INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 13, No. 3, p. 117-121, 2018
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Microbial content of pasteurized cattle milk at different packaging materials and storage duration

Babylyn P. Canceran*

Cagayan State University, Piat Campus, Piat, Cagayan, Philippines

Article published on September 30, 2018

Key words: Microbial load, Dairy milk, Packaging material, Storage duration.

Abstract

Milk is an important source of nutrients to human and animals, but due to its high water activity and nutritional value it serves as an excellent medium for growth of many kind of microorganisms under suitable conditions. This study determined the presence and levels of microbial content of pasteurized cattle milk using three packaging materials: Polyethylene terephthalate (PET), tetra pack and glass and stored at different durations: six (6), twelve (12) and twenty (24) hours. Samples were subjected to microbiological analysis for Aerobic Plate Count at the Department of Science and Technology (DOST), Tuguegarao City. Results showed that PET packaging material produced the least mean microbial load and recorded the most delayed production and growth of microbes at different storage durations. Using ANOVA, analysis further showed that the combined effect of the packaging material and storage duration on the mean microbial load of dairy milk is significant (P>0.01). Results imply that the use of PET packaging material allows dairy milk to be stored for a longer period with the least growth of microorganisms compared to the use of glass and tetra pack packaging materials.

***Corresponding Author:** Babylyn U. Canceran ✉ gilbertmagulod_rdecsulasam28@yahoo.com

Introduction

Milk and milk products are excellent high quality foods providing both nutritional and culinary values. However, milk is extremely susceptible to spoilage by microorganisms and the microbiologist plays a major role in the dairy industry in quality control of milk (Gunasekera *et al.*, 2002). Cattles's milk consists of a variety of nutrients such as fats, proteins, minerals, vitamins, carbohydrates and water and thus it serves as an excellent medium for bacterial growth. Given the appropriate conditions milk can act as a carrier of disease causing microorganisms transformation from cows to humans. Bacteria can be introduced into milk from a wide variety of sources such as workers, infected cows udder, faeces, dust in barns, milk containers or other equipment. Some microbes can serve as disease causing agents when present in milk (Brock *et al.,* 1991. Milk can be polluted by Mycobacterium bovis Brucella species Streptococc and Coxiella burnetti from infected cattle. Agents from human sources such as Salmonella species. Shigella species, Corynebacterium, diphtheria, and Streptococcus species can also be presented in milk. Microorganisms are the most important group of microbes present in milk and dairy products.

Milk meant for human consumption must be free from any pathogenic organisms (Bertu *et al.*, 2010). According to Kanyeka (2014) microbial contamination in milk may cause milk-borne diseases to humans while others are known to cause milk spoilage. Many milk-borne epidemics of human diseases are spread through milk contamination. Sources of microbial contamination in milk include primary microbial contamination from the infected or sick lactating animal.

Prevention and control of microbial quality of milk is through elimination of organisms from human carriers by general improvements in water supplies, public health education, personal and environmental hygiene. Also can be achieved through proper boiling or pasteurization of raw milk before processing and consumption. Pathogenic organisms from the lactating animals can be controlled through improvements in animal husbandry and maintanance of good animal practices, and those from the environments and equipments can be prevented by adhering to general hygienic practices and environmental cleanliness.

Generally, microbial contamination in milk can be minimized through adherence to effective good hygienic practices at farm level; and in order to protect the public against milk-borne infections it is important to screen milk which is informally taken to the market. The lack of awareness of milk-borne infections in many developing countries and consumption of raw milk predispose small-scale livestock keepers, consumers and the general public at risk of contracting these infections (Mosalagae *et al.*, 2011). Milk processor or handler will only be assured of the quality of raw milk if certain basic quality tests are carried out at various stages. It is for this reason that this study is conducted to determine the microbial load of pasteurized cattle milk at different packaging materials and storage duration. Specifically, it aimed to determine the effect of the different treatments on the mean microbial load of dairy milk and to determine the interaction effect of packaging materials and storage duration on the mean microbial load of dairy milk.

