

## Cosmopolitan Nature of the Eggs of *Ascaris lumbricoïdes* Identified in Wells Water Destined for Domestic Usage in Sub-Urban Areas in the Center Region of Cameroon

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**Abstract:** In order to evaluate the cosmopolitan character of the eggs of *Ascaris lumbricoïdes* identified in the wells of four (04) sub-urban areas (Mbalmayo, Mbankomo, Okola and Soa) of the Central region of Cameroon, a study was conducted from September 2018 to March 2019. Sampling was carried out on 16 wells following a monthly sampling frequency. Eggs of *Ascaris lumbricoïdes* were identified using the formalin-ether concentration and the Kato-Katz identification methods. The result of the physico-chemical analysis shows that the water has an average temperature of 25.31°C and an acidic pH (6.7). Parasitological analysis shows the presence and predominance of the species *Ascaris lumbricoïdes* at any place and at any time in these waters. The highest parasitological densities were obtained during the rainy season. Statistical analysis shows that orthophosphates are significantly and positively correlated with the densities of the eggs of *Ascaris lumbricoïdes* ( $p \leq 0.01$ ). While nitrates, ammonia nitrogen, colour, turbidity and Dissolved Total Solids are significantly and positively correlated with the densities of the eggs of *Ascaris lumbricoïdes* ( $p \leq 0.05$ ). Water from these wells is therefore a source of contamination by Ascariasis.

**Keywords:** Cosmopolitan Nature, *Ascaris lumbricoïdes*, Eggs, Well Water

### I. Introduction

Intestinal parasitosis is a serious public health problem. These intestinal parasitosis are usually caused by intestinal helminths and protozoa. Among the helminths, *Ascaris lumbricoïdes* is the largest of the nematodes and the largest of the helminthiasis that affect humans (Khuroo, 1996). While overall health status and levels of health and hygiene have improved over the past centuries, at least in industrialized countries, 350,000 people are severely affected by *Ascaris*-like worms and 60,000 deaths per year are believed to be directly associated with this parasite (CDC, 2015). This parasitosis is predominant in developing countries, where heat, humidity and poor hygiene all contribute to its transmission (Ndiaye *et al.*, 2012). Ascariasis is endemic in sub-Saharan Africa, South-East Asia and Latin America. It affects about a quarter of the world's population Verhaeghe *et al.* (1989), with high prevalence in all the age groups in poor, sub-urban, and even tropical rural areas, reaching up to 80% of the population (Sun, 1980; Messou *et al.*, 1997; Ravaoalimalala *et al.*, 2002). In Bangladesh Aubry and Gaüzère (2018), for example, the prevalence is 80%. Fertilized females of *Ascaris lumbricoïdes* lay eggs that are disposed of in the external environment. These eggs

may accidentally end up in aquatic environments. As a result, water can act as a vector for potentially dangerous parasites such as. The present study aims at assessing the cosmopolitan character of the eggs of *Ascaris* identified in well water in relation to abiotic factors in four sub-urban areas of the Central region Cameroon (Mbalmayo, Mbankomo, Okola and Soa). More specifically: to measure the main physico-chemical variables of these waters, to identify the eggs of *Ascaris lumbricoïdes* in these waters and to evaluate the influence of abiotic variables on the distribution of the eggs of *Ascaris lumbricoïdes* in these wells water.

### II. Material and Method

#### II.1. Study area

The study took place in the cities of Mbalmayo, Mbankomo, Okola and Soa (Central Region of Cameroon). Mbalmayo, capital of Nyong and So'o Department, is located 48 km South of the capital Yaounde, Central Cameroon Region between 3°31' North latitude and 11°30' East longitude. With an area of about 650 km<sup>2</sup>. The municipality of Mbankomo is located in the Central Region, in the department of Mefou and Akono, 25 km southwest of Yaounde and extends between 3°47' North latitude

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and 11°24' East longitude (CPDD, 2011). The Okola district is a municipality of Cameroon located in the Central region and the department of Lekie, 25 km from Yaoundé, on the Nkolbisson-Monatelé axis. It lies between 3° 01' North latitude and 11°23' East longitude (BUCREP, 2005). Soa is a municipality of Cameroon located in the Central region and the Mefou and Afamba department, 14 km northeast of Yaoundé. It lies between 3°58' North latitude and 11°35' East longitude. These cities are characterized by a four-season Guinean climate comprising: a long dry season (LDS) from mid-November to mid-

