

QUALITY OF MILK SOLD IN WARDHA CITY

THESIS

**Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfilment of the requirements
for the Degree of**

**MASTER OF SCIENCE
IN
AGRICULTURE
ANIMAL HUSBANDRY AND DAIRY SCIENCE
(DAIRY SCIENCE)**

By

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Enrolment Number – KK/336

2018

DECLARATION OF STUDENT

I hereby declare that, the experimental work and its interpretation of the thesis entitled, “**QUALITY OF MILK SOLD IN WARDHA CITY**” or the part of their has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been fully acknowledged.

Place : Nagpur

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Date : 28/05/2018

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CERTIFICATE

This is to certify that thesis entitled, "**QUALITY OF MILK SOLD IN WARDHA CITY**" submitted in partial fulfillment of the requirement for the degree of "**Master of Science in Agriculture (Animal Husbandry and Dairy Science)**" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **SHINGNE SANTOSH DIGAMBAR** under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

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Date : 28/05/ 2018

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(D)**Abbreviations**

%	:	Per cent
/	:	Per
>	:	Greater than
@	:	At the rate of
°C	:	Degree Celsius
°F	:	Degree Fahrenheit
BIS	:	Bureau of Indian standard
Conc.	:	Concentration
et al.	:	et alia (and associates)
FSSA	:	Food Safety and Standard Act
FSSAI	:	Food Safety and Standard Authority of India
FAO	:	Food and Agricultural Organization
Fig	:	Figure
g.	:	Gram
hrs.	:	Hours
i.e	:	That is
IS	:	Indian standard
Kg	:	Kilogram
Lit.	:	Litre
Min.	:	Minute
ml	:	Milliliter
N	:	Normality
PFA	:	Prevention of food adulteration
qty.	:	Quantity
rpm	:	Rotation per minute
Rs.	:	Rupees
SMP	:	Skim Milk Powder
SNF	:	Solids-Not-Fat
temp.	:	Temperature
TS	:	Total solids
viz.	:	Namely
Vol.	:	Volume
Wt.	:	Weight

(E) THESIS ABSTRACT

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ABSTRACT

The present investigation entitled “Quality of milk sold in Wardha city” was undertaken during the year 2017-18. For this study total of 80 samples were randomly collected from milk producers, milk vendors, hotel and restaurants and co-operative societies of Wardha city and tested for the determination of physico-chemical quality and extent of adulteration in milk at Post Graduate Laboratory, Section of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur.

The results indicated that out of 80 samples the highest per cent of milk samples for specific gravity level below 1.028 were found in milk vendors (60.00%) and the lowest per cent of milk samples for specific gravity level below 1.028 were found in milk producers (15.00%). For the fat level group, highest per cent of milk samples in group of 3.5 to 4.5 were found in milk producers (60.00%) and the lowest per cent were found in hotel and restaurants (30.00%) and for the SNF level group, highest per cent of milk samples level group of between 8.5 to 9.0 were found in milk producers (70.00%) and the lowest per cent were found in milk vendors (45.00%). For the acidity level group, highest per cent between 0.14 to 0.15 found were found in hotel and restaurants (55.00%) and lowest in milk producers and co-operative societies (45.00%).

As indicated by specific gravity, the highest per cent of milk samples adulterated with water were found in milk vendors (60.00) followed by hotel and restaurants (55.00%), co-operative societies (40.00%). The lowest per cent of milk samples adulterated with water were found in milk producers (15.00%).

It was a good report for people of Wardha city that nobody added any adulterant in their milk samples, except that they are adulterating with water.

Chapter I

INTRODUCTION

1.1 Background information:

Milk is a complex, homogeneous fluid containing various components in several state of dispersion. It is a unique product secreted by the mammary glands of mammals under complex hormonal control and is intended for nutrition of infants. The composition of milk determines its nutritive quality, its value as raw material for making food products. Milk is defined as lacteal secretion practically free from colostrum obtained by the complete milking of the healthy animals. It is a white opaque liquid having a typical clean smell and sweetish-salty taste. Immediately after parturition, the udder secretes a fluid known as colostrum which differs considerably in composition from the later secretion.

Milk is considered as nearly perfect food which is readily digested and absorbed (Kamthania *et al.*, 2014). Milk is very important due to its special nutritive value and important role for human and animal health. Due to its nutritive value, milk is recommended to young and old people (Kandpal *et al.*, 2012). It is chemically very complex system containing more than one lakh substances. Physically milk is heterogeneous mixture of various components, present either in solution, suspension or emulsion in water. The major constituents of milk include fat – a mixture of mixed triglyceride, casein and whey proteins - the major proteins of milk, lactose – milk sugar and ash - mineral matter of milk (Singuluri and Sukumaran, 2014).

