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Economic Evaluation of Four Imported Floating Feeds Used for Cultivation of Common Carp in Floating Cages in Basrah Province, Iraq

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Abstract: A cage culture trial was conducted in floating cages located in Shatt Al-Arab river near Al-Hartha district, northern Basrah for cultivation of common carp, *Cyprinus carpio* by using four types of imported floating fish feeds. The aim of this experiment is to evaluate these imported fish feeds (Arasco from Saudi Arabia T1, Faradaneh T2 & Raman T3 from Islamic Republic of Iran and Aller from Poland T4) and advise the culturist to use better economic feed that give highest profit. Results of current experiment revealed that highest weight increment achieved (484.5±25.4 g) by fish fed on T4, while lowest (411.4±7.8 g) achieved by fish fed on T3, at the same time, better daily growth rate (8.21±0.13 g/day) was achieved by fish fed on T4, while worst daily growth rate (4.07±043 g/day) achieved by fish fed on Raman feed T3. Values of FCR for current experiment were 3.21, 3.41, 7.07 and 2.56 for fishes fed on T1, T2, T3 and T4, respectively. The costs of feeds only to produce one kg of fish were 2900 ID for T1, 3100 ID for T2, 8100 ID for T3 and 3800 ID for T4. According to these results, and from the economic point of view, it is not recommended to use these feeds for common carp cultivated in floating cages because of low fish prices (3000 dinars for 1 kg fish).

Keywords: Common carp, Floating feeds, Feed conversion rate, Daily growth rate, Weight increments

Introduction

The primary aim of all culturists around the world is producing tasty marketing fishes with lower prices. Feeding is the most important management practice doing each day, and simply stated that no feeding will mean no growth and no profit. On the other hand, bad feeds can be adversely affected the culture practice. Cardia & Lovatelli (2015) mentioned that the choice of feeding strategies and feeding systems is one of the main operational issues that enhance technical and financial success, especially because feed accounts a large percentage of the operating budget. Diet components must be formulated well to get better feed conversion, because feeding requirements of fishes are different according to species, fish size and other factors such as environmental conditions especially water temperature and physiological status (Piska & Naik, 2013).

Different feeds that used to feed cultivated species in floating cages, semi-closed systems and closed systems must contain all fish feeding requirements, due to the absent of natural food. Artificial feed that contains all nutritional requirements of carp must be used if carp is produced in tanks or cages (Woynarovich et al., 2011). Bolorunduro (2002) stated that in earthen fish ponds, the natural food provides all feeding requirements for fishes and added food supplements the natural food, while at the absent of natural food, it is necessary to feed

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fishes on feed that contains all fish feeding requirements. To minimize fish stress and maximize fish growth, special attention would be taken to proper nutrition and feeding practices required in floating cages (Lazur, 2000).

Floating pellets were first developed for catfishes in 1960 (Avault, 1981). They have superior water stability properties, more easily digested and can incorporate higher levels of oil (Jobling et al., 2001), but they had high prices and also high losses of some vitamins during processing due to high temperature and pressure used. Schmittou (1993) claims that catfishes, common carp and tilapia quickly learn to take any type of feed. Beveridge (2004) stated that quality of feed and the manner of using it are significant tools to determine the profitability. In addition to fulfilling nutritional requirements, feeds must also have other criteria such as reducing pollution of the environment.

In Iraq, there were some studies dealing with culture of common carp in floating cages (Abdul-Hakim, 2005; Thjeel, 2011; Al-Jader & Al-Sulevany, 2012; Taher, 2014; Abbas et al., 2016; Al-Dubakel et al., 2018; Albahadly, 2019; Taher, 2020), but these studies were not dealing with feeding strategies and with evaluation of floating fish pellets. Hossain et al. (2014) studied the evaluation of different commercial feeds for culturing juvenile sobaity seabream (*Sparidentex hasta*) in Kuwait. The aim of the current experiment is to economically evaluate four imported floating fish feeds (Arasco from Saudi Arabia, Faradaneh & Raman from Islamic Republic of Iran and Aller from Poland) and advise the culturist to use better economic feeds that give highest profit.

Materials and Methods

A cage culture trial was conducted in floating cages located in Shatt Al-Arab river near Al-Hartha district, northern Basrah for cultivation of the common carp, *Cyprinus carpio* by using four types of imported floating feeds (Plate 1). These floating feeds are Arasco from Saudi Arabia (T1), Faradaneh (T2) & Raman (T3) from Islamic Republic of Iran and Aller from Poland (T4). Table 1 showed the chemical composition for these feeds according to factory plates on packages. Eight floating cages with dimensions of 3×4×2 meters were used in the current experiment; two cages for every treatment. About 400 fishes were used in every cage of average weight ranged from 302.4-412.2 g. Fishes were fed to saturation for 59 days.

