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Effects of Four Imported Floating Diets on Feed Intake and Daily Feeding Rate of Grass Carp, *Ctenopharyngodon idella* (Valenciennes, 1844)

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Abstract

The present study was conducted in the laboratories of the Aquaculture Unit, College of Agriculture, University of Basra, to determine the effect of four imported floating feeds (Arabco, Aleer, Arasco and Grand).Feed intake as well as the daily rate of. Twelve glass aquarium were used, with four treatments and three replicates for each treatment. The average weight of the experimental fish was 50.62 ± 2.61 g. The experimental fish were brought from Al-Bahaa Fish Farm located in Abi Al-Khaseeb District, south of Basra City, Iraq. The results showed that the daily feed intake was 12.40, 16.53, 14.50 and 12.31 g. and the daily feeding rate was 0.12, 0.17, 0.15 and 0.12 g. for grass carp fed floating diets from Arabco, Aller, Arasco and Grand, respectively. The statistical analysis's results showed that there were significant differences ($P \leq 0.05$) in the in the daily feed intake of grass carp fed floating diets from Arabco, Arasco, Grand, and Arasco from Aller, The floating diets of Grand and Arabco were not different significantly ($P > 0.05$). with the floating diets of Arabco and Grand.

Keywords: Floating diet, Arabco, Aller, Arasco, Grand, Daily consumed feed, Daily feeding rate

I. Introduction:

Grass carp are one of the most commercially important freshwater fishes, accounting for 11% of global production, including one species, *Stenopharyngodon idella* (FAO, 2022) One of the thing fish farmers must consider is nutrition for optimal growth and, consequently, economic benefits. Producing fish at affordable prices and of good quality is the primary goal of fish farmers. Nutrition is one of the main tasks of daily fish farm management, and therefore, improper feed management practices can negatively impact fish growth. Furthermore, the highest cost in aquaculture projects is feed, which can account for up to 80% of the variable costs in fish production operations. Therefore, financial and technical success in aquaculture projects comes from adopting precise strategies and methods in the areas of nutrition and food systems (Cardia and Lovatelli, 2015).

An important consideration is that feeds used for fish, other than natural food, must contain all nutritional and growth requirements (Woynarovich, *et al.* 2011). Explained that the artificial feed used for feeding carp, must contain all the elements necessary for growth. Natural food in ponds is the basis for providing all the necessary nutritional requirements, while added feeds are complementary feeds (Bolorunduro 2002). Among the characteristics of floating feeds is their high stability in water for longer periods, the possibility of adding oil to them, and their ease of digestion (Jobling *et al*., 2001). However, their high prices and the loss of many vitamins due to pressure and high temperatures during the manufacturing process are negative factors for this type of feed (Assan *et al*., 2021).

Grass carp is a fish found primarily in large rivers in East Asia, but it has been introduced to many countries for farming and to control aquatic plants in those countries (Kırkağaç and Demir, 2006). Grass carp are primarily herbivorous, but they can also consume artificial feeds (Masser, 2002). Recent evolutionary studies have shown that grass carp belong to the Xenocypridinae family (Tan and Armbruster, 2018).

Materials and Methods:

Experimental fish were brought from Al-Bahaa Fish Farm, located in Abu Al-Khaseeb District, south of Basra City, Iraq, with an average weight of 50.62 ± 2.61 g. These fish were transported to the Aquaculture Unit's aquaculture lab at the College of Agriculture, University of Basra by 100-liter plastic containers. Ice

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was added to the transport water to maintain the temperature. The fish were acclimatized for 10 days in glass aquarium measuring in a glass aquarium with dimensions of 25 cm in height, 25 cm in width, and 50 cm in length. Feed pellet density was estimated according to Maysara *et al*. (2002).

