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Effects of doses of chicken manure on the structure and dynamic of zooplankton in ponds

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Abstract
In order to contribute to the improvement the production of fry through larval feeding, a study on the effect of doses of chicken manure on the structure and dynamic of zooplankton was realized in 9 ponds (5.7 x 5.7 x 1 m) at a flow rate of 0.05 l/s. It was carried out from May to November 2016 at the Farm of Application and Research of the University of Dschang, Western region - Cameroon. At each of the randomly selected ponds, one of the doses of 0; 800 and 1000 kg/ha was administered weekly. Different water quality characteristic and zooplancton were measured at 15 days interval. At the end of the study, the results showed that, nitrites (5.64 ± 0.19 mg/l), nitrates (6.23 ± 0.13 mg/l), phosphates (3.34 ± 0.07 mg/l), as well as the density (51858 individuals/liter) and biomass (49.3 mg PS) of zooplankton were significantly higher ($p<0.05$) in the treatment 1000 kg/ha. The biomasses of 32.3; 13.9 and 3.2 mg/l dry weight respectively of copepods, cladocerans and rotifers were obtained in the treatment 1000 kg/ha.
In practice the treatment 1000 kg/ha could be used for a better weekly fertilization.

Keywords: Zooplankton, density, biomass, dynamic, chicken manure, pond

1. Introduction

Recent trends show a decline in the landing of catch fisheries, indicating that fish stocks are gradually declining. In fact, between 2004 and 2009 the catch fishery increased from 92.4 to 90.0 million tons [15], because of various constraints, including over-exploitation of fisheries linked to the population explosion, the pollution of aquatic environments and the climate change. On the other hand, aquaculture production has increased gradually from 41.9 to 55.1 million tons in the same period due to the different technics of production realized by different country. Faced with this situation, aquaculture is therefore a reliable alternative for increasing fish production to meet the needs of the human population. But in Cameroon, it represents less than 0.1% of total fish intakes despite water surfaces covering nearly 3.5 million hectares, distributed in 4 major river basins [25]. The lower contribution of fish farming in the coverage of national needs is imputable to various constraints including the unavailability of fry for stocking ponds. The major problem is mainly related to larval feeding [4]. In fact, the food must be accessible and available in sufficient quantity and quality for the passage from the larval stage to the fry [5]. In hatcheries, saltwater zooplankton, particularly Artemia is the most commonly used for feeding larvae. However, its availability in local markets remains difficult. Because, its production technique is very sophisticated and the cost is high [5]. It is therefore essential to produce low cost freshwater zooplankton as an alternative. Zooplankton is any microorganism of animal origin suspended in the water column that feeds mainly on phytoplankton, itself dependent on minerals and available organic or chemical matter. The production of zooplankton from organic fertilizers, including animal waste (poultry droppings, cow dung and pig droppings) is no longer demonstrated. Several authors have reported that droppings improve the physicochemical and planktonic characteristics of water [30]. In this regard, some studies have been conducted in the West African region [1, 3, 5, 7, 8], especially in the laboratory and in the tank. However, in Cameroon, some studies have been carried out on the fertilization of ponds from animal manure at various doses, 700; 840 and 1200 kg / ha / week [13]. Few studies have been carried out on the evaluation of the optimal weekly dose in pond for the efficient production of zooplankton without the risk of eutrophication or sub-production. This underlines the importance of the present study, whose the general objective is to contribute to the improvement of the production of zooplankton for larval feeding through fertilization. More specifically, it involves assessing the effect of the doses of chicken manure on physicochemical characteristic of water, density and zooplankton biomass.

2. Material and methods

2.1 Zone and period of the study

The study was carry out from May to November 2016 at the University of Dschang Application and Research Farm (FAR) (LN: 5 ° 44'-5 ° 36 'and LE: 10 ° 06'-9 ° 85 ', altitude: 1392 - 1396 m) in the Sudano-Guinean zone characterized by annual precipitations varying between 1500 and 2000 mm. Temperatures range from 14 °C (July-August) to 25 °C (February). The area is characterized by a short dry season (mid-November to mid-March) and a long rainy season (mid-March to mid-November).

