

**PARASITIC HELMINTHS OF MEDICAL IMPORTANCE AND YEAST INFECTION ON FRUITS SOLD IN THE MARKETS AND STREETS OF BUEA, FAKO DIVISION, SOUTH WEST REGION. CAMEROON****Judith Lum Ndamukong-Nyanga^{1*}, Chrisantus Anye Akuma², Ngum Catherine Ndamukong^{2,3}, Desdemona Njabi Nji⁴**¹Department of Biological Sciences, Higher Teachers Training College, University of Yaounde I, Cameroon.²Department of medical Laboratory Science, School of Health, Biaka University Institute of Buea, Cameroon.³Department of Political Science, Faculty of Law and Political Science, University of Dschang, Cameroon.⁴Department of Biochemistry and Molecular Biology, Faculty of Science, University of Buea, Cameroon.***Corresponding Author: Judith Lum Ndamukong-Nyanga**

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ABSTRACT

Introduction: Fruits are a vital part of a balance diet. They add color, variety, and taste to our meals and are a good source of vitamins, minerals and dietary fiber. Fruits are of great importance for an adequate and balanced diet owing to the role they play in preventing many health related problems such as obesity, cancer and cardiac diseases. Buea has good cultivating land like apples, guava, pear, mangoes, pineapples, tomatoes and water melon. This is done during the rainy season or by irrigation during the dry season. Irrigation water is obtained from different sources like streams, rivers, and ponds which may be polluted with parasite eggs, cyst and larvae from animal and human faeces. Excreta polluted water is a health risk to both the farmers and the consumers who eat the produce fresh and without disinfection. **Methods:** The study was a cross-sectional one involving 160 fruit samples sold in the markets streets of Buea and consumed by the population. Data was collected from March to June 2016. Ten different types of fruits were sampled for the presence of parasites. These included Tomato (*Lycopersicon esculentum*), Orange (*Citrus sinensis*), Mango (*Mangifera indica*), Pawpaw (*Carica papaya*), Pineapple (*Ananas cosmosus*) Water melon (*Citrullus lanatus*), Apple (*Aberia cattra*), Banana (*Dusa accuminata*) Cucumber, Avocado. The zinc sulphate floatation technique was used for concentrating the cysts and ova of the parasites. The sedimentation method was also done using normal saline and iodine. Data was analysed using SPSS version 17.0. **Results and discussion:** A total of 21 (13.12%) fruits were contaminated. Highest contamination was found in mangoes 6(30%), followed by tomatoes 5(20%) while bananas, apples and avocados 0 (00 %) had the lowest contamination. *E. histolytica* recorded significantly ($p=0.002$) highest prevalence (17, 10.6%), followed by *Ascaris lumbricoides* with 5(3.1%) while *Trichuris trichuria* was the least with 1(0.6%). Yeast cells were seen to contaminate the fruit samples with the highest prevalence being on water melon 4(40%), banana 3(15%) and cucumber 2(20%).

KEYWORDS: Fruits, parasites, helminths of medical importance, prevalence, streets and markets.**1.0 INTRODUCTION**

Fruits are a vital part of a balance diet. They add color, variety, and taste to our meals and are a good source of vitamins, minerals and dietary fiber. According to FAO and WHO, (2005),^[1] the daily recommended intake of fruits is 400g. Fruits are of great importance for an adequate and balanced human diet owing to the role they play in preventing many health related problems such as obesity, cancer and cardiac diseases. In certain parts of the world, fruits are the major of a well balance diet and healthy eating plan.^[2] Apart from being a rich source of vitamins, and minerals, the production of fruits also contributes significantly to regional and national income through national and international trade. It serves as a

means through which flowering plants disseminate seeds.^[3] The fruit term is most often used for those plants fruits that are edible, sweet, and fresh. There are three kinds of fruits (Simple fruits, Aggregate fruits and Multiple fruits). Simple fruits can be either dry or fresh. Examples are carrot, wheat, tomato, avocado, banana etc.^[4] The examples of aggregate fruits are pineapple, bread fruit, etc. Many fruits are used to make beverages, such as fruit juice, (orange juice, apple juice, grape juice).^[5] Poorly handled fruits can be a major source of intestinal parasitic diseases in the developing countries due to poor sanitation and inadequate personal hygiene.^[6] About one third of the world's population is infected by parasites.^[2] In Africa, the transmission of intestinal

parasitic infection has been considered to increase due to frequent use of untreated human and animal dung as manure in cultivation by local farmers. This serves as a source of zoonotic parasitic infection.^[7]