Feed pellet density was estimated based on Maysara *et al*. (2002): Five fish were placed in each glass tank. Feed was provided daily at 9:00 a.m., and the remaining floating feed collected after three hours in Petri dishes, dried, and then weighed. This feeding process was repeated over four consecutive days. The time and percentage of the feed pellet sinking were determined following the method outlined by Al-Habib (1996). A measured amount of feed was placed into a graduated glass beaker filled with water, and the time taken for the pellets to sink along with the number of sinking pellets was documented. Meanwhile, feeding For four days in a row, each feeding was done yet again Disintegration was calculated by counting the number of disintegrated pellets. Density (g /cm ^{3}) = mass (g) / volume (cm ^{3}). Water absorbency of the feed was calculated according to APHA (1992). One feed was submerged in water for one minuteand then the submerged pellets were removed and weighed. The equation was then calculated using the following:

% Absorbance = (Wt*P/Wt*D) × 100

Four commercial floating feeds (Arabco, Aller, Arasco and Grand) were used, with four treatments and three replicates per treatment. Fish were fed at 9:00 a.m. Three hours after feeding, the remaining feed was collected and weighed after drying. This was to determine the effect of these four floating feeds on the feed intake rate of grass carp. The difference between the feed added and consumed was converted to the consumption rate.

The following equation was used to determine daily feeding rates:

Daily feeding ratio = daily feed intake/total fish weight.

A chemical analysis of the four feeds was carried out at the central laboratory of the College of Agriculture, University of Basra. A statistical analysis was conducted employing a completely randomized design and analysis of variance (ANOVA). Significant differences were evaluated with the LSD test at a 0.05 significance level, utilizing the SPSS statistical software.

Result.

Table (1) presents the chemical composition of the four diets.. The fat percentage ranged between 6.78% and 4.93%, the protein percentage between 30.96% and 35.75%, and the moisture percentage ranged between 5.93% and 5.37%.

Table (2) shows the amount of feed the grass carp consumed on the four floating diets while a period of three hours and four days, in addition to the daily feeding rate and consumption of feed. 12.87 g. was greatest daily feed intake rate, while 12.08 g. was the lowest.

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

Chemical composit (%)	Floating feed types Arabco	Aller	Arasco	Grand
Crude Protein	31.68	32.96	35.75	33.98
Ash	8.11	8.44	6.32	6.61
Fat	6.78	6.33	4.98	4.93
Fiber	3.79	3.97	4.91	3.81
Moisture	5.93	5.52	5.37	5.76
Carbohydrates (NFE)	43.71	42.78	42.67	44.91

Table 2 shows the physical characteristics of the four floating diets that were used in the present study.

Physical criteria	Arabco	Aller	Arasco	Grand
Pellets weight (g.)	0. 28	0. 85	0. 26	0. 21
Pellets density (g /cm. ^{3})	0. 49	0. 20	0. 46	0. 57
Water absorption (%.)	2. 03	2. 71	2.34	1. 67
Sinking ratio (%.)	37	46	40	47
Sinking time (hour)	13	14	13	14
Disassembly (hour)	18	17	17	20
Total sinking time (hour)	17	17	17	17

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Table (3) Explain the feed intake of grass carp fed on floating Arabco feed for three hours and four consecutive days, as well as the daily feed intake as well as the rate of feeding per day. 17.37 g was the lowest daily feed intake and 17.37 g was the highest. while the highest feeding rate was 0.17 g and the lowest was 0.16 g.

Table (3) Explain the total feed intake of Arasco feed for three hours and four consecutive days. The daily feed intake ranged between 14.22 and 14.76 g, while the feeding rates ranged between 0.14 and 0.15 g

Table 3 Feed intake throughout the three-hours Arabco floating diet

Date	Total weigl of fish (;	Aquarium No.	quantity food added (;	Residual c after 3 ho (g)	Dietary consumption (g)	Consump n ratio (%)	Consumption ratio from weight of fish (%)	Feed consum daily (g)	Daily inta of feed
11 .	255.5	1	12.78	6.54	6.23	48.79	2.44	12.20	0.12
2023	255.5	2	12.78	6.46	6.31	49.42	2.47	12.36	0.12
	253	3	12.65	6.14	6.51	51.48	2.57	12.87	0.13
12 Jar	252	1	12.6	6.43	6.17	48.95	2.45	12.23	0.12
2023	252	2	12.58	6.49	6.08	48.33	2.42	12.08	0.12
	253	3	12.5	6.37	6.13	49.05	2.45	12.26	0.12
13 Jar	250	1	12.73	6.35	6.37	50.07	2.50	12.52	0.13
2023	256.5	2	12.6	6.46	6.14	48.71	2.44	12.18	0.12
	250	3	12.65	6.25	6.41	50.63	2.53	12.66	0.13
14 Jar	252	1	12.83	6.25	6.57	51.24	2.56	12.81	0.13
2023	250	2	12.8	6.43	6.37	49.75	2.49	12.44	0.12
	257.5	3	12.53	6.44	6.09	48.66	2.43	12.17	0.12

