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EFFECTS OF DIFFERENT PREDATOR-PREY STOCKING RATIOS (*Channa marulius* : *Oreochromis mossambicus*) ON THE MEAT QUALITY OF *Channa marulius* IN FERTILIZED PONDS

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The experiment was conducted by using four predator-prey (*Channa marulius* : *Oreochromis mossambicus*) stocking ratios of 1:10, 1:20, 1:30 and 1:40 in eight earthen ponds. Both the predator and prey species were stocked for one year in fertilized ponds at densities of 40:400=440, 40:800=840, 40:1200=1240 and 40:1600=1640 under T_1, T_2, T_3 and T_4 respectively. Fertilization was done @ 28 kg nitrogen and 7 kg phosphorus ha^{-1} $week^{-1}$ throughout the experimental period. The results of present study revealed that the highest percentage 18.85±1.32% of crude protein contents were observed in the flesh of *Channa marulius* with T_3 in which fish gained maximum weight as compared to all other treatments. Moisture contents were higher with T_1, in which fish gained minimum weight as compare to all other treatments. Statistical analysis showed that there was a non-significant difference for all the recorded parameters of proximate body composition i.e. moisture, crude protein, total fat, total ash and carbohydrates, among all treatments. The organoleptic evaluation showed that T_3 earned highest score points for color, taste, texture and softness than T_1, T_2 and T_4 which was due to the sufficient availability of *Oreochromis mossambicus* offsprings as a food of *Channa marulius*.

INTRODUCTION

In nutrient contents, aquatic products are appreciably better than livestock products (Liao, 1980). Fish is considered nutritionally equivalent to meat in protein, high in essential minerals, amino acids and low in saturated fats. Worldwide, fish contributes about 17% of animal protein supplies. There is need to increase in the fish production in future due to increasing population and income, and changing consumption patterns for health reasons (Shang, 1996). Moav *et al.* (1977) reported good flesh color and intra muscular fat levels for fish grown in intensively manured ponds. There appeared to be non-significant difference in the taste and texture of fish meat grown in manured ponds and those fed on commercial diets. Allen and Hepher (1979) also reported that the fish reared in ponds receiving well-treated domestic wastes, tasted as good or even better than the fish grown in waste-free ponds. Tiews *et al.* (1973) observed a strong influence of feeding intensity and the plan of nutrition on the chemical composition of fish (*Salmo gairdneri*). Channa spp. has a considerable higher protein and lower fat contents than carps and tilapia (Sharma and Simlot, 1971). Further *Channa marulius* has higher protein (16.18%) contents than *Cyprinus carpio* (14.14%), *Cirrhina mrigala* (14.11%), *Tilapia nilotica* (13.89%) and *Labeo rohita* (13.63%) in fresh form (Shaheen, 1988). The fat contents basically determined the quality of fish meat (Zeitler *et al.*1984). Both the fat and protein contents of fish varied widely depending up on the feed ingested (Stansby, 1962). Besides the high quality flavor and texture of their flesh, snakeheads are especially regarded as diet for invalids and recuperating patients. These are well known for their nutritive, invigorating and therapeutic qualities and recommended by physicians for inclusion in the diet of convalescent (Munshi and Hughes, 1992). They have long been regarded as valuable, highly food fishes in South and Southeast Asian countries and widely cultured in Far East (Wee, 1982; Agrawal, 1999). In recent years high market price for its firm, white particularly boneless and more agreeably flavored flesh have made the culture of *Channa marulius* economically viable.

Thus a project was planned to study the effects of different predator-prey stocking ratios (*Channa marulius* : *Oreochromis mossambicus*) on the meat quality of *Channa marulius* in fertilized ponds.

MATERIALS AND METHODS

The experiment was conducted by using four predator-prey (*Channa marulius*: *Oreochromis mossambicus*) stocking ratios of 1:10, 1:20, 1:30 and 1:40 in eight earthen ponds each with a size of 40.00 x 10.00 x 1.50 meter at Bismillah Fish Farms, Ghotki, Sindh. After preliminary preparation, on 18 April 2003, all the ponds were fertilized @ 28 kg nitrogen and 7 kg phosphorus

ha–1 week–1; fertilization was done at the same rate throughout the experimental period (Yi et al., 2000). The brooders of *Oreochromis mossambicus* (mixed-sex of 15.00±0.97 to 16.10±1.45g) were collected on 2nd May 2003 from natural water and introduced on the same day in stocking ponds after giving a bath in 2% $KMnO_4$ solution to avoid infection. . On 1st June 2003, (one month after the stocking of *Oreochromis mossambicus*) *Channa marulius* of 19.50±0.22 to 20.50±0.26g were stocked after giving a bath in 2% $KMnO_4$ solution. Both the predator and prey species were stocked for one year at densities of 40:400=440, 40:800=840, 40:1200=1240 and 40:1600=1640 under T_1, T_2, T_3 and T_4 respectively.

