# The use of dry fish and dry bread in feeding common carp, Cyprinus carpio L. cultivated in floating cages

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**Doi 10.29072/basjs.202034**

## Abstract

A cage culture trial was conducted in floating cages located in Shatt Al-Arab River near Hartha, Northern Basra for the cultivation common carp, *Cyprinus carpio*. The aim was to investigate the ability of using dry bread (DB) and dry fish (DF) as feed for two stocking densities of these fish. Eight cages were used in this experiment, four of them (two for high density and two for low density) were fed on 25% DF & 75% DB, while the other four cages were fed on 40% DF & 60% DB. A feeding ratio of 5% of live fish weights was used for both rations, separated into early morning and afternoon meals. The average fish weight was measured at the beginning, after 23 days, and at the end of the experiment, after 56 days. Results of the current experiment revealed that there were no significant differences (P>0.05) between growth criteria for fish fed on the two different rations at two different feeding densities, except for the DGR values, which showed significant differences (P≥0.05) between fish fed on 25% DF & 75% DB reared at high and low densities. The results of growth and food conversion rates are not promising compared with other local feeding practices. The average food conversion rate was around 6 in both feeding trials. From the point of view of economics, it is not recommended to use DF and DB alone in feeding common carp reared in floating cages.

**Article inf**.

*Received: 10/8/2020*

*Accepted*

*15/11/2020*

*Published*

*31/12/2020*

**Keywords:**

Dried bread, Weight increment, Daily growth rate, Feed conversion rate

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## 1. Introduction

Feeding is the most important management practice that fish culturist does each day. Simply stated, no feeding means no growth and no profit, and on the other hand improper feeding can be adversely affect culture practices. Many researchers give different ranges (40-70%) for fish feed cost of fish farms. It was stated that in most fish farms feed typically accounts for 50–75 percent of the operating costs, and if feed costs are less than this percentage, then other costs would be too high [8]. Therefore, the development of efficient equipment and feeding techniques is a priority to enhance technical and financial success. In large cage systems, the choice of feeding strategies and feeding systems is one of the main operational issues [8,9].

It is well known that the nutrient and energy sources in feed are needed for growth and maintenance of cultured fish species [19]. Pongpet *et al*. [14] mentioned that as main nutrient, fish food must contain appropriate protein level which can provide essential amino acids, such as fish meal and other animal and plant protein sources. Feeding requirements are different according to fish species, fish size and other environmental factors such as water temperature and also physiological conditions such as stress. Accordingly, food components should be formulated in such manner to get better feed conversion [13]. Woynarovich *et al*. [18] pointed that if such requirements are fulfilled in the feed of common carp cultivated in cages, fishes do not need then to rely on natural food.

A major determinant of successful intensive aquaculture is feed. Sunep and Ahmed [15] stated that performance of the food does not depend on its quality but also depends on feeding management. It was concluded that good quality feed may give poor performance unless proper feeding practices (feed allowance, feeding frequency, feeding method and daily feeding schedules) are applied [11]. Fish feeding is the most important management task to optimize, this is necessary in order to increase the efficiency of fish production. Cardia and Lovatelli [8] showed that the primary objective for most fish culturist is to produce high-quality fish with the lowest cost. Particular attention must be directed towards feeding strategies development that are necessary to obtain economical production and maintain healthy environment [15].

World production of animal feeds reached $10^{12}$ kg, 26% for pigs, 44% for poultry, 22% for ruminants, and only 4% for fish. The reason of such small ratio for fish was the high cost of fish feed compared with other animals [3]. Yan *et al*. [19] stated that as human population increased, aquaculture is emerging as one of the ways to satisfy human consumption, but a lot of work is

needed to improve the way that aquaculture is practiced. A lot of research has so far been done on the inclusion and substitution of various proteins and protein products to see their impact on the growth of commercially cultivated fish species. Specific changes in metabolic and biological parameters have been reported by many researchers around the world. Nevertheless there are some gaps still left, which needs further research in nutritional aspects of aquaculture [15]. Number of nutritional studies on fish cultivated in cages have been reported [10,6,12,7]. Results of these studies revealed a kind of misunderstanding about the interaction between feeding methods and feeding ratios in terms of environmental changes and fish densities. They need to determine the best feed intake that leads to better growth and production.