March, a short rainy season (SRS) from mid-March to the end of May, a short dry season (SDS) from June to August, and a long rainy season (LRS) from September to mid-November with an average annual rainfall of 1564.7 mm (Foahom, 1983; Abossolo, 2015). The soils are predominantly ferralitic and hydromorphic (Onguene Mala, 1993). Ferralitic soils are formed on moderately or strongly denatured acidic rocks. They have good physical properties. They are deep soils with good permeability. Hydromorphic soils are found in swampy areas and along riverbanks.

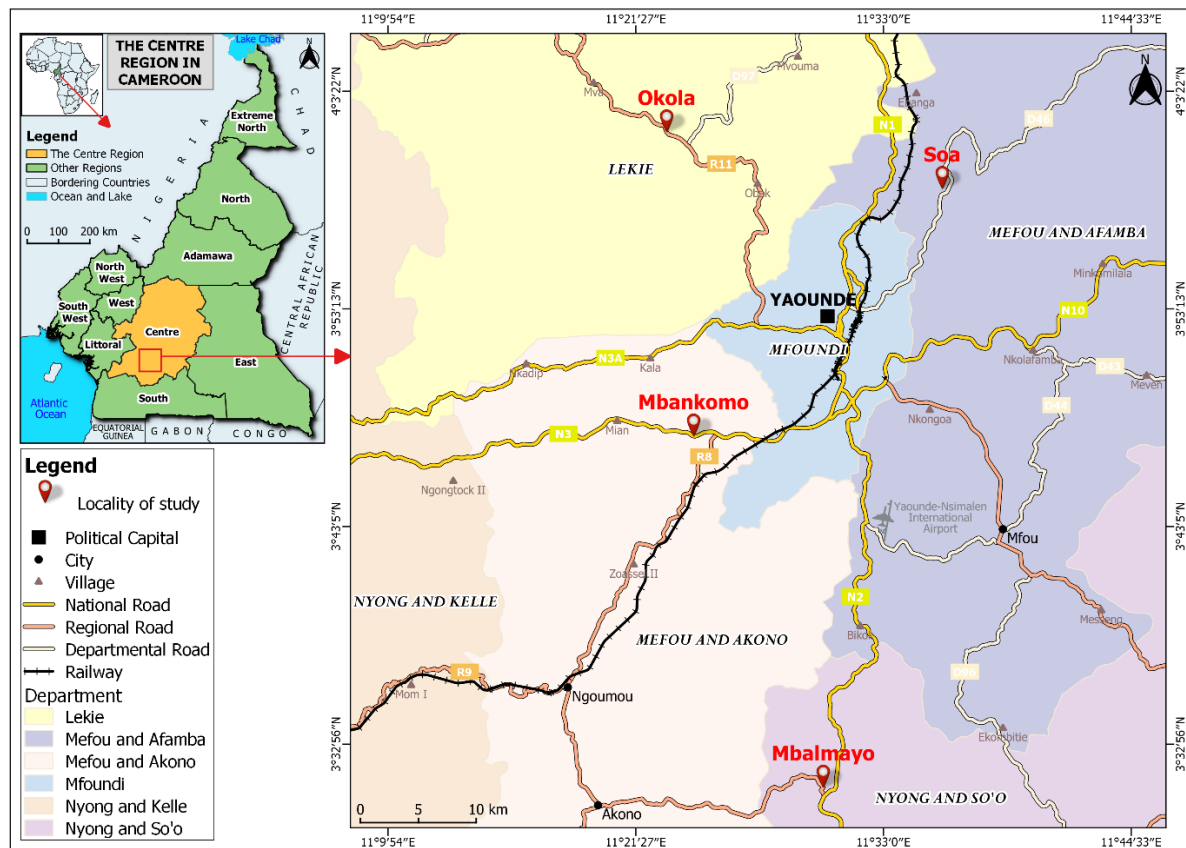


Figure 1: Location of study areas (Source: INC, 2019 modified)

