Sudan University of Science and Technology

College of Graduate Studies

Effect of Milking System on Total Bacterial Count in Cow Raw Milk

تأثير نظام الحلب في العد البكتيري في لبن البقر الخام

A thesis submitted in partial fulfillment the requirements of the Degree of Master in Science of Animal Production

By

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الآية

قال تعالى:

(أَوَلَمْ يَرَوْا أَنَّا خَلَقْنَا لَهُمْ مِمَّا عَمِلَتْ أَيْدِينَا أَنْعَامًا فَهُمْ لَهَا مَالِكُونَ *وَذَلَّلْنَاهَا لَهُمْ فَمِنْهَا رَكُوبُهُمْ وَمِنْهَا يَأْكُلُونَ * وَلَهُمْ فِيهَا مَنَافِعُ وَمَشَارِبُ أَفَلَا يَشْكُرُونَ)

صدق الله العظيم

سورة يس ، الآيات (71-73)

Dedication

To my dear family; father, mother, brother and sisters.

To my dear friends and colleagues with love and respect to my dear teachers.

Acknowledgement

I am indebted to "Allah" who granted me everything including mind, health and patience to accomplish this work.

I wish to record my gratitude to my supervisor Dr. Ahmed Khalil for patience, guidance, advice and support.

I am happy to acknowledge the assistance of the department and staff of diagnosis and tests in Lab.,especially.

I would like to thank all the farmers and my colleagues; Osman, Salah Edin, , who provided me with samples and information.

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Abstract

This study was conducted to determine the effect of the milking system on the bacterial count in raw milk.
This experiment was conducted on different milk samples taken from two different Aleppo systems.
.The results showed significant differences (0.05) in the bacterial count of manual and automatic milking samples for bacterial types Bacteria (bacillus, staphylococcus, salmonella, E.coli , Streptococcus and micrococcus) (25, 16,7,25,0,8,0,25,16,7,16,8) respectively, where the results showed that the milking mechanism is better than manual milking.
The results also showed significant differences at the mean level (0> 0.05)).
The acidity of milk in both manual and automatic milking samples was significantly lower than that in the manual milking machine (0.11 ± 0.01,0.19 ± 0.21) respectively. This was in favor of machine milking.

المستخلص

اجريت هذه الدراسة لمعرفة اثر نظام الحلب على العد البكتيري في اللبن الخام.
تم اجراء هذه التجربة على عينات اللبن المختلفة المأخوذة من نظامين حلب مختلفين.
.حيث اظهرت النتائج وجود فروقات معنويه عند مستوى المعنوية (>0.05) في كلا من العد البكتيري لعينات الحلب اليدوي والآلي لأنواع من البكتيريا وكانت البكتيريات (باسلس ، استافيلوكوكاس، سالمونيلا ،إيكالاي ، استربت وكوكس و ميكرو كوكس) نسبة البكتيريا
(25 ,16,7,25,0,8,0,25,16,7,16,8) على التوالي حيث اظهرت النتائج ان الحلب الآلي افضل من الحلب اليدوي كما اظهرت النتائج وجود فروقات معنوية عند مستوى المعنوية (0>0.05) لحموضة اللبن في كلا من عينات الحلب اليدوي وللآلي وكانت نسبة الحموضة في الحلب الآلي اقل من نسبته في اليدوي وكانت كالاتي (0.21± 0.11±0.01,0.19) على التوالي وكان ذلك لصالح الحلب الآلي.

CHAPTER ONE

INTRODUCTION

Khartoum state is the Sudan political and economic capital. The climate is considered as a semi desert very hot in summer and rather cold in winter. The animal population in the state in 2000 was almost 1.2 million heads (cows, goats, camels and sheep) divided into two systems; modern and traditional system, 222.000 heads are cows of different breeds.(Ministry of Agricultural and animal wealth,2005)

The milk consumption in the state was estimated in 1999 to be 400.000 tons although the actual 360000 tons were produced in the state, almost 95% of this was milk produced from cows (Awad, M, 2006).

Milk is the most complete food for all mammals and this is especially true during the early period of the life until weaning, it supplies the body with protein, at, carbohydrates, minerals and vitamins in manner to suit the nutritional requirements of the body (Omer, 2006).

Milk and dairy production have become major part of the human diet in many countries over many years considerable attention has been paid to improve the yield, compositional and hygienic quality of milk (Harding, 1999).

