


Spring 2015

Dying for a Drink: How the Consumption of Home brews Affects Health within the Kibera Slum of Nairobi, Kenya

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Dying for a Drink:
How the Consumption of Home brews Affects
Health within the Kibera Slum of Nairobi,
Kenya



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SIT Kenya: Urbanization, Health and Human Rights

Spring 2015

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Acknowledgements

This paper would not have been possible without the help of my family and friends. First, I would like to thank the SIT staff who have helped me along the way. Thank you to Milton and Mama Mary for always being supportive during our stay in Kenya. I would like to thank Philip Ndemwa and Dr. Karama for giving your academic advice and input throughout my project. Thank you as well to Athman for your help with everything throughout the semester as well as always finding newspaper articles relevant to my ISP topic.

To my Nairobi host family, thank you for allowing me to stay with you during the ISP period. Mama Susan, Marjorie and Ray, you made me laugh so many times and really made me feel as though I was part of the family. And to Christine, thank you for being my little host sister. As Dorothy says to Scarecrow in *The Wizard of Oz*, I think I'll miss you most of all. I love you all like a second family.

My fellow study abroad friends Amina, Monil and Nadia, thank you for always keeping things interesting. Amina, thanks for coming up with this awesome topic for my research as well as for getting me hooked on *How I Met Your Mother* and *Modern Family*. You're a real peach. Monil, thanks for being your sassy self and overusing the words "mad" and "homie." And Nadia, thank you for being the person to give improv speeches and laughing at all my not-so-funny jokes.

And finally, I would like to thank my family back in the United States. Mom, Dad, Tasha, Eric and Patrick, thank you all for the frequent skype calls and keeping things lively on the other end. To you and the rest of my family and friends, thank you all for your support during this time and keeping me updated on the events back home. I definitely could not have accomplished this without you.

Abstract

Home-brewed alcohols are inexpensive, thus they are especially consumed by low-income individuals such as those residing in Kibera. This project investigates three alcohols brewed within this area: muratina (mugasha), busaa and chang'aa. With the help of Philip Ndemwa, a nutrition expert from the Kenya Medical Research Institute, I was able to gain insight regarding the process of these alcohols, as well as the sanitation conditions of the production sites of these home brews and how these factors affect the health of the consumer. Both qualitative and quantitative research methods were utilized in order to fully understand the health repercussions from consuming such products. Key informant interviews were conducted with producers in order to gain information about the process involved. The sanitation conditions of these breweries were I assessed using my observations and a guide created in accordance to the regulations as written in the Alcoholic Drinks Control Act of 2010 and the Kenya Health Act. In-depth interviews with experts within the chemical and alcohol field were conducted in order to provide technical information as to how the consumption of these products may affect health. The information gathered was used to determine how the original processing and sanitation conditions at the production site affect the health of consumers within Kibera.

Introduction

Kenya is often referred to as the gateway to Africa because of the investment and employment opportunities available, resulting in the migration of people to urban areas. The population is estimated to be around 45 million, with a quarter living in urban areas and a 3.5 percent annual urbanization rate of change which is expected to last until 2050 [20]. One of the major consequences of this rapid urbanization has been the formation of informal settlements, otherwise known as slums. Nairobi is home to some of the most dense and unsanitary slums within Africa. In fact, of the nearly 4 million residents of Nairobi, roughly 2.5 million individuals live within informal settlements [20]. The largest of these slums is Kibera, located in Nairobi.

Three main brews which are primarily produced and consumed in Kibera are muratina, busaa and chang'aa because they are inexpensive. The history regarding the legality of such homebrews has been a complicated one. Chang'aa was once used to cure illnesses such as malaria, flu and typhoid in Kenya [1]. Although this remains true in some areas of the country today, chang'aa is now usually consumed for recreational and social purposes. Also known as "kill me quick", this spirit is brewed illegally by local residents and, when processed correctly, possesses an alcohol by volume (abv) which residents say is similar to that of vodka. Although the licensed production of chang'aa has been legalized, this is a relatively recent decision.

Chang'aa has not always been legal in Kenya due to the harmful health effects which may be suffered from its consumption. The Chang'aa Prohibition Act, written in 1980, banned the production, sale, supply, consumption and possession of chang'aa, as well as the possession of any apparatus which had been designed for the production of chang'aa. Anyone found within the premises of or in possession of such materials would pay a fine which would not exceed ten

thousand shillings, or up to two years imprisonment, or a combination of both punishments [11]. Despite its name, this act does not only set restrictions for chang'aa; it also sites "any intoxicating liquor in the nature of an essence of or abstract from any substance, obtained by distillation, and includes any liquor mixed with spirits" [11].

Muratina and busaa were not included within The Chang'aa Prohibition Act because they were fermented instead of distilled alcohols. That being said, The Traditional Liquor Licensing Act was created in 1971 to control the production and sale of, as well as the premises which manufacture and sell, alcohols other than those spirits covered by The Chang'aa Prohibition Act [12]. Supposedly this act was brought about because these home brews were being manufactured in unhygienic conditions, and people within rural communities would sell their cattle and other livestock in order to afford these local brews [12].

Specifically, the act sites traditional liquors as those which are "manufactured by African methods" in which fermentation occurs. Muratina and busaa are examples of alcohols which were considered to be covered by the Traditional Liquor Licensing Act. The Kikuyu tribe traditionally brew muratina, and is also very popular within the Central province of Kenya. Muratina is also known as honey beer, as it is an alcohol made from the sweet muratina fruit and is processed with water, sugar and honey [21]. Busaa is a home brewed cereal-based beer generally produced from the fermentation of maize, millet or sorghum. The consumption of busaa is very popular among social and religious ceremonies, such as weddings and funerals [16]. The mean ethanol content of busaa is about 4 percent- much less than the average 34 percent for chang'aa [16].

