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Full Length Research Paper

An evaluation of milk quality in and around Rawalakot Azad Kashmir

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The present study was conducted to evaluate the quality of milk from Rawalakot and its surroundings. Milk samples were collected from house hold animal, milkman and restaurant milk in order to assess the hygienic status of raw milk, which was collected from three different parts of the city, Rawalakot Azad Jammu and Kashmir. It was observed that the milk samples which were collected from house hold milk showed better quality compared to the other two sources. For the assessment of adulterants, clot-on-boiling (COB), alcohol perception and methyleneblue tests were conducted. In COB test, the result was 29% positive in house hold animal milk, 38% in milkman and 38% in restaurant milk; whereas, in COB test, results of milkman and restaurant milk were similar. The results of alcohol tests showed variation among the three sources of milk: in household animal milk (APT) it was 34%; 44% in milkman and 34% in restaurant milk. Methyleneblue test results show variation among the three sources; the mean values of A+, B+, C+ and D+ for HH were 29, 44, 17, 11 and 14%; 62, 11, 14% were recorded for MM; whereas 14, 33, 33 and 11%, in RM, respectively. The quality of milk was different in all three sources. Milk composition was assessed by specific gravity, fat % and acidity test. The result of Gerber test (fat% age) shows slight variation among the three sources of milk (7.00%, 6.31% and 5.55), respectively. The results of specific gravity were 0.128 g/ml for house hold, 1.027 g/ml for milkman and 0.125 g/ml for restaurant milk, respectively. All three sources showed low specific gravity than standards. The result of acidity test shows slight difference in all three sources of milk. The acidity of milk samples was recorded as 0.18 in house hold milk, 0.21 for milkman milk and 0.19 in restaurant milk. The acidity was higher than the standard values in both milkman and restaurant milk. In organoleptic test, the result was based on sensory evaluation and scoring system. The lowest value was 5.5 and highest value was 7.4. As the results show the HH animal milk was graded as good compared to the other two sources of milk.

Key words: Organoleptic, adulterants, milk, acidity.

INTRODUCTION

Milk is the lacteal secretion which is free from colostrums during the period of 15 days before parturition and five days after; it contains: 8.5% solids-not-fat, 87.20% water, 3.50% protein, 3.70% fat, 4.90% milk sugar, 0.70% ash

and 12.80% dry matter (Tenvir, 2007). Thus milk is a balance diet which contains all basic components to fulfill the needs of an individual. Milk protein is considered as high quality protein with all essential and non essential amino acid, highest biological value and easily digested to the extent of 97 to 98 % (Tenvir, 2007). Milk and milk products contribute ⅓rd of world's intake of animal protein. Milk plays a vital role in building a healthy society and can be used as vehicle for rural development. Fresh or raw milk as diet contributes to infants and adults all over the world **(**Cousin, 1982).

Pakistan is in 3rd position in milk production with annual contribution of 43.29 million tons (Ministry of Livestock and Dairy Development Pakistan, 2009-10). Buffalo and cow account for 96% of the total milk production in Pakistan, of which buffalo is in first position and cattle, 2nd position (Khan et al., 2008). Livestock sector contributes 11% of total GDP and provides main work force for 30-35 million people of rural population (Anonymous, 2008). Milk and milk products represent 27% of the total house hold expenditure on different food items (Zia*,* 2006).

There are several factors which decrease the quality of raw milk. These include poor animal health, delivery services, poor house hygiene, unhygienic milking practices, udder infection and zoonotic infection. Other factors such as presence of antibiotic residues and animal diseases (mastitis) also affect milk quality. On the other hand, environmental changes such as seasonal and nutritional change also affect milk composition.

Absence of cooling rooms and hygiene facilities may affect the quality standards of milk (Blowey and Edmondson*,* 2000; Grange*,* 1998; Hogeven et al*.,* 2000). Milk quality can also be decreased by some other factors like milk adulteration during and after milking, udder disorder and inflammation of mammary glands of different milking animal cattle, sheep and camels (Molla and Bekele, 2000; Edmondson, 2001; Ali, 2001).

