QUALITY OF RAW MILK SUPPLIED TO ORGANIZED MILK COLLECTION CENTERS OF WESTERN CHITWAN

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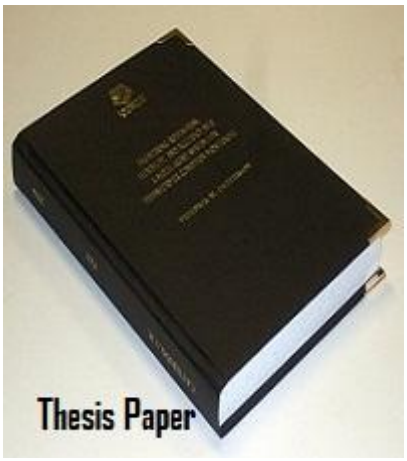

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ABSTRACT

An experiment was undertaken at Bijaya milk production cooperative Ltd, Chitwan and its milk shed command area of western Chitwan covering a period from 2nd February to 2nd May, 2012. The study was accomplished in two phases viz. field survey and laboratory analysis with lactoscan and adulteration test. The survey findings revealed that most of the farmers (95%) knew the basic importance and the procedures to be adopted for quality milk production however they were lacking putting them into practice. Majority of farms (78.75%) used maize and bran as principal ingredients of concentrate. Most of the farms (81.25%) supplied green throughout the year and there 90% farms maintained their animals under stall feeding. Less than fifty percent farmers (43.75%) practiced hand washing with soap before milking and rest (56.25%) washed their hands by common water only. Majority of farmers (83.75%) practiced udder washing by water only. Laboratory analyses were carried out by taking 128 raw milk samples fortnightly from different MCCs in order to analyse fat, SNF, protein, electrical conductivity,sp. gravity and water. Sixty four samples from Bijayanagar, Gadhi, Saranpur, Chowki, Haraiya, Narayanchowk, Shantichowk and Bangai were considered for the study of adulteration by substances like sugar, salt, starch, neutralizer, urea etc. The data indicated that 1.56 and 3.12; 3.12 and 3.12; 3.12 and 3.12; 1.56 and 1.56; 1.56 and 3.12 percent for salt and sugar respectively for the MCC Bijayanagar, Gadhi, Saranpur, Chowki and Bangai. However, the values of 4.68% for sugar and 1.56% of the samples were adulterated by salt respectively for Haraiya and Narayanchowk. None of the samples were adulterated with any substances in Shantichowk. As a whole, none of the MCC showed any other adulterants.

The highest and the lowest values for fat, SNF, protein, conductivity, specific gravity and water content location wise were Chowki and Bijayanagar; Saranpur and Haraiya;

Bijayanagar and chowki and Bijayanagar and Saranpur respectively. Rest of the location indicated the values within these. Similarly, periodwise, highest and lowest values for fat, SNF, protein, conductivity and water content were 3rd and 7th; 7th and 4th; 7th and 4th; 7th and 1st; 7th and 4th; 4th and 3rd fortnight respectively. The result obtained from the study on the quality of raw milk from different places of western Chitwan indicated that the current situation need improvement from adulteration point of view as most of the samples were adulterated from salt and sugar. However, none of the samples were found to be adulterated by starch, neutralizer and urea.

Key words: Fat, SNF, Protein, Electrical Conductivity, Adulteration

1 INTRODUCTION

1.1 Background

Dairy farming is one of the most appropriate and viable sector, which is the major component of farming system in Nepal and contributes 31% of AGDP (CBS, 2001). Among various sub-sectors of the livestock, the highest contribution (78%) comes from dairy farming. The dairy animals in Nepal are basically constituted of cattle and buffalo. More specifically, 30% of AGDP comes from cow and 48% from buffalo (CBS, 2004). Dairy farming helps farmers such as, vital sources of cash income, sources of family nutrients, sources of manure for agricultural land. The total milk production of Nepal reached to 1312.14 thousand metric ton of milk every year, out of which 926.85 thousand metric ton was shared by buffalo milk (MOAC, 2007). This amount of milk is insufficient for domestic consumption. Hence, Nepal imports milk in the form of powder milk, mostly from India, Australia and Bangladesh. It was estimated that the total import of powder milk in 2001 was 696, 978 ton (DDC, 2004). The compositional quality, the hygienic quality, the health of the cow and the level of contaminants present can all have an impact on the yield and quality, and hence financial return from products made from milk (Harding, 1995).

Cattle and buffaloes provide direct cash income and are living bank for marginal farmers (Nakao, 2005). To target the export market the quality of milk is to be standardized and pricing should be based on milk quality and products should be diversified so that they suit the export market. However, hygienic and quality regulations for production anddistribution of milkare more relaxed in Nepal, and are not subject to specific microbiological standards in a legalsense. Gaps and deficiencies in such standards are to be identified and made compatible with World Trade Organzation (WTO) and South Asia Free Trade Agreement (SAFTA), which have potentially open markets in the South Asian Region. Nepal will have to compete aggressively on price along with quality. In Nepal, the formal

markets for collectionof raw milk produced by farmers are public sector dairy viz.the Dairy Development Cooperation (DDC), private dairies and the farmers' cooperatives, either the milk producers' cooperatives or milk producers' cooperative unions. Informal market for selling milk to the urban consumers by the producer farmers directly or through tea shops is also significant.

Chitwan is a leading dairy pocket area of the country. Of the 902,286 milking cows and 1,050,977 milking buffaloes in the country (MOAC, 2006), Chitwan houses 20,697 milking cows and 39,217 milking buffaloes (DLSO, 2006). Dairying can be one of the major components for addressing poverty alleviation in the country (HMG/TLDP, 2002). Livestock have been playing an important role in farm economy of rural households. It alone contributes 47.3%, 35.7% and 20% of the total agricultural income in the mountains, hills and the Terai, respectively (Tulachan and Neupane, 2009). Milk and its products fill a universal necessity for a food supply that functions around the clock, day after day from cow to consumer. Public health supervision must be efficiently geared to fulfill its task so that the consumer accepts the daily delivery to stores and homes.

Milk is synthesized in specialized cells of the mammary gland and is virtually sterile when secreted into the alveoli of the udder (Tolle, 1980). Being a nutritionally balanced foodstuff that contains a low microbial load (less than 1000 ml-1) when drawn from the udder of a healthy cow, milk gets contaminated at various stages, including the cow itself, the milker (manual as well as automated), extraneous dirt or unclean process water (Lues, *et al.*, 2003). The health and hygiene of the cow, the environment in which the cow is housed and milked, and the procedures used in cleaning and sanitizing the milking and storage equipment are all key in influencing the level of microbial contamination of raw milk. Raw milk quality remains an important component in assessing the performance of dairy chains. It is generally based on chemical components fat; SNF and protein contents which are influenced as a result

of feeding practices (Demeyer and Doreau, 1999) breed and lactation stage (Kelsey *et al.*, 2003). Fat and protein contents are key elements affecting the possible uses of milk. The most important factor in milk is its safety. Jayarao *et al*. (2004) observed that milk producers and cooperatives viewed bulk milk tank (BMT) analysis as an important part of milk quality assurance program. Besides, Bonfoh *et al*. (2003) concluded that the health of dairy herd and milking conditions are basic determinants of milk quality. Vasavada (1988) concluded that pathogenic bacteria in milk have been a major factor for public health concern since the early days of the dairy industry. Many diseases are transmissible via milk and milk products. Besides, the hygienic quality of milk affects its shelf-life (Ma *et al.*, 2000) and its eventual acceptability to consumers (Noordhuizen and Metz, 2005).

Despite of nourishing and wholesome effect of milk, bad quality of milk i.e. milk produced and handled under unhygienic condition can be source of number of diseases. In some cases, milk may be rendered dangerous and may be the cause of serious hazards to human life. Therefore it is very essential to control production, processing and marketing of milk at all stages (Yadav *et al.*, 1993). Any improvement in the quality of milk could contribute to the insurance of public health safety while at the same time having positive economic consequences.

The whole milk, which is consumed by the public in the western Chitwan, mostly comes from small scale dairy farmers who deliver the milk via milk collection centers. Lack of proper sanitation and hygiene during the course of milk production has been a major issue. Apart from this, chances of transmission of zoonotic diseases via milk and adulteration practices of unhygienic products in milk by the producers for more profit are the other important issues. This all leads to the production of inferior quality of milk that can have a very deleterious effect on the public health perspective. Therefore, this study is aimed at testing and analyzing the quality of raw milk that is sold at consumer level in the selected

area and review the public health impact due to it. All the information gathered will help to develop a management program to implement the public health concern in the area.

