VECTOR COMPETENCE AND TRANSMISSION RATES OF ONCHOCERCIASIS IN KOKONA AND KARU LOCAL GOVERNMENT AREAS OF NASARAWA STATE NIGERIA

Supported by tetfund TERTIARY EDUCATION TRUST FUND

R. J. Ombugadu[1]*, B. M. Matur[2] and J. D. C. Tongjura
[1]Department of Zoology Nasarawa State University, PMB 1022, Keffi, Nigeria
[2]Department of Biological Sciences, University of Abuja, Gwagwalada, Nigeria
*Corresponding author: ruthombugadu@gmail.com

Received: August 30, 2017 **Accepted:** October 12, 2017

Abstract: A vectorial study was conducted at Kokona and Karu Local Government Areas of Nasarawa State to assess the vector competence and transmission rates of onchocerciasis in the two local government areas. Monthly black fly catching was carried out over a period of 12 months, January to December 2010. A total number of 278 blackflies were caught for the period of study at the two Local Government areas. Kokona LGA recorded 207 blackflies while Karu LGA recorded 71 blackflies. Morphological identification of blackflies was as forest or savannah types. Dissections of blackflies were carried out to determine parous rate; infection and infectivity rates. The result indicated a seasonal (wet season) biting activity with a peak in month of September at both LGAs. The savannah species dominant the flies caught 94(49.7%) were parous flies for Kokona LGA while 19(30.2%) parous flies dissected for Karu LGA. At Kokona LGA 49(25.9%) were infected with *Onchocerca volvulus* L_3 larvae, while Karu LGA recorded zero L_3 larvae. The maximum monthly biting rate (MBR) and monthly transmission potential (MTP) for Kokona LGA recorded 502^* in the month of September and 137.8^B, respectively. The annual biting rate (ABR) and annual biting potential (ATP) for Kokona LGA was 1582 and 417, respectively; while Karu LGA recorded 210 Maximum monthly biting rate (MBR) in month of September and Minimum monthly biting rate was noted in the month of May 07.8. The monthly transmission potential (MTP) recorded Zero, while annual biting rate (ABR) of 542 and annual tansmission potential (ATP) of Zero was recorded for Karu LGA. L_3/ 1000 parous flies for Kokona LGA and Karu LGA recorded 2923.6 and Zero respectively. The results were statistically analysed using analysis of variance (ANOVA) and separation of means to determine least significant difference (LSD). Transmission rates were significantly decreased in relation to study areas ($p<0.05$). The findings recorded low Onchocerciasis transmission in Kokona LGA and no transmission in Karu LGA in the year of study.

Keywords: Kokona, Karu, vector competence, Ochocerciasis

Introduction

Simulium damnosum species and Onchocerciasis have been known in Nigeria for over a century (Parsons, 1909; WHO, 1995). The disease is an occupational disease of rural farmers animal rearers, fishermen, hunters, wild fruits collectors as well as field scientist, peace corps volunteers whose daily work expose them to constant bite of blackflies (Crosskey 1956; Otubanjo and Mafe, 2002; Kenneth; *et al*., 2005). Several other reseachers have knowledge on the epidemiology of the disease in Nigeria (Nwokolo, 1950; Budden 1956; Gemade, 1998; Hopkins *et al.*, 2002). Miri (1998) reported the pioneering mectizan distribution project in Nigeria thereby leading to effective control of the disease today.

The study aimed at determining the relative abundance and transmission rates of blackflies at Kokona and Karu local government areas of Nasarawa State, Nigeria.

Materials and Method

Adult blackflies were caught using human bait at study areas, Kokona and Karu LGA in year 2010. Each location was sample monthly between 7am – 6pm (Walsh *et al.*, 1978). The adult blackflies were identified morphologically (Crosskey, 1973, Wilson *et al.*, 1993). Blackflies were dissected to determine parous and nulliparous as well as infection of flies. The head, thorax, and abdomen were cut with dissecting needle and the larvae where present was seen moving (Service, 1980). The calculation of biting rates and transmission potential were calculated by standard methods of Walsh *et al.* (1978).