Materials and methods

Method of Research

The study used the experimental design using treatments arranged in a Completely Randomized Design (CRD), Two Factorials with three (3) replications. The first factor considered was the packaging material (plastic or PET, glass and tetra pack) while the second factor was storage duration (6, 12 and 24 hours). Samples of pasteurized milk at different milking time from CSU Piat Dairy Cattle Project were used as the subject of investigation.

More specifically, the samples were subjected to microbiological analysis in determining the microbial load, total Coliform count, *E. coli* and *Salmonella* sp. at the Department of Science and Technology (DOST), Tuguegarao City, Cagayan.

Statistical Treatment

All data generated were subjected to Analysis of Variance (ANOVA) using Statistical Tool for Agricultural Research (STAR).

Table 1. Methods Used for Microbial Analysis of the Samples.

Parameter Tested	Method
Microbial Load	Aerobic Plate Count (APC)
Total Coliform Count	Pour Plate Method
E. coli	Pour Plate Method
Salmonella	Streak Plating Method

Results and discussion

Microbial Count

Fig. 1 presents the microbial counts of dairy milk as affected by different microbial load of $5x10^6$, followed by A2 (12 hours) with a mean of 460 and the least mean of microbial load was obtained in A1 (6 hours) with a mean of 30. Analysis of variance reveals highly significant difference among treatment means. On comparison among means when A1 and A2 were compared with each other, no significant difference was observed. But when A3 was compared with the two treatments, there was a significant difference observed. Results imply that the longer the storage duration, the higher is the microbial load. This idea is supported by a study conducted by Dey and Karimm (2013) with the same observation that both raw and pasteurized milk tends to increase in microbial population during refrigeration while Ultra-High Temperature (UHT), milk regarded as a readily drinkable drink, must not be purchased or consumed after three months from the production due to microbial content. Revised PMO 2015 stated that] the bacteria standards for grade A pasteurized milk should be less than 20,000 total bacterial count /ml (IDFA, 2016).

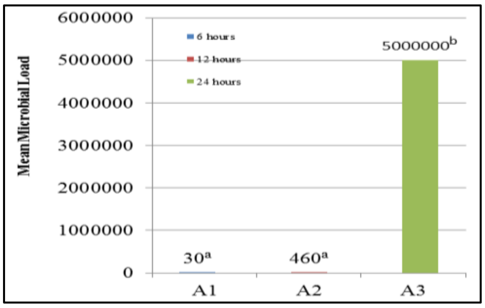

Fig. 1. Mean Microbial Load of Dairy Milk under Different Storage Duration.

Fig. 2 shows the mean microbial load of dairy milk in CFU/ml as affected by different packaging materials. As presented on the Fig., B1 (tetra pack) obtained the highest microbial load with a mean of $6.7x10^5$, followed by B2 (glass) and B3 (pet) with a mean of $5.7x10^5$ and $5.5x10^5$respectively. This shows that the use of glass and pet container, having almost the same microbial content, is more recommended compared to the use of tetra pack container. However, analysis of variance reveals no significant difference observed among treatment means. This implies that the use of any of the three packaging materials under study will not make so much difference in the amount of microorganism that the milk can have.

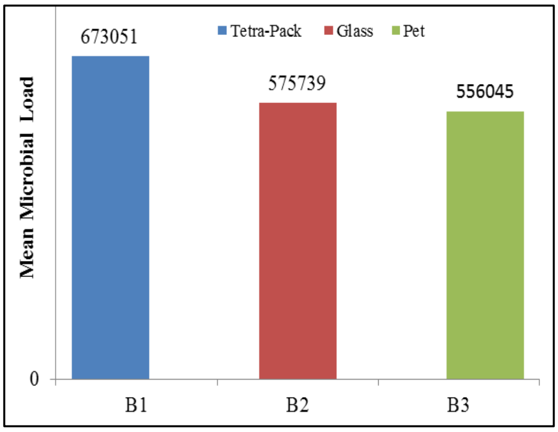

Fig. 2. Mean Microbial Load of Dairy Milk under Different Storage Duration.

Fig. 2 shows the mean microbial load of dairy milk in CFU/ml as affected by different packaging materials. As presented on the Fig., B1 (tetra pack) obtained the highest microbial load with a mean of $6.7x10^5$, followed by B2 (glass) and B3 (pet) with a mean of $5.7x10^5$ and $5.5x10^5$ respectively.

