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Research Article

Microbiological Quality of Human Milk: A Research on Pumwani Maternity Hospital Milk Bank

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ABSTRACT

The first hospital to have ever formerly frozen and distributed donor milk was launched in Vienna in the year 1909. Currently, there are more than 500 nonprofit human milk banks operating in around 40 countries run by either charities or hospitals with Kenya being the third country in the sub Saharan Africa to have done so at the Pumwani maternity hospital establishment.

The hospital's human milk bank pasteurizes milk for the mother's own hospitalized baby (personalized milk) and for donation however before doing so, the milk should be screened for presence of potential pathogenic microbes for instance Staphylococcus aurous and total aerobic flora thanks to specific legislations that regulate the activity of human milk banks. Any sample of milk that is found to test positive for either of the above mentioned microbes is acknowledged unfit for human consumption and discarded.

The purpose of this study is to determine the prevalence of potentially pathogenic microorganisms that indicate the hygienic and sanitary conditions of human milk sample collected at the Pumwani maternity hospital milk bank. One hundred samples of human milk will be collected from the Pumwani maternity hospital milk bank (both pre pasteurized and post pasteurized), and submitted to the laboratory for microbiological analysis. Later on the samples will be plated on both McConkey and Blood Agar media depending on the type of microbe.

The results will be read 24 hours later and submitted back to the Human Milk Bank (HMB) department. This will provide great information to the department concerning the hygiene of the procedures involved particularly during pasteurization and assist in improving where flaws have been spotted for better services.

Keywords: Microbiology; Personalized milk; Human milk; Human milk bank

INTRODUCTION

Infant and neonatal mortality remains a challenge in Kenya. Despite progress over the last decade, Kenya did not achieve the MDG 4 target of two thirds reduction in child deaths by 2015 of all the child health indicators, the Neonatal Mortality Rate (NMR) has demonstrated the slowest decline from 33 deaths/1000 live births in 2013 to 22 deaths/1000 lives births in 2014. This was against an MDG target of 15 deaths/1000 live births by 2015, as such neonatal mortality now contributes 40% of all infant deaths in Kenya. With the SDGs calling for an end to all preventable child deaths by 2016 and reduction of neonatal mortality to at least 12 deaths/1000 live births, more effort and resources need to be focused on this critical vulnerable period of life. Currently, prematurity and Low Birth Weight (LBW) is the leading causes of dealth among children under 5 around the world and a leading cause of disability and ill health later in life. Globally, 15 million premature babies are born every year with about 1 million dying as a result of complications related to preterm birth. In Kenya, an estimated 193,000 babies are born premature every year and 13,300 die annually from complications related to prematurity [1].

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Breastfeeding is the single most powerful intervention for the reductions of infant deaths as human milk contains unique properties not just for the nutrition for the infant but for development of a healthy immune system. In addition to the proven effect of breastfeeding on mortality, breastfeeding protects against infectious diseases, improves cognitive function and may protect from the acquisition of metabolic later in life. For preterm and LBW babies, feeding on breast milk as opposed to formula or other substitutes results in better outcomes, shorter hospital stay, less frequent infections and decreased rates of feeding intolerance and necrotizing enterocolitis a devastating disease that affects mostly the intestine of premature infants where the wall of the intestine is invaded by bacteria, causing local infection and inflammation that can ultimately destroy the wall of the intestine.

Additionally, due to psychological or emotional reasons, some mothers are unable to produce milk. On the other hand milk derived from animals may trigger allergies. For these and many other reasons, a lot of infants rely on HMBs for their milk. The microbiological quality milk from HMBs is a public health issue because the consumers of this milk have low resistance to neonatal infections. The most pressing issue concerning HMBs is the bacteriological control of this donated milk, for the consumption of milk that has been contaminated may be the reason for contraction of neonatal diseases. It is therefore important to acquire epidemiological statistics on bacterial contamination of human milk and educate mothers, nurses, pediatricians and any other practitioner that is involved in the handling of infants to make them aware of the risks involved in the preparation and consumption of human milk [2].

