Chemsearch Journal 1(1): 19 - 23
Received: October, 2009
Accepted: May, 2010
Publication of Chemical Society of Nigeria, Kano Chapter

NITROGEN AND PHOSPHORUS CONTENT IN FISH TISSUES OF *CLARIAS GARIEPINUS* AND *LATES NILOTICUS* HARVESTED FROM ZARIA EUTROPHIC WATERS

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ABSTRACT

The nitrogen and phosphorus level in fish tissues of Clarias gariepenus and Lates niloticus harvested from Zaria eutrophic waters were investigated for a year. Results showed high percentages of moisture and organic contents during the rainy season, while high percentages of dry matter and ash contents were observed during the dry season. The results also showed high mean percentages of water content in flesh (79.81±0.25%) at E2 with highest wet season range as (80.10 – 80.30%), dry matter content in heart (28.04±0.15%) at E2 with highest dry season range as (28.30 – 28.70%), organic content in kidney (94.80±0.12%) at E2 with highest wet season range as (94.80 – 95.50%) and ash content in gills (10.61±0.17%) at E1 with highest dry season range as (9.90 – 10.40%). There were no significant differences in the proximate composition between fish tissues and between species (P>0.05). The result also revealed high mean concentration of nitrogen (2.155±0.259%) and phosphorus (0.083±0.02%) all at E2 in Kidney. Nitrogen is significantly higher in the fish tissues (P<0.05) in all the sites. The results also showed that the levels of nitrogen and phosphorus in the tissues of the species harvested from eutrophic waters is above that of tissues from fresh water, but is within the recommended level for human consumptions.

Keywords: Fish, *Clarias gariepinus, Lates niloticus,* Nutrients, Eutrophic

INTRODUCTION

Eutrophication is the enrichment of natural waters with plant nutrients, which results in the simulation of an array of symptomatic changes (Morse *et. al.*, 1993). It may be described as pollution resulting from an excess of nitrates and phosphates discharge that leads to disturbances of the ecosystem such as shift in the natural environment species composition or oxygen deficiency near bottom. Some lakes and other surface water are naturally eutrophic, i.e. they receive sufficient plant nutrients from natural source to produce excessive crops of algae and macrophytes (Hasler, 1947). These include the increase production of algae and other aquatic plants affecting the Man has rapidly increased his use of nutrients especially in agriculture fertilizer and detergents, many of which end up in water ways and accelerate the process of eutrophication (Hutchinson, 1970). The factors that cause eutrophication are heavy use of nitrogen fertilizers on agricultural land and increased discharge of phosphates from sewage works (Manson, 1981).

Fish is known to be the cheapest sources of animal protein and other essential nutrients required in human diets (Sadiku and Oladimeji, 1991). The nature and quality of nutrients in most animals is dependent upon their food type. Also the feeding habit of an individual fish species has great effect on its body nutrients composition (Laglar et. al., 1977). The knowledge of fish nutrient contents and factors affecting them allow the assessment of fish health and the quality of nutrients available to the consumers (Sharer, 1994). The measurement of some proximate and mineral profile is necessary to ensure they meet the requirements of food regulations and commercial specifications (Watermann, 2000). Throughout the years, fishes are subjected to considerable environmental changes and fluctuations that will affect their proximate and mineral composition (Olsson, et. al., 2002). Factors affecting fish consumption can be either endogenous or exogenous (Mahmut et. al., 2002)

It has been established that Zaria surface water system is eutrophic due to the discharge of wastes and other agricultural activities (Okibe, 2005). Since the water is

eutrophic, there is the likely hood that fish in the water system has been affected. Therefore, considering the various health hazard and the nutritional benefits associated with fish consumption, it has become important that, fish's mineral and proximate composition and their health status be assessed to establish the safety level of the fish species prior to their consumption. *Oreochromis niloticus* harvested from Zarias eutrophic waters and compare the levels with those of fresh water fishes of same species and the recommendation level for human consumption. The aim of this research is to investigate the status of eutrophication in the fish species in the fish species.

MATERIAL AND METHODS

Three sampling sites were selected with consideration for the availability of fish throughout the year. Sample of *Oreochromis niloticus* at three sites were collected/purchased randomly. Samplings were done monthly in the early morning for the period of one year. The fish collected were of the same size as variability in size stands to affect the proximate and level of nutrient elements. The fish samples were washed and dissected under laboratory conditions and from each fish different tissues namely liver, kidney, heart, flesh and gills were removed from their positions and placed separately in weighed labelled crucibles.

