.1 ^c	3.66±0.2 ^b	4.10±0.3 ^a	3.73±0.2 ^b
Net length gain	1.14 ^c	1.71 ^b	2.12 ^a	1.81 ^b
Feed conversion ratio	3.11±0.8 ^a	2.52±0.4 ^b	2.24±0.1 ^c	2.93±0.2 ^{ab}
Survival rate (%)	100 ± 0.00 ^a	100 ± 0.00 ^a	100 ± 0.00 ^a	100 ± 0.00 ^a

Note: Values given are mean ± standard error. Means with the same letter in the same column are not statistically significantly ($P < .05$) different

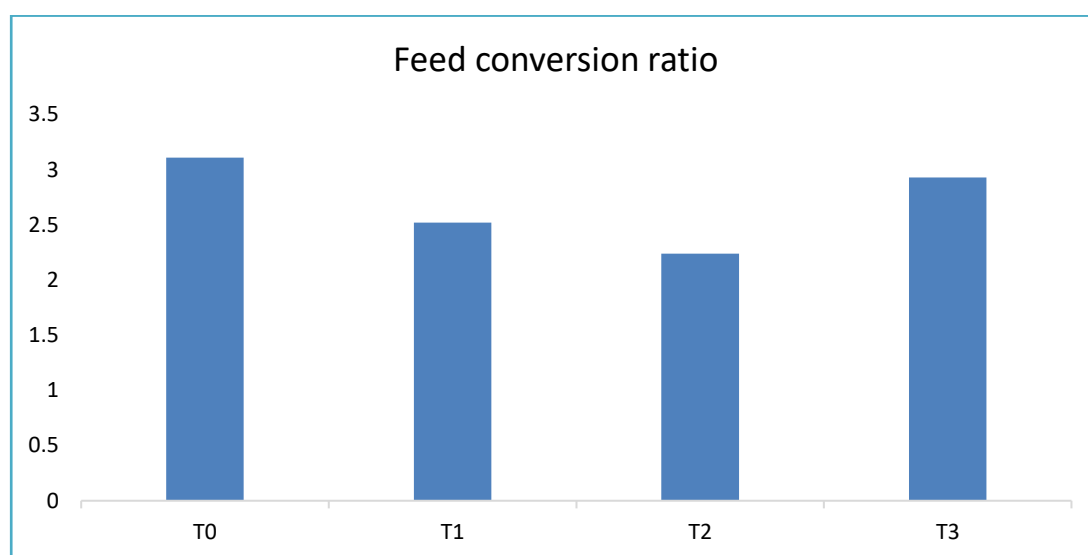


Fig. 2. Mean values of feed conversion ratio under varying stocking concentration of fennel extract on *Poecilia reticulata*

