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Evaluation of physicochemical and adulteration quality of raw milk sold by dairy farmers and traders in Indore district (Madhya Pradesh)

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Abstract
There is a great concern about quality of the raw milk sold in market. In present investigation, a total of 120 raw milk samples were collected from various farmers and traders marketed milk in all four administrative blocks of the Indore district (M.P.). On physicochemical examination of milk, the mean values for pH and specific gravity were found to be between 6.5±0.03 to 6.6±0.03, 1.024±0.00 to 1.028±0.00, respectively. The colour of the milk in the Indore district was found to be white in 55 (45.83%) samples, while yellowish white in 65 (54.17%) samples. The smell of milk was found to be sweet in 97 (80.83%) samples, whereas unpleasant in 23 (19.17%) samples. None of the milk samples was found to be positive for sediments in the studied area. Present study revealed that the mean values for milk protein in different milk samples was found to be between 3.17±0.09 to 3.38±0.06, respectively and mean values for fat in various milk samples were found to be 3.50% to 4.06%, respectively. Assessment of raw milk samples for common chemical adulterants revealed that 3 (2.50%) for sugar, 26 (21.67%) for detergent, 34 (28.34%) for common salt and 40 (33.33%) for pond water were found to be positive. None of the samples was found to be adulterated with starch, skim milk powder, glucose, ammonium sulphate, formalin, urea, neutralizer, hydrogen peroxide, cellulose, maltose and boric acid. The overall picture of the adulteration of milk in the Indore district showed that out of total, 65 (54.17%) milk samples were found to be positive for at least one adulterant while 55 (45.83%) were found to be negative for common milk adulterant.

Keywords: Milk, physicochemical, adulterants, quality

Introduction
Milk is the normal mammary secretion derived from complete milking of a healthy milch animal without either addition thereto or extraction therefrom (Makadiya and Pandey, 2015) [18]. Milk, if present in its natural form has high food value. It supplies nutrients like good quality proteins, fat, carbohydrates, vitamins, and minerals in significant amounts than any other single food (Chanda *et al*., 2012) [4]. It is a complex mixture which can easily be adulterated due to its physical nature. The milk adulteration is the fraudulent practice, which involve addition and; or subtraction of one or more legally prohibited substances into or from milk, in order to increase the bulk and make more profit. In the first type of adulteration, the natural milk is diluted with water and adding of substances like urea, fat, sugar, neutralizers, salt, hydrogen peroxide, etc. to maintain its desired viscosity and specific gravity (Gupta *et al.*, 2013) [9]. The second type of adulteration process is by making synthetic milk including blending of urea, cooking oil, detergent, caustic soda, sugar, salt, and skimmed milk powder in water (Bansal and Bansal, 1997) [2]. Synthetic milk does not contain natural milk and hence is devoid of essential nutrients. Consuming such type of milk is highly poisonous to the health of the public. Despite becoming self-dependent and massive increase in the production of milk, illegal production of adulterated milk has emerged as the major problem for the dairy industry. According to a national survey on milk adulteration conducted by food safety and standard authority of India (FSSAI) in 2011, 68.40% of the milk samples were found to be adulterated, of which 31.00% were from rural areas. Of these, 16.70% were packet or branded milk and rest were loose milk samples from dairies. In the urban areas, 68.90% of milk sample was found to be adulterated with water, detergent, urea, and skim milk powder (Swathi and Kauser, 2015) [32]. Thus, chemical safety of milk is an issue of paramount importance to safeguard the health of the public as a whole.

Keeping in view the above facts and points present study was undertaken to assess the physicochemical quality and common chemical adulterants in market milk of Indore district of Madhya Pradesh.

Materials and Methods

Collection of milk samples

A total of 120 raw milk samples were collected in the studied area. Thirty milk samples were taken from each administrative block i.e. Mhow, Indore, Sanwer and Depalpur of Indore district of Madhya Pradesh. The milk samples were collected in 100 ml screw-capped clean and sterilized plastic bottles using a random sampling technique. These samples were taken from dairy farmers, milk outlets and non-organized dairy outlets, etc. The samples were brought to The Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Mhow under chilled condition.

Evaluation of the raw milk samples

The collected raw milk samples were subjected for physicochemical examination. Specific gravity was measured by lactometer (O'Mahony, 1988) [22]. pH value was determined by digital pH meter (Hossain and Dev, 2013) [12]. Colour of the milk sample was determined by naked eye (Sherikar *et al*., 2013) [30]. Smell of the milk samples was determined by methodology as described by BIS (2007) [3]. Sediment was estimated by sediment test (Draaiyer *et al*., 2009) [6]. Determinations of protein were performed using method described by Hi Media Laboratories (Hi Media, 2011). The fat values of milk samples were measured by Gerber method (FSSAI, 2016).

