

Prevalence of Bovine Onchocerciasis in Karu Nasarawa State of Nigeria

Ajobiwe H.F.^{1*}, Ajobiwe O.J.², Okwudiri M.E.¹, Ogundeji AA³, Umeji L⁴¹Biological Sciences Department Bingham University Karu, Nasarawa State of Nigeria²Microbiology Department National Hospital Abuja, Nigeria³United State Department of Defence, Walter Reed Program-Nigeria, US Embassy, Abuja, Nigeria⁴Defence Reference Laboratory, Asokoro, Abuja, NigeriaDOI: [10.36347/sjams.2020.v08i06.027](https://doi.org/10.36347/sjams.2020.v08i06.027)

| Received: 15.06.2020 | Accepted: 22.06.2020 | Published: 26.06.2020

*Corresponding author: Ajobiwe H.F

Abstract

Original Research Article

The aim of this research work was to investigate the prevalence of *Bovine Onchocerciasis* affecting cattle in Karu F.C.T Abuja between March, 2017, and August, 2017. The method adopted in the study was a random survey carried out on the prevalence of Bovine onchocerciasis in Karu FCT area of Nigeria. A total of 300 cattle were sampled for species of *Onchocerca* parasite. The animals were of four major breeds, namely; Garawa, Bunaje, White Fulani and Abora. Three species Bovine onchocerciasis encountered during this study were *Onchocerca gutturosa*, *Onchocerca duckei*, and *Onchocerca gibsoni*. The result showed that, of this number, 146 (48.66%) were infected with the various species of *Onchocerca* namely; *Onchocerca gutturosa* 92(63.0%), *Onchocerca duckei* 51(34.93%), and *Onchocerca gibsoni* 3 (2.05%). Prevalence of Bovine onchocerciasis were higher in animal aged (5- 6years) followed by those between (3-4 years) and lastly those age 7 years and above. Calculated Chi Square, χ^2 was higher than tabulated χ^2 hence the prevalence of infection of the various breeds of the cattle by onchocerca species was significant ($P < 0.05$). In conclusion, the prevalence of *Onchocerca* species infection in various breeds of Cattle in Karu local government area of Nasarawa state of Nigeria was very significant ($P < 0.05$).

Keywords Bovine, Onchocerciasis, Filarial worms, *Simulium*.

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STUDY BACKGROUND

Onchocerciasis originated from Africa and was exported to the Americas by the slave trade. As part of the Columbian exchange that introduced other old world diseases such as yellow fever into the new world [1]. *Onchocerciasis* also known as river blindness is a disease caused by infection with the parasitic worm *Onchocerca volvulus* [2].

It is the second most common cause of blindness due to infection, after trachoma. The parasite worm is spread by the bite of a black fly of the *Simulium* type. Usually, many bites are required before infection occurs. These flies live near rivers, hence the name of the disease. Once inside a person, the worm creates larvae that make their way out of the skin. Here, they can infect the next black fly that bites the person. A vaccine against the disease does not exist. Therefore, prevention is by avoiding being bitten by flies. This may include the use of insect repellent and proper clothing. The life of the parasite can be traced through the black fly and the human hosts, with the following steps: A *Simulium* female black fly takes blood meal on infected human hosts, ingest microfilaria; The

microfilaria enters the gut and thoracic flight muscles of the black fly, progressing into the first larvae stage; The larvae mature into the second larvae stage and move to the proboscis and into the saliva in its third larvae stage; Maturation takes about seven days; The black fly takes another blood meal, passing the larvae into the next human host blood. Adult worms remain in subcutaneous nodules, limiting access to the host immune system, Microfilariae, in contrast are able to intense inflammatory responses, especially upon their death. Symptoms include severe itching, bumps under the skin, and blindness. *Onchocerciasis* is caused by *Onchocerca volvulus*, a parasitic worm that lives for up to 14 years in the human body. It is spread through the bite of a blackfly of the *Simulium damnosum* species complex, which breeds in fast-flowing rivers and streams. When the fly bites, it deposits the larvae of a parasitic worm, which matures to adulthood and produces millions of tiny worms, called microfilaria. Adults emerge after 8-12 days and live for up to four weeks, during which they can cover hundreds of kilometers in flight. Each adult female worm, thin but more than 0.5 meter in length, produces millions of microfilariae (microscopic larvae) that migrate throughout the body. After mating, the female blackfly

seeks a blood meal and may ingest microfilariae if the meal is taken from an animal infected with *Onchocerciasis*. Bovine *Onchocerciasis* (worm nodule disease) is the infestation by the filaria worm of *Onchocerca* species namely: *Onchocerca gibsoni*, *Onchocerca armilatta*, *Onchocerca gutturosa* which are common parasites of cattle in many temperate, tropical and subtropical regions, and has been recorded in Asia, Africa, Europe, North and South America as well as in Australia [3]. Microfilariae have been linked with condition of “periodic ophthalmia, however, most authors now agree that there’s no causal relationship hence is an unobtrusive parasite and is not regarded as a cause of ill-health in cattle handler [4].