2.2 Conduct of the study and data collection

Chicken manure was collected within the same farm and kept at room temperature. A sample was previously collected and analyzed. The dry matter composition was 80.2%; total nitrogen 2%; and total phosphorus 1.5%.

Zooplankton production was conducted in 9 ponds (5.7 x 5.7 x 1m), with a residual flow rate of 0.05 l / s, fed from a holding lake located 100 m away. In order to eliminate unwanted organisms and to increase the alkalinity of the medium, the ponds were put in assec for a period of 7 days and limed with quicklime at a dose of 400kg / ha.

A net of 50 mm mesh was attached to the feed pipe of each pond to prevent the intrusion of fish from the reservoir. At each of the randomly selected ponds, one of the doses 0; 800 and 1000 kg / ha was administered by the spreading weekly as the fertilizer and each has three replications. The physicochemical characteristics of the water were measured bimonthly. Transparency, temperature, pH, dissolved oxygen and electrical conductivity were directly measured in the field using respectively a secchi disk, Thermo-Conductivity meter, ThermopH-meter, Thermo-Oximeter and Thermo-Conductivity Meter HANNA. The concentration of nitrites, nitrates and phosphates of water samples were determined by HACH kit (DR / 2000 a direct reading spectrophotometer) using Nitra Ver-3 Nitri Ver-3 and phos ver 5 powder pillows [18].

Zooplankton were collected bimonthly between 6 and 8 am in order to avoid vertical migration to the bottom after sunshine. The sampling was carried out at twenty different points of the water column of each pond using a calibrated polyethylene container of 1 liter capacity, ie a total volume of 20 liters / pond filtered by means of a sieve plankton of 40 µm mesh. A volume of 350 ml zooplankton concentrate was recovered, fixed by the addition of 5% formalin (¼ volume of the concentrated sample). Finally, samples were taken to laboratory for further analysis.

In Laboratory, after homogenization of the sample were, 10 ml taken by means of a calibrated pipette and introduced into a Petri dish 90 mm in diameter for the identification and counting of rotifers, cladocerans and copepods group of zooplankton. Species identification of these different group of zooplankton was carried out through the use of key determinations and works [9, 12, 16, 19, 28, 29, 32]. The count was done by duplicating counting. At least 100 individuals were counted each time per sample using the Motic Binocular Magnifier. The density of individuals was calculated by the following formula [10]

D = n / V1 * V2 / V3; where D is the density (individuals/liter), n: number of individuals counted; v1: volume of sub sample taken; v2: volume of the concentrated sample; v3: total volume of filtered water

Zooplankton biomass was calculated by multiplying the density of each zooplankton group by their mean dry weight (PS). Dry weights of rotifers, copepodites and adults of copepods; larval of copepods and cladocerans are 0.18; 1.36; 0.08 and 1.32 µg [17, 22].

2.3 Statistical analysis

The collected data were subjected to one-way analysis of variance (ANOVA 1). In case of significant differences between means, the Duncan test was applied to separate them at the 5% significance level. The SPSS 20.0 software (Statistical Package for Social Sciences) was used for these analysis.

3. Results

3.1 Physicochemical characteristics of water

The physicochemical characteristics of the water according to the doses of chicken manure are summarized in Table 1. It brings out that the transparency, dissolved oxygen, nitrites, nitrates and phosphates have significantly (p<0.05) varied with the treatments. For transparency and dissolved oxygen, the highest values were recorded in the control treatment (unfertilized pond). Nitrite and nitrate were significantly (p<0.05) higher in a fertilized pond. However, no significant differences (p>0.05) were observed between the doses of the fertilized ponds. As for the conductivity and the temperature no significant difference (p>0.05) was observed between the treatments. However, the conductivity values increased with the treatment dose.

