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Effects of Four Imported Floating Diets on Feed Intake and Daily Feeding Rate of Common Carp, *Cyprinus carpio*

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Abstract: The current experiment was conducted in the Fish Laboratory of Aquaculture Unit, College of Agriculture, University of Basrah to investigate the effects of four imported floating diets (Raman, Gharb Daneh, Lajvar and Kemia) on feed intake and daily feeding rate of common carp, *Cyprinus carpio*. Twelve aquaria (Three replicates of each floating diets) of dimensions 60 cm length, 30 cm width and 40 cm height were used. Common carp (average weight 20.07±2.45 g) brought from earthen ponds of Aquaculture Unit located in Al-Hartha Station for Agricultural Researches, North Basrah. The fishes were acclimatized for ten days in laboratory aquaria fed on the same floating diets before the beginning of the experiment. Five fishes were placed in every aquarium. Feeds were given daily at 8 AM and residual floating pellets were collected after three hours in Petri dishes and dried before weighing. Feeding trails were replicated for four days. Results appeared that the average daily consumed diets were 24.40, 18.31, 15.38 and 25.91 g, and average daily feeding rate were 0.24, 0.18, 0.15 and 0.26, for common carp fed on Raman, Gharb Daneh, Lajvar and Kemia floating diets, respectively. Statistical analysis of the results proved that there were significant differences ($P \leq 0.05$) of daily consumed feed for common carp fed on Raman and Kemia with Gharb Danen and Lajvar. Statistical analysis of the results proved that there were significant differences ($P \leq 0.05$) of daily feeding rate for common carp fed on Raman and Kemia with Lajvar.

Keywords: Floating diet, Kharb Daneh, Raman, Lajvar, Kemia, Daily consumed feed, Daily feeding rate

Introduction

It is well known that fish feeding is the most important factor that undertaking each day, and simply it was stated that no growth and no profit without feeding. The primary aim of fish culturists is producing tasty marketing fishes with lower prices. The most important management practice doing each day in fish culture is the feeding, so bad feeds or feedings practices can be adversely affected the culture practice. Because feed accounts a large percentage of the operating budget, so feeding strategies and feeding systems are one of the main operational issues that enhance technical and financial success (Cardia & Lovatelli, 2015). Different feeds that used to feed cultivated species in certain systems without natural food must be contains all fish feeding requirements. Woynarovich et al. (2011) stated that

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artificial feed must contains all nutritional requirements of carp that produced in tanks or cages, while Bolorunduro (2002) mentioned that natural food in earthen ponds provides all feeding requirements for fishes and the added feed supplements the natural food.

Floating pellets have some positive characteristics such as a superior water stability properties, more easily digested and can incorporate higher levels of oil (Jobling et al., 2001), but the negative characteristics include high prices and high losses of some vitamins during processing due to high temperature and pressure used. Assan et al. (2021) stated that feed is one of the most important external signals in fish that stimulates its feeding behavior and growth, and feed intake is the main factor determining efficiency and cost, as well as it can maximizing fish production in fish farms. The latest researchers pointed also that extrinsic factors have a great influence on feed intake and feeding behavior, so under these factors, fish feeding is decontrolled and the appetite indicators in the brain do not function appropriately, while in controlling conditions which result in the fluctuations in the expression of these appetite relating genes that in turn decrease feed consumption.

Common carp *Cyprinus carpio* is one of the most species that occupies an important part of the fish production in freshwater rearing systems, so it was introduced to inland waters for different regions around the world. Common carp was much favored for cultivation in ponds because of the excellent growth rate and omnivorous feeding habits. According to FAO reports, common carp is the fourth important freshwater cultivated species around the world in 2020 (FAO, 2022). The main aquaculture cultivated species in Iraq was common carp, so many field and laboratory studies were done on this species. Taher (2020a) studied the economic evaluation of four imported floating feeds used for cultivation common carp in floating cages at Basrah Province. The aim of the current experiment is to investigate the effects of four imported floating diets from Islamic Republic of Iran on feed consumed and daily feeding rate of common carp.