The first description of Bovine *Onchocerca* (*Onchocerca gutturosa*) was given by Neumann [2] who studied the parasite in the necks of cattle from Algeria. Due to the guttural dilation of the body of the worm at the level of the naval ring, it was given the specific name *gutturosa*. Further study on the morphology of the parasite *Onchocerca gutturosa* in particular, was carried out by Eberhand [5] and also by Copeman [6] who studied specimens from Egypt, England and Puerto-Rico, by Steward [1] in England, by Cheema *et al.* [7] in Central America. In Rwanda relatively few observations have been made on the biology of the parasites, Steward [1] have studied the development of the infection stage in the intermediate host. *Bovine onchocerca* (*Onchocerca gibsoni*) causes unsightly trimming which result in rejection of beef carcasses from the high meat trade, hides damage may also be important. In cattle, *Onchocerca gibsoni* infect the subcutaneous tissues especially the brisket, *Onchocerca ochengi* causes a dermatitis resembling a demodex mange and pox. [8] *Onchocerca gutturosa* infect the *ligamentous nuchae* and *Onchocerca lienalis* is found in gastro splenic ligamentum [9], *Onchocerca armilatta* has been causing aortitis in cattle, Indian buffalo and goats. In Iran and India Cheema and Ivoghli [10]; Nelson, G.S. [1] stated that *Onchocerca gutturosa* and *Onchocerca armilatta* were common in Western Kenya as observed from cattle slaughtered from Nairobi. A high incidence of *Onchocerca gutturosa* and *Onchocerca gibsoni* was noted in British cattle with *Onchocerca gutturosa* being concentrated in the umbilical region, this being the area easily accessible by *Simulium ornatum*, which feeds preferentially on the mid-line area [13]. Various species of *Onchocerca* especially *Onchocerca gutturosa* in the *ligamentum nuchae*, gastro splenic ligament e.t.c can be detected only on postmortem examination, although nodules of other species may be palpated in the subcutaneous tissue. There are specific locations or predilection sites for the skin dwelling microfilariae species within the Bovine host, though not much studies has been conducted in this area, previous works has been limited to areas along the cervical spine, ears brachium and umbilicus [14]. Studies by, Ferenc, Courtney and Copeman [15] have shown that when the umbilical and

cervical harbor microfilariae, they are always present in highest concentration and the reason given was that microfilariae localize in the umbilical region regardless of the location of the adult worm so as to ensure transmission by *S. ornatum* [16]. It was also observed that microfilariae can be obtained from the umbilical cord, nuchal and neck region. This information is to a corresponding general theory of epidemiology of the disease, and thirty, to determine in detail the local conditions which favors or control the dissemination of this infection in the given area. In general, epidemiological evidence therefore consists of interrelated facts from which a conclusions or series of conclusions may be drawn. Epidemiological factors affecting the vector *Schistosoma ornatum* alighting and biting activities include wind; few flies come for blood-meal if there’s the slightest of breeze. [17] also noted that a wind speed of 5.m.p.h usually completely inhibited activity. It completely stops if precipitation consisting of more than a very slight shower occurred. In general the greatest activity appeared to take place in warm, calm days particularly if the humidity was high [17]. Kershaw *et al.* [18] observed that the strength of illumination of the surface of cattle by sunlight is a major factor in controlling the alighting activity of *Simulium ornatum*. That observed that the flies settled mainly on the ventral region of the animal rather than elsewhere but when sunlight reflected unto the umbilicus during period of heavy biting, this resulted in a rapid and marked decrease in the number of flies feeding, as feeding flies were not distributed but fresh flies did not start feeding until the mirror was removed. On one occasion light was reflected unto the umbilicus continually for twenty minutes, during which only few flies settled and fed on a part shaded by a fold on the skin but when the mirror was removed, flies began to arrive and feed on the umbilicus within a few seconds. Kershaw *et al* (2001) [18] showed in their study that the distribution of microfilariae of *Onchocerca* species in the cattle varied in different areas of the skin according to the site of the adult worm, when the worm is present only in the neck, microfilariae were found in the ear skin and near-by but when splenic worms are present many of the ear skin snip were negative. The distribution of microfilariae in the umbilical region of the skin has an effect on the transmission of *Onchocerca gutturosa* and the distribution of the adult worms of *Onchocerca gutturosa* and its larvae has been described [19]. Almost all the microfilariae migrate to the umbilicus and so have maximum opportunity of being ingested by the vector. Not only do the microfilariae concentrate on the umbilical skin, but majority are found at its Centre, where *Simulium ornatum* has the greatest opportunity of penetrating the hairs and taking a blood meal; a striking example of the adaptation of a parasite to the habit of its intermediate host [19]. For *Bovine Onchocerca* to be transmitted there must be a source of *Simulium ornatum* and or *cullicoide* species of fly whose breeding places are in the forest or savannah regions.