1.2 Objectives

General objective

- To evaluate the physical and chemical quality of raw milk produced by small scale dairy farmers and brought in collection center.

Specific objectives

- To identify contaminants of raw milk production.
- To determine the chemical composition of loose market milk.
- To detect different adulterants in milk.

2 LITERATURE REVIEW

2.1 Quality of milk

Milk is a complex mixture of fats, proteins, carbohydrates, minerals, vitamins and other miscellaneous constituents dispersed in water (Harding, 1999). Synthetic and secretary tissues of the mammary gland, the initiation and establishment of lactation, the milk ejection reflex, the breeds and genetic factors, the nutrition, the environment and the milking management practices, all these factors have important effect on milk composition and quality (Nickerson, 1999). According to Muir (1996) the shelf life of a dairy product is best defined as the time during which the product remains wholesome and exhibits no physical or sensory defects. The colloidal nature of cow's milk is a crucial structural feature that affects final product quality as well as its processing behavior. The colloidal system can be divided into two compositional domains, the casein micelle and the milk fat globule. These colloidal domains comprise nearly 80% of the approximate 12.7 g total solids 100 g-1 in milk (Tamime, 2007).

It has a water content of 88% and 12% of solids which constitute of 4.8% sugars, 3.5% fats, 3.1% protein and 0.6% salts (Stewart, 1978). It has a wide range of positive nutritional benefits and supplies a variety of nutrients including protein for body building, vitamins, minerals (especially calcium), fat and carbohydrate for energy (Harding, 1995). Fresh milk is neutral or slightly alkaline but on souring becomes acid because of the lactic acid formed by bacterial action on lactose. The fat and protein composition of the milk of the various animal species differs only slightly, but in every case it has a high priority in human nutrition (Hinrichs,2004).Milk composition for a Holstein herd revealed percentages of fat, protein, and lactose averaged 3.5,3.1, and 4.8, respectively (Pape-Zambito,2007). The milk proteins are characterized by a high content of essential amino acids beyond those macromolecules, which have various biological functions, are available or may be formed by

proteolysis in milk (Hinrichs, 2004). White *et al.* (2001) found potentially important differences in fatty acids composition of milk from cows consuming a warm season pasture species compared with milk from cows consuming a total mixed ration, as well as differences between Holstein and Jersey breeds.

In the developed countries, the industrial dairy sector conducts simple routine analytical tests to assess milk quality at the farm level. These tests provide a basis for farm payment and eventually a direct incentive to improve milk quality (Valeeva *et al.* 2007). In developing countries, the situation is quite different as milk is supplied by numerous smallholder farms that daily deliver small quantities to dairy plants (Moll *et al.* 2007).

Srairi *et al.* (2008) reported linkages between on farm practices with milk chemical quality parameters (fat and protein). The sanitary and nutritional quality of raw milk is an important issue in Nepal for social, economical and health reasons. Jayarao *et al.* (2004) observed that milk producers and cooperatives viewed bulk milk tank analysis as an important part of milk quality assurance program. Besides, Bonfoh *et al*. (2004) concluded that the health of dairy herd and milking conditions are basic determinants of milk quality. Another source of contamination by microorganisms is unclean teats. The use of unclean milking and transport equipments also contributed to the poor hygienic quality. Similarly, Vasavada (1988) concluded that pathogenic bacteria in milk have been a major factor for public health concern since the early days of the dairy industry. Many diseases are transmissible via milk products. Traditionally raw or unpasteurized milk has been a major vehicle for transmission of pathogens. An analysis of the raw milk marketed through the informal sub sector in Uganda, revealed two main issues: poor hygiene conditions form the production location all the way to the consumer and lack of an efficient preservation ststem to limit bacteria proliferation during transportation (Grimaud *et al*., 2007)

The components of milk and its physical and chemical properties provide a very favourable milieu for the multiplication of micro-organisms. Micro-organisms are naturally present in milk and their multiplication doesn't start immediately after milking. This protection is efficient for several hours following milking. It is necessary to take advantage of this perid to cool the milk to check microbial growth (Faye and Loiseau, 2002). The new concepts in milk production and processing, and the new product ideas such as genetically modified foods and the nutraceuticals advocated by Anand (2005) have set new goals for quality assurance and food safety. This has also necessitated the greater emphasis on regularory assurance and food safety. This has also necessitated the greater emphasis on regulatory aspects with advanced methods of analysis and monitoring.

The amount of product manufactured and the consequent number of samples to be analysed in today's dairy industry demand reliable and easy methods to determine the quality of both the raw mik and the end-products. Standard count methods are time-consuming. In the case of psychrotrophs, cultures need to be incubated for 8-10 days at 7^0C (Cousin *et al*,1992). Therefore, rapid methods for enumeration of microorganisms are of paramount importance. The number of rapid tests for the estimation of the microbiological quality of foods has increased considerably in recent years. Many tests have been proposed, including methods based on antibody and nucleic acid recognition, a wide range of biochemical and enzymetic assays, phage probes, membrane filyratio and impedance (Vassavada, 1993; fung, 1994; patel, 1999; Entis *et al.*, 2001). Despite the number of rapid methods that have been developed, the methods are generally unsatisfactory for the dairy industry as many of them lack accuracy for mixed bacterial populations, are too expensive, inaccurate or complex, and many are still too slow to provide useful results to the manufacturer. Furthermore, a number of the rapid methods available within the dairy industry are used to detect microorganisms rather than enumerate them. Enumeration, rather than detection, is a very important

requirement when assaying of milk quality. For all these reasons, few of the current methods hve gained wide acceptance, with the exception of the Bactoscan technique (Foss Electric, Denmark), based on flow cytmetry, which is registered as a routine method by the aurhorities in many countries.

Solid not fat (SNF) content of milk

SNF is the solid portion of milk excluding fat. It includes protein (3/4 casein), lactose, minerals (Ca, P, citrate, Mg, K, Na, Zn, Cl, Fe, Cu, sulfate, bicarbonate, others), acids (citrate, formate, acetate, lactate, oxalate), enzymes - peroxidase, catalase, phosphatase, lipase, gases (oxygen, nitrogen, carbondioxide) and vitamins (A, C, D, thiamine, riboflavin, others). Total Solid (TS) is the sum of SNF and fat (Jenness and Stuart, 1959).

The SNF component of milk, which consist of protein, lactose and mineral, may vary with changes in the diet but to a lesser degree than the fat content. Specific factors that have been reported to affect SNF production include nutrition, genetics, disease, stage of lactation, and season of year (Harris and Bachman, 2003). The SNF% recorded was 7.35 ±0.65% according to Chapagain (2008), Javaid *et al*. (2009), Bille *et al.* (2009) and kittivachra *et al.* (2006).

Proteins

Proteins are the body's 'building blocks' affecting our growth and immunity. Antibodies, enzymes and hormones all contain proteins, thus the proteins we eat provide the amino acids needed to replace both these and essential body cells. Whilst the body is able to synthesise some amino acids, there are eight essential amino acids it cannot make and have to be supplied in the diet (Harding, 1995).

In the digestion process proteins are broken down, in a process called hydrolyzation, from poly-peptides to smaller oligo-peptides, and then to dipeptides or tri-peptides, which are

made up of two or three links of specific amino acids, called free form amino acids, that are finally absorbed into the bloodstream. Proteins in excess of the body's requirements are used for energy.

There are numerous proteins found in milk. The major groups of milk proteins are caseins and whey proteins. Milk provides easily digested protein of a high nutritional value and is a rich source of essential amino acids (Harding, 1995).

Protein content is influenced by various genetic as well as environmental factors, such as nutrition, stage of lactation, age on the animal, season, climatic effects, milking system, milking time, udder health, etc. Energy supply has the strongest impact on the protein content. Sufficient energy supply enables maximal synthesis of proteins in the rumen, representing as much as 60 to 80% of all proteins that digest in the small intestine (Klopcic *et al.*, 2003).