Statement of the problem

Neonates and infants are very delicate beings since their immune system is not that well established to fight off either bacterial or viral infections. In count to that, some of these infants are incapable of suckling their mothers owing to several inescapable reasons like prematurity or infected mothers who might pass a particular disease to the newborns and consequently they place a heavy reliance on Human Milk Banks for milk that is essential for their survival because it carries with it nutrients that are vital to these infants at that stage of life. This milk therefore needs to be free from any contaminants that might otherwise endanger the life of its consumers particularly infants and hence before being administered to them, it has to undergo thorough screening to ensure it is safe for consumption.

Contamination becomes one of the main challenges in HMBs and to curtail it, stringent measures like quality assurance particularly hygiene maintenance must be put in place to guarantee that no infections are transmitted by these microbes to infants. Milk stored in milk banks at times may become contaminated with either pathogenic or potentially pathogenic bacteria despite the sterilization procedures involved and when consumed by either neonates or infants, may transmit infections. This therefore questions the hygienic procedures involved more specifically, pasteurization and possess a challenge to these Human Banking Institutions to come up with much better and advanced ways to control the contamination of the donated milk.

Donated milk is pasteurized and tested with mother and baby safety at the fore front. The process of pasteurization preserves most of the milks nutrients and immune properties apart from killing bacteria. However pasteurization is not an assurance of the safety of donated milk because the general hygiene of the institution should be the main concern. According to the professor of internal medicine in the division of infectious diseases at Virginia Commonwealth University, hand hygiene works for so many different types of microorganisms in the aim of preventing infectious diseases. This is because the hands come into contact with a lot of surfaces carrying with them both pathogenic and potentially pathogenic microbes and transferring them to the next surfaces that they contact. The most common bacterial species found to be transmitted through the hands include Klebsiella spa and Staphylococcus aurous and when these infect milk, they are pathogenic [3].

MATERIALS and METHODS

A brief introduction to human milk banks

Also called a breast milk bank, a human milk bank is a facility that collects, screens, processes and dispenses according to prescription human milk that has been donated by mothers who are necessarily not biologically related to the recipient infants. Nevertheless, the consumers of this milk are not only infants but also adults with medical conditions who are not able to feed themselves or rather can only consume a specific category of food. Newborns therefore become the main consumers of donated breast milk whose optimum source of nutrients is breastfeeding and if possible for the first year. Human milk banks offer a solution for mothers who are unable to supply their own milk to their children due to unavoidable circumstances for instance putting the infant at a risk of acquiring infections or disease that he would be transmitted from an infected mother, low birth weight of the infant and such at risk for conditions such as necrotizing enter colitis or when a mother is unable to produce milk for her infant due to her medical condition [4].

Mother who is interested in donating their excess milk undergoes a screening procedure that includes a questionnaire as well as health screening. All donated milk is tested, pasteurized and frozen ready to be supplied to the vulnerable babies who need it. All healthy breastfeeding mothers are potential donors. Other donor selection criteria followed include:

- Non smoker
- Non drug and alcohol user
- Living a healthy lifestyle
- Willingness to undergo screening procedures that involve HIV, VDRL (a test for syphilis), TB, Hepatitis A and B.

Human milk banking is important because human milk is easily digested by a premature baby. It also provides immune factors that protect the baby against infection, allergies and illnesses as at their stage of life; their immune system is not very well

established. It provides all the nutrients babies need for their growth in the first 6 months of their life. As per the WHO, Human Milk Banks are a safe way of providing safe breast milk to babies who need it the most and has asked countries to promote the use of safe breast milk to babies who need it the most [5].