Along the courses of free flowing, shallow and well oxygenated rivers and streams with flint gravel bed in the case of *Simulium*, or in swampy areas along the banks of rivers, pools, in muds and sand soaked by sea water and around decaying trees and vegetation including rotten banana tree stumps in the case of *Culicoides*, thus if all these factors are eradicated epidemiology is affected. Factors affecting transmission includes the cattle-fly contact. The intensity of this contact depends mainly on: The density of the vector and the cattle population; The bionomics of the vector, its host preference, dispersal, migration and daily biting activity: these may all vary at different times of the year depending on the seasonal changes and climatic conditions [20]. Cattle factors such as location of cattle, daily or seasonal activities and migration in relation to breeding sites and movements of inter-mediate host are necessary. Factors influencing the intake and development of the parasite, the major factor being determine the proportion of vectors becoming infected with *Bovine Onchocerca* species as the prevalence and intensity of microfilariae in the cow population.

Treatment of *Bovine Onchocerciasis* in many developed countries has been possible by the use of DEC and ivermectin. A number of studies have been conducted by many researchers which are geared towards incorporating ivermectin into the primary health care of many countries. It is worthy to observe that results from these studies in the treatment of *Onchocerciasis* have been encouraging as ivermectin in most cases has compared favorably with DEC which is currently a reference drug. Ivermectin has also been reported to show a number of advantages over DEC with particular reference to adverse effects or reactions in *Onchocerciasis* victims. This may have control and epidemiological implications especially with regard to mass chemotherapy [19]. *Onchocerciasis* and its black fly vectors are rather wide-spread in Nigeria. In particular about 50, 000 people are known to suffer from the disease. Efforts have recently been directed to establishing various essential base line information on the prevalence of *Onchocerciasis* in various parts of plateau state [21, 22] as well as documenting the relative abundance and circadian activity of the black fly species that transmits the disease [23]. However, data on the aspect of Bovine Filariasis in part of Northern Nigeria is very scanty [24]. The various species of *Bovine Onchocerca* exhibit almost a similar pattern of reproduction which is cyclical in introduction into host cell, though length of cycle varies with temperature and may be prolonged several weeks beyond the approximate given time, the time of molting and rates of development correspondingly vary. *Onchocerca gibsoni* has been known to be harboured by midges, *Culicoides* species which serve as intermediate host. The life cycle of *Onchocerca gutturosa* resembles that of *Onchocerca cervicalis* in horse but rather than development to take place in *Culicoides*, it occurs in the

blackfly. Fly *Schistosoma ornatum* (intermediate host). *Onchocerca gutturosa* can also develop in *Schistosoma erythrocephallum* but not in *Culicoides*.

Attempts to get it develop in *Stomoxys calcitrans*. And species of the genus *Musca* failed. Further works of Steward [7] conducted near Cambridge in England on *Onchocerca gutturosa* showed that microfilaria ingested by *Simulium* develop into infective larva within three weeks. His observations on other cattle- biting flies and midges indicated that *Schistosoma ornatum* was probably the only vector in the area. Subsequently, Gnedina, [25] also described the parasite's development in the same stimuli species in Russia and Australia, but a research conducted in Kyusu, Southern Japan (1975-1977) on *Onchocerca* of cattle suggested that *Schistosoma ornatum* is also a vector of *Onchocerca gutturosa* in cattle.