## II.2. Selection of sampling points

Sixteen wells were retained (designated as MW1, MW2, MW3, MW4 in Mbal Mayo locality; BW1, BW2, BW3, BW4 in Mbankomo locality; OW1, OW2, OW3, OW4 in Okola locality and SW1, SW2, SW3, SW4 in Soa locality. These water points have been chosen in different districts according to criteria

such as: the great interest that the population shows for these water points, accessibility, level of urbanization. Nowadays, well water is increasingly used by the population to meet their domestic needs, dental hygiene, drinking, cooking and bathing, among others.

Table 1: Characteristics of sampling points

Study localities	Wells	Contact details Geographic	Altitudes (m)	Types of pollution in the vicinity of the water point	Use
Mbalmayo	MW1	03°31'22.98"N 011°30'43.12"E	646	Presence of the toilets	Domestic needs/food
	MW2	03°31'23.77"N 011°30'40.84"E	660	Domestic effluent	Domestic needs/food
	MW3	03°31'28.13"N 011°30'40.84"E	647	Latrine effluent + animal dung	Domestic needs/Food/crop watering
	MW4	03°31'32.54"N 011°30'54.54"E	648	Presence of the toilets	Domestic needs/food
Mbankomo	BW1	03°47'34.6"N 011°24'21.4"E	757	Presence of cannon toilets and domestic pollution	Domestic needs/food
	BW2	03°47'25.0"N 011°24'22.6"E	718	Latrine effluent + animal dung	Domestic needs/food
	BW3	03°47'21.9"N 011°24'19.4"E	742	Domestic effluent	Domestic needs/food
	BW4	03°47'21.2"N 011°24'19.7"E	740	Domestic effluent + Flooding	Domestic needs/food
Okola	OW1	04°01'26.9"N 011°22'47.0"E	619	Domestic effluents	Beverage / Domestic needs/food
	OW2	04°01'25.8"N 011°22'44.6"E	603	Presence of the toilets + domestic effluent	Domestic needs/food
	OW3	04°01'23.0"N 011°22'45.3"E	602	Presence of cannon toilets and domestic pollution	Domestic needs/food
	OW4	04°01'24.5"N 011°22'45.9"E	618	Presence of the toilets	Domestic needs/food/dental hygiene
Soa	SW1	03°58'28.11"N 011°35'43.14"E	661	Domestic effluent	Domestic needs/food
	SW2	03°59'7.14"N 011°35'34.71"E	660	Domestic effluent	Domestic needs/food/crop watering
	SW3	03°59'4.19"N 011°35'31.61"E	671	Domestic effluent	Domestic needs/food
	SW4	03°58'29.98"N 011°35'17.58"E	644	Presence of the toilets	Domestic needs/food/crop watering

### II.3. Sampling method

Monthly sampling was conducted in these wells from September 2018 to March 2019 following the recommendations of Rodier *et al.* (2009). Water samples for physico-chemical analysis were collected in 250 and 1000 mL double-capped polyethylene bottles and transported to the laboratory in a refrigerated.

For the identification of eggs of *Ascaris lumbricoïdes*, water samples were taken from wells at locations characterized by an accumulation of organic matter or the presence of the herbarium. The water samples collected were immediately placed in 1000 mL sterile polyethylene bottles and preserved by the addition of 2 mL of 10% formalin and returned to the laboratory in a cooler.

### II.3. Physico-chemical analysis

In the field, the physico-chemical parameters such as water temperature (°C), dissolved oxygen (mg/L O<sub>2</sub>), pH, Total Dissolved Solids (TDS) (mg/L) are measured respectively using a thermometer, an oximeter, a pH meter and a multiparameter of the brand HANNA HI 9829. Turbidity (FTU), Suspended Solids (SS) (mg/L), Nitrates (NO<sub>3</sub><sup>-</sup>) (mg/L), Orthophosphates (PO<sub>4</sub><sup>3-</sup>) (mg/L) and colour (Pt.Co) were measured in the laboratory using a HACH DR/3900 spectrophotometer. Oxidability (mg/L of

KMnO<sub>4</sub>) was measured by volume.