This shows that the use of glass and pet container, having almost the same microbial content, is more recommended compared to the use of tetra pack container. However, analysis of variance reveals no significant difference observed among treatment means. This implies that the use of any of the three packaging materials under study will not make so much difference in the amount of microorganism that the milk can have.

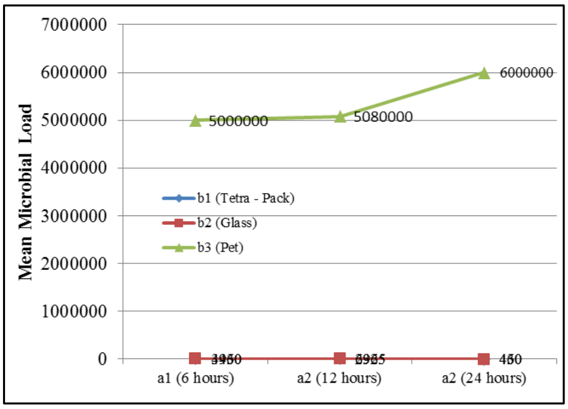

Fig. 3. Mean Microbial Load Of Dairy Milk Under Different Storage Duration and Packaging Materials.

Fig. 3 shows the interaction effect of packaging materials and storage duration on the microbial load of dairy milk. No significant difference was observed between the two factors involved in the experiment in terms of microbial count.

This implies that when using any of the three packaging materials included in the study, and one stores the milk for 6 hours or 12 hours to 24 hours, growth of microorganisms will be at same rate. However, if one has to choose only one packaging material and storage duration to avoid microbial load in pasteurized milk, the researchers recommend the use of pet and glass materials stored up to 24 hours.

Further, result of total bacterial count for pasteurized milk obtained during this study showed low count (AbdelRahman, 2009). This is believed to have been due to the good quality of raw milk, proper heat treatment and efficient storage conditions as also revealed by (AbdElrahman, Said Ahmed, Zubeir, El Owni, Ahmed, 2009). The lower count of bacteria may also be due to good cleaning system and good handling from farms as required at CSU Dairy Project Center.

Total Number of Coliform

Fig. 2 presents the total number of coliform in dairy milk as affected by different packaging materials. Data shows that the highest number of coliform was obtained in T_3 (pet) with a mean of 52 MPN/g and followed by T1 (glass) with a total of 14 MPN/g. The lowest coliform was obtained in T2 (tetra-pack) with a mean of 7 MPN/g. Although coliforms were found lowest in the use of pet and glass, statistical analysis reveals no significant difference was observed among treatments. This means that any among packaging materials can be used however lower number of coliform must be considered.

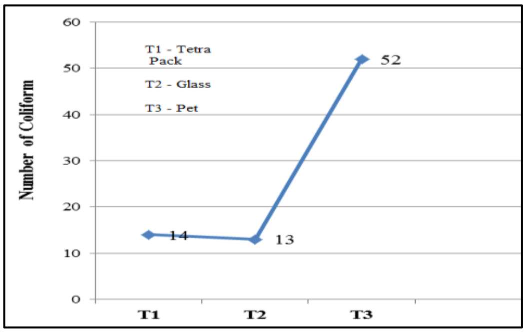

Fig. 2. Mean Total Number of Coliform as Affected by Different Packaging Materials.

Total Number of Salmonella

Table 2 presents the mean number of *Salmonella* using different packaging materials. Result shows that *Salmonella* was absent at 25 gram sample in the three packaging materials.

Table 2. Mean Number of *Salmonella* as Affected by Different Packaging Materials.

Packaging Material	Result
Glass bottle	Absent at 25 g sample
Tetra Pack	Absent at 25 g sample
Pet Bottle	Absent at 25 g sample

Total Number of E. coli

Fig. 3 shows the number of *E. coli* in dairy milk as affected by different packaging materials. Data show that in all the packaging materials, results obtained 3.0 MPN/g of E. coli at 25 gram sample tested. This means that any among packaging materials can be used.

Table 3. Mean Number of E.Coli as Affected by Different Packaging Materials.