The assessment of common chemical adulterants in milk samples were also performed using standard procedures. Sugar was estimated by resorcinol test (Kamthania *et al*., 2014) [14]. Starch was detected by iodine test (Sharma *et al*., 2017) [14]. Glucose was evaluated by modified barford's reagent method (Kamthania *et al*., 2014) [14]. Common salt (NaCl) was estimated by silver nitrate method (Aparnathi *et al*., 2020) [1]. Hydrogen peroxide was detected by paraphenylene diamine hydrochloride method (Singh *et al*., 2012) [31]. Formalin was examined by H_2SO_4-$FeCl_3$ method (Kamthania *et al*., 2014) [14]. Borax and boric acid were detected by turmeric paper method (Singh *et al*., 2012) [31]. Neutralizer was evaluated by rosalic acid method (Singh *et al*., 2012) [31]. Urea addition in milk was detected by para-dimethyl amino-benzaldehyde method (FSSAI, 2016). Ammonium sulphate was examined by phenol method (Kumar *et al*., 2002) [16]. Detergent was estimated by method described by FSSAI (2016). Skim milk powder was estimated by phosphomolybdic acid method (Sharma *et al*., 2017) [14]. Maltose was estimated by trichloroacetic acid method (draaiyer *et al*., 2009) [6]. Assessment of pond water or nitrate and cellulose were performed using adulteration testing of milk kit supplied by Hi Media Laboratories Pvt. Ltd., (Mumbai).

Results and discussions

Physicochemical assessment of milk

The present study showed that the mean values of pH were found to be 6.5±0.03 to 6.6±0.03. The standard value of pH is 6.4 – 6.6 for cattle milk and 6.7 – 6.8 for buffalo milk (De, 1991). A non-significant ($P<0.05$) difference was observed between all the milk samples of the various administrative blocks. An earlier investigation conducted by Javaid *et al*. (2009) [13] observed remarkable differences among the mean pH values as 6.54, 6.53, 6.65, and 6.66, respectively, of several milk samples sold at Tandojam, Pakistan. The difference in pH values of milk in our study may be due to different feeding, climate, and physiological condition of the animals.

The present study showed that the mean values of specific gravity were found to be 1.024±0.00 to 1.028±0.00. The standard value of specific gravity is 1.028-1.030 for cattle milk and 1.030–1.032 for buffalo milk (De, 1991). A significant difference ($P<0.05$) was reported between all the milk samples of various administrative blocks. An earlier study conducted by Saiqa *et al*. (2013) [27] reported the same pattern, the mean values were found to be 1.028, 1.027, and 1.025 for household milk, milkman, and restaurant milk, respectively. In current study variation may be attributed to the common practice of adding water to milk at every point, the addition of water causes a decrease in the specific gravity of milk which is slightly higher than the water.

The present investigation showed that the colour of milk in the Indore district was found to be white in 55 (45.83%) and yellowish white in 65 (54.17%) samples. An earlier study conducted by Khan *et al*. (2008) [15] reported that 60.00% of the milk samples were found to be yellowish white, 20.00% of milk samples were found to be white,10.00% of milk samples were found to be light yellowish white and the remaining 10.00% milk samples were found to be deep yellowish white. The difference in colour of milk in current study may be due to changes in the feeding habits of the animal. The animal which eats more consolidated feed has a more yellowish or pale colour of milk as compared to pasture-feeding animals.

The current investigation showed that smell of milk in the Indore district was found to be sweet as 80.83% and unpleasant as 19.17% samples. An earlier study conducted by Gwandu *et al*. (2018) [10] reported that 7.10% milk samples were found to be with a bad smell (unpleasant). In our study, the percentage of samples with unpleasant smell is slightly higher. It may be ascribed to spoiled milk, dirty containers, type of feed, drugs and animal diseases like pyometra, etc.

In the current investigation, none of the milk samples was found to be positive for sediment in the Indore district. Earlier study conducted by Saha *et al*. (2022) also reported that none of the samples was found to be positive for sediment in the Sylhet region, Bangladesh. The sediment less milk samples in our study may be attributed to clean milk production practices followed by dairy farmers of the studied area.