Materials and Methods

The current experiment was conducted in Fish Laboratory of Aquaculture Unit, College of Agriculture, University of Basrah. The common carp in the current experiment fed four floating diets (Raman, Gharb Daneh, Lajvar and Kemia) imported from Islamic Republic of Iran. Twelve aquaria (three replicates of each floating diets) of dimensions 60 cm length, 30 cm width and 40 cm height were used. Common carp (average weight 20.07±2.45 g), brought from the earthen ponds of Aquaculture Unit located in Al-Hartha Station for Agricultural Researches, North Basrah. The fishes were acclimatized for ten days in laboratory aquaria and fed on floating diets before the beginning of the experiment. Five fishes were put in every aquarium. Feeds were given daily at 8 AM and residual floating diets were collected after three hours in Petri dishes and dried before weighing. Feeding trails were replicated for four days.

Consumed diet for three hours was calculated by the difference between added and residual feeds, then transformed to the ratio of consumption. Daily feeding rates were calculated according to the following equation:

DFR = Daily consumed feed/ Total fish weigh

Chemical composition of floating diets was conducted in Al-Khadeer Office for Veterinary Supplements in Babylon Province. Density of dietary pellets was estimated according to equation by Misra et al. (2002):

Density (gm/cm^3) = Mass/ Volume.

Water absorbance of diets was calculated according to APHA (1992), where one g of dry diet moisturized by immersion into water for one minute then pellets were taken out of water and weighed, then were calculate by following equation:

% Absorbance= (Wt P/ WtD) ×100.

Sinking ratio and time were calculated according to Al-Habbib (1996), where known weight of diet was put into a glass aquarium filled with water, and the time of sinking down was recorded with numbers of sinking pellets. Disassembly was calculated according to the amount of pellets that crumbled from all pellets diet.

The results of current experiment was conducted with a completely randomized design, and the differences between the means were tested by analysis of variance (ANOVA). The significant differences were tested by LSD test at 0.05 probability level by SPSS program Version 26.

Results

Table 1 showed the chemical composition of the four floating diets used in the current experiment. Moisture ratio ranged between 5.33% and 6.19% and fat ratio ranged between 3.92% and 7.10%, while crude protein ratio ranged between 30.46% and 34.75%. Table 2 showed some physical criteria of four floating diets used in the current experiment. Pellets density ranged between 0.18 g/cm^3 and 0.53 g/cm^3 and water absorption of pellets ranged between 1.76 and 2.78. All pellets types began to sink after 12 hours, while they were disassemble after 18 hours.

Table 3 showed consumed diets during three hours for common carp fed Raman floating diets at four consecutive days. This table also showed daily consumed feed and daily feeding rate. The highest daily consumed feed was 31.84 g and the lowest was 18.80 g, while the highest feeding rate was 0.32 and the lowest was 0.19. Table 4 showed diet consumed during three hours for common carp fed Gharb Daneh floating diets at four consecutive days, and also showed daily consumed feed and daily feeding rate. The highest daily consumed feed was 31.60 g and the lowest was 9.48 g, while the highest feeding rate was 0.32 and the lowest was 0.10. Table 5 showed diet consumed during three hours by common carp fed Lajvar floating diets at four consecutive days with daily consumed feed and daily feeding rate. The range of daily consumed feed was 7.60-24.80 g, while the range of feeding rate was 0.08-0.25. Table 6 showed diet consumed during three hours for common carp fed Kemia floating diets at four consecutive days with daily consumed feed and daily feeding rate. The range of daily consumed feed was 5.84-40.72 g, while the range of feeding rate was 0.06-0.40.