However, there arose some problems with the Traditional Liquor Licensing Act, especially in the 1990's. What the Traditional Liquor Licensing Act failed to address was the

limitations in the consumption of such alcohols; although the manufacture and sale of such products were prohibited, their consumption was not [10]. Also, as a result from the enforcement of this act, several farmers reduced their production of sorghum and millet: two crops which were important in decreasing the number of individuals suffering from famine. Some members within the Kenya National Assembly proposed to amend this act in 1993. Within this amendment, the Government was urged:

“(a) to lift the ban on traditional liquor brewing, and

(b) to amend the Traditional Liquor Licensing Act to allow small scale breweries as well as home brewing for domestic consumption.” (16)

Those in favor of this amendment argued that it would provide an income for more individuals, allowing them to afford education for their children and thus resulting in an improved economy. Nevertheless, this amendment showed some misunderstandings of the original act [16]. For example, the Traditional Liquor Licensing Act did not ban the manufacturing of such alcohols; it placed a requirement that small-scale and large-scale breweries alike acquire the proper licensing in order to process such alcohols covered under this act. Therefore, the amendment proposed for this act was denied by the majority of the Kenya National Assembly during this time [16]. It was not until 2010 that amendments to the aforementioned acts were put in place.

The Alcoholic Drinks Control Act of 2010 was created to primarily control the sale and consumption of alcoholic drinks. However, the amendment of this act, which was written in 2013 and is still in place today, put restrictions upon the “promotion, sale and consumption of alcoholic drinks and the treatment and rehabilitation of persons dependent on alcoholic drinks”

[17]. The Alcoholic Drinks Control Act repealed both the Chang'aa Prohibition Act and the Traditional Liquor Licensing Act, and addressed issues with licensing as a result from these original acts. The amendment also stated guidelines for dealing with the adulteration of, the education in relation to, and the enforcement of the safe consumption of such products [17].

Setting

As previously mentioned, Kibera is located in Nairobi and is the largest slum in Kenya. Although the surface area of Kibera is only 2.38 km², it is home to an estimated 400,000 to 700,000 individuals [4]. This figure results in 300,000 residents per kilometer; a higher population density than the largest slum in Bangladesh (250,000 residents per kilometer). Nearly half of this population residing in Kibera is under the age of 15 [4].

A survey conducted by Research International found that there was an average of five people living in each household in 2004. Overall, there are more females than males living in this area, except between the ages of 26 and 50 where there are more men [4]. Although the average number of children per household has continued to decrease over time, the urbanization of Nairobi has led many people to move to the urban area.

Many rural Kenyans are attracted to Kibera because it is located near the Industrial Area of Nairobi. With that being said, the unemployment rate in Kibera is around 50 percent; a statistic that is higher than the national average [4]. Many households rely on an income of around one dollar per day. Many of the jobs currently held by many of these individuals are informal. With the unemployment rate being so high in this area, many young women have

resorted to selling local brews in order to bring in extra income. Hence, I chose Kibera as my site for this project because home brews are commonly consumed amongst low-income populations.



Above: Satellite image of Kibera [5]

Statement of the Problem

Alcoholic beverages are consumed globally, with a large portion of these being noncommercial, home-brewed alcohols. Nearly 90 percent of the alcohol consumed within East Africa come from these sources due to their affordability [14]. That being said, these brews are generally manufactured illegally. The sanitation conditions of these breweries generally do not meet the standards set by licensing boards, and many manufacturers create adulterated products in order to increase the alcohol content of these brews. Many individuals buy local brews because they are less expensive than commercial products, so they are popular amongst low-income families. This is why I have chosen to conduct my research within Kibera.

Access to clean and safe water is one of the main health issues that Kenyans face. Only a small portion of the population of Kenya have direct access to clean and safe water. With that being said, this water usually lacks the sanitation required in order to be consumed without harming health [18]. This issue with water quality is directly linked to the safe consumption of locally brewed alcohols. One of the ingredients required for the distillation and fermentation of these home brews is water, and water resources within Kibera is of poor quality; the pipes for local water access are generally made of plastic and are easily contaminated with abundant amounts of sewerage [18]. Some diseases which are associated with water in Kenya include typhoid and cholera. This is water which could be used during the processing of local brews, and they present a health danger to those who consume them.

Just last year, in May of 2014, there was a case in which dozens of individuals from various Kenyan counties were killed and even more were blind or otherwise ill from a batch of poisoned alcohol [6]. And this isn't the only incident which has occurred; there have been many other instances in which chemicals have been added as ingredients to these home brews. One of the chemicals which is generally incorporated into the production of local alcohols is methanol, a substance which is detrimental to health and lethal if consumed in high enough quantities.

In my research, I address the issues of sanitation and adulteration. I was already aware that these issues are present in Kenya, but I wanted see how prevalent these problems are within home breweries. My research was specifically important in providing first-hand information as to the process of local alcohols, the sanitation conditions of these breweries, and how their consumption affects social, mental and physical well-being.

Objectives

1. Determine the processes of chang'aa, busaa and muratina;
2. Assess the sanitation conditions of the areas in which these alcohols are produced and sold;
3. Identify the health implications perceived in relation to the consumption of these local brews

Methodology

My research utilizes both qualitative and quantitative methods in order to gain insight about local brews within Kibera. Interviews with producers of these alcohols will provide a basis as to the process required to create the final product. With the help of a local police officer and a village elder, I was able to find the three sources necessary for my research. For this portion of my research, Mr. Ndemwa translated my questions as I took extensive notes as to the step-by-step procedure used in making muratina (mugasha), busaa and chang'aa. Since mugasha and muratina are very common in the way they are produced, I visited a licensed mugasha site and used this information for my research. I also asked the police officer questions regarding the issues associated with licensing and the process of these illicit brews. This mixed method approach to the process is vital because many producers may not include information regarding adulteration, chemicals involved or their source of materials.

