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THE ABILITY TO USE *SPIRULINA SP.* AS FOOD FOR COMMON CARP FISH (*CYPRINUS CARPIO* L. 1758)

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Abstract

This study was carried out to study the effect of adding different concentration of the alga *Spirulina* spp. on the growth of carp fish by monitoring weight gain. In Ecology laboratory of Biology Department, College of Science of Baghdad University, Iraq. Using 88 common carp fish weight 45±8 gm (to test the effect of three different levels of the algae Spirulina platensis. The control treatment (T1) 100% pure Spirulina diet, (T2) with 30 gm Spirulina /kg diet (3%), (T3) adding 15 gm Spirulina /kg diet (1.5%), and (T4) with commercial diet only. Each treatment in three replicates in which eight common carp were stocked in each aquarium. Results indicated that first treatment higher significant than other treatments in final mean weight 69.34 ± 2.83 and the T2 treatment with 3% spirulina platensis seem to be more effective than T3.

***Keywords*: ***Spirulina sp*., common carp fish, *Cyprinus carpio L.*

Introduction

Fish diet is the most important source of protein in aquaculture, The cost of fish diet is about 80 percent of aquaculture industry operating costs where protein is the controlling factor, which determines the cost of fish diet (Shepherd & Jackson, 2013) for instance fish diet, As natural feeds include all essential nutrients for fish development and growth, they are imperative in the diet of pond fish (Tuchapska and Krazhan, 2014). They revealed that integration of artificial feeds; growth and immunity of fish are greatly affected by the portion of natural feeds in fish diet. Aba *et al.* (2012) presented that the improvement formulation of a food economy affects the development of the fish farming sector, however it has to comply with the requirements of the fish in terms of quantity and quality (Aba *et al.,* 2012).

In accordance to Sirakov *et al.* (2015) algae is one of the easily accessible and comparatively low-cost constituents of food that can effectively answer the encounter question raised by the fish farming sector. The need for healthier food sources compared with traditional animal products has revived interest largely in plants and predominantly in microalgae (Muller-Feuga, 2000; Hemaiswarya *et al.,* 2011).

Microalgae use has recently gained the attention of a number of researchers as a potential alternative to fishmeal, Microalgae are important in aquaculture and have been eaten as live feed for finfish, larval or adolescent crustaceans for all bivalve mollusks, including musk clams, scallops and oysters. They are used as feed for zooplankton used in aquaculture Microalgae are rich in essential fatty acids, carotenoid pigments, essential amino acids, vitamin and minerals for aquatic animals (Augustin *et al*., 2011). Algae have positive effects on the physiology (by providing a large profile of minerals, natural vitamins and essential fatty acids; improved fertility and immune response; and better weight control) and their external appearance (resulting in healthy skin and a lustrous coat) of animal (Certik and Shimizu 1999), Microalgal use by indigenous populations has occurred for centuries. Indeed, edible blue-green algae including Nostoc, Arthrospira (Spirulina) and Aphanizomenon species have been used for food for thousands of years (Jensen *et al*., 2001). The high protein content of many microalgal species is one of the main reasons why they are regarded as an unconventional source of protein (Cornet, 1998; Soletto *et al*., 2005).

Spirulina platensis is a uni-cellular microalgae which grows in fresh water, in salt water, as well as in brackish bodies of water (Capelli and Cysewski, 2010a), Spirulina is the most commonly available and widely used genus in the world, which has been studied extensively in various fields, especially the food and medicine industries (Beheshtipour *et al.,* 2012).