For the determination of moisture contents, fish tissues were oven dried to constant weight at 105^{o}C for 72hrs. Percentage proximate content in the dried fish tissues were determined by methods (AOAC, 1980). The dried fish tissues were grounded into fine homogeneous powder. Ash content was determined by incinerating 2g of each powdered sample in a muffle furnace at 600^{o}C until complete ashing was achieved by constant weight. The total organic matter was determined by subtracting the ash weight from the weight of dried powder. The nitrogen in the fish tissues was determined using micro Kjeldahl method, while phosphorus was determined using Atomic absorption spectrophotometer (AOAC, 1980). The data obtained were subjected to one way ANOVA (Steel and Currie, 1980), and t- test.

RESULTS AND DISCUSSION

The moisture content of the fish tissue at the three sites is presented in table1.The moisture in flesh was significantly higher (P=0.05) at all the sites, with the mean value as (82.9+0.2%) at sites E2. The moisture values were high during wet season; this could be due to high amount of rainfall received. The highest moisture content was (80.10-80.3%) at site E2 (Table 1). This work is in conformity with the work of Abolude (2008). Who reported high moisture content in flesh than in waste of *clarias gariepenus* and *Oreochromis niloticus*. Abolude and Abdullah (2003) reported higher moisture content in flesh that in the waste of *tilapia Zill.* The order of moisture content in the fish tissues are as follows: Flesh > gill> liver > Kidney >heart.

The heart was significantly higher (P=0.05) in dry matter content in all the sites, with higher mean values as (28.04+0.15%) at site E2. The dry matter content was higher during dry season with highest dry season range as (28.30-28.70%). This is in conformity with the work of Mohammad (2000). Who reported that heart had the highest dry matter content in *Synodentis schall* from bakura. The order dry matter content in the fish tissue were: fish > Kidney > Liver > gills > flesh. The dry matter content is reverse of moisture content in the fish tissue of the fish specie at all the sites.

The kidney was significantly higher (P=0.05) in organic matter content at all the sites, with the highest mean value (94.80+0.12%) at site E2. The values were higher during the wet season with the highest wet season range as (94.80-95.50%). This work is in conformity with the work of Abolude and Abdullah (2003). The order of organic matter content in the fish tissues were: Kidney > heart > liver > flesh > gills.

The gill was significantly higher in ash content in all the sites with the highest mean value as (10.61+0.11%) at site E1. The values were higher during dry season with the higher dry season range as (9.90-10.40%). The order of ash content in the fish tissues were: Gill > flesh > liver > heart > kidney. Ash content is the reverse of organic matter content in the fish tissue of the fish specie at all the sites.

Table 1: Summary of the Moisture Content of the fish tissues in the three fish species at three sites

Species	Sites	Tissues	Year Av. Mean±S.D(%)	Wet Season range (%)	Dry Season range (%)
		liver	77.92 ± 0.34	78.10 – 78.40	77.40 – 77.90
		kidney	76.93 ± 0.22	76.90 – 77.40	76.70 – 77.20
S1	E1	heart	75.73 ± 0.18	75.80 – 76.20	75.70 – 76.00
		flesh	79.81 ± 0.25	80.10 – 80.30	80.10 – 79.60
		gills	79.01 ± 0.23	79.10 – 79.50	78.70 – 79.20
		liver	76.94 ± 0.23	77.10 – 77.40	76.90 – 76.40
		kidney	75.63 ± 0.29	75.90 – 76.40	75.80 – 76.20
S1	E2	heart	74.74 ± 0.15	74.90 – 75.20	74.70 – 75.00
		flesh	78.81 ± 0.19	78.70 – 79.30	78.50 – 79.20
		gills	78.02 ± 0.24	78.20 –78.50	77.70 – 78.20
		liver	73.45 ± 0.33	73.40 – 74.00	72.20 – 73.30
		kidney	72.65 ± 0.20	72.00 – 73.10	72.50 – 72.80
S2	E1	heart	72.35 ± 0.18	72.40 – 72.70	72.30 – 72.60
		flesh	75.44 ± 0.25	75.40 – 75.90	75.30 – 75.60
		gills	74.74 ± 0.23	74.60 – 75.20	74.50 – 74.90
		liver	72.65 ± 0.31	72.90 – 73.10	72.20 – 72.90
		kidney	71.76 ± 0.20	71.80 – 72.20	71.50 – 71.90
S2	E2	heart	71.36 ± 0.15	71.40 – 71.80	71.40 – 71.60
		flesh	74.54 ± 0.18	74.60 – 75.00	74.30 – 74.50
		gills	73.95 ± 0.29	73.70 – 74.40	73.60 – 74.00