Many studies in Iraq deal with culture of common carp in floating cages [2,17,5,16,1,4,], with little dealing with feeding strategies. The aim of this experiment is to determine the ability of common carp to use dry bread (DB) and dry fish (DF) for feeding in floating cages. Such feeding practice was reported to be useful by many fish culturist in the area (Basra, Iraq) for carp reared in earthen ponds.

## 2. Materials and methods

Current experiment was conducted in floating cages of (3×4×3) meters size, located in Shatt Al-Arab River north Basrah (Plate, 1). Common carp (*Cyprinus carpio* L.) ranging in weight between 200-443 g were used as experimental fish for this trials. They were cultivated for 74 days (July-October, 2017). A total of eight cages were used to accommodate fish at two stocking densities (2 repetitions each). In high density 840-955 fish per cage were raised while low density stocking comprise raising 536-640 fish per cage. Fish were fed the experimental rations which consist of dried fish (DF) and dried bread (DB) for pre-experimental three weeks for adaptation. They were raised before on a commercial imported floating pellets. Feeding behavior was recorded during adaptation. Fish were found swimming under the floating new feed without consuming, but after ten days they were noticed feeding well on both ingredients. Two feeding regimes were practiced. The first one include using 25% DF & 75% DB in four cages, while fish in the other four cages were fed on 40% DF & 60% DB. The experimental design for the treatments is shown in Table (1). Feeding ratio 5% of fish weights were used for both rations. Feed was distributed by hand twice a day (early morning and afternoon).

Average fish weight was measured at the beginning of experiment, after 23 days and at the end of experiment after 56 days. Daily amount of fish feed was calculated after fish weighing

depending on total fish weight and feeding ratio. Water temperature was measured during experiment using simple thermometer. Growth criteria [specific growth rate (SGR), daily growth rate (DGR) and weight increment (WI), in addition to food conversion rate (FCR)] were calculated according to the following equations:

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

$DGR = (W_2 - W_1)/t$

$WI = W_2 - W_1$

FCR = Food consumed/Weight gain

Where $W_1$ is initial weight, $W_2$ is 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 difference between the means.

3.

**4. Table 1. Design of experimental treatments.**

| Feeding Treatment | Stocking Density | Cage No. |
|---|---|---|
| 25% DF & 75% DB | Low | 1 & 4 |
| | High | 2 & 3 |
| 40% DF & 60% DB | Low | 7 & 8 |
| | High | 5 & 6 |

Figure 1. Floating cages in Shatt Al-Arab River, Hartha District, Basrah.

5.

## 3. Results

Table 2 shows fish measurements and food consumed for common carp fed on 25% dried fish and 75% dried bread with water temperature during the experiment. Final weights reached by fish cultivated at low density were 649.3 and 462 g, while final weights reached by fish cultivated at high density were 400.5 and 338.2 g. Water temperature were 33, 30 and 26 $^{0}$c for August, September and October respectively. Table 3 shows fish measurements and food consumed for common carp fed on 40% dried fish & 60% dried bread during the experiment. Final weights reached by fish cultivated at low density were 493.7 and 502.9 g, while final weights reached by fish cultivated at high density were 483.2 and 365.9.2 g. Total fish died was seven at high density cages and 19 at high density cages. Table 4 contains the growth criteria (WI, DGR, SGR and FCR) for common carp fed on 25% dried fish & 75% dried bread at low and high density. Average WI for fishes at high density was 130.1 g, while at low density 225.7 g. Average DGR and SGR were 2.30 g/day and 0.93 %/day at high density, while at low density they were 3.62 g/day and 0.85 %/day. Average FCR was 5.81 for high density and 6.08 at low density. Statically analysis for mortality, WI, SGR and FCR proved that there aren't any significant differences ($P>0.05$) between fishes reared at high and low density. DGR values showed significant differences ($P\geq0.05$) between fishes reared at high and low density.