Moisture for feeds were estimated by using oven with temperature of 105 ^{0}C, while ash was estimated by using muffle furnace with temperature of 525 ^{0}C for 16 hours (AOAC, 1990). Total nitrogen was estimated by using semi-microkjeldal method and protein ratio was measured by multiplying total nitrogen by factor of 6.25. Fat level was estimated according to Soxhlet method by using chloroform and methanol with a ratio of 2:1 (Egan et al., 1988). Density of feeds was estimated according to Misra et al. (2002), while floating time was estimated according to Al-Habbib (1996). Growth criteria [specific growth rate (SGR), daily growth rate (DGR) and weight increment (WI), in addition to feed conversion rate (FCR)] were calculated according to the following equations:

$SGR = \{(\ln W_2 - \ln W_1)/ t\} \times 100$

$DGR = (W_2 - W_1)/ (t_2 - t_1)$

$WI = W_2 - W_1$

FCR = Feed consumed/ Weight gain

Where W_1 is the initial weight, W_2 is the final fish weight and t is the time in days. By application of SPSS (version 22), the data were subjected to one-way analysis of variance (ANOVA) to determine the differences among the means. Feeding ratio was calculated

according to the average of daily amount of feed consumed by fishes (DF) and fish weight according to following equation:
Feeding ratio (%) = (DF × 100)/ total fish weight.

Plate 1: Floating cages in Shatt Al-Arab river near Al-Hartha district, northern Basrah.

Table 1: Chemical composition of four feed types according to the factory plates with their prices per one ton.

Feed type (Treatments)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Price (Iraqi dinars)
T1	-	28	4	4	900000
T2	5-11	27-31	3-8	7-11	900000
T3	-	30	7	7.6	1150000
T4	10	32-38	5-8	12	1500000

Results

Table 2 showed the results of chemical analysis of four fish feed types, values of floating time and density for these feeds. Protein ratio in four feeds are less than the ratio that recorded on packages. Better floating time (more than 60 hours) was found for Aller feed (T4), while the lowest (15 hours) was found for Raman feed (T3). Table 3 showed average fish weight for eight cages during the experiment. Highest final average weight (890.9 g) was achieved by fishes reared in cage No. 8 which fed on Aller feed (T4), while the lowest (633.7 g) was achieved by fishes reared in cage No. 5 which fed on Raman feed (T3). There were differences in weigh increments between cages, while highest weight increment was achieved by fishes reared in cage No. 3 which fed on Faradaneh feed (T2) and the lowest was achieved by fishes reared in cage No. 5 which fed on Raman feed (T3).

Table 4 showed growth criteria for common carp fed on four types of feed. Highest weight increment (484.5±25.4 g) was achieved by fishes fed on Aller feed (T4), while lowest weight increment (411.4±7.8 g) was achieved by fishes fed on Raman feed (T3). Statistical analysis for WI showed no significant difference ($P > 0.05$) between T1 and T2, while there were significant differences ($P \leq 0.05$) among T3 and T4, and also between them and other two treatments. Higher daily growth rate (8.21±0.13 g/day) was achieved by fishes fed on Aller feed (T4), while lower daily growth rate (4.07±0.43 g/day) was achieved by fishes fed on Raman feed (T3). Statistical analysis for DGR showed no significant differences ($P > 0.05$)

between T1 and T2, while there were significant differences (P≤0.05) between T3 and T4, and also among them and other two treatments. Highest specific growth rate (1.34±0.24 %/day) was achieved by fishes fed on Faradaneh feed (T2), while lowest specific growth rate (0.80±0.10%/day) was achieved by fishes fed on Raman feed (T3). Statistical analysis for SGR showed no significant difference (P> 0.05) between T1, T2 and T4, while there were significant differences (P≤0.05) between them and T3.

Better feed conversion rate (2.56) was achieved by fishes fed on Aller feed (T4), while worst feed conversion rate (7.07) was achieved by fishes fed on Raman feed (T3). Statistical analysis for FCR showed no significant differences (P> 0.05) between T1 and T2, while there were significant differences (P≤0.05) between T3 and T4, and between them and other two treatments. Highest feed consumption was achieved by fishes fed on Raman feed (T3), where feeding ratio was 7.70% of fish weigh, while lowest feed consumption was achieved by fishes fed on Faradaneh feed (T2), where feeding ratio was 4.72% of fish weigh. Statistical analysis for feeding ratio showed no significant differences (P> 0.05) between T1 and T2, while there were significant differences (P≤0.05) among T3 and T4, and also among them and other two treatments. From previous results, it can concluded that better growth criteria was achieved by using Aller (T4), then Arasco (T1) and Faradaneh (T2), while the worst was achieved by using Raman (T3).

Table 2: Chemical composition and physical characteristics of four types of fish feeds.