Table 2: Summary of the Dry Matter Content of the fish tissues in the three fish species at three sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season Range (%)	Dry season range (%)
		liver	22.08 ± 0.34	21.60 – 21.90	22.10 – 22.60
		kidney	22.76 ± 0.22	22.60 – 23.10	22.80 – 23.30
S1	E1	heart	23.74 ± 0.18	23.80 – 24.20	24.00 – 24.20
		flesh	19.93 ± 0.25	19.70 – 20.30	19.90 – 20.40
		gills	20.81 ± 0.23	20.50 – 20.90	20.80 – 21.30
		liver	23.06 ± 0.23	22.60 – 22.90	23.10 – 23.60
		kidney	23.74 ± 0.29	23.60 – 24.10	23.80 – 24.30
S1	E2	heart	24.82 ± 0.15	24.80 – 25.10	25.00 – 25.40
		flesh	20.71 ± 0.19	19.70 – 21.20	20.80 – 21.40
		gills	21.79 ± 0.23	21.50 – 21.80	21.10 – 22.30

Table 2 continue

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season Range (%)	Dry season range (%)
S2	E1	liver	26.18 ± 0.33	26.00 – 26.60	26.60 – 26.80
		kidney	27.36 ± 0.23	26.90 – 27.10	27.20 – 27.50
		heart	27.06 ± 0.20	27.30 – 27.60	27.40 – 27.70
		flesh	24.03 ± 0.59	24.10 – 24.60	24.40 – 24.70
		gills	24.91 ± 0.31	24.80 – 25.40	25.10 – 25.50
S2	E2	liver	27.15 ± 0.31	26.90 – 27.60	27.10 – 27.80
		kidney	27.84 ± 0.20	27.80 – 28.20	28.10 – 28.50
		heart	28.04 ± 0.15	28.20 – 28.60	28.30 – 28.70
		flesh	25.11 ± 0.18	25.00 – 25.50	25.50 – 25.70
		gills	25.89 ± 0.31	25.60 – 26.30	26.00 – 26.50

Table 3: Summary of the Organic Matter Content of the fish tissues in the three fish species at three sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season range (%)	Dry season range (%)
S1	E1	liver	91.83 ± 0.28	92.90 – 92.90	92.40 – 92.80
		kidney	93.80 ± 0.20	93.70 – 94.40	93.50 – 94.20
		heart	92.11 ± 0.15	92.20 – 92.70	92.00 – 92.50
		flesh	90.91 ± 0.12	91.00 – 91.50	90.90 – 91.30
		gills	90.31 ± 0.10	90.40 – 90.80	90.40 – 90.70
S1	E2	liver	93.60 ± 0.20	92.80 – 94.70	93.50 – 94.00
		kidney	94.80 ± 0.12	94.80 – 95.40	94.60 – 95.20
		heart	93.20 ± 0.19	93.20 – 93.80	93.20 – 93.60
		flesh	92.41 ± 0.11	92.40 – 93.00	92.30 – 92.80
		gills	91.51 ± 0.30	91.50 – 92.10	91.60 – 91.90
S2	E1	liver	90.81 ± 0.32	90.60 – 91.40	90.50 – 91.20
		kidney	90.22 ± 0.17	90.20 – 90.80	90.20 – 90.60
		heart	90.61 ± 0.15	90.40 – 91.20	90.30 – 91.00
		flesh	89.82 ± 0.16	89.90 – 90.20	89.90 – 90.20
		gills	89.72 ± 0.11	89.70 – 90.10	89.60 – 90.10
S2	E2	liver	91.81 ± 0.10	91.90 – 92.50	91.90 – 92.20
		kidney	91.21 ± 0.13	91.30 – 91.80	91.30 – 91.60
		heart	91.51 ± 0.16	91.50 – 92.10	91.40 – 91.90
		flesh	90.92 ± 0.13	91.00 – 91.60	90.90 – 91.10
		gills	91.01 ± 0.21	90.30 – 91.40	90.20 – 91.20

