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INFLUENCE OF USING DECAPSULATED *ARTEMIA* CYSTS FOR REARING OF CARP (*Cyprinus carpio* L.) LARVAE

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ABSTRACT

Cyprinids larvae should be fed natural feed using the first few days of exogenous feeding. The use of dry decapsulated *Artemia* cysts as feed for larviculture of carps (*Cyperinus carpio*) and its effects on growth and survival rat were investigated. Carp larvae (five days after hatching) weighted about 0.6 mg were reared (10 larvae l^{-1}) in fibre-glass-tanks (20 l) under controlled conditions. The larvae were fed on the following diets: A- Dry decapsulted cysts. B- *Artemia nauplii*. C- Commercial diet (46% CP). After a 21-day rearing period, the highest survival rate (80.0%) was obtained with the larvae receiving decapsulated cysts. Larvae fed on commercial diet resulted in a significantly ($P \leq 0.05$) lower survival rate (35.7%) compared with the other two groups (80.0 and 70.0%). at the end of the experiment, the larvae fed on *Artemia nauplii* yielded a significantly longer mean length (14.32 mm) compared with the other two groups (13.6 and 9.96 mm). Feeding on commercial diet resulted in a significantly lower average weight (10.86 mg), mean length gain (9.96 mm), K factor (1.10) and SGR (13.79%/d) compared with the other two groups. Therefore, dry decapsulated *Artemia* cysts appear to be a suitable feed for rearing carp larvae. Also, this is an economic issue since *Artemia nauplii* are more expensive than some commercial feeds.

Keywords: Carp (*Cyprinus carpio*), *Artemia* cysts, Survival rate, Growth.

INTRODUCTION

The onset of exogenous feeding is one of the most critical moments in the lives of larvae (Kaiser *et al*., 2003). The decapsulated cysts of *A. salina* are suitable as starter feed for some fish larvae because they are able to combine the advantages of live and dry diets (Vanhaecke *et al*., 1990). Moreover, its use advances including the possible commercializing of poor-hatching and less expensive cyst products for rearing of carp larvae. Wolnicki (2005) indicated that from the nutritional point of view, the gross composition of decapsulated cysts is comparable to freshly-hatched nauplii. In addition, their individual dry weight and energy content are on the average 30 to 40% higher than for instar I nauplii. For example, for rearing carp larvae in the first two weeks, the use of decapsulated cysts constitutes a saving of over one third in amount of *Artemia* cysts, compared to the use of live nauplii.

The brine shrimp *Artemia* is widely used as a live food organism for many larval fish cultured in intensive systems. However, increased demand for good quality *Artemia* cysts and recent fluctuations in world harvests have sharply increased prices. As a result, attention is again concentrating on new alternative diets to *Artemia* nauplii (Leger, 1999).

Poor quality *Artemia* cysts might represent a potential alternative to *Artemia* nauplii. The outer layer of the *Artemia* cyst is non-digestible by

predator organisms, but this outer layer can be quickly removed with hypochlorite treatment, a procedure called decapsulation. Decapsulated *Artemia* cysts have been successfully fed to fish larvae (Lavens and Sorgeloos, 1996).

As decapsulated embryos have more energy content than newly hatched nauplii, they are potentially more nutritious and several other advantages of its uses in larval rearing of fish are listed in Pector *et al*. (1994).

The aim of the current study was to investigate the suitability of decapsulated *Artemia* cysts for rearing carp larvae during their early feeding stage and its effects on growth, survival rate and condition factor (K).

MATERIALS AND METHODS

This study was carried out at *Artemia* Research Unit (ARU), Faculty of Agriculture, Seuz Canal University.

Larval (from FRC) rearing were started five days after hatching (10 larvae l^{-1}) in fibre-glass-tanks (0.50 x 0.25 x 0.25 m) containing 20 L of dechlorinated tap water using a flow-through system. Aerated water was used in a flow through system of 0.2 L min^{-1} in each tank. The parameters of water quality were: dissolved oxygen about 8.5 mg L^{-1}, pH 7.5-8.0. Water temperature was maintained at 25.5±1°C and the photoperiod was natural.

The initial larval total length (mean ± SD) and average wet body weight were 5.2±0.28 mm and 0.60 mg, respectively.

Three feeding treatments were tested: (A) dry decapsulated cysts; (B) freshly hatched *Artemia* nauplii (4 ml l^{-1}) and (C) commercial diet (46%) crude protein (Table 1 according to NRC, 1993). Each day just before feeding, bottom debris was siphoned from each tank. There were three replicates per treatment.