Packaging Material	Result
Glass Bottle	3.0 MPN/g
Tetra Pack	3.0 MPN/g
Pet Bottle	3.0 MPN/g

Conclusions and recommendations

It is concluded that among the packaging materials, tetra-pack produced the least number of coliform thus is best recommended for use along with pet glass as packaging materials since they did not differ significantly in terms of microbial load and that pasteurized milk can be best stored in six (6) hours. Follow up studies were recommended on the microfiltration prior to pasteurization to test the removal of spores thereby enhancing the microbiological safety of pasteurized milk and microbial load of pasteurized milk under different temperatures be further studied for safer and better quality of dairy milk. It is also recommended that veterinarians, extension officers and all stakeholders should play their roles in order to ensure safe quality milk delivery to consumers.

References

Abdelrahman SMA, AMM, Said Ahmed IEM, El Zubeir OAO, El Owni MKA, Ahmed. 2009. Microbiological and Physicochemical Properties of Raw Milk Used for Processing Pasteurized Milk in Blue Nile Dairy Company (Sudan). Australian Journal of Basic and Applied Sciences **3(4),** 3433-3437.

Anderson, Melisa. 2011. "The Microbial Content of Unexpired Pasteurized Milk Selected Supermarkets in a Developing Country" Asian Pac J Trop Biomed. 205-211.

Batool, Syeda Afifa, Kalsoom, Razia, Rauf, Naseem, Tahir SS, Hussain, Fouzia. 2012. Microbial and Physico-Chemical Quality Assessment of the Raw and Pasteurized Milk Supplied In the Locality of Twin City of Pakistan. Internet Journal of Food Safety **14,** p.17-22 .

Bertu WJ, Dapar M, Gusi AM, Ngulukun SS, Leo S, Jwander LD. 2010. Prevalence of brucella antibodies in marketed milk in Jos and environs. African Journal of Food Science **4(2),** 062-064.

Brock TD, Madigan, Biology of microorganisms MT. 1991. 6th ed. New Jersey: Prentice Hall; 1991. p. 345.

Dey S, Krim MH. 2013. Study on Physicochemical and Microbial Quality of Available Raw, Pasteurized and UHT Milk during Preservation. Int. J. Sci. Invent. Today **2(2),** 150-157.

Griffiths, Mansel W. 2010. Improving the Safety and Quality of Milk: Milk Production and Processing. Woodhead Publishing Limited.

Gunasekera TS, Sorensen A, Attfield PV, Sorensen J, Veal DA. 2002. Inducible gene expression by non-culturable bacteria in milk after pasteurization. Appl Environ Microbiol. 2002; **68(4),** 1988-1993.

IDFA. 2016. Grade "A" Pasteurized Milk Ordinance, 2015 Revision. Retrieved March **30,** 2018.Making a Difference for Dairy.https://www.idfa.org/news-views/headline-news/article/2016/03/31/2015-pmo-and-related-documents-now-available-online.

Koirala, Sushil. 2016. Quality and Safety Assessment ofMmilk Supply Chain: A Case Study. Asian Institute of Technology.

MAK BIOTEk. 2017. "Understanding Milk Adulterstion in India" iOrganic.Retieved Feb **10,** 2018.

Mosalagae D, Pfukenyi DM, Matope G. 2011. Milk producer's awareness of milk-borne zoonoses in selected smallholder and commercial dairy farms of Zimbabwe. Tropical Animal Health and Production **43,** 733-739.

Olatunji EA1, Jubril AE1, Okpu EO1, Olafadehan OA1, Ijah UJ2, Njidda AA. "Bacterial Assessment and Quality Analysis of Raw Milk Sold in Gwagwalada Area Council of the Federal Capital Territory (FCT)" Abuja, Nigeria.

Padilla, Nathaly C. 2017. Foodborne Bacteria in Dairy Products: Detection by Molecular Techniques. Departamento de Cienciasanimales. Pontificia Universidad Católica de Chile. https //scielo.conicyt. cl/pdf/ciagr/v44n3/0304-5609-ciagr-44-03-0215.pd.

Sarkar S. 2015. Microbiological Considerations: Pasteurized Milk. International Journal of Dairy Science **10,** 206-218.