India is considered as the 'agricultural power house' of the nation where cultivation is the primary profession of various states with the staple food production of rice, wheat, maize, along with milk to a high percentage significantly. Over the past years, there has been an increased demand in the production of milk in India which exhibits has the main food supplement in everyday's life remarkably. It has been

estimated that the total production of milk has crossed over about 165.4 million tons in 2016-17 along with per capita availability 355 g/day which is remarkably significant to imagine. We have the A2 milk which is generated from the cows and was taken by Rishis, Munis and Saints in order to nourish their brains. (Anonymous Department of Animal Husbandry, Dairying and Fisheries Ministry of Agriculture, GOI).

In India the top seven milk producing states are UP (23.33 MT), Rajasthan (13.94 MT), AP (12.762 MT), Gujarat (10.32 MT), Panjab (9.72 MT), MP (8.84 MT) and Maharashtra (8.73 MT) annually. With an annual milk production of 8.734 Million Tonnes. In India, Maharashtra rank seventh in milk production. Maharashtra Rajya Sahakari Dudh Mahasangh Maryadit or MRSDMM is the state milk federation incorporated in the year 1967 and sells dairy products under the brand name of Mahanand. MRSDMM comprises of more than 100 member unions with over 24,000 milk societies and has daily milk handling capacity of 8.5 Lakh Litres.

Milk adulteration may be defined as any change caused in the natural level of milk ingredients. Also, incidental contamination during the period of growth, harvesting, processing, transportation and distribution is considered as adulteration. Milk adulteration is a rampant practice in developing countries including India, Pakistan and Bangladesh. Recently, there were many reports of milk adulteration from different parts of India. Milk is adulterated with several chemicals like urea, starch, sodium bicarbonate and other adulterants such as cane sugar, salt, skim milk powder, etc. Milk is transported from the point of production to the processing units and finally to consumers by middleman. So, debasing can be done at any of these points.

Adulteration is one of the major problem that stands against the progress of dairying in India and it has detrimental effect on export of our dairy products. The image of milk as healthy food has been considerably deteriorated due to its adulteration with harmful chemicals

(Sharma *et al.*, 2012). In the recent past, the menace of adulteration has taken serious proportion as highlighted by many media reports as well as by the report of Food Safety and Standards Authority of India (FSSAI, 2011).

In Wardha city many people are coming from different areas and residing in Wardha city in Wardha district and so naturally they are very much differ in their food habits. But milk is a common item in their diet. Various agencies are engaged to meet the milk requirements of Wardha like milk producers, co-oparative societies, milk vendor, hotel and restaurant etc.

To get genuine, safe, unadulterated, good quality milk to people, it is essential to check the quality of milk. It is convenient to test the quality of milk not only for quality evaluation of milk but also for further processing and manufacturing of various indigenous and other dairy products and also for reception by consumers. It can help dairy sector to produce quality milk foods at competitive prices and to safe guard the consumer.

1.2 Importance and need of the study

Milk offers entire nourishment for the body as it contains all the vital nutrients play a fundamental role in the growth. The milk production in the Indian states has increased exponentially at a very fast pace over the decade.

Normally, the adulteration in food is done either for financial gain or lack of proper hygienic conditions of processing, storing, transportation and marketing. This ultimately leads to the stage that the consumer is either cheated or becomes victim of diseases. Such types of adulteration are quite common in developing countries. It is equally important for the consumer to know the common adulterants and their effects on health. Milk is produced throughout the year. However, milk production is greatly reduced during summer months due to heat stress and scarcity of fodder. Milk is transported from point of production to

cities mainly through middlemen. Such milk is watered/ skimmed to increase profit.

To maintain its composition, adulterants like starch, flour, urea, cane sugar and vegetable oil are added in milk. Milk dealers may either dilute the milk or extract valuable components and there after add cheap substances to maintain its compositional parameters. These substances include starch, urea, preservatives like formalin, hydrogen peroxide, boric acid and various antibiotics. Urea is added for whitening of milk and only few grams of urea are enough to bring milk in its original state. Hydrogen peroxide is used as preservative usually in summer season when environmental temperature is very high. This unethical activity is usually adapted to prevent the financial losses due to the spoilage of milk during its transportation and sale. According to Basic Animal husbandry Statistics (2015-16) stated that the milk production for 2015-16 is 155.3 million tonnes.

A national survey in India has revealed that almost 70% of the milk sold and consumed in India is adulterated by contaminants such as detergent and skim milk powder, but impure water is the highest contaminant. According to National Survey on Milk Adulteration conducted by FSSAI (India) in 2011, water is the most common adulterant followed by detergent in milk. A survey by FSSAI in 2012, 68% milk samples was found to be adulterated in which 31 % were from rural areas. Out of these 16.7 % were packed or branded milk and rest were loose milk samples from dairies. In the urban areas, 68.9 % milk was found to be adulterated with water, detergent, urea and skim milk powder. In Uttarakhand, 88% milk was found to be adulterated. Despite the laws governing the quality and sale of milk existing in India for decades, the adulteration of milk has not been checked completely.