***The Objectives of this study are :**

1)To assess the effect of milking machine on bacterial count of bacteria.

2) To raise sensitizing about food safety and concerns made about the presence of microbes in the milk.

3) To determine the level of the existence bacterial count of hand milking and milking machine in some areas of Khartoum State.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definitions

Milk is the physiological secretion of the mammary gland of mammals to provide nourishment for their young. Throughout history man has recognized the milk value and dairy products as food not only for the young but also for the adults(Nikerson, 1999).

The Sudan University of Science and Technology farm:

The University of the Sudan Higher Studies farm is located in the western Bahri, which contains about 19 hybrid cows, including 10 cows and open-sided buildings in the gable system. There are other barns, sheep and goats, and the milking is based on the manual system morning and evening and natural ventilation in the barn, and there are Entrances for vehicles transporting fodder.

Oud Al Lail Farm:

Located in Abu Halima, north of the Bahri, which also contains pens of the open-ended type, the farm has a population of about 200 dairy cows, of which 93 are cow, the milking system is automatically by skilled labour, Aleppo morning and evening, natural ventilation, and the farm contains trees, an entrance to the fodder carts and the carriage Bin.

The overall effect of the lactoperxsedase (Lp –S) is bacterolictic in fresh raw milk. It is important that the system is applied / activated within two hours of milking to have full effect before there is abloom of bacteria activity in the raw milk, recent scientific research also indicates that the (Lp-S) also has a slight restructure effect on E. coli, the system cannot in improve the bacterial quality of milk but maintains the bacterial quality of milk to that of the application . Although the codex Guideline refers to " raw milk bovine and buffalo" , the Lp-S has also been shown to be effective in the preservation of other types of milk including cameelids. Additional research across a boarder

number of lactating species is ongoing and we except that other species will be included in the guideline in the coming years (FAO,2016).

The vital factor and health value of milk result from the optional balance of its components (Ocana, 2006).

FAO (1997) reported that, composition of milk varies considerably depending on specicies, breed feeding, health status and stage of lactation. The average composition of milk as shown in the following table:

Table (2.1): composition of cow milk

Main constituents	Range %	Mean %
Water	85.5 – 89.5	87.5
Total solids	10.5 – 14.5	12.5
Fat	2.9 – 5.0	3.9
Protein	1.5 – 6.0	3.8
Lactose	3.6 – 5.5	4.6
Minerals	0.6 – 0.9	0.8

The act of removing or extracting milk from the udders or mammary glands, of animal such as cow, goat or sheep.

2.2 Hand Milking

Is performed by massaging and pulling down on teats of the udder, squiring the milk into a bucket. Two methods are used:

i- The top of the teat is pinched shut between finger and thumb, trapping milk in the lower part.

ii- The Bottom of the teat is pinched shut by the fingers and thumb which are then slid down the teat pushing the milk towards the top.

2.3 Machine Milking

Most milking in developed world is done using machines. Teat cups are attached to the cow's teat and then the cups alternate between vacuum and

normal air pressure to extract the milk. The milk is filtered and cooled before added to large bulk tank o milk for storage. But today there exist fully automatic milking machines which give a cow the freedom to choose when to be milked, allowing for a large amount of milk to be obtained more efficiency.

At the beginning of American (1996), the latest version of Delval was launched to the markets. They focus for this version was user friendliness and robustness. The new touch on screen allows for speed, control and flexibility to the unique hydraulic arm, allowing more care cows to be milked. Also integrates more optional features such as the stam the steam Backfush- a system to reduce the risk of contamination and extra liner alternatives to fit different cows (AmericanArtiacts , 1996).

Unless properly washed, rinsed, sanitized and operated, the milking machine may become a serious source of bacterial contamination. The sanitary care under correct operation of milking machines should prove no greater source of contamination than drawing of milk by hand as given by Henderson (1971).

Also the number of microorganisms from the udder and teats sliced with manure mud feeds or bending material is very large and exceeds 10^8-10^{10} CFU Per gram and the bacterium strains commonly found include Streptococci, and rom other gram negative bacteria (Bramly*et al*, 1990).

2.4 Titratable Acidity (lactic acid):

The lactic acid bacteria are most important bacteria in desirable food fermentation, being responsible for the fermentation sour dough bread sorghum beer, all fermented milk, cassava and most pick led (fermented) vegetables (Axelsson,1998)

Historically, food fermentation developed by default rather than by design(Stiles, 1996).

