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Comparing the Effect of Frozen Live Food and Artificial Diets on The Common Carp (*Cyprinus carpio* L.) Fry

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□ ABSTRACT □

This study aimed to investigate the effect of frozen live food (*Daphnia magna*) and artificial diets on growth performance, feed conversion ratio and survival of *Cyprinus carpio* fry reared in 25-liter glass aquaria. Duplicate groups of fry were fed on the tested diets three times a day to satiation for 21 days.

The results revealed that the growth rates (weight gain, % weight gain) were significantly ($P<0.05$) affected by the used diets. Fry fed on the frozen live food showed the worst growth rates, even their feed conversion ratio expressed the lowest value compared with the results obtained from fry fed on the artificial diets, although survival was not significantly ($P>0.05$) affected with the different diets. No significant differences ($P>0.05$) were noticed in the results obtained from fry fed on the different artificial diets.

Key words: *Cyprinus carpio*, Fry, Live food, Artificial diets, Fish growth.

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مقارنة تأثير العلف الطبيعي المجمد والأعلاف الاصطناعية على صغار سمك الكارب العادي(*Cyprinus carpio* L.)

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□ ملخّص □

تم إجراء البحث لدراسة مدى تأثير كل من العلف الطبيعي المجمد ، و نوعين من العلائق الاصطناعية على النمو، معامل التحويل الغذائي و البقاء على قيد الحياة لصغار سمك الكارب العادي (*Cyprinus carpio*) ، الذي تم تربيته في أحواض زجاجية سعة 25 ليتر من المياه العذبة. علفت الصغار (بمعدل مكررين لكل معاملة) ثلاث مرات في اليوم حتى الشبع ، لمدة 21 يوماً.

أوضحت النتائج أن مظاهر النمو المختلفة تأثرت على نحوٍ واضح ($P<0.05$) بالأعلاف المستخدمة. حققت الصغار التي تغذت على العلف الطبيعي المجمد أدنى معدلا ت للنمو (معدل الكسب بالوزن والنسبة المئوية للوزن المكتسب) ، و كذلك الأمر مع معامل التحويل الغذائي لهذه الصغار ، إذ سجل قيماً منخفضة مقارنة بمثيلاتها التي قدم لها الأعلاف الاصطناعية، مع العلم أن البقاء على قيد الحياة لم يتأثر ($P>0.05$). كذلك لم تسجل اختلافات جوهرية ($P>0.05$) بين نوعي العلف الاصطناعي المستخدم.

الكلمات المفتاحية: الكارب العادي–صغار الأسماك–الغذاء الطبيعي–العلف الاصطناعي–نمو الأسماك.

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Introduction:

Carps (Cyprinidae) are the biggest group of cultured fish throughout the world (after Salmonids). This may due to the unique characteristics that characterize carps such as their feeding habits at a low level of the food chain, high survival & growth performances under culture conditions and tolerance of high variations of water quality and diseases. All of these had led to the development of numerous production systems in both temperate and tropical regions (Kestemont, 1995). The common carp (*Cyprinus carpio* L. 1758) has been cultured for several thousand years ago and is now widely distributed ; it is the second in the world aqua- cultural production. Common carp is cultured on almost all countries under a wide range of geographic, climatic and technological conditions (Jeny, 1995).

For many fish species, the larval period is considered critical in life history. Success of larval rearing depends mainly on the availability of suitable diets that readily consumed, efficiently digested and that provide the required nutrients to support good growth and health (Giri *et al*., 2002). Most fish species larvae depend basically on live food (such as daphnia, artemia and rotifers) as start feeds. Later with progressive stages (fry), artificial diets can be offered partially or totally. However, live feeds have several disadvantages such as seasonal availability and the introduction of pathogens and parasites into the hatchery (Jeny, 1995). Providing good larvae quality leads to obtain good fry quality that improves the culture process by guaranteeing good health fingerlings to the fish farms, through providing the proper nutrition during these early stages.