The cultivation of fruits in Buea municipality is done by peasant farmers for commercial purposes. These farmers at times defecate indiscriminately in the farms they cultivate with the belief of enriching the land. This is a common practice and it pollutes water bodies that are used for irrigation which in turn infect the cultivated produce. Consumption of unwashed fruits such as carrots, mangoes, tomatoes, watermelon, and others, is considered to be risk factor for human parasitic infection.^[8] Factors like the lack of latrine and adequate sewage disposal facilities and the conditions in which the produce are sold in the markets have been known to contribute to the spread of the infective states of the parasites. Infection can be acquired through contaminated unwashed fingers, insects, circulation of currency and by wind during the dry season. Contamination of fruits with eggs and cyst especially those hawked by fruit vendors may also serve as a source of infection to consumers of such fruits items. These parasites includes: *Entamoeba histolytica*, *Giardia duodenale*, *Trichuris trichura*, *Ascaris Lumbricoides* and *Enterobius vermicularis*.^[4] *Amoebiasis* is known to cause about 450 million infections per annum in developing countries.^[2] *Giardiasis* is more common in children and has a worldwide prevalence of about 1-30%.^[2] *Ascaris* is the commonest nematodes of man especially in tropical Africa with a prevalence of about 1.9% (Ndamukong *et al.*,2015) in Buea. The resistance capacity of the eggs and cyst of these parasites is a feature of profound influence on the epidemiology. Eggs of *Ascaris* can remain viable for up to six years,^[8] act as vehicles for the transmission of parasitic infections when contaminated as a result of various associated factors related to planting, such as while they are still on the field, harvesting, transportation, storage, market chain, and even at home.^[8] Despite the fact that intestinal parasitosis is common in Buea there is limited studies conducted to assess the level of contamination of fruits and with parasites of medical importance. Considering the important role of fruits there is need for routine investigation or surveillance programs to be conducted from time to time to check the presence of parasites on fruits consumed by the population. If our target is to control the intestinal parasitic diseases, it is not enough to depend merely on the chemotherapeutic intervention of identified cases, but need the concerted effort to reduce and eliminate the potential sources of infection.

Buea is considered one of the areas that have good cultivating land. This is done usually during rainy season or use of irrigation during dry season. Irrigation water is obtained from different sources like streams, rivers, ponds etc. which may be polluted with eggs, cyst, and larvae from animal and human faeces. Due to high number of eggs, cyst and larvae of human intestinal

parasites present in the waste water, the use of excreta polluted water is a health risk to both the farmers and the consumers that eat the produce, raw and fresh, like apples, guava, pear and mango pineapples tomatoes ,and water melon.

There is limited document to attest the level of parasitological contamination of fruits and vegetables in Buea. Therefore, this study was designed to determine the level of parasitic contamination of selected fresh fruits ready to eat and associated factors of contamination in Buea municipality.

There has been an increase in the demand of fresh fruits.^[9] as seen by the increasing number of vendors in our markets and along the streets of Buea. The production of fresh fruits embraces different activities such as farming, harvesting, and post-harvest treatment, processing and selling. Within all these activities, specific hazards exist that affect product safety and quality and might therefore pose a health risk for the consumer. In order to reduce this risk and to increase produce safety, it is necessary to first assess the potential hazards. Once the potential sources of produce contamination or other hazards have been identified, practices can be implemented to control, reduce or eliminate them. There is therefore the need to evaluate these medically important parasites found on fruits sold in our local markets.

The aim of this study was to assess the prevalence of intestinal parasites and yeast infection on fruits sold in our local markets so as to bring out the possible ways of which fruits are contaminated suggesting existence of a great risk of acquiring intestinal parasites by eating improperly washed fruits. The data generated will reveal the local risk factors in which unwashed fruits sold in the markets can be hazardous; it will therefore contribute to fill the gap of good hygienic practice and be useful for health education of the population.