Feed Type (Treatments)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrates (%)	Density (g/cm^3)	Floating Time (Hour)
T1	5.82	26.54	4.23	10.32	53.09	0.50	24
T2	6.44	25.76	7.85	10.44	49.84	0.45	17
T3	9.34	22.56	6.32	9.18	47.60	0.45	15
T4	6.78	28.23	7.65	8.55	48.79	0.30	More than 60

Table 3: Average fish weight during experiment for eight cages.

Date	Average fish weight (g)							
	T1 C1	T1 C2	T2 C3	T2 C4	T3 C5	T3 C6	T4 C7	T4 C8
1/4/2019	350.6±98.1	397.8±112.6	302.4±88.5	422.1±111.8	411.7±113.6	379.5±88.8	398.5±112.8	412.2±96.7
20/4/2019	500.9±200.8	520.6±216.7	423.9±143.2	560.9±100.6	508.9±110.9	488.3±120.4	555.9±115.8	580.7±107.9
10/5/2019	620.8±215.5	670.9±234.8	600.7±184.8	707.8±154.7	570.5±143.9	575.8±170.8	717.4±188.9	720.7±134.8
29/5/2019	770.8±210.9	800.4±260.7	735.7±220.7	840.7±196.8	633.7±177.6	637.5±220.9	888.5±260.7	890.9±199.7

Table 4: Growth criteria of common carp fed on four types of feeds.

Growth Criteria	Treatments			
	T1	T2	T3	T4
Weight Increments (g)	411.4^a	425.9^a	243.0^b	484.5^c
Daily Growth Rate (g/day)	6.97^a	7.22^a	4.07^b	8.21^c
Specific Growth Rate (%/day)	1.26^a	1.34^a	0.80^b	1.33^a
Feed Conversion Rate	3.21^a	3.41^a	7.07^b	2.56^c
Feeding Ratio (%)	4.72^a	4.91^a	7.70^b	6.10^c

Different letters in each row indicated significant (P≤0.05) differences.

Discussion

The feed conversion rate (FCR) is the most appropriate way to judge the acceptability and suitability of artificial feed for fishes cultivated in floating cages, and it was the precise way to

economic evaluation of fish culture projects. Chemical and physical characteristics of fish feed don't give enough evaluation of concentrated fish diets, except if these information are supported by the important values of FCR. Feed conversion rate values for the current experiment were 3.21, 3.41, 7.07 and 2.56 for fish fed on T1, T2, T3 and T4, respectively. The costs of feeds to produce one kg of fishes in the current experiment by using these feeds were 2900 ID for T1, 3100 ID for T2, 8100 ID for T3 and 3800 ID for T4. According to the results of the current experiments, and from the economic point of view, it is not recommended to use these feeds for common carp cultivated in floating cages because the price of one kg fish was about 3000 Iraqi dinars and sometimes may be less.

Thjeel (2011) stated that best FCR was 3.7, while Al-Jader & Al-Sulevany (2012) showed that FCR were 2.70, 2.27 and 3.01 for common carp fed on diet with protein ratio of 25%, 30% and 35%, respectively. Taher (2014) reported that best results achieved by common carp cultivated in floating cages at using 5% feeding ratio where FCR was 2.63. Abbas et al. (2016) stated that best FCR was 2.63. Average FCR for common carp fed on 25% dried fishes and 75% dried bread was 6.08, while it was 6.62 for common carp fed on 40% dried fishes and 60% dried bread (Taher, 2020).

Bolorunduro (2002) stated that fish density was the major factor affecting fish growth, water temperature, quality of feed, feeding methods and feeding frequency. DGR values of current experiment were 6.97, 7.22, 4.07 and 8.21 g/day for T1, T2, T3 and T4, respectively, while SGR were 1.26, 1.34, 0.80 and 1.33%/day for these treatments, respectively. Comparing with the current experiment, Al-Jader & Al-Sulevany (2012) recorded very low DGR (0.73 g/day and less) for common carps cultivated on diets of different feeding ratios. Albahadly (2019) stated that DGR and SGR were 10.64 g/day and 0.94%/day, respectively for fishes fed on floating diet, while they were 7.31 g/day and 0.73%/day, respectively for fishes fed on sinking diet. DGR and SGR were 7.53 g/day and 0.79%/day for graded cultivated common carps in cages, while for ungraded cultivated fishes, they were 4.66 g/day and 0.5%/day (Albahadly, 2019). Taher (2020) stated that average DGR and SGR for common carps cultivated in floating cages were 3.62 g/day and 0.85 %/day, respectively for fishes fed on 25% dried fishes and 75% dried bread, while average DGR and SGR were 2.90 g/day and 0.71 %/day, respectively for fishes fed on 40% dried fishes and 60% dried bread.

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