Water chemistry of some rivers draining the basement complex in southwestern Nigeria

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Abstract

The pH, conductivity, total alkalinity, dissolved O_2, CO_2, silicate-Si, PO_4-P, NO_3-N, Fe, Cl^-, Ca^{2+}, Mg^{2+} and dissolved organic matter, over a fifteen month study period (1980-81) of Rivers Owena, Ohoo and Orunro, draining the Basement Complex of central southwestern Nigeria are presented. pH varied from neutral to slighthy alkaline ($\bar{x} = 6.8$, 7.0, 7.2 respectively) while the mean conductivity values are 63, 208 and 258 µS. cm^{-1} (25 °C) respectively.

pH, conductivity, alkalinity and total CO_2 showed clear relationships with the seasonal pattern of rainfall and streamflow.

Water chemistry reflected the chemistry and susceptibility to weathering of rocks underlying the basins of the rivers (quartzites, quartz-schists, granite-gneisses, amphibolites and basic schists).

Key words : Rivers — Fresh waters — Tropical area — West Africa — Chemical composition.

Résumé

La chimie des eaux de quelques rivières du sud-ouest du Nigeria

Nous avons effectué une étude physico-chimique pendant quinze mois, des eaux des fleuves Owena, Ohoo et Orunro, dans le bassin du Sud-Ouest nigérian afin d'en relever le pH, la conductivité, l'alcanité, O_2 dissous, CO_2, silicate-SI, PO_4-P, NO_3N, Fe, Cl^-, Ca^{2+}, Mg^{2+} et la matière organique dissoute. Le pH allait du neutre au légèrement alcalin ($\bar{x} = 6,8$; 7,0; 7,2 respectivement) tandis que les valeurs moyennes de conductivité sont 63, 208 et 258 µs cm^{-1} (25 °C) respectivement.

Le pH; la conductivité, l'alcalinité et le CO_2 total sont en rapport direct avec le mode saisonnier des précipitations et les crues.

La composition des eaux reflète la composition chimique et l'altérité des bassins des fleuves (granite-gneiss, les amphiboles et schistes ordinaires).

Mots-clés : Rivières — Eau douce — Zone tropicale — Afrique de l'Ouest — Composition chimique.

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INTRODUCTION

Information on the spatial and temporal dynamics of water quality of rivers draining the humid tropics of West Africa in general, and Nigeria in particular, is scanty. The few studies on this aspect of hydrology (e.g. Holden and Green, 1960; Balogun, 1970; Imevbore, 1971; Egborge, 1971; Grove, 1972; Adebisi, 1981; Iltis and Lévêque, 1982; Wright, 1982, 1985; Ogunkoya, 1986, 1987) with the exception of Wright (1985) and Ogunkoya (1986, 1987) have been on large regional rivers such as the Niger, Benue, Sokoto and Ogun which drain predominantly savanna areas. Knowledge of the factors which promote spatial variations in water quality in the region is also very limited. Although it is generally known that variations in river water quality can be explained in terms of dominance of either precipitation chemistry, bedrock chemistry or evaporation-crystallization process within the river channel and its basin (Gibbs, 1970; Welcomme, 1985), only Wright (1982) and Ogunkoya (1986) have attempted to determine the dominant causative agents peculiar to this region.

Elucidation of the spatial and temporal dynamics of river water quality and their influencing factors would thus be of importance. Apart from enhancing knowledge, such elucidation, especially through the establishment of correspondence between nature of basin geology and river chemistry, may facilitate preliminary determination of the suitability of a river for specific water resource utilization project. This paper thus describes the water quality of three fifth order rivers draining the Basement Complex of central southwestern Nigeria, and attempts to highlight the factors promoting the observed patterns. Water quality is described using pH, conductivity ($\mu S. cm^{-1}$; 25 °C) alkalinity ($mg.l^{-1}$ $CaCO_3$), dissolved, oxygen and carbon dioxide ($mg.l^{-1}$), silica ($mg.l^{-1}$), PO_4^{3}($\mu g.l^{-1}$) NO_3^-, Cl^-, Fe, Ca^{2+}, Mg^{2+}, and dissolved organic matter ($mg.l^{-1}$).