Carp rearing has become more complex and precarious due to various ecological conditions. Climate changes being the most prominent one (Jelkic *et al*., 2012). The main obstacle to higher production of commercial fish in a three-year cycle on carp fish farms are larger losses of fish per unit (Jelkic *et al*., 2012). The highest losses, which could go from 50-90 % in mud pond conditions, occur in the larvae to fry growth period, i.e. in a month old fry (Jelkic *et al*., 2012). The authors suggested this great losses to inadequate ecological water temperature fluctuations, lack of oxygen, pollution, large zooplankton, natural predators (e.g. birds, frogs) or feeding conditions (Feldlite and Milstein, 1999; Jirasek and Mares, 2001). As the growth and development of hatched larvae in endogenous feeding phase are dependent on the yolk-sack (Heming and Buddington, 1988), the transition to the exogenous phase is a critical stage in larval life (Shimma *et al*., 1977). Up until the beginning of 80s, it was generally thought that carp larvae cannot be fed artificially by starter-feed if live zooplankton was not given first (Bryant and Matty, 1981).

Recent research was conducted by complete replacement of live feed with artificial one (Charlon and Bergot, 1984; Escaffre *et al*., 1997; Carvalho *et al*., 1997; Cahu *et al*., 1998 and Yufera *et al*., 1999). Appelbaum (1976) suggested that carp larvae can in fact be reared exclusively on artificial feed from the beginning of the exogenous feeding phase. Since the beginning of the 90s, significant attempts have been made to solve the problem of larval starter feeds. The dependence of small larvae, such as carp larvae, on live feed is trying to be reduced in practice by switching to artificial feed at various time (Jelkic *et al*., 2012).

Aim of Research:

The necessary control in the early rearing stages based on artificial feed is considered to be the key problem and a drawback to carp aquaculture. The purpose of this research was to compare between both frozen live food (*Daphnia magna*) and artificial diets on growth performances and survival of common carp fry reared under the laboratory conditions.

Materials and Methods:

This experiment was achieved at the Research Laboratory, Zoology Department, Faculty of Science, Tishreen University, Lattakia, Syrian Arab Republic. *Cyprinus carpio* fry (0.15 g mean initial weight) were transported from El-Sin Fish Farm, in plastic containers supplied with air produced by a pump. In the laboratory, fry were put randomly in glass aquaria (filled previously with dechlorinated tab water) to rest and kept unfed for one day. The dead fry (due to manipulation and transportation) were removed and a commercial diet was offered for two days. Then, the fry were distributed in 6 (duplicate for each treatment) glass aquaria (25 liter capacity) at a ratio of 100 fry/aquarium and fed on the experimental diets for two days prior to the test. The aquaria were cleaned daily to remove the feces and the expelled water was replaced with another dechlorinated tap water. The aquaria were provided with an air stone for aeration. Water temperature, pH and dissolved Oxygen were recorded daily using (Dissolved Oxygen Kit-WTW milti 34oi), the water temperature ranged between 22.4-27.27 °C, pH 7 - 7.3 and dissolved Oxygen 5.39 - 6.11 mg/liter.

Common carp fry were fed frozen live food (*Daphnia magna*) prepared before starting the research and two experimental diets containing the same protein level (45 % protein and 600 cal GE/100g diet) but with different protein sources: fish meal (FM) and soybean meal (SBM), respectively. The composition of the tested diets is given in table (1), the diets were prepared as described by El-Sayed (1990).

The fry were fed on the live food and the artificial diets to satiation, three times daily (at 8 am, 12 and 4 pm), seven days a week for 21 days (from 1-6-2012 to 21-6-2012).

To study the effect of the tested diets on fry performance, the initial weight (g/fish), the final weight (g/fish) and the amount of food given (g/fish) were recorded and the survival rate was calculated. The fry were weighed at week intervals to obtain a look on the weight increasing with time. Growth and survival data are powerful tools for understanding the effects of both live and manufactured diets on first-feeding fish larvae (Wang *et al*., 2005).

At the end of the experiment, the fry in each aquarium were netted and weighed to obtain the final body weight (g/fish). The statistical analysis was performed by using A two-way Analysis Of Variance (ANOVA) to test the effect of the manipulated diets on the fry growth performance.

Table (1): Composition of the experimental diets (%) fed to *Cyprinus carpio* fry.

