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# Growth and development of three species of the zooplankton (*Brachionus Calyciflorus*, *Moina micrura* and *Thermocyclops* sp.) breeding on poultry dropping in mixed condition in tanks

**Hyppolite Agadjihouede, Elie Montchowui, Simon Ahouansou Montcho, Clément Agossou Bonou and Philippe A. Laleye**

**Abstract**
Breeding of *Brachionus Calyciflorus* (rotifer), *Moina micrura* (cladoceran) and *Thermocyclops* sp. (copepod) on poultry dropping were investigated in mixed condition. The most production per day was obtained in chicken dropping medium ($p < 0.05$) with in top *B. Calyciflorus* (973 ± 249 individuals/L), followed *M. micrura* (126 ± 08 individuals/L) and *Thermocyclops* sp. (45 ± 19 individuals/L). *M. micrura* had a higher intrinsic rate (*a*) and the less duplication time (Td) ($a = 0.88 \pm 0.05$; Td = 1.13 ± 0.07), followed *B. Calyciflorus* ($a = 0.73 \pm 0.02$; Td = 1.38 ± 0.05) and *Thermocyclops* sp. ($a = 0.21 \pm 0.01$; Td = 5.08 ± 0.88). The colonization phase ranged 6-12$^{th}$ day for *M. micrura* and *B. calyciflorus* and 18-21$^{th}$ day for *Thermocyclops* sp. Evolution profile and dynamic of populations showed: (1) quickly evolution marked by a peak followed a crash of species rotifer (*B. calyciflorus*) and cladoceran (*M. micrura*); (2) more late evolution of copepod (*Thermocyclops* sp.). In perspectives of culture of life food for larviculture, it result of this experiment that the harvest of zooplankton may be realized 6-12$^{th}$ day when the zooplankton production reached its high level; and rotifers and cladocerans were abundant.

**Keywords:** Growth, Development, Zooplankton, *Brachionus Calyciflorus*, *Moina micrura*, *Thermocyclops* sp., Breeding and Poultry dropping.

## 1. Introduction

Among freshwater zooplanktons, protozoans, rotifers, cladocerans, and copepods are numerically more abundant than other groups [1]. In terms of biomass, rotifers and crustaceans (cladocerans and copepods) are often the dominant group [2, 3]. Because of their high sensitivity to changes in the physico-chemical characteristics of natural water systems, there are sometimes only a few cladoceran species present as dominant groups. For example, *Bosmina*, *Cercopagis*, and *Daphnia* are usually wide-spread in temperate water, while *Ceriodaphnia*, *Moina*, and *Simocephalus* attain higher densities in tropical waters [2].

The most important environmental factors controlling generally the growth and reproduction of zooplankton are temperature [4, 5] and food quantity and quality [6, 7]. Algae are one of the most important and commonly affecting factors for herbivorous zooplankton such as cladocerans and rotifers. However, there is not always a good equivalence between size (or nature) algae and those of the dominant herbivorous [8]. The big cladocerans as *Daphnia* which are the most effective herbivorous in temperate environment, are little represented in tropical environment [9] when the grazing especially exercised by bodies of small size (rotifers, shorts cladocerans, nauplii of copepods, etc.) on the small cells will rather have tendency to move competition for nutriments in favor of the big algae or cyanobacteries not consummate and susceptible to proliferate. But, the pressure of grazing by zooplankton herbivorous is indirectly modulated with the selective predation of bodies' zooplanktivorous (fishes, invertebrate predators), of which some belong to the zooplankton, as some rotifers, cladocerans or the terminal stages of cyclopids. The importance of such interactions trophics in cascade [10] was demonstrated in many ecosystems. All those studies especially concerned the temperate environments and the natural ecosystems and the models elaborated for those environments are not necessary transposable at 2 tropical environments [11] and especially in environment controlled as tanks. The studies of dynamics of zooplankton were realized in controlled conditions [12, 1, 13] according to monospecific breeding. But the behavior of each group of zooplankton (rotifers, cladocerans and copepods) breeding in mixed condition in tanks is unknown.

The present study aims to appreciate the evolution of the population of each group of zooplankton breeding in mixed condition to determine until which moment the harvest of the zooplankton would be advised to feed well the larvae of fishes.

## 2. Materials and methods

### 2.1. Experimental design

Experiment was realized in four tanks: two tanks for treatment test and its rehearsal and two tanks for controlled treatment and its rehearsal. Experiment started with preparation of nutrient medium which was prepared by adding poultry dropping in two tanks corresponding to treatment test and its rehearsal. Each tank was filled with 3 liters of clean water and 2 liters of waters of fish ponds initially filtrates under plankton net (space: 50 µm) for inoculating phytoplankton in the mediums [14]. No poultry dropping was used in controlled treatment. Treatment test and its rehearsal were added equal quantity of poultry dropping which was 3 g dry weight (then doses 600 g/m$^3$) [15]. This poultry dropping is compound of 80.80% of dry matter, 43.59% of organic matter, 56.41% of mineral, 25.28% of total organic carbon 2.14% of nitrogen total and 1.93% of total phosphorus. Three days after poultry dropping were introduced (necessary period to allow the development of the phytoplankton) [16], 25 individuals/L of *B. calyciflorus*, 8 individuals/L of *M. micrura*, 13 individuals/L of copepodits+adults and 1 individual/L of Nauplii of *Thermocyclops* sp. were inoculated all in each tank. This report of the bodies of zooplankton inoculated is similar to the one that often observes in the natural environment (Bonou, *com. Pers*).