2.0 MATERIALS AND NMETHODS

2.1 Study Area

This study was carried out in Buea. Buea Municipality is bounded to the north by tropical forest on the slope of mount Cameroon (4100m above sea level). The mountain range extends to the beautiful sandy beaches of Atlantic Ocean. The town also share boundary with other major towns like the City of Limbe to the South West, Tiko municipality to the South East, Muyuka municipality to the East and Idenau district to the West. With an equatorial climate, temperatures are moderate with a slight seasonal variation (rainy and dry season). Buea has moderate economy with agricultural, administrative, business, tourism and the financial sector taking the central stage of the town. Buea has an estimated population of above 200.000 inhabitants (2005 BUCREP figures and annual growth rate of 5% as per UN projections for urban population growth rate for Africa) constituting essentially of the Bakweris (the

indigenes) in the villages and a highly cosmopolitan population within the urban space putting the indigenes at a minority. Buea is one of the fastest growing towns in Cameroon today with a mix cosmopolitan setting and a constellation of about 67 villages. These villages are inhabited by the Bakweris who, according to social scientists, have lived around Mount Cameroon for at least 4,000 years. Its urban rims now includes: Molyko, Buea station, Muea, GRA, Mile 16, Clerks and Federal quarters, Great Soppo, Likoko-Membea, Bokwaongo, and Bonduma. Buea is presently the headquarter of the South West Region of Cameroon. The soil is very rich in nutrients and allows the cultivation of various crops such as tomatoes, cabbage, okra, pepper, corn, cocoyam, yams, cassava, plantains, beans, vegetables and even some cash crops such as palm trees, cocoa and bananas. Citrus trees are less prosperous as one ascends and climate gets cooler. The soil and climate is very supportive for vegetation and agriculture though in some areas digging is difficult due to the stony nature of the rocks' he Muea market is found in the South-West Region of Cameroon about 7 minutes by car from the Buea bus station The market is said to have existed as a major trading centre long before the colonial era. The Muea market eventually developed into an important market for the sale of food stuffs, vegetables and other items. the Muea market is the largest in Fako Division. It attracts traders from far and near and from neighbouring countries the new market is located along the Bokova Road near the Catholic Co-Cathedral because it is a junction between Buitingi, Bokova, Ngongo, Bonduma, Molyko Located in the town of Buea. Mile 16 market is one of the markets in the Fako subdivision found after few kilometers from Mutengene heading towards Mile 17 but it comes before mile 17 motor park. It is a small market in size as compare to other renowned markets like Muea, Mutengene and Tiko market but it is reach in varieties. This market holds from Mondays to Fridays with official markets days being on Mondays, Wednesdays and Thursdays and sells items like fresh vegetables, tomatoes, maize, Irish potatoes, plantain, cocoyam's, fresh and dry pepper, second handed clothes just to name a few. It is simple and reserved market with it layout along the road making it easy for buyers to alight from cars and be able to buy.

2.2 Study Population

This study involved fruit samples that are consumed by the population of Buea Municipality, and being sold in the markets and along the streets.

2.3 Research Design

This research is a cross sectional and stratified design carried out on fruit samples that are found and being sold in our local market and along the streets of Buea Municipality.

2.4 Sample Collection

This study was carried out between March and June 2016. Ten different types of fruits that are frequently

consumed in Buea were sampled for intestinal parasites. Fruits that were screened for the presence of parasites are Tomato (*Lycopersicon esculentum*), Orange (*Citrus sinensis*), Mango (*Mangifera indica*), Pawpaw (arica papaya), Pineapple (*ananas cosmosus*) Water melon (*citrullus lanatus*), Apple (*Aberia cattra*), Banana (*dusa accuminata*) Cucumber, Avogado They were purchased during market hours at the time the traders are arriving from the different supplying farms. The items were picked randomly from the various markets and along the streets in order to obtain qualitative estimation of parasitic contamination of the samples. They were collected in plastic bags and buckets sterilized with 10% chlorine water swab, sealed and analyzed in the laboratory for the presence of intestinal parasites.

2.5 Examination of fruits for intestinal parasites

2.5.1 Macroscopic Examination

The samples were examined carefully for the presence of dirt, manure, with the naked eye.

2.5.2 Microscopic Examination

The zinc sulphate floatation technique was used for concentrating the cysts and ova of the parasites. The samples were washed in distilled water. The washings were centrifuged at 250 rpm for one minute and the supernatant was decanted using a Pasteur pipette. 2ml of the sediment was placed in a 15ml test tube which was filled with zinc sulphate solution to the brim and a cover slip was placed on top. The cover slip was removed after twenty (20) minutes to allow enough time for the cysts and ova to float. The cover slip was placed face downwards on a slide and was examined under x10 and x40 objectives with a drop of iodine under the cover glass, to identify the cysts and ova of parasites as stated by Cheesbrough, 2003.^[10]

2.5.3 Guide to the identification of eggs and cysts of various parasites

The various cysts and eggs of the parasites were identified by their morphological characteristic such as the shapes and sizes of the eggs using the guide from Centers for Disease Control and Prevention /DPDx, 2016, and Cheesebrough, 1998.^[10,11]

Alternatively the sedimentation method was also used in which each type of fruits was washed in 50ml of normal saline. Each suspension was strained through a sieve which filtered off coarse sandy particles but allowed the passage of helminthes ova; cyst and larvae. The filtrate was centrifuge at 2500pm for one minute. The supernatant was poured off from the different tube and the sediment was examined for helminthes ova and a drop of iodine for cyst of protozoa by the concentration technique as described by Cheesebrough.^[11] was used for the identification of the ova, cyst and larvae observed.

