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Study of Milk Adulteration in Hyderabad, Telangana State

Research Article

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Abstract

Food adulteration is age old practice and is an issue of concern throughout world. The threat of adulteration in food is seen more in developing countries due to lack of proper monitoring facilities. However, this can be one foremost common phenomenon that has been overlooked in many countries. Unfortunately, milk adulterants can pose serious health hazards resulting in fatal diseases. This paper showed the results for presence of milk adulterants in 20 milk samples collected from various places from Hyderabad. We have checked for adulterants like urea, formalin, detergent, salt, maltodextrin etc. and we observed that majority of the samples are positive for formalin, maltodextrin and salt. These adulterants can result in health problems like liver damage, allergic reactions, weight gain etc. Other adulterants are found in less number of samples.

Keywords: Milk adulteration; Food adulteration; Viable count; Antibiotic sensitivity

Introduction

Milk is a very important source of nutrients required for growth in infants and kids and for maintenance of health in adults. Milk is the lacteal secretion produced from the mammary glands of the mammals. Milk in its natural form has very high nutrient value. It gives nutrients like carbohydrates, vitamins, fat, protein and minerals in moderate amount which can be easily digestible [1].

Normally, the adulteration in food is done either to gain benefits in monetary form or due lack of proper hygienic conditions of processing, storing, transportation and marketing. This ultimately ends in cheating of consumers or become victim of diseases. Such adulteration is quite common in developing countries. Milk is produced throughout the year. However, milk production is decreased to great extent due to the stress of heat and fodder shortage in summer. Milk is transported from point of production to cities mainly through middlemen. Such milk is added with adulterants to make more profits by adding materials like starch, flour, urea, cane sugar and edible fat as adulterants. Milk dealers may either dilute the milk or extract valuable components and there after add cheap substances to maintain its compositional parameters. These cheap substances include starch, urea, and preservatives like formalin, hydrogen peroxide, boric acid and various antibiotics [1]. An editorial of esteemed e-paper "Economic Times", in September 2018 stated that around 68.7% of milk and milk products sold within the country is not as per the standards laid down by the Food Safety and Standards Authority of India (FSSAI) [2].

Many types of adulterants are added into milk to gain financial benefit but the effects they cause may be dangerous [3]. The external addition of water in milk though contains no health hazards associated with it but the water used is contamination free but dilutes the quality of nutrients in milk. One of the important parameters in estimating the quality of milk is total SNF (Solid-Not-Fat) content. Some adulterants added to milk can enhance the SNF content of the milk however alters the sanctity and purity of milk [4]. Sometimes in order to increase the natural protein content in the milk, melamine is added [5]. Some amount of Melamine can be present in milk samples acquired during milk packaging and use of nitrogen rich fertilizers. According to The US Food and Drug Administration (FDA), maximum permissible limit of melamine in milk is 50 ppb, whereas The Food Safety and Standards Authority of India (FSSAI) have set melamine limits from 0.5 ppm to 2.5 ppm [6]. Urea is also

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added sometimes to increase non-protein nitrogen content of milk. Permissible limit given for urea by FSSAI is 70 mg / 100 mL [7]. In some areas, Formalin is added to milk as preservative but it can result in renal problems.

There are reports of milk adulteration with other preservatives such as potassium dichromate, benzoic acid, hydrogen peroxide, salicylic acid etc. putting the common people's health at stake [3]. Another component that is found frequently in milk, to maintain the required density is ammonium sulphate [4]. The addition of detergents gives frothy appearance to milk [8]. Whey is added to milk because it promotes an increase in the volume of milk without significantly changing the percentage of proteins or effecting noticeable sensory changes for most people [9]. The other adulterants added to milk are starch, to increase the SNF content and Formalin, Salicylic acid, Benzoic acid and Hydrogen peroxide act as preservatives and increase the shelf life of the milk [3,4]. Most of the above mentioned compounds decrease the quality of milk but simultaneously cause serious health risk to consumers. Melamine if consumed over a prolonged duration may cause kidney failure and can sometimes prove to be fatal, especially to infants [4].