Table 7 showed the average of daily consumed diet and daily feeding rate for common carp fed four different floating diets with standard deviation. The averages daily consumed diets were 24.40, 18.31, 15.38 and 25.91 g, respectively and averages daily feeding rate were 0.24, 0.18, 0.15 and 0.26 g for common carp fed on Raman, Gharb Daneh, Lajvar and Kemia floating diets, respectively. Statistical analysis of the results proved that there were significant differences ($P \leq 0.05$) of daily consumed feed for common carp fed on Raman and Kemia with Gharb Danen and Lajvar, while there were no significant differences ($P > 0.05$) between Raman and Kemia and also between Gharb Danen and Lajvar. Statistical analysis of the results proved also that there were significant differences ($P \leq 0.05$) of daily feeding rate for common carp fed on Raman and Kemia with Lajvar, while there were no significant differences ($P > 0.05$) between Raman, Gharb Danen and Kemia.

Table 1: Chemical composition of four floating diets used in the current experiment.

Chemical composition (%)	Floating feed types			
	Raman	Gharb Daneh	Lajvar	Kemia
moisture	6.19	5.33	6.19	5.38
Fat	7.10	6.00	4.44	3.92
Crude protein	32.10	33.45	34.75	30.46
Ash	7.98	8.45	7.76	7.34
Fiber	3.92	3.30	3.01	4.36
Carbohydrates (NFE)	42.71	43.47	43.85	48.54

Table 2: Physical criteria of four floating diets used in the current experiment.

Physical criteria	Floating feed types			
	Raman	Gharb Daneh	Lajvar	Kemia
Pellets weight (g)	0.26	0.90	0.23	0.27
Pellets density (g/cm^3)	0.45	0.18	0.46	0.53
Water absorption (%)	2.09	2.78	2.16	1.76
Sinking ratio (%)	35	40	40	50
Sinking time (hour)	12	12	12	12
Disassembly (hour)	18	18	18	18
Total sinking time (hour)	18	20	20	18

Table 3: Diet consumed during three hours in experiment conducted with Raman floating feed.

Date	Total fish weight (g)	Pond No.	Quantity of added diet (g)	Residual diet after 3 hours (g)	Consumed diet (g)	Ratio of consuming (%)	Ratio of diet consuming (% from fish weight)	Daily consumed feed (g)	Daily feeding rate
11 Dec. 2021	100.09	1	7.06	3.88	3.18	45.04	3.18	25.44	0.25
	99.88	2	7.00	3.39	3.61	51.57	3.61	28.88	0.29
	100.76	3	7.00	4.39	2.61	37.29	2.59	20.88	0.21
12 Dec.	100.09	1	7.05	4.02	3.03	42.98	3.03	24.24	0.24
	99.88	2	7.11	3.93	3.18	44.73	3.18	25.44	0.25
	100.76	3	7.04	4.61	2.43	34.52	2.41	19.44	0.19
13 Dec.	100.09	1	7.05	4.59	2.46	34.89	2.46	19.68	0.20
	99.88	2	7.04	4.69	2.35	33.38	2.35	18.80	0.19
	100.76	3	7.04	4.32	2.72	38.64	2.70	21.76	0.22
14 Dec.	100.09	1	7.10	3.12	3.98	56.06	3.98	31.84	0.32
	99.88	2	7.09	3.93	3.16	44.57	3.16	25.28	0.25
	100.76	3	7.09	3.20	3.89	54.87	3.86	31.12	0.31

Table 4: Diet consumed in three hours during experiment conducted with Gharb Daneh floating feed.

Date	Total fish weight (g)	Pond No.	Quantity of added diet (g)	Residual diet after 3 hours (g)	Consumed diet (g)	Ratio of consuming (%)	Ratio of diet consuming (% from fish weight)	Daily consumed feed (g)	Daily feeding rate
11 Dec. 2021	100.09	4	7.01	4.25	2.76	39.37	2.76	22.08	0.22
	99.88	5	7.12	4.92	2.20	30.90	2.20	17.60	0.18
	100.76	6	7.06	5.23	1.83	25.92	1.82	14.64	0.15
12 Dec.	100.09	4	7.09	4.83	2.26	31.88	2.26	18.08	0.18
	99.88	5	7.13	5.60	1.53	21.46	1.53	12.24	0.12
	100.76	6	7.09	4.11	2.98	42.03	2.96	23.84	0.24
13 Dec.	100.09	4	7.07	5.39	1.68	23.76	1.68	13.44	0.13
	99.88	5	7.03	5.55	1.48	21.05	1.48	11.84	0.12
	100.76	6	7.06	4.91	2.15	30.45	2.13	17.20	0.17
14 Dec.	100.09	4	7.08	3.13	3.95	55.79	3.95	31.60	0.32
	99.88	5	7.00	5.77	1.23	17.57	1.23	9.84	0.10
	100.76	6	7.08	3.67	3.41	48.16	3.38	27.28	0.27