Milk fat

Fats are components of the brain, nerve cells and are essential to many physiological processes. Milk fat being an animal fat, is characterized as being a saturated fat. However about 32% of milk's fatty acids are unsaturated, primarily as mono-unsaturated acids like oleic acid (C18:1). Milk supplies the essential fatty acids linoleic acid (2.1%), linolenic acid (0.5%) and arachidonic acid (0.14%). These are required by the human body for normal metabolism and growth. Short (C2 to C6) and medium chain (C8 to C12) fatty acids account for about 12% of the fatty acids of milk and being more readily digested. They do not contribute to the elevation of blood lipids nor are they deposited in adipose tissue (Harding, 1995). Nutrition and breeds of the cow have a marked effect on milk composition, particularly the fat content of milk. Venkatachalapathy and Iype (1998) estimated fat % by Gerber's method (IS: 1224 – Part I 1977) and TS percentage by gravimetric method (IS: 1479 – part II 1961). SNF content of milk was determined by finding the difference between TS

and fat content of milk. Although fat rarely accounts for 50 percent of the value of milk, small variations in fat percentage can significantly affect economic returns to dairy producers (Pennington, 2008). The mean Fat% was recorded as 4.83 ± 1.18% reported by Chapagain (2008).

4.3 Milk handling and cooling

If milk can be cooled rapidly to below 15 degree C (60 degree F), bacterial growth is slowed; if it can be cooled to below 5 degree C (40 degree F), it is arrested. Unfortunately in the tropics, it is rarely possible to cool milk to 15 degree C (60 degree F) without expensive mechanical refrigeration; if this is beyond the resources of the farmer, he is advised not to attempt cooling at all but to get his milk to the cooling centre (where there is mechanical cooling) to the dairy, or to the consumer as rapidly as possible (Barrett *et al.,* 1977).

When cows leave the milking parlor after milking, their teat sphincters are still relatively relaxed. If they immediately went back to lie down on a cubicle bed contaminated with *Escherichia coli* it would be relatively easy for these organisms to gain entry. Dipping or spraying teats after milking may accelerate the closure of the teat sphincters but it is also good practice to prevent cows from returning to their cubicles for 30 minutes after milking. If they can wait under cover and with access to food and water, so much better (Webster, 1987).

In India, quality of raw milk becomes a matter of grave concern as the total counts, normally encountered, are extremely high. Since such micro-organisms are present in the raw milk either as a natural infection through the udder or as a secondary contamination owing to unclean handling during milking, to unclean milking utensils, or to air-borne infections care must be taken to use only such raw milk for UHT processing which as a relatively low total count. Reduction in initial microbial load of raw milk can be achieved by employing strict sanitary practices over secondary contamination at producers' level and also during transportation of raw milk. For the production of long-life products such as UHT milk

in a country like ours, raw milk need to be collected from only selected routes as being practiced by some private plants (Mathur *et al.*, 1998).

Factors affecting milk quality

The nutritional and microbial quality of raw milk is an important issue for economical and public health reasons. The quality of the starting raw milk has a very definite effect on the yield and quality of products made from it. The compositional quality, the hygienic quality, the health of the cow and the level of contaminants present can all have an impact on the yield and quality, and hence financial return from products made from milk (Harding, 1995). Dairy products quality defects have been attributed to poor microbiological quality of raw milk and heat-resistant enzymes (Marshall, 1982, Muir *et al.*, 1986). Milk from a healthy udder contains very few numbers of bacteria ($<3x10^4$ cfu/ml) but may become contaminated by microorganisms from the surrounding environment during milking and milk handling, from water and milk equipments (Cousins and Bramley, 1981).

The production of high quality milk should therefore be priority for good quality end products of long shelf life and for marketing of value added products. This is generally not easy to achieve in developing countries due to factors such as poor hygiene and sanitation during milking and milk handling, unclean water, high ambient temperatures, lack of cooling facilities and inadequate infrastructures for milk transportation to the processing facilities (Berg, 1988; Bille, 2000).

Milk is synthesized in specialized cells of the mammary gland and is virtually sterile when secreted into the alveoli of the udder. Beyond this stage of milk production, microbial contamination can generally occur from three main sources (Bramley and McKinnon, 1990); from within the udder, from the exterior of the udder and from the surface of milk handling and storage equipment (IDF, 1996). The health and hygiene of the cow, the environment in

which the cow is housed and milked, and the procedures used in cleaning and sanitizing the milking and storage equipment, personal hygiene of milker are all important in influencing the level of microbial contamination of raw milk. Equally important are the temperature and length of time of storage, which allow microbial contaminants to multiply and increase in numbers. All these factors will influence the total bacteria count or Standard Plate Count (SPC) and the types of bacteria present in bulk raw milk.

The microbiological infection of milk taking place inside the udder is called primary infection. The main groups of microorganisms for this infection are the aerobic mesophilic microflora, and they contributed little to the deterioration of good quality raw milk (<5000 cfu/ml) (IDF, 1996). Natural flora originated of the cow generally has little influence on total plate counts (Murphy and Boor, 2000). While the healthy udder should contribute very little to the total bacteria count of bulk milk, a cow with mastitis has the potential to shed large numbers of microorganisms into the milk supply (Bramley and McKinnon, 1990).Bacteria are the most common causes of mastitis, but other types of organisms such as yeasts, mycoplasmas, and algae may occasionally infect the udder (Harding, 1995).

Housing condition can contribute to the higher incidence of mastitis. Contamination of bedding material can be very high, due to absorption of urine and feaces. For mastitis causing bacteria different bedding materials can be of influence as a vehicle of contamination (IDF, 1996). Damaged teats can affect milk quality in that any break in the skin can become a reservoir for mastitic bacteria and give rise to a significant increase in bacterial count. Physical injury to teats is usually caused by cows treading on their own teats, usually due to poor housing design, rough concrete, high cubicle steps, and narrow cubicles or overcrowding. This can result in mastitis and in severe cases, blood being drawn into the milk supply during milking (Harding, 1995).

Bacteria are present in the air, dust and water, especially any water containing traces of milk residues which may have been left in the milking plant overnight, as such residues provide a very good source of food for bacteria, thereby enabling the bacterial counts to increase rapidly.

Cleaning regimes are based on removing visible dirt, removing milk residues (fat, protein, milkstones) which harbour bacteria, then sterilization of the cleaned surfaces using heat or chemical sterilants such as sodium hypochlorite (Harding,1995). Attachment of bacteria to different surfaces (Husmark and Ronner, 1990) and possible scaling may cause problems with cleaning and disinfection. In most cases not all bacteria are killed and removed during cleaning and disinfection.

Mathur *et al.* (1998) highlighted the reduction in initial microbial load of raw milk can be achieved by employing strict sanitary practices over secondary contamination at producers' level and also during transportation of raw milk. Prakash *et al.* (2007) suggested that the high number of bacteria and their activity may result in the degradation of milk during transport and storage, hence utmost care is to be taken while handling raw milk to according to milk temperature (for 40˚F very slow growth, 50˚F five folds growth, 60˚F fifteen folds, 70˚ F 700 folds and 80˚F 3000 folds growth of bacteria).

Reinemann *et al.* (1997) reported that inadequate cooling increase bacteria count by allowing a better environment for bacteria growth during storage.

Effects on electrical conductivity

The idea of an EC for mastitis detection dates back to the early 1940s (Batra and McAllister, 1984). It is a measure of the resistance of a particular material to an electric current. The electrical resistance of an electrolyte solution is defined as the resistance of cube of solution in $1cm^3$ volume. The conductivity is the reciprocal of the resistance.

Resistance (impedance) is measured in Ohms and is calculated by dividing voltage by amperes. Conductivity is measured in Siemens and is calculated by dividing ampere by voltage. An EC of normal cow milk lies between 4.0 and 5.5 mS/cm (Wong, 1988) and for buffalo milk at 25° C is 3.76 mS/cm (Dhakal, 2005).

The EC of milk has also been expressed as a concentration of NaCl with the same conductivity as examined milk in milimoles, which reflects the total ionic concentration of milk in miliequivalents per liter (Kitchen *et al.,* 1980). In milk, EC is determined by the concentration of anions and cations. The most important ions in the milk are Na^+, K^+ and Cl^- (Kitchen, 1981; Wong, 1988). The secretary cells in the mammary gland have active transport system for pumping Na+ in to the extracellular fluid and K^+ into the cells. The $Na^+$and K^+ are transported passively from the secretary cells into the milk. The Na^+: K^+ ratio is 3: 1 in the extracellular fluid and blood and 1:3 in extracellular fluid and the milk. The Cl^- concentration is higher in blood and extracellular fluid than in milk (Kitchen, 1981). Mastitis causes changes in the conductivity of milk by damaging the mammary epithelium altering the balance of Na^+, K^+ and Cl^- pumping system (Kitchen *et al*, 1980). After the cell damage Na^+ and Cl^-, which have high concentration in extracellular fluid pour in to the lumen of the alveolus. In order to maintain the osmotic pressure K^+ and lactose concentration decrease in milk (Kitchen 1981). EC has the advantage of defining the infection status. Many factors affect EC of milk, however, only intra-mammary infection is likely to influence EC of individual quarters (Schultz, 1986 in Dhakal 2005). Milk electrical conductivity changes during milking because of the changes in the electrolyte or fat concentration of the milk.