Growth parameters (length and wet weight) were measured on days 7, 14 and 21 of the experimental period. Fish length was measured with a binocular microscope equipped with an ocular micrometer. For length measurements, 10 larvae were randomly collected from each tank. The individual weight was determined by means of precise balance (to the nearest 0.1 mg).

Survival of the larvae was calculated by counting the fish in the tank at days 7, 14 and 21.

Specific growth rate (SGR) was expressed as $SGR = 100 (\ln W_t - \ln W_o)/t$, where W_t is the mean final weight, W_o is the mean initial weight, and t is the duration of experiment (days), according to Brown (1957). Fulton's coefficient (K) was used to determine the fish condition factor (K), with $K = 100 (W_t/TL^3)$, according to Barnabe (1994).

Artemia cysts (Alex, 1998, from ARU) were decapsulated following the methodology of Bruggemen *et al.* (1980). Fresh stocks of cysts were prepared everyday. Decapsulated cysts were distributed on a 100 μm screen in a < 5 mm thick layer and dried at 35ºC for 24 h. The quantity of

decapsulated cysts per larva was estimated according to Vanhaecke *et al.* (1990).

Fish *Artemia* nauplii were obtained from hatching *Artemia* cysts (Port Said Strain, 2000, from ARU) according to (Lavens and Sorgeloos, 1996) and were supplied manually at two times a day.

Fresh larvae were fed a commercial diet of 46% crude protein according to (NRC, 1993), produced by Sinai shrimps 21 Company, Port Said (Table 1). This starter feed (0.3-0.5 mm) was crushed in a mortar and sieved to a particle size of < 200 μm. Larvae were fed *ad libitum* daily. The diet was stored at (4ºC) during the experimental duration to avoid the nutrients deterioration.

Data were analyzed by one-way ANOVA procedure of statistical analysis system (SAS, 1988). Means were compared by Duncan's new multiple range test (Zar, 1996).

Table (1): Ingredients composition and proximate analysis of the commercial diet.

Ingredients	%
Fish meal[a]	59.9
Soluble fish protein concentrate [b]	1.0
Cod liver oil	5.8
Gelatinized starch [c]	29.8
Vitamins premix [d]	1.0
Minerals premix [e]	1.0
Choline chloride (50%)	0.5
Lignin sulphate	1.0
Proximate analysis (% DM):	
Dry matter	95.5
Crude protein	46
Crude fat	11.7
Crude fiber	4.3
Nitrogen free extract (NFE)	29.6
Crude Ash	8.4

a- Triple Nine, Denmark (CP: 78.6% DM; GL: 9.8% DM).

b- Sopropèche G, France (CP: 72.7% DM; GL: 18.0% DM).

c- C-Gel Instant-12016, Cerestar, Mechelen, Belgium.

d- Vitamins (mg kg−1 diet): retinol, 18,000 (IU kg−1 diet); calciferol, 2000 (IU kg−1 diet); alpha tocopherol, 35; menadion sodium bis., 10; thiamin, 15; riboflavin, 25; Ca pantothenate, 50; nicotinic acid, 200; pyridoxine, 5; folic acid, 10; cyanocobalamin, 0.02; biotin, 1.5; ascorbyl monophosphate, 50; inositol, 400 (Pfizer).

e- Minerals (mg kg−1 diet): cobalt sulphate, 1.91; copper sulphate, 19.6; iron sulphate, 200; sodium fluoride, 2.21; potassium iodide, 0.78; magnesium oxide, 830; manganese oxide, 26; sodium selenite, 0.66; zinc oxide, 37.5; potassium chloride, 1.15 (g kg−1 diet); sodium chloride, 0.40 (g kg−1 diet); dibasic calcium phosphate, 5.9 (g kg−1 diet) (Pfizer).

RESULTS

Data in Table (2) indicated that on day 7, 14 and 21, the mean weights of the larvae fed on freshly hatched *Artemia nauplii* and dry decapsulated cysts were not significantly different ($P>0.05$) from each other. However, a better growth (in terms of wet weight) in *Artemia* nauplii-fed larvae was observed throughout the entire period of the experiment. The larvae fed on the commercial diet had the significantly ($P\leq0.05$) lowest wet weight 2.11, 6.25 and 10.86 mg on day 7, 14 and 21, respectively.

Table (2): Wet weight (mg) of carp (*Cyprinus carpio*) larvae measured on days 7, 14 and 21 of the experiment (mean ± SD).