Table 5: Diet consumed in three hours during experiment conducted with Lajvar floating feed.

Date	Total fish weight (g)	Pond No.	Quantity of added diet (g)	Residual diet after 3 hours (g)	Consumed diet (g)	Ratio of consuming (%)	Ratio of diet consuming (% from fish weight)	Daily consumed feed (g)	Daily feeding rate
11 Dec. 2021	99.95	7	7.01	4.63	2.38	33.95	2.38	19.04	0.19
	99.88	8	7.13	4.03	3.10	43.48	3.10	24.80	0.25
	101.23	9	7.11	5.41	1.70	23.91	1.68	13.60	0.13
12 Dec.	99.95	7	7.10	5.27	1.83	25.77	1.83	14.64	0.15
	99.88	8	7.07	4.08	2.99	42.29	2.99	23.92	0.24
	101.23	9	7.14	6.15	0.99	13.87	0.98	7.92	0.08
13 Dec.	99.95	7	7.10	5.22	1.88	26.48	1.88	15.04	0.15
	99.88	8	7.10	6.15	0.95	13.38	0.95	7.60	0.08
	101.23	9	7.06	5.79	1.27	17.99	1.25	10.16	0.10
14 Dec.	99.95	7	7.18	4.71	2.47	34.4	2.47	19.76	0.20
	99.88	8	7.05	5.30	1.75	24.82	1.75	14.00	0.14
	101.23	9	7.00	5.24	1.76	25.14	1.74	14.08	0.14

Table 6: Diet consumed in three hours during experiment conducted with Kemia floating feed.

Date	Total fish weight (g)	Pond No.	Quantity of added diet (g)	Residual diet after 3 hours (g)	Consumed diet (g)	Ratio of consuming (%)	Ratio of diet consuming (% from fish weight)	Daily consumed feed (g)	Daily feeding rate
11 Dec. 2021	101.00	10	7.05	3.28	3.77	53.48	3.73	30.16	0.30
	100.71	11	7.17	4.48	2.69	37.52	2.67	21.52	0.21
	100.26	12	7.04	2.65	4.39	62.36	4.38	35.12	0.35
12 Dec.	101.00	10	7.07	5.71	1.36	19.24	1.35	10.88	0.11
	100.71	11	7.04	2.94	4.10	58.24	4.07	32.80	0.33
	100.26	12	7.07	3.27	3.80	53.75	3.79	30.40	0.30
13 Dec.	101.00	10	7.05	6.32	0.73	10.35	0.72	5.84	0.06
	100.71	11	7.13	3.17	3.96	55.54	3.93	31.68	0.31
	100.26	12	7.06	4.22	2.84	40.23	2.83	22.72	0.23
14 Dec.	101.00	10	7.15	5.50	1.65	23.08	1.63	13.20	0.13
	100.71	11	7.15	2.06	5.09	71.19	5.05	40.72	0.40
	100.26	12	7.08	2.60	4.48	63.28	4.47	35.84	0.36

Table 7: Average consumed feed and average daily feeding rate for common carp fed four different floating feeds.

