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ESSENTIALITY OF DIETARY PHOSPHOLIPID AND / OR ω-6 FATTY ACID FOR DEVELOPMENT OF COMMON CARP *CYPRINUS CARPIO L.* LARVAE STAGE

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SUMMARY

Trials were undertaken with first-feeding common carp *Cyprinus carpio* larvae after hatching to determine the effect of dietary soy bean oil as ω-6 source and / or phospholipid (PL) with two levels (2 and 4%) ,on the average growth performance and survival rate in series of two periods (about 30-day each) located in Fish Research Station belonging to National Institute of Oceanography and Fisheries. Low morality % was occurred with level of 4% PL in the first period, and with level of 2% oil in the second period. The average growth performance were improved with diet contained 2% PL in the first period and with diet contained 2% soy bean oil and PL together (50 : 50%) in the second period. Concerning, body fatty acid composition, (FA's), the high values of saturated FA were occurred in fish received 4% oil while, the higher values of unsaturated and ω-6 FA's were obtained with diet contained 2%PL .

The present study clearly confirmed that addition of phospholipid to the diet was important to obtain good survival of first-feeding common carp larvae up to 4% dietary level. In the other old stage of larvae the uptake and desertification of fatty acid occurred without addition of more phospholipid to the diet that may be due to a sufficient quantity of phospholipid of endogenous origin for micelle formation in the intestinal lumen.

Key word: Phospholipid, ω-6, soybean oil, dietary fatty acid ,common carp, larvae stage, survival rate.

INTRODUCTION

It is well recognized that the most critical period

in the life of fish, which consequently determines the size of a year-class, is when the larvae start acquiring external food. The much larger difficulty encountered in culturing fresh water species is mainly caused by the strict requirements of the larvae to their first feed. They demand living feeds, while larvae of fresh water species, such as common carp *Cyprinus carpio*, will accept pelleted diets (Sargent *et al.*, 1988) . Recent reviews concerning lipid nutrition of fish suggest that certain larvae stages require phospholipids (PL) in their diets (Kanazawa, 1993; Sargent, *et al.*, 1994, 1997). As animals in general, including juvenile and adult fish, are known to be able to synthesize PL (Sargent, 1976), the nature of the requirement of PL entity requires further investigations. There are only a limited number of experimental data available on the larvae response to dietary PL manipulation, which contracts with the large number of nutritional studies conducted to examine the essential fatty acids requirements of fish larvae. This is partly due to the difficulty in modifying the PL content of live prey (*Artimia*) by the classical enrichment techniques (Tackaert *et al.*, 1991). Moreover, since most start-feeding fish do not accept artificial diets, studies on the effect of PL inclusion in artificial diets concern mainly larvae which were initially fed live food (Kanazawa, et al., 1981,1983., Koven et al., 1993). In this context, carp larvae offer some advantages since they can be fed exclusively on semi-purified diets and strongly react to PL supplementation. Koven et al., (1993) and Radunz-Neto et al., (1994) suggested that PL could improve lipid absorption by their emulsifying properties and compensate for the presumed insufficient billiard secretion of larvae. In the same species a beneficial effect of PL on the incorporation of ω-3 fatty acids originating from dietary neutral lipids into larvae lipids was also reported by Salhi *et al.*, (1995).

The qualitative and quantitative prerequisites for fatty acids in diets for fish have been intensively investigated. These investigations examined survival, growth and fatty acid composition in the tissue of fish fed various experimental or natural diets. The storage fat in the eggs of fish is used as building material and as energy for the developing larvae (Sargent *et al.*,1988). Considering the importance of the first-feed on the survival of the larvae, it would be of interest to study its influence of fatty acid composition on the larvae. Surprisingly few investigations have examined this problem. Those carried out conclusively demonstrated the strong influence of the start-feed on the fatty acid composition of the larvae, e.g., in channel catfish (Yingst and Stickney, 1979) turbot (Scott and Middleyon, 1979) and herring (Gatten *et al.*, 1983; Fraser *et al.*, 1989). A strong dietary influence of the fatty acid composition on the tissue of fresh water fish also indicated in review article of Henderson and Tocher (1987). In none of the above investigations, however has the similarity between the diet and larvae been quantified. The similarities were only expressed in general qualitative terms such as: the fatty acid composi-

tion of the larvae "reflects" the dietary levels (Yingst and Stickney, 1979; Gatten *et al*; 1983 and Hove and Grahl-Nielsen, 1991).