Data analysis

Significance of difference of *Smulium damnosum*l relative abundance microfilaria parasites in the body of blackflies caught and transmission rates in relationship to the two study sites were evaluated by Analysis of Variance (ANOVA) using SPSS software version 20.

Results and Discussion

The transmission indices of black flies caught at Kokona in 2010 recorded number of days persons worked as 48 in 12 months. The total flies caught were 207. The Savannah blackflies caught at Kokona LGA were 187 (90.34%) while forest type was 20 (9.66%). The total number of flies dissected were 189 (91.3%), number of parous flies recorded were 94 (49.7%) while nulliparous flies recorded 95 (50.3%). Infected flies encountered with L_1L_2 Larvae were 45 (23.8%) while L_3 Larvae recorded 49 (25.9%). Monthly biting rates (MBR) were recorded as shown on (Table 1) with an annual biting rate (ABR) of 1582. The maximum monthly biting rate was recorded in the month of September 502.5 which indicated the peak biting period of black flies observed in 2010 at Kokona LGA while the minimum biting rate was in the month of May 15.5. Monthly transmission potential specified as seen on (table1); annual transmission potential (ATP) was 417. L_3/1000 parous flies were 2923.6.

Out of 71 (100%) black flies caught at Karu LGA year 2010, 63 (88.7%) were dissected as seen (Table 2). The number of total days persons worked for the 12 months was 48 and average daily caught of 1.4 while 19 (30.2%) were parous and nulliparous recorded 44 (69.8%) Infective Larvae (L_3 Larvae) of *Onchocerca volvulus* recorded zero also L_1 and L_2 Larvae recorded zero. Monthly biting rate (MBR) varied as seen (Table 2) with recorded annual biting rate (ABR) of 542. The maximum monthly biting rate was recorded in the month of September (210) which was the peak biting period observed for Karu LGA in 2010 while minimum monthly biting rate was noted in May (07.8). Monthly transmission potential (MTP) recorded zero, also annual transmission potential (ATP) was zero. L_3/1000 parous flies recorded zero since there were no L_3 Larvae seen in dissected black flies.

Table 1: Transmission indices of Blackflies caught at Kokona L.G.A, in 2010

Characteristics	Months												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Persons days worked	4	4	4	4	4	4	4	4	4	4	4	4	48
Total flies caught	0	0	0	0	02	05	36	58	67	20	16	03	207
Average daily caught	0	0	0	0	0.5	1.3	09	14.5	16.8	05	04	0.8	51.8
No(%) of flies dissected	0(0)	0(0)	0(0)	0(0)	02 (100)	05 (100)	30 (83.3)	51 (87.9)	62 (92.5)	20 (100)	16 (100)	03 (100)	189 (91.3)
No(%) of parous flies	0(0)	0(0)	0(0)	0(0)	0(0)	02 (40)	15 (50.0)	27 (52.0)	35 (56.5)	08 (40.0)	06 (37.5)	01 (33.3)	94 (49.7)
No(%)of Nulliparous flies	0(0)	0(0)	0(0)	0(0)	02(100)	03 (60.0)	15 (83.3)	24 (47.1)	27 (43.6)	12 (60.0)	10 (62.5)	02 (66.7)	95 (50.3)
Flies(%) infected with L_1 L_2	0(0)	0(0)	0(0)	0(0)	0(0)	01 (20.0)	06 (20.0)	10 (19.6)	18 (29.0)	05 (25.0)	04 (25.0)	01 (33.3)	45 (23.8)
Flies(%) infected with L_3	0(0)	0(0)	0(0)	0(0)	0(0)	01 (20.0)	09 (30.0)	17 (33.3)	17 (27.4)	03 (15.0)	02 (12.5)	0 (0)	49 (25.9)
Monthly Biting rate (MBR)	0	0	0	0	15.5*	37.5	279	449.5	502.5^{x}	155	120	23.3	1582^{A}
MonthlyTransmission potential (MTP)	0	0	0	0	0	7.5	83.7	149.8	137.8	23.3	15	0	417^{B}
No of infective larvae par 1000 parous flies(L_3/1000 pars)	0	0	0	0	0	500	600	629.6	485.7	375	333.3	0	2923.6