### II.4. Parasitological analysis

The samples were left to stand at room temperature for 24 hours to settle. The supernatant was poured and the remaining pellet was measured. The concentration of helminths eggs was then determined using Kato-Katz and formalin-ether techniques, followed by observation under the Olympus CK2 inverted microscope at 40X magnification.

#### II.4.1. Kato-Katz technique

A pellet fragment resulting from centrifugation at 500 rpm for 5 minutes was removed and deposited in the center of a slide. The slide was covered with a rectangle of glycerol-soaked cellophane paper and the pellet was spread between the slide and the cellophane in a smear using a test tube. The preparation thus obtained was directly observed under an optical microscope for the identification of the eggs of *Ascaris lumbricoïdes*.

#### II.4.2. Formol-ether concentration technique

After homogenization of the pellet, 5 mL were collected with a graduated syringe and introduced into a 10 mL test tube. To this, 2 mL formalin and 3 mL ether were successively added. The resulting mixture was centrifuged at 500 rpm for 5 minutes

using a MEDIFRIGER centrifuge (the contents of the tube were separated into 4 layers: a top layer of ether, a cap of fatty debris, a layer of formalin and the pellet). With the help of a wand, the fatty debris plug was peeled off and the top three layers were discarded at once. Then 2 or 3 drops of staining solution were added (lugol or cresyl violet) and one drop of suspension was transferred to a slide for examination under a slide.

#### II.4.3. Identification and enumeration of helminth eggs and larvae

The identification of these eggs was carried out using the plates of (OMS, 1994). Thus, the enumeration was carried out using the formula proposed by (Ajeagah *et al.*, 2010).

The number (x) of the eggs of *Ascaris lumbricoïdes* contained in 1L of sample is obtained by:

$$x = \frac{y \cdot V_x}{V_y} \quad (1)$$

$V_x$  being the volume of the pellet in 1 L of sample,  $V_y$  = the volume of the pellet used for observation and  $y$  the number of the eggs of *Ascaris lumbricoïdes* observed in  $V_y$ .

#### II.4.4. Data analysis

The data obtained were grouped by season: LRS (Long Rainy Season) from September to November and LDS (Long Dry Season) from December to February. Spearman's 'r' correlation test was performed using SPSS 20.0 software and is used to evaluate the physico-chemical parameters that influence the distribution of parasites in water depending on the degree of binding between the different parameters.

### III. Results

#### III.1. Results of physico-chemical analysis

Water temperatures ranged from 24. 25° C in wells SW3 and SW4 during the main rainy season (LRS) to 27° C at the OW1 station during the main dry season (LDS). Suspended Solids (SS) and turbidity fluctuated from 3 to 39 mg/L and 3 to 75.5 mg/L respectively with the highest values obtained in LRS. The greatest value of colour (394.5 Pt.Co) were obtained at well OW4 during the long rainy season (LRS) while well SW3 had the lowest colour value (3.5 Pt.Co) during the long dry season (LDS). In general, the highest colour values are obtained during the Long Rainy Season. Dissolved Total Solids (DTS) ranged from 19 mg/L in well BW4 to 366.5 mg/L in well MW1 during the long rainy season (Table 2).

Table 2: Physical parameters of the water during the period of study

Study locations	Wells	T (°C)		SS (mg/L)		Colour (Pt.Co)		Turbidity (FTU)		DTS (mg/L)	
		LRS	LDS	LRS	LDS	LRS	LDS	LRS	LDS	LRS	LDS
Mbalmayo	MW1	24.75	25.25	7.5	3	71	19.5	12.5	3.5	366.5	364
	MW2	24.5	25.75	7.5	2.5	117	6	14	12.5	231	212
	MW3	25	26	13.5	4	106.5	36.5	9	15.5	193.5	184
	MW4	25.25	25.25	13	7	55	13	11	12.5	213.5	405
Mbankomo	BW1	25.5	25	39	16	206	122.5	42.5	20	87	170
	BW2	25.5	26.5	16.5	7	136.5	78	24.5	15.5	23	31.5
	BW3	25.5	25	13	5	82	86	8.5	18.5	27	46.5
	BW4	25	25.5	10.5	6.5	44	55.5	4	16.5	19	32.5
Okola	OW1	25.5	27	31.5	11	253.5	64.5	75.5	15.5	68	123.5
	OW2	26	26	8	8	101.5	58	20	18	135	92.5
	OW3	25.5	25.75	17	21.5	105.5	121	22	26.5	102	141
	OW4	25.5	26.25	14.5	13	394.5	70	12	26	81.5	103
Soa	SW1	25	24.75	17	8.5	127.5	14	30.5	4.5	260.5	274
	SW2	24	24.25	15.5	8.5	137.5	4	13.5	6	46	33
	SW3	24.25	24.5	13.5	7	61.5	18	48	3	21.5	23.5
	SW4	24.25	25.25	10.5	8	51.5	10	16.5	6	287.5	224