The present study was undertaken in order to obtain more information on the effect of phospholipids and /or soy bean oil levels as source of ω 6 fatty acid on growth and survival rate of common carp *Cyprinus carpio* L. larvae.

MATERIALS AND METHODS

Brood fish of common carp *Cyprinus carpio* L. were brought to the concerte ponds (1:1, male :female) containing balm fibers in hot day at the summer season . After 72 h the larvae were coming afterwhich hatching, they were randomly distributed in 100 liter glass aquaria each (1000 larvae per glass aquaria) of the rearing system described by Charlon and Bergot (1984).

Experimental design

During the first week, the temperature was increased from 19°C (day 0) to 24°C, afterwhich it was kept constant at 24 ±1°C. The first period lasted 30 days (from 5-5 to 5-6-1999) and the second period also lasted 30 days, (from 5-6 to 6-7-1999). All experimental diets were fed in duplicate on the same basal diets (Table,1) which differed in soy bean oil as source of ω6 and / or marine phospholipid (CTPP, Boulogne - sur -Mer, france). Two treatments, (2 and 4% soy bean oil) two treatments, (2 and 4% PL) and two treatments, (soy bean oil and phospholipid together (1% : 1%) at level of 2 and 4%. Starting the following day (day 0 of the experiment) food was delivered in excess throughout the 16 h light period. Lipids were added as an emulsion to the mixed dry ingredients, the moist blend was pelletized with a meat grinder. Diets were dried for 48h in a ventilated oven at 49°C. Table (2) gives an overview of the percentage of fatty acid composition of different experimental diets.

Mortality was recorded daily. At the end of first period, the number of missing larvae was calculated and distributed over the second period as a proportion of actually observed mortality. Average body, length and weight measurements were performed on 10 larvae from each aquaria once a week. Also, at the end of each period, the remaining populations were anaesthetized with phenoxy ethanol and weighed in order to determine the final individual wet weight.

Fatty acid determination

Lipids were extracted according to the procedure of Folch *et al.*, (1957) and transesterfied using a methanol / acetylchloride mixture (20 : 1, volumetric). Fatty acid methlester determination was performed on a gas chromatograph (Center lab. of Cairo University) according to procedure of Coutteau and Sorgeloos (1995).

Statistical analysis

Statistical analysis was done according to the procedure of Steel and Torrie (1980). In factorial design manner (3x2) [oil only, PL only or oil with PL together at two levels of 2 and 4%] . Duncan, s test was applied whenever possible to test means differences (Duncan, 1955).

RESULTS AND DISCUSSION

The mortality percentages of common carp (*Cyprinus carpio L.*) larvae after hatching directly through the 1st period and the second period through were calculated and shown in Tables (3 and 4) . Significant differences ($P \leq 0.05$)were found among all experimental treatments .Low mortality percentages were occurred in larvae fed diet contained 4% PL (about, 13%)in the first period, and 2% oil in the second experimental period (about, 33%) .

The data clearly confirmed that the addition of PL to the diet was important to obtain good initial

Table (1): The feed formulation and chemical composition of the experimental diets.