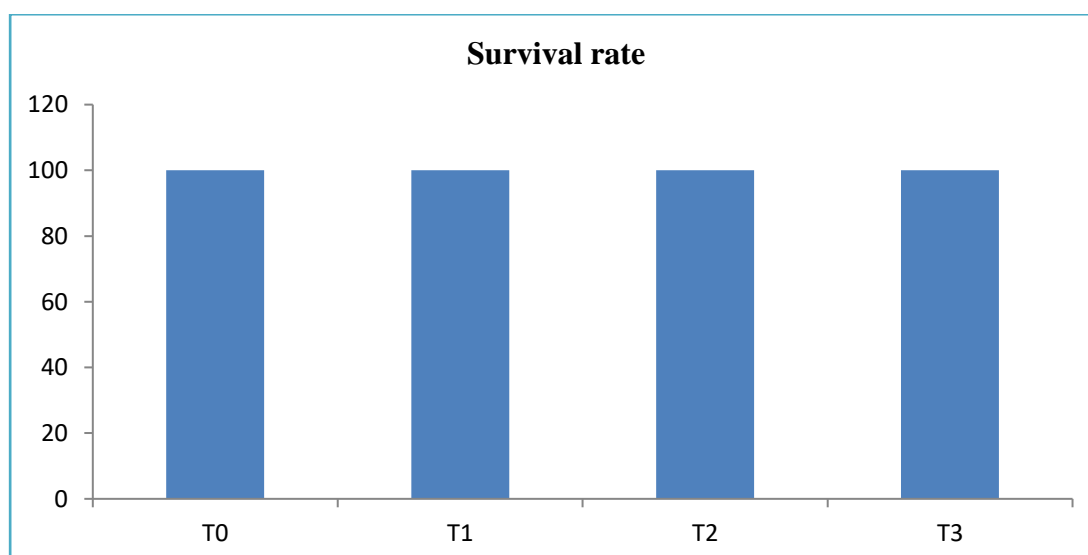


Fig. 3. Mean values of survival rate under varying stocking concentrations of fennel extract on *Poecilia reticulata*

Table 4. Age, fish, and gonad weight, Gonadosomatic index (GSI) of *P. reticulata*

Sr.no	Treatments	T ₀	T ₁	T ₂	T ₃
1	Age in days	180-192	180-198	180-210	180-195
2	Fish weight	0.79±0.008 ^c	0.93±0.008 ^b	1.04±0.01 ^a	0.93±0.008 ^b
3	Gonads weight	0.023±0.002 ^d	0.041±0.004 ^c	0.065±0.001 ^a	0.053±0.003 ^b
4	GSI	6.07±0.11 ^c	7.03±0.04 ^b	8.69±0.15 ^a	7.54±0.05 ^{ab}

Note: Values (mean ± SEM) of GSI are superscripted by alphabets within the same line and are different significantly (P<0.05)

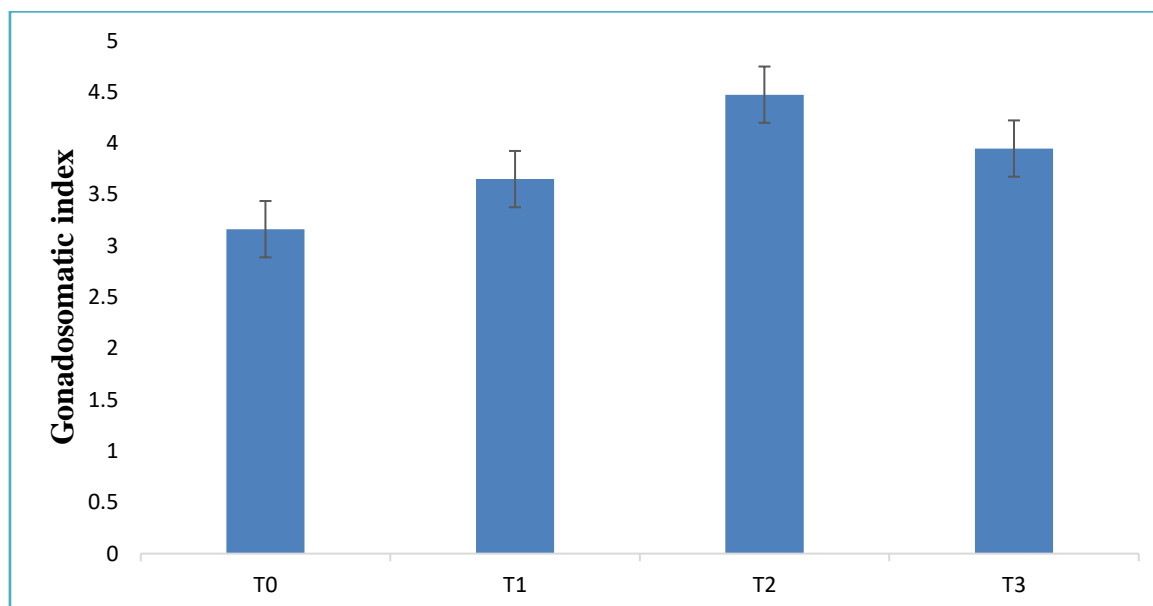


Fig. 4. Effect of *Foeniculum vulgare* mingle diet containing different concentrations on gonadosomatic index (Mean ± SD) of *Poecilia reticulata*

3.2.2 Fecundity

Findings of reproductive parameters are presented in Table 5 and Fig. 5. Significant differences were found among treatments in Gonadosomatic index (P<0.05); although absolute fecundity and relative fecundity of guppy fish significantly increased (P<0.05) in T₂ fed with 100 µl of *Foeniculum vulgare* extract.