Experiments were carried out in 26.4 - 27.3 °C, pH 8.4 - 8.9, oxygen 8.5 - 10.4 mg/L and a photoperiod of 12 h light: 12 h dark. Nutrients parameters and plankton population was determined each three days. Nutrients parameters ($NH_4$-N, $NO_3$-N, $NO_2$-N and $PO_4$-P) are determined by colorimetric method with the tests kits (ammonium 3, Nitrate Test, Nitrite Test and Phosphate Test) (Macherey-Nagel 3316 9 II 915).

To estimate the value of chlorophyll-a, water sample of 100 ml was filtered using cellulose acetate filter paper (Wathman GF/C, 0.45 µm), and the concentration of chlorophyll-a was calculated using the Lorenzen [17] method.

For zooplankton harvest, half of volumes of production were collected into each medium and filtered through a net of plankton (space: 50 µm). This harvest was concentrated at 100 ml and 20% were collected with a pipette (kind: Eppendorf; capacity: 1000 µl) for counting. The rest was immediately returned to the mediums. Then, each group of zooplankton is systematically counted using electronically microscope (type Motic; G 10X).

The experiments were terminated after 30 days, when most replicates showed a declining trend.

### 2.2. Data analysis

Based on collected data, the density (D), the production per day (P), the rate of population increase per day ($a$) and the duplication time (Td) were derived using the following equations: $D = (n/v_1) \times (v_2/v_3)$, $P = (N_t - N_0)/t$; where n= invidious counted, $v_1$= volume of aliquot, $v_2$= volume of sample concentrated, $v_3$ = volume of water filtered, $N_0$= initial population density and Nt = population density after time t [18]. The daily rate of population increase ($a$) is equal to the hillside of the regression right fitting the couples (time; *ln* Biomass) which join the phase of increase of the species, bounded by the inoculate day ($t_0$) and the day of the maximum of biomass ($t_x$) [19]. Td = 1/$a$ or Td= 24/$a$; Td = duplication time; 1/$a$ = days per division; and 24/$a$ = hours per division [20]. We used one-way analysis of variance (ANOVA) to statistically evaluate the differences between averages of densities, production, rate of population increase and peak population abundances of the tested zooplankton. Differences were considered significant when $p < 0.05$. Tests of correlation were realized using STATVIEW.

## 3. Results

### 3.1. Nutrients quality of water

The nutrient medium was analyzed and it was observed from Figure 1 the highest amount of ammonium (0.2 – 0.8 mg/L, mean = 0.57 ± 0.3 mg/L), nitrate nitrogen (1.00 - 3.00 mg, mean = 2.8 ± 0.6 mg/L) and phosphorous (0.3 - 0.8 mg/L, average = 0.57 ± 0.17 mg/L) are obtained in poultry dropping medium ($p < 0.05$). The nitrites are less in all medium. Also, the algae biomass expressed by chlorophyll-a (Figure 2) is more important in poultry dropping medium ($p < 0.05$). Mean value is 10.47 ± 10.40 mg/L with poultry dropping, but in controlled medium, its 1.33 ± 0.68 mg/L.