2. 5 Total Bacterial count

* Microorganism of milk

International Dairy Federation (IDF), (1994) recommended that the most common spoilage microorganism of milk and dairy products are gram negative rod-shaped bacteria Pseudomonaspp, coliforms, gram positive spore-forming bacteria, Bacillus, Clostridium spp., lactic acid producing bacteria staphylococcus and streptococcus spp.

The ability of any microorganism to grow in food products depends on number of limiting factors such as; temperatureredes potential, PH, water activity and preservatives and competitive micro flora (Garze, 1992). There is a wide number of bacteriocins produced by different LAB and they can be classified according to their biochemical and genetic characteristics (Gonzalez, Martinez *et al*., 2003).

Bacteriocins biological action occurs through the specific receptors located on the largest cell surface. After binding with these receptors, various mechanisms act by isolated or concomitant way, causing the microbial cell killing (Brashears *et al*., 1998). Bacteriocins, often very specific, and usually produced during the exposition of some bacterial lineages to stressful conditions when released in environment cause quick elimination of non-immune or non-resistant neighboring microbial cells (Tadashi and Schnneewind, 1998).

2.5.1 Staphylococci

IDF, (1994), recommended that staphylococcus aureus may cause human disease by production of toxins, now six staphylococcal enterotoxins are recognized and the formation effective level of toxin and requires high

numbers of the organism being approximately 10^3–10^8 microorganisms /ml of milk. (2001), found that, (66%) of S. aureus strains isolated from raw milk, have the ability to produce enterotoxins.

IDF, (1994) recommended that staphylococcus aureus may be present in raw milk from the udder and teat canal of cow, particularly, if lesions are present. Also the nasal area and hands of human are recognized as sites of contamination and poor personal hygiene and result in contamination of milk.

2.5.2 *Escherichia Coli*:

Ray and Fleming, (1994), reported that, Escherichia coliis classified as being member of the family enterbacteriaceae. This bacterium gram negative, non-spore-forming, straight rods. They are also mentioned four pathogenic categories of E. Coli which include enteropathogenic (EPEC), entrotoxigenc (ETEC), entroinvasive (EIEC) and entrohaemoragic (EHEC). In Italy Eposito*et.al*,(1993), found that very toxemic E. coli isolated from milk and milk products is associated with enteric infection heamolyticuraemic syndrome and possiblythrombetpenicpurpura; in many countries in Ameica and Europe.

2.5.3 Salmonellaspp:

IDF, (1994), recommended that the presence of Salmonella in raw milk is often attributable to direct or indirect fecal contamination during the milk and subsequent practices. Furthermore, pasteurization is an effective control and will eliminate Salmonella from milk in addition to chilling of milk and dairy products to less than 5°Cwill prevent the growth of all strains of Salmonellae.

Vlaemynch,(1994), reported that, contamination of raw milk usually takes place by Salmonellae from external sources which can be fasces the farmer or his family. Polluted water, dust and healthy cows can also regularly excrete Salmonellae in their dung. He also mentioned that primary habitat of

Salmonellae is the intestinal tract of animals and their pathogenesis to human can be distinguished to typhoid, paratyphoid fever and gastro enteric infections.

2.5.4 Bacillus :

Bacillus group, such as B. and other spp, mainly similar B cereus toxin causes food poisoning. The toxin is produced when the Bacillus sporulate, usually in rice or other cereals (Cheesbrough, 2000).

2.5.5 Streptococcus lactic:

The optimum temperature for these bacteria range between (22-35 C° minimum 10 C° and maximum 45 C° , hence the bacteria can grow very fast in milk and accordingly The pH of the milk will decrease from 6.7 to 4.6 and milk get sour, this is due to the utilization of the lactose by these bacteria converting it in lactic acid. Str. Lactis is mainly considered as responsible for the developed acidity in milk. When the pH reaches 4.6, the acid affects the casein and starts clotting. (International Dairy Federation, (1994) recommendation for the Hygiene measures of Milk and based products. No292.