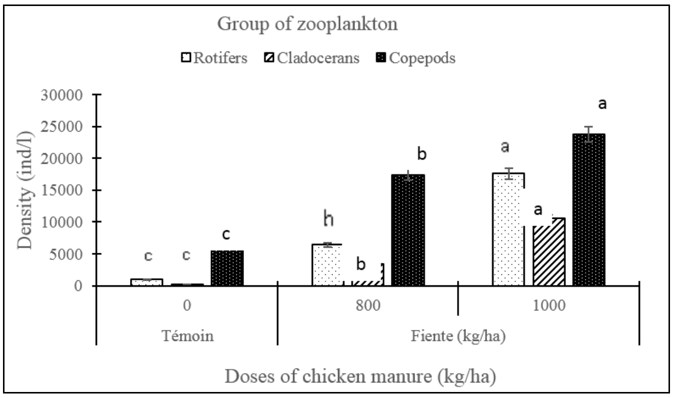
Table 1: Physicochemical characteristics of water according to doses of chicken manure

Physicochemical characteristics of water	Doses of chicken manure (kg/ha)		
	Control(0)	800	1000
Transparency (cm)	$74{,}16 \pm 10{,}10^{a}$	$43{,}26 \pm 10{,}61^{b}$	$32{,}29 \pm 2{,}50^{b}$
Temperature (ºC)	$20{,}65 \pm 0{,}11^{a}$	$20{,}42 \pm 0{,}35^{a}$	$20{,}45 \pm 0{,}36^{a}$
O_2 (mg/l)	$5{,}34 \pm 1{,}42^{a}$	$4{,}37 \pm 0{,}18^{ab}$	$3{,}53 \pm 0{,}18^{b}$
pH (UI)	$7{,}53 \pm 0{,}25^{a}$	$7{,}44 \pm 0{,}22^{ab}$	$7{,}43 \pm 0{,}04^{ab}$
NO_2^-(mg/l)	$2{,}03 \pm 0{,}13^{a}$	$4{,}92 \pm 0{,}09^{b}$	$5{,}64 \pm 0{,}19^{b}$
NO_3^-(mg/l)	$2{,}40 \pm 0{,}22^{a}$	$5{,}58 \pm 0{,}26^{b}$	$6{,}23 \pm 0{,}13^{b}$
PO_4^{3-}(mg/l)	$1{,}28 \pm 0{,}05^{a}$	$3{,}79 \pm 0{,}05^{b}$	$3{,}34 \pm 0{,}07^{c}$
Conductivity (µs/cm)	$36{,}79 \pm 4{,}28^{a}$	$37{,}75 \pm 4{,}47^{a}$	$39{,}81 \pm 1{,}50^{a}$

a, b, c, d; assigned values of the same letter on the same line do not differ significantly (p>0.05)

3.2 Density of zooplankton

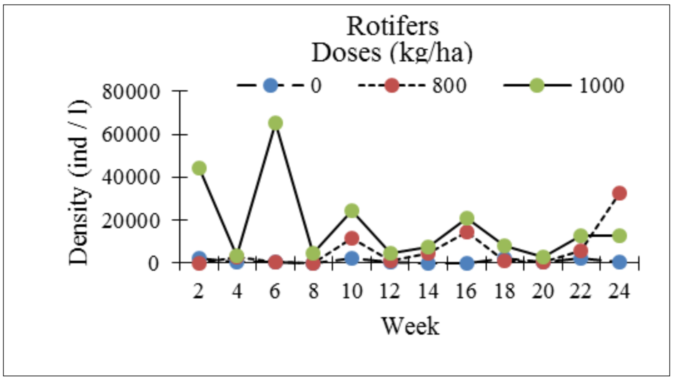
The density of the zooplankton groups according to the doses of chicken manure illustrated in Fig 1 shows that the highest density was obtained in the treatment 1000 kg / ha. However, it was significantly ($p<0.05$) higher in copepods (nauplius + juvenile copepods + adult copepods), followed by rotifers irrespective of dose. The lowest value was recorded in the control treatment.