Milk differs in compositional variations in different species due to factors such as species of animal, breed, individuality, stage of lactation, frequency of milking, age, seasonal variations, feed, milking interval, use of drugs and hormonal change (Ensminger, 1993). All these factors cause economic losses in dairy industry throughout the world (Kossabati et al., 1998).

In Rawalakot (AJK), majority of the people use raw milk but no proper guidelines are available for milking, handling and storing at house hold level restaurants and shops. In AJ&K very limited work has been under taken to assess the quality standards of milk.

The objective of this study was to evaluate the hygienic quality and level of microbial contamination in raw milk which was collected from house hold animals, milk man and restaurants. The present study was therefore planned to investigate the quality and safety standards.

MATERIALS AND METHODS

The present study was carried out in the Food Technology Research Laboratory of Department of Food Sciences and Technology Faculty of Agriculture Rawalakot University of Azad Jammu Kashmir, to study the hygienic quality of raw milk from Rawalakot and its surroundings.

Collection of samples

Milk samples were collected from house hold animals directly, from the milkers/gawala and from the respondents of restaurants in bottle from Rawalakot Azad Jammu and Kashmir, and its surroundings. They were collected in aseptic plastic bags with the help of sampling spatula. They were labeled, placed in ice packing and then transported to the laboratory for further analysis. These samples were transferred in to the refrigerator immediately at 4°C and culturing was conducted within 24 h. The sample was subjected to the following quality tests.

Quality tests of milk

Clot on boiling test

This test was performed according to the method described by Marshall (1992) for acid milk having pH less than 5.8 or abnormal milk (e.g. colostral or mastitis milk) to assess milk acidity. The alcohol test was done by using a 68% ethanol solution. Tests were done immediately after the samples were delivered to the laboratory within four hours. 2 ml of the raw milk sample was taken and mixed with 68 percent ethanol solution in a sterile test tube. The solution was prepared from 68 ml 96 percent alcohol and with 28 ml of distilled water.

Alcohol perception test

This test was also performed according to method of Marshall (1992); the test is based on the proteins (instability) and concentration of acid or rennet is increased. Test assesses the increased levels of albumen colostrum milk and salt concentrates (mastitis).

Methylene blue test (MBRT)

Methylene blue test for the assessment of mastitis was performed according to the procedure described by Awan and Rahman (2005). The test is used to diagnose mastitis, the ability of bacteria to reduce the color of methylene blue dye from the milk sample. Dye reduction time is inversely proportional to the presence of total number of bacteria in sample; hence the greater the bacterial population, the shorter is the dye reduction time.

Acidity test

Acidity in different milk samples has been calculated by the method described by Marshall (1992). The natural acidity of milk is 0.16 - 0.18%. Figure higher than this signifies developed acidity due to the action of bacteria on milk sugar.

Table 1. Value for clot-on-boiling of different milk samples.

Sources	Positive (%)	Negative (%)
House hold	29[b]	71[a]
Milkman	38[a]	62[b]
Restaurant	38[a]	62[b]

Table 2. Values for alcohol precipitation test of different milk samples.

Sources	Positive (+ive)%age	Negative (-ive) %age
House hold	34[b]	66[a]
Milkman	44[a]	56[b]
Restaurant	35[b]	65[a]

Specific gravity

The specific gravity of milk was determined by Lactometer according to Marshall (1992).

Gerber test

Gerber test is used for the determination of fat percentage. For this purpose butyrometer is used. Fat % in different milk samples was determined by the method of Marshall (1992).

Organoleptic tests

The rapid segregation of low quality milk samples at milk receiving platform was based on Marshall (1992). Milk grade should have good sight, smell and taste.

Statistical analysis

The data obtained were subjected to statistical analysis by using CRD (Steel, 19 97).

RESULTS AND DISCUSSION

The present study was carried out to assess the hygienic quality of raw milk from Rawalakot and its surroundings. The research project was conducted in Food Technology Research Laboratory Faculty of Agriculture Rawalakot, University of Azad Jammu and Kashmir. About 102 milk samples were collected from different sources mainly, the house hold (HH), milkman (MM) and restaurant milk (RM). These samples were analysed for different parameters like adulteration (clot on boiling, alcohol precipitation test, methylene blue test), gross milk composition (specific gravity, acidity, fat) and organoleptic characteristics.