	Experimental treatments					
Lipid sources	Oil		Phospholipids		Oil+ Phospholipids	
Lipid levels	2%	4%	2%	4%	2%	4%
Ingredient: (%)						
Wheat bran	28.0	26.0	28.0	26.0	28.0	26.0
Soybean meal	25.0	25.0	25.0	25.0	25.0	25.0
Fish meal	39.0	39.0	39.0	39.0	39.0	39.0
Soybean oil	2.0	4.0	-	-	1.0	2.0
Phspholipids	-	-	2.0	4.0	1.0	2.0
Vit. and Min. premix (1)	6.0	6.0	6.0	6.0	6.0	6.0
Nutrient composition (DM basis)						
Cnude protein , %	34.14	35.02	34.36	34.61	33.98	34.31
Ether extract, %	6.77	8.68	6.80	7.30	7.02	8.08
Total carbohydrate , %	38.99	38.05	39.99	38.95	41.89	38.51
Ash , %	20.0	18.25	18.85	19.14	17.11	19.10
Protein/Energy ration, (P/E ratio)	106.17	106.19	107.45	107.81	104.33	105.91
Gross energy (MJ/Kg) (2)	17.63	18.39	17.83	17.90	18.16	18.06
Metabolizable energy (MJ/Kg) (3)	13.45	13.79	13.73	13.43	13.62	13.55

(1) Vitamin and mineral mixture each 1 kg of mixture contains: 4.8m. I.U, Vit A., 0.8m.I.U. Vit D3., 4.0 g. Vit E., 0.8 g. Vit K., 4.0 g. Vit B12., 4.0 g. Vit B2., 0.6 g. Vit B6., 4.0 g. Vit Pantothenic acid., 8.0 g. vit Nicotinic acid., 400 mg. vit Folic acid., 20 mg. vit Biotin.; 200 g. Choline., 4 g. Copper., 0.4 g. Iodine., 12 g. Iron., 22 g. Manganese., 22 g. Zinc., 0.04 g. Seleniu

(2) GE was calculated using values 5.65 Kcal/ g protein, 4.2 Kcal/ g carbohydrate and 9.45 Kcal/ g fat according to Hepher *et al.*, (1983).

(3) ME was calculated from gross energy as 70% as reported by Hepher *et al.*, (1983).

Table (2): The fatty acid composition (% dietary fat) of different experimental diets.

	Experimental treatments					
Lipid sources	Oil		Phospholipids		Oil+ Phospholipids	
Lipid levels	2%	4%	2%	4%	2%	4%
Saturates:						
14:0	0.097	0.099	0.153	0.211	0.115	0.145
16:0	0.627	0.833	0.859	1.297	0.743	0.065
18:0	0.165	0.241	0.431	0.773	0.298	0.507
Total	**0.889**	**1.173**	**1.443**	**2.281**	**1.156**	**1.717**
Monounsaturated:						
16: 1ω 9	0.293	0.298	0.359	0.429	0.289	0.326
18: 1 ω 9	1.206	1.662	0.768	0.786	0.987	1.224
20: 1ω 9	0.218	0.218	0.340	0.462	0.279	0.340
22: 1 ω 9	0.160	0.164	0.151	0.151	0.151	0.153
Total	**1.877**	**2.342**	**1.618**	**1.828**	**1.706**	**2.043**
Diounsaturated:						
18:2ω 6	1.176	2.196	0.156	0.156	1.666	1.176
20:2ω 6	0.047	0.047	0.652	0.083	0.056	0.065
Total	**1.223**	**2.243**	**0.808**	**0.239**	**0.722**	**1.241**
Polyunsaturated:						
18:2ω 3	0.169	0.305	0.033	0.033	0.101	0.169
18:4 ω 3	0.330	0.330	0.530	0.730	0.430	0.530
20:5 ω 3 (EPA)	0.372	0.372	0.582	0.792	0.477	0.582
22:5 ω 3	0.050	0.050	0.050	0.050	0.050	0.050
Total	**0.921**	**1.057**	1.195	1.605	**1.058**	**1.331**
Total unsaturated	4.52	4.81	2.51	1.61	3.02	6.08
Total ω 3/ ω 6	0.75	0.471	1.480	6.720	1.470	1.070