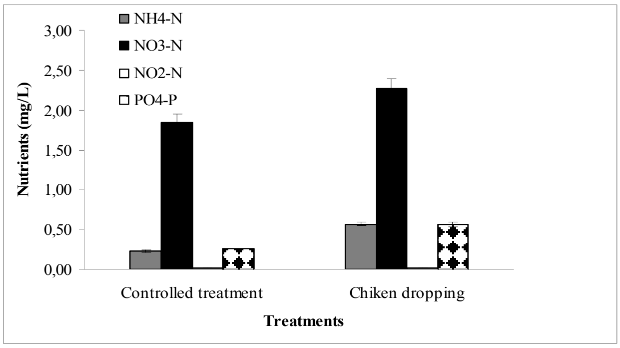



**Fig 1:** Nutrients amount in the medium

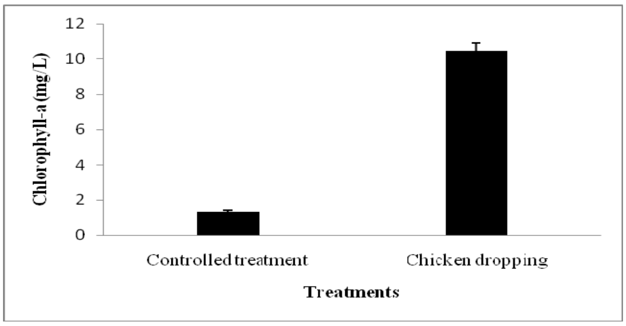



**Fig 2:** Chlorophyll-a amount in the medium

### 3.2. Zooplankton production

#### 3.2.1. Evolution of densities

The poultry dropping medium give the most densities of each group. Those densities evolve of 25 ind/L to 11 695 individuals/L (maximum) for rotifer *B. calyciflorus*, 8 to 1 291 individuals/L (maximum) for cladoceran *M. micrura* and 13 to 1 971 individuals /L (maximum) for copepods *Thermocyclops* sp.

In poultry dropping medium, the densities of *B. calyciflorus* and *M. micrura* increase and peak 12th day. But the density of *Thermocyclops* sp. increases and peak 21th day (Figure 3). After their respect peaks, these densities decrease until the end of experiment.
The same thing are observed in controlled medium, only that the peaks are obtained a 6th day for *B. calyciflorus*, 9th day for *M. micrura* and 18th day for *Thermocyclops* sp. (Figure 4).

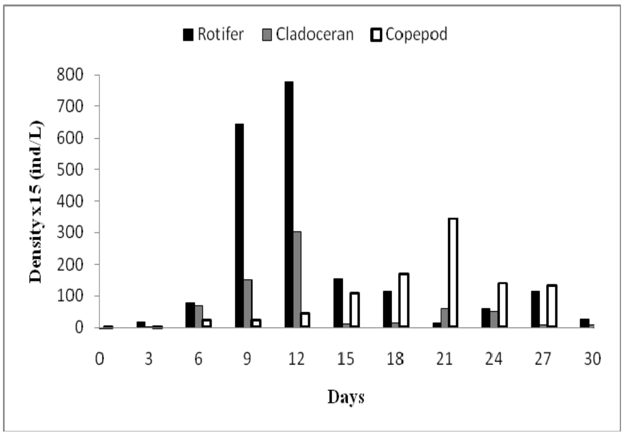



**Fig 3:** Evolution of densities of zooplankton in chicken dropping medium

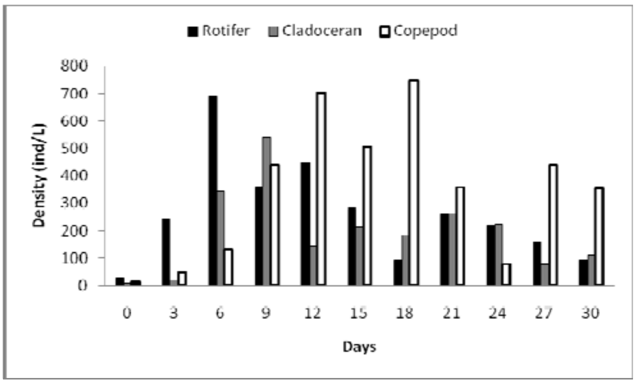
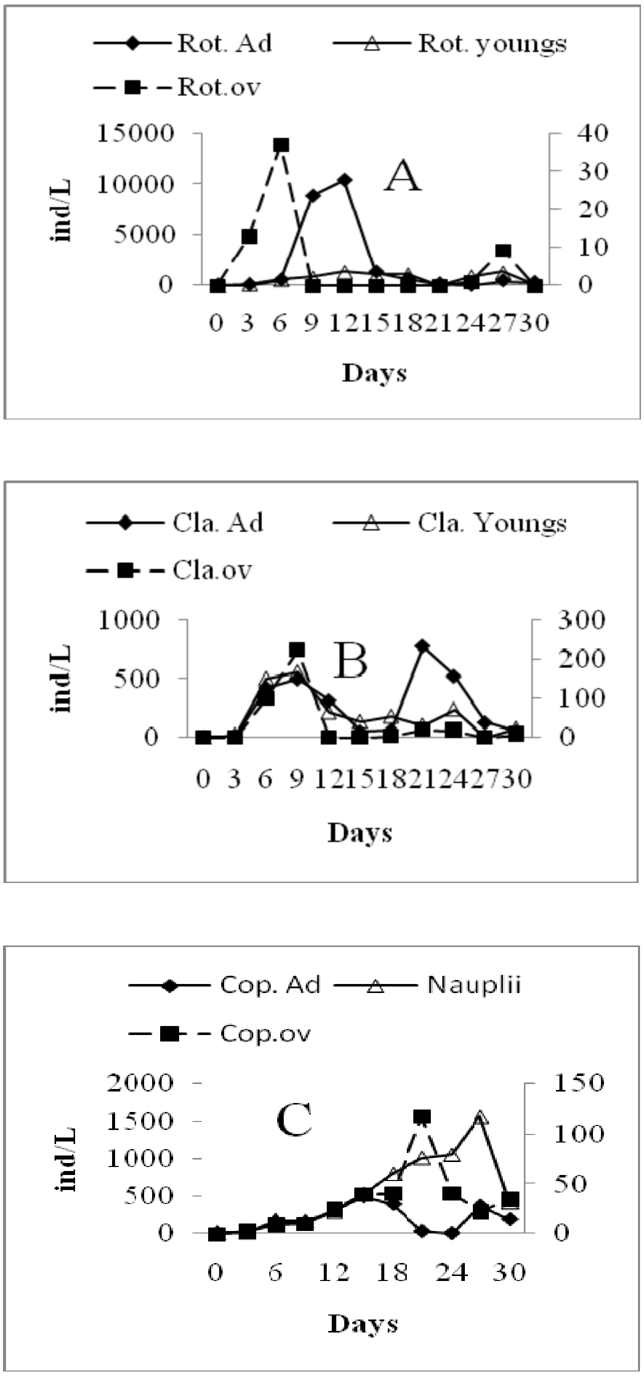