Minimum monthly biting rate=15.5*May Annual Transmission Potential (ATP) MBR=417^{B}; Maximum monthly biting rate=502.5^{x}(Sep); Annual Biting Rate (ABR) is Sum of MBR=1582^{A}

Table 2: Transmission indices of Blackflies caught at Karu LGA, in 2010

Characteristics	Months												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Persons days worked	4	4	4	4	4	4	4	4	4	4	4	4	48
Total flies caught	0	0	0	0	01	04	10	18	28	07	03	0	71
Average daily caught	0	0	0	0	0.3	01	2.5	4.5	07	1.8	0.8	0	1.4
No(%) of flies dissected	0 (0)	0 (0)	0 (0)	0 (0)	01 (100)	04 (100)	07 (70.0)	16 (88.9)	25 (89.3)	07 (100)	03 (100)	0 (0)	63 (88.7)
No(%) of parous flies	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	01 (25.0)	02 (28.6)	05 (31.3)	9 (36.0)	02 (28.6)	0 (0)	0 (0)	19 (30.2)
No(%)of Nulliparous flies	0 (0)	0 (0)	0 (0)	0 (0)	01 (100)	03 (75.0)	05 (71.4)	11 (68.8)	16 (64.0)	05 (75.0)	03 (100)	0	44 (69.8)
Flies(%) infected with L_1 L_2	0(00)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Flies(%) infected with L_3	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Monthly Biting rate(MBR)	0	0	0	0	07.8*	30	77.5	139.5	210^{x}	54.3	22.5	0	541.6^{A}
MonthlyTransmission potential (MTP)	0	0	0	0	0	0	0	0	0	0	0	0	0^{B}
No of infective larvae par 1000 parous flies(L_3/1000 pars)	0	0	0	0	0	0	0	0	0	0	0	0	0

Minimum biting rate = 07.8* Month May; ATP = 0^{B}; Maximum biting rate = 210^{x} Month Sep; ABR = 542^{A}

A total of 278 adult blackflies were caught during the period of study at Kokona and Karu LGA areas. Two types of blackflies were identified, the savannah type *Simulium damnosum* and the forest type *Simulium squamosum.* These findings are in consonance with the result of Hudu *et al.* (2013) recorded savannah types mainly in their work in Kaduna state. It is obvious that the savannah types of blackflies are predominantly found at the savannah regions while the few forest types might have migrated from forest region since the flies are notably strong fliers. There was a remarkable seasonal variation in the relative abundance of blackflies caught at the two study sites. An upsurge of flies caught during the raining season (May to September) than the dry season (October to April); This may be as a result of increase in volume of water in the streams, rivers, ponds, e.t.c during the rainy season hence increase in ecological habitats for blackflies abundance in study sites. This observation is in agreement with the reports of (Renz, 1987; Crooskey, 1990; Matur and Davou 2007; Tonjura *et al.*, 2014) that Simu0lidae are insects with worldwide distribution often in most rivers. It was further ascertained that the pick of biting activity of parous flies coincides with the hours of human activities out door. Activities notably observed were farming, cattle rearing, river banks soil collectors, fetching of water for domestic purposes, swimming, fishing, travellers on motorcycles and bicycles were seen at locations of study. There by predispose these vulnerable groups of people to the bites and nuisance of blackflies. The activities above increase human –vector contact (Opara *et al*., 2008) hence there is possibility of coming in contact with infected blackflies since these flies are strong fliers with capacity to fly long distances from 10 to 400 km. Infection rate of flies L_1, L_2, and L_3 were significantly decreased in relationship to the two study sites, as well as transmission potentials. From this study there may be slight transmission in Kokona LGA and no transmission in Karu LGA. Low transmission rates may indicate successful control of Onchocerciasis with ivermectin (Diawara *et al.*, 2009).

In conclusion, the control of blackflies should not be downplayed as long as these flies are available in communities.

References

Budden FH 1956. The epidemiology of Onchocerciasis in Northern Nigeria. *Transaction Royal Society Tropical Medicine and Hygiene*, 97: 41797.