Adulterations

The adulterants such as chemicals, starch, oils, salts, soaps and water are commonly added to milk by milk sellers which may adversely affect the milk quality. So it is necessary to evaluate the milk quality with regard to adulterants that are added to the milk to increase the quantity and raising extra money. Therefore, the quality of milk affected by these adulterants was evaluated in the laboratory by clot on boiling (COB) and alcohol perception test (APT), respectively.

Clot-on-boiling

The results pertaining to the test clot on boiling (COB) are presented in Table 1. The results obtained from different sources differ significantly from each other. The positive results for COB (29, 38 and 38%) were obtained from house hold, milkman and restaurant milk respectively. Higher difference in COB values for house hold animal milk and milkman might be due to the management practices during the handling of raw milk. It was obvious from the results that HH milk was in better condition as compared to other sources. There was no significant difference observed in COB values of milkman and restaurant that might be due to similar practices in handling, keeping, transportation and storage practices. Variations in COB values are the main reasons of quality deterioration of milk. Furthermore it is revealed that deterioration increases as the steps increase towards marketing. Similar trend in deterioration was investigated previously by Grimaud et al. (2004).

Alcohol perception test (APT)

The results pertaining to the APT test are shown in Table 2. The result of the APT test shows the significant differences among all three sources of milk. Positive cases recorded 34% in HH milk whereas in MM, 44% and RM, 35% values. The result shows high level of acid and excess of salt concentration in the milk samples that indicate low quality milk. Milk coagulated only when the acidity of milk reached 0.21-0.23%. According to the results the positive test was slightly lower in RM and HH but a big difference was observed in MM milk. The result of APT for house hold animal's milk showed better quality compared to the other milk sources. The milkman frequently used the adulterants (chemicals, salts, starch, etc) in milk before marketing; therefore, such adulterants can cause the increase of acidity of milk. The results are in agreement with Grimaud et al. (2004), who observed

Table 3a. Values for methylene blue test of different milk samples.

Sources	A+ (%)	B+ (%)	C+ (%)	D+ (%)
House hold	29[e]	44[b]	17[f]	11[h]
Milkman	14[g]	62[a]	11[n]	14[g]
Restaurant	14[g]	33[c]	33[u]	11[n]

A + 8 h, B + 6 h, C + 4 h, D + 2 h.

Table 3b. Grading of samples on the basis of (MBRT) in different milk sources.

Quality of milk	Decolonization time
Excellent	More than 8 h
Good	About 6 h
Fair	Between 2 and 6 h
Poor	Less than 2 h

Table 4. Mean values for acidity (%) of different milk samples.

Source	Mean
House hold	0.18[b]
Milkman	0.21[a]
Restaurant	0.19[u]

Table 5. Mean values for specific gravity (g/ml) of different milk samples.

Source	Mean
House hold	1.028[a]
Milkman	1.027[a]
Restaurant	1.025[b]

similar results in milk samples taken from market.

Methylene blue reduction test (MBRT)

The data regarding to methylene blue reduction test (MBRT) are given in Table 3a and b. The results obtained from the three different sources are found highly significant. The mean values of A+, B+, C+, and D+ for HH were 29, 44, 17 and 11, 14, 62, 11%;14% was recorded for MM and 14, 33, 33 and 11% in RM, respectively. In all three sources of milk grading was different; milkman milk contains high percentage (14% D+) of poor quality milk. However, restaurants milk contains high percentage (33% C+) of fair milk quality; whereas milk quality of HH milk was comparatively better than the other two sources. The poor quality of milk for restaurants and milkman may be due to the following reasons.