The river basins' climate and geology

The rivers, Owena, Ohoo, and Orunro, drain basins which are contiguous, with Owena being the westernmost and Orunro, the easternmost. The basins extend from Latitude 7°27′ N to 7°47′ N and Longitude 4°55′ E and 5°10′ E (fig. 1). The basins are all under the wet Equatorial Rainforest climate, characterized by a short, dry season extending from November to March and a rainy season extending from April to October. The mean annual rainfall in the basins during the study period are 1425, 1286 and 1495 mm respectively. The mean annual temperature is 26 °C.

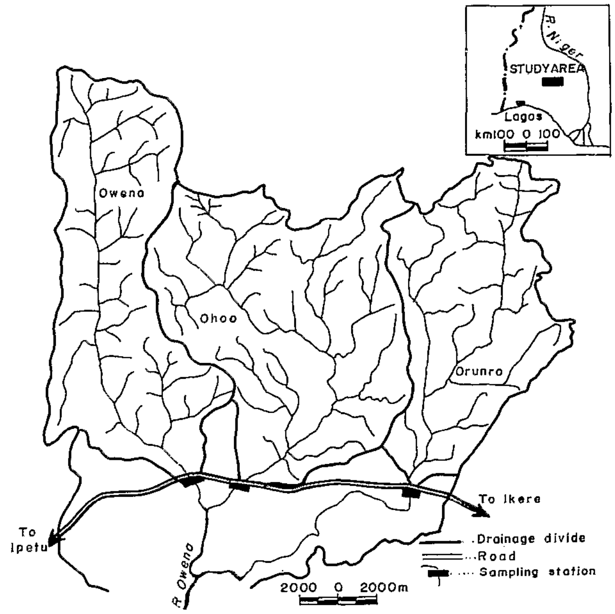

Fig. 1. — The three basins, Owena, Ohoo and Orunro in Nigeria (West Africa).
Les bassins des trois rivières, Owena, Ohoo et Orunro dans le sud-ouest du Nigeria (Afrique de l'Ouest)

Each of the basins incorporates some degree of physical diversity. The basins are underlain variously by quartzites and quartz-schists, fine grained gneisses and schists, granite gneisses, and, amphibolites and basic schists (see table 1). All the rocks belong to the Pre Cambrian Basement Complex and have been described by de Swardt (1953), Smyth and Montgomery (1962) and Jones and Hockey

Table I

Some physiographic attributes of the river basins
Physiographie des trois bassins

Basin	OWENA	OHOO	ORUNRO
Area (km^2)	135.3	160.3	99.8
% of basin area underlain by			
Qz	35.2	23.1	9.1
Fn	58.0	-	-
Gg	6.8	70.3	90.9
Amph	-	6.6	-
Rainfall (mm)	1425	1286	1495

Qz = quartzites and quartz schist
Fn = fine grained biotite gneisses and schists
Gg = variously magmatised granite gneisses
Amph = amphibolites and undifferenciated basic schists.