METHOD

In the sample collection, biopsies of about 2mm in diameters were taken from the shaved sites (nuchal crest, umbilicus and neck) of fleshly slaughtered cattle for onward transmission to the laboratory for examination. The skin biopsies were each preserved in 5ml volume of physiological saline in universal bottles at the abattoir for gradual emergence of filarial parasites before proceeding to the laboratory. Prior to sample collection, the slaughtered animals are examined to determine the sex, breed and age. Age determination is carried out by counting the number of permanent incisors in the animal. Sterile, sharp surgical blades, needles and hand gloves were employed during the exercise, with adequate precaution to minimize accident. Wet mounted and incubated for three hours and thereafter:

A 5 ml sample were incubated for three hours and thereafter transferred into test tube and centrifuged at 3.00pm for 5 minutes. With the aid of clean pastures pipettes,

Deposits were transferred to clean slides, covered with cover slip and viewed for presence of microfilaria worms from the various biopsies. Isolates were studied for differentiation into species using unique characteristics features shown in the table below. Non-positive samples were subjected to further incubation with addition of 5mg of Streptomycin and procaine penicillin antibiotics overnight. This antibiotic addition will arrest invasion of the sample by bacteria. The re-incubated sample were all re-examined microscopically for assurance. Giemsa and Fields staining methods were adopted as described by Monica Cheesbrough [26].

HYPOTHESIS

H₀: The overall prevalence of infection of

Onchocerca species in various breeds of Cattle in Karu Nasarawa State of Nigeria is not significant during each month of study.

H_a: The overall prevalence of infection of *Onchocerca* of species in various breeds of Cattle in Karu Nasarawa State of Nigeria is significant during each month of study.

Pictures of *onchocerca* species as seen under x100 oil immersion objective



Fig-1: Picture of *Onchocerca gibsoni* stained with Methylene blue



Fig-2: Picture of *Onchocerca gutturosa* stained with Giemsa



Fig-3: Picture of *Onchocerca dukei* stained with 2% HCl in Methylene blue



Fig-4: A White Fulani breed showing the essential parts

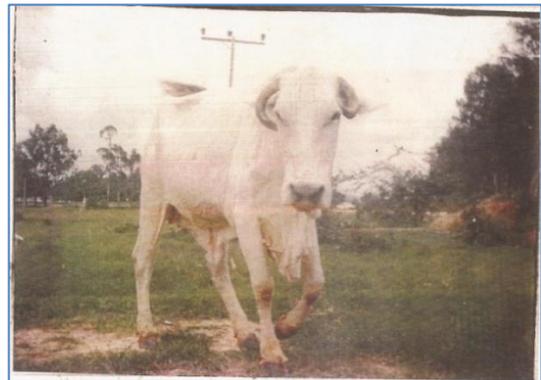


Fig- 5: The researcher collecting specimen from a white Fulani breed



Fig-6: The researcher collecting specimen from a white Fulani breed

RESULT

A total of 300 cattle were sample for species of *Onchocerca* parasite. The animals were of four major breeds, namely; Garawa, Bunaje, White Fulani and Abora. Three species of Bovine onchocerciasis encountered during this study were *Onchocerca gutturosa*, *Onchocerca duckei*, and *Onchocerca gibsoni*. The result showed that, of this number, 146 (48.66%) were infected with the various species of *Onchocerca* namely; *Onchocerca gutturosa* 92(63.0%), *Onchocerca duckei* 51(34.93%), and *Onchocerca gibsoni* 3 (2.05%). Prevalence of Bovine onchocerciasis were higher in animal aged (5- 6years) followed by those between (3-4 years) and lastly those age 7 years and above.

Breed- Related Infection

Table-1: Species of *Onchocerca* encountered during the study. n=300

Species	Number of cattle infected	% Infection
<i>Onchocerca gutturosa</i>	92	63.00
<i>Onchocerca duckei</i>	51	34.93
<i>Onchocerca gibsoni</i>	3	2.05
Total	146	48.67

Table-2: Chi Procedure Square (λ^2) to Show the Breed Related Prevalence of Infection

Breed of Cattle	Total number of Examined (O_1)	Number Infected (O_2)	Average (E)	Expected value
White Fulani	103	78	90.0	90.0
Abora	57	16	36.5	36.5
Bunaje	43	5	24.0	24.0
Gamawa	97	47	72.0	72.0
Total	300	146	223.0	223.0

$$\lambda^2 = \frac{(300-233)^2}{223} + \frac{(146-233)^2}{223} = 53.2$$

λ^2 calculated= 53.2

λ^2 Tabulated = 16.92 Calculated X^2 is greater than tabulated X^2 so there is significance between infection rate and breed of cattle at $P < 0.05$

Table-3: Overall prevalence of infection

Month	Number Examined	Number Infected	Percentage Infection
March	50	25	50.00
April	50	27	54.00
May	47	19	40.45
June	45	17	37.78
July	55	28	50.91
August	53	30	56.60
Total	300	146	48.66

A chi square (X^2) to show the infection rate relative to monthly period of the study