Basically, Spirulina consists of 55-70% protein and 5-6% lipid (w/w dried cell). Polyunsaturated fatty acids (PUFAs) constitute 1.5-2% of the total lipid content of this alga. In fact, Spirulina spp. is rich in ⊥-linolenic acid (36% of the total PUFAs), vitamins (B1, B2, B3, B6, B9, B12, vitamin C, D and E), minerals (K, Ca, Cr, Cu, Fe, Mg, Mn, P, Se, Na and Zn), pigments (chlorophyll a, xanthophyll, betacarotene, echinenone, myxoxanthophyll, zeaxanthin, canthaxanthin, diatoxanthin, 3-hydroxyechinenone, beta-cryptoxanthin, oscillaxanthin, phycobiliproteins, C-phycocyanin, and allophycocyanin) and enzymes (e.g. lipase) (Belay,2002) (Demir and Tükel, 2010).

Phycocyanin derived from *Spirulina platensis* has antioxidant, anti-inflammatory, and radical scavenging properties, phycocyanin protect against diabetic nephropathy by inhibiting oxidative stress (Zheng *et al.*, 2012)**.**

The aim of present study was to examine the effects of using the microalgae Spirulina platensis in common carp diet in different concentration on growth performance.

Material and Method

To produce sufficient biomass for the experiment modified zarrouk media were used to culture *S. Platensis* according to (Al-hussieny *et al.*, 2014), Modified zarrouk media was prepared according to Aiba and Ogawa (1977); Schlosser, (1994).

Experimental animal

The experiment was lasted for 60 days and for this purpose 88 common carp *C. carpio* L. (weights ranged between 40-45 g) were brought. The fish were weighed and put in experimental plastic aquariums. The fish were acclimated to laboratory conditions and fed with control diet prior to the feeding trials for 14 days.

Experimental design

Ten Glasses aquaria were designed measurement (60 × 30 × 30) cm for acclimatization for collecting fish and for experiment supplier oxygen by central pump distributes rubber tubes to all aquaria, contains (30) liter water (Abdul-Ahad, 1996; Al-Azawi, 2010). Each aquarium was stocked with eight fish. The numbers of treatments in the trial were four. a daily cleaning by siphon method was applied to remove remaining particles from the system.

Fish diet formulation

Experimental diets composed of a standard commercial diet type found in Baghdad city markets. Having 32% total protein. According to Abdel-Tawwab and Ahmad (2009) The cultured Spirulina added to the commercial diet to represent the levels of 0.0 (control), 15, 30g for each 1kg diet. Spirulina was suspended in 100mL distilled water and added to the ingredient so for each diet, which was blended for 40min at least to make a paste of each diet. The pastes were separated, The pastes were dried at room temperature for a few days and crushed to create fine particles ,the diets were air-dried and stored in plastic bags . Fish were fed twice a day with a ratio of 3 % of body weight. Fish in every tank were weighed every two weeks. The feeding trial continued for 8 weeks.

Growth parameters

The individual body weight (g) for all fish per treatment were measured during the 8 weeks of the experiment. The feed consumption of each treatment was recorded.

Result and Discussion

This study explored the growth performance of common carp fish using *S. platensis* for fish meal being the source of protein in the fish diet.

Behavioral changes in the fishes under this study were observed and found that some selective behavioral changes were noticed as a function of *Spirulina platensis*. It was observed that the fish that were feeding spirulina as their diets seem to be calmer in the aquarium and in the time of feeding, they have more appetite than the fish that were feeding commercial diets only. The spirulina fed fish show more resistance and very fast movement when it's hunted.

It was observed that the skin of common carp fed with pure spirulina only and diet that contain spirulina seems to be lighter than the one fed with only commercial diet, this change could be explained that *Spirulina platensis* enhanced the coloration in muscle, skin and fins of *Pagrus major* (Mustafa *et al.,* 1994) which supports the observation made in the study of Yuangsoi *et al*. (2010).

The major polymeric component in *S. platensis* is a branched polysaccharide, structurally similar to glycogen. High molecular weight anionic polysaccharides with antiviral and immunomodulating activities have been isolated from Spirulina (Parages *et al.,* 2012). Their applications are mainly to provide nutrition and to enhance the color of the flesh of salmonids. The larvae of molluscs, echinoderms and crustaceans as well as some fish larvae feed on microalgae (Hemaiswarya *et al.*, 2011).