TABLE II

Water quality of River Owena
Composition de l'eau de la rivière Owena

Date*	pH	Cond.*	Alka.[a]	0_2[a]	$C0_2$[a]	$Si0_3$-Si[a]	$P0_4$-P[b]	$N0_3$-N[a]	Fe[a]	Cl^-[a]	Ca^{2+}[a]	Mg^{2+}[a]	DOM[a]
31/1	7.0	60	22.0	6.7	0.7	6.1	58.8	.23	.42	11.0	6.9	2.7	1.4
25/2	6.8	59	22.0	6.8	1.1	5.5	37.6	.23	.70	5.3	7.2	1.1	5.0
30/3	6.7	70	17.3	5.6	2.6	11.5	6.5	.40	.32	8.4	5.6	21.6	20.5
28/4	6.9	63	23.0	5.4	2.9	6.4	94.0	.44	.12	4.3	6.4	11.2	5.1
25/5	6.6	62	21.0	5.3	1.7	6.6	63.5	.47	.06	3.8	5.9	27.5	2.4
30/6	6.9	60	23.8	6.3	2.0	6.9	81.3	.78	.55	4.5	6.4	25.6	1.6
31/7	6.9	62	23.1	6.6	1.7	7.2	71.5	.44	1.00	4.5	7.2	2.4	2.9
22/8	6.9	63	22.9	6.4	2.2	6.0	29.3	.44	.47	3.1	15.0	61.7	2.5
30/9	6.8	65	26.5	6.5	2.7	6.1	55.3	.57	.67	0.8	8.0	4.2	8.3
2/11	6.8	62	25.1	6.4	1.6	6.1	55.3	.50	1.50	0.0	8.8	3.4	2.0
6/12	6.7	70	22.0	6.7	0.6	4.8	32.5	.78	.63	4.8	7.0	38.1	2.0
30/1	6.9	55	24.8	6.7	1.9	6.4	32.5	.68	.07	4.3	8.8	9.3	3.7
3/3	6.6	63	20.5	5.6	3.2	5.0	26.0	.47	.80	0.3	5.1	13.9	2.0
$\bar{x}$	6.8	62.6	22.6	6.2	1.9	6.5	49.5	.50	.60	4.2	7.6	17.1	5.3
S.D	0.1	4.1	2.3	0.6	0.8	1.6	24.8	.20	.40	3.0	2.4	17.0	5.5
% C.V	1.5	6.5	10.2	9.7	42.1	24.6	50.1	40.0	66.7	71.4	31.6	99.4	103.8

* units of $\mu S.cm^{-1}$

a = $mg.l^{-1}$; b = $\mu g.l^{-1}$; DOM = dissolved organic matter, matière organique dissoute; x = mean, moyenne; SD = standard deviation, écart-type; CV = coefficient of variation %, coefficient de variation.

(1964). The quartz-schists consist of muscovite and quartz while the fine grained gneisses and schists consist of biotite, plagioclase and quartz. The granite gneisses are variously migmatised rocks consisting mainly of hornblende, plagioclase, quartz and biotite. Amphibolites and basic schists also consist of hornblende, quartz, biotite and plagioclase but with a higher content of the more basic minerals. The saprolites in the basins are generally shallow (< 12 m) but have differing textures depending on the nature of the bedrock on which they have developed. Those on the quartzitic rocks are shallowest (< 2 m) and coarsest while those on the granite gneisses are deeper (3-5 m) and finer grained. Those on the fine grained gneisses and schists, and amphibolites and basic schists are the deepest (up to 12 m) and most clayey (SMYTH and MONTGOMERY, 1962).

The relief in the basins also correspond closely with the geology. The highly resistant though heavily fissured quartzites give rise to hog-backed ridges while the other rock types are associated with gentler relief but with inselbergs of various dimensions developed on the granite gneisses. The fine grained gneisses and schists give rise to a broad vale in which River Owena flows in some part of its course. The land use in the basins consists of a pattern of patches of small farmlands planted to a variety of tree and field crops separated by forest or fallow land.

The tributaries of River Owena and Ohoo have their sources and flow mostly on the quartzitic rocks. Orunro flows almost wholly on granite gneisses. Around the bridge points where sampling was carried out, the river channels were about 10 m wide. Owena has a rocky channel with perennial and turbulent flow, and generally clear water except during and immediately after rains. The other two rivers Ohoo and Orunro have muddy channels with Ohoo having a large amount of fallen bamboo stems and leaves. This river had murky water at the beginning of the year but which became clearer with the rains. Orunro's water had a brownish tinge at the beginning of the year and contained some algae.