Proximate composition

Ten fishes (*Channa marulius*) were selected randomly from each of the treatment to obtain three meat samples (bone free fillet) for the determination of proximate composition. Moisture, crude protein, crude fiber, total fat, total ash and carbohydrates contents of fish meat were analyzed by following A.O.A.C. (1984).

Organoleptic evaluation

A panel of trained judges from the academic staff member of the Department of Zoology and Fisheries, University of Agriculture, Faisalabad (Pakistan) was asked to perform the organoleptic evaluation (scoring for color, taste, texture, flavor and softness) of meat using three samples of each treatment by following the method of Larmond (1977).

RESULTS

Proximate composition of fish meat

Meat of *Channa marulius* reared under four treatments was analyzed at the end of experiment for its proximate composition and organoleptic evaluation to determine fish meat quality (Table 1).

The maximum moisture contents (76.27±1.48%) were recorded in the flesh of *Channa marulius* with T_1 in which fish gained minimum weight as compared to all other treatments, while minimum percentage (73.85±1.63%) of moisture were found in the fish meat of T_3 in which fish gained the maximum weight as compared to all other treatments. Analysis of Variance showed that there was a non-significant difference for moisture contents among all treatments.

The highest percentage (18.85±1.32%) of crude protein contents were observed in the flesh of *Channa marulius* with T_3 in which fish gained maximum weight as compared to all other treatments, while minimum (16.98±0.91%) of crude protein were observed in the fish meat of T_1 in which fish gained the minimum weight as compared to all other treatments. Statistical analysis showed that there was a non-significant difference for crude protein contents among all treatments.

The crude fibre contents were not found in the flesh of *Channa marulius* under all treatments. Total fats contents of *Channa marulius* were 2.38±0.35%, 2.40±0.11%, 2.50±0.13% and 2.42±0.13% under T_1 T_2 T_3 and T_4 respectively. The maximum value (2.50±0.13%) of total fat contents were found in the flesh of *Channa marulius* with T_3 in which fish gained maximum weight as compared to all other treatments while minimum (2.38±0.35%) values of total fat were estimated in the fish meat of T_1 in which fish gained the minimum weight as compared to all other treatments. Analysis of Variance showed that there was a non-significant difference for total fat contents among all treatments.

Table 1. Proximate composition of *Channa marulius* cultured under different treatments with their standard error

Treatments	Parameters					
	Moisture (%)	Crude protein (%)	Fibre (%)	Total fat (%)	Total ash (%)	Carbohydrates (%)
	Mean ± SE					
T_1	76.27 ± 1.48	16.98 ± 0.91	-	2.38 ± 0.35	1.90 ± 0.01	2.47 ± 0.20
T_2	75.64 ± 0.73	17.47 ± 0.51	-	2.40 ± 0.11	1.92 ± 0.02	2.58 ± 0.09
T_3	73.85 ± 1.63	18.85 ± 1.32	-	2.50 ± 0.13	1.95 ± 0.05	2.85 ± 0.13
T_4	75.60 ± 2.22	17.40 ± 1.79	-	2.42 ± 0.13	1.94 ± 0.08	2.64 ± 0.22
ANOVA						
S.o.v.	d.f	Mean squares				
Replication	1	18.392	10.306	-	0.2592	0.01361	0.2048
Treatments	3	2.160^{NS}	1.318^{NS}	-	0.0055^{NS}	0.00118^{NS}	0.0510^{NS}
Error	4	0.747	0.597	-	0.0259	0.00181	0.0073

NS = Non-significant (P>0.05).

The maximum (1.95±0.05%) of total ash contents were found in the flesh of *Channa marulius* with T_3 in which fish gained maximum weight as compared to all other treatments, while minimum (1.90±0.01%) of total ash contents were estimated in the fish meat of T_1 in which fish gained the minimum weight as compared to all other treatments. Statistical analysis showed that there was a non-significant difference for total ash contents among all treatments.

The maximum percentage (2.85±0.13%) of carbohydrates were recovered in the flesh of *Channa marulius* with T_3 in which fish gained maximum weight as compared to all other treatments, while minimum percentage (2.47±0.20%) of carbohydrates contents were recorded in the fish meat of T_1 in which fish gained the minimum weight as compared to all other treatments. Analysis of Variance showed that there was a non-significant difference for carbohydrates among all treatments. All the variables except moisture contents are of higher value under T3.