Growth performance often provides vital information aiding the diagnosis for health assessment and management of cultured fish (Abdel-Tawwab and Shady, 2012). Studies using Spirulina platensis as a supplement and as a partial substitution in the diets have noted that spirulina platensis improves immune responses in Mekong giant catfish (Tongsiri *et al*., 2010), and African sharp tooth catfish (Promya and Chitmanat, 2011). Moreover, S. platensis has been reported to improve infection resistance in the shrimp, *Litopenaeus vannamei* (Chen *et al*., 2016). Further, S. platensis is accounted for alleviating organ toxicities induced by heavy metals, such as cadmium and lead (Simsek *et al*., 2009). Owing to its free radical scavenging and potent antioxidant activity, S. platensis administration has been shown to reduce the toxic effects of deltamethrin on *Oreochromis niloticus* caused by pesticides owing to its free radical scavenging and active antioxidant activity (Abdelkhalek *et al*., 2015). Likewise, S. platensis polysaccharide was found to possess anti-mutagenic and hematopoietic system activation potential when studied in animal model systems (Rehab and Makhlouf, 2012).

In the current study, the *S. platensis* concentration in diet were 15, 30, g/kg and total pure *S. platensis* diet in order to observe the optimum dietary concentration for common carp fish . The result in the current study showed that total pure S. platensis diet found to be of potential effects on growth with mean value weight and standard deviation (69.34 ± 2.83) more than the two other treatment (T2: 55.41 ± 2.63, T3: 58.16 ± 2.71) as it shown in Table 1.1.

Table 1.1 : Gives mean values ± standard deviation of fish weights (gm) fed with different spirulina concentrations in their diets for eight weeks

Weeks	Treatment			
	T1 (gm)	**T2 (gm)**	**T3 (gm)**	**T4 (gm)**
Day 1	45.47 ± 2.44	46.16 ± 1.82	52.13 ± 2.14	48.8 ± 2.61
2 week	50.31 ± 2.36	48.43 ± 2.17	53.2 ± 2.75	49.99 ± 2.94
4 week	57.97 ± 2.55	52.00 ± 2.84	55.48 ± 2.58	53.78 ± 2.92
6 week	63.81 ± 2.57	53.64 ± 2.15	57. 9 ± 3.05	53.78 ± 1.95
8 week	69.34 ± 2.83	55.41 ± 2.63	58.16 ± 2.71	54.52 ± 2.14

(T1: total pure spirulina diet 100%, T2: commercial diet + 3% spirulina,
T3: commercial diet + 1.5% spirulina, T4: commercial diet + 0% spirulina)

These results are in agreement with those obtained by many studies (Badawy *et al*., 2008; Ungsethaphand *et al*., 2009; Nandeesha *et al.,* 1998 and Güroy *et al.,* 2012; Abdulrahman, 2014, Holman) which they found that the addition of algae in fish diets of common carp (*C. carpio*), *O. niloticus* and *Catla catla* fingerlings enhanced the growth in terms of weight gain, specific growth rate, and survival rate of the fish.

Improved fish growth and feed consumption may be due to improved feed intake and nutrient digestibility, supplemented with live spirulina. Otherwise, Spirulina contains several nutrients, in particular vitamins and minerals, which can help to promote growth. Spirulina's strength appears to lie in its ability to improve growth, survival and non-specific immune function against fish pathogens, as well as its chemical-protective efficacy

Spirulina p. have no cell wall, which results in improved digestion and absorption Growth in fish is primarily due to muscle protein deposition and it therefore follows that the flow of amino acids from food to growing biomass (Abdulrahman, 2014).

James *et al.* (2006) suggested that *S. platensis* improves the intestinal flora in fish rendering break down of indigestible feed components to extract more nutrients from the feed; this also stimulates the production of enzymes that transport fats within the fish for metabolism instead of storage.

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