Adulteration in milk

Public consume fluid milk which has been adulterated and diluted to an extent that there is very little nutritive value left in it leading to public health concerns and malnutrition(Lateef *et al.*,2009). Suppliers of milk appear to have found three ways to

increase their margin from the sale of milk: (i) dilution (ii) extraction of valuable components, *i.e.* milk fat removed as cream, and (iii) a combination of (i) and (ii) with the addition of cheap (and sometimes potentially harmful) bulking additives, such as low quality flour, to bring the total solids to a level which is acceptable to consumers. Such milk is watered /skimmed to increase profit. To maintain its composition, starch, flour, urea, cane sugar, vegetable oil, etc., are added. Milk is a perishable commodity. So during summer months, it is likely to be spoiled during transportation. The middlemen therefore add chemical preservatives such as penicillin, strepto-penicillin, formaldehyde, hydrogen peroxide, sodium bi-carbonate, etc. The adulterants/ preservatives assume the proportion of health hazards for end consumers, particularly infants.

3 MATERIALS AND METHODS

3.1 Study area

The study was conducted in Western part of Chitwan District of Nepal from2nd February to2nd May, 2012. The study encompasses two parts : i) A survey regarding management practices including cleaning and sanitation of barns, utensils, milking practices and milk transportation and ii) Laboratory analysis to know chemical composition of milk and adulteration of milk.

3.2 Field survey

Field survey was conducted at 4 milk collecting units located at command area of Vijaya Milk Producing cooperatives Ltd, Bijayanagar. 80 farmers with of each MCC were selected purposefully on the basis of regularity on milk selling. The farmers were interviewed according to a short structured questionnaire to establish facts about farming and milk handling practices. The interview was conducted in an informal way with semi-structured

open questions for complete information within each farm on practices of cattle and buffalo rearing, feeding and milking, and milk handing practices (Appendix 1). The informal approach was used to make the respondents feel comfortable with questionnaire. The survey was conducted 2nd and 3rd weeks of December 2012.

3.3 Sampling methods and experimental design

The total samples collected were 128 from Chowki, Haraiya, Sharanpur &Bijayanagar milk collection center. Random samples from different farmers were collected fortnightly. No specific farmers were taken for the study and the farmers also randomly selected. Any farmer may be the large seller or the minimum quantity of milk seller was selected for the milk sample that was taken. The experimental design used was factorial Completely Randomized Design. Sampling of milk was done 8 times in overall for all treatment. Nearly 50 ml of milk sample was collected fortnightly in sample bottles of 100 ml capacity and taken to DLSO,Chitwan for quality assessment by using LACTO SCAN PROTOCOL ("milkanalyzer", MILKOTRONIC LTD., Europe).Altogether 64 milk samples were taken to test adulteration in raw milk of different location of western Chitwan.

3.4 Milk composition

The chemical composition of milk was estimated using Lactoscan ("milkanalyzer", MILKOTRONIC LTD., Europe).The lactoscan estimated Fat, Solid Not Fat, Protein, Water, Density and Conductivity%.

3.5 Adulteration test

The detection of various adulterants like sugar, starch, urea, salt, and neutralizer etc. was done by using the Standard Adulteration Testing Kit developed by National Dairy Development Board, (NDDB) Anand- 388001, Gujarat, India and marketed by Mother Dairy Foods Processing Ltd. Delhi in the dairy laboratory of IAAS.

3.5.1 Salt test

Five ml of salt reagent I was added with few drops of salt reagent II and one ml of milk was added and mixed well. The appearance of yellow colour denoted positive test.

3.5.2 Sugar test

One ml of milk and one ml of sugar reagent was mixed well and placed in boiling water for 3-5 minutes. The appearance of red colour denoted positive test.

3.5.3 Neutralizer test

Two ml of milk and two ml of neutralizer reagent was mixed well. The appearance of rose red or pink colour denoted positive test.

3.5.4 Urea test

Two ml of milk and two ml of urea reagent was mixed well. The appearance of light yellow colour denoted positive test.

3.5.5 Starch test

Five ml of milk was boiled and then cooled and few drops of starch reagent was added. The appearance of blue colour denoted positive test.

4 RESULTS AND DISCUSSION

4.1 Field survey

4.1.1 Farmers awareness on milk quality

Field survey study regarding the awareness of the farmers in quality milk production indicated that majority of farmers (95%) know the basic importance and the procedures to be adopted for quality milk production however they were lacking putting them into practice (Table 1).

4.1.2 Feeding management status

Feeding practices adopted by farmers are summarized in Table 1. About (42.5%) farms kept buffalo only as a major milch animal, and (25%) farms maintained cow only. However (32.5%) kept both buffalo and cow for milk production. This might be due to the fact that buffaloes are better yielders than local cows besides high fat content. In addition, it might be also due to some NGO's and INGO's mostly AEPF (Heifer International Project) that they are contributing a lot to develop buffalo pocket area in Western Chitwan. This is the reason why buffaloes have been considered as the most potential milch animal in farm household.

Majority of farm (78.75%) used maize and bran as principal ingredients of concentrate. This might be due to easy accessibility and cost effectiveness of maize and bran in the locality.

This is also supported by Banerjee (1998) who reported availability and cost effectiveness in Indian subcontinent. Most of the farms (81.25%) are supplying green throughout the year.

Table 1. Distribution of variables associated with feeding management of dairy farm (n=80)

Description	Categories	No. of farm(%)
Awareness on milk quality	Yes	76(95)
	No	4(5)
Type of milch animal	Only cow	20(25)
	Only buffalo	34(42.5)
	Both cow and buffalo	26(32.5)
Ingredients of concentrate	Only maize and bran	63(78.75)
	Maize, bran and others	17(21.25)
Management of green	Six month only	15(18.75)
	Whole year	65(81.25)
Feeding	Stall feeding	72(90)
	Limited grazing + tethering	8(10)
Knowledge on clean milk production	Yes	78(97.5)
	No	2(2.5)

Year round availability of green was possible due to the reason that most of the farmhouses were located nearby forest. When system of rearing was concerned, majority farms (90%) were maintaining their dairy stock under stall feeding and very few farms (10%) under limited grazing + tethering which might be due to restriction adopted by community forestry as well as national forest policy.

4.1.3 Milk handling and hygienic practices

Milk handling and hygienic practices are depicted in Table 2. Less than fifty percent farmers (43.75%) practiced hand washing with soap before milking and rest (56.25%) washed their hands by common water only. Washing of hands with soap contributes to greater extent in clean milk production than washing hands with normal water which was also observed by Srairi *et al*. (2006). (81.25%) of farms adopted straining milk before delivery. Udder washing before milking was quite systematic (100%). However, farmers from majority of farm (83.75%) practiced such washing by only water and few (16.25%) by warm water and/or detergent. Similarly (42.5%) farmers practiced washing of milk utensils with only common water; such utensils were reutilized without drying off by nearly (6%) farm households which might result into a significant bacterial multiplication. This later finding is in conformity with Bonofoh *et al.*(2003) who reported that the use of uncleaned milking utensils contributed to poor hygienic quality of milk. When taking into account of washing and cleaning of milch animal prior to miling, it was interesting to note that majority of farms (87.5%) were not adopting this practices.

Table 2. Distribution of variables associated with milk handling and hygienic practices (n=80)

Description	Categories	No. of farm (%)
Washing hands before milking	With water only	45(56.25)
	With soap	35(43.75)
Straining of milk	Yes	65(81.25)
	No	15(18.75)
Washing of udder before milking	With only water	67(83.75)
	With warm water and/or soap	13(16.25)

Washing of utensils	With only water With warm water With detergent	34(42.5) 18(22.5) 28(35)
Dry off utensils by inverting	Yes No	75(93.75) 5(6.25)
Brushing or cleaning of animal just before milking	Yes No	10(12.5) 70(87.5)

4.1.4 Quality milk production and management

Quality milk production and management paramaeters are summarized in Table 3. Only 16.25% of milch animals showed the mastitis the incidence of mastitis and rest were free from the disease. Mastitis, one of the important farm animal diseases, might have contributed higher microbial load to bulk milk tank. This was supported by Bramley and Mckinnon (1990) who inferred that if the mastitis milk from one cow with 10^7 bacteria per ml comprises 1% of the bulk tank milk, the total bulk milk tank count, disregarding other sources, would be 10^5 per ml. Only 7.5% of farms deliverd the milk to MCC within five minutes of milking, 31.25% within 15 minutes, 36.25% wthin 30 minutes and 25% within 45 minutes to deliver the milk. Milk transportation time may be considered one of the factor to maintain milk quality. Prakash *et al*. h(2007) also suggested that the high number of bacteria and their activities may result in the degradation of milk during transportation. Occasional sale of the evening milk in the morning is relatively less frequent (12.5%).