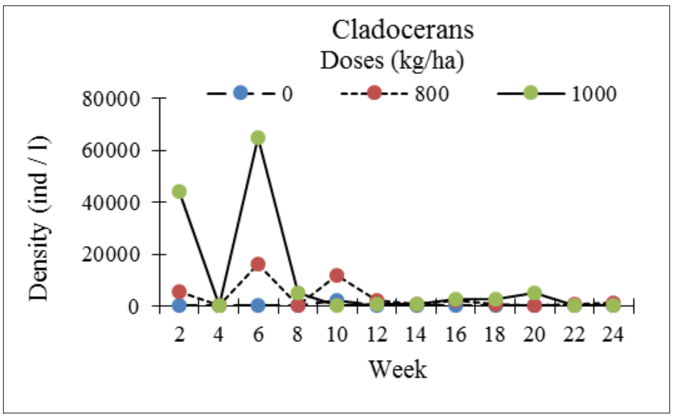


a, b, c; histograms of the same motif with the same letter are not significantly different ($p>0.05$)

Fig 1: Density of zooplankton groups as a function of the dose of dung

The bimonthly zooplankton cluster density shown in Fig 2 shows that, independently of the doses, the increased density of rotifers and cladocerans was accompanied by the decrease in copepods between 14 and 23 weeks. Furthermore, a concomitant increase was observed between the 4 to 8 week period of the test with higher value obtained at the 6th week in the 1000 kg / ha treatment. At the end of the test, the rotifers tendency was opposed to that of copepods and cladocerans with higher values in the 800 kg / ha treatment.





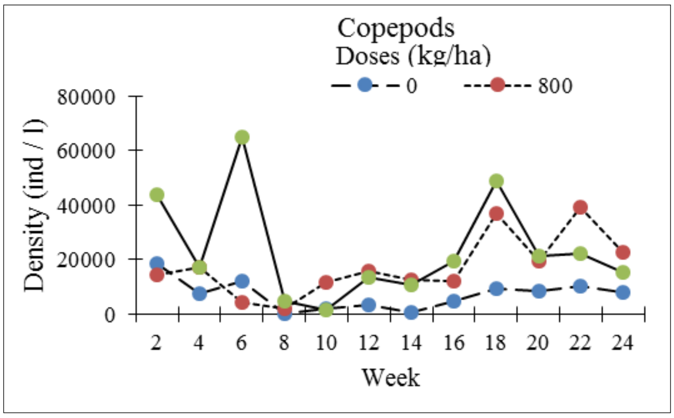
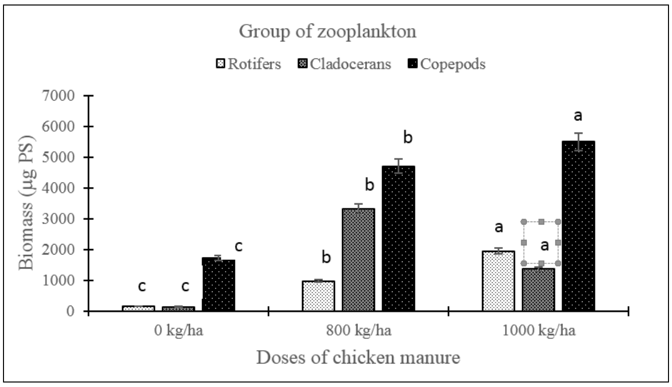


Fig 2: Bimonthly change in density of zooplankton groups

3.3 Biomass of zooplankton

The biomass of the zooplankton groups according to the doses of chicken manure is illustrated in Fig 3. It appears that, independently of the groups, the biomass was significantly ($p<0.05$) higher in the treatment 1000 kg / ha. Thus, the biomass of the copepods (nauplius + juvenile copepods + adult copepods) was significantly higher, followed by that of the cladocerans regardless of the dose.



a, b, c; histograms of the same motif with the same letter are not significantly different ($p>0.05$)

Fig 3: Evolution of biomass of zooplankton groups

3.4 Correlations between physicochemical characteristics of water and density of zooplankton groups

The correlations between physicochemical characteristics of water and the density of zooplanktonic groups are summarized in Table 2. It appears that no significant correlation ($p>0.05$) was observed. Except temperature, all physicochemical characteristics of water were weakly and negatively correlated with rotifers and cladocerans density in the control treatment.

Total phosphates and transparency were weakly and positively correlated with copepod density. Negative correlations were observed between the physicochemical characteristics of water and density of rotifers and copepods in the 800 kg / ha treatment. The reverse has been observed in the treatment 1000 kg / ha.

Density of cladocerans was weakly and negatively correlated with transparency, conductivity and temperature respectively in 800 and 1000 kg / ha treatments.