The assessment of the sanitation conditions of these local breweries was highly reliant on my observations. For this, I created a check-list which was similar to those outlined by the Kenya Health Act. While conducting my interviews with the producers, I referred to this list and

determined whether the conditions of these breweries are within these guidelines. The issues which were addressed in this reading, as well as during my observations, included sources of material, location of processing as well as nuisances located in the production area [13]. Water was an especially important issue addressed during this portion of my research. Since water is a well-known issue within Kenya, and is necessary for the preparation of alcohol, this is one sanitation issue which may affect the safe consumption of these home brews. After analyzing the sanitation condition of the production site and the hygiene of the producer, I was then able to determine if the site was operating within the issues addressed by the Kenya Health Act and the Alcoholic Drinks Control Act.

The final portion of my research project will address the health implications perceived from the consumption of these local alcohols. This will rely on quantitative methods, such as in-depth interviews with assorted individuals who have information regarding health and the consumption of home brews. Experts from the National Authority for the Campaign Against Alcohol and Drug Abuse (NACADA) in Kenya will be interviewed in relation to the health effects which may be suffered from both short-term and long-term consumption of these local brews. NACADA assists governments in implementing policies and laws to control drug abuse, but they also work with rehabilitation facilities in order to ensure that those suffering from substance abuse receive adequate care. Therefore, their experts will be able to provide information regarding the issues associated with home breweries and how their consumption may be detrimental to health.

I was also able to uncover more information about health in regards to alcohol from the police officer. The police officer provided another source of information about health which came from a different perspective. Unlike the statistics and information provided by health

professionals such as NACADA, this interview was focused on health issues that affect individuals within Kibera. I was able to learn a little about how alcohol consumption affects consumers, as well as their family and friends. Although his information was limited, he provided some insight as to how consumption of these alcohols has affected the social and physical health of local individuals.

Discussion and Analysis

Process

My first objective was to learn about the different processes involved with muratina, busaa and chang'aa. All of the production and distribution sites are located within Kibera. I wanted to uncover what materials and what quantities of ingredients were used, as well as to compare these processes to how similar commercial products are made. Each of the brews in this study are different types of alcohol and therefore require different processes in order to create the final product. Each interview was conducted with either the current producer or a previous producer of either muratina, busaa or chang'aa.

Muratina

I was brought to a licensed producer of mugasha by a local police officer for my first interview. Mugasha is an alcohol with a sweet taste that is similar to muratina, but there are a few differences in their production. As previously mentioned, muratina is also known as “honey beer”. Unlike muratina, mugasha does not use fruit and utilizes an ale yeast. However, the two undergo the same processing stages. The ingredients which are used for this brew are water, sugar, honey, jaggery and yeast. First the producer obtains about 100 liters water, which is tap

water from the City Council. Since the water in Kibera is not always safe for consumption, the producer uses a chlorine-based treatment called Aquaguard; this technique will remove most, of the microorganisms which may be harmful to consumers.

Once the water has been treated and set aside for twenty-four hours, five kilograms of sugar, one kilogram of honey, one kilogram of yeast and an unknown amount of jaggery are combined with the water in a large drum. The yeast used in this process contained *saccharomyces cerevisiae*, which is a top-fermenting ale yeast, also known as “baker’s yeast” or “brewer’s yeast”. *Saccharomyces cerevisiae* means “sugar fungus”; a fitting name as this yeast gets its energy from glucose and uses sugar as its food.

Instead of using specific germination and fermentation processes, the yeast acts as a shorter version of fermentation. Within a three day period, the *saccharomyces cerevisiae* in the yeast ferments the sugar from the ingredients. This process then gives off carbon dioxide and ethanol as by-products, which explains how the finished product contains alcohol. This strain of yeast usually works best in temperatures ranging from 10-25°C, so it does not require any additional heating or cooling. The producer then sells these products to customers for ten shillings per cup.

Busaa

Immediately following my first interview, the police officer then brought me to a licensed producer of busaa. Busaa would be categorized as an ale and its production utilizes both germination and fermentation processes. The three main ingredients in busaa are water, maize and millet. The water used in the process is local tap water from the City Council. First, the maize flour is soaked and mixed in water where it sits for three days. After this time, the maize is

then put into a large pan and roasted over the fire to release most of the moisture, then it's left to sit on a large sheet on the floor. This then needed to be cooled on the ground.

As this process is beginning, millet is soaked in water as the beginning of the germination process. During germination, a grain is soaked in water which produces an enzyme. This enzyme then turns the starch content of the grain into sugar. The millet is then put into a sack to remove most of this moisture, then it is moved to a large sheet on the ground outside. At this point, the millet is sprayed with water every so often for a duration of three days. The millet is then roasted on a pan over a fire before being combined with the maize flour and water.

The final stage in the process of busaa is the combination of the maize flour, millet and water. The producer uses somewhere 90 kilograms of maize flour and three-twenty liter containers of water, for a total of 60 liters. Six kilograms of millet is added to this mixture on the first day, and then two more kilograms are added the next day. This is the fermentation. Although the production did not involve the addition of yeast, the fermentation is somewhat similar to that of mugasha. During fermentation the sugars produced from the germination are broken down into ethanol and carbon dioxide. This is why bubbling can be seen while fermentation occurs. This process takes two to three days. The final product is sold in cups for ten shillings, or cans for twenty shillings. The consumer can choose to either have this as is or heated over the fire for a warmer drink.

Chang'aa

It was hard to find any producers of chang'aa, but I had the opportunity to interview a woman who distributes the alcohol within Kibera. Although the site that I visited in Kibera was not used for the production of chang'aa, the woman was well informed about the process of

chang'aa. The woman I met with was a former producer and had learned the trade from her mother. However, now the chang'aa is made outside and brought into Kibera. She also informed me that the following process is not only what she followed, but also what the producer (whom she buys the chang'aa from) follows.

The beginning stages of the process for chang'aa are similar to that of busaa. First, the maize is ground into flour and mixed with water to form a paste. This is then wrapped in plastic and allowed to sit for one week to remove the moisture. After this time has elapsed, what's remaining is then spread onto a tin pan and roasted over fire. This must be turned continuously until it's brown. The product from this is then combined with 100 liters of water and ten to twenty kilograms of millet in a large, sealed drum and allowed to sit for four to five days. As with the final stages of busaa, this is the final fermenting process. Once this fermentation process has been achieved, the producer filters this with a cloth in order to separate the solid and liquid. Jaggery, sugar and the malted grain are then added to the liquid. This mixture is then set aside and allowed to ferment for one more week.