Table 3. Distribution of variables associated with quality milk production and management

Description	Categories	No. of farm (%)
Incidence of mastitis	Yes	13(16.25)
	No	67(83.75)
Time taken to deliver milk	Within 5 minutes	6(7.5)
	Within 15 minutes	25(31.25)
	Within 30 minutes	29(36.25)
	Within 45 minutes	20(25)
Frequency of stale milk	Yes	10(12.5)
	No	70(87.50
Shed cleaning per day	One time	10(12.5)
	Two times	60(75)
	Three times	10(12.5)
Manure disposal from shed	Very near to shed	25(31.25)
	Far from shed	55(68.75)

Farmers from 12.5% of farms cleaned their shed once a day while 75% and 12.5% cleaned shed twice and thrice daily. There were a large number of farms (68.75%) disposing animal manure considerably far from shed and only 31.25% farms disposed waste very near to the shed.

4.2Fat content of raw milk

The fortnightly fat percent of milk collected from different MCC is presented in Table1.Analysis of variance showed significant effect ($p<0.05$) of different location and dates on fat content of milk. Accordingly, maximum fat content was recorded in Chowki, (6.26%) which was statistically similar with Haraiya (5.86%) followed by Saranpur (5.21%) and Bijayanagar (4.92%).

Analysis of variance also showed significant effect on fat content of milk in different dates. Accordingly, significantly ($p<0.05$) maximum fat percentage was recorded at 4^{th} fortnight of collection (6.22%) which was statstically similar with 1^{st}, 2^{nd}, 5^{th} and 6^{th} fortnightly collection. However, minimum (4.94%) was recorded in 8^{th} fortnight was similar with 3^{rd} fortnightly collection.

The result showed the change in fat percent of raw milk with respect to different locations and time intervals which coincides with the work of Pennington (2008) who reported variation of fat percentage which effect economic returns to dairy production. Similarly Chapagain (2008) also reported change in fat percentage as per location with different point of time who recorded mean fat% as 4.83 ± 1.18%. The change in fat content of raw milk with different locations at different time intervals might be due to physiological state of animals which effect their production potential and milk composition. The fat content of raw milk is the most changeable component in different locations with different levels of time interval which affect the composition and quality of milk.

Table 4. Fortnightly fat percent of milk collected from different MCC.

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	5.44	5.85	4.53	5.27	4.82	4.59	4.64	4.23	4.92^{b}
Saranpur	4.95	5.25	4.57	6.61	4.55	5.47	5.37	4.93	5.21^{b}
Haraiya	4.97	5.19	5.29	7.44	6.02	6.68	5.93	5.35	5.86^{a}
Chowki	6.60	8.23	5.61	5.53	7.17	5.97	5.76	5.23	6.26^{a}
Mean	5.49^{abc}	6.13^{ab}	5.00^{c}	6.22^{a}	5.64^{abc}	5.68^{abc}	5.42^{bc}	4.94^{c}	LSD=0.55
LSD=0.78									

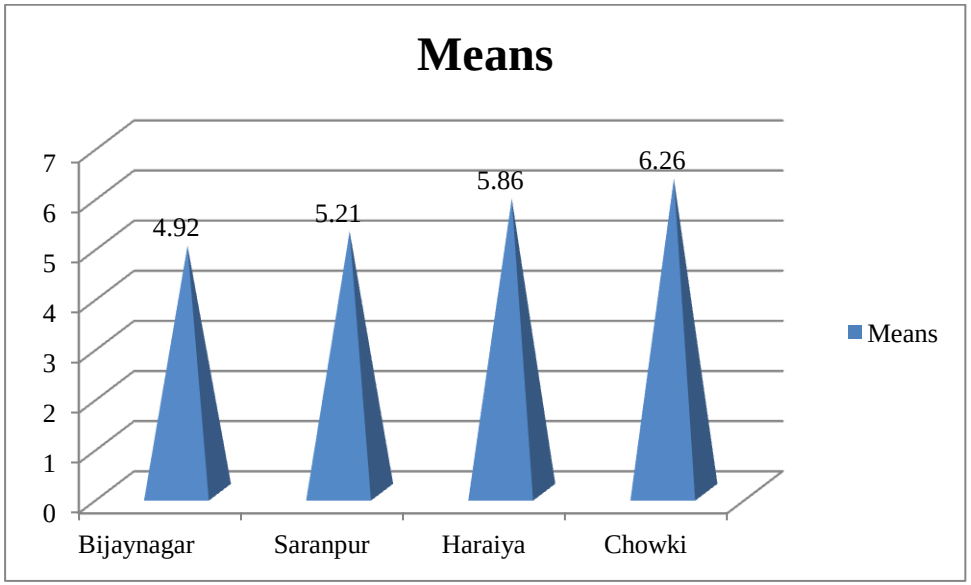

Figure 1. Average fat content of raw milk from different locations of Western Chitwan.

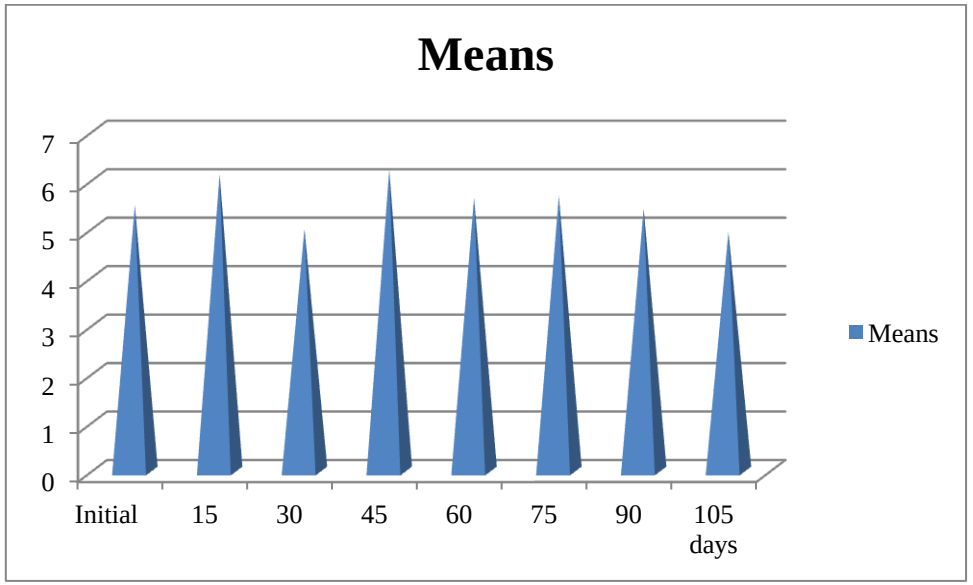

Figure 2. Average fat content of raw milk in different time intervals from Western Chitwan.

4.3SNF content of raw milk

SNF content of raw milk at different location of research site not significantly different ($p>0.05$) is presented in Table 2. Accordingly, maximum SNF content (6.98%) was recorded in Saranpur followed by Bijayanagar (6.96%), Chowki (6.89%) and minimum was recorded in Haraiya (6.88%).

Similarly, the effect of days interval was also not significantly different ($p>0.05$).The maximum SNF content was recorded at 8^{th} fortnight. However, minimum SNF content (6.63%) was recorded at 5^{th} fortnight. Other days interval were in between 5^{th} and 8^{th} days interval.

The study showed the variation of SNF content of milk with different locations at different interval of time which might be due to animal's behavior and its production affect in different weather condition of different location in different time interval. Harris and Bachman (2003) reported that specific factors that have been reported to affect SNF production include nutrition, genetics, disease, stage of lactation, and season of the year. The SNF% recorded by Chapagain (2008), Javaid *et al*. (2009), Bille *et al.* (2009) and kittivachra *et al.* (2006) was found to be 7.35 ±0.65% . Harris and Bachman (2003) found that summer SNF values were lower than winter SNF values. Periods of drought, high temperatures and high humidity tend to result in lower SNF values. The present results inconsistent fat % differed from the results of Sargeant et al. (1998) who observed the lowest fat percentages during summer months, and the highest between winters

Table 5. Fortnightly SNF content of milk collected from different MCC.