History of human milk banks

When a woman breast feeds someone else's baby it's called wet nursing. It was an ancient occupation mentioned in many early medical texts including those by Aristotle and Ibn Sina. Wet nurses may act as foster parents for motherless babies or those whose mother was simply ill or not able to produce enough milk. The first record of regulations regarding the sharing of milk is found in the Babylonian code of Hammurabi.

By the 11th Century, European culture considered breastfeeding indecent which led to wet nursing becoming a common practice among royalty and aristocracy in Europe. The practice of wet nursing declined by the 19th century due to concerns regarding unhealthy lifestyles by nurses. The medical community therefore began running alternative researches where neonates can be fed. Theodor Escherich of the University of Vienna conducted studies from 1902 to 1911 investigating different sources of nutrition and their effects on neonates. His studies demonstrated that breastfed neonates intestinal bacteria was significantly different compared to neonates fed by other means. In 1909, Escherich opened the first human milk bank in the US. The 1960's saw a decline in milk banking because of recent advances in neonatal care and baby formula. Despite these advancements, the WHO and United Nations Children's Fund (UNCF) in 1980 maintained their position that donor breast milk is the best alternative to mother's breast milk [6].

Currently, improved screening methods and standardization procedures have made donated milk a viable alternative to the breast milk of a mother. The ability to pasteurize and store breast milk for up to 8 months since its donation means that human milk banking could become a global enterprise. Contamination as a challenge to human milk banking (*S aurous, Enterobacteriaceae coli*, coliforms yeast and molds).

The presence of high levels of contaminants in raw human milk entails in a reduction of its biological benefits because its nutrients are being utilized by microflora present in the milk thus diminishing its protective immunological qualities. These situations majorly lead to classification of the milk as improper for consumption taking into consideration the vulnerability of infants and therefore is discarded leading to huge losses. Moreover, the greater the quantity of microorganisms present in the milk, the less efficient the process of pasteurization will be [7].

Staphylococcus aurous

The prevalence of *S aurous* in the oropharynx of human beings varies from up to 35%-40% and in the mouth and saliva, 10%-35%. However its presence in the human milk may be from secondary sources such as the skin and nasal fossa or unsatisfactory or unhygienic or sanitary conditions of the utensils employed in its manipulation. The greatest concern with respect to its presence is the occurrence of strains which produce toxins that are resistant to pasteurization [8].

Pereira reported the presence of *Staphylococcus* in all the samples of maternal milk collected from 19 women with symptoms of mastitis. Among the 19 samples, 8 were shown to have detectable quantities of enterotoxins, being that in some cases it was observed that they also produced the toxin of the toxic shock syndrome. As to the raw milk, the results presented in the study are similar to those reported by observed *S. aurous* in 13 of 207 samples of expressed human milk. Other researchers found coagulase positive *Staphylococcus* in different proportions of human milk samples submitted for analysis *i.e.* 28.1% by Nicomedia 16%, 29% by 51.7%.

Enterobacterias

Isolated enterobacterias in 18% of the 51 samples of colostrum that they submitted for analysis, revealing the low level of personal hygiene and conditions of the study population, living in the small village of Santa Maria Cauqui in Guatemala [9].

RESULTS AND DISCUSSION

Other authors found *E coli* in 8.5% of the 59 samples of maternal milk, in 2% of 44 samples thus indicating the fecal contamination of the milk, and Enterobacterias in 15 (7%) samples. This therefore presented inferior hygienic conditions [10]. Among the enterobacterias, coliforms have been singled out as particularly important in bacteriological control of HMBs since their presence may indicate fecal contamination even if it originates from an indirect source and doesn't necessarily imply in the isolation of *E coli*. Research indicated that contamination by coliform microorganisms may originate from the environment as observed in the study where a group of bacteria were isolated in 38.4% of a total of 472 milk samples and among 5,710 samples, coliforms were detected in 1,139 and in 837 samples, 71 of them were contaminated while only three of these were *E coli*. This indicated that the efficiency of pasteurization may be compromised by an initially high count of microbes (Table 1).