Table 4: Summary of the Ash Content of the fish tissues in the three fish species at three sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season range (%)	Dry season range (%)
S1	E1	liver	7.33 ± 0.23	7.10 – 7.70	7.60 – 7.80
		kidney	6.27 ± 0.20	5.90 – 6.30	5.80 – 6.50
		heart	7.72 ± 0.15	7.50 – 7.80	7.50 – 8.00
		flesh	8.78 ± 0.12	8.80 – 9.00	8.70 – 9.10
		gills	9.45 ± 0.15	9.30 – 9.60	9.30 – 9.60
S1	E2	liver	6.94 ± 0.19	6.00 – 6.50	6.10 – 7.20
		kidney	5.88 ± 0.12	4.80 – 5.40	4.90 – 6.10
		heart	6.56 ± 0.19	6.40 – 6.80	6.50 – 6.80
		flesh	7.43 ± 0.21	7.10 – 7.40	7.20 – 7.70
		gills	8.20 ± 0.13	8.10 – 8.40	8.20 – 8.50
S2	E1	liver	9.16 ± 0.11	8.60 – 9.20	8.80 – 9.50
		kidney	9.45 ± 0.09	9.30 – 9.60	9.40 – 9.80
		heart	9.36 ± 0.15	9.00 – 9.60	9.00 – 9.70
		flesh	9.74 ± 0.18	9.80 – 10.10	9.80 – 10.30
		gills	10.61 ± 0.11	9.90 – 10.20	9.90 – 10.40
S2	E2	liver	7.81 ± 0.15	7.10 – 8.10	7.80 – 8.20
		kidney	8.49 ± 0.13	8.20 – 8.80	8.40 – 8.90
		heart	8.30 ± 0.16	8.00 – 8.50	8.10 – 8.60
		flesh	8.78 ± 0.30	8.70 – 9.00	8.90 – 9.10
		gills	9.71 ± 0.02	8.60 – 9.60	9.80 – 9.80

Minerals Composition

The results of the level of nitrogen and phosphorous in the fish tissues were presented in Tables 5- 7. Generally the levels followed same trend. The level does not change significantly during the season until towards the end of dry season were it suddenly changes, this could be due to decrease in the volume of water there by making it more concentrated. At the beginning of the rainy season the level gradually increased due to runoff which washed nutrients from farms into the river channels, but decreases in August, due to heavy amount of rainfall received making the volume of the water high thereby making the level of the nutrient in the water to be low. Higher level of nitrogen and phosphorus at Site E2.

The results showed that the level of nitrogen and phosphorus were higher in the kidney with the following mean values, nitrogen (2.1550.25%) and phosphorus (0.0830.02%) at E2respectively. Nitrogen is significantly higher ($p<0.05$) in fish tissues of the fish species and between the nutrient elements at the entire sites. This work agrees with the work of Abdullahi and Abolude (2005), who reported that protein and lipid contents were significantly higher during rainy season in the three *bagrids* species. Mohammed (2000), reported that kidney, had the highest level in *Synodontis schall.*

The variation recorded in the content of mineral elements in fish tissues examined could be as a result of the rate at which they are available in the water body and the availability of the fish to absorb these elements from the diet and water body where they live (Adewoye and Omotosha, 1997). The level of nitrogen in the fish tissues can be attributed to the fact that nitrogen is a component of protein (Taylor, et. al., 2002).

Table 5: Summary of level of nitrogen in the fish tissues of the three fish species at three sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season range (%)	Dry season range (%)
		liver	1.440 ± 0.360	1.092 – 2.016	0.883 – 1.955
		kidney	1.901 ± 0.251	1.643 – 2.214	1.496 – 2.540
S1	E1	heart	1.196 ± 0.197	0.962 – 1.586	0.912 – 1.392
		flesh	1.161 ± 0.366	0.952 – 1.662	0.421 – 1.781
		gills	0.818 ± 0.358	0.453 – 1.460	0.406 – 1.498
		liver	1.554 ± 0.352	1.281 – 1.993	1.032 – 1.993
		kidney	2.155 ± 0.259	1.952 – 2.489	1.768 – 2.614
S1	E2	heart	1.340 ± 0.202	1.140 – 1.786	1.075 – 1.523
		flesh	1.288 ± 0.366	1.145 – 1.884	0.632 – 1.793
		gills	0.641 ± 0.372	0.496 – 0.914	0.463 – 0.716
		liver	1.320 ± 0.326	1.013 – 1.754	0.752 – 1.853
		kidney	1.737 ± 0.229	1.562 – 2.096	1.413 – 1.911
S2	E1	heart	1.074 ± 0.209	0.893 – 1.493	0.783 – 1.261
		flesh	1.051 ± 0.340	0.831 – 1.592	0.382 – 1.692
		gills	0.660 ± 0.130	0.352 – 1.041	0.334 – 0.321
		liver	1.459 ± 0.303	1.236 – 1.942	0.984 – 1.881
		kidney	1.914 ± 0.288	1.784 – 2.241	1.732 – 2.324
S2	E2	heart	1.219 ± 0.190	1.082 – 1.613	0.854 – 1.331
		flesh	1.198 ± 0.338	1.058 – 1.783	0.583 – 1.701
		gills	0.549 ± 0.116	0.421 – 0.801	0.411 – 0.663