Treatment group	Day 7	Day 14	Day 21
Dry decapsulated cyst	3.10 ^{a} ±0.06	12.96 ^{a} ±0.24	31.21 ^{a} ±1.27
Artemia nauplii	4.41 ^{a} ±0.38	15.82 ^{a} ±0.36	34.95 ^{a} ±3.61
Commercial diet	2.11 ^{b} ±0.29	6.25 ^{b} ±0.71	10.86 ^{b} ±0.95

Different superscript letters within a column indicate significant differences (P<0.05).

The results of larval total length (Table 3) showed that on day 7 and 14 the mean sizes of larvae fed freshly hatched *Atemia nauplii* and decapsulated cysts were not significantly different ($P>0.05$) from each other. However, a significantly better growth in *Artemia* nauplii-fed larvae was observed at the end of the experiment. Both diets (dry decapsulated cysts and *Artemia* nauplii) produced significantly faster growth (in terms of total length) than the commercial diet. At the end of the experiment, the larvae fed on the commercial diet had the lowest mean length (9.96 mm).

Table (3): Total length (mm) of carp (*Cyprinus carpio*) larvae measured on days 7, 14 and 21 of the experiment (mean ± SD).

Treatment group	Day 7	Day 14	Day 21
Dry decapsulated cyst	6.40 ^{a} ±0.50	10.3 ^{a} ±0.60	13.6 ^{b} ±0.88
Artemia nauplii	7.20 ^{a} ±0.81	11.1 ^{a} ±0.71	14.32 ^{a} ±1.10
Commercial diet	5.99 ^{b} ±0.42	3.58 ^{b} ±9.50	9.96 ^{c} ±1.72

Different superscript letters within a column indicate significant differences (P<0.05).

From the tabulated data (Table 4), no significant difference were observed in larval survival at all intervals among the treatments fed dry decapsulated cysts and *Artemia* nauplii. The survival rate of the larvae fed on commercial diet was significantly lower compared with the other treatment groups. At the end of the experiment, no significant difference was observed between the survival of larvae fed on *Artemia* nauplii and those on decapsulated cysts (70.5 and 80.0%).

Table (4): Survival rate (%) of carp (*Cyprinus carpio*) larvae calculated on days 7, 14 and at the end of the experiment (mean ± SD).

Treatment group	Day 7	Day 14	Day 21
Dry decapsulated cyst	90.5 ^{a} ±4.3	86.2 ^{a} ±1.7	80.0 ^{a} ±6.3
Artemia nauplii	92.6 ^{a} ±8.5	75.87 ^{a} ±9.1	70.5 ^{a} ±7.2
Commercial diet	60.8 ^{b} ±3.8	41.3 ^{b} ±6.9	35.7 ^{b} ±6.4

Different superscript letters within a column indicate significant differences (P<0.05).

Table (5) indicated the condition factor (K) and specific growth rate (SGR) for the three groups fed different larval diets. The greatest (P≤0.05) larvae condition (1.24) was obtained at the end of the experiment with the larvae fed dry decapsulated cysts, while the lowest condition (1.10) was recorded to the larvae fed commercial diet. At the end of the experiment, the highest value of SGR (19.35) was observed in larval rearing on *Artemia* nauplii. On the other hand, no significant difference was observed among the treatments fed dry decapsulated cysts (18.81) and *Artamia* nauplii (19.35). The lower SGR value (13.79) was obtained for the larval treatment fed on the commercial diet.

Table (5): Condition factor (K) of carp (*Cyprinus carpio*) larvae calculated on days 7, 14, 21 and SGR%/d at the end of the experiment (mean ± SD).

Treatment group	Day 7	Day 14	Day 21	SGR
Dry decapsulated cyst	1.15 ^{a} ±0.03	1.19 ^{a} ±0.20	1.24 ^{a} ±0.02	18.82 ^{a} ±0.25
Artemia nauplii	1.13 ^{a} ±0.02	1.17 ^{a} ±0.03	1.19 ^{b} ±0.01	19.35 ^{a} ±0.18
Commercial diet	0.98 ^{b} ±0.02	0.99 ^{b} ±0.01	1.10 ^{c} ±0.01	13.79 ^{b} ±0.12

Different superscript letters within a column indicate significant differences (P<0.05).

DISCUSSION

The use of decapsulated *Artemia* cysts as a starter feed source in early larval feeding of marine and freshwater fish, and marine shrimp has been previously suggested (Pector *et al*., 1994 and Ribeiro and Jones, 1998). They concluded that initial feeding of the larval fish with decapsulated cysts appeared to be suitable for complete replacement of live *Artemia* nauplii and might support acceptable survival when offered solely or incorporated into artificial feeds. However, the argued that the main problem using decapsulated cysts as a direct food source was their fast sedimentation in water and lack of motility.