Table 5 appear growth criteria for common carp fed on 40% dried fish & 60% dried bread at low and high density. Average WI for fishes at high density was 131.4 g, while at low density 161.6 g. Average DGR and SGR were 2.56 g/day and 0.66 %/day at high density, while at low

density they were 2.90 g/day and 0.71 %/day. Average FCR was 5.39 for high density and 6.62 at low density. Statically analysis for mortality and growth criteria proved that there weren't any significant differences (P>0.05) between fishes reared at high and low density. Table 6 shows growth criteria for common carp fed on two feeding treatments at high density. Average mortality ratios were 0.45% for fishes fed on 25% DF & 75% DB and 0.96% for fishes fed on 40% DF & 60% DB. Averages growth criteria values were 130.1 g, 2.30 g/day, 0.93 %/day and 5.81 of WI, DGR, SGR and FCR respectively for fishes fed on 25% DF & 75% DB. Averages values were 131.4 g, 2.56 g/day, 0.66 %/day and 5.39 of WI, DGR, SGR and FCR respectively for fishes fed on 40% DF & 60% DB. Statically analysis for mortality and growth criteria proved that there weren't any significant differences (P>0.05) between fishes fed on 25% DF & 75% DB and fishes fed on 40% DF & 60% DB.

Table 7 show growth criteria for common carp fed on two feeding treatments at low density. Average mortality ratios were 0.81% for fishes fed on 25% DF & 75% DB and 0.96% for fishes fed on 40% DF & 60% DB. Averages values for fishes fed on 25% DF & 75% DB were 225.7 g, 3.62 g/day, 0.85 %/day and 6.08 of WI, DGR, SGR and FCR respectively. Averages values for fishes fed on 40% DF & 60% DB were 161.6 g, 2.90 g/day, 0.71 %/day and 6.62 of WI, DGR, SGR and FCR respectively. Statically analysis for mortality and growth criteria proved that there weren't any significant differences (P>0.05) between fishes fed on 25% DF & 75% DB and fishes fed on 40% DF & 60% DB.

Table 2. Fish measurements and food quantity for common carp fed on 25% dried fish & 75% dried bread with water temperature during the experiment.

| Cage No. | Date | | | | | | Daily food consumed | |
|---|---|---|---|---|---|---|---|---|
| | 11/8/2017 | | 4/9/2017 | | 6/10/2017 | | Dried fish (kg) | Dried bread (kg) |
| | Average fish weights | Fish No. | Average fish weights | Fish No. | Average fish weights | Fish No. | | |

| | (g) | | (g) | | (g) | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 443.7 | 640 | 530.6 | 640 | 649.3 | 636 | 3.50 | 10.50 |
| | | | | | | | 4.75 | 14.25 |
| 2 | 277.8 | 900 | 325.0 | 900 | 400.5 | 890 | 3.12 | 9.38 |
| | | | | | | | 3.62 | 10.88 |
| 3 | 200.7 | 955 | 257.7 | 955 | 338.2 | 955 | 2.37 | 7.13 |
| | | | | | | | 3.10 | 9.15 |
| 4 | 261.1 | 580 | 358.0 | 578 | 462.0 | 572 | 1.87 | 5.63 |
| | | | | | | | 3.20 | 9.60 |
| Water Temp. $^0$C | 33 | | 30 | | 26 | | | |

Table 3. Fish measurements and food quantity for common carp fed on 40% dried fish & 60% dried bread during the experiment.

| Cage No. | Date | | | | | | Daily food consumed | |
|---|---|---|---|---|---|---|---|---|
| | 11/8/2017 | | 4/9/2017 | | 6/10/2017 | | | |
| | Average fish weights (g) | Fish No. | Average fish weights (g) | Fish No. | Average fish weights (g) | Fish No. | Dried fish (kg) | Dried bread (kg) |
| 5 | 335.7 | 850 | 399.9 | 846 | 483.2 | 840 | 5.70 | 8.55 |
| | | | | | | | 6.80 | 10.20 |
| 6 | 250.6 | 940 | 298.3 | 940 | 365.9 | 933 | 4.70 | 7.05 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 5.60 | 8.40 |
| 7 | 312.6 | 540 | 395.6 | 537 | 493.7 | 536 | 3.40 | 5.10 |
| | | | | | | | 4.20 | 6.30 |
| 8 | 360.7 | 610 | 423.5 | 610 | 502.9 | 605 | 4.40 | 6.60 |
| | | | | | | | 5.20 | 7.80 |