Feed type	Consumed diet (g)	Ratio of consuming (%)	Ratio of diet consuming (% from fish weight)	Daily consumed feed (g)	Daily feeding rate
Raman	$3.05^{a}\pm0.56$	$43.21^{a}\pm7.84$	$3.04^{a}\pm0.56$	$24.40^{a}\pm4.48$	$0.24^{ab}\pm0.04$
Gharb Daneh	$2.29^{b}\pm0.83$	$32.36^{b}\pm11.79$	$2.28^{b}\pm0.83$	$18.31^{b}\pm6.68$	$0.18^{bc}\pm0.07$
Lajvar	$1.92^{b}\pm0.70$	$27.12^{b}\pm9.85$	$1.92^{b}\pm0.70$	$15.38^{b}\pm5.60$	$0.15^{c}\pm0.06$
Kemia	$3.24^{a}\pm1.38$	$45.69^{a}\pm19.48$	$3.22^{a}\pm1.38$	$25.91^{a}\pm11.04$	$0.26^{a}\pm0.11$

*Different letters in one column were significantly different ($P\leq0.05$).

Discussion

Feeding strategies in cultivated fishes may be influenced by some factors such as fish size, water temperature and stocking densities. The best results of the current experiment was by fishes fed Kemia floating diets followed by Raman floating diets. These results may be attributed to some physical or chemical characteristics of Kemia floating diets, where it had lowest water absorption and highest density and also lower protein ratio and higher carbohydrate ratio comparing with the other three types of floating diets. Also, these results may be attributed to some flavoring components that added to some feeds. Taher (2020b) stated that water temperature affected daily consumed feed and daily feeding rate for grass carp too much comparing with the low effect of fish weight. It has been concluded that the relative feeding rates decline with an increase in fish weight (Osborne & Riddle, 1999).

Results of the current experiment showed that pellets density ranged between 0.18-0.53 g/cm^3. Mahdi et al. (2006) recorded significant differences ($P \leq 0.0.5$) in pellets density of control diet (2.50 g/cm^3) without addition of binders, comparing with starch addition (0.83 g/cm^3), okra (*Abelmoschus esculentus*) addition (0.88 g/cm^3) and sebestan (*Cordia myxa*) addition (1.67 g/cm^3). Al-Dubakel et al. (2012) recorded higher pellets density from the current experiment that ranged between 1.04-1.10 g/cm^3 for experimented four pellets diets, while Al-Dubakel et al. (2014) stated that pellets density ranged between 1.1-1.4 g/cm^3 and also recorded very little floating times (5.30-8.55 sec) compared with four floating pellets diet in the current experiment. Al-Hamdani et al. (2021) stated that pellets density for three diets were 1.17, 1.06 and 1.03 g/cm^3.

Yaqoob et al. (2010) pointed out that floating pellet do not have such problems like sinking pellets, where some quantity of the supplementary feed goes waste as it sinks to the bottom and fish cannot consume it. Munguti et al. (2014) stated that most of the mash feeds are remained non-eaten, which results in feed wastage and an increase in organic loading that eventually leads to undesirable water quality. The daily consumed feed for common carp in the current experiment was very high comparing with that of grass carp (55 g average weight) recorded by Taher (2020b), where it was 1.05, 1.74, 1.66, 3.06 and 2.90 g for the temperatures of 10, 15, 20, 25 and 30°C, respectively. This big difference may be attributed to herbivorous feeding habits of this fish, so it prefers soft plants rather than fish pelleted. Taher et al. (2021) pointed out the same results for the differences of preferring pelleted feed between common and grass carp cultivated in earthen ponds. Essa et al. (2004) recorded an average daily consumed pelleted feed of 1.95 g per fish in 15 weeks experiment of cultivation of grass carp (30.6 g average weight) in concrete ponds.

Al-Dubakel et al. (2014) recorded daily feed intake for four treatments (1.34-3.57% of fish weight) that resemble to some extent to daily feed intake (1.92-3.22% of fish weight) in the current experiment. Al-Hamdani et al. (2021) recorded feed intake of 2.17, 2.46 and 2.03% of fish weight for experimented three diets.

Conclusions

From the results of the current experiment, it can be concluded that the best two floating diets were Kemia and Raman compared with Gharb Daneh and Lajvar.

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