The present investigation showed that the mean values of protein were found to be between 3.17±0.09 to 3.38±0.06 %. An earlier study conducted by Paul *et al*. (2018) [23] reported the same pattern, the mean values of protein content of own farm milk (OFM) and middleman collecting milk from single farm were found to be 3.24% and 3.38%, respectively. According to Rajarajan (2021) [24], the presence of protein milk samples varies between 3.00 - 4.10%. The results of the present study were found to be in the prescribed limit for the protein content in the milk. Dairy farmers of studied area are aware about protein diet plan for milch animals so, there is no protein deficiency present in animals' milk.

The present investigation showed that the mean value of fat was found to be 3.50% to 4.06% in Indore district. Minimum

fat value was found to be 3.50% in Depalpur and maximum fat value was found to be 4.06% in Mhow. An earlier study conducted by Nawaz *et al.* (2022) [20] reported the same pattern, the minimum mean value of fat was found to be 3.53% in Bijalighar and maximum mean value of fat was found to be 4.04% in Bazar Mardan (Pakistan). The results of the present study were found to be in the prescribed limit for the fat content in the milk. It seems that dairy farmers of studied area are attentive about nutrition plan of the milch animals.

Assessment of chemical adulterants in milk

The present analysis showed that out of 120 milk samples, 3 (2.50%) for sugar, 26 (21.67%) for detergent, 34 (28.34%) for salt/sodium chloride, and 40 (33.33%) for pond water were found to be positive. There was no sample found to be adulterated with starch, skim milk powder, glucose, ammonium sulphate, formalin, urea, neutralizer, hydrogen peroxide, cellulose, maltose and boric acid. The overall percentage of common milk adulterants found in the market milk of Indore district was presented in Figure 01.

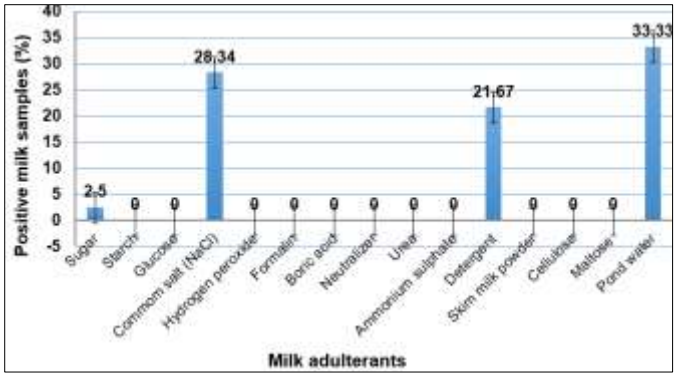

Fig 1: Overall percentage of common milk adulterants in Indore district

According to the present observation, the sugar adulterated milk samples were found to be 2.50% in Indore district of Madhya Pradesh. Earlier studies conducted by Sen *et al.* (2022) [28] reported a high percentage of milk adulteration with sugar to be 4.00% at Siddipet, Telangana. The sweetening agent might be added to increase the solid not fat content of milk which is decreased by dilution of milk with water. This malpractice was slightly observed in the studied area. It might be for obtaining monetary benefits arises by increase of solid not fat content.

In the present investigation, adulteration of milk with starch was found to be as 0% in the Indore district. Earlier Makadiya and Pandey (2015) [18] reported the same finding of milk adulteration with starch as 0% in Gandhinagar, Gujarat. Although starch may be added to increase the thickness of adulterated milk and to maintain its viscosity. In present investigation, this malpractice was not observed in studied areas.

According to the present investigation, the glucose adulterated milk samples were observed to be 0% in Indore district of Madhya Pradesh. An earlier study conducted by Sen *et al.* (2022) [28] reported a high percentage of milk adulteration with glucose to be 4.00% in Siddipet, Telangana, where sweetening agent might be added to increase the solid not fat content of milk which is decreased by dilution of milk with water. This malpractice was also not observed in the investigated areas.

During the current investigation, it was observed that milk adulteration with common salt/sodium chloride was found to be 28.34% in the Indore district. An earlier study conducted by Gupta *et al.* (2013) [9] reported a higher percentage of milk adulteration with salt to be 32.00%. The presence of salt in milk may be attributed to either addition of mastitis milk which has increased chloride ion content or it might be added as a thickening agent to maintain the physical state and density of milk.

The present investigation revealed that none of the milk samples were found to be positive for hydrogen peroxide in the Indore district. Earlier Moosavy *et al.* (2019) [19] reported the same result of milk adulteration with hydrogen peroxide at 0% in northwest of Iran. It is used as preservative to increase the shelf life of milk.