Table 4. Growth criteria for common carp fed on 25% dried fish & 75% dried bread at low and high density.

| Density | Cage No. | Growth criteria | | | | |
|---|---|---|---|---|---|---|
| | | WI (g) | DGR (g/day) | SGR (%/day) | FCR | Mortality (%) |
| High | 2 | 122.7 | 2.16 | 0.65 | 6.98 | 0.90 |
| | 3 | 137.5 | 2.44 | 1.21 | 4.64 | 0.00 |
| Average | | 130.1 a | 2.30 a | 0.93 a | 5.81 a | 0.45 a |
| Low | 1 | 250.6 | 3.66 | 0.68 | 7.04 | 0.91 |
| | 4 | 200.9 | 3.59 | 1.02 | 5.13 | 0.72 |
| Average | | 225.7 a | 3.62 b | 0.85 a | 6.08 a | 0.81 a |

Different letters in one row is significantly different ($P \leq 0.05$).

Table 5. Growth criteria for common carp fed on 40% dried fish & 60% dried bread at low and high density.

| Density | Cage No. | Growth criteria | | | | |
|---|---|---|---|---|---|---|
| | | WI (g) | DGR (g/day) | SGR (%/day) | FCR | Mortality (%) |
| High | 5 | 147.5 | 3.07 | 0.66 | 7.03 | 1.18 |
| | 6 | 115.3 | 2.06 | 0.67 | 3.75 | 0.74 |
| Average | | 131.4 a | 2.56 a | 0.66 a | 5.39 a | 0.96 a |
| Low | 7 | 181.1 | 3.26 | 0.83 | 5.48 | 1.11 |
| | 8 | 142.2 | 2.55 | 0.60 | 7.77 | 0.82 |
| Averages | | 161.6 a | 2.90 a | 0.71 a | 6.62 a | 0.96 a |

Different letters in one row is significantly different (P≤0.05).

Table 6. Growth criteria for common carp fed on two feeding treatments at high density.

| Feeding treatments | Cage No. | Growth criteria | | | | |
|---|---|---|---|---|---|---|
| | | WI (g) | DGR (g/day) | SGR (%/day) | FCR | Mortality (%) |
| 25% DF & 75% DB | 2 | 122.7 | 2.16 | 0.65 | 6.98 | 0.90 |
| | 3 | 137.5 | 2.44 | 1.21 | 4.64 | 0.00 |
| Average | | 130.1 a | 2.30 a | 0.93 a | 5.81 a | 0.45 a |
| 40% DF & 60% DB | 5 | 147.5 | 3.07 | 0.66 | 7.03 | 1.18 |
| | 6 | 115.3 | 2.06 | 0.67 | 3.75 | 0.74 |

| | | | | | |
|---|---|---|---|---|---|
| Averages | 131.4 a | 2.56 a | 0.66 a | 5.39 a | 0.96 a |

Different letters in one row is significantly different (P≤0.05).

Table 7. Growth criteria for common carp fed on two feeding treatments at low density.

| Feeding treatments | Cage No. | Growth criteria | | | | |
|---|---|---|---|---|---|---|
| | | WI (g) | DGR (g/day) | SGR (%/day) | FCR | Mortality (%) |
| 25% DF & 75% DB | 1 | 250.6 | 3.66 | 0.68 | 7.04 | 0.91 |
| | 4 | 200.9 | 3.59 | 1.02 | 5.13 | 0.72 |
| Average | | 225.7 a | 3.62 a | 0.85 a | 6.08 a | 0.81 a |
| 40% DF & 60% DB | 7 | 181.1 | 3.26 | 0.83 | 5.48 | 1.11 |
| | 8 | 142.2 | 2.55 | 0.60 | 7.77 | 0.82 |
| Averages | | 161.6 a | 2.90 a | 0.71 a | 6.62 a | 0.96 a |

Different letters in one row is significantly different (P≤0.05).