Table 4 Feed intake throughout the three-hours Aller floating diet

Date	Total weight the f (g)	Aquarium No.	Quantity food adc (g)	Residual c after 3 ho (g)	Dietary consumption (	Consumption ratio (%)	Consumption ratio from weight of fish (%)	Feed consumed daily (g)	Daily intake feed
11 .	253	1	12.6	4.25	8.35	66.25	3.31	16.56	0.16
2023	251.5	2	12.6	4.03	8.57	68.01	3.40	17.00	0.17
	250	3	12.65	4.24	8.41	66.49	3.32	16.62	0.17
12 Jan	253	1	12.65	4.28	8.37	66.20	3.31	16.55	0.17
2023	250.5	2	12.53	4.21	8.31	66.38	3.32	16.60	0.17
	250	3	12.5	4.25	8.25	66.02	3.30	16.50	0.17
13 Jan	256.5	1	12.68	4.37	8.31	65.56	3.28	16.39	0.16
2023	251.5	2	12.7	4.32	8.38	65.98	3.30	16.49	0.16
	250	3	12.5	4.27	8.23	65.80	3.30	16.45	0.16
14 Jan	256	1	12.68	4.38	8.30	65.48	3.27	16.37	0.16
2023	254	2	12.58	4.30	8.28	65.82	3.29	16.46	0.16
	250	3	12.6	4.31	8.29	65.79	3.29	16.45	0.16

Table (5) shows the feed intake from Grand ration for three hours and four consecutive days, the feed intake was between 11.72 and 12.62 g, while the feeding rates were between 0.11 and 0.13 g. Table (6) shows the daily feed intake rate for grass carp fed four types of floating rations, as well as the daily feeding rate with standard deviation. Feed consumed daily was 12.40, 16.53, 14.50, and 12.31 g, respectively, while Daily

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intake of feed were 0.12, 0.17, 0.15, and 0.12 g for grass carp fed floating rations from Arabco, Aleer, Arasco, and Grand, respectively table 7.

The results of the statistical analysis showed that there were significant differences (P≤0.05) in the daily feed consumption rates of grass carp fed on floating rations from Arabco, Arasco, Grand and Arasco from Aleer, Arabco and Grand, while there were no significant differences (P>0.05) between the floating Arabco and Grand rations.

Table (5) Dietary intake throughout the three-hours Aller floating diet

Date	Total weight the f (g)	Aquarium No.	Quantity food adc (g)	Residual c after 3 ho (g)	Dietary consumption (	Consumption ratio (%)	Consumption ratio from weight of fish (%)	Feed consumed daily (g)	Daily intake feed
11 .	254.5	1	12.5	5.26	7.24	57.91	2.90	14.48	0.14
2023	252	2	12.82	5.30	7.52	58.64	2.93	14.66	0.15
	253	3	12.5	5.39	7.11	56.90	2.85	14.22	0.14
12 Jan	253.5	1	12.82	5.25	7.57	59.03	2.95	14.76	0.15
2023	254	2	12.58	5.32	7.26	57.73	2.89	14.43	0.14
	250	3	12.5	5.38	7.12	56.99	2.85	14.24	0.14
13 Jan	257	1	12.85	5.31	7.54	58.67	2.93	14.67	0.15
2023	255	2	12.75	5.32	7.43	58.27	2.91	14.57	0.15
	254.5	3	12.73	5.25	7.47	58.71	2.94	14.68	0.15
14 Jan	250.5	1	12.5	5.38	7.12	56.99	2.85	14.24	0.14
2023	253.5	2	12.6	5.29	7.31	58.02	2.90	14.50	0.15
	250	3	12.65	5.28	7.37	58.29	2.91	14.57	0.15