The present study revealed that none of the milk samples were found to be positive for formalin in the Indore district. Earlier Nirwal *et al.* (2013) [21] reported the same result of milk adulteration with formalin as 0%. The formalin is usually added to increase the shelf life of the milk.

The current study showed that adulteration of milk with boric acid was found to be 0% in the Indore district. Earlier Nirwal *et al.* (2013) [21] reported the same finding of milk adulteration with boric acid as 0% in Hyderabad and its outskirts. The boric acid usually added to preserve the milk.

The present study revealed that milk adulteration with neutralizer was found to be 0% in the Indore district. Earlier Gimire (2022) reported the similar results related to neutralizer adulteration in milk as 0% in Hattisar, Dharan, Nepal. The neutralizer is usually added in milk to neutralize the developed acidity.

During the present evaluation, it was investigated that milk adulteration with urea was detected as 0% in the Indore district. Previously Sen *et al.* (2022) [28] reported a similar result with the present data related to urea adulteration as 0% in Siddipet, Telangana. Urea is usually added as milk thickener and also added as a part of synthetic milk.

The adulteration of milk with ammonium sulphate was observed to be 0% in the Indore district. Earlier Nirwal *et al.* (2013) [21] reported a parallel finding of milk adulteration with ammonium sulphate as 0% in Dehradun. Ammonium sulphate is a chemical fertilizer, which is added to milk to raise the density of watered milk and to increases the lactometer reading by maintaining the density of milk.

The current study showed that milk adulteration with detergent was found to be 21.67% in the Indore district. Earlier Sen *et al.* (2022) [28] reported that milk adulteration with detergent was found to be 26.00% Siddipet, Telangana. Detergents are added as a non-dairy fat emulsifier and can cause food poisoning and other gastrointestinal complications.

According to the present investigation, the skim milk powder adulterated milk samples were observed to be 0% in Indore district of Madhya Pradesh. Earlier Moosavy *et al.* (2019) [19] observed a similar result of milk adulteration with skim milk powder as 0% in northwest of Iran. Skim milk powder may be added to either increase the weight or relative mass of the milk.

In current study, the adulteration of milk with cellulose was found to be 0% in all four blocks of the Indore district. The results of present investigation were in line with Raju *et al.* (2017) [25] who observed milk adulteration with cellulose as

0% in Secunderabad and Hyderabad, Telangana. This malpractice was also not observed in the studied area. The cellulose is usually added as a thickener in the milk.

In the present study, milk adulteration with maltose was found to be 0% in the Indore district. The results of present investigation were in line with Raju *et al.* (2017) [25] who observed milk adulteration with maltose as 0% in Secunderabad and Hyderabad, Telangana. This malpractice was also not observed in the studied area. The maltose is usually added as a thickener in the milk.

The present study revealed that the most common adulterant in milk samples was pond water. It was found to be 33.33% in the Indore district. An earlier study conducted by Raju *et al.* (2017) [25] reported a higher percentage of milk adulteration with pond water was to be 50.00% in Secunderabad and Hyderabad, Telangana. Presence of pond water denotes nitrate content in the milk. The occurrence of nitrate in milk is generally at a trace level with secretary and post-secretary contamination. The secretary contamination that occurs via dietary and water intake is usually of minor significance, while the post-secretary contamination may occur via added water as some natural waters contain them. So, their presence in milk may serve as a confirmatory test for added water (Ling, 1963) [17].

Block wise status of adulteration of milk

In this investigation, adulteration of milk samples in Indore district showed that out of total 120 milk samples 54.17% of milk samples were found to be positive and 45.83% of milk samples were found to be negative. In the Indore block, 66.67% of milk samples were found to be positive followed by Mhow, Sanwer and Depalpur block where 60.00%, 46.67% and 43.33% of milk samples were found to be positive, respectively. On application of the Chi-Square test, results observed no significant association between blocks and positive samples and negative samples ($P<0.05$) in the Indore district. The overall picture of the adulteration of milk in the Indore district is presented here in Table 01.

Table 1: Over all percentage of common adulterants found in milk samples of Indore district

S. No.	Administrative Block	Total number of sample analysed	Positive samples	Negative samples
1	Mhow	30	18 (60.00)	12 (40.00)
2	Indore	30	20 (66.67)	10 (33.33)
3	Sanwer	30	14 (46.67)	16 (53.33)
4	Depalpur	30	13 (43.33)	17 (56.67)
	Total	120	65 (54.17)	55 (45.83)

*Values within parentheses indicates percentages

Area wise status of adulteration of milk

In the present study, adulteration of milk samples in Indore district showed that 45.00% and 72.50% of milk samples were found to be positive in the rural and urban areas, respectively. On application of the Chi-Square test, results observed a significant association between areas and positive samples and negative samples ($P<0.05$) in the Indore district (Table 02).