METHODS

Water samples were taken in the morning (c 10.00 hrs.) at the bridge points almost monthly over fifteen months, from January 1980 to March 1981 (see table 2). The waters were analyzed for pH, conductivity, alkalinity, dissolved oxygen, carbon dioxide, silica (SiO_2-Si), phosphate (PO_4-P) nitrate (NO_3-N), iron, chloride, calcium, magnesium, and dissolved organic matter. pH and conductivity were determined on the field using portable meters. The other analyses were carried out in the laboratory shortly after sampling. Total alkalinity and dissol-

TABLE III

Water quality of River Ohoo (for abbreviations see tab. II)

Composition de l'eau de la rivière Ohoo (pour les abréviations, voir le tableau II)

Date	pH	Cond.*	Alka.[a]	O_2[a]	CO_2[a]	SiO_3-Si[a]	PO_4-P[b]	NO_3-N[a]	Fe[a]	Cl^-[a]	Ca^{2+}[a]	Mg^{2+}[a]	DOM[a]
31/1	8.0	275	145.0	6.4	1.2	11.6	49.4	.16	.33	7.7	28.5	16.2	0.5
25/2	7.5	275	160.0	1.5	23.8	11.1	47.0	.23	.17	4.3	37.6	22.4	7.5
30/3	7.0	210	67.0	5.1	4.3	12.2	55.3	.26	.17	5.1	22.4	13.4	33.8
28/4	7.3	220	109.5	7.1	3.7	13.4	115.2	.33	.05	3.3	26.4	17.8	5.6
25/5	7.1	140	76.2	5.1	2.5	8.6	61.1	.44	.07	3.3	18.9	17.1	11.0
30/6	7.3	170	90.2	6.0	2.5	6.0	81.3	.44	.50	4.0	24.5	23.5	1.0
31/7	7.3	225	91.4	6.2	2.4	12.7	48.8	.37	.50	1.9	27.6	27.2	3.4
22/8	7.3	228	117.0	6.2	1.8	10.8	29.3	.00	.75	2.7	29.8	29.4	1.0
30/9	7.2	190	126.0	5.8	2.6	10.2	65.0	.37	.33	1.1	31.2	16.6	7.0
2/11	7.0	170	93.0	7.1	8.6	10.2	35.8	.33	1.17	3.0	32.8	11.2	0.9
6/12	7.2	230	134.5	5.8	3.6	10.9	42.3	.57	.31	5.8	34.4	28.8	2.0
30/1	7.1	225	143.2	3.7	9.2	10.6	32.0	.71	.08	11.8	37.6	16.8	5.6
3/3	6.9	145	68.5	4.3	4.8	8.2	97.5	.54	.85	2.1	17.6	49.0	3.2
$\bar{x}$	7.2	208	109.3	5.4	5.5	10.5	58.5	.40	.40	4.3	28.4	22.3	6.3
S.D	0.3	43.2	29.7	1.5	6.0	2.0	25.8	.20	.30	2.9	6.2	9.5	8.8
% C.V	4.2	20.8	27.2	27.8	109.1	19.0	44.1	50.0	75.0	67.4	21.8	42.6	139.7

ved oxygen were determined titrimetrically using HCl (A.P.H.A., 1980) and the azide modification of the Winkler's — iodometric method (A.P.H.A., 1980) respectively. Free carbon dioxide and chloride were also determined titrimetrically using NaOH, and A_gNO_3 — argentometric method, respectively (A.P.H.A., 1980). Silica, phosphate, nitrate, and iron were determined using colorimetry while calcium and magnesium were determined using the A.A.S. Dissolved organic matter was determined titrimetrically after acid ($K_2Cr_2O_7$) mineralization, (GOLTERMAN *et al.*, 1978).

Arithmetic mean, standard deviation and coefficient of variation of each water quality parameter were computed while analysis of variance was used to test for the existence of significant ($\alpha = 0.05$) differences among the rivers in their water quality parameters.

RESULTS

Tables 2 to 4 and figs. 2 and 3 show the patterns of the water quality parameters of the three rivers

TABLE IV

Water quality of River Orunro (for abbreviations see tab. II)

Composition de l'eau de la rivière Orunro (pour les abréviations voir le tableau II)