survival of first-feeding stage carp larvae, as also observed by Radunz-Neto *et al.*, (1994) in carp and Szlaminska *et al.*, (1993) gold fish. Moreover, Fontagne *et al.*, 1998 reported that dietary PL deficiency in the first-feeding period for common carp was associated with an accumulation of fat droplets in the enterocytes of the anterior intestine, an increase in the height of mucosal epithelium, a reduced total liver volume and mean hepatocyte volume. In contrast, diet supplementation with PL prevented the intestinal steatosis and resulted in larger liver volume and larger hepatocyte volume (Watanabe, 1985; Boulhic and Gabaudan, 1992; Bengtson, 1993; Bisbal and Bengtson, 1995; Sarasquete *et al.*, 1995). In this connection, Senger *et al.*, (1997) suggested that the enhanced lipid deposition in enterocyte after first dry food-feeding stage could be pathological but, did not exclude other explanations such as an enhanced apical absorption or an impaired basal release of lipids by the enterocytes. Meanwhile, Fontagne *et al.*,(1998) found that there was no evidence of a pathological origin of the steatosis which was observed in larvae fed phosphatidylinositol PL, with high survival, and in larvae fed PL-free diets, with high subsequent mortality (Geurden *et al.*, 1997a,b). With respect of dietary supplementation sources (soybean oil, PL and oil with PL together), irrespective of the two levels, the low mortality, % were occurred when larvae fed diet contained PL only (about 17%). While, no significant differences ($P \leq 0.05$) were found between the two levels in the first period. In the second period, the low mortality percentages was occurred when larvae were fed diet contained soybean oil only, whereas, when concerning the levels, the 2% showed the best (about,49%) (Table, 4).

The average growth performances of common carp (*Cyprinus carpio L.*) larvae fed the different experimental diets (period, 1) are shown in Tables (5 and 6). The highest significant differences (P (0.05) in final body weight (FBW), final biomes (FB), average daily gain (ADG) and specific growth rate (SGR) were observed when fish larvae were fed level of 2% phospholipids. The beneficial effect of diet supplementation with PL, 2% had been reported earlier for juveniles sturgeon (Hung *et al.*, 1987). In a pervious experiment of Radunz-Neto *et al.*, (1995) a diet with 2% PL, identical to diet content lyso soy bean oil provided better larval performance than a diet with only 1% PL. Further increasing of the PL level up to 4% improved final weight after 25 days, but, did not significantly increase survival or growth during the first 10-14 days. Kanazawa (1993) also found that the addition of 7% of soya lecithin (containing 53% PL) did not provide better results than 5% PL supplementation, which was considered the optimum level. In the second period, data in Table (7) revealed that the highest significant differences ($P \leq 0.05$) in (FBW), (ADG) and (SGR) were occurred when fish fed diet contained

Table (3): The mortality % of Common carp fed the different experimental diets.

	Experimental treatments						
Lipid sources	Oil		Phospholipids		Oil+ Phospholipids		SE±
Lipid levels	2%	4%	2%	4%	2%	4%	
Criterion:							
From 5/5 to 5/6 1999	38.0^{a}	18.0^{b}	21.0^{b}	13.0^{bc}	14.0^{bc}	50.0^{a}	6.61
From 5/6 to 5/7/1999	33.0^{c}	45.0^{b}	61.0^{b}	79.0^{a}	52.0^{b}	56.0^{b}	4.31
Over all the period	59.0^{a}	55.0^{a}	51.0^{a}	82.0^{b}	55.0^{a}	72.0^{b}	5.42

Table (4): The response of Common carp mortality % among sources and levels

Criterion	Lipid sources				Lipid levels		
	Oil	Phospholipids	Oil+ Phospholipids	SE±	2%	4%	SE±
Criterion:							
From 5/5 to 5/6 1999	28.0^{b}	17.0^{c}	32.0^{a}	6.31	24.0	27.0	1.3
From 5/6 to 5/7/1999	39.0^{c}	70.0^{a}	54.0^{b}	5.33	49.0^{b}	60.0^{a}	15.2
Over all the period	57.0^{b}	67.0^{a}	64.0^{a}	5.70	55.0^{b}	70.0^{a}	6.39

Table (5): The growth performance of Common carp larvae fed the different experimental diets (Period , 1).