Table 2: Correlations between Physicochemical Characteristics of Water and Zooplankton Density

Density of zooplankton	Doses of the fertilizer	Physicochemical characteristics of water							
		Conductivity	Temperatury	pH	O_2	NO_2^-	NO_3^-	PO_4^{3-}	Transparency
Rotiferes	Control	-0,233	+0,234	-0,236	-0,123	-0,182	-0,222	-0,171	-0,242
	800	-0,314	-0,322	-0,265	+0,383	-0,387	-0,388	-0,383	+0,227
	1000	+0,179	+0,178	+0,165	-0,113	+0,143	+0,135	+0,092	+0,146
Cladocerans	Control	-0,209	+0,213	-0,218	-0,019	-0,113	-0,186	-0,318	-0,352
	800	-0,160	-0,169	-0,112	+0,279	-0,274	-0,267	-0,249	+0,079
	1000	+0,166	+0,098	+0,001	-0,337	-0,082	-0,105	+0,346	-0,071
Copepods	Control	-0,211	+0,208	-0,205	-0,284	-0,261	-0,226	+0,152	+0,033
	800	-0,092	-0,103	-0,035	+0,270	-0,258	-0,244	-0,214	-0,002
	1000	+0,217	+0,244	+0,263	-0,039	+0,263	+0,260	+0,002	+0,264

Copepods: (nauplius + juvenile copepods + adult copepods)

4. Discussion

Results on the physicochemical characteristics of water showed that dissolved oxygen, transparency, nitrites, nitrates and phosphates were significantly affected by dung doses. Thus, the concentrations of nitrate ions and phosphates were higher in a fertilized pond. Our values were lower than 11.06 mg / l of nitrates and 12.56 mg / l of phosphate obtained on the production of zooplankton based on pig dungs in plastic buckets [3]. This would be related to the composition of the mineral elements of the droppings and also the high temperature of the water (31.28 ºC against 20, 50 ºC in our ponds) which contributed to the better decomposition of the organic matter. In addition, the concentrations of nitrate and phosphates were higher than those recorded [20] in nursery tanks fertilized with chicken manure and cow dung. Such a difference would be due to the lack of fry in our ponds that feed on the organic matter in suspension responsible for the increase of the mineral elements after decomposition.

The waters of the fertilized ponds with the greatest amount of manure were remarkable for their low transparency. This trend is largely due to the distribution of seston elements in the water column, including plankton swarming.

Dissolved oxygen was significantly lower with the largest amount of the fertilizer. The tendency is dissimilar to the observation of Agadjihouede *et al* [5] and Akodogbo *et al* [3]. This is certainly due to the activity of bacteria that are more numerous in environments receiving organic matter. In fact, deoxygenation is the consequence of the oxidation of organic matter, carried out biologically or chemically [24]. The average temperature and pH in the fertilized ponds were in the favorable range of plankton development, respectively 20-30 ° C; 6.5 - 7.5[11, 14]. The results of the study revealed that the average temperature of water was around 20.5 ° C with a minimum value of 19 ° C and a maximum of 22 ° C during the study.

The low temperature range observed is a feature of most tropical waters [25]. Thus, none significant difference observed among the treatment is similar to that obtained by several authors [1, 3, 7].

The density and biomass of rotifers, cladocerans and copepods was increased significantly with the dose. The same trend was observed by Akodogbo *et al* [3], but the biomass in dry weight of zooplankton (1.2 and 4.2 mg/L) obtained by Mitra *et al*. [26] in the fertilized pond in India is lower than those obtained in this study. This would be due to the richness of the medium in biogenic elements such as nitrites, nitrates and phosphates as revealed by the positive correlations. Indeed, these biogenic elements are essential for the good development of phytoplankton, the main food source of zooplankton. Such a relationship has already been demonstrated and confirmed through several studies [21, 24, 31] who found a positive correlation between nutrient enrichment and phytoplankton biomass on the one hand, between phytoplankton biomass and zooplankton biomass somewhere else. The density copepod significantly (p<0.05) high observed is due to their opportunistic and predatory nature on rotifers and cladocerans. Indeed, the decrease of these last from the 10th week was accompanied by the progressive increase of the copepods. This observation corroborates that made by Agadjihouede *et al* [5] about the dynamics of zooplankton in the tanks. With regard to zooplankton group biomass, that of cladocerans in contrast to density was higher than those of rotifers. This result is similar to the observation of Agadjihouede *et al* [5] and would be due to the higher individual weight of cladocerans. Indeed, the dry weights of rotifers, copepodites and adults of copepods; nauplius of copepods and cladocerans are 0.18; 1.36; 0.08 and 1.32 µg [17, 22].