Date	pH	Cond.*	Alka.[a]	O_2[a]	CO_2[a]	SiO_3-Si[a]	PO_4-P[b]	NO_3-N[a]	Fe[a]	Cl^-[a]	Ca^{2+}[a]	Mg^{2+}[a]	DOM[a]
31/1	6.8	320	140.0	6.9	4.0	11.0	94.0	.26	.02	21.0	32.3	12.6	0.9
25/2	7.6	420	270.0	9.8	0.0	8.3	216.2	.33	1.44	25.7	50.4	18.4	0.1
30/3	6.9	500	126.0	7.6	11.6	22.0	42.3	.44	.67	43.5	43.8	18.1	15.9
28/4	6.9	280	141.0	7.9	7.6	13.4	94.0	.40	.00	25.0	36.8	26.4	5.5
25/5	6.6	280	128.2	0.7	2.8	14.0	28.2	.43	.00	24.6	44.0	8.2	3.7
30/6	6.9	148	51.8	3.0	4.1	12.3	133.3	.75	.78	11.0	16.3	14.1	1.0
31/7	7.1	175	82.5	6.0	3.5	10.1	175.8	.54	.00	6.4	12.8	16.8	2.6
22/8	7.1	175	74.5	5.6	2.4	11.5	110.5	.54	1.00	9.0	14.4	40.3	6.0
30/9	7.1	140	68.0	6.6	3.8	10.7	130.0	.44	1.05	0.7	12.0	10.4	5.2
2/11	7.1	125	60.5	7.0	3.3	11.3	136.5	.19	1.64	0.0	17.6	5.4	1.7
6/12	6.9	185	90.0	3.5	9.0	11.6	347.8	.54	.50	10.3	21.8	30.2	3.2
30/1	7.1	280	151.0	4.8	6.7	15.1	45.5	.61	.05	14.8	40.0	20.8	33.5
3/3	6.6	325	142.0	10.9	17.1	6.0	357.5	1.02	1.94	25.0	5.6	109.1	15.0
$\bar{x}$	7.0	258	117.4	6.9	5.8	12.1	147.0	.50	.70	16.7	26.8	25.4	7.3
S.D	0.3	114.5	57.8	4.3	4.6	3.8	105.3	.21	.68	12.2	14.4	25.8	9.3
% C.V	4.3	44.4	49.2	62.3	79.3	31.4	71.6	42.0	97.1	73.1	53.9	101.2	127.4

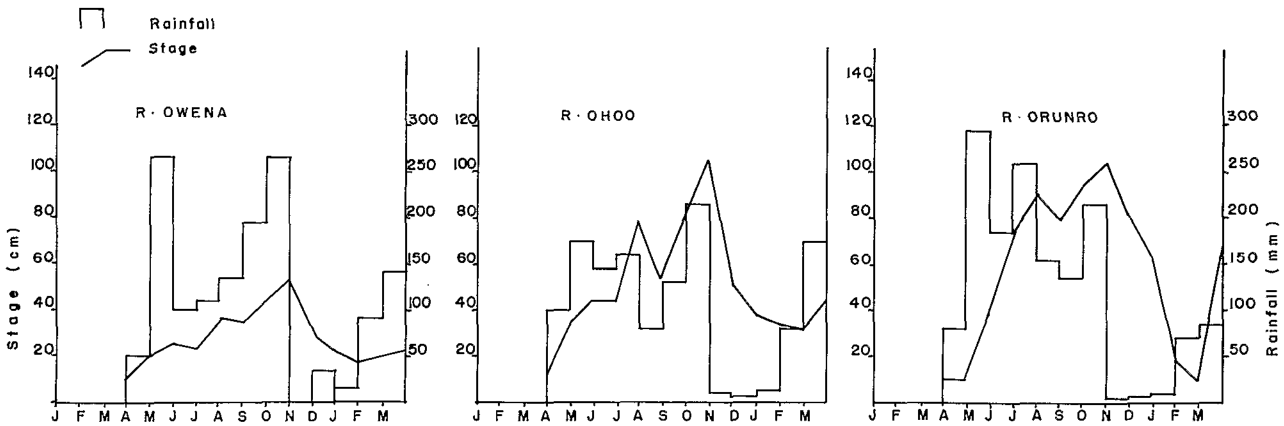

FIG. 2. — Rainfall and stage patterns for the three rivers (1980-81).
Variations saisonnières des précipitations et du niveau de l'eau dans les trois rivières (1980-81).