The milkman collected the milk from infected animals and the casual organism of mastitis may easily be transferred from one animal to another animal; even by milking practices. In case of mastitis positive animals, they need time to be cured and to recover, but the common people of the area are not well aware about mastitis and its cure. The quality of milk depends on the degree of diseases invasion and the rate of contamination; as the number of organisms (*Staphylococcus aureus*) was more in milk, the quality of milk was lower. If the microbial load is low milk is considered of good quality. Furthermore increase in microbes decreases the quality of milk graded as B, C, D or poor quality of milk. According to the results, the high quality of milk was observed in house hold animal whereas milkman milk and restaurant milk percentage decreased. The result of the test is in agreement with Chatterjees et al. *(*2006).

Acidity test

Data pertaining to acidity of milk samples have been shown in Table 4; while its statistical evaluation is given in Table 8. The mean values (Table 8) are found to be significant. It is revealed from the work that acidity of MM (0.21) was higher than that of HH and RM. The acidity of milk increased by increasing temperature of storage room.

In MM and RM acidity of milk was higher than normal. It has two main reasons: the milkman has surplus store of milk after buying, so he used it next day by mixing it with fresh milk. Unsterilized utensils also enhance milk acidity. Milk is transported from far off places, which is another factor of high acidity because almost all the restaurants have to purchase the raw milk from local milkman or house hold animals. In restaurant milk, the raw milk is collected in big utensil/container in which milk of different sources was mixed, and this kind of mixing may increase the acidity of milk because some of them are already acidic and can be the source of high acidity in whole milk container.

Specific gravity

The result pertaining to specific gravity is presented in Table 5 and its statistical analysis is given in Table 9. The analysis of variance shows that the mean values for

Table 6. Mean values for fat percentage of different milk samples.

Source	Mean
House hold	7.00[a]
Milkman	6.31[a]
Restaurant	5.55[b]

Table 7. Mean values for the sensory evaluation of different milk samples collected from house hold, milk man and restaurants.

Source	Color	Flavor	Taste
House hold	7.4a	6.9a	6.0[b]
Milkman	6.9b	6.5b	6.6[a]
Restaurant	5.9c	5.7c	5.5[c]

Table 8. Mean values for acidity (%) of different milk samples.

Source	Mean
House hold	0.18[b]
Milkman	0.21[a]
Restaurant	0.19[b]

Table 9. Analysis of variance for specific gravity.

Source	df	SS	MS	F-Value	P
Source	2	0.0001088	0.000544	1.63*	0.025
Error	6	0.00200	0.0033		
Total	8	0.0020			

*Significant.

Table 10. Analysis of variance for fat percentage.

Source	df	SS	MS	F-V	p
source	2	2.97787	1.48893	14.6**	0.0050
Error	6	0.61193	0.10199		
Total	8	3.58980			

**Highly significant.

specific gravity were found to be significant. The mean values of the HH milk (1.028 g/ml) and MM (1.027 g/ml) are at par whereas RM (1.025g/ml) is higher than the other two sources. Hence there is slight difference in all the three sources. The specific gravity of HH animal milk was almost similar with MM milk; whereas the specific gravity of RM was found lower than that of the other sources. The recorded specific gravity was lower than the standard value of specific gravity that was 1.033 g/ml for buffalo and 0132 g/ml for cows, respectively.

Since the common practice is to add water to milk in every platform/collection point, the addition of water causes the decrease in specific gravity of milk as specific gravity of milk is slightly higher than the water. Thus the change in composition changes the specific gravity of milk. Due to removal of fat, the specific gravity of milk may increase because the weight of fat is much lower than the water. The fat content has low density so it increases the specific gravity of milk and reduces the milk nutritive contents; finally makes it low standard milk quality. The adulteration rate of water was almost common besides that some chemicals and powders might be commonly added to increase the specific gravity of milk. The widely used adulterant was water due to its cheapness and easy availability and it becomes the source of serious problem. This practice cannot be stopped because the people and MM used it as weapon of earning and it becomes a challenge for hygiene and safety measure of raw milk. The specific gravity of MM contains the lowest values compared to the other two sources. However, the results of specific gravity of milk were lower in all three sources as compared to standard and it may be an indication of adulteration, which was water. The results of the test were in line with findings of Grimaud et al. (2004) and similar trends were found in findings of Khan et al. (2008).