5. Conclusion

The present study has shown that the physicochemical characteristics of water have been significantly affected by the doses of chicken manure. In fact, the concentration of nitrites and phosphates were higher in the treatment 1000 kg / ha, against the opposite was observed with dissolved oxygen and transparency.

The dose of chicken manure was significantly influenced density and biomass of zooplankton, thus they were significantly (p<0.05) higher in the treatment 1000 kg / ha. The biomass of copepods, followed by cladocerans were significantly higher independently of the doses. In practice, 1000 kg / ha of chicken manure can be used for weekly fertilization.

6. Acknowledgement

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7. References

1. Agadjihouédé H, Bonou CA, Montchowui E, Lalèyè PH. Recherche de la dose optimale de fiente de volaille pour la production spécifique de zooplancton à des fins piscicoles. Cahiers Agricultures. 2011b; 20(4):247-260.
2. Agadjihouédé H, Bonou CA, Lalèyè Ph. Effet de la fertilisation à base des fientes de volaille sur la production du zooplancton en aquarium. Annales des Sciences Agronomiques. 2010a; 14(1):63-75.
3. Agadjihouédé H, Bonou CA, Chikou A, Lalèyè Ph. Production comparée de zooplancton en bassins fertilisés avec la fiente de volaille et la bouse de vache.

International Journal of Biological and Chemical Sciences. 2010b; 4(2):432-442.