The pH values recorded during the study ranged from 4.92 CU at well OW1 to 6.80 CU at well SW1 during the long rainy season. These pH values vary from one sampling point to another during both seasons. Dissolved oxygen ranged from 35.15 mg/L (LDS) and 67.10 mg/L (LRS) in wells OW1 and OW3 respectively. Nitrate and orthophosphate levels ranged from 0.09 to 9.50 mg/L  $\text{NO}_3^-$  and 0.02 to 7.50 mg/L  $\text{PO}_4^{3-}$  respectively, with high levels obtained in LRS. Oxidability levels in the water ranged from 1.57 mg/L at OW4 well in LDS to 5.04 mg/L at MW3 well in LRS (Table 3).

Table 3: Results of the chemical parameters of the waters studied

Study locations	Wells	pH		O <sub>2</sub> (mg/L)		PO <sub>4</sub> <sup>3-</sup> (mg/L)		NO <sub>3</sub> <sup>-</sup> (mg/L)		Oxydability (mg/L)	
		LRS	LDS	LRS	LDS	LRS	LDS	LRS	LDS	LRS	LDS
Mbalmayo	MW1	6.31	6.50	61.45	55.65	1.55	0.24	2.10	0.55	4.44	2.67
	MW2	6.31	6.74	62.15	55.90	1.15	0.40	5.15	0.63	3.65	2.77
	MW3	6.61	5.45	61.45	54.35	1.95	0.57	9.50	0.65	5.04	4.05
	MW4	6.63	6.78	60.75	62.00	2.30	0.58	3.30	0.70	2.67	1.58
Mbankomo	BW1	6.71	6.30	64.85	48.05	7.50	0.30	1.90	0.66	4.15	1.97
	BW2	5.59	6.33	65.55	60.20	1.50	0.12	3.60	0.26	3.85	1.98
	BW3	5.50	6.65	65.25	57.10	0.85	0.03	2.75	0.09	3.95	1.78
	BW4	5.65	6.30	65.00	53.35	0.70	0.02	2.20	0.65	2.87	2.27
Okola	OW1	6.80	6.40	56.97	35.15	2.65	0.11	3.00	0.64	4.84	2.77
	OW2	6.17	6.69	65.75	36.50	3.50	0.03	1.03	5.00	2.27	1.87
	OW3	6.50	5.29	67.10	38.85	2.90	0.03	6.15	0.69	2.77	1.87
	OW4	6.00	5.92	65.90	38.25	1.60	0.03	3.30	0.34	4.15	1.57
Soa	SW1	4.92	4.99	64.70	51.60	2.70	0.09	6.35	1.09	3.85	2.47
	SW2	6.31	5.81	65.65	57.05	0.87	0.25	0.48	0.15	2.17	2.67
	SW3	6.27	5.83	66.05	54.20	0.83	0.30	1.43	0.09	2.27	1.58
	SW4	6.47	6.09	66.05	53.45	0.49	0.45	0.29	0.15	3.65	2.07

### III.2. Results of biological analysis

Results regarding the identification of the eggs of *Ascaris lumbricoïdes* in well water revealed the presence during the study period in all four localities. Water samples taken throughout the study period

were found positive for eggs in both seasons with the exception of wells SW1, SW2 and SW3 in Soa. The highest densities were obtained during the long rainy season (Table 4).

