

RISK BASED ANALYSIS OF MICROBIAL SAFETY OF MILK FROM TRADITIONAL DAIRY MARKETS IN PUNJAB (INDIA)[#]

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ABSTRACT

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Microbial safety of milk is an emerging problem of public health significance. It can be determined by two approaches; hazard based and risk based. Risk based approach provide a new manner of coping with food safety particularly in developing nations. They are most effective at reducing risks and also form a link between food protection and livelihood concerns. The result of present investigation revealed that milk sold by door to door vendors posed higher levels of risk. Therefore, decision makers should formulate strict laws and ensures their proper enforcement with particular focus on middle man. Regular monitoring of milk traders and special raids during festive seasons should also accomplish. Training of all stakeholders including milk venders should be conducted to aware them about health risk related to supply of unsafe milk. Consumer societies and NGO's awareness regarding frequent checks may play a vital role to achieve these goals. The result of the study also recommends purchasing of pasteurized milk which is supplied from organized sector to safe guard the health of public as a whole.

Key words: Milk, microbial safety, qualitative, risk, decision makers

Introduction

Milk is an important and one of the most consumed food items in every family and at each stage of life. India stands first in milk production among all the countries of the world (Ghotekar, 2017). Out of total milk produced in the country, only 20-22 % of milk was handled by the organized sector (Srivastava, 2010). While major proportion of milk was produced and processed by unorganized sector, the quality of such milk is far away from the acceptable level (Barui *et al.*, 2013). The physical, chemical and microbiological safety of milk handled by un-organized sector is very poor and there is lot of scope for its deterioration (Prasanti, 2017).

The milk and milk products from the Punjab state are also famous for its wholesomeness. Despite having only 1.6 per cent of the total geographical area of India, Punjab stands first in terms of per capita availability of milk at around 915 grams per day as well as 4th in milk production in country (Kaur *et al.*, 2012). The sanitary and phytosanitary (SPS) agreement of the WTO stipulates that the producers must implement necessary measures to ensure that the food products produced are free from health risks (Hundal *et al.*, 2013).

Risk based approach provide a new manner of coping with food safety in developing nations. They are most effective at reducing risks and also form a bridge between food protection and livelihood concerns. The first portion of risk analysis, risk assessment generates an estimate of negative health impacts of a hazard as well as chances of their occurrence. This statistics can then be compared with economic information at the costs and benefits of small holder production and marketing, and of risk mitigation. This allows decision makers to set suitable degrees of safety primarily based on evidence rather than anecdote and subjective desire. Risk based designing classify the milk suppliers into a risk hierarchy, thus allowing milk actors which pose maximum risk to human health to be diagnosed and inspection and intervention directed consequently (Grace *et al.*, 2009). Keeping in view the above points and facts, the present investigation was undertaken to assess microbial safety of milk in north India: a

case study in Punjab.

Materials and Methods

In total, one hundred and sixty milk samples were collected from all five agro-climatic zones in Punjab. Samples were collected aseptically in sterile containers with stratified random sampling and comprising pasteurized, packed and unpasteurized, raw and open samples from various shops, vendors and farmers supplying milk to consumers, in the months July 2016 to June 2017. Data for these milk samples were recorded with keeping its city/place of sale (different locations), point of sale (farmer, vender and shop), type of origin (organized, un-organized) and processing method (raw, pasteurized) into account. Samples were transported in an isothermal box to School of Public Health and Zoonoses, GADVASU, Ludhiana.

All the samples were evaluated on the same day for microbiological safety analysis with method described by Grace *et al.*, (2009). Standard or total plate counts (TPC) and coliform counts (CC) were initially assessed using dehydrated agar media. These counts were then related for risk estimation qualitatively. For standard or total plate count determination, method recommended by American Public Health Association (APHA) and described by Marshall (1992) was used; 1 ml of milk sample was mixed with 9 ml of NSS to make a dilution of 1:10, in aseptic conditions. Other tenfold serial dilutions (1:100, 1:1000) were also made successively. The plate count agar media (Hi media laboratories, India) was used to culture the bacteria. Pour plate method was used for inoculation of milk samples. 1 ml milk sample of various dilutions was transferred to petri plates and 10-12 ml of plate count media (at temperature 42-45°C) was added and mixed to it. The plates were then incubated at 37± 1°C for 48± 3 hours. The plates having 30-300 colonies were taken to count the number of bacteria using colony counter. The colony forming unit per ml of milk were obtained by multiplying the number of colonies and reciprocal of the dilution factor and recorded.