At this point in the interview, I asked the woman if there was any way to make this portion of the process occur faster. Clearly, this portion of the chang'aa process is time consuming; it takes approximately three weeks to reach this point. So far, this process is fairly similar to that of busaa, aside from the second fermentation stage. Since the two are so alike, the distributor also informed me that a producer could also purchase busaa in order to decrease this time.

The next stage for the process of chang'aa is the distillation. Distillation is a somewhat complicated practice used to create a stronger alcohol content. First, the producer pours the brew into a large clay pot which is heated over a fire. An empty pot is just above the mouth of the clay

pot, and then another pot filled with water is held over the top. The pot filled with water is also covered by a damp cloth and is constantly being changed. The main idea behind this method is to separate the ethanol.

The boiling point of ethanol is about 173.3°F (or 78.5°C), while the boiling point for water is 212°F (or 100°C). Since ethanol has a lower boiling point than water, so it will vaporize before water. The ethanol vapors will rise to the pot containing the water, where it will condense do to the lack of heat. This liquid will then fall into the empty pot. This separation of water and ethanol is how chang'aa and other spirits get their alcohol content.

Sanitation

My second objective was to survey the production or distribution sites and determine their level of sanitation. For this, I created a checklist which I brought with me to each site. As mentioned previously, this checklist was created from the information provided in the Kenya Health Act. These points considered water quality, nuisances (such as presence of animals or offensive odors), location of materials and personal hygiene. I looked at these key points for my analysis, and I also compared each site to the next to see how they differed.

Muratina

I was informed that the mugasha site which I visited was licensed, so I took this into consideration when performing my analysis. During my interview with the producer of mugasha, I learned that city council water was used during production. Kenya has had previous issues with water quality, especially waterborne illnesses. Many of the pathogens associated with these diseases cannot survive in high enough temperatures, however there was no heat applied during

production. Having said that, the producer also informed me that he treated his water with chlorine. Treating the water would avoid the presence of most, if not all, pathogens that may be in the water.

The production site for mugasha was separate from the area where it was distributed. Large drums were used to hold the materials during fermentation. Upon entering the room used for production, I could see that the drums were covered with a lid. This discouraged the presence of flies or vermin, which would create a health hazard due to their ability to transmit disease.

The final product from this site was sold in cups, so I also wanted to know whether these were cleaned regularly. The woman who distributes the mugasha showed me the only sink. She also informed me that the cups are cleaned every day. However, it was hard to determine how often the producer and distributor washed his or her hands.

In my analysis, the mugasha site was, for the most part, operating in accordance with the Health Act. The water was treated in a way which would reduce the risk of contracting any diseases from the source. The production area was kept very clean, and, aside from the large drums, none of the utensils or materials were kept on the ground. Having said this, I think the producer may benefit from the addition of a washroom with an additional sink as I was unable to see if there was one present in the vicinity. The cups should also be cleaned more frequently than once per day. Overall, it is my opinion that the mugasha production and distribution site was operating within the guidelines set by the Kenya Health Act.

Busaa

The busaa production site which I visited was also a licensed brewery. Like mugasha, the production of busaa also required water, and the source was also that from the city council.

However, the producer did not treat the water before it was used in the production of busaa, which compromises the health of the consumer.

There were several more pieces of equipment used during the busaa process. The first was a plastic tarp which where the maize was kept to ferment, which was located on the floor in the back corner of the room. As I walked past this, I noticed how easy it would be to contaminate the maize with dirt from the ground. Similarly, the millet was germinated outside on a tarp. Not only did this also increase the possibility of dirt contamination, but I noticed there was an abundance of wrappers throughout the sample.

My next focus was on the presence of flies and vermin on the premises. Although I did not witness any rats, livestock or pets, I did witness an abundance of flies in this vicinity. The producer also chose to use large drums for the final fermentation process. These drums were not covered, which may have encouraged the appearance of flies. Also, there were flies present around the millet outside. Since flies can easily spread disease, this was a definite health issue.

The final product was sold to customers in either cans or cups depending on their preference. I realized that there was no sink in the main production area where these sources or their hands could be cleaned. Upon my departure, I saw a large bowl which contained many cups and was used to clean them. I learned that the cans and cups were washed outside every day. However, as with the inside of the building, there were many flies landing on these even after they had been cleaned.

This site is clearly violating some important issues raised in the Kenya Health Act. For example, the materials should not be left on the ground as this can cause contamination before they are processed. There were an obscene amount of flies throughout the production area which

poses a risk of spreading disease. Also, it was clear that there were not enough water sources for the producer to wash her hands, and the basin which was used to wash the materials was not hygienic. For these reasons, I would say that this production site was not operating with accordance to the Kenya Health Act, and therefore could negatively affect the health of consumers.

Chang'aa

Although I was unable to see the production area for chang'aa, I was able to take a glimpse at the area in which it was distributed. The woman who distributed the alcohol sold the product from a small room. From this location, I was only able to conclude that there was a basin available for the cleaning of the glass cups in which the chang'aa was sold. The distributor told me that she washes these materials out with hot water after each drink unless the consumer wishes to have another glass.

Unlike the other two sites in which I had visited, the woman was not a licensed producer or distributor. Since I was only allowed to have a small glimpse at this area, it was hard for me to determine why this area was not able to be licensed. From what I could see, it looked as though this distribution site was fairly sanitary. For example, she had a wash basin with warm water, and she had said that she used this to wash the cups, sometimes as frequent as after each drink. That was a characteristic of this site that was very different from the others. However, since I was unable to clearly see the distribution or production area, it's hard to determine whether this site was actually sanitary.

Health Implications

To gain information regarding muratina, busaa and chang'aa in relation to health, I was able to interview a man working for the National Authority for Campaign against Alcohol and Drug Abuse (NACADA). Since this organization works closely with alcohol and other drugs, they are knowledgeable about the health implications related to the consumption of these home brews.