2.6 Data analysis

The results obtained were checked, verified recorded and every week for the use of correct codes and consistency.

The data was entered and analyzed using Microsoft word and Excel.

3.0 RESULTS

A total of 160 fruit samples all ripened and ready to eat were collected in the markets and along the streets of Buea municipality. All the samples were analyzed giving a rate of 100%. The 160 samples analyzed showed 21(13.1%) of contamination rate, with mangoes and tomatoes 5(20%) being the most contaminated fruits and the least contaminated were bananas, apples, and avocados 0(00%).Yeast cells were seen to contaminate the fruit samples with the highest prevalence being on water melon 4(40%), banana 3(15%) and cucumber 2(20%).

3.1 Distribution of fruits samples collected

A total of 160 samples were got from the various markets and along the streets of Buea (table 1).

Table 1: Samples collected and examined.

S/N	Samples	Total No. of samples collected and examined in markets and along the streets.
1	Bananas	20
2	Pawpaw	15
3	Pineapple	10
4	Cucumber	10
5	Oranges	20
6	Tomatoes	25
7	Mangoes	20
8	Apples	15
9	Avocados	15
10	Water melon	10
	Total	160

3.2 Prevalence of contaminated fruits with parasites in markets and on the street

Out of the 160 fruits sampled, a total number of 21 (13.12%) were contaminated. Highest contamination was found in mangoes 6(30%), followed by tomatoes 5(20%) while bananas apples and avocados 0 (00 %) had the lowest contamination (Table 2).

Table 2: Distribution of fruit samples infected in the study area.

	Samples	Number examined	Number infected	Percentage (%)	Confidence interval (%)
1	Bananas	20	0	0	0.00 – 0.00
2	Pawpaw	15	2	13.3	4.38 - 29.10
3	Pineapple	10	2	20	13.22 - 44.43
4	Cucumber	10	2	20	13.22 - 44.43
5	Oranges	20	1	5	3.36 – 22.38
6	Tomatoes	25	5	20	10.63 - 32.76
7	Mangoes	20	6	30	21.49 – 50.61
8	Apples	15	0	0	0.00 – 0.00
9	Avocados	15	0	0	0.00 – 0.00
10	Water melon	10	3	30	10.82 – 40.79
	Total	160	21	13.12%	11.16 – 18.16

3.3 Prevalence of parasites of medical importance (pathogenic parasites) that can be found on some fruits in the markets of Buea.

E. histolytica recorded significantly ($p=0.002$) highest prevalence (17, 10.6%), followed by *Ascaris*

lumbricoides with 5(3.1%) while *Trichuris trichuria* was the least with 1(0.6%) as shown in table 3.

Table 3: Distribution of different parasites found on fruits.

S/N	Samples	No Examined	<i>Ascaris lumbricoides</i>	<i>Trichuris trichuria</i>	<i>E.histolytica</i> cyst	<i>Giardia</i> cyst	Yeast cells
1	Banana	20	0	0	0	0	3(15%)
2	pawpaw	15	0	0	2(13.3%)	0	-
3	Pineapple	10	0	0	4(40%)	0	-
4	cucumber	10	0	0	3(30)	0	2(20%)
5	Oranges	20	0	0	0	2(10%)	-
6	Tomatoes	25	2(8%)	0	2(8%)	0	-
7	Mangoes	20	2(10%)	1(5%)	4(20%)	0	-
8	Apples	15	0	0	0	0	-
9	Avocado	15	0	0	0	0	-
10	Water melon	10	1(10%)	0	2(20%)	0	4(40%)
	Total	160	5 (3.1%)	1(0.6%)	17(10.6%)	2(1.3%)	9(5.6%)

	Chi-Square	DF	P-Value
Pearson	25.534	9	0.002
Likelihood Ratio	30.038	9	0.000

3.4 Conditions in which fruits are sold in the markets and on the streets?

Most of the fruit samples were sold to consumers displayed on the ground with little or no protection from soil, dust, and flies that can act as vectors for a number of pathogenic microorganisms, some were put directly

put on the ground besides the main drainage gutter that ferries off waste and drainage water from the various neighborhood which pre disposes them to contamination as seen in figure 1, 2, 3, and 4. Besides, there might be bacterial and viral contamination of the produces during display for sale on the floor.