For coliform count determination, method recommended by American Public Health Association (APHA) and described by

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Marshall (1992) was used; undiluted milk sample and its tenfold serial dilutions (1:10, 1:100) were prepared in aseptic condition. The violet red bile agar media (Hi media laboratories, India) was used to culture the coliform bacteria. 1 ml of milk sample (undiluted milk, 1:10, 1:100 dilutions) was taken to petri plates, and 10-12 ml of VRB media (at 42-45°C) was added and mixed to it. The plates were then incubated at 32± 1°C for 24± 2 hours. Purple red colonies (0.5 mm or larger in diameter), with or without a zone of precipitated bile were enumerated as coliforms. Numbers of coliform in various dilutions were recorded.

The importance of different factors on milk safety was assessed through one way ANOVA with pair wise comparison using Duncan's Multiple Range Test (SAS software version 9.3) in which the dependent variables were log of total plate counts and log of coliform counts, respectively and the independent variables included city/place of sale, points of sale, type of origin and processing method. Independent variables which had a significant effect on bacterial load were used to determine microbial safety and risk hierarchy of milk samples in Punjab.

Results and Discussion

The present investigation indicated that milk samples collected from vendors (n=27) showed log total plate count mean and log coli-form count mean to be 5.2 and 2.8, respectively, while procured from farmer (n=25) and shop (n=108) to be 4.8 and 1.8, 4.5 and 1.7, respectively. The results revealed a high log value of both counts for vendors, in comparison to that of farmers and shops (Table 1). Moreover, the raw milk samples originated from unorganized sector (n=80) showed log total plate count mean and log coli-form count mean to be 5.0 and 2.3, respectively, while pasteurized milk samples, originated from organized sector (n=80) to be 4.3 and 1.5, respectively. The study revealed a high log value of both counts for raw milk of unorganized sector, in comparison to that of pasteurized milk of organized sector and these mean values were also found significantly different (Table 2). The present study showed a significant association between point of sale, type of origin, processing method and bacterial counts (P<0.05), but not between city/place of sale and bacterial counts (P>0.05). By categorizing according to point of sale and type of origin, processing method we were able to develop a hierarchy of risk. Milk sold from shops and pasteurized milk of organized sector is associated with lower levels of risk and raw milk and milk sold by door to door vendors with higher levels of risk. The result of present study was comparable with an earlier investigation conducted by Grace *et al.* (2009) to assess milk safety in Guwahati and Jorhat, the two major cities of Assam, India and reported that milk sold from shops and processed milk (UHT) is associated with lower levels of hazard and raw milk and milk sold by door to door vendors with high levels of risk. Hence, results of our study was almost in accordance with that reported in literature.

The present investigation exhibited that how application of some of principles of risk based qualitative analysis can be made

Table 1: Microbial safety of milk samples in Punjab according to point of sale

Point of sale	N	Log of TPC mean*	Log of CC mean*	Risk category
Vender	27	5.2 ^A	2.8 ^A	Highest
Farmer	25	4.8 ^B	1.8 ^B	
Shop	108	4.5 ^C	1.7 ^B	Least

N = Total number of sample analyzed; *Mean's superscript with the same letter is not significantly different

whilst evaluating milk safety associated with traditional dairy retail markets. The risk hierarchy was obtained by assessing sale points of milk. The total plate counts denote number of viable aerobic bacteria and coliform counts represents number of bacteria that originate from manure or a contaminated environment having disease causing enteric pathogens. These counts were related here for risk estimation qualitatively. The result of study suggests that milk sold by door to door vendors posed higher levels of risk. Therefore, decision makers should formulate strict laws and ensures their proper enforcement with particular focus on middle man. Regular monitoring of milk traders and special raids during festive seasons should also accomplish. Trainings of all

Table 2: Microbial safety of milk samples in Punjab according to type of origin and processing method

Type of Origin	Processing method	N	Log of TPC mean*	Log of CC mean*	Risk category
Unorganized	Raw	80	5.0 ^A	2.3 ^A	Highest
Organized	Pasteurized	80	4.3 ^B	1.5 ^B	Least

N = Total number of sample analyzed; *Mean's superscript with the same letter is not significantly different

stakeholders including milk vendors should be conducted to aware them about health risk related to supply of unsafe milk. Consumer societies and NGO's awareness regarding frequent checks may play a vital role to achieve food safety goals. Investigation also recommends purchasing of pasteurized milk which is supplied from organized sector to safe guard the health of public as a whole.

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