**Fig 4:** Evolution of densities of zooplankton in controlled medium




Rot Ad: Adults of *B. Calyciflorus*
Rot youngs: youngs of *B. Calyciflorus*
Rot. ov: ovigerous females of *B. Calyciflorus*
Cla. Ad: adults of *M. micrura*
Cla. youngs: youngs of *M. micrura*
Cla. ov: ovigerous females of *M. micrura*
Cop. Ad: adults of *Thermocyclops sp.*
Cop. ov: ovigerous females of *Thermocyclops sp.*
Nauplii: Nauplii of *Thermocyclops sp*

**Fig 5:** Demography of *B. calyciflorus* (A), *M. micrura* (B) and *Thermocyclops sp*. (C) in chicken dropping medium.

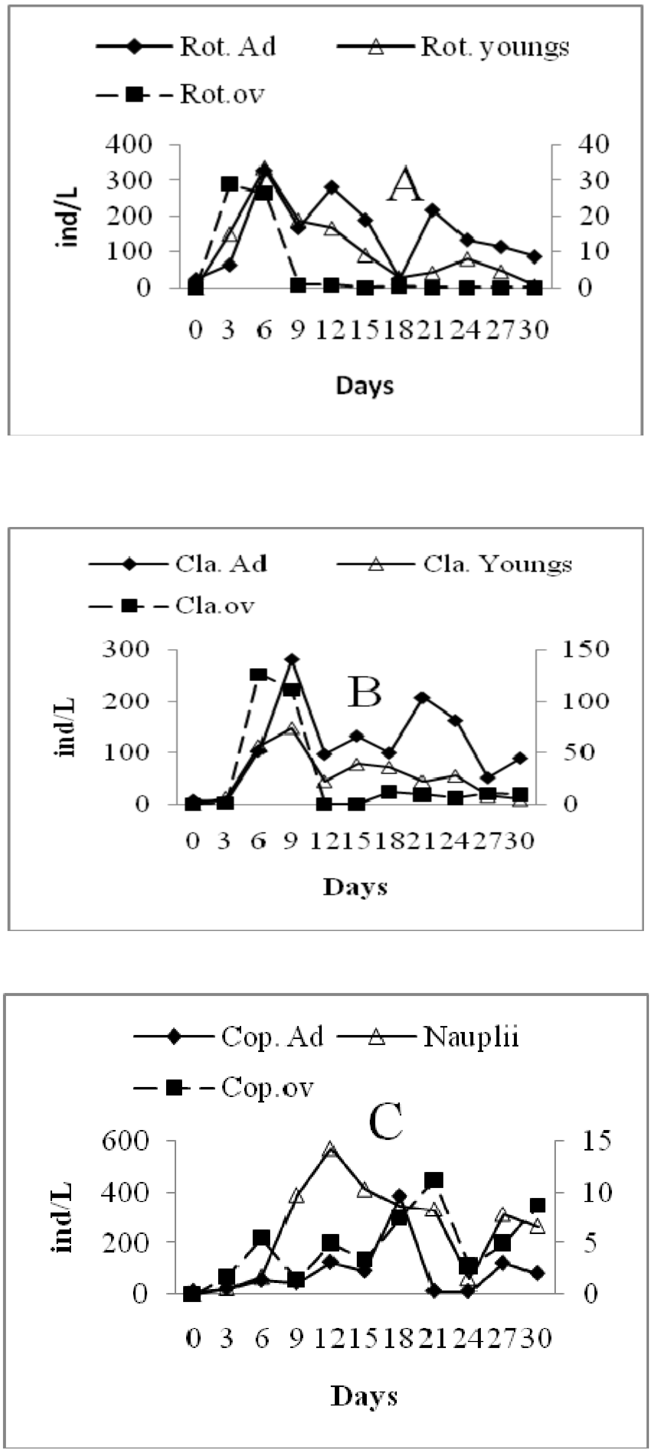
### 3.2.2. Demography and growth performance of populations

#### 3.2.2.1. Demography of populations

A demography structure in the mediums was defined by account of groups of adults' individuals, ovigerous females and young individuals for all species (Figure 5 and Figure 6).