	Experimental treatments						
Lipid sources	Oil		Phospholipids		Oil+ Phospholipids		SE±
Lipid levels	2%	4%	2%	4%	2%	4%	
Initial body weight (mg/fish)	3.0	3.0	3.0	3.0	3.0	3.0	0.001
Final body weight (mg/fish)	73.4^{b}	70.7^{c}	82.7^{a}	74.8^{b}	60.9^{d}	79.3^{ab}	3.5
Final biomes/pond/gram	2.73^{c}	2.90^{b}	3.56^{a}	1.12^{e}	2.62^{c}	1.90^{cd}	0.81
Average daily gain (mg/day)	2.21^{b}	2.12^{b}	2.49^{a}	2.24^{b}	1.81^{c}	2.38^{b}	0.22
Specific growth rate (%day)	10.0^{b}	9.87^{b}	10.40^{a}	10.05^{b}	9.41^{c}	10.23^{b}	0.33
Final total length (mm)	13.1^{b}	12.1^{bc}	17.4^{a}	13.5^{b}	9.6^{d}	13.5^{b}	2.42

(1) Average daily gain (ADG) = [Final body weight - Initial body weight] / period (days)].
(2) Specific growth rate (SGR) = 100 [(In final body weight - In initial body weight) /Time (days)].
(3) Feed conversion ratio (FCR) = Total dry weight of feed (g) / weight gain (g).
SE, standard error. Calculated from residual mean square in the analysis of variance.
a,b..... etc. mean in same raw with different superscripts are different (P≤0.05).

Table (6): The response of Common carp larvae performance among sources and levels (Period , 1).

Criterion:,	Lipid sources				Lipid levels		
	Oil	Phospholipids	Oil+ Phospholipids	SE±	2%	4%	SE±
Initial body weight (mg/fish)	3.0	3.0	3.0	0.001	3.0	3.0	0.001
Final body weight (mg/fish)	72.2^{b}	78.8^{a}	70.1^{b}	4.12	72.4	74.9	1.51
Final biomes/pond/gram	2.82^{a}	2.34^{b}	2.26^{b}	0.28	2.97	1.97	0.60
Average daily gain (mg/day)	2.17^{b}	2.37^{a}	2.10^{b}	0.13	2.17	2.25	0.05
Specific growth rate (%day)	9.94^{b}	10.23^{a}	9.82^{b}	0.19	9.94	10.1	0.07
Final total length (mm)	12.6^{b}	15.5^{a}	11.6^{b}	1.84	13.4	13.0	0.22

Table (7): The growth performance of Common carp larvae fed the different experimental diets (Period , 2).

	Experimental treatments						
Lipid sources	Oil		Phospholipids		Oil+ Phospholipids		SE±
Lipid levels	2%	4%	2%	4%	2%	4%	
Initial body weight (mg/fish)	73.4^{b}	70.7^{c}	82.7^{ba}	74.8^{b}	60.9^{d}	79.3^{ab}	3.5
Final body weight (mg/fish)	225.6^{c}	308.8^{b}	203.7^{d}	285.8^{b}	321.9^{ab}	363.1^{a}	37.65
Final biomes/pond/gram	8.35^{b}	12.66^{a}	8.76^{b}	4.29^{c}	13.84^{a}	8.71^{b}	3.27
Average daily gain (mg/day)	4.75^{c}	7.44^{b}	3.78^{d}	6.59^{b}	8.16^{ab}	8.87^{a}	2.90
Specific growth rate (%day)	3.50^{c}	4.61^{b}	2.82^{d}	4.19^{b}	5.20^{a}	4.76^{b}	0.84
Final total length (mm)	23.4^{b}	24.4^{b}	27.9^{a}	23.8^{b}	25.1^{b}	27.0^{a}	1.73

Table (8): The response of Common carp larvae performance among sources and levels (Period , 2).