As the gonads' weight increases, relative fecundity and absolute fecundity also increase. The number of eggs was the highest count in T₂. This showed that fennel seed extract with 100µl concentration in the diet has significant results (p<0.05) on the Gonads' initial maturity and fecundity.

The present study reported that the gestation period of *Poecilia reticulata* was 25-35 days with an average of 28 days.

In *Poecilia reticulata*, treatment is interior and happens through the mating of couples demonstrating explicit mating conduct. The male plays out an S-formed stance known as a 'sigmoid display' and orientates himself before the females toward the start of courtship [15].

3.2.3 Hatching

Results for hatching rate (%) were presented in Table 5. According to graph (Fig. 6) highest value was observed in T₂ (p< 0.05) which shows that increased significantly followed by T₁, T₃ and T₀ respectively. Results were best in T₂ which contains 100 µl extract of *Foeniculum vulgare*. The highest and lowest hatchling rates were respectively in T₂ and the control group. According to the result *Foeniculum vulgare* has a positive effect towards increase in hatching percentage.

Table 5. The impact of different concentrations of *Foeniculum vulgare* extract on reproductive parameters of *Poecilia reticulata* (♀) for 90 days

Sr. no.	Parameter	Treatments			
		T ₀	T ₁	T ₂	T ₃
1	Fish weight	0.79± 0.008 ^c	0.93 ± 0.008 ^b	1.04 ± 0.01 ^a	0.93±0.008 ^b
2	Fish length	3.9 ± 0.2 ^d	4.4 ± 0.12 ^c	5.6 ± 0.08 ^a	5.1 ± 0.04 ^b
3	Absolute fecundity	5.7± 0.12 ^d	7.9 ± 0.12 ^c	9.4 ± 0.19 ^a	8.3 ±0.15 ^b
4	Relative fecundity	46.8 ± 1.20 ^c	53.5 ± 0.98 ^b	62.3 ± 1.87 ^a	57.1±1.71 ^{ab}
5	Gonadosomatic index	6.07 ± 0.11 ^d	7.03±0.04 ^c	8.69 ± 0.15 ^a	7.54 ± 0.05 ^b
6	Hatching (%)	62.3 ± 1.69 ^c	81.2 ±0.08 ^b	91.3± 4.1 ^a	85.5 ± 2.3 ^b

Note: Values (mean ± SEM) superscripted by various letter sets inside a similar line are differ essentially (P < 0.05)

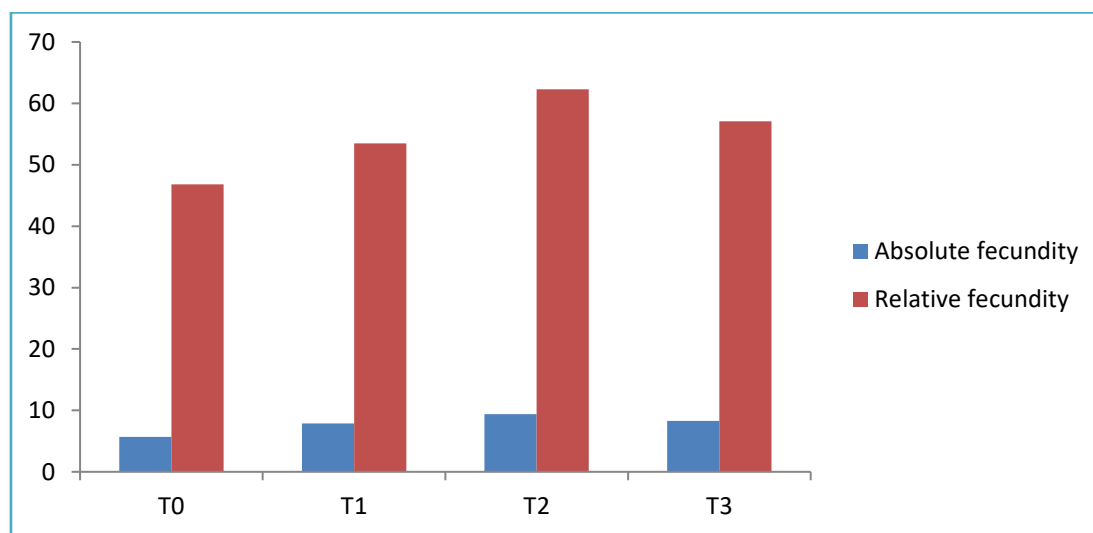


Fig. 5. Comparison of absolute fecundity and relative fecundity changes in test groups and control during the experiment