Table 2: Area wise status of milk adulteration in Indore district

S. No.	Type of areas	Total number of samples analyzed	Positive samples
1	Rural	80	36 (45.00)
2	Urban	40	29 (72.50)
	Total	120	65 (54.17)

*Values within parentheses indicates percentages

Sector wise status of adulteration of milk

In this investigation adulteration of milk samples in Indore district showed that 28.57% and 55.75% of milk samples were found to be positive in organised sector and unorganised sector, respectively. On application of the Chi-Square test, results observed no significant association between sector and positive samples and negative samples ($P<0.05$) in the Indore district (Table 03).

Table 3: Organised and unorganised sector wise status of milk adulteration in Indore district

S. No.	Type of sector	Total number of sample analysed	Positive samples
1	Organised	7	2 (28.57)
2	Unorganised	113	63 (55.75)
	Total	120	65 (54.17)

*Values within parentheses indicates percentages

Packing wise status of adulteration of milk

In the Present study, adulteration of milk samples in Indore district showed that 37.50% and 55.35% of milk samples were found to be positive in packed and unpacked milk, respectively. On application of the Chi-Square test, results observed no significant association between type of packing and positive samples and negative samples ($P<0.05$) in the Indore district (Table 04).

Table 4: Packed and unpacked milk wise status of adulteration in Indore district (n=120)

S. No.	Type of packing	Total number of sample analysed	Positive samples
1	Packed	8	3 (37.50)
2	Unpacked	112	62 (55.35)
	Total	120	65 (54.17)

*Values within parentheses indicates percentages

Conclusions

In the present study, the findings reveled that mean values for pH and specific gravity of milk samples were found within normal limits. Milk color, smell and sediments were also found to be typical as a whole. The mean values for milk protein and fat in various milk samples were found to be within normal range. The result showed that the most common type of milk adulterant was pond water followed by salt, detergent and sugar. None of the milk sample was found positive for starch, glucose, skim milk powder, ammonium sulphate, formalin, urea, neutralizer, hydrogen peroxide, cellulose, maltose and boric acid. So, study suggests that necessary interventional measures should be adopted to resolve the menace in the studied area as a whole.