Unfortunately, although I tried to gather as much information referring to these brews as possible, the organization works with alcohol in general. It's especially hard to account for the consumption of the alcohols mainly focused in my study because most are operating illegally and the alcohol is unrecorded. Therefore, although the purpose of this interview was to gain insight as to how these specific alcohols affected health both positively and negatively, I was only able to uncover information about alcohol in general. It is my opinion that the majority of the information provided can be applied to home brews as well.

My first objective during this interview was to see how prevalent the consumption of alcohol is and who is usually affected by its abuse. Therefore, I began by asking him to list the drugs which are most frequently abused in Kenya. The list which he gave me is as follows:

1. **Alcohol**
2. Tobacco
3. Miraa
4. Marijuana
5. Heroin
6. Cocaine

Trends show that most of those who abuse these drugs are low-income, young adults (ages 25-35 years). More specifically, alcohol is most often abused in urban areas, especially urban slums. Having said that, alcohol is cross cutting. This means that it affects individuals of all age groups. The type of alcohol which is most abused in Kenya is illicit brews because of they are inexpensive.

Most of the home breweries, especially those which produce muratina, busaa and chang'aa, are not licensed. This is due to the fact that they do not meet the standards as outlined by the Alcoholic Drinks Control Act. One of the issues associated with the production of these brews that had been mentioned during the interview was related to hygiene and sanitation.

Even with such regulations in place, people are still participating in the production and consumption of these illicit brews. These sites are not licensed, they are able to sell these products throughout the day. There has also been an increasing trend of alcohol consumption among underage individuals. The increasing popularity and availability of these brews has affected the social, mental and physical well-being of Kenyan citizens.

Regarding social health, many incidents have taken place which affect both the consumer and those around them. The consumption of alcohol affects judgement and reaction time. For example, several incidents of assault and domestic violence have been known to be attributed to alcohol consumption. Also, due to impaired reaction time, road accidents are often caused by those who are inebriated. Nearly 8.4% of deaths from alcohol are attributed to road traffic accidents. These sorts of issues can have dire consequences, such as injuries from physical abuse or even death.

Mental health is also compromised when consuming alcohol, especially in excess quantities. Alcohol is considered a depressant, meaning it can cause anyone to feel depressed as they continue to drink. Those who already suffer from anxiety or depression are more likely to feel advance effects. This has been known to result in self-harm, or in less common but more severe cases, suicide.

During this interview, I was also informed of four major problems associated with the consumption of alcohol. Each of these issues plays a role in the physical health of the consumer, and are as follows:

1. High addiction
2. Liver Cirrhosis
3. HIV/AIDS
4. Compliance to medication

My main objective in relation to health was to focus on how the consumption of alcohol can affect the body and its functions. Binge drinking is very high in Kenya. Addiction is hard to treat, but has become more mainstream as alcohol has become more easily accessible. This excess intake of alcohol can have a negative effect on physical health. Although the following information provides statistics for alcohol in general, with illicit brews being common, the details are relevant to my research as well.

The liver plays a vital role in the digestion of alcohol. The main role of the liver is to break down any harmful substances, such as alcohol, or poisons which enter the body. An excess amount of alcohol in the liver can result in both short-term and long-term effects. One example of a lifelong health problem is liver cirrhosis. This occurs when liver cells are replaced by scar

tissue, therefore resulting in a liver which cannot perform normal functions. Although treatment is available, further damage may result in death. In fact, 21.2% of deaths from alcohol are attributed to liver cirrhosis.

As previously stated, alcohol impairs one's judgement, thus their behavior. Therefore, many individuals make decisions without being completely coherent. An example of this would be unprotected sex, which makes the individual more likely to contract HIV. HIV, also known as Human Immunodeficiency Virus, is a lifelong disease that weakens the immune system and is detrimental to health. Due to the effects that alcohol has on the brain, those who are intoxicated may lack the ability to make an informed decision and may result in unprotected sex. During my interview with NACADA, I learned that 5.7% of deaths associated with alcohol are attributed to HIV/AIDS.

Most of the information I had uncovered before starting my research had said that there were two main issues with the consumption of these illicit brews. First, I had read that there had been problems with the addition of methanol to chang'aa resulting in loss of sight or death in some cases. However, when I asked about this matter during my interview, I was told that this was actually the opposite: chang'aa is quite safe. Alcohols which are called second generation alcohols are usually laced with methanol, especially during the months of April and May. Although no one has been able to determine why this trend has occurred, the government has addressed this issue by ensuring that those who are not certified to handle methanol do not.

The other issue which had dealt with the presence of aflatoxins in maize used for alcohol preparation. Aflatoxin has been known to appear in maize, which is an ingredient clearly found in brews such as those in this research. There is a correlation between aflatoxins and liver cancer.

With that being said, I was informed that there are no current studies which have found that aflatoxins affect alcohol consumers.

Conclusion

In utilizing both qualitative and quantitative methods for my research, I was able to obtain information about my three objectives. For my first objective, I wanted to gain insight about the process for muratina (mugasha), busaa and chang'aa. The information obtained would include materials used, steps required as well as elapsed time. In order to do this, I thought it would be best to go to the source: the producers. The methods used included germination, fermentation and distillation processes. Although these local producers may not use the same high tech materials as most commercial brands do, the processing techniques are those which are employed by many alcohol producers globally.

After visiting the three different sites, I was able to analyze and compare their sanitation conditions. I noticed a discrepancy between what was being practiced and what the Kenya Health Act requires for sanitation and hygiene. For example, there were numerous flies in the busaa production area which is detrimental to human health. Also, some materials were kept on the floor, such as the maize flour and millet. During my interview with a local police officer, it came to my attention that these production areas are visited once a year in order to renew their licensing. The producers are actually made aware of this before the visit occurs. This could potentially allow the brewery to make adjustments in order to suit the needs licensing committee.