Criterion	Lipid sources				Lipid levels		
	Oil	Phospholipids	Oil+ Phospholipids	SE±	2%	4%	SE±
Initial body weight (mg/fish)	72.2^{b}	78.8^{a}	70.1^{b}	4.12	72.4	74.9	1.51
Final body weight (mg/fish)	267.2^{a}	244.8^{b}	242.5^{b}	12.4	250.4^{b}	319.2^{a}	27.70
Final biomes/pond/gram	10.51^{a}	6.53^{b}	11.28^{a}	2.32	10.32^{a}	8.55^{b}	1.06
Average daily gain (mg/day)	6.10^{b}	5.20^{b}	8.52^{a}	1.50	5.56^{b}	7.63^{a}	1.20
Specific growth rate (%day)	4.10^{ab}	3.51^{b}	4.98^{a}	0.61	3.84^{b}	4.52^{a}	0.40
Final total length (mm)	23.9^{b}	25.9^{a}	26.1^{a}	0.74	25.65	25.1	0.24

Table (9) : The fatty acid composition of whole body fish (% dietary lipid) of Common carp larvae at the end of period ,2.

Lipid sources	Oil		Phospholipids		Oil+ Phospholipids	
Lipid levels	2%	4%	2%	4%	2%	4%
Saturates:						
<8 c	3.83	1.77	15.85	4.98	2.16	3.22
10:0	0.08	0.58	5.88	0.88	0.02	0.36
12:0	22.70	4.26	0.99	0.15	0.22	1.43
14:0	0.19	34.67	9.55	14.29	1.05	16.55
16:0	9.02	1.34	0.95	12.09	19.98	16.66
18:0	6.66	12.49	5.46	2.03	5.52	2.52
Monounsaturated:						
16: 1ω 9	0.21	15.31	13.40	15.88	4.18	3.18
18: 1 ω 9	35.49	3.79	3.94	29.05	31.82	32.38
Diounsaturated:						
16: 2ω 9	0.22	3.82	4.22	2.03	5.10	8.92
18:2ω 6	18.43	13.64	19.15	15.54	24.35	13.27
Polyunsaturated:						
18:3ω 3	0.18	7.25	11.49	0.62	3.01	0.33
22:5 ω 3	1.44	1.07	0.48	0.80	0.80	0.18
Profile variables:						
Total saturated	42.48	55.11	36.68	34.42	28.95	40.79
Total unsaturated	54.35	36.56	40.71	62.50	65.45	57.75
Total polyunsaturated	1.62	8.32	11.97	1.42	3.81	0.51
Others	1.55	0.01	8.64	1.66	1.79	1.00
Total ω 9	35.7	19.1	17.34	44.93	36.00	35.56
Total ω 6	18.65	17.46	23.37	17.57	29.45	22.19
Total ω 3	1.62	8.32	11.97	1.42	3.81	0.51
ω 3/ ω 6 ratio	0.08	0.48	0.51	0.08	0.13	0.51

Table (10) : The fatty acid composition of whole body fish (% dietary lipid) of Common carp larvae at the end of period ,2 among sources and levels .

Criterion	Lipid sources			Lipid levels	
	Oil	Phospholipids	Oil+ Phospholipids	2%	4%
Saturates:					
<8 c	2.80	10.42	2.69	7.28	3.32
10:0	0.33	3.38	0.19	1.99	0.61
12:0	13.48	0.57	0.83	7.97	1.95
14:0	17.43	11.92	8.80	3.60	21.84
16:0	5.18		18.32	9.98	10.03
18:0	9.58	3.75	4.02	5.88	5.68
Monounsaturated:					
16: 1ω 9	7.76	14.63	3.68	5.93	11.46
18: 1 ω 9	19.64	16.50	32.10	23.75	21.74
Diounsaturated:					
16: 2ω 9	2.02	3.13	7.01	3.18	4.92
18:2ω 6	16.04	17.35	18.81	20.64	14.15
Polyunsaturated:					
18:3ω 3	3.72	6.06	1.67	4.89	2.73
22:5 ω 3	1.26	0.64	0.49	0.91	0.68
Profile variables:					
Total saturated	48.8	36.56	34.86	36.70	43.43
Total unsaturated	45.46	51.61	61.6	53.5	52.27
Total polyunsaturated	4.98	6.70	2.16	5.8	3.41
Others	0.76	5.12	1.38	4.0	0.89
Total ω 9	27.4	31.14	35.78	29.68	33.20
Total ω 6	18.06	20.48	25.85	23.82	19.07
Total ω 3	4.98	6.7	2.16	5.80	3.41

soybean oil with PL (4%, (50%: 50%)).