2.5.6 Micrococcus:

It is a gram-positive to gram-variable nonmotile, coccus, tertrad arranging pigmented, saprotrophic bacterium that belongs to the family Micrococcae. It is urease and catalase positive. An obligate aerobe. M. luteus is found in soil, dust, water and air, and as part of the normal flora of the mammalian skin. The bacterium also colonizes the human mouth , mucosae, oropharynx and upper respiratory tract. It was discovered by sir Alexander Fleming before he discovered Penicillin (Greenblatcl*et al*, 2004).

Micrococcus occurs in a wide range of environments, including water. The cells ranging from about 0.5 to 3 micrometers in diameter and typically appear in tetrads.

In a study in dairy farm at Khartoum State, the microbial tests showed that positive average percentage for bacteria S. aureus in raw milk was 32.4% , 38.2%, and 35.3%, for E. coli 23.5%, 32.4% and 26.5% and for Salmonella 23.4%, 14.7% and 14.7% in raw milk of Khartoum, Khartoum North and Omdurman farms respectively. No Significant difference. (Amal Osman, 2011).

Another study conducted to determine if the sterilized milk produced in Khartoum State free from micro-organisms. Ninety samples of sterilized milk (30) samples from Capo factory, (30) from premier factory and (30) from Best Factory are collected randomly from different sources and subjected tomicrobialtests which are DMG and E. coli isolationtests. Theresultsare then compared with the standard levels given by the Sudanese standardand metrology organization for sterilized milk. The results showed no growth of microorganisms in the different samples of the sterilized milk. And accordingly the produced sterilized milk is safe for consumption (Sumia Ahmed, 2007)

Also, in a study conducted to investigate the bacterial hazards in milk samples collected randomly from different areas in Khartoum state; nine samples from different areas of sales points and 12 samples from different end consumers. Aerobic plate count (A.P.C), coagulase positive staph count and coliform group count were investigated. Also the presence of E. coli and Salmonella was detected. For the (A.P.C) coagulase positive staph and coliform group count no significance differences were observed in all milk samples collected from the three sources. The milk samples collected from the three sources showed 17.5% (+ve) and 82.5% (-ve) when detected for E. coli. The milk samples collected from farm showed that 11.1% (+ve) and 88.9% (-ve). The samples point showed 21.1% (+ve) and 78.9% (-ve). While the samples point showed collected from the end consumer showed 16.7% (+ve) and 83.3% (-ve). The milk samples collected from the three sources revealed no significant

(p>0.05) variation for presence of E. coli. All samples collected from the three sources showed 4.5% Salmonella 88.9% and 59.5% (-ve). Farms samples showed 11.1% and 88.9% (-ve). Samples of milk collected from sales point bshowed 21.1% and 78.9% (-ve) Salmonella. While the end consumer samples showed 8.3% and 91.7% (-ve), Salmonella present abcent.(Mohamed, 2007)

In a study conducted to determine the total count of bacteria in the raw milk produced in the farm of the colleges of Veterinary Medicine an Animal Production , Sudan university of Science and Technology, and accordingly bacterial contamination of the milk and suitability for consumption. Sixty samples of bulk raw milk were collected, 30 from morning milk and 30 from evening milk and then subjected to laboratory tests. The data obtained was then compared with different standards given for the total bacteria count in milk. According to the results obtained the produced farm milk is satisfactory and acceptable for consumption with a total bacteria count of an average 650.000 cell per 1 ml o milk. The statistical analysis showed no significance variation in the total count of bacteria betweenmorning and evening milk (650.000 ± 1402.3 and 651.000 ± 98443.1) respectively.(Koc. 2009)

CHAPTER THREE

MATERIALS AND METHODS

3.1 Sampling

Twenty four cow's milk samples were collected during the period from 16.9.2017 to 21.9.2017.The samples were selected random 12 from farms of hand milking 12 from milking machine farm at Khartoum state as follow:

Twenty four samples were collected from the two farms in the morning and evening located at two areas in Khartoum State namely; university farm and AwdAlla farm. All cows are kept under the same shed without considering the breed difference and under special milked systems are unscientifically designed. The milk collection was done without any procedures or controls. Health status is poor, no available veterinary services. In many farms, manure will be collected and put it in front of the farms till manure collectors arrive, that creates infections.

The hygiene measures are not practiced before during or after milking.

Four milk samples were collected from each dairy farm. And our samples were collected from other farm, both from the morning and the evening.