Ingredients	Diet (1)	Diet (2)
	FM (g)	SBM (g)
Fish meal (62% protein of dry matter)	55	36
Soybean meal (44.8% protein of dry matter)	20	49
Wheat bran (15.2% protein of dry matter)	10	5
Corn meal (9.6% protein of dry matter)	5	-
Fish oil	4	4
Plant oil	6	6
Total	100	100

Results and Discussion:

-Results:

The results of the tested diets are summarized in table (2) and graphically pointed in figure (1).

The results of this experiment revealed that the artificial diets which contained FM and SBM, respectively as a major protein source, produced the best growth rate, feed conversion ratio and survival as shown in table (2) and figure (1). Weight gain and percent weight gain were much better in fry fed artificial diets than those fed frozen live food. FCR was affected by treatments, significant differences ($P<0.05$) were noticed between fry fed frozen live food (10.5) and fry fed the artificial diets (1.4 and 1.3).

No significant differences ($P>0.05$) were found among fry fed the artificial diets regardless of the protein source used. Both groups of fry (table 2) revealed a comparable growth rates and FCR, even during the feeding of carp fry with artificial feed, and no behavioral changes were noted, in which fry accepted the pellets of the diets (but not accepted frozen live food) directly at the onset of the experiment.

Meanwhile, survival was another parameter that was affected by tested regimes. A significant differences ($P<0.05$) were recorded among fry fed frozen live food and those fed artificial diets. Fry fed frozen live food revealed the lowest survival as shown in figure (1), while survival was comparable in fry fed the artificial diets, no significant differences ($P>0.05$) were observed among fry fed on both artificial diets.

Table (2): Growth rate and feed conversion ratio of *Cyprinus carpio* fry fed different tested diets for 21 days.

Parameters	Live food	Diet (1)	Diet (2)
	Frozen	FM	SBM
Initial weight (g/fish)	0.15	0.16	0.16
Final weight (g/fish)	0.17	0.26	0.26
Given food (g/fish)	0.21	0.14	0.13
Weight gain[1] (g/fish)	0.02	0.1	0. 1
%Weight gain[2]	13.33	62.5	62.5
Feed conversion ratio[3]	10.5	1.4	1.3

[1]Weight gain = final body weight (g) - initial body weight (g)

[2]Percent weight gain (%) $= W_2\text{-}W_1/W_1\times100$

[3]Feed conversion ratio (FCR) = dry feed intake (g) /fish live weight gain (g)

Where: W1 = initial weight (g), W2 = final weight (g)

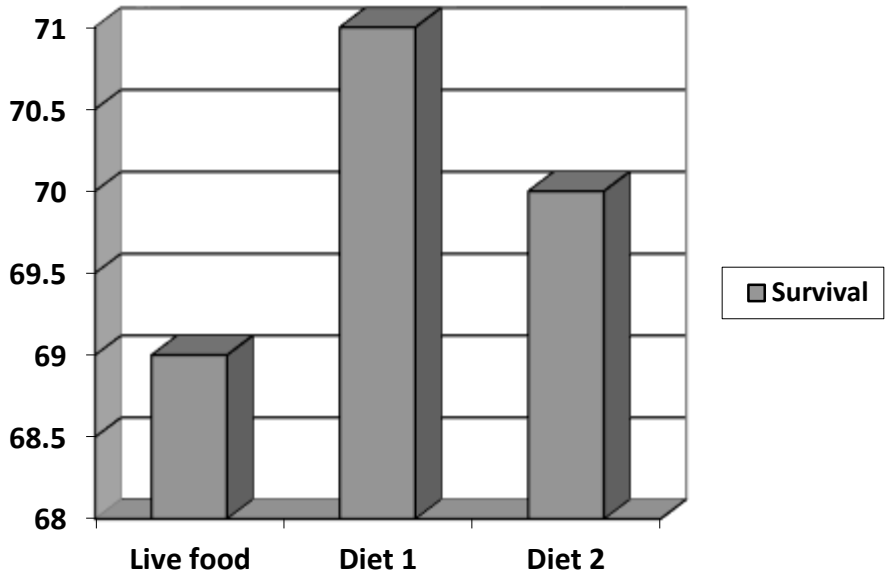

Figure (1): Survival of *Cyprinus carpio* fry fed tested diets for 21 days.