Table 4: Identification results of the eggs of *Ascaris lumbricoïdes* during the study period.

Locations	Wells	Seasons	<i>Ascaris lumbricoïdes</i>	
			Densities (eggs/L)	Presence/Absence
Mbalmayo	MW1	LRS	15.00	+
		LDS	9.00	+
	MW2	LRS	8.00	+
		LDS	7.00	+
	MW3	LRS	11.00	+
		LDS	9.00	+
	MW4	LRS	9.00	+
		LDS	8.50	+
Mbankomo	BW1	LRS	7.50	+
		LDS	6.50	+
	BW2	LRS	7.50	+
		LDS	5.50	+
	BW3	LRS	6.50	+
		LDS	5.50	+
	BW4	LRS	8.00	+
		LDS	4.50	+
Okola	OW1	LRS	9.00	+
		LDS	7.00	+
	OW2	LRS	9.00	+
		LDS	7.00	+
	OW3	LRS	11.00	+
		LDS	7.00	+
	OW4	LRS	7.00	+
		LDS	5.50	+
Soa	SW1	LRS	0	-
		LDS	0	-
	SW2	LRS	0	-
		LDS	0	-
	SW3	LRS	0	-
		LDS	0	-
	SW4	LRS	7.00	+
		LDS	5.50	+

Legend: + = Presence; - = Absence



### III.3. Influence of physico-chemical variables on the distribution of the eggs of *Ascaris lumbricoïdes*

Significantly, orthophosphates, nitrates, ammonia nitrogen, colour, turbidity and Dissolved Total Solids values were correlated with densities of the eggs of *Ascaris lumbricoïdes* (Table 5). Orthophosphates

were significantly and positively correlated with the eggs of *Ascaris lumbricoïdes* ( $p \leq 0.01$ ). Nitrate, ammonia nitrogen, colour, turbidity and Dissolved Total Solids values were significantly and positively correlated with densities of the eggs of *Ascaris lumbricoïdes* ( $p \leq 0.05$ ).

**Table 5:** Spearman's correlation coefficient "r" between physico-chemical variables and the eggs of *Ascaris lumbricoïdes* density.

Variables	Oxy	Ortho	Nitra	NH <sub>4</sub> <sup>+</sup>	Temp	MES	Coul	Turb	STD	Ascaris
Oxy	1	0.473**	0.262	0.186	-0.489**	0.121	0.245	0.036	-0.001	0.343**
Ortho		1	0.375*	0.522**	0.024	0.714**	0.484**	0.451**	-0.028	0.395*
Nitra			1	0.206	-0.040	0.255	0.331	0.121	0.053	0.511**
NH <sub>4</sub> <sup>+</sup>				1	0.155	0.663**	0.439*	0.652**	-0.164	0.449**
Temp					1	0.026	0.092	0.112	-0.116	-0.181
MES						1	0.635**	0.716**	-0.267	0.109*
Coul							1	0.484**	-0.272	0.322**
Turb								1	-0.244	0.330*
STD									1	0.463**
Ascaris										1

Legend: Temp = Temperature, Oxy = Dissolved Oxygen, STD = Total Dissolved Solids, TSS = Suspended Solids, Colour = Colour, Turb = Turbidity, PO<sub>4</sub><sup>3-</sup> = Orthophosphates, NO<sub>3</sub><sup>-</sup> = Nitrates, NH<sub>4</sub><sup>+</sup> = Ammonium; Ascaris = eggs of *Ascaris lumbricoïdes*. \* = correlation is significant at threshold  $p \leq 0.05$  and \*\* = correlation is significant at threshold  $p \leq 0.01$ .