Organoleptic Evaluation of fish meat

At the end of the experiment, the organoleptic evaluation was performed to check the effects of different treatments along with its replication on the meat quality of *Channa marulius* (Table 2).

points for taste. Statistical analysis showed that there was non-significant difference for taste among all treatments. *Channa marulius* scored 7.60±0.15, 7.85±0.28, 8.20±0.37 and 7.90±0.65 points (out of 9) for texture, under T_1, T_2, T_3 and T_4, respectively. T_3, earned maximum scores points for texture. Statistical analysis indicated that there was non-significant difference among all treatments. Flavor of *Channa marulius* was awarded 8.00±0.44, 7.99±0.43, 7.96±1.12 and 8.10±0.45 points (out of 9), under T_1, T_2, T_3 and T_4, respectively. T_4, earned maximum scores points. Statistical analysis revealed that there was non-significant difference for flavor among all treatments. Softness earned 7.50±0.37, 7.66±0.41, 8.10±0.38 and 7.80±0.62 points (out of 9), under T_1, T_2, T_3 and T_4, respectively. T_3, earned maximum scores points for taste. Statistical analysis showed that there was non-significant difference among all treatments.

DISCUSSION

The results of present experiment showed that the highest percentage of crude proteins and total fats were observed with T_3 (predator-prey stocking ratio 1:30) in which fish gained maximum weight as compared to all other treatments. This higher growth

Table 2. Organoleptic evaluation of *Channa marulius* under all treatments with their standard error

Treatments		Parameters				
		Color	Taste	Texture	Flavor	Softness
		Mean ± SE				
T_1		7.85 ± 0.61	7.75 ± 0.73	7.60 ± 0.15	8.00 ± 0.44	7.50 ± 0.37
T_2		7.87 ± 0.42	7.70 ± 0.20	7.85 ± 0.28	7.99 ± 0.43	7.66 ± 0.41
T_3		7.99 ± 0.38	7.85 ± 0.14	8.20 ± 0.37	7.96 ± 1.12	8.10 ± 0.38
T_4		7.80 ± 0.38	7.80 ± 0.25	7.90 ± 0.65	8.10 ± 0.45	7.80 ± 0.62
ANOVA						
S.o.v.	d.f	Mean squares				
Replication	1	0.1624	0.0098	0.0112	1.2168	0.1458
Treatments	3	0.0130^{NS}	0.0083^{NS}	0.1213^{NS}	0.0074^{NS}	0.1298^{NS}
Error	4	0.5041	0.4334	0.4365	0.8180	0.5073

NS = Non-significant (P>0.05).

Color of *Channa marulius* scored 7.85±0.61, 7.87±0.42, 7.99±0.38 and 7.80±0.38 points (out of 9), under T_1, T_2, T_3 and T_4, respectively. T_3 earned maximum scores points. Statistical analysis revealed that there was non-significant difference for color among all treatments. The overall range of score obtained for taste obtained by *Channa marulius* remained 7.75±0.73, 7.70±0.20, 7.85±0.14 and 7.80±0.25 points (out of 9) for taste, under T_1, T_2, T_3 and T_4, respectively. T_3, earned maximum scores

rate with T_3 was perhaps due to the sufficient availability of the tilapia offsprings (forage fish) as a feed. During present study it was observed that the over all proximate composition of T_3 was almost better (low fats and high proteins) than all other treatments but statistically results of proximate composition i.e. moisture, crude proteins, total fats, total ash and carbohydrates were non-significantly different. Similar results were observed for other species by Stansby (1962) who found that both of the fat and protein

contents of fish varied widely depending upon the feed ingested. Zeitler *et al.* (1984) also reported that total fat and protein contents of *Cyprinus carpio* showed direct dependence on the quantity of food supplied.

In the present study 16.98±0.91 to 18.85±1.32% crude protein was observed in *Channa marulius* under different treatments. Almost same percentage (16.18%) of protein contents was reported in the *Channa marulius* by Shaheen (1988). However, Sharma and Simlot (1971) reported that *Channa marulius* had higher protein contents (90.01%) than carp (74.20) and tilapia (59.30%) in dry form.

Moisture contents were higher with T_1, in which fish gained minimum weight as compare to all other treatments, which was probably due to the insufficient supply of tilapia offsprings as a feed of *Channa marulius*. The results of this experiment are in accordance with the finding of Love (1980) who reported that the fish during starvation at first consume lipid then muscles protein after that, as proteins were utilized, water moves into take its place and water contents increased in the body of fish.

The results of present experiment revealed that T_3 (in which fish gained maximum weight) earned highest score points for color, taste, texture and softness than T_1, T_2 and T_4 which was due to the sufficient availability of tilapia offsprings as a feed of *Channa marulius*. Similar observations for other species were made by Allen and Hepher (1979) who reported that fish reared in ponds receiving well-treated domestic wastes, tasted as good or even better than the fish grown in waste free ponds. Moav *et al.* (1977) reported that good flesh color and intra muscular fat level for fish grown in intensively manured ponds. There appeared to be non-significant difference in the taste and texture of fish meat grown in manured ponds and those fed on commercial diets.

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