Table(6) Dietary intake throughout the three-hours Grand floating diet

Date	Total weight the f (g)	Aquarium No.	Quantity food adc (g)	Dietary consumption (	Consumption ratio (%)	Consumption ratio from weight of fish (%)	Feed consumed daily (g)	Daily intake feed
11 .	256.5	1	12.6	6.34	6.26	49.67	2.48	12.42	0.12
2023	256	2	12.5	6.64	5.86	46.87	2.34	11.72	0.11
	250.5	3	12.88	6.55	6.33	49.16	2.46	12.29	0.12
12 Jan	253.5	1	12.8	6.33	6.47	50.55	2.53	12.64	0.13
2023	251.5	2	12.7	6.43	6.27	49.35	2.47	12.34	0.12
	252	3	12.5	6.48	6.02	48.19	2.41	12.04	0.12
13 Jan	250	1	12.53	6.39	6.14	49.01	2.45	12.25	0.12
2023	252	2	12.68	6.32	6.35	50.13	2.50	12.53	0.13
	250	3	12.5	6.43	6.07	48.54	2.42	12.14	0.12
14 Jan	253.5	1	12.68	6.29	6.39	50.37	2.52	12.59	0.13
2023	256.5	2	12.83	6.35	6.47	50.48	2.52	12.62	0.13
	250	3	12.5	6.40	6.09	48.74	2.44	12.18	0.12

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Table (7) Average consumed feed and average daily feeding rate for grass carp fed four different floating feeds.

Feed type	Dietary consumption (g	Consumption ra (%)	Consumption ra from the weight fish (%)	Feed consun daily (g)	Daily intake feed
Arabco	6.28 ±0.17 c	49.59 ±1.05 c	2.48 ±0.05 c	12.40 ±0.26 C	0.12 ±0.001 c
Aller	8.34 ±0.09 a	66.15 ±0.66 a	3.31 ±0.03 a	16.53 ±0.17 A	0.17 ±0.001 a
Arasco	7.34 ±0.17 b	58.01 ±0.73 b	2.90 ±0.04 b	14.50 ±0.18 B	0.15 ±0.001 b
Grand	6.23 ±0.19 c	49.26 ±1.09 c	2.46 ±0.05 c	12.31 ±0.27 C	0.12 ±0.002 c

II. Discussion:

There are many factors that influence feeding strategies in fish farms, such as fish density, fish size, water temperature, and density. Fish fed Aller diets achieved the best results, followed by Arasco diet. The chemical characteristics of Aller diets may be the cause of these outcomes, which were characterized by a lowe protein content and an increase in carbohydrate content compared to the other three types of floating diets. This result is consistent with the finding of Taher (2023). Taher (2020b) demonstrated that water temperature affects the daily feed intake and daily feeding rates of grass carp, compared to a lower effect on fish weight. Osborn and Riddle (1999) concluded that relative feeding rates decrease with increasing fish weight. From the results obtained in the current experiment, the density of feed pellets was between 0.20-0.57 g/cm ^{3}. Mahdi *et al*. (2006) found significant differences in the density of feed pellets in the control feed (2.50 g/cm ^{3}) without adding any binding materials compared to adding starch (0.83 g /cm ^{3}). Feed pellets with densities ranging from 1.04 to 1.10 g/cm^3 for the four diets were reported by Al-Dubakel *et al.* (2012), which is higher than what was found in the current study, while Al-Dubakel *et al.*, (2014) reported very low flotation times (5.30-8.55 seconds) compared to the flotation time for the four diets in the current study. The pellet density of the three feeds was 1.17, 1.06, and 1.03 g/cm.^{3} (Al-Hamdani *et al.* (2021). There are no problems with floating feeds compared to sinking feeds, as there is a waste of supplementary feed and the fish cannot consume it (Yaqoob *et al.* 2010). Most feeds that are in powder form or are easily soluble in water are not eaten, which leads to poor water quality (Munguti *et al.* 2014). Taher (2029b) recorded a lower percentage of daily feed intake for common carp than that recorded in the current study. Taher *et al.* (2021) reported similar results regarding differences in feed preference between common carp and grass carp in earthen ponds. Eissa *et al.* (2004) conducted a 15-week feeding experiment on grass carp (average weight 30.6 g) in concrete ponds and recorded an average daily intake of 1.95 g of feed per fish. For four treatments, for four treatments Al-Dubakel *et al.* (2014) measured the daily feed consumption (1.34 3.57% of fish weight). Which is somewhat similar to the daily feed intake in this experiment (1.92–3.22 % of fish weight). Al-Hamdani *et al.* (2021) found that the three experimental diets resulted in feed intakes of 2.17%, 2.46%, and 2.03% of fish weight. The current experiment's findings indicate that, in comparison to Arabco and Grand, Aller and Arasco are the two best floating diets.

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