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	6.87	6.69	7.12	6.98	6.82	6.94	7.17	7.09	6.96
Saranpur	7.02	6.70	6.92	7.07	6.58	7.15	7.19	7.22	6.98
Haraiya	7.00	7.46	6.76	6.62	6..39	6.80	6.80	7.20	6.88
Chowki	6.94	6.83	6.43	6.99	6.71	7.05	6.66	7.48	6.89
Mean	6.96	6.92	6.80	6.91	6.63	6.99	6.96	7.25	

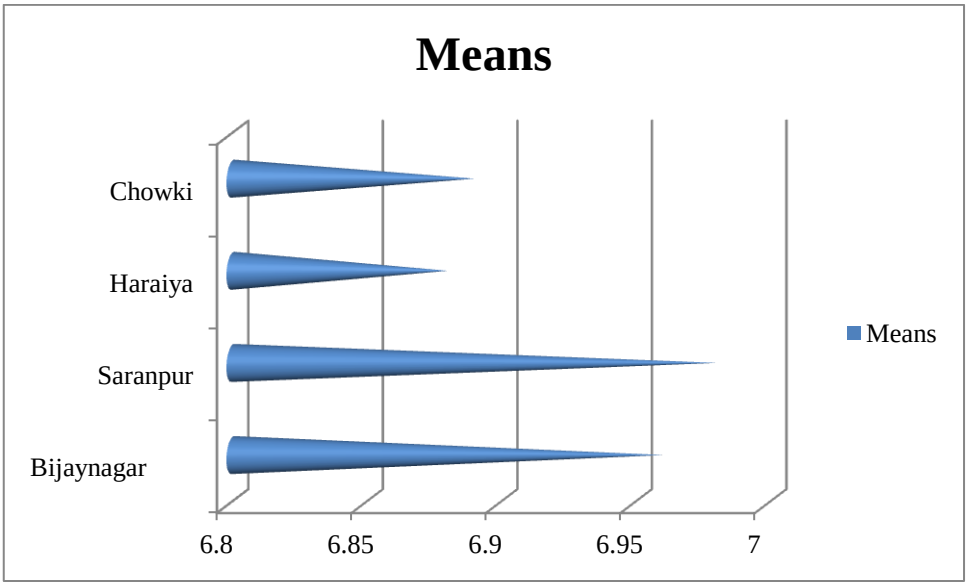

Figure 3. Average SNF content of raw milk of different places from Western Chitwan.

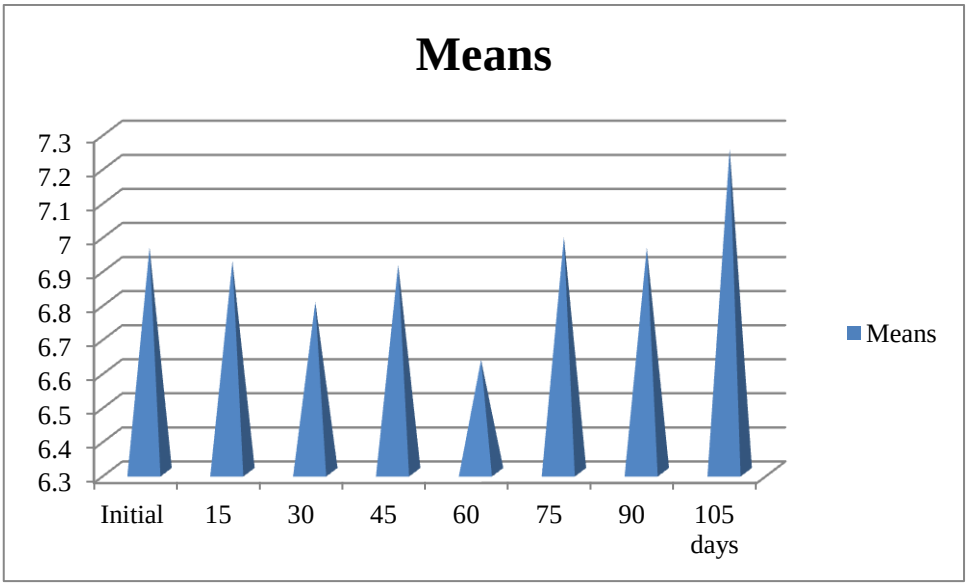

Figure 4. Average SNF content of raw milk in different time intervals.

4.4Protein

The protein content of raw milk in different location not significantly($p>0.05$) different is present in Table 3 and Fig. 5. The maximum (2.54%) protein content was recorded in Bijayanagar. However, minimum (2.49%) protein content was recorded in Saranpur. Protein content of Haraiya and Chowki were in between protein content of Bijayanagar and Saranpur which was statistically ($p>0.05$) similar.

Analysis of variance showed significant effect of different date of collection of milk on protein content (Fig. 6). Significantly ($p<0.05$) maximum (2.66%) protein content was recorded in 8th fortnight of collection of milk which was statistically similar with 1st , 2nd , 3rd and 4th fortnight of collection of milk.

Table 6. Fortnightly protein content of milk collected from different MCC.

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	2.55	2.45	2.64	2.59	2.52	2.44	2.55	2.59	2.54
Saranpur	2.61	2.49	2.49	2.63	2.25	2.46	2.45	2.57	2.49
Haraiya	2.52	2.77	2.51	2.46	2.38	2.39	2.54	2.63	2.52
Chowki	2.58	2.38	2.49	2.59	2.49	2.45	2.44	2.85	2.53
Mean	2.56^{ab}	2.52^{abc}	2.53^{abc}	2.56^{ab}	2.41^{c}	2.43^{bc}	2.49^{bc}	2.66^{a}	
LSD=0.15									

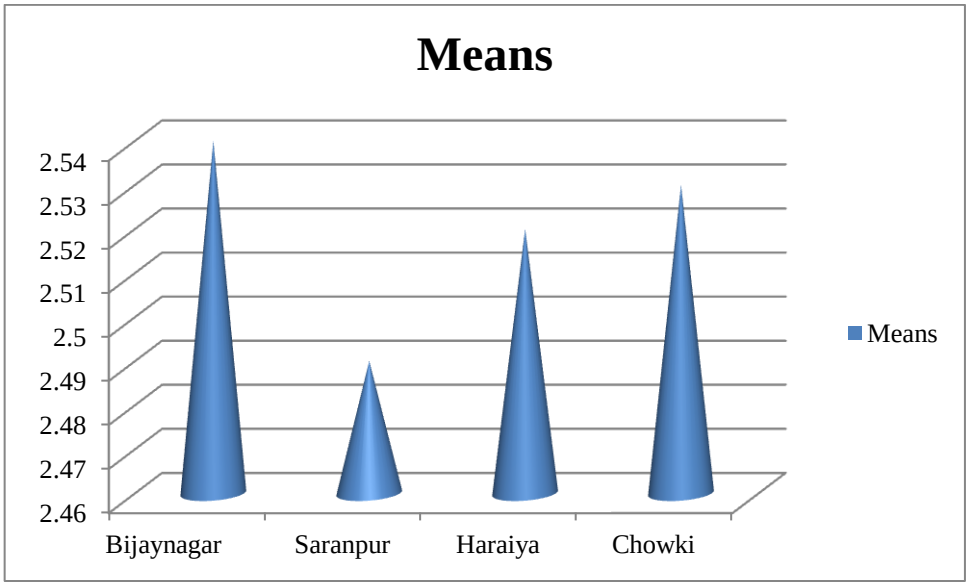

Figure 5. Average protein content of raw milk from different places of Western Chitwan.