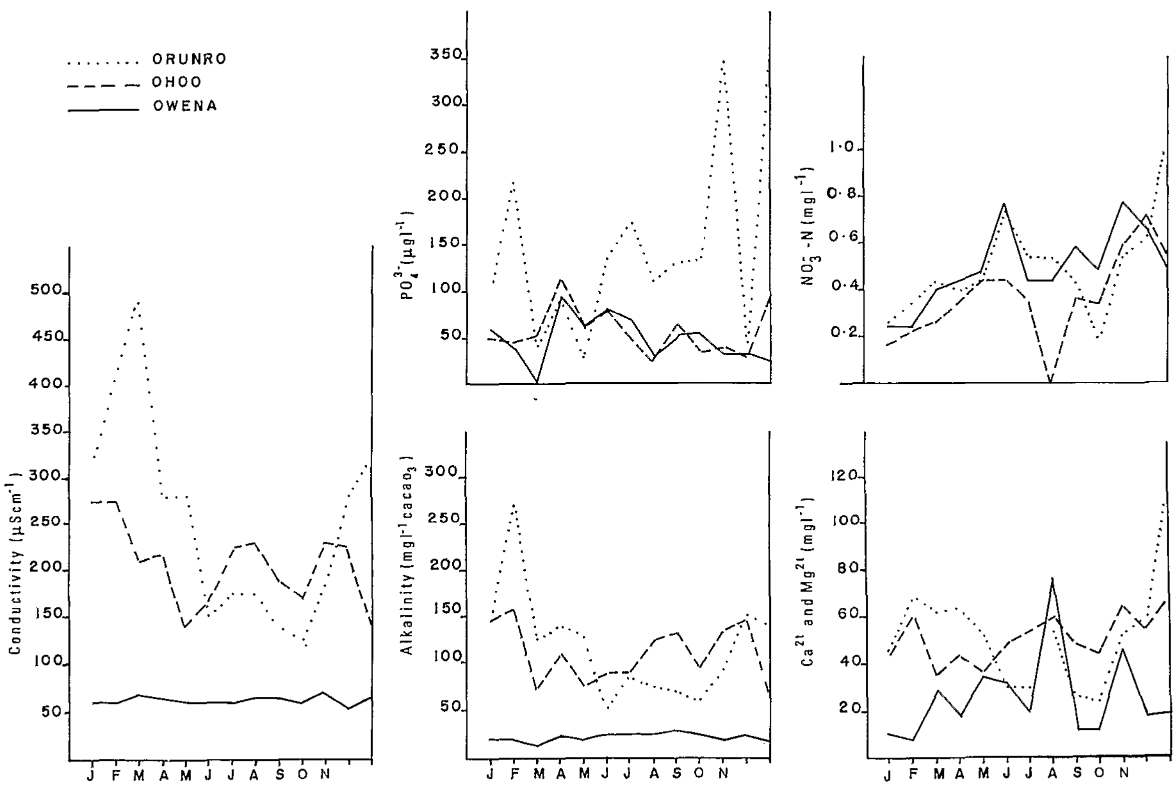

FIG. 3. — Patterns of some water quality indicators in the rivers Owena, Ohoo and Orunro.
Variations saisonnières de quelques indicateurs de la qualité de l'eau des rivières Owena, Ohoo et Orunro.

during the study period. They show that there was some seasonality in the water quality of the rivers. For instance, conductivity ($\mu S.cm^{-1}$, 25 °C) appeared to be lower and less variable during the rainy than in the dry season. This was also observed in the pattern of pH, alkalinity and free carbon dioxide.

pH values ranged from an average of 6.8 in Owena to 7.2 in Ohoo, with the lowest individual value being 6.6 in Owena, and the highest, 8.0 in Ohoo. The highest values were recorded for the three rivers early in the year, between January and May. This was the period of low water flow. Between July and December, pH was virtually constant, but lower than in the preceding period.