Methodology

Detection of urea in milk: To 1 ml of milk in a test tube, 1 ml of 1.6% (w/v) DMAB reagent was added and mixed well. Positive result is indicated by yellow colour [10].

Detection of formalin in milk: This detection was done by leach test. In this 5ml milk is taken in test tube. Then it is added with concentrated HCl and ferric chloride. Then the tube is kept in water bath for 3-4 min. Positive result is indicated by brownish pink colour and negative result by white colour [10].

Detection of salt in milk: Salt was detected in milk by silver nitrate test. In this reagents like silver nitrate and potassium dichromate were used. To 5 ml of milk in test tube, 1 ml of 0.1 n silver nitrate solutions were added and mixed thoroughly. To this again 0.5 ml of 10% potassium dichromate solution was added. Positive result is indicated by yellow colour and negative result by red colour [10].

Detection of detergent in milk: Detergent in milk sample was tested by using methylene blue dye and chloroform. In this test, 1ml of milk sample is taken in 15 ml test tube. To the milk sample 1 ml of dye solution was added followed by addition of 2 ml chloroform. Then the contents were vortexed for 15 seconds and centrifuged at 1100 rpm for 3 min. In this case intensity of blue colour in the upper and lower layer was checked. Positive result is indicated by presence of more intense blue colour in the lower layer and negative result in indicated by blue colour in the upper layer [10].

Detection of maltodextrin in milk: Maltodextrin in the milk sample was tested by Iodine reagent. In this test 5 ml milk sample is added with 2ml Iodine reagent. The contents were mixed well and observed for colour change. The positive result was observed by chocolate red colour and negative result by slight yellow colour [10].

Detection of cane sugar in milk: Cane sugar in milk sample was tested by resorcinol test. In this method, reagents resorcinol and conc. HCl were used. 5 ml of milk is taken in test tube, to that 1 ml of concentrated HCl and 0.1g resorcinol were added and mixed. The tube is kept in boiling water bath for 5 min and then observed for colour change. Positive result was indicated by red colour and negative test by no colour change [10].

Detection of hydrogen peroxide in milk: Hydrogen peroxide in milk samples was tested by using reagents like potassium iodine and starch. In this method first 1 ml of milk is taken in test tube, and then to this, 1ml of a mixture of potassium iodine-starch reagent is added and mixed well. The tubes are observed for colour change. Positive colour is indicated by blue colour and negative colour is indicated by white colour [10].

Detection of sucrose in milk: Sucrose presence in milk was tested by molisch test. In this test, molisch reagent and Conc. H_2SO_4 were used. In this test 1ml of milk sample is taken in the test tube and to these 2-3 drops of Molisch reagent was added and then 1 ml of Conc. H_2SO_4 was added through walls of the test tube. Positive result was indicated by the violet ring formation at the junction of two layers [10].

Kirby-Bauer method: Antibiotic sensitivity test is done by Kirby-Bauer method. In this method, 1:10 diluted milk samples are spread on nutrient agar plates and antibiotics discs (Penicillin, Amoxicillin, Tetracyclin, Gentamycin) were placed on nutrient agar and incubated at 37°C for 24 hours. After allowing the bacteria to grow overnight, areas of clear zone surrounding the discs indicate that the antibiotic inhibited bacterial growth. The concentration of antibiotic that diffuses into the media decreases with increasing distance from the source [11].

Results & Discussion

We have collected 20 milk samples from different areas of Hyderabad. For these samples we have checked for various adulterants like urea, formalin, salt, detergent, maltodextrin, cane sugar, hydrogen peroxide and sucrose. The results are given in the following table 1 (Figure 1).

Out of 20 samples, Formalin, maltodextrin and salt showed positive result for 19, 18 and 20 samples respectively. The presence of these adulterants in majority of the samples may result in health diseases for example formalin may cause liver damage and maltodextrin may result in side effects like allergic reactions, weight

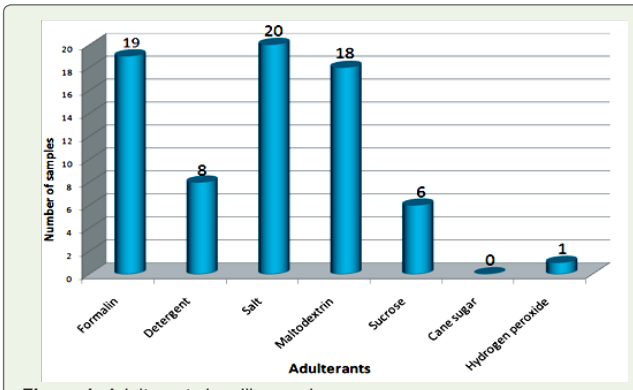

Figure 1: Adulterants in milk samples.