Health is directly affected by the consumption of alcohol, including illicit brews such as muratina, busaa and chang'aa. Addiction to these alcohols has been an increasing trend, and

overconsumption is common. I witnessed this issue first hand. I visited both the mugasha and busaa production areas around one in the afternoon and the chang'aa distribution area around eleven in the morning. Although licensing states that these sites should only be open between five and eleven in the evening, people were already intoxicated during my visits. This poses an issue to the health of such individuals; as alcohol becomes more available, addiction issues will continue to rise. This will lead to more deaths related to alcohol, such as from cancers or liver cirrhosis.

The enforcement of the Liquor Licensing Act is not reaching its full potential. Not only are individuals able to still produce and sell illicit brews without obtaining a license, but even those who are not licensed are disobeying the law. Aside from those issues discussed earlier, there are still issues regarding the operating hours of these home breweries. These problems increase the likelihood of contracting disease, whether they have short term or long term effects. The police officer informed me that common reasons for why producers cannot be licensed are due to expense, structures or inaccessible locations. However, aside from sanitation issues, the process in making these breweries are safe for consumption as they do not contain harmful chemicals. In knowing that these issues exist, and since illicit brews are common amongst low-income communities, the government should adjust some of their guidelines and provide education about safe production and consumption.

Recommendations

Although I was able to complete my research, I think there are still many possible projects to be conducted in regards to alcohol in Kenya. I chose to conduct my research in Kibera because it's the largest slum in Kenya and I had read previous articles stating that there were known breweries in that area. With that being said, I think looking into other areas would be an interesting research project. This area could be another slum such as the other two we visited during our stay in Kenya (Mathare in Nairobi and Obunga in Kisumu), or even areas which are not slums; drinking these brews may be common among low-income citizens, but others are known to consume them as well. The information gained from this could then be compared to that of previous studies in different areas.

Focusing specifically on noncommercial alcohol, there were a few other ideas which had presented themselves through my readings and interviews. My first idea for research involved a chemical analysis of the brews within my research. In previous readings, I had found that there was a specific issue with the adulteration of chang'aa, so I wanted to see how the results from this analysis would compare amongst the three brews. However, this posed a possible time constraint since I was still focusing on production and sanitation conditions as well.

The police officer that I had interviewed had mentioned issues that many producers had with licensing. For example, structures and the location of these businesses need to fit a certain standard. Regarding licensing, my research only focused on sanitation and hygiene. I think further information about building codes and regulations for breweries could be a possible future research idea.

The most promising idea to me would be research about the second generation alcohols which are legal in Kenya. I had actually never heard of these until my interview with NACADA. I was able to learn that they can be more dangerous than the illicit brews which I had studied because they are more likely to contain methanol. Within this research, it could also be possible to uncover why alcohol containing methanol is more common during the months of April and May than any other point of the year.

As for my study, there are only a few things which I would have changed. First of all, I do not feel as though I was able to gain as much information about sanitation as I could have since I only visited three sites. I would like to have tried to visit two or three sites of each type of alcohol, some licensed, some not, to see how they compared in their process and sanitation. I also would have talked to more individuals regarding health. I wanted to talk to a consumer of one of the alcohols, but I found that I was unable to do so because they everyone was intoxicated before I had even arrived. If I could recommend anything, I would say to incorporate more differing sources of information in order to obtain information from those who are directly and indirectly affected by alcohol.

Literature Review

Muratina, busaa and chang'aa are commonly drunk among low-income individuals because they are inexpensive. But, there is a higher cost involved with their consumption: health. The lack of sanitation and proper, quality materials used to make these brews has presented health risks associated with their consumption. Because these alcohols are often not legal, they are not tested for their safety, which compromises the well-being of the consumer. Although I

was unable to uncover much information regarding adulteration taking place during the process of illicit brews in my research, there are many studies which have shown that there tends to be a prevalence of harmful chemicals within these homebrews.

One study conducted in June of 2013 looked into the prevalence of nitrate within these home brews. Sources of nitrate include fertilizers and animal waste, which may also affect water sources via agricultural runoff [8]. Nitrate is relatively harmless, but when it is converted to nitrite in the body, it can have detrimental health effects. For example, nitrite can convert hemoglobin and iron to methemoglobin [15]. Unlike hemoglobin and iron, methemoglobin cannot carry oxygen. This limits the amount of oxygen that your body carries, and this disease may result in seizures or even death [15]. With the poor sanitation in Kibera, these studies should be conducted to ensure the safety of health in Kenya.

The study was conducted in several areas within Nairobi, including Kibera. Although the Kenya Bureau of Standards does not have a set requirement for alcohol, the Alcohol Measures for Public Health Research Alliance has set a recommended maximum contamination level at 500 mg/l [8]. The findings revealed that, within Kibera, each of muratina, busaa and chang'aa had levels of nitrate which averaged around 40 mg/l [8]. This means that the average level of nitrate in these illicit brews did not exceed the contamination level. With that being said, only a limited amount of alcohol should be consumed as to ensure that the body does not suffer from diseases associated with nitrate and nitrite.

In my readings, one of the most common chemicals to be added during processing is methanol. Chang'aa originates from the early 1900's, but the brew which is made today is quite different from its initial processing. During the 1990's, many individuals began to suffer from economic hardship. This had a direct effect on the amount of alcohol which these people could

purchase. Therefore, in order to get the same feeling of intoxication for a lower cost, producers began to add other materials such as formaldehyde, alkaline battery content or airline fuel in order to increase the alcohol content [2]. These materials expose the consumer to harmful substances such as lead, DDT, and mercury.

Nowadays, producers have realized that the addition of ethanol would also strengthen the alcohol content. This, too, has presented a problem as most producers are not knowledgeable in chemistry and have been known to add methanol instead. Methanol is much more toxic than ethanol; when consumed at high enough levels, its consumption can lead to blindness or even death. Kenya has suffered dramatically from the addition of methanol to brews. Even though the government has adopted regulations which do not allow for unlicensed individuals to handle methanol, there are still trends showing that people are dying from drinking alcohol laced with this chemical.