Gerber test

The data regarding the fat percentage test are presented in Table 6. The statistical evaluation (Table 10) represented that all three sources have significant differences. The average value of HH animal was 7.00% fat; in MM it was 6.31%, whereas means value for RM was 5.55%. Hence the fat percentage found varied in different sources of milk.

Raw milk received from HH animal was very pure and adulteration was lower than the other sources. The variation in the fat % may be due to the species or breed difference, as all the animal species have different fat percentage. In MM and RM milk the difference among the percentage was slightly lower as compared to HH; this might be due to mixing of milk from different sources. Mixing of milk is most common practice in MM milk and RM, because milk purchased from different sources may show variation in fat percentage. Fat proportions also deviate by the skimming practices of raw milk which is also common in milkman and other milk sellers. The fat percentage of MM and RM was lower than that of HH

animal milk. In RM the fat percentage was recorded as 5.55%; it was not objectionable but comparatively lower than that of the other two sources.

Organoleptic evaluation

The results regarding organoleptic characteristics test are presented in Table 7. It is observed that samples from house hold, milkman and restaurants are significantly different in color, flavor and taste.

Color

The mean values of color for different milk sources (Table 7) showed grade A for HH, grade B for MM and grade C for RM respectively. The results show that HH milk has normal (yellowish white) color as compared to the other two sources. However, the color of MM sources is slightly different from HH milk source and shows more yellowish pale color than normal milk color. However, the milk color for the RM source shows abnormal milk color; the abnormality of color might be due to adulteration factors like water, chemical (starch, formaldehyde, olive oil, etc.). The color difference in milk was also observed due to change in feeding habits of animal. The animal which eats more consolidated feed has more yellowish or pale color of milk compared to pasture feeding animals.

Flavor

The comparison of mean values for the flavor of different milk sources (Table 7) showed A grade for HH milk, B grade for MM milk and C grade for RM samples. The results showed that the flavor for all three milk sources was highly significant; all the three sources show variation among them. The flavor for HH milk was almost equal to normal flavor of milk but in case of MM the flavor was slightly bitter than normal taste of milk. However, the flavor for the RM sources was not good and has off flavor different from normal milk flavor. This flavor differences among the milk sources are due to addition of chemicals, long term storage and lack of storage facilities and also due eating habits of animals. Commonly, milk flavor is based on animals' feed; those animals that eat herbs or bushes have unpleasant smell that gives the off flavor milk. Some medicinal plants also produce bad smell and off flavor, which is objectionable; this leads to the devalue of milk. The results are in line with the findings of Islam et al. (1984).

Taste

The results regarding taste of different milk sources (Table 7) showed that the taste for HH milk was B grade, A grade for MM and C grade for RM, respectively. The taste for HH and RM has poor results as compared to the MM sources of milk. The variation of taste in different milk samples depends on feedings habits of animal to some extent; the nutritive feeding of animals given the good results in all aspect of milk characteristics such as flavor taste and color. There were few samples in which abnor-malities seemed to be sweet less taste of milk (containing saltish taste, bitter taste); due to all these abnormalities, milk was graded as low quality. Overall evaluation of HH milk samples was good and better than the other two sources of milk.

Conclusion

The milk samples collected from house hold, milkman and restaurant represented considerable differences among them with regard to quality. Adulteration test (COB, APT and MBR) showed that milk sample from house hold milk has superior quality to milkman and restaurants milk. Milk composition (fat percentage, specific gravity, acidity) in HH and MM is almost similar but lower in RM. Specific gravity in all three sources was lowered. House hold milk due to lower acidity was better than the other two sources. Organoleptic test (color, flavor, taste) result regarding taste and color is also better in house hold milk sample. In case of flavor, house hold milk and milkman's man have quite better results than the restaurants milk. However, the contamination status in milkman and restaurants was higher and hence represented poor quality than the house hold milk samples. The low quality of raw milk in milkman and restaurant milk is due to mis-handling, contamination originating from farm level and lack of storage facilities.

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