### III.4. Photographs of the eggs of *Ascaris lumbricoïdes* identified during the study

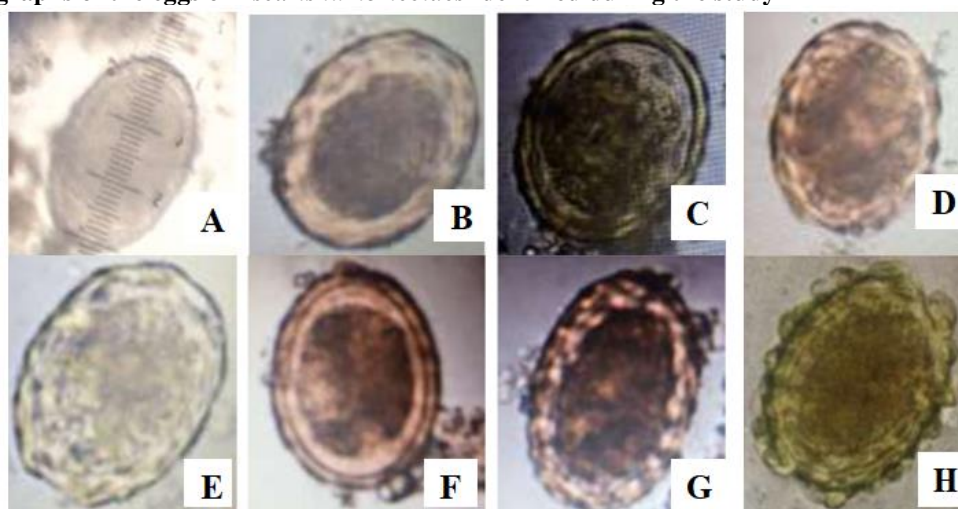


Figure 2: A, B, C, D, E, F et G= Eggs of *Ascaris lumbricoïdes* that have lost their hilly external envelope; H= egg of *Ascaris lumbricoïdes* with a hilly external envelope

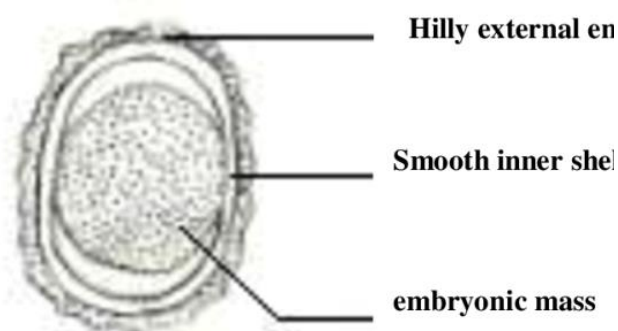


Figure 3: Annotated drawing of the egg of *Ascaris lumbricoïdes*

## IV. Discussion

### IV.1. Physico-chemical analysis of the well water studied

The temperature of the wells is globally similar (around 25°C) during all seasons but is highly variable in LDS (between 24.25 and 27°C) in all study localities except the Soa locality. This variation in temperature could be explained by the fact that the wells are shallow and open, so that the light energy reaches the water table. Similar results were obtained by Tuekam Kayo (2013) in the groundwater of Mbalmayo. The well water of the 04 localities analysed have an overall acidic pH. This acidity

would be linked to the nature of the soil in the central region. In this respect, Nola *et al.* (1998) point out that the pH of water depends on the nature of the land it crosses. TSS, colour and turbidity were high in the different study areas during both seasons with the exception of wells MW2, MW4 and SW4 for colour and MW1, BW4 and SW4 for turbidity. These high values would be explained by the absence or inadequacy of wells. This is because the development of the water points by the construction of curbs at least 0.5 m high, the presence of a cover and the concreting of the structure may prevent the risks of pollution. The low nitrate, orthophosphate and oxidability values obtained overall could be justified by the low use of agricultural inputs during the study period by the populations surrounding the various wells. The high values of dissolved oxygen obtained in all localities (LRS) except Okola locality and well BW1 in Mbankomo (LDS) would be related to the decrease in organic matter. Indeed, when the quantity of organic matter is low in the environment, the quantity of oxygen consumed by the microorganisms in the mineralization process is low.

#### IV.2. Parasitological analysis of the water from the wells studied

The results of the parasitological research of the sampled waters allowed to highlight the eggs of *Ascaris lumbricoïdes*. These eggs are believed to come mainly from human and animal faeces that accidentally end up in well water.