In this study, poor specific growth rate (13.79%/d) and survival (35.7%) of carp larvae was obtained with the commercial diet in comparison with other treatments. According to El-Sherif (2001), better performance of prawn post-larvae fed on decapsulated cysts appeared to be related to retention of the nutritional value after rehydration in water, thus leaching very low levels of soluble protein and carbohydrates in comparison with the artificial diets. Also, Pector *et al*. (1994) observed high water stability of decapsulated cysts and fast growth for African catfish (*Clarias gariepinus*) as opposed to artificial diets. Slow growth and high mortality of larvae fed on commercial diet may be related to the absence of a stomach and low digestive capacity at the beginning of their development. In most cyprinud larvae fed exclusively on artificial diets, high mortality and poor growth

occurred in most cases (Wolnicki and Myszkowski, 1999 and Kujawa *et al*., 2000).

On the other hand, dry decapsulated cysts exhibited a positive effect on growth and survival of carp larvae. After 14 days, the mean larval size was nearly similar when fed *Artemia* nauplii and decapsulated cysts. At the end of the experiment, however, mean length and wet weight of the larvae were larger when fed on *Artemia* nauplii in comparison to dry decapsulated cysts. During long-term feeding (beyond 14 days post-hatching), dry decapsulated cysts did not result in a much growth in carp larvae as did live *Artemia* nauplii, perhaps because of the limited size of the decapsulated cysts. A similar finding was also reported by Vanhaecke *et al*. (1990) and El-Sherif (2001).

The larval growth in the current experiment indicates that live feed used is highly suitable for rearing fish in comparison with commercial feed. Before fish have fully developed digestive canal live feed with the exogenous digestive enzymes is very important to permit proper development (Kaiser *et al*., 2003). They added, attempts to rear larvae on artificial feed alone ended in most cases with 100% stock mortality that stemmed from loss of appetite, arrested growth and a significant decrease in disease resistance. Larvae reared on *Artemia* nauplii and dry decapsulated cysts had the highest SGR (19.35 and 18.82%/d, respectively) than that of commercial diet (13.79%/d). It is significant that the contact time between food and digestive enzymes in such young fish is very short (Wolnicki, 2005). Additionally, according to the classification by Dabrowski (1984), larval cyprinid fish belong to the third group of species that is characterized by a short, weakly developed digestive tract with a poor enzyme composition.

CONCLUSION

The results of the present study demonstrate that dried decapsulated *Artemia* cyst (which has poor hatching quality and low price) appear to be a suitable live feed for rearing the early developmental stage of carp (*Cyprinus carpio*) larvae. This is also an economic issue, since *Artemia* nauplii are more expensive than some commercial feeds.

REFERENCES

Barnabe, G. (1994). Aquaculture: Biology and ecology of cultured species, Ellis Horwood, London, 403 pp.

Brown, M.E. (1957). Experimental studies of growth. In: The Physiology of Fishes (Ed.) M.E. Brown, Academic, Press, New York: 361-400.

Bruggeman, E., P. Sorgeloos and P. Vanhaecke (1980). Improvements in the decapsulation technique of *Artemia cysts*. In: Persoone, G., Sorgeloos, P , Roels, 0 and Jaspers, E. (eds.) The Brine Shrimp *Arternia*, Vol 3. Ecology, culturing, use in aquaculture. Universa Press, Wetteren, pp. 261-269.

Dabrowski, K. (1984). The feeding of fish larvae : present « state of the art » and perspectives. Reprod. Nutr. Dévelop., 24: 807-833.

El-Sherif, M.S. (2001). Studies on growth performance of prown (*Macrobrachium rosenbergii*) as affected with type of feeding and stocking density. J. Agric. Sci. Mansoura Univ., 26:4177-4185.

Kaiser, H., F. Endemann and T. G. Paulet (2003). A comparison of artificial and natural foods and their combinations in the rearing of goldfish, *Carassius auratus* (L.). Aquaculture Res., 34(11): 943-950

Kujawa, R.; D. Kucharczyk and A. Mamcarz (2000**).** The rearing methods of chub, *Leuciscus cephalus* **(L.)** on artificial diets. European Aquaculture Society Spec. Publ. 28, Oostende, Belgium, P. 356.

Lavens, P. and P. Sorgeloos (1996). Manual on the production and use **of** live food for aquaculture. FAO Fisheries Technical Paper 361 FAO, Rome, 292 pp.

Leger, P (1999) Possible solutions to *Artemia* crisis. Fish Farm Intl 26(12):28–29.

NRC(National Research Council), (1993). Nutrient requirements of warm water fishes and shellfishes, revised edition. National Academy Press, Washington. D.C., USA.