3.2 collection of milk samples

The row milk samples were collected into clean sterile plastic container and cooled immediately at approximately +5c˚ in an ice bag until examinations were carried out, the samples were transported to the laboratory of the department of animal productions, faculty of Animal production on Khartoum University laboratory.

3.3 Microbiological Analysis

3.3.1 Equipments

Autoclave, incubator, oven, PH meter, water bath, colony counter, sensitive balance, refrigerator.

3.3.2 Total viable bacterial count

It was carried out by using the pour plate count method as described by W.FH arrigam(1998).

Suitable medium for this purpose is plate count agar.

Preparation of serial dilution .Aseptically 1ml of sample was added in test tube containing 9 ml of sterile diluents (0.1% peptone solution) .it was mixed well to give dilution (10^{-1}). By using sterile pipette 1ml was transferred to a test tube containing 9ml of sterile diluents and it was mixed well to dilution (10^{-2}).In the same way the preparation of serial dilution was continued until the dilution(10^{-6}).One ml of each dilution was transferred into sterile petri dish. To each plate 15ml of sterile melted plate count agar medium were added.

The inoculums was mixed with medium and allowed to solidify.

The plates were incubated at 37c˚ for 48 hours. A colony counter was used to count the viable bacterial colonies after incubation .and the result were expressed as colony- forming unit (cfu/ gram).

3.4 Purifical and identification of isolated:

Predominant microorganisms from morphologically different colony types were selected from plate count agar.

Sub- culturing purified these isolates.

Typical colony was streaked onto sterile nutrient agar plates .The plates were incubated at 37c° for 24 hour.

The representative colonies of various microorganisms were sub- cultured in their respective media(on slopes)and then the culture were kept in the refrigerator at 4c° until used for further test .The identification of purified isolates was carried out according to Cowan and Steel (2003).

3.5 Determination of Acidity

The acidity of milk was determined according to AOAC (1990). Ten milliliters of sample were placed in a white porcelain dish ,and five drops of phenolphthalein indicator were added. Titration was carried out using o .1 N NaOH until a faint pink color which lasts for 30 seconds was obtained. The titration figure was divided by 10 to get the percentage of lactic acid.

3.6 Statistical Analysis

The data obtained were analyzed using SPSS soft ware (version 16) .one way (ANOVA) test.

CHAPTER FOUR

RESULTS and DISCUSSION

4 Results

4.1 The obtained results are given in the following tables:

Table (1): percentage of E .coli count in hand milking and milking machine

Milking Types	No of Samples	E. coli	
		No.	Percentage (cfu/gram)
Hand milking	12	3	25
Milking machine	12	-	-

The above table displays the microbiological analysis of hand milking sand milking machine for E. coli. There were three out of (12) of the hand milking samples represented (25%) contain this type of bacteria; while none of the (12) samples of Milking machine contain such type of bacteria. This result shows *E.coli* more common in hand milking.

Table (2):percentage of Bacilluscount in hand milking and milking machine

Milking Types	No of Samples	Bacillus	
		No.	Percentage ((cfu/gram))
Hand milking	12	3	25
Milking machine	12	2	16.7

As table (2) shows, Bacillus found in (3) samples of hand milking represented (25%), while it was found in two samples represented (16.7%). This indicates bacillus more common in hand milking.

Table (3): percentage of *Staphylococcus* count in hand milking and milking machine

Milking Types	No of Samples	*Staphylococcus*	
		No.	Percentage ((cfu/gram))
Hand milking	12	3	25
Milking machine	12	-	-

From table (3), it clear that *Staphylococcus* was found in three samples of hand milking type represented (25%), while it doesn't occur in any of milking machine samples. This ensures that *Staphylococcus* occurrence was significant in sample of hand milking types.

Table (4): percentage of *Salmonella*count in hand milking and milking machine

Milking Types	No of Samples	*Salmonella*	
		No.	Percentage ((cfu/gram))
Hand milking	12	1	8
Milking machine	12	-	-

Table (4) presents the occurrence of *Salmonella*. One sample of hand milking type (8%) contained salmonella. On the other hand salmonella did not found in any of milking machine samples. This result relates *Salmonella* presence to hand milking method.

Table (5): percentage of *Streptococcus*count in hand milking and milking machine

Milking Types	No of Samples	*Streptococcus*	
		No.	**Percentage ((cfu/gram))**
Hand milking	12	2	16.7
Milking machine	12	3	25

From table (4.5), *Streptococcus* was more frequent in hand milking (16.7%), than in the milking machine samples (25%).