Conductivity ranged from an average of 62.6 $\mu S.cm^{-1}$ (25 °C) for Owena through 207.9 in Ohoo to 257.9 $\mu S.cm^{-1}$ in Orunro. Monthly variation was least in Owena and with conductivity being almost constant between April and November, ranging from 60 to 65 $\mu S.cm^{-1}$. Variability was greatest in Orunro with values ranging from 125 $\mu S.cm^{-1}$ to 500 $\mu S.cm^{-1}$. The conductivity peaks and minimum in the three rivers tended to occur simultaneously. The highest values were recorded in February-March 1980 and December-February 1981, i.e. in the dry season, while the lowest values were recorded in May-June in Ohoo and Orunro.

Total alkalinity was very low and fairly constant in Owena (range 17-27 $mg.l^{-1}$ expressed as $CaCO_3$) when compared to those of the other rivers (Ohoo, 69 — 160; $\bar{x} = 109.3$ $mg.l^{-1}$ $CaCO_3$). Alkalinity and conductivity appear to have a similar pattern with peaks and lows coinciding.

Dissolved oxygen was constantly high in Owena (5.3 $mg.l^{-1}$ to 6.8 $mg.l^{-1}$) but varied more strongly in the other two rivers. The lowest values recorded were 1.5 $mg.l^{-1}$ and 0.7 $mg.l^{-1}$ for Ohoo and Orunro, respectively.

Free carbon dioxide was lowest in Owena ($\bar{x} = 1.9$ $mg.l^{-1}$) and much higher in Ohoo ($\bar{x} = 5.5$ $mg.l^{-1}$). Low values were recorded in all the rivers between May and September. Silica was also lowest in Owena ($\bar{x} = 6.5$ $mg.l^{-1}$) and highest in Orunro ($\bar{x} = 12.1$ $mg.l^{-1}$).

PO_4-P values of Owena and Ohoo were similar and showed a decreasing trend from a maximum in April 1980 till January 1981. The peaks in Owena and Ohoo were recorded in April 1980 (94.0, 115.2 $\mu g.l^{-1}$, respectively), while it was recorded in March 1981 in Orunro (375.5 $\mu g.l^{-1}$).

NO_3-N showed an increasing trend in all the rivers from January 1980 to June 1980 after which there was a decline to minimum values in Owena and Ohoo in August and Orunro in November.

(Ca + Mg) was lowest in Owena ($\bar{x} = 24.7$ $mg.l^{-1}$) and highest in Orunro ($\bar{x} = 52.4$ $mg.l^{-1}$). It was least variable in Ohoo. The three rivers however appear to have a similar temporal distribution in the concentration of (Ca + Mg) with the peaks and minimum occurring simultaneously.

Dissolved organic matter was lowest in Owena (5.3 $mg.l^{-1}$) and highest in Orunro (7.3 $mg.l^{-1}$). Maximum values were recorded in the rivers in February, March and September, 1980, and January, 1981.

Although concentrations of Na^+ and K^+ were not determined, and thus, a more complete electrostatically balanced solution could not be made, the low value of alkalinity and relatively high Cl^- in Owena compared to those in the other two rivers may suggest that Owena exhibits a "rain dominated" water chemistry while the other two rivers exhibit "rock dominated" water chemistry (see GIBBS, 1970). This appears to follow the observations of Ogunkoya (1986) where it was shown that rivers draining quartzites have rain dominated chemistry. This was ascribed partly to the short residence time of water in the rocks and soils due to high soil and rock permeability.

Analysis of variance (ANOVA) revealed that there are significant ($\alpha = 0.05$) differences among the three rivers in their pH, conductivity, alkalinity and concentration of silica, PO_4-P, Cl^-, and (Ca + Mg) over the fifteen months. There were no significant differences in concentration of O_2, CO_2, NO_3-N, Fe and dissolved organic matter. Further, it showed that Rivers Owena and Ohoo had significant similarities in their conductivity, alkalinity and silica, while Ohoo and Orunro had similar concentration of PO_4-P and Cl^-.

The results thus show that there are significant differences among the three rivers. River Owena which drains a basin with the largest percentage area underlain by quartzites had the lowest pH, conductivity, alkalinity, and concentrations of some ions. Orunro, which drains the basin with the lowest areal coverage of quartzites had the highest levels of ionic concentrations.