In the poultry dropping medium, the rapid growth of rotifer *B. calyciflorus* and cladoceran *M. micrura* are assured by adults and ovigerous females' individuals. While the maximum abundance period (3-12th day) of rotifer *B. calyciflorus*, ovigerous females and adults individuals are important with 37 individuals /L and 1310 individuals /L, respectively (Figure 5A). After this period, all groups are decrease.

For the cladoceran *M. micrura*, the evolution of population presents two peaks (Figure 5B). During the first peak obtained rapidly 9th day, all groups of specie are important. After, its decrease until the ovigerous females disappears between 12-18th days. For 2nd peak, only the adults' individuals are important.




Rot Ad: Adults of *B. Calyciflorus*
Rot youngs: youngs of *B. Calyciflorus*
Rot. ov: ovigerous females of *B. Calyciflorus*
Cla. Ad: adults of *M. micrura*
Cla. youngs: youngs of *M. micrura*
Cla. ov: ovigerous females of *M. micrura*
Cop. Ad: adults of *Thermocyclops sp.*
Cop. ov: ovigerous females of *Thermocyclops sp.*
Nauplii: Nauplii of *Thermocyclops sp.*

**Fig 6:** Demography of *B. calyciflorus* (A), *M. micrura* (B) and *Thermocyclops sp*. (C) in controlled medium.

The population of ovigerous females, nauplii and adults of *Thermocyclops* sp. increase in the same report (adjoining 1) between the beginnings of experiment to 15$^{th}$ day. From the 15$^{th}$ day, the adults individuals decrease; but ovigerous females and nauplii individuals still to be increase considerably and present the peaks respectively 21$^{th}$ day and 27$^{th}$ day with 118 ind/L for eggs females and 1573 ind/L for nauplii.

In the controlled medium, *B. calyciflorus* and *M. micrura* present same dynamics like in poultry dropping medium. But its densities are very less (Figure 6A and Figure 6B). For *Thermocyclops* sp., the population of ovigerous females increases early the 6$^{th}$ day and present its maximum peaks the 21$^{th}$ day. During this moment, the population of nauplii increases and reaches its peaks the 12$^{th}$ day, then the population decrease with relatively important level at the end of experiment. The population of adults increases weakly at beginning and reaches a peak the 18$^{th}$. After that, the population of adults decreases at the end.

### 3.2.2.2. Performances of population growth

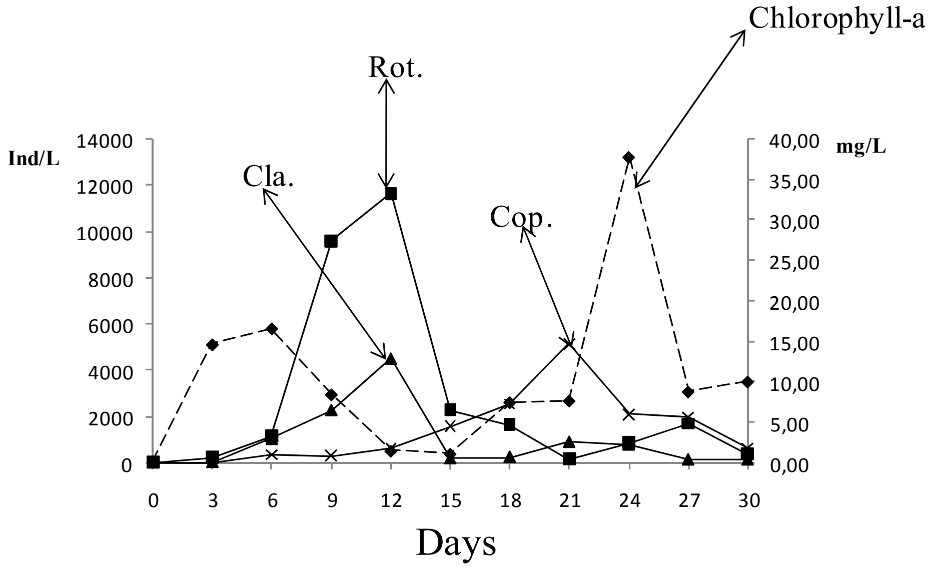
The intrinsic rate of increase (*a*), duplication time (Td) and production per day determined when the maximum of densities of each species are given in the table 1. The intrinsic rate of increase and production per day are highest in the poultry dropping medium. In this medium, *a* values range 0.71 - 0.74 for *B. calyciflorus*, 0.85 - 0.92 for *M. micrura* and 0.20 - 0.22 for *Thermocyclops* sp. But in controlled medium, *a* values range 0.22 - 0.30 for *B. calyciflorus*, 0.44 - 0.45 for *M. micrura* and 0.32 - 0.41 for *Thermocyclops* sp. Then, whatever the medium cladoceran *M. micrura* present the highest intrinsic rate of increase. But, in all mediums, rotifer *B. calyciflorus* give the most production per day (table 1). It is followed by *M. micrura* and *Thermocyclops* sp.