The wide dispersion of concentrations in the various samples would depend on several factors: the number of infested individuals and/or animals, the number of eggs laid daily by the helminth species and the number of eggs removed per gram of infested human faeces. In this regard, Desoubaux and Duong (2011) point out that for agents whose transmission is linked to the fecal-oral hazard, the promiscuity found in certain communities is conducive to the spread of the parasite. *Ascaris lumbricoïdes* eggs have been identified in the waters of all the wells studied and in all the 4 localities and this would testify to the cosmopolitan nature of this organism. Indeed, Ascariasis is cosmopolitan and is endemic in sub-Saharan Africa, in poor, sub-urban or even tropical rural areas (Ndiaye *et al.*, 2012). Only wells SW1, SW2 and SW3 in Soa do not harbour *Ascaris lumbricoïdes* eggs.

This may be explained by the good state of protection of these water points. Certainly, these two wells comply with the well construction standards as recommended by the WHO. The absence of *Ascaris* eggs in these wells may also be justified by the fact that these wells are deep and not located in swampy areas; therefore, they cannot be receptacles for waste water carrying any substance. Eggs of *Ascaris*

*lumbricoïdes* were present in the wells sampled during both seasons. High densities were obtained during the long rainy season (LRS) compared to the long dry season (LDS). This could be explained by the increased parasitic prevalence of helminthiasis in the rainy season, as during the rainy season it is the run-off water carrying all kinds of substances that pollute the well water. The distribution of environmental forms of helminths vary from one point to another according to the level of contamination. It would also be crucial to mention that these muds could support contamination of the water table by the process of infiltration or draining water into unprotected wells via domestic effluents (Ajeagah *et al.*, 2018). Eggs of *Ascaris lumbricoïdes* were abundant in all the wells and in all the study localities, which would justify its resistance in the environment. According to Dold and Holland (2011), embryonated eggs can remain in this state for 2 to 6 years while waiting to be ingested by the final host. The resistance of this organism can also result from the structure of the membranes and certain abiotic factors. In this respect, the wall of *Ascaris* is thick and hilly, if the environmental conditions are favorable, the eggs can remain infectious for up to six years. Most of the eggs of *Ascaris lumbricoïdes* identified have been modified by the environment. This modification has been marked by the loss of the hill on the external envelope, by the modification of the shape and the decrease in diameter among other things.

#### IV.3. Influence of physico-chemical variables on the density of eggs of *Ascaris lumbricoïdes*

Statistical analyses ( $p \leq 0.05$ ) have shown that the distribution of *Ascaris lumbricoïdes* eggs in the wells water is a function of the physico-chemical characteristics of the water. Thus, the high densities of eggs found in well MW1 may be favor to the high oxygenation of the water at this sampling point. This resulted in significant and positive correlations found between dissolved oxygen ( $r = 0.343$ ;  $p = 0.007$ ) and the eggs of *Ascaris lumbricoïdes*. The positive correlations obtained between ammoniacal nitrogen, orthophosphates, nitrates and densities of eggs of *Ascaris lumbricoïdes* would explain the parasite loads observed in the water points. Indeed, the high concentrations of mineral elements in the environment can increase the activation and development of forms of parasite resistance.

The positive correlations obtained between SS, colour, turbidity and egg densities of *Ascaris lumbricoïdes* show that helminth eggs are most often adhered to organic matter suspended in water (Ajeagah *et al.*, 2016).

#### V. Conclusion

At the end of this study on the evaluation of the cosmopolitan character of *Ascaris lumbricoïdes* eggs

identified in well water in relation to abiotic factors in four sub-urban areas of Central region of Cameroon (Mbalmayo, Mbankomo, Okola and Soa), it turned out that the water has an average temperature of 25, 31° C, an acid pH and is oxygenated. A parasitological analysis shows the presence of the species *Ascaris lumbricoïdes* everywhere and along the period of study. In addition, these well waters are contaminated with eggs of the *Ascaris lumbricoïdes* through domestic effluent and through the use of cannon and flush latrines, usually located downstream and less than 15 m from the water points. This contamination is also due to the non-compliance of wells with construction standards. The distribution of helminth eggs in the waters studied is a function of certain physico-chemical parameters such as dissolved oxygen, temperature, turbidity, colour, and ammoniacal nitrogen. The populations that use these waters on a daily basis may be therefore exposed to an increased health risk. To mitigate this, it is necessary to treat these waters before any use by usual methods.

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