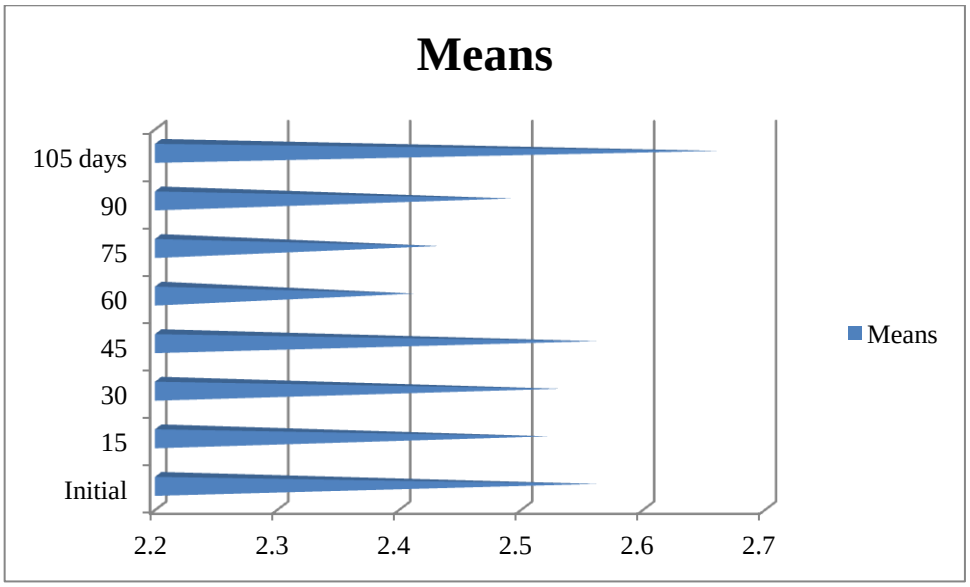

Figure 6. Average protein content of raw milk in different time intervals in Western Chitwan.

The study showed variation in protein content of raw milk with different interval of time and with different locations which might be influenced by various genetic as well as environmental factors, such as nutrition, stage of lactation, age on the animal, season, climatic effects, milking system, milking time, udder health, etc. Energy supply has the strongest impact on the protein content (Klopcic *et al.*, 2003) reported that sufficient

energy supply enables maximal synthesis of proteins in the rumen, representing as much as 60 to 80% of all proteins that digest in the small intestine.

4.5Conductivity

The conductivity of milk of different location in different fortnights of collection was not significantly ($p>0.05$) different and is presented in Table 4. Accordingly, maximum (2.13%) conductivity of milk was recorded in Bijayanagar followed by Saranpur (2.62%) and Chowki (2.59%). However, minimum (2.57%) conductivity of milk was recorded in Haraiya.

Conductivity of milk at different fortnight of collection of was not significantly ($p>0.05$) different is presented in Table 4 and appendix 8. Maximum (2.74%) conductivity of milk was recorded in 8^{th} fortnightly collection and minimum (2.46%) in 2^{nd} fortnightly collection. Conductivity of milk at other dates of collection were in between 2^{nd} and 8^{th} fortnight of collection of milk.

The study observed change in conductivity which might be due to change in ionic condition of sodium, potassium and other ions with change in location and time which coincides with the findings of Kitchen *et al*, (1980) who reported altering the balance of Na^+, K^+ and Cl^- pumping system. The change in milk electrical conductivity during milking might be due to changes in the electrolyte or fat concentration of the milk.

Table 7 Fortnightly Conductivity of milk from different MCC of western chitwan

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	2.41	2.14	2.59	2.61	2.97	2.49	2.92	2.90	2.63
Saranpur	2.84	2.44	2.55	2.37	2.52	2.92	2.59	2.72	2.62
Haraiya	2.92	2.79	2.49	2.37	2.46	2.64	2.37	2.52	2.57
Chowki	2.54	2.46	2.51	2.59	2.51	2.79	2.56	2.82	2.59
Mean	2.68	2.46	2.54	2.49	2.61	2.71	2.61	2.74	

4.6Sp. gravity

The fortnightly sp. Gravity of milk of different location in different dates is presented in Table 5. Analysis of variance (ANOVA) showed statistically similar ($p>0.05$) sp. Gravity of milk in different location (Appendix 10).

Sp. Gravity of milk of Bijayanagar, Saranpur, Haraiya and Chowki were 22.42%, 22.04%, 21.92% and 21.79% respectively.

Analysis of variance (ANOVA) showed significant ($p<0.05$) effect of different date of milk collection. Significantly maximum (23.31%) sp. Gravity was recorded at 8^{th} fortnightly collection. However, minimum (20.83%) sp. Gravity was recorded at 6^{th} fortnightly collection presented in Figure 8.

Table 8. Fortnightly Sp. Gravity of milk collected from different MCC.

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	22.23	21.12	23.38	22.71	22.31	22.53	22.29	22.79	22.42
Saranpur	22.76	21.55	22.47	22.39	19.72	22.26	21.78	23.38	22.04
Haraiya	22.96	24.49	21.36	20.51	20.33	21.32	21.19	23.17	21.92
Chowki	22.96	19.36	20.50	22.32	20.95	21.84	22.51	23.91	21.79
Mean	22.73^{ab}	21.63^{bc}	21.93^{abc}	21.99^{abc}	20.83^{c}	21.99^{abc}	21.94^{abc}	23.31^{a}	
LSD=1.39									

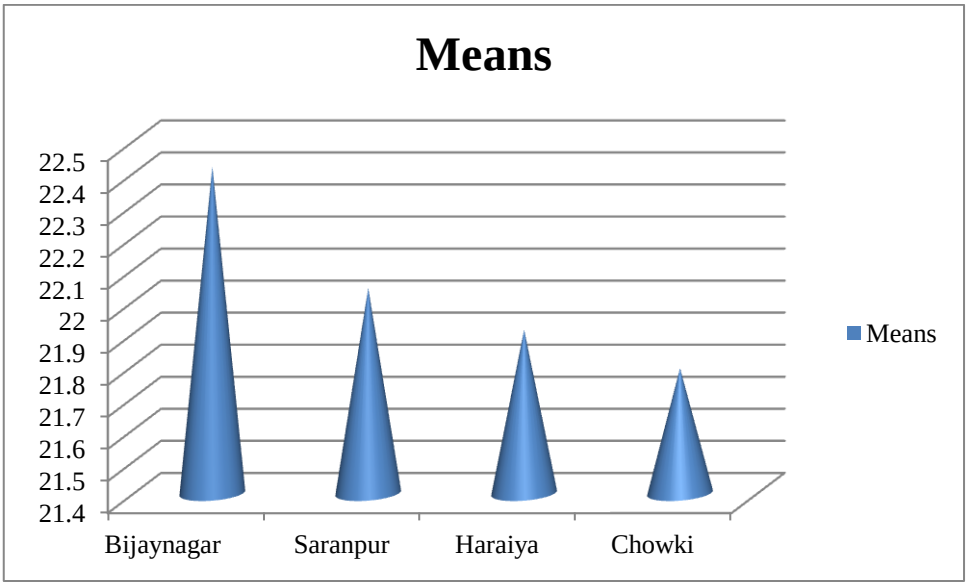

Figure 7. Average sp. gravity of raw milk of different locations from Western Chitwan.

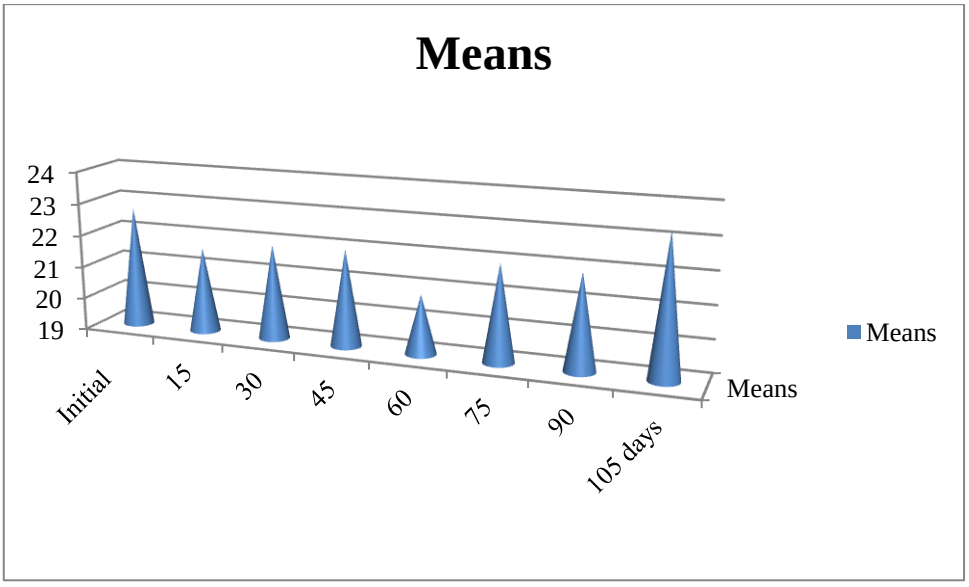

Figure 8. Average sp. gravity of raw milk in different time intervals of Western Chitwan

The observation showed variation in sp. Gravity with different locations and in different time interval which might be due to change in fat and SNF content of milk which indirectly affect the sp. Gravity of milk. The weather condition,level of nutrition, milking interval, genetic potential etc might affect the sp. Gravity of raw milk.