The duplication time (Td) of *B. calyciflorus* and *M. micrura* are lower at 2 days (1.38 ± 0.05 days for *B. calyciflorus*; 1.13 ± 0.07 days for *M. micrura*) in poultry dropping. But in controlled medium, the Td values are superior at 2 days. The duplication time of *Thermocyclops* sp. is 5.08 ± 0.88 days in poultry dropping medium and 2.6 ± 0.48 days in controlled medium.

### 3.3. Chlorophyll influence on the zooplankton population

The Figure 7 shows a compared evolution of rotifer (*B. calyciflorus*), cladoceran (*M. micrura*) and copepod (*Thermocyclops sp.*) and chlorophyll-a.

Evolution curve of chlorophyll-a presents two peaks. The first peak is quickly obtained at 6$^{th}$ day. Then, it decrease and reaches the weakly level the 12$^{th}$ until 15$^{th}$ day. After that, it increases a new and reaches a second peak at 24$^{th}$ day. This second peak reaches more level than the first. The populations of *B. calyciflorus*, *M. micrura* and *Thermocyclops* sp. present only one peak. The peaks of *B. calyciflorus* and *M. micrura* appear early just after the first peak of chlorophyll-a. The peak of *Thermocyclops* sp. is farther obtained at 21$^{th}$ day. Then, a trophic regulation processes is observed and appear between zooplankton and chhlrophyll-a. Appearance of second peak of phytoplankton observed in the present experiment will be due of lower presence of herbivorous species (*M. micrura* and *B. calyciflorus*).




Rot.: rotifer (*B. calyciflorus*); Cla. : cladoceran (*M. micrura*); Cop.: copepod (*Thermocyclops* sp.)

**Fig 7:** Evolution of the trophic conditions (as chlorophyll concentration) and the densities of rotifer (*B. calyciflorus*), cladoceran (*M. micrura*) and copepods (*Thermocyclops sp*.) during the experiment.

**Table 1:** Daily rates of increases in numbers (*a*) for growing populations of *B. calyciflorus, M. micrura* and *Thermocyclops sp.* observed during colonization phase in different medium; $t_0$: day of inoculation; $t_1$: day of maximum density; n: number of couple values; r: correlation coefficient for numbers *vs* time significant; α: significant seuil of r; P: production per day; td: duplication time.

| Especies | Tanks | $t_0$ | $t_1$ | n | r | α | P | *a* | td |
|---|---|---|---|---|---|---|---|---|---|
| Chicken dropping | | | | | | | | | |
| Rotifer: *B. Calyciflorus* | 1 | 0 | 9 | 4 | 0,99 | 0,007 | 1075 | 0,71 | 1,41 |
| | 2 | 0 | 9 | 4 | 0,97 | 0,002 | 873 | 0,74 | 1,34 |
| | Mean | 0 | 9 | 4 | 0,97 | 0,004 | 973±249 | 0,73±0,02 | 1,38±0,05 |
| Cladocerean: *M. Micrura* | 1 | 0 | 9 | 4 | 0,92 | 0,004 | 146 | 0,92 | 1,08 |
| | 2 | 0 | 9 | 4 | 0,92 | 0,051 | 104 | 0,85 | 1,18 |
| | Mean | 0 | 9 | 4 | 0,92 | 0,01 | 126±08 | 0,88±0,05 | 1,13±0,07 |
| Copepods: *Thermocyclops* sp. | 1 | 0 | 18 | 7 | 0,87 | 0 | 46 | 0,22 | 4,45 |
| | 2 | 0 | 18 | 7 | 0,89 | 0 | 45 | 0,2 | 5,7 |
| | Mean | 0 | 18 | 7 | 0,88 | 0 | 45±19 | 0,21±0,01 | 5,08±0,88 |
| Controlled treatment | | | | | | | | | |
| Rotifer: *B. Calyciflorus* | 1 | 0 | 6 | 3 | 0,96 | 0,004 | 41 | 0,3 | 3,33 |
| | 2 | 0 | 6 | 3 | 0,85 | 0,005 | 33 | 0,22 | 4,54 |
| | Mean | 0 | 6 | 3 | 0,92 | 0,005 | 37±103 | 0,26±0,05 | 3,94±0,85 |
| Cladocerean: *M. Micrura* | 1 | 0 | 6 | 3 | 0,91 | 0,034 | 63 | 0,44 | 2,27 |
| | 2 | 0 | 6 | 3 | 0,92 | 0,019 | 56 | 0,45 | 2,22 |
| | Mean | 0 | 6 | 3 | 0,91 | 0,017 | 59±03 | 0,45±0,00 | 2,2±0,03 |
| Copepods: *Thermocyclops sp.* | 1 | 0 | 12 | 5 | 0,98 | 0,035 | 38 | 0,41 | 2,44 |
| | 2 | 0 | 12 | 5 | 0,88 | 0,032 | 28 | 0,32 | 3,12 |
| | Mean | 0 | 12 | 5 | 0,9 | 0,03 | 33±31 | 0,4±0,06 | 2,6±0,48 |