With respect of the sources irrespective of the two levels (Table, 8), the higher values of (ADG), (SGR) and final total length (FIL) were found when the diet was supplemented with oil and PL(1% : 1 %) . Concerning the two levels regardless of the dietary supplementation sources, the higher values of (FBW), (ADG) and (SGR) were occurred when larvae were fed diet with 4% level. In fact, the present observations indicated that in the older stage of larvae the uptake and esterification of fatty acids occurred without addition of more PL to the diet, possibly because there was a sufficient quantity of PL of endogerous origin for micelle formation in the intestinal lumen. This reduces the importance of dietary PL as an emulsifier that was proposed by Koven *et al.*, (1993). Phospholipids are known to act as emulsifiers in an aqueous environment such as the intestinal lumn. According to Kanazawa (1993) they could be essential in allowing the absorption of dietary neutral lipids such as cholesterol and triglycerides as found in crustacean larvae. Geurden *et al.*, (1995) reported the strong effect of PL supplementation, it could be directly attributed to improvement of the physicochemical properties of the food particles, by reducing the leaching of water-soluble nutrients or by preventing oxidation.

Concerning, the whole body fatty acid content (Table, 9) the data showed the relationship between the dietary fatty acids (FA`s) content and their efficiency in promoting larval performance. Pervious experiments of Radunz-Neto *et al.*, (1995) proved that carp larvae, in contrast to marine fish larvae, were able to survive and grow well on diets with ω-3 FA as low as 0.05-0.1% on a dry matter diet basis. In the present study the diet supplemented with 4% PL that contained the high saturated FA (2.28%), polyunsaturated FA (1.605%), and also the higher value of ω-3 FA (1.605%), obtained significant improvement in larvae growth performance than supplementing with soy bean oil. For this reasons, the higher value of unsaturated and polyunsaturated of whole body FA`s composition were observed when fed diet content soybean oil with PL (50% : 50%) at 2% level (65.45%) or PL at 2% level (11.97%) only than other treatments (Table, 9) .

With respect of sources irrespective of the two levels the higher value of ω-3 FA`s was recored ed when larvae fed level of 2% (5.8) (Table, 10) The higher value of unsaturated FA was found in fish fed soybean oil with PL (1 % : 1 %) (61.6) while, the polyunsaturated of ω-3 was highly value (6.7) when fish fed PL only. Concerning, the two levels, the highly unsaturated FA (53.5% and polyunsaturated FA (5.8%) were occurre when larvae were fed level of 2%. The data disagreed with the finding of Geurden *et al.*, (1995 who not found any relationship between the essential fatty acids (EFA) content of the added P sources and their efficiency in promoting larval performances.

With regard to ω6 FA, previous experiments of Takeuchi and Watanabe (1977) was estimated the requirement at approximately 1% as linoleic acid (18 : 2 ω6) on total dry weight of diets for carp juveniles and for first-feeding larvae (Radunz - Neto *et al.*, 1994). In the present study, the changes in the whole body composition of the total ω6 fatty acid in their first age of common carp larvae become more similar compart to the all experimental diets fed. No relationship was observed between the essentiality of dietary ω6 and whole body ω6 FA content.

CONCLUSION

The present study clearly confirmed that the addition of phospholipid to the diet was important to obtain good survival of first-feeding stage common carp larvae up to 4% dietary level. In the other old stage of larvae the uptake and esterification of fatty acid occurred without addition of more phospholipid to the diet that may be due to a sufficient quantity of phospholipid of endogenous origin for micelle formation in the intestinal lumen.

Further studies was needed to solve some problem remain unclear for instance, it is not clear whether the provision of a single PL class is sufficient meet the requirement or whether the supply of a mixture of PL classes, similar to the PL class composition of fish larvae is more effective.

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