Pector, R., W. Tackaert, P. Abelin , F. Ollevier and P. Sorgeloos (1994). A Comparative study on the use of different preparations of decapsulated *Artemia* cysts as food for rearing African catfish (*Clarias gariepinus*) larvae. J. World Aquacult. Soc., 25(3): 366-370.

Ribeiro, F. A. L. T. and D.A. Jones (1998). The potential of dried, low hatch, decapsulated Artemia cysts for feeding prawn post-larvae. Aquacult. Internat., 6:421-440.

SAS, (1988). SAS users' guide. Statistics. A. A. Ray. Ed. SAS Inst., Inc., Cary, NC., 67 (3).

Vanhaecke, P., L. De Vrieze, W.Tackaert and P. Sorgeloos (1990). The use of decapsulated cysts of the brine shrimp *Artemia* as direct food for carp *Cyprinus carpio* L. larvae. J. World Aquacult. Soc., 21(4): 257-262.

Wolnicki, J. (2005). Intensive rearing of early stages of cyprinid fish under controlled conditions – Arch. Pol. Fish. 13 (suppl. 1): 5-87.

Wolnicki, J. and L. Myszkowski (1999**).** Larval rearing of rheophilic cyprinids, *Aspius aspius* **(L.)** and *Leuciscus cephalus* (L**.**), on live, dry or mixed diet. In: Aquaculture Europe 99, towards predicable quality. L. Laird and H. Reinersten (Eds.). European Aquaculture Society Sepc. Publ., 27 Oostende Belgium, pp 258-259.

Zar, J.H. (1996). Biostatistical Analysis. Prentic Hall, Upper Saddle River, NJ, USA.

تـأثير اسـتخدام بـيض الأرتيميـا منـزوع القشـرة الخارجيـة لرعايـة يرقـات أسـماك المبروك العادى

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نظراً لأن رعاية يرقات الأسماك فى مراحل نموها الأولى يجب أن تكون على الأغذية الحية المرتفعة الثمن غالباً – فقد استخدم فى هذه الدراسة ثلاثة أنواع من الأغذية لرعاية يرقات أسماك المبروك العادى فى مراحلها الأولى (بعد اليوم الخامس من الفقس) بمتوسط وزن ٠,٦ مجم ووضعت بمعدل ١٠ يرقات / لتر ماء فى أحواض فيبرجلاس (٢٠ لتر) لمدة ٢١ يوماً تحت ظروف الرعاية المثلى .

كانت التغذية تتم بمعدل مرتين يومياً فى ثلاث مجموعات باستخدام كل من :

١- بيض أرتيميا مجفف منزوع القشرة الخارجية .
٢- يرقات أرتيميا بعد الفقس مباشرة .
٣- عليقة تجارية تحتوى على ٤٦% بروتين .

أظهرت النتائج فى نهاية التجربة أن أعلى معدل لبقاء يرقات المبروك العادى (٨٠%) قد تم الحصول عليه للمجموعة الأولى التى غذيت على بيض الأرتيميا المجفف منزوع القشرة الخارجية مقارنة بالمجموعتين الثانية والثالثة – وكان الفرق معنوياً ($P \leq 0.05$)٠بين المجموعتين الأولى والثانية (٨٠ و ٧٠,٥%) مقارنة بالمجموعة الثالثة (٣٥,٧%) . انخفض متوسط الطول معنوياً فى المجموعة الثالثة (٩,٩٦ مم) عنه فى المجموعة الأولى (١٣,٦ مم) والمجموعة الثانية (١٤,٣٢ مم) .

وعموماً أدت النتائج النهائية إلى أن رعاية يرقات أسماك المبروك العادى باستخدام عليقة تجارية قد ادت إلى متوسطات منخفضة معنوياً لكل من الوزن (١٠,٨٦ مجم) ، الطول (٩,٩٦مم) ، معدل النمو النوعى (١٣,٧٩ % / يوم) ، ومعامل الحالة (١,١٠) وذلك مقارنة باستخدام كل من بيض الأرتيميا المجفف منزوع القشرة الخارجية ويرقات الأرتيميا .

وعلى ذلك يتضح أن استخدام بيض الأرتيميا منزوع القشرة الخارجية فضلاً عن كونه رخيص الثمن لانخفاض جودته – هو الأمثل لرعاية يرقات أسماك المبروك العادى فى مراحلها الأولى لتحقيق أعلى أداء اقتصادى للنمو والحياتية ومعامل الحالة والتى تؤثر فيما بعد على مراحل الاستزراع السمكى .