## 4. Discussion

Application of poultry dropping increased significantly ($p < 0.05$) $NH_4$-N, $NO_3$-N and $PO_4$-P values of the water. Also, chlorophyll-a amount and zooplankton produced are very important in poultry dropping medium ($p < 0.05$). These results were in agreement with those reported by Agadjihouèdé *et al.* [14, 18], Damle and Chari [13] who successfully used animal wastes on culture of zooplankton. The explanations for these results are a positive effect of organic fertilization on nourishing quality of water which improves the production of zooplankton.

In the present study, cladoceran *M. micrura* has the high intrinsic increase around 0.88 and corresponding to doubling times near 1.2. The similar data are fine in the literature. For example Saint-Jean and Bonou [8] fund for *M. micrura* reared in tanks and in ponds Layo the intrinsic rate range 0.72 - 0.92. However, this intrinsic rate obtained here, is lower than the values fund by Shep [21] for a same species reared in tanks which range 1.13 - 1.25. This difference may result from the distinct rearing conditions. Those authors had cultivated *M. micrura* in monospecies condition, but in this present case, *M. micrura* is reared in mixed with rotifer *B. calyciflorus* and copepods *Thermocyclops* sp. In fact, present of *B. calyciflorus* and *Thermocyclops* sp. could influence the development rate of *M. micrura* through food competitor action of rotifer [19] and predator action of copepods [8]. Now, the rates of population increase of cladoceran were influenced by food density [1, 3, 6]. These rates exceed largely those *Diaphanosoma birgei*, *Ceriodaphnia cornuta, Moina macrocopa, Pleuroxus aduncus and Simocephalus vetulus* which respectively range 0.18 - 0.22, 0.17 - 0.23, 0.54 - 0.60, 0.09 - 0.15 and 0.12 - 0.28 using the life table demography approach [1, 20, 22].

The rate of *B. calyciflorus* obtained is relatively high and comparably of values reported by Pourriot and Rougier [23] in laboratory (*a* = 0.42-0.734 à 25 °C). For Bonou [24], rotifers generally showed higher rates comprised between 0.73 and 4.12; although, its may have been increased by massive release from dormancy, and, above all, corresponded to conditions a priori more favorable (food abundance, lack of predation or even of competition for food), because rotifers were the sole or dominant consumers at that moment of the recolonization phase. These rates exceed largely those *B. calyciflorus* reared on *Dictyosphaerium chlorelloides* by Awaïss and Kestemont [12] (*a* = 0.53).

In *Thermocyclops* sp., increase rate values registered are sharply lower, equivalent around less of third (1/3) of *B. calyciflorus* and *M. micrura*. These are relatively weak for *Thermocyclops* sp. *a* values obtained by Shep [21] range 0.36-0.37 and *Mesocyclops ogunnus* (0.42 < *a* < 0.66) [24]. The weak increase rates of *B. calyciflorus* and *M. micrura* obtained in the controlled mediums result from the poverty of these mediums in nourishing elements. In these same controlled mediums, the increase rates more high than present *Thermocyclops* sp. with regard to the two other species on one hand and with regard to the poultry dropping mediums on the other hand shows that *Thermocyclops* sp. exercises really a predation on the *B. calyciflorus* and *M. micrura* as indicated Saint-Jean and Bonou [8] and Agadjihouèdé *et al*. [14].

Although *M. micrura* has a higher increase rate in poultry dropping mediums, it don't reach the high density in term of colonization phase: 1 291 ± 46 individuals/L (1 258 – 1 323 individuals/L) *versus* 11 695 ± 1732 individuals/L (10470 – 12920 individuals/L) at *B. calyciflorus* and 960 ± 333 individuals/L (724 - 1195 individuals/L) at *Thermocyclops* sp.

Those maximums densities are reached 6 - 12 days at *M. micrura* and *B. calyciflorus* and 18 - 21 days at *Thermocyclops* sp. Then, the colonization of the zooplankton is massive and rapid in the mediums. This colonization is happened firstly by rotifers *B. calyciflorus* and cladoceran *M. micrura*; after by copepod *Thermocyclops* sp. No succession is notified here between rotifer and cladoceran. But it's clear that copepod follows rotifer and cladoceran. Nevertheless, Legendre *et al*. [25] reported that the recolonization of zooplankton in the fishponds of Layo (Ivory Coast) are realized firstly by rotifers (in the 10th day), followed by cladocerean and copepods (13-20th day) in order which the data could not defined. According to some works a succession rotifers-crustaceans is classic [26, 27]. Those results could be justified by development duration and fecundity of each specie. Embryonic and juvenile development duration of rotifers and few cladocerans like *M. micrura* are quickly, range few hours in temperature and trophics conditions of present experiment. For example, embryonic development (De) and juvenile development (Dj) values range 10.5 h and 12.4 h respectively at 30 °C for *Brachionus dimidiatus* [23], 19.68 h and 19.2 h at 29.9 °C for *M. micrura* [8, 19]. Somewhere else, nourishing conditions are in present study optimal in colonization phase (abundance food, no or lower predation).