Table (6): percentage of *Micrococcus*count in hand milking and milking machine

Milking Types	No of Samples	*Micrococcus*	
		No.	**Percentage ((cfu/gram))**
Hand milking	12	2	16.7
Milking machine	12	1	8

Micrococcus bacterium seems to be more frequent in hand milking samples (16.7%) than in the milking machine ones (8%). As shown in table (4.6).

Table (7): acidity

Milking Types	Mean ± SD	Sig.
Hand milking	0.19± 0.21	**0.000****
Milking machine	0.11±0.01	

**= high significance (p-value < 0.001

Hand milking samples shows greater mean of acidity (0.19± 0.21) than milking machine samples (0.11±0.01).The T-test shows statistical significance of difference between the two means.Milk more acid when use hand milking method.

Table (8):Two-sample T-test result for bacterial count

Milking Types	Mean ± SD	Sig.
Hand milking	$6.15\times 10^5 \pm 1.86$	**0.000****
Milking machine	$4.50\times 10^4 \pm 1.21$	

**= high significance (p-value < 0.001

Hand milking samples shows greater mean of bacterial count ($6.15x10^5 \pm 1.86$) than milking machine samples ($4.50x10^4 \pm 1.21$) the T-test shows statistical significance of difference between the two means**.** There more bacteria when using hand milking method.

4.2 DISCUSSION

4.2.1 Total bacterial count

Table (4.1,4.2,4.3,4.4,4.6,)showed the *E. coli* Bacillus, Staphylococcus, Salmonella , Streptococcus and micrococcus count in two types milking (Hand milking , Milking machine)the percentage of bacterial was (25,0,25,16,7,25,0,8,0,25,16,7,16,8)% respectively in all sampling.
Results indicated significant difference between the means of the *E.coli*.Results indicated significant difference between the means of the *E.coli* count in low types milking Similar results revealing significant different by international Dairy federation (IDF) , (1994) , the microbial tests showed that positive average percentage for bacteria S. aureus in raw milk was 32.4% , 38.2%, and 35.3%, for E. coli 23.5%, 32.4% and 26.5% and for Salmonella 23.4%, 14.7% and 14.7% in raw milk of Khartoum, Khartoum North and Omdurman farms respectively. No Significant difference. (Amal Osman, 2011).

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recommended that the most common spoilage microorganism of milk and dairy products are gram negative rod-shaped bacteria pseudomonas pp ,coliforms gram positive spore-forming bacteria , bacillus ,Clostridium spp ,IDF ,(1994) recommended that the presence of salmonella in row milk is often attributable to direct or indirect fecal contamination during the milk and subsequent practices ,bacteriocins biologicalaction occurs through the specific receptors located on the largest cell surface,after binding with these receptors , various mechanisms act by isolated or concomitant way ,causing the microbial cell killing (Brashears *et al*., 1998).

According to the results obtained the total bacterial count milking machine less compared to hand milking this agreed with that reported by the above mentionedauthors .

4.2.2 Total titratable acidity

Table (4.7,4.8). Showed two types acidity of milking (acidity of hand milking , machine milking the mean of milking acidity was :(0.19± 0.21 , 0.11 ± 0.01) respectively in all milking . Results indiceted significant difference between machine acidity low in the milking simitar result reveling significant difference by study on by Bio- security in dairy farms at Khartoum state For (Amal Osman,2011) . 0.14± 0.002.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

This study concludes that there was statistical significance of variation in bacterial count between samples of milk obtained by hand milking method and the samples obtained by milking machine. The samples of hand milking showed higher mean of bacteria count than those of milking machine. This indicates that using milking machine can decrease the bacterial count and consequently prevent milk contamination.

Also there was significant difference in acidity between samples of milk obtained by hand milking and those obtained by milking machine. Hand milking samples showed more acidity. This ensures that milking machine decrease action of lactic bacteria. And consequently prevent raw milk changes.

5.2 Recommendation

The learner recommends:

1- Necessity of use of milking machine in all farms used to distribute milk to the consumers.
2- Agricultural bank and bank of Animal resources should provide milk farm with milking machine through suitable finance.
3- Public Health authorities should increase awareness about using milking machine to avoid milk contamination

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