References

1. Aparnathi KD, Shaikh AI, Patel SI. Qualitative tests for detection of adulterants in milk, Directorate of Research, Anand Agricultural University, Anand, 2020, 48.
2. Bansal P, Bansal N. Synthetic Milk: Genesis, current status and options. Curr Sci. 1997;73(11):904-905.
3. BIS. Indian Standard Methods of Test for Dairy Industry. 8th Edn. Bureau of Indian Standards, New Delhi. 2007, 13.
4. Chanda T, Debnath GK, Hossain ME, Islam MA, Begum MK. Adulteration of raw milk in the rural areas of Barisal district of Bangladesh. Bangladesh J Anim Sci. 2012;41(2):112-115.
5. De S. Outlines of dairy technology. 38th Edn. Oxford University Press, New Delhi. 1991, 21.
6. Draaiyer J, Dugdill B, Bennett A, Mounsey J. Milk testing and payment systems. Resource book: a practical guide to assist milk producer groups. 1st Edn. FAO; c2009. p. 23-45.
7. FSSAI. Manual of methods of analysis of foods milk and milk products: Laboratory manual. Food Safety and Standards Authority of India, New Delhi, 2016, 43.
8. Ghimire M. Microbiological quality and adulteration of pasteurized milk marketed in Dharan, Nepal. B.Sc. thesis (Microbiology), Tribhuvan University, Nepal; c2022.
9. Gupta VK, Shukla S, Singh RV, Gupta P. Assessment of milk food safety status: common milk adulterants in rural and urban areas of Indian Malwa plateau and their public health significance. Vet Practitioner. 2013;14(2):536-539 (Supple. 1).
10. Gwandu SH, Nonga HE, Mdegela RH, Katakweba AS, Suleiman TS, Ryoba R. Assessment of raw cow milk quality in smallholder dairy farms in Pemba Island Zanzibar, Tanzania. Vet Med Int. 2018;2018:1-9.
11. Hi Media. Adulteration testing of milk. Instruction manual. Hi Media Laboratories, Mumbai; c2011. p. 01-07.
12. Hossain MB, Dev SR. Physicochemical characteristics of various raw milk samples in a selected dairy plant of Bangladesh. Int J Eng. 2013;1(3):91-96.
13. Javaid SB, Gadahi JA, Khaskeli M, Bhutto MB, Kumbher S, Panhwar AH. Physical and chemical quality of market milk sold at Tandojam, Pakistan. Pak Vet J. 2009;29(1):27-31.
14. Kamthania M, Saxena J, Saxena K, Sharma DK. Milk adulteration: methods of detection and remedial measures. Int J Eng Tech Res. 2014;1:15-20.
15. Khan MTG, Zinnah MA, Siddique MP, Rashid MHA, Islam MA, Choudhury KA. Physical and microbial qualities of raw milk collected from Bangladesh agricultural university dairy farm and the surrounding villages. Bangladesh J Vet Med. 2008;6(2):217-221.
16. Kumar A, Lal D, Seth R, Sharma R. Recent trends in detection of adulteration in milk fat: A review. Indian J Dairy Sci. 2002;55(6):319-330.
17. Ling TR. Textbook of dairy chemistry. 3rd Edn. Chapman and Hall, London. 1963;2:44.
18. Makadiya J, Pandey A. Quality assessment and detection of adulteration in buffalo milk collected from different areas of Gandhinagar by physicochemical method. Int J PharmTech Res. 2015;8(4):602-607.
19. Moosavy MH, Kordasht HK, Khatibi SA, Sohrabi H. Assessment of the chemical adulteration and hygienic quality of raw cow milk in the northwest of Iran. Qual Assur Saf Crops Foods. 2019;11(5):491-498.
20. Nawaz T, Rehman ZU, Ullah R, Ahmed N, Sayed SM. Physicochemical and adulteration study of fresh milk collected from different locations in Pakistan. Saudi J Biol Sci. 2022;29(12):103449-103454.
21. Nirwal S, Pant R, Rai N. Analysis of milk quality, adulteration and mastitis in milk samples collected from different regions of Dehradun. Int J PharmTech Res. 2013;5(2):359-364.
22. O'Mahoney F. Rural Dairy Technology- Experiences in Ethiopia. ILCA manual No 4. Dairy Technology Unit. ILCA, Addis Abeba, Ethiopia. 1988, 64.
23. Paul P, Chanda T, Hassan T, Dutta A, Das P, Hossain S *et al*. Quality of milk consumed by inhabitants of city corporation and rural areas of Sylhet division. Int J Nat Soc Sci. 2018;5(2):55-60.
24. Rajarajan G. Assessment of Market milk adulteration in Tiruchirapalli city of Tamil Nadu. Indian J Dairy Sci. 2021;74(3):232-237.
25. Raju K, Ramanujam AS, Sukumaran MK. Qualitative detection of some adulterants in milk samples supplied in the twin cities of Secunderabad and Hyderabad, Telangana. J Med Sci Clin Res. 2017;8:26242-26250.
26. Sah S, Pory S, Ahmed SSU, Mehedi M. Physico-Chemical and Microbial Properties of Black Bengal Goat Milk. Int J Agric Innov Res. 2022;11(1):1-7.
27. Saiqa B, Muhammad SA, Khan SA, Rathore HA, Qureshi MA, Kathu ZH. An evaluation of milk quality in and around Rawalakot Azad Kashmir. Afr J Food Sci. 2013;7(11):421-427.
28. Sen S, Donthula H, Ravindar B, Jala S, Mitta C, Kalepu S. Qualitative and quantitative analysis for adulteration and nutritional value of milk: a case study. Neuroquantology. 2022;20(17):227-237.
29. Sharma R, Rajput YS, Barui AK. Detection of Adulterants in Milk: Laboratory Manual. 2nd Edn. National Dairy Research Institute, India; c2017. p. 97-99.
30. Sherikar AT, Bachhil VN, Thapliyal DC. Textbook of elements of veterinary public health. 3rd Edn. Directorate of Knowledge Management in Agriculture, Indian Council of Agriculture Research, New Delhi; c2013. p. 103.
31. Singh A, Chandra G, Aggarwal A, Kumar P. Adulteration detection in milk. Double Helix Res. 2012;5:52-55.
32. Swathi JK, Kauser N. A study on adulteration of milk and milk products from local vendors. Int J Biomed Adv Res. 2015;6(9):678-681.