In *Potent Brews: A Social History of Alcohol in East Africa (1850-1999)*, author Justin Willis actually addressed the issue regarding adulteration through the addition of methanol, “...well-known public tragedies of poisoning seem to be associated with the adulteration of beverages with industrial ethanol or methanol, rather than with the products of local distillation” [19].

Another study conducted in August of 2013 within the Nairobi County was concerned with the arsenic levels within homebrews and water samples. High levels of arsenic are toxic to the body, and has been linked to many forms of cancer such as bladder, lung, skin and kidney cancers [9]. The toxicity levels of arsenic vary depending on the contaminated sources. For example, levels found at or over ten parts per billion have been linked to various forms of cancer, such as those listed above [9].

Although the World Health Organization set a limit of 0.02 mg/L for alcoholic beverages, the Kenyan Bureau of Standards has set a maximum concentration level of arsenic in homebrews at 0.1 mg/L. The median arsenic concentration within alcohol sampled was 0.39 mg/L: much higher than the allowable limit [9]. The levels of arsenic within these homebrews poses a great threat to lifetime health of consumers. Therefore, the government should be taking the necessary precautions in order to ensure the safe consumption of these alcohols.

Aside from health risks associated with the process of the illicit brews, I also came upon several diseases which can be contracted in poor sanitation conditions. During my research, I wanted to also examine the sanitation conditions in which the production of these alcohols were taking place. In *Environmental Health for East Africa* by Gerald K. Rukunga, he states that the low pH of fermented foods should help with spoilage and are generally antimicrobial [18]. Having said that, there are still guidelines in place to ensure that sanitation issues are being addressed in food and beverage production.

In the food industry, it's always better to be precautionous at every stage so if contamination does occur, it will be easier to determine the source. Some of these objectives are highlighted in this book. For example, questions such as "Is there an established pest control programme for rodents, insects, birds and other pests?" or "Is the product susceptible to microbial growth?" [18]. These questions are important to consider when determining how sanitary these conditions are.

One of the major issues associated with poor sanitation which Kenya regularly faces is water-borne diseases. Examples of these diseases include typhoid and cholera, and breakouts occur almost annually. For this reason, I was majorly concerned with the sources of water used in the process of those alcohols outlined by my study. Diarrhea is a disease which kills many

young children, especially those who are malnourished according to Rukunga [18]. Different microorganisms enter the water supply, and the consumption of this contaminated water is how the individual contracts the disease [18]. Poor sanitation conditions and use of contaminated drinking water are associated with high incidence of diarrhea, as well as typhoid and cholera.

Although Rukunga also states that fermented products are preserved by their low pH, he also continues by adding that sanitary procedures should still take place due to prevent potential sources of contamination. One of these procedures would be the water treatment. The muratina production site which I had visited utilized chlorination in order to treat their water source. According to Rukunga, this is one of two conventional ways to ensure the sample does not contain any dangerous microorganisms (the other being iodination) [18]. Even in the presence of ammonia, although it would require more time, the chlorine would still have the ability to remove chemicals which are present.

While adulteration, sanitation and the presence of chemicals do present health risks, there are many forms of alcohol which have been shown to have positive effects on health as well. For example, while the French consume a large quantity of fat, this is addressed with the consumption of wine which contains resveratrol. This is known as the French Paradox. Similarly, the illicit brews of Kenya may also present positive health effects when consumed in moderation. Mainly, unstrained grain beer, such as that which is produced in Kenya, has a high vitamin-B content, and can therefore be of importance in providing vitamins to low-income individuals or those who are malnourished [19].

Aside from the health benefits related to alcohol, there are also social health and economic benefits as well. Even when the consumption of unstrained grain beer was popular, many tried to discourage its use. It was deemed a “wasteful use of foodstuffs” in hardships and

was often consumed instead of eating food during these times [19]. However, this is a misconception as the consumption of these alcohols has actually been of importance in “increasingly money-oriented economies” [19].

My overall focus with my research was to address how the processing and consumption of alcohols, and the conditions of the production areas could affect overall health. Although there has been significant research in relation to illicit brews in Kenya, there are mixed conclusions. Some studies have shown that there are chemicals which are detrimental to health, while others have shown that these alcohols contain vitamins essential to physical well-being. These pieces of literature provided information which I considered during my own research.

Unlike the studies discussed above, my research focused on the production of three different brews: muratina (mugasha), busaa and chang’aa. I was able to interview individuals who produced these alcohols. However, I may have not witnessed any adulteration take place because I was unable to actually see the process occur. As a food science major, sanitation is a key component in the safety of food and beverages. I had no previous knowledge of sanitation requirements in Kenya, so my literature helped me learn about the issues which should be addressed. Also, with the abundance of information regarding the negative effects that illicit brews could have on health, I also wanted to focus on the positive attributes. Since I was unable to uncover any in my research, Willis was able to further inform me about the benefits of drinking local alcohols. These works were able to give insight towards the objectives in my research and successfully tie them all together with health as their commonality.

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Appendix A- Sanitation Checklist

Sanitation Observations

- Is water present? Yes No
 - What is the source for the processes? Tap cans bottles
 - If this is cans or bottles, are they reused? Yes No Cleaned? Yes No
- Presence of: Water-tank Drainage system Sewer Toilet
 - Where are they located?
 - Are there any offensive odors coming from these sources? Yes No
 - Who is responsible for cleaning the toilets?
 - Are they public or private? Public Private
- Raw Materials
 - Where does germination occur? Floor Table Other: _____
 - Where does fermentation occur? Floor Table Other: _____
 - Where does distillation (chang'aa) occur?
 - Are flies present? Yes No
 - How often is water changed? Where?
 - How are these brews served or sold? Cups Bottles Other: _____
 - How clean are the vessels in which they are served?
 - Where are these materials stored? Fridge Closet Other: _____
- Nuisances
 - Are animals present in the workplace? (Examples: Vermin, pets, livestock, birds)
Yes No
 - If yes, explain: _____
 - Is there manure present? Yes No
 - Is there proper ventilation? Yes No
- Hygiene
 - Does the producer wash his/her hands? Yes No
 - If the producer has long hair, is it tied back and/or are they wearing a hair net? Yes No
 - How often are utensils cleaned?