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Table 1: Adulteration in milk samples.

S.No	Sample Code	Sample	Urea	Formalin	Salt	Detergent	Cane sugar	H_2O_2	Sucrose
1	A	Aarogya	Mild +	-	+	+	-	-	-
2	B	Buffallo raw milk(collected from Nagole)	+	+	+	+	-	-	-
3	C	Vijaya	+	+	+	+	-	-	-
4	D	Heritage	-	+	+	+	-	-	-
5	E	Good life	-	Mild +	+	+	-	-	-
6	F	Heritage std. Milk	-	+	+	-	-	-	-
7	G	Amul	-	+	+	-	-	-	-
8	H	Heritage double toned milk	-	+	+	-	-	-	-
9	I	Raw mik (collected from Mehdipatnam)	-	+	+	-	-	-	+
10	J	Tirumala Milk	-	+	+	-	-	-	+
11	K	Dodla Milk	-	+	+	-	-	-	-
12	L	Jersey std Milk	-	+	+	+	-	-	-
13	M	Shakthi Milk	-	+	+	+	-	-	-
14	N	Modern dairy	-	+	+	-	-	-	-
15	O	Jersey enriched toned	-	+	+	-	-	-	-
16	P	Swetha Milk	-	+	+	-	-	-	+
17	Q	Masqati	-	+	+	+	-	-	-
18	R	Nandini	-	+	+	-	-	-	+
19	S	Raw milk (collected from Tolichowki)	-	+	+	+	-	-	+
20	T	NSR Dairy	-	+	+	+	-	+	+

gain, gas, flatulence and bloating. It may also cause allergic reactions, asthma, cramping and difficulty in breathing. Detergent found to be positive in 8 samples, and sucrose is positive in 6 samples whereas urea and hydrogen peroxide were positive in 3 and 1 samples respectively. These results show that adulteration is present in majority of the milk samples and they can also cause considerable health issues.

The present study reported the presence of salt in all milk samples tested. This is similar to the findings of the study by Hemanth and Sukumaran (2014) [12], Riya and Gurmeet (2022) and Arun Kumar et al (2015) where the presence of salt was found in 82, 82 and 80% of samples, respectively [13,14]. However, Brindha et al (2017) reported fewer samples were added with salt, i.e. 13-16% [1]. This study also showed that the presence of formalin was more prevalent in milk samples; i.e., 95% of samples in the present study tested positive for formalin. The presence of formalin in studies conducted by Hemanth and Sukumaran (2014) [12], Riya and Gurmeet (2022) and Arun Kumar et al (2015) was found to be 32%, 32% and 30% respectively [13,14]. Next adulterant found in the majority of samples was maltodextrin , i.e., 90% samples showed positive result for maltodextrin presence, whereas Amita et al (2021) found it to be 50% [15]. Detergent was found to be present in 40% of samples in our study. This result is in accordance with Hemanth and Sukumaran (2014) [12]; Riya and Gurmeet (2022) and Arun Kumar et al (2015) [13,14], where detergent was found to be present in 44%, 32% and 44% respectively. Sucrose was found to be present in 30% of our samples; where as Hemanth and Sukumaran (2014) found 22% of samples were positive for sucrose [12]. The presence of hydrogen peroxide was found in 5% of samples in our study. However, Brindha et al (2017) did not find Hydrogen peroxide in any sample [1], and Hemanth and Sukumaran (2014) [12], Riya and Gurmeet (2022) and Arun kumar et al (2015) observed its presence in 32%, 44% and 36% of samples, respectively [13,14].