Figure 1: Water melon on the ground.



Figure 2: Tomatoes on some protective material.



Figure 3: Mangoes with little protection.



Figure 4: Fruits contaminated by human action.

This was seen with water melon (30%), mangoes (20%), tomatoes (20%) and cucumber (20%).

However, those that were not contaminated (apples 00%) were sold to consumers on protected make shift containers, as seen in figures 5 and 6.



Figure 5: Apples on protected tray.



Figure 6: Avocado on protected tray.

4. DISCUSSION

The recovery of ova and cysts of parasites from fruits and vegetables is of great public health significance. This is because some of the fruits and vegetables may be eaten raw, in addition people often pick up fallen fruits and eat after merely dusting off the visible dirt with their hands or clothing. This study reported high prevalence rate of parasitic contamination of fruits sold in our local markets. The presence of intestinal parasite in fruits samples is suggestive of faecal contamination from man.

A total number of 160 fruits were examined, out of which 21 (13.12%) were contaminated. Highest contamination was found in mangoes 6(30%), followed by tomatoes 5(20%) while bananas apples and avocados 0 (00 %) had the lowest contamination. This result is lower than that of Tamirat *et al* (2014) in Jimma Town Ethiopia,^[12] who reported 46.7% and that of Simon-Oke *et al*, (2014) who reported 37.5% positive cases of parasites on fruits.^[12] This variation in contaminations may be attributed to geographical location, type and number of samples examined.

Among the fruit varieties, pineapple was the most contaminated this is due to the uneven surface of pineapple fruit which make the parasitic eggs, or cysts

attached to the surface of the fruit more easily either in the farm or when washed with contaminated water which could be as a result of its low growth height above the soil level that predisposed it to contamination with parasites during flooding as well as heavy rain splashes, followed by water melon. Banana, Apples and avocados 0(00%) were the least contaminated, this is due to the smooth skins of the fruits which makes it easy for the eggs, or cysts of the parasites to be washed off easily.

The most frequent parasitic ova, cysts and Yeast seen among the 21 contaminated samples were *E. histolytica* 7 (10.6%), *A. lumbricoides* 5(3.1%), and Yeast cells 9(5.6%). This is similar to the study by Yiola and Utitofon (2016) in Abuja.^[14] The highest prevalence was found in *E.histolytica* cyst this may be as a result of the viability of the cyst being able to resist chlorine as indicated by Sara-Jones, 2010.^[15] *A. lumbricoides* may be as a result of the viability of the eggs in the soil for months and being the commonest parasite in the tropics.^[16] they are also sticky and may be found adhering to fruits, vegetables, utensils and even door handles.

The condition in which the fruits were sold in the markets as seen in figures 1, 2 3, 4 are ways in which the fruits can become contaminated with microorganisms capable of causing human diseases during harvesting, transport, processing, distribution and marketing as most of the fruit samples were displayed on the ground with little or no protection as seen with mangoes water melon and tomatoes contaminated respectively.

Those that were not contaminated were sold on make shift stands that are elevated up from ground level away from contamination figures 5 and 6.

4.0 CONCLUSION

Fruits sold in the markets and streets of Buea are contaminated with intestinal parasites due to poor sanitary environment of the markets, and unhygienic transportation of the product to the markets.

Hence, the findings of the present study are of public health importance, requiring an appropriate intervention to prevent transmission of parasitic diseases that can be acquired through consumption of contaminated fruits.

The study has revealed the potential risk of contracting intestinal parasite infections through ingestion of locally grown unwashed fruits.

ADMINISTRATIVE/ETHICAL CONSIDERATION

Administrative/ethical approval was obtained from the Regional delegation of public Health in Buea.

Author's contribution

This work was carried out in collaboration between all authors. Author JLNN designed the study and wrote the

protocol, carried out field work and laboratory work, corrected the manuscript. Author CAN designed the study and wrote the protocol, carried out field and laboratory work and wrote the first draft of the manuscript. Authors NCN and DNN participated in data collection and analysis and corrected the manuscript.

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