Month	Total number of Examined (O_1)	Number Infected (O_2)	Average (E)	Expected value
March	50	25	62.5	62.5
April	50	16	36.5	36.5
May	47	5	24.0	24.0
June	45	47	72.0	72.0
July	55	28	41.5	41.5
August	53	30	41.5	41.5
Total	300	146	273.0	273.0

$$\lambda^2 = \frac{(300-273)^2}{273} + \frac{(146-273)^2}{273} = 53.2$$

273 27

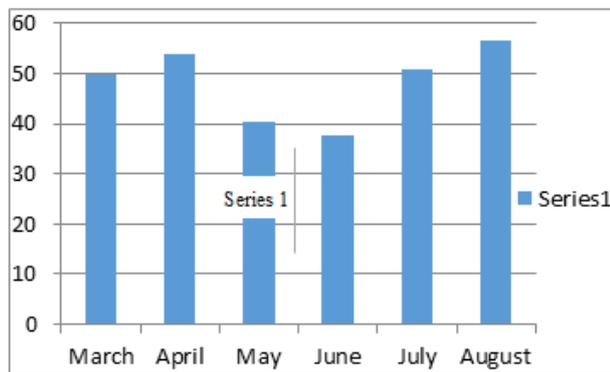
λ^2 calculated= 61.75

Degree of freedom df= (6-1) (4-1) (5) (3) =15

λ^2 Tabulated = 25.00

Calculated λ^2 is greater than tabulated λ^2 so we have no enough evidence to reject the alternate hypothesis;

H_a : The overall prevalence of infection of Onchocerca species in various breeds of Cattle in Karu Nasarawa State of Nigeria is significant during each month of study. Thus H_a , it is retained.



DISCUSSION

The present study shows that, three different skin dwelling microfilarial parasites viz: *Onchocerca gutturosa*, *Onchocerca duckei*, and *Onchocerca gibsoni* in Karu F.C.T Abuja.

However, all these species of *Onchocerca* have been reported in different parts of Nigeria and so no new parasite was encountered. Thus, the presence of this three species of filarial nematodes in this investigation supports the earlier observation by Anosike [27] and Edungbola [28] that bovine *Onchocerciasis* constitutes a major health problem in parts of Nigeria, particularly the Northern region.

Among the three techniques of staining employed for the study, the result of (1:5000 methylene blue in physiological saline) technique was quite outstanding and in fact the best it colored all rather attributed 1 structures especially the nuclei in varied shades of blue thus, assisting in differentiating individual especially morphologically. Therefore, this is an advantage over the other two techniques namely: Giemsa, 2% HCl in methylene blue and Fields. This is in agreement with the observation of shape, that microfilariae *Onchocerca* species, *Acanthocheilonema perstan* and *loa loa*, absorbs the above stain in that concentration while *Wuchereria bancrofti* microfilariae are particularly inert to the action of the stain. With respect to these results, it is evidence that *bovine onchocerciasis* is relatively high in the study area (Karu

FCT Abuja). This is attributed to continuous alteration of ecological sites for *Simulium* by yearly activities of farmers in bush burning, various activities which pollutes the stream. Furthermore, it is interesting to know that, the existence of *Bovine Onchocerca* infection in the study area is related to the peculiar ecological nature of the area which favors the breeding of different filarial vectors. Therefore, cattle infections with the observed filarial parasites in different breeds of cattle are an indication that their respective insect vectors are undoubtedly present. Hence, there is a local transmission.

Nevertheless, cases of imported *bovine Onchocerciasis* in this area may not be ruled out entirely since the cattle usually move from one area to another in search of food, especially during the dry season. Certain factors are belief to have affected this result in relation to the monthly prevalence and microfilaria density in the study area. Such factors are rainfall, temperature as well as the harsh cold weather experienced between March and August.

Calculated Chi Square, λ^2 was higher than tabulated λ^2 hence the prevalence of infection of the various breeds of the cattle by onchocerca species was significant ($P<0.05$).

The lowest infection rate Of 37.78% recorded within the month of June. The highest infection rate of 56.60% in August during the wet season is in agreement with observation of Sam-Wobo *et al.* [29], Townson *et al.* [21] both of whom attributed this relationship to the behavior *Simulium ornatum* and climatic condition. This aspect of the result also confirms the observations of Crosskey R.W [30], Sam-Wobo *et al.* [29], on the activity *Simulium ornatum* to a particular reference to its behaviors on grazing cattle, noted that rainfall, temperature and wind had effect on transmission of *Onchocerca. gutturosa*. High wind intensity completely inhibits feeding by *Simulium ornatum*. This was also evidenced in June, prior to the onset of the rainy season.

CONCLUSIONS

In conclusion, the prevalence of *Onchocerca* species infection in various breeds of Cattle in Karu local government area of Nasarawa state of Nigeria was very significant ($P<0.05$).

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