Appendix B- Interview Questions

Process:

What are the alcoholic beverages consumed?

How and where are they made (differences among chang'aa, busaa and muratina)?

What materials are used during the process of these home brews? What size?

Are there outside sources?

Are these beverages being produced in one site and sold in another?

What are the typical ingredients or chemicals involved with the process of chang'aa, busaa and muratina?

How long do the germination and fermentation processes occur?

How do you keep these materials moist? What about distillation?

What temperature is this prepared at?

Sanitation:

What are the usual sources of water?

What sort of conditions are needed in order to be licensed?

How often are these visits?

Health Implications

What are the most commonly abused substances?

Which forms of alcohol are most commonly consumed?

What do people usually suffer from?

How prevalent are diseases contracted from the consumption of these alcohols?

How does this consumption affect mental health?

Health problems suffered? Impacts on social well-being?

Are there issues of getting arrested? For what?

What are the statistics in relation to death from alcohol?

Is there an issue with chemicals being used, especially in chang'aa?

Are aflatoxins a health risk to those who consume beer from maize?

Appendix C- Interview Notes

Muratina Producer:

- ✚ Licensed
- ✚ Mugasha- like muratina
- ✚ Water supply is from city council and is treated with chlorine-based treatment (Aquadguard)- this takes about 24 hours
- ✚ Add sugar, honey, jaggery
 - 100 L water, 1 kg yeast, 5 kg sugar, 1 kg honey
 - Yeast- *saccharomyces cerevisiae*, Emulsifier- Sorbitan Monostearate E 491
- ✚ Leave for three days at room temperature
- ✚ Sold in cups for ten shillings
- ✚ Bins are covered so flies don't get in
- ✚ Wash basin used to clean cups everyday

Busaa Producer:

- ✚ Licensed
- ✚ Open Containers
- ✚ No Sink, but wash basin outside for washing cups- surrounded by flies
- ✚ More flies
- ✚ Fermentation on floor
- ✚ Maize flour soaked in water, mix, sit for three days, roast (fire), let cool on sheet on floor, put into water for two to three days for fermenting
- ✚ Ground millet is germinated with water
- ✚ Water source: tap water (city council)
- ✚ Millet sits outside after soaking in water overnight, put in sack, sprinkled with water for three days (germination)- flies present during this process
- ✚ Heat the millet after germination, then mix with water and maize flour
 - 90 kg maize flour, three 20 L of water, six kg millet one day then add two the next
- ✚ Sold in cans for 20 shillings or cups for ten

Chang'aa Distributor:

- ✚ Not licensed
- ✚ Not brewed in Kenya, but she learned from her mother and knows how
- ✚ Maize ground to flour, mixed with water, forms paste, wrapped in plastic for one week
- ✚ Spread on thin tin, heated to roast (turn it continuously until it's brown), put into drum with 100 L of water, add millet (10-20 kg), seal the drum and wait four to five days (fermenting)
- ✚ Filter using cloth to separate solid and liquid
- ✚ Add in jaggery/sugar to liquid, add malted grain again and let ferment again for one week

- ✚ Can buy busaa to make this occur faster, then continue the process from there

Mr. Ndemwa then provided a drawing of how the woman described that the distillation took place

- ✚ Sold in 200 ml for 100 shillings
- ✚ Basin for washing hands and cups
- ✚ Hot water after each drink (unless they want more)

Police Officer:

- ✚ Chang'aa produced, not licensed
 - Hard to identify where they are
- ✚ Water source is from city council (even in homes)
- ✚ Normal to make and sell in the same area
 - *Chang'aa might be brought from other places
- ✚ Might be other places for busaa and muratina, but not licensed
- ✚ Hours are usually from 5-11 pm for weekdays
- ✚ Public Health Office, sanitation must be considered, go through inspection about once per year, producers known when they're being inspected
- ✚ Issues with consumption include neglecting children, liver issues, people shake, very red lips (skin begins to peel off)
- ✚ Sanitation and hygiene issues
- ✚ Issues with government regulation: licensing is expensive, structures or buildings, capital problems, sanitation, location (not easily accessible)

NACADA:

- ✚ Drugs most commonly abused:
 1. Alcohol (cross cutting)
 2. Tobacco
 3. Miraa
 4. Marijuana
 5. Heroin
 6. Cocaine
- ✚ Usually consumed by low-income, young adults (25 to 35 years)
- ✚ Illicit brews most common (unrecorded alcohol)
 - Most are not licensed
 - Don't meet standards
 - Common among poor
 - High in urban areas, especially urban slums
- ✚ Abuse and high addiction
- ✚ Sell throughout day making them available

- ✚ Underage
- ✚ Higher Crime Rate
- ✚ Hygiene issues
- ✚ Problems associated with consumption:
 1. High addiction- hard to treat
 2. Liver Cirrhosis
 3. HIV/AIDS- behavioral issues
 4. Compliance to medication
- ✚ Discipline- binge drinking is very high
- ✚ Social issues: harm to others, domestic violence, self-harm, road accidents, advance effects of alcohol on depression
- ✚ Mental health: not as much from alcohol, usually from use of other drugs
- ✚ Chang'aa is quite safe:
 - Second generation alcohols (legal)
 - Cheap spirits
 - Add ethanol to make spirits or fortified wines
 - Add methanol by mistake
 - April and May- usually when methanol is added
- ✚ Tighten handling of methanol, get escorted from port to place of usage
- ✚ Kenya Revenue Authority auction methanol from port, but that's no longer a trend
- ✚ You cannot handle methanol unless you are certified
- ✚ Deaths from alcohol:
 - 39.2% of cancer
 - 21.2% of liver cirrhosis
 - 17.6% of alcoholism
 - 8.4% of road traffic accidents
 - 5.7% of HIV/AIDS
- ✚ Risks of aflatoxin and consuming alcohol are not known
- ✚ Cancer of the liver and aflatoxins are related