DISCUSSION

The pH of the three rivers ranged from neutral to slightly alkaline as is the case with reported Nigerian rivers (cf. HOLDEN and GREEN, 1960; EGBORGE, 1971; IMEVBORE, 1971; GROVE, 1972; ADEBISI, 1981). They are however much higher than those reported by WRIGHT (1982, 1985) for R. Jong and its tributaries in Sierra Leone (pH = 5.0 — 6.5) and WELCOMME (1985) for forest rivers (4.0 — 6.5). The pH of River Owena may reflect the absence of basic minerals in the quartzitic rocks which the river drains and which provides most of its base flows (cf. Ogunkoya, 1986). It may also reflect a rain dominant water quality. In general, the pH values of the three rivers appear to reflect basin geology with the river draining the largest area of quartzites being neutral and those predominantly draining rocks with basic constituents (e.g. migmatites, amphibolites, basic schists) being more alkaline. The geological influence may also explain the observed pattern of total alkalinity and Ca + Mg among the rivers.

The conductivity of two of the rivers, Ohoo and Orunro appear to be high when compared with most of those reported for rivers in West Africa, and specially for other humid tropical areas (Gibbs, 1967; Holden and Green, 1960; Egborge, 1971; Grove, 1972; Adebisi, 1981; Iltis and Lévêque, 1982; Wright, 1982, 1985). For instance, Gibbs (1967) reported values of between 7 and 11 $\mu S.cm^{-1}$ for the Amazon river system while values reported for Nigerian rivers (draining mostly savanna areas) range from 31 to 131 $\mu S.cm^{-1}$ (Holden and Green, 1960; Egborge, 1971; Adebisi, 1981). Gibbs ascribed the reported low values to low rate of supply consequent upon excessive leaching of the soils and rocks and the diluting high precipitation. The conductivities of the three rivers appear to reflect the mineralogy, weathering susceptibility and solubility of the rocks underlying the basins drained by the rivers. This influence of basin geology on water quality, particularly ionic concentration, has been reported for both the humid tropical and other environments (Hack, 1960; Miller, 1961; Douglas, 1968; Walling and Webb, 1975). Miller (1961) observed that the ratio of the ionic concentration of waters draining quartzites to those draining granites is 1:2.5. The results obtained in this study show a higher ratio of 1:4 (cf. conductivity, alkalinity).

The temporal pattern of conductivity in the rivers appears to reflect the dilution effects of rainfall. Hence the decrease in conductivity from April to June and the increase during the "short dry season" of August when the main source of streamflow would be from ground water and throughflow/interflow. Conductivity again decreased from September to November after which it increased till the end of the dry season. Similar observations of seasonality were made by Egborge (1971) and Adebisi (1981) in Oshun and Ogun rivers of southwestern Nigeria, respectively.

The temporal patterns of dissolved oxygen concentrations of the three rivers are similar to those reported for River Ogun ($4.9 - 7.6$ $mg.l^{-1}$) by Adebisi (1981). It is however difficult to determine the relative effects of physical (stream flow, turbulence), chemical and biotic factors (pollution by Ogotun settlement as indicated by NO_3-N values in Owena, algal growth and photosynthesis).

CONCLUSION

The water quality parameters of three rivers draining the Basement Complex of southwestern Nigeria have been presented. Among other parameters, pH of Rivers Owena, Ohoo and Orunro range from neutral to slightly alkaline ($\bar{x} = 6.8$, 7.2, 7.0, respectively) while average conductivity varies from 63 to 258 $\mu S.cm^{-1}$.

The chemistry of the waters appears to reflect basin geology, particularly rock chemistry and rock susceptibility to weathering. It also reflects the flow pattern of the rivers, whether sluggish or turbulent. Low conductivity, neutral pH and continuously high dissolved oxygen concentration occur in waters of basins substantially underlain by quartzites and associated rocks (River Owena and River Ohoo). Higher ionic concentrations, slightly alkaline waters and relatively low dissolved oxygen content characterize rivers draining granite gneisses, amphibolites and basic schists (River Orunro).

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