Discussion:

In recent years, much progress has been made in the rearing of common carp larvae fed only with artificial diets. The results of the present paper demonstrated that growth rates, feed utilization efficiency and survival were significantly affected by the tested regimes. Common carp fry fed frozen live food exhibited the worst results either in weight gain or in feed conversion ratio, while fry fed the artificial diets showed advanced growth and feed conversion.

Many researches within the past two decades were trying to deal with such an important issue concerning the replacement of live food with artificial diets partially or completely for fish larvae and fry in both marine and fresh water species. This is because the process of producing and preparing live food is time-consuming and requires a high level of expertise and organisms ((Jelkic *et al*., 2012). Person-Le Ruyet *et al*. (1993) estimated that the expanses of feeding live feed amounts to 79% of total fry production cost. Hence comes the importance of this paper. Significantly higher survival (91%) and growth were observed in common carp larvae fed on live food system in the low density (25larvae/15-L aquarium) (Sharma and Chakrabarti, 2007). Average weight of larvae of common carp in the previous study in the live food system was 3 to 5 folds higher than larvae at the same density for the artificial diet. This result appears on contrary to the present study. This difference in the results could be explained by the findings of Grabner *et al*. (1981) who assumed that frozen or freeze-dried zooplankton material when introduced into water, enzymes activity is rapidly lost. While Sharma and Chakrabart (2007) found that the highest enzyme activity was observed in the live food system. So freezing *Daphnia magna* in the present study can explain the bad growth achieved by the fry fed on, and the results could be reversed if zooplankton (*Daphnia magna*) was used live and not frozen. The final mean weight and specific growth rate of African catfish (*Heterobranchus longifilis*) larvae fed live artemia nauplii were significantly higher than those of larvae fed all other tested diets which included frozen artemia nauplii, live and frozen *Monia micrura*, a dry diet based on yeast powder and beef liver and a commercial trout diet (Nanthawat and Legendre, 1994). Survival rates did not significantly differ

between the tested diets except commercial trout diet that led to significantly lower growth and survival rates (Nanthawat and Legendre, 1994) . The authors recommended that the artificial feed based on yeast powder and beef liver leads to survival rates as high as those obtained with living diets and thus represented a promising way for feeding *H. longifilis* fry. *Clarias gariepinus* larvae fed live daphnids for two weeks performed better in terms of growth rate than those fed frozen daphinds, though statistically, no significant difference, larvae fed frozen food had greater survival than those fed live daphnids, therefore, live daphnids is recommended for larvae though frozen one can be used as supplement (Ojutiku,2008).

Coregonus schinzi palea larvae were fed dry pelleted diets based on single cell protein (yeast or bacteria) and freeze-dried liver and compared with live artemia nauplii as first food (Dabrowski *et al*., 1984). The authors found that a significant difference in mortality was observed after 35 days of the experiment between fish fed dry diets (8-10%) and those fed live artemia nauplii (50%), and increase in wet weight was highest in fish fed artemia (161 mg individual weight) though two of the three dry diets based on yeast also gave very satisfactory growth. It appears that live food can be totally eliminated from the initial diet of coregonid larvae (Dabrowski *et al*., 1984). In another study,the survival rates of the fish groups fed zooplankton were similar in *Coregonus albula* and *C. muksun* or even lower in *C. lavarelus* than those of the groups fed on the dry diet, whereas the growth rate of the fish fed the live prey was better than that of those fed the pelleted diet (Luczynski *et al*., 1986). The authors concluded that the larvae of the tested fish species can be fed solely on a dry diet after hatching with satisfactory growth and survival.

Conclusions:

- Live food should provided for economical fish larvae.
- Natural live food better than frozen live food.
- Artificial diets could be used as a complementary diet.

Recommendations:

- The necessity of providing the hatching facilities with live food production units for post larvae rearing.
- Searching of cheap and notorious diets from the local markets as complementary diets for fish fry after passing critical age.
- Taking advantage of others knowledge in hatching and rearing fish larvae and providing good fingerlings quality.

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