4.7Water

The added water content of milk of different location in different fortnightly collection is presented in Table 6. Significant ($p<0.05$) effect was recorded in different fortnightly collection of milk. Maximum (23.49%) added water content of milk was recorded in 5th fortnightly collection which was statistically similar with 6th, 7th, 8th, 2nd and 3rd fortnightly collection. Minimum (18.09%) added water was recorded in 1st collection which was statistically similar with 4th fortnightly collection. However, statistically similar added water content was recorded in different location. Maximum (21.71%) was recorded in Bijayanagar followed by Chowki (20.88%), Haraiya (20.83%) and Saranpur (20.35%).

Table 9. Fortnightly added Water content of milk from different MCC.

Location	Fortnight								Mean
	0	15	30	45	60	75	90	105	
Bijayanagar	19.04	22.36	16.05	17.74	27.45	23.94	23.68	23.39	21.71
Saranpur	18.80	21.54	20.59	15.74	20.53	22.04	22.45	21.15	20.35
Haraiya	17.15	14.41	20.51	20.57	25.81	23.23	23.68	21.24	20.83
Chowki	17.38	23.14	24.99	16.97	20.19	20.88	22.50	21.02	20.88
Mean	18.09^{b}	20.36^{ab}	20.53^{ab}	17.76^{b}	23.49^{a}	22.52^{a}	23.08^{a}	21.70^{ab}	
LSD=4.20									

The research revealed change in water content of raw milk with location and time interval which might be due to various conditions like seasonal changes in milk composition, milking intervals, physiological condition of animals during milking, plane of nutritions,climatic condition,adulteration by farmers etc. The change in water content of raw milk might be due to change in other content of milk such as change in fat , SNF, TS,protein etc which indirectly affect the water content of milk.

4.8Determination of adulteration test of raw milk from different places of western Chitwan

In Bijayanagar MCC, 1.56% of the milk samples were found to be adulterated with salt and 3.12% of the milk samples were found to be adulterated with sugar, However, none of the samples were found positive for Urea, Starch and Neutralizer. Similarly, in Gadhi MCC, 3.12% of the milk samples were found positive for Salt and 3.12% of the milk samples were found positive for sugar and none of the samples were adulterated with Urea, Starch and Neutralizer. In Saranpur 3.12% of the milk samples were positive for salt and sugar while none of the samples were found positive for other adulterants which was tested. In Chowki 1.56% of the milk samples were positive for salt and 1.56% of the milk samples were found to be adulterated with sugar and none of the samples were positive for other adulterants such as urea starch and neutralizer. In Haraiya only 4.68% of the milk samples were adulterated with sugar and rest of the samples were not adulterated with any other adulterants. Similarly in Narayanchowk only 1.56% of the milk samples were found to be adulterated with salt and rest of the samples were not found to be adulterated. None of the samples were found to be adulterated with any adulterants in shantichowk. In Banghai 1.56% of the milk samples were adulterated with salt and 3.12% of the milk

samples were adulterated with sugar and none of the samples were found to be adulterated with other adulterants.

Most of the samples were found adulterated with sugar followed by salt and none of the samples were found adulterated with urea starch and neutralizer. This may be due to lower price of salt and sugar and its easy availability compared to other adulterants. Other reason for more positive case of salt adulteration might be due to incidence of mastitis. Farmer mostly using salt and sugar as adulterants was to increase the SNF content of milk. An increased salt content was found to be associated with mastitis infection i.e. increase in Na and Cl content of milk due to inflammation of mammary epithelium (Dhakal, 2005). This may be due to urine contamination in milk by unhygienic milking practices

Table 10. Determination of adulteration test of raw milk from different places of western Chitwan

Adulterants	Bijayanagar	Gadhi	Saranpur	Chowki	Haraiya	Narayanchowk	Shantichowk	Banghai
Salt	(1)1.56%	(2)3.12%	(2)3.12%	(1)1.56%	0	(1)1.56%	0	(1)1.56%
sugar	(2)3.12%	(2)3.12%	(1)1.56%	(3)4.68%	(3)4.68%	(0)	0	(2)3.12%
Urea	0	0	0	0	0	0	0	0
Starch	0	0	0	0	0	0	0	0
Neutralizer	0	0	0	0	0	0	0	0
Sample size	64	64	64	64	64	64	64	64

5 SUMMARY AND CONCLUSIONS

5.1 Summary

An experiment was undertaken at Bijaya milk production cooperative Ltd, chitwan and its milk shed command areas of western chitwan covering a period from 02/02/2012 to 02/05/2012. The study was accomplished in two phases viz. laboratory analysis with lactoscan and adulteration test. Both the laboratory analyses were carried out by taking bulk raw milk samples for fortnightly at different MCCs.

Adulteration tests of raw milk from different places wereconducted which showed milk adulterated with different substances like sugar, salt, starch, neutralizer, urea etcAdulteration tests of 64 raw milk samples from different places were conducted which showed milk adulterated with different substances like sugar, salt, starch, neutralizer, urea etc. Sixty four samples from Bijayanagar, Gadhi, Saranpur, Chowki, Haraiya, Narayanchowk, Shantichowk and Bangai were considered for the study of adulteration by substances like sugar, salt, starch, neutralizer, urea etc. the data indicated that 1.56 and 3.12; 3.12 and 3.12; 3.12 and 3.12; 1.56 and 1.56; 1.56 and 3.12 percent for salt and sugar respectively for the MCC Bijayanagar, Gadhi, Saranpur, Chowki and Bangai. However, the values of 4.68% for sugar and 1.56% of the samples were adulterated by salt respectively for Haraiya and Narayanchowk. None of the samples were adulterated with any substances in Shantichowk. As a whole, none of the MCC showed any other adulterants. In Shantichowk, most of the farmers were new to animal husbandary and they were not familiar with adulteration of milk. As for the salt and sugar adulterants, the reasons for using these commodities as adulterants is its easy availability and non harmful from health point of view but other adulterants are expensive and harmful as well.

The highest and the lowest values for fat, SNF, protein, conductivity, specific gravity and water content location wise were Chowki and Bijayanagar; Saranpur and Haraiya; Bijayanagar and chowki and Bijayanagar and Saranpur respectively. Rest of the location

indicated the values within these. Similarly, period wise, highest and lowest values for fat, SNF, protein, conductivity and water content were 3rd and 7th; 7th and 4th; 7th and 4th; 7th and 1st; 7th and 4th; 4th and 3rd fortnight respectively. In chowki most of the farmers rear buffalo for milk production point of view so it has high fat content as compared to other milk collection centers.

The result obtained from the study on the quality of raw milk from different places of western Chitwan indicated that the current situation need improvement from adulteration point of view as most of the samples were adulterated from salt, sugar. However, none of the samples were found to be adulterated by starch, neutralizer and urea.

5.2Conclusions

The results obtained during this work on the quality or raw milk in Nepal indicated that the current situation is critical and needs real improvement.Lack of incentive and motivation might be one of the single most important factors that discourage farmers from producing quality milk. Though it is the matter of ethics also in part of producers, sometimes farmers might be compelled to produce milk in unhygienic way due to simply lack of water. Ignorance, lack of proper training and skill might also lead to compromise in the quality milk production. It is possible that farmers are unaware about the implication of antibiotic residues in the milk and they are selling milk from the animals during the antibiotic treatment period. Some farmers are concerned only about the visible external contamination. Most of the dairy farmers in the country perceive that the milk price is not conducive enough to produce hygienic milk.

In effect, a great majority of milk samples showed variation in milk composition like fat, SNF, protein, conductivity, sp. Gravity and water. The study revealed variation in milk composition with respect to location and time. Adulteration tests showed raw milk adulterated mostly with sugar and salt by local farmers. So, adulteration tests are necessary in

order to test the quality of raw milk from farmers. The following recommendations are made in order to avail quality milk to the consumers

- Government should include legal enforcement of adulteration test and other quality control test of raw and marketed milk considering Nepalese situation.
- NDDB should bring all dairy stakeholders together to set milk pricing policy in order to stimulate the awareness among farmers and processors for quality milk production.
- Good hygienic practices should be applied throughout the production and processing chain so that milk and milk products are safe and suitable for their intended use.

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