Crosskey RW 1956. The distribution of *Simulium damnosum* Theobald in Northern Nigeria. *Transaction Royal Society of Tropical Medicine and hygiene.* 50: 379-392.

Crosskey RW 1973. *Simuliidae*. In: Smith KGV (Ed.) Insects and other arthropods of medical importance. Lodon, Brittish Museum (Natural History), pp. 109-153.

Crosskey RW 1990. The National History of Blackflies. London: British Museum of Natural History.

Diawara L, Traore MO, Badji A, Bissan Y, Doumbia K, Goita SF, Konate L, Mounkoro K, Sarr MD, Seck AF, Toé L, Tourée S & Remme JH F 2009. Feasibility of onchocerciasis elimination with ivermectin treatment in endemic foci in Africa: first evidence from studies in Mali and Senegal. PLOS *Neglected Tropical Diseases*, 3: e497.

Gemade EII 1998. Human onchocerciasis current assessment of the disease burden in Nigeria by rapic epidemiological mapping. *Annals of Tropical Medicine & Parsitology*, 92(1): 79-85.

Hopkins DR, Eigege A, Miri ES, Gontor I, Ogeh G, Umaru J, Gwonkudu S, Mathai W, Oyenekan OK, Korve K & Richards FC 2002. Lymphatic filariasis elimination and schistosomiasis control in combination with onchocerciasis control in Nigeria. *Am. J. Medical Hygeine*, 67: 785-789.

Matur BM & Davou B 2007. Comparative larvicidal property of leaf extract of *Chromolaena odorata* L. (composidae) and chloropyrifos (organo-phosphorus compound) on *Simulium* larvae. *Biomed. Envtal. Sci.*, 4: 313-316.

Miri ES 1998. Problems and perspectives of managing an onchocerciasis control programme: a case study from Plateau state, Nigeria. *Annals Tropical Medical Papasitology*, 1: 5121-5128.

Opara KN, Usip LP & Akpabio EE 2008. Transmission dynamics of *Simulium damnosum* in rural communities of Akwa-Ibom State, Nigeria. *J. Vector Borne Diseases*, 45: 225-230.

Otubanjo OA & Mafe MA 2002. Control of parasitic diseases of poverty: An overview of the Nigeria situation. *The Zoologist*, 1(1): 1-17.

Kenneth NO, Olakunle BF, Asuqo E & Daniel MNO 2005. Status of forest onchocercciasis in the lower cross River basin Nigeria; Entomologic profile after five years of ivemectin intervention. *Am. J. Medical Hygiene*, 73(2): 137-376.

Parsons AC 1909. Filar volvulus leukart, its distribution, structure and pathological effects. *Parasitological*, 1: 359-368.

Renz A, Fugisang A & Anderson J 1987. Studies on the dynamics of transmission of onchocerciasis in a Sudan-savannah area of North Cameroon. IV. The different exposure to *Simulium* bite and transmission of boys and girls and men and women, and the resulting manifestation of onchocerciasis. *Annals Tropical Medicine Parasitology*, 81(3): 253-262.

Service MW 1980. *A Guide to Medical Entomology.* 1st ed. The Macmillan press LTD. London and Basing Stoke, pp. 71 – 186.

Tongjura JDC, Ombugadu RJ, Amuga GA & Mafuyai HB 2014. Seasonal distribution of Simuliid larvae (Simullidae) in Nasarawa State, Nigeria. *J. Natural & Appl. Sci.*, 3(1): 84-95.

Walsh JF, Davis JB & Le Berre R 1978. Standardization of Criteria for assessing the effect of *Simulium* control in the Onchocerciasis control programme. *Transaction Royal Society Tropical Medicine Hygiene*, 72(6): 6 75-676.

WHO 1995. Onchocerciasis and its control. Report of a WHO Expert (for control) Committee on Onchocerciasis control. WHO *Technical Reports Series* No. 852: 1-104.

Wilson MD, Post RJ & Gomulski L 1993. Multivariate morphotaxonomy in the identification of adult females of *Simulium damnosum*Thesbald complex Onchocerciasis control programme area of West Africa. *Annals of Tropical Medcine & Parasitology*, 87:6.