## 4. Discussion

Past experiments of cultivation common carp in floating cages proved that this fish can grow without natural feed using different supplementary artificial feed [13]. In order to reduce prices of common carp feed, in this experiment, DB and DF used to fed common carp cultivated in floating cages without any artificial processing. Results of growth and food conversion rate are not encouraging. Average food conversion rate in this experiment was around 6 in both ratio of feeding comparing to 1.5-3 for most artificial floating pellets used by other researchers. From the economics of view, it is not recommended to use dry fish and bread in feeding common carp cultivated in cages. This result may be attributed to the fact that these two feed stuffs doesn't

cover all the feeding requirements of this fish, especially there wasn't any natural feed in cages. Fish feeding in floating cages need completely feed contain proteins, oil, carbohydrate in addition to minerals and vitamins, and any lack in these components lead to slow growth and low production. In earthen ponds, these two feeding stuffs can be used as a supplementary feed for common carp, as many culturist in Basrah claimed.

Results of this experiment proved that increasing the ratio of DF from 25% to 40% don't develop growth of common carp and don't reduce the FCR. Protein concentration of DF may be more 3-4 times than protein concentration of DB. This result are differ from the results of [15] who found better growth of common carp in feed with 35% protein concentration comparing with 25% and 30%. It was stated that increasing protein concentration in feed reducing food conversion rate because fish will consume little feed to grow [8]. Food conversion rate of 2.63 was recorded for common carp cultivated in the same cages of current experiment when using sinking pellets at feeding ratio of 5% [16], while at present study food conversion rate was 6.00 and 5.94 for both feeding ratio. Food conversion rate for common carp were 3.01, 2.27 and 2.70 when fed on pellets contain protein concentration of 25, 30 and 35% respectively [5]. Average FCR in current experiment were 5.6 and 6.35 for high and low fish density respectively. It was pointed that FCR of common carp cultivated in floating cages ranged between 2.63-3.16 for different fish densities [1].

## 5. Conclusions

Depending on the results of current experiment It isn't recommended to use DF and DB alone in feeding common carp reared in floating cages, especially from the point of view of economics.

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# استعمال السمك المجفف والخبز اليابس كغذاء لاسماك الكارب الشائع Cyprinus carpio L. المستزرعة في الاقفاص العائمة

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الملخص

اجريت تجربة استزراع اسماك الكارب الشائع Cyprinus carpio في الاقفاص العائمة المنصوبة داخل نهر شط العرب بالقرب من قضاء الهارثة الواقع شمال محافظة البصرة، لغرض فحص امكانية استخدام الاسماك المجففة والخبز اليابس في تغذية هذه الاسماك المستزرعة في كثافتين. استعملت ثمانية اقفاص في هذه التجربة، اربعة منها (اثنان للكثافة العالية، 840-895 سمكة لكل قفص واثنان للكثافة الواطئة، 536-640 سمكة لكل قفص) غذيت على 25% من السمك المجفف و75% على الخبز اليابس، بينما غذيت الاقفاص الاربعة الاخرى على 40% سمك مجفف و60% خبز يابس. استعملت للكثافتين نسبة تغذية قدرها 5% من وزن الاسماك الحي وقسمت كمية الغذاء اليومي الى وجبتين الاولى في الصباح الباكر والثانية عصرا. قيس معدل وزن الاسماك في بداية التجربة وبعد 23 يوم وفي نهاية التجربة (بعد 56 يوم). اشارت نتائج التجربة الحالية بانه لا توجد فروقات معنوية($P>0.05$) بين معايير النمو للأسماك التي غذيت على نسبتي التغذية وفي الكثافتين، عدا قيم معدل النمو اليومي التي اظهرت اختلافات معنوية ($P<0.05$) بين الاسماك التي غذيت على 25% سمك مجفف و75% خبز يابس وفي الكثافتين. ان نتائج النمو والتحويل الغذائي غير مشجعة مقارنة مع بقية الاغذية المحلية الاخرى، إذ كان معدل التحول الغذائي حوالي 6 في نسبتي التغذية. من وجهة النظر الاقتصادية فلا ينصح باستخدام السمك المجفف والخبز اليابس لوحدهما في تغذية اسماك الكارب الشائع المستزرعة في الاقفاص العائمة.