Table 1: Despite progress over the last decade.

Year	Deaths	Out of lives
2013	33	1000
2014	22	1000

2015	15	1000
2016	12	1000

Yeast and molds

The presence of molds and yeast in foods may also indicate contamination originating from the environment or resulting from handling in hygienic and sanitary conditions. Almeida found a 69.4% prevalence of fungus and yeast in samples obtained after employing the usual measures of hygiene (soap and water) on the mammary gland. Other researchers however observed 230 of a total of 7,570 samples analyzed contained mold and yeast. The percentages of mold and yeast detected in the pasteurized milk are a matter of concern for they indicate a possible environmental contamination occurring after the process of pasteurization or that the process itself may be ineffective. The presence of pathogenic yeast in pasteurized human expressed milk breastfeeding. Quality control by means of yeast counts in expressed milk may be a good indicator of problems relate to hygiene, storage and transportation [11].

Inadequate pasteurization not only presumably endangers the beneficial properties of expressed human milk, but may also increase the susceptibility to subsequent contamination. The study will utilize an experimental research type of design where the cause (contamination of milk by microorganisms) and effect (discarding of contaminated milk and causing diseases) of a situation is established [12].

Sampling method

Simple random sampling method will be chosen for this study where milk samples will be randomly selected with each sample having an equal chance of being chosen.

Materials/instruments:

- Donated human milk
- Media; blood agar and McCaskey media
- Petri dishes for culturing
- Sterile inoculating sticks

Sample size

100 samples of human milk will be collected from the Pumwani maternity hospital milk bank and submitted to the laboratory at the same facility for microbiological analysis.

Sample collection

From the Pumwani maternity hospital milk bank, 50 samples will be collected from donors who must meet certain requirements including,

- Being healthy.
- Being in the process of lactation.
- Must have tested negative for VDRL (a test for syphilis).
- Must have no evidence of neither Hepatitis A nor B.
- Must be HIV negative.

Among these 50 samples collected, 40 of them will be pre-pasteurized whereas 10 will be post-pasteurized which will be packaged and sent to the lab for microbial analysis.

Sample plating

The milk samples received at the PMHL both pre and post pasteurized will be plated on both Blood agar and McConkey media that will be prepared following the manufacturer's instructions and based on the type of bacteria that will be isolated, posterior identification will be undergone in appropriate media for instance bacteria pertaining to the Staphylococci genus will be tested for their capacity to produce coagulase (coagulase test). To distinguish between the gram positive and gram negative bacteria, a gram staining technique will be conducted. Yeast and molds can be identified macroscopically based on the formation of their colonies on the media. They can as well be identified by means of a technique that involves plating the samples on a 10% PDA (Potato Dextrose Agar), acidified to a PH of 3.5 e.g. by tartaric acid and incubating at 250°C for 5 days to 7 days [13].

The data obtained daily will be documented. Quantitative data will be entered into Ms. Excel to establish a primary database. Descriptive and inferential statistics will be used. For descriptive statistics, measures of dispersion will be analyzed (variance, standard deviation). Measures of central tendency will also be used (mean).

CONCLUSION

This research will clearly provide a number of benefits to the beneficiaries, particularly neonates and infants who cannot suckle their own mothers. Benefits. Children who cannot suckle their biological mothers will have an alternative source of nutrition that is reliable and healthy. The sanitary conditions involved in the handling and processing of milk will be adjusted to reduce levels of contamination and consequently transmission of neonatal infections. The most common microbial contaminants will be realized and stringent measures to curb their spread to milk will be established. Explanation of the benefits; Due to lack of a well-developed immune system, neonates can easily acquire neonatal infections through consumption of contaminated milk that may have been invaded by microorganisms through unhygienic handling. Realizing the sanitary procedures that are not being observed will provide the institution and related bodies with an overlook of the situation and come up with new ideas on how to deal with the invasive pathogens.

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