Table 6: Summary of level of phosphorus of the fish tissues in the three fish species at three sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season range (%)	Dry season range (%)
		liver	0.038 ± 0.018	0.018 – 0.072	0.030 – 0.063
		kidney	0.066 ± 0.018	0.043 – 0.103	0.061 – 0.092
S1	E1	heart	0.031 ± 0.017	0.017 – 0.064	0.021 – 0.058
		flesh	0.019 ± 0.013	0.008 – 0.049	0.011 – 0.038
		gills	0.014 ± 0.008	0.005 – 0.033	0.009 – 0.026
		liver	0.063 ± 0.019	0.036 – 0.108	0.049 – 0.091
		kidney	0.083 ± 0.020	0.057 – 0.118	0.069 – 0.109
S1	E2	heart	0.055 ± 0.017	0.030 – 0.095	0.040 – 0.084
		flesh	0.040 ± 0.014	0.025 – 0.062	0.030 – 0.049
		gills	0.035 ± 0.008	0.019 – 0.057	0.028 – 0.048
		liver	0.046 ± 0.021	0.023 – 0.079	0.036 – 0.071
		kidney	0.072 ± 0.019	0.049 – 0.112	0.068 – 0.099
S2	E1	heart	0.038 ± 0.021	0.023 – 0.076	0.029 – 0.063
		flesh	0.023 ± 0.012	0.010 – 0.053	0.014 – 0.045
		gills	0.018 ± 0.010	0.009 – 0.037	0.012 – 0.029
		liver	0.066 ± 0.020	0.051 – 0.116	0.059 – 0.096
		kidney	0.091 ± 0.019	0.068 – 0.127	0.074 – 0.118
S2	E2	heart	0.063 ± 0.017	0.045 – 0.096	0.048 – 0.080
		flesh	0.051 ± 0.018	0.029 – 0.091	0.036 – 0.061
		gills	0.042 ± 0.012	0.026 – 0.068	0.029 – 0.052

Table 7: Summary of level of potassium in the fish tissues of the three fish species at three Sites

Species	Sites	Tissues	Year Av. (%) Mean ± S.D	Wet season range (%)	Dry season range (%)
		liver	0.056 ± 0.018	0.042 – 0.092	0.036 – 0.084
		kidney	0.087 ± 0.019	0.071 – 0.131	0.068 – 0.112
S1	E1	heart	0.050 ± 0.017	0.030 – 0.085	0.031 – 0.071
		flesh	0.045 ± 0.017	0.029 – 0.073	0.028 – 0.070
		gills	0.041 ± 0.015	0.026 – 0.065	0.024 – 0.060
		liver	0.068 ± 0.013	0.054 – 0.106	0.052 – 0.094
		kidney	0.107 ± 0.017	0.092 – 0.152	0.087 – 0.132
S1	E2	heart	0.060 ± 0.013	0.048 – 0.094	0.046 – 0.079
		flesh	0.055 ± 0.013	0.042 – 0.088	0.040 – 0.078
		gills	0.051 ± 0.012	0.037 – 0.079	0.035 – 0.068
		liver	0.047 ± 0.017	0.038 – 0.079	0.032 – 0.065
		kidney	0.072 ± 0.019	0.056 – 0.101	0.055 – 0.094
S2	E1	heart	0.042 ± 0.014	0.031 – 0.070	0.029 – 0.060
		flesh	0.036 ± 0.016	0.025 – 0.067	0.022 – 0.056
		gills	0.031 ± 0.014	0.022 – 0.053	0.020 – 0.050
		liver	0.061 ± 0.016	0.048 – 0.095	0.046 – 0.088
		kidney	0.090 ± 0.014	0.076 – 0.121	0.075 – 0.106
S2	E2	heart	0.054 ± 0.014	0.041 – 0.088	0.040 – 0.069
		flesh	0.048 ± 0.015	0.037 – 0.078	0.035 – 0.064
		gills	0.045 ± 0.011	0.035 – 0.068	0.031 – 0.061

CONCLUSION

This study has reported that the moisture content was high in flesh, dry matter and ash contents were higher in heart, while organic matter content was higher in kidney. It also reported that the moisture and organic matter contents were higher during wet season, while dry matter and ash contents were more during dry season. The level of nitrogen and phosphorus were more in the kidney. Nitrogen is significantly higher ($p<0.05$) in the fish tissues at all the sites. The study therefore showed that nitrogen phosphorus contents in the fish tissues of the fish species from Zaria eutrophic waters were above that of fresh water fishes, but within the recommended level for human consumption. This indicates that the fishes in the eutrophic waters are affected.

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