Antibiotic sensitivity

For all the 20 samples we have conducted Antibiotic sensitivity test by Kirby-Bauer method. In this we have used penicillin, amoxicillin, gentamycin and tetracycline (Table 2). In this method we have taken 1:10 dilution of milk sample and spread on the nutrient agar plates (Figure 2). Then different antibiotic discs were placed on them and incubated at 37°C for 24 hours. In this test, it was observed that for penicillin and amoxycillin antibiotics, out of 20 samples, only 3 samples showed some sensitivity, whereas bacteria present in all 17 samples showed resistance towards these antibiotics. For tetracyclin and gentamycin, zone of inhibition was seen in all the 20 samples and the diameter of zone of inhibition is in the range of 0.5 to 3.3 cm. Similar experiments were conducted by Reta et al (2016) [16], where they observed that *Staphylococcus aureus* isolated from milk samples showed resistance rate of 93.1 towards penicillin followed by tetracycline (69 %), and very low level of resistance to vancomycin (6.9 %) and rifampicin (3.4 %) (Figures 3 & 4).

Conclusion

It is observed that most of the milk samples taken by us are found to be added with some adulterants. We have checked for viable count and antibiotic sensitivity also. In these we have observed that there is considerable viable count in most of the samples and for antibiotic sensitivity most of the samples showed resistance towards penicillin

Table 2: Pattern of Antibiotic sensitivity.

S.No	Antibiotics	Sensitivity	Resistant
1.	Penicillin	03	17
2.	Amoxycillin	03	17
3.	Gentamycin	20	0
4.	Tetracyclin	20	0

Antibiotic sensitivity test by using Kirby-Bauer method.

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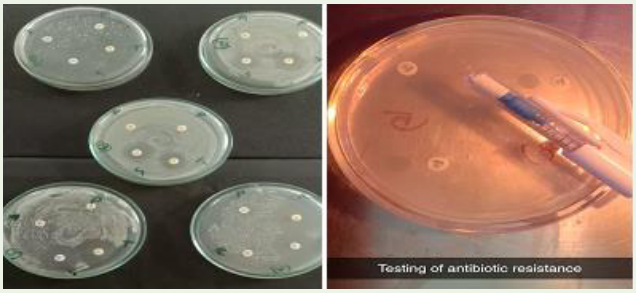

Figure 2: Antibiotic sensitivity plates.

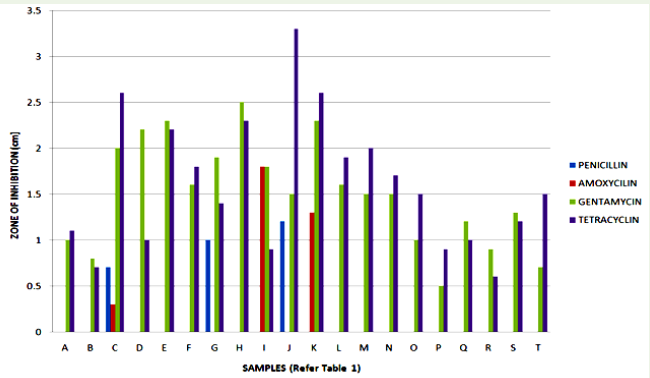

Figure 3: Graphical representation of antibiotic sensitivity in milk samples.

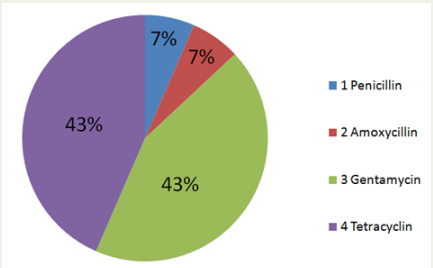

Figure 4: Antibiotic sensitivity pattern in all milk samples.

and amoxycillin and they were sensitive towards gentamycin and tetracyclin. Milk is one of the best nutrition sources so, while choosing the source, we have to be careful and select a good sample for consumption so that we cannot get affected by possible health problems.

To stop milk adulteration, the regulatory bodies, public administration, scientific communities should work together to bring an end to all such unethical malpractices at large. Giving right information to the consumers and making detections of adulterations easy and exercising awareness campaigns can drastically reduce this malpractice.

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