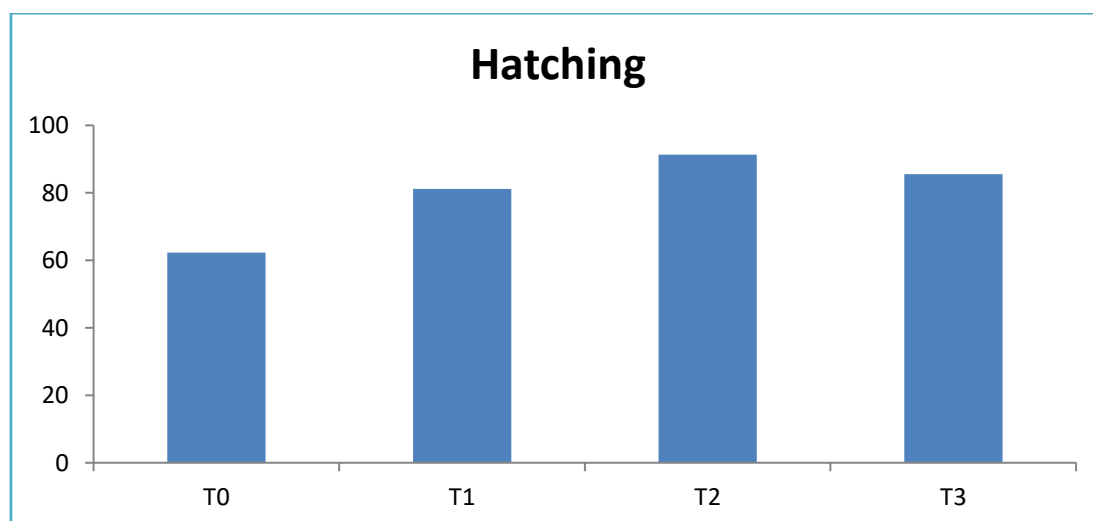


Fig. 6. Number of young ones released by control and experimental groups with varying concentrations of *Foeniculum vulgare*

Table 6. Evaluation of the spawning response of *Poecilia reticulata*

Parameters	Treatments			
	T ₀	T ₁	T ₂	T ₃
Survival rate percentage	100 ± 0.00 ^a	100 ± 0.00 ^a	100 ± 0.00 ^a	100 ± 0.00 ^a
Number of larvae	45±3.5 ^d	74± 1.4 ^c	91± 0.81 ^a	82± 1.6 ^b
Number of ova	34±2.4 ^d	68±2.9 ^c	81±2.1 ^a	75±2.4 ^b
Spawning time(hours)	88±0.81 ^a	65±0.81 ^c	39±2.94 ^d	76±1.63 ^b

Note: Values (mean SEM) superscripted by alphabets are significantly different ($P < 0.05$)