4. Agadjihouède H, Bonou CA, Montchowui E, Chikou A, Laleye P. Development Capacity of Three Species of Aquacol Interests Zooplankton (*Brachionus calyciflorus*, Moinamicrura, *Thermocyclops* sp.) Breeding in Monospecific Condition in Aquariums with Poultry Droppings (Text in French). Tropicultura. 2011a; 29:231-237
5. Agadjihouèdé H, Bonou CA. Lalèyè PH. Effet de la fertilisation à base des fientes de volaille sur la production du zooplancton en aquarium. Annales des Sciences Agronomiques. 2010; 14(1):63-75.
6. Akodogbo HH, Agadjihouèdé H, Bonou CA, Fiogbé ED. Production du zooplancton à partir des déjections animales et son importance dans la vie des larves de poisson: synthèse bibliographique. Annales des Sciences Agronomiques. 2015; 19(1):97-113.
7. Akodogbo HH, Bonou CA, Fiogbè ED. Effect of pig dung fertilizer on zooplankton production. Journal of Applied Biosciences. 2014; 84:7665-7673.
8. Akodogbo HH, Bonou CA, Fiogbè ED. Optimization of zooplankton production from pig dung optimal dose: non-renewed medium. Journal of Experimental Biology and Agricultural Sciences. 2015, 3(1).
9. Amoros C. Crustacés cladocères. Introduction pratique à la systématique des organismes des eaux continentales françaises. Bull. Mens. Soc. Lin. Lyon. 1984; 3:53-63.
10. Cacot P. Contribution à l'amélioration de la production d'alevins au Cameroun: essais de reproduction et d'élevage de nurserie avec *Clarias gariepinus* et deux autres espèces. CIRAD, France, ordre de mission. 2007, n° 30.06.20620. 65.
11. Carballo E, Eer A, Schie T, Hilbrands A. La pisciculture à petite échelle en eau douce. Agrodok (15): Pays-Bas. 2008.
12. Durand JR, Levêque C. Flore et faune aquatiques de l'Afrique Sahelo-Soudanienne. T.1. ORSTOM, I.D.T. Paris. 1980, 389.
13. Efole ET. Optimisation biotechnique de la pisciculture en étang dans le cadre du développement durable dans l'exploitation familiale agricole au Cameroun. *Agrocampus* Thèse de doctorat à l'Université de Dschang. 2011, 176.
14. FAO. La situation mondiale des pêches et de l'aquaculture; Département de Pêches et Aquaculture, FAO (Ed), Rome (Italie). 2016, 227.
15. FAO. La situation mondiale des pêches et de l'aquaculture. Rome. 2010, 1-100.
16. Fernando CH. Introduction in a guide to tropical fresh water zooplankton. Identification ecology and impact on fisheries. C. H. Fernando (Ed.), Leiden (Netherlands), 2002.
17. Gras R, Saint-Jean L. Croissance en poids de quelques copépodes planctoniques du lac Tchad. Revue Hydrobiologia Tropicale. 1981; 14:135-147.
18. Greenberg A. Standard methods for the examination of water and waste water. Édit. American Public Health Association, Washington, 16ème edition. 1985, 1268.
19. Koste W. Rotatoria die rädertieremitteleuropos. Edit. BORN TRAEGE, Belin, 1978; 2:673, 234.
20. Kumara A, Edirisinghe U, Dematawewa CMB. Effect of Chicken Manure and Cow Dung on Water Quality, Pond Productivity, and Growthand Survival of Goldfish (*Carassius auratus*) Fry. Tropical Agricultural Research. 2003; 15:242-255.
21. Lazzaro X, Lacroix G. Impact des poissons sur les communautés aquatiques. In Limnologie Générale, Pourriot R, Meybeck M (eds). Masson Publication. 1995, 648-686.
22. Legendre M, Pagano M, Saint-Jean L. Peuplements et biomasse zooplanctonique dans des étangs de pisciculture lagunaire (Layo, Côte d'Ivoire). Etude de la recolonisation après la mise en eau. Aquaculture. 1987; 67:321-341.
23. Lewis WMJ. Tropical limnology. Annl. Rev. Ecol. Syst. 1987; 18:159-185. Aquaculture, FAO (Ed), Rome (Italie). 2010, 244.
24. MCQueen DJ, Johannes MRS, Post JR, Stewart TJ, Lean DRS. Bottomup and top-down impacts on freshwater pelagic community structure. Ecological Monographs. 1989; 59:289-309.
25. MinEPIA (Ministère de l'Elevage des Pêches et des Industries Animales). Plan de développement durable de l'aquaculture au Cameroun. Ministère de l'Elevage des Pêches et des Industries Animales, Yaoundé (Cameroun). 2009, 55.
26. Mitra G, Mukhopadhyay PK, Ayyappan S. Biochemical composition of zooplankton community grown in freshwater earthen ponds: Nutritional implication in nursery rearing of fish larvae and early juveniles. Aquaculture. 2007; 272:346-60.
27. Njine T, Kemka N, Zebaze Togouet SH, Nola M, Niyitegeka D, Ayissi Etoundi PT *et al*. Peuplement phytoplanctonique et qualité des eaux en milieu lacustre anthropisé: cas du lac municipal de Yaoundé (Cameroun). African Journal of Science and Technology (AJST). Science and Engineering Series. 2007; 8(1):39-51.
28. Pourriot R, Francez AJ. Rotifères. Introduction pratique à la systématique des organismes des eaux continentales françaises. Bull. Mens. Soc. Lin. Lyon. 1986; 8:1-37.
29. Rey J, Saint-Jean L. Branchiopodes Cladocères In: IDT ORSTOM, Flore et faune aquatique de l'Afrique sahélo-soudanienne I, Paris, 1980, 307-332.
30. Tavares LHS, Santeiro RM, Coelho RMP, Braga FM. Effect of fertilization in water quality and in zooplankton community in open plankton-culture ponds. Bioscience Journal. 2009; 25(3):172-180.
31. Vanni MJ, Findlay DL. Trophic cascade and phytoplankton community structure. Ecology. 1990 ; 71(3):921-937.
32. Zébazé TSH. Biodiversité et dynamique des populations du zooplancton (Ciliés, Rotifères, Cladocères et Copépodes) au lac municipal de Yaoundé (Cameroun). Thèse de 3ème cycle, Université de Yaoundé I (Cameroun). 2000, 175.