In the all mediums, the demography structure of *M. micrura* present two peaks *versus* one peak of *B. calyciflorus*. The crash of the population of *M. micrura* after the first peak is similar at a passage of parthenogenetic reproduction habitual in the normally ecological conditions (favourable) to sexual reproduction when those conditions are defavourable. It's be justified by lower amount of chlorophyll during this period (12-18th day). This result agrees what reported by Shep [21], Saint-Jean and Bonou [8] for *M. micrura* and Benider-Belkoura [28], Benider *et al*. [29] for *Moina macrocopa*. The eggs of this sexual reproduction didn't immediately hatch. Its hatched and the population increase a new at 18-21th day.

The crash of the population of rotifers after its peaks could be explained by its short life cycle ranged from 3.4 to 4.4 days at 25 °C for the *Brachionus* [30, 31]. As well, the predation pressure from terminal stages of *Thermocyclops* sp. may play a role in the crash of *M. micrura* and *B. calyciflorus*.

A succession of ovigerous females, followed of nauplii and adults (copepodits+adults) observed in all mediums is a cohort typical evolution. The report between those three groups of *Thermocyclops* sp. (near 1) mentioned in poultry dropping medium during the first 15th day, drops a hint of a quickly development of nauplii to copepodits stage. It's resulted of favourable conditions given the poultry dropping medium. Because, according to Dessier [32], the declenchement of the metamorphoses of nauplii depend food resources, their insufficient provokes an elongation of the development stages and the maturation of the adults.

Like mentioned in literature [33, 34, 35] and above, a trophic regulation between chlorophyll and zooplankton could explain oneself by the action of grazing of the phytoplankton by zooplankton. An example is the successive appearance of species, high chlorophyll concentration and low predator densities, just before the proliferation of *M. micrura* and *B. calyciflorus*, during the colonization phase (Figure 7). Here, the decrease in chlorophyll concentrations followed by the increase in *M. micrura* and *B. calyciflorus* densities corresponds to a typical food limitation scenario.

It's important to signal that the dynamics of zooplankton are controlled by an others environmental factors like the temperature [4, 5]; but it not study in the present experiment.

**Consequences for aquaculture**

Examined in the perspectives of culture of life food for breeding the larvae of fish, it result of this experiment that the harvest of zooplankton may be realized 6-12th day when the zooplankton production reaches its high level; and rotifers and cladocerans (species preferentially consumed by the larvae of zooplanktonophagous fishes) are abundant. Among those species, it will be notified some potentials candidates of African aquaculture: *Labeo parvus, Clarias gariepinus, Heterobranchus longifilus, Heterotis niloticus* etc. The culture of life food may be focus on the species which increase quickly like *Moina* sp. and *Brachionus* sp. With those species, a culture will be short and intensive. Then several cultures may be realized.

In the fishpond, the introduction of fish must be also premature: 6-12th days after the fertilization of water to exploit the first push of rotifers and cladocereans and 15-24 days later if it is about juveniles and species which consuming bigger preys like *Oreochromis niloticus* [36]. Because the evolution of the population is of short duration, so that their exploitation is possible, continuation then preservation of strong densities of zooplankton is indispensable in ponds. Impoverishment there zooplankton are attributable to a decrease of the biomass of phytoplankton. It would be a question so first of all, without presuming secondary effects of one introduction of fish, to maintain strong biomasses of algae by regular fertilizing.

Some researches are necessary to determine the frequency of fertilization in fishponds to maintain the biomass of algae high.

## 5. Conclusion
In the terms of the present experiment, one can hold back, the species studies present different capacity of populations increase with intrinsic rate higher at *M. micrura* and *B. calyciflorus*. At those rates increases correspond the differency in the duration of colonization phase (period during the species increase while reaches its high development in environmental conditions determined). Those period range 6-12th day for *M. micrura* and *B. calyciflorus* and 18-21th for *Thermocyclops* sp. The evolution profile and dynamic of populations show: (1) quickly evolution marked by a peak followed a crash of species rotifer (*B. calyciflorus*) and cladoceran (*M. micrura*); (2) more late evolution of copepod (*Thermocyclops* sp.). This evolution of populations of rotifers and cladocerans will be regulated by several factors like trophics conditions and pressure of the adults of the copepod. In the end, necessary to signal that 6-12th day correspond a period of maximum production of zooplankton when the harvest may be realized to breeding the larvae of the fishes.

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