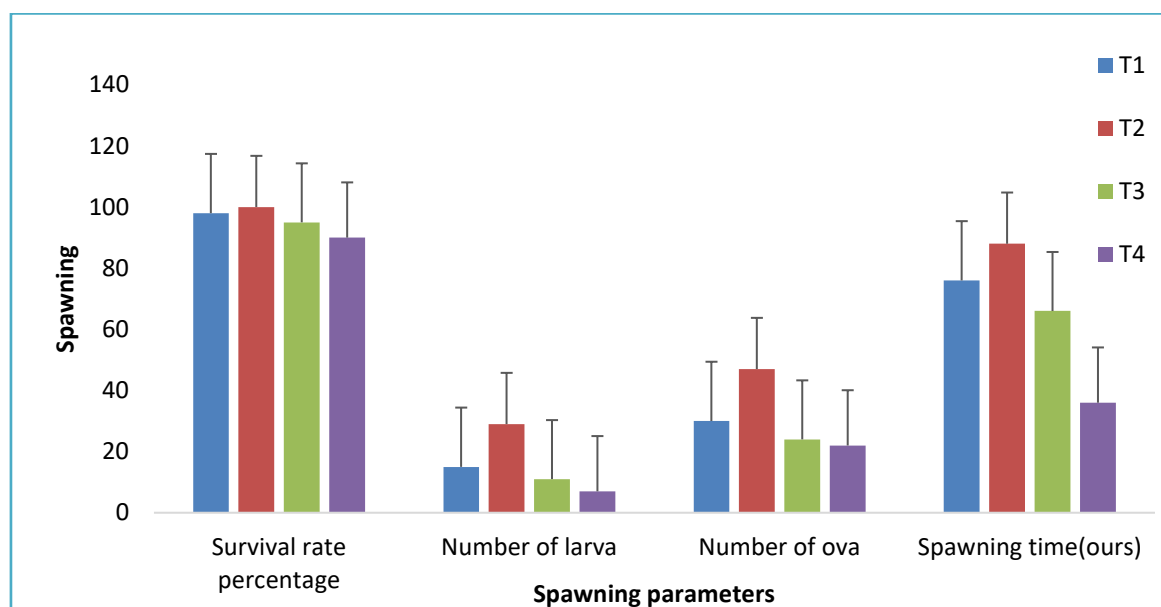


Fig. 7. Graphical comparisons of different doses of *Foeniculum vulgare* mingle diet on spawning performance in *Reticulata*

3.2.4 Spawning performance

To evaluate the influence of *Foeniculum vulgare* on the spawning performance of Guppy fish results were presented in the Table 5. Graphical presentation (Fig. 7) presented that guppy fish laid more egg when treated with Ethanolic extract of *Foeniculum vulgare* with 100µl concentration. Treatment (T₂) when treated with 100µl *Foeniculum vulgare* resulted a significantly positive effect ($p < 0.05$) 91±2.1 on no of young ones produced by *Poecilia reticulata*. Present findings indicated that herbal extract of *Foeniculum vulgare* is a positively effective stimulator for spawning of *Poecilia reticulata*.

4. DISCUSSION

The success of aquaculture depends on a number of parameters, the most important is a suitable diet that contains the completely

balanced nutritional diet for the average growth of fish [16].

The aim of this research was to investigate the effect of *F. vulgare* extract mingles diet on the growth and reproductive performance of *Poecilia reticulata*. According to the results of the present study, FCR decreased in T₂ as compared to other treatments. *Foeniculum vulgare* seed extract contains Anethole and Estragole perform the function as a digestive stimulant may be a reason for the decrease in FCR [17].

More than this growth of *Poecilia reticulata* significantly ($p < 0.05$) positive increase in T₂. The growth parameter, the survival rate was uniformly the same in all treatments which is about 100% in all treatments.

This justified that *Foeniculum vulgare* has no ($p > 0.05$) effect on the survival rate. There are similarities between the current study and those

investigated by Sotoudeh & Yeganeh [18]. The finding of the research is also co-related with the work of Yilmaz et al. [19]. His research investigated that dietary thyme improved the growth performance of *Dicentrarchus labrax*.

Water parameters recorded during the experiment were temperature, alkalinity, dissolved oxygen, TDS, TSS, and EC. The water temperature recorded during the experiment ranged from 24°C to 30°C.

Environmental parameter, the temperature was according to the work of Dawes, (1991). The results of this study are congruous with the findings of Yilmaz et al. [19]. They evaluated that a dietary cumin level of 1% provides the best survival rate for tilapia, *Oreochromis mossambicus*, with no inauspicious effect on growth performance simultaneously.

Tribulus Terrestris showed the same results with a significant difference ($P < 0.05$) in weight gain [18]. The present investigation showed similar findings as *Thymus vulgaris*, *Rosmarinus officinalis*, and *Trigonella foenum graecum* had a positive response towards the growth performance of *Dicentrarchus labrax* [20].

After the chemical analysis of *Foeniculum vulgare* seed extract it was found that *Foeniculum vulgare* extract contains the trans-anethole (64.49 %) which is similar in structure to 17-beta- estradiol.

The presence of trans-anethole may cause a significant increase in estrogenic hormones; and lead to an increase in reproductive performance and fecundity (Albert-Puleo, 1980). An increase in the reproduction activities of *Poecilia reticulata* fed feed containing *F.vulgare* seed extract, a reason for increasing the level of estrogenic hormones leads to an increase the reproductive performance. A similar result was reported by Nazari and Roozbehani, [13]. Their finding showed that the fertility rate of *Poecilia reticulata* enhanced when *Foeniculum vulgare* extract in the diet.

Among dietary treatments used in this research, T₂ show a positive increase in GSI (8.69 ± 0.2), Fecundity (9.4 ± 0.19), and hatching rate. Dada and Adeparusi [21] intimate that diets with *Sesamum indicum* supplement and seed powder of *Croton zambesicus* improved female *C. gariepinus* GSI.

Dada and Ajilore [21] distinguished an increase in egg diameter and fecundity of *C. gariepinus* when treated with *Garcinia* seeds extract. Sadeghpour et al. [22] commented on an increase in serum level estrogen in mice female when injected with extracts of *Foeniculum vulgare*.

The findings of another research are also consistent with this current research, the fecundity of guppy was directly proportional to the body weight of the fish, which means that the fecundity increased with the increase in body weight (Shahjahan et al., 2013). The use of injection of ovaprim showed the highest fecundity of *Pterophyllum scalare* suggested by Chatterjee, Patra, and Talwar, [23].

Ghosh et al. [9] reported that incorporation of probiotics in feed influenced the reproductive performance of livebearers in terms of high fecundity, high Gonadosomatic index, high fry survival rate, reduction in fry mortality and deformity, and higher average weight and length gain of fish fry.

Nielsen and Baatrup, [24] treated *Poecilia reticulata* with estrogens that enter into the aquatic system, results of this research showed that no significant difference was seen in the Gonadosomatic index (GSI).

A similar observation was found with *Cyprinus carpio* when treated with *Ferula coskunii* [25]. Current research findings indicated that *Poecilia reticulata* treated with *Foeniculum vulgare* seed extract increased the number of young's ones produced by guppy fish in T₂ were 91 ± 2.1 while the control group produced 45 ± 2.5 . Dada [21] investigated that feed supplements with *G. kola* seed powder improved the hatchability and fecundity of *C. gariepinus*.

Successful spawning of *C.punctatus* at 0.3 and 0.5ml/kg and 3000IU/kg weight of HCG was noted by Kather and Sridhar [26]. For *H.fossilis* the utilization of ovaprim came about the greatest Successful body spawning [23]. Effective spawning of *C.punctatus* is when treated with HCG. *Natrum muriaticum* showed a positive effect on the spawning performance of *Poecilia* [27].

The findings of previous research are similar to the results of the current investigation. There are also similarities between the work of [7] when *Puntius conchoniis* was treated with a similar

herbal medicine *Natrum muriaticum* on spawning response [28-30].

5. CONCLUSION

The present study investigated that *F.vulgare* seed extract has a significant effect on the growth performance of *Poecilia reticulata*.

Under the report of the current investigation, *F.vulgare* seed extract has a significant positive effect on reproductive parameters.

Increasing the level of estrogen hormones in fish fed with *F.vulgare* ethanol extract, due to the presence of trans-anethole, reproduction activities and fecundity of the fish was increased.

Considering, that fennel seed extract within the diet has a significant increase in the Gonad's initial maturity Gonadosomatic index increase is directly proportional to a female's body size.

As the gonad's weight increases, relative fecundity and absolute fecundity also increase the number of eggs.

It is suggested that herbal extracts contain estrogenic compounds as in *Foeniculum vulgare* can be used as a supplement in fish diets.

In the future, the use of plant extract in aquaculture will be an effective tool to attain durable, economically safe fish production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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