Keeping the above facts in view, a study was planned to find out the quality of milk among the milk samples being supplied by different sources in Wardha City with the following objectives-

1.3 Objectives of study

1. To know the extent of adulteration in milk
2. To assess the physico-chemical composition of milk
3. To know the sale price of milk

1.4 Scope and limitation of study

The research was conducted to obtain useful information and collect the data from milk producers, milk vendors, hotels and restaurants and cooperative societies of Wardha city. Major scope of this project is they can improve quality fresh milk and increase production volume.

The study indicates that 80 percent of the milk produced by the rural producer is handled by an unorganized sector and the remaining 20 percent is handled by an organized sector. It is found that dairy co-operatives play a vital role in alleviating rural poverty by augmenting rural milk production and marketing. Involvement of intermediaries; lack of bargaining power by the producers; and lack of infrastructure facilities for collection, storage, transportation, and processing are the major constraints which affect the prices received by producers in milk marketing. Milk quality, product development, infrastructure support development, and global marketing are found to be future challenges of India's milk marketing (Rajendran and Mohanty, 2004).

The quality raw milk received at dairy industry should be excellent for product preparation and selling as a market milk. Raw milk is essential to achieve an excellence in dairy industry.

1.5 Hypothesis

Milk content an essential components like proteins, lactose, milk fat, minerals and vitamins in a highly digestible form and is recommended as compulsory part of daily diet for the expectant mothers as well as growing children.

Organized dairy, direct sellers, milk collection centers, milk vendor shops, hotels and dairy farms from the surrounding areas is the basic milk supply sources in the Wardha city and is based on unorganized marketing system. Thus, milk for consumption is hardly assumed to be of high quality.

Presently milk is adulterate with various chemicals and other adulterants which lower the quality of milk and also harm the health of the people. Milk dealers can maximize their profit margin by three ways as dilution, extraction of valuable components like milk fat which is removed as cream, addition of cheap substances like starch to increase the value of total solids up to a level which is acceptable by the consumers. In our country raw milk is distributed by a traditional system which involves middlemen. These middlemen used to adulterate milk to maximize their profit.

Chapter II

REVIEW OF LITERATURE

The present study entitled “Quality of milk sold in wardha city” aim to judge the physico-chemical quality and adulteration of milk received from different sources in Wardha city. Brief account of research carried out and published by previous workers based on the studies related to milk adulteration reviewed under different group.

The review of literature has been grouped into the following parts:

2.1 Physico-chemical quality of milk

2.1.1 Specific gravity

2.1.2 Fat and Solids-not-fat (SNF)

2.1.3 Acidity

2.2 Test for detection of adulteration

2.2.1 Cane sugar

2.2.2 Sodium bicarbonate

2.2.3 Starch

2.2.4 Urea

2.2.5 Sodium Chloride

2.2.6 Skim milk powder

2.3 Sale price of milk

2.1 Physico-chemical quality of milk:

It attributes specific gravity, fat, SNF and acidity indicates the physico-chemical quality of milk.

2.1.1 Specific gravity

Rao *et al.* (2002) examined 20 samples of milk from the major market sources in Hyderabad city and analyzed for chemical quality and adulteration. All the samples from Andhra Pradesh dairy development cooperative federation met the legal standards and majority of the samples from private dairies also met the standards. Almost all the samples from unorganized sector collected and distributed by vendors and sold by local sweetmeat shops and small traders could not meet the minimum legal standard requirements.

Kolhe *et al.* (2003) collected total of 100 milk samples, 10 each from 10 different agencies from local market. These samples were compared with known unadulterated 10 cow milk samples collected from cattle breeding farm, Nagpur veterinary college, Nagpur as control samples. All the samples were subjected for determination of specific gravity (per cent). The specific gravity ranged between 1.023 to 1.031.

Upadhyay *et al.* (2003) collected the milk samples in Uttar Pradesh, India, and analysed for physical parameters including colour, flavour, specific gravity and pH and chemical parameters like acidity and fat percentage. All milk samples collected from the organized sector showed the highest mean colour (8.32) and flavour (40.07) scores, highest mean specific gravity (1.029). Milk collected from the unorganized sector showed the lowest mean colour (6.37) and flavour (36.96) scores and lowest mean specific (1.026), (5.84) and (3.20%) in respect of specific gravity, pH and fat percentage, respectively and the mean values of acid was 0.142.

Deogade *et al.* (2007) analyzed a total of 100 milk samples comprising 10 each of 6 different brands and 3 vendors from the local market of Parbhani, India and compared with fresh samples from the Cattle Farm, College of Veterinary and Animal Sciences in Parbhani

as control samples. The specific gravity ranged from 1.025% to 1.031% in which sample C was lowest and the sample from vendor 2 was the highest.

Kumar *et al.* (2008) determined the physico-chemical parameters of 150 milk samples from different markets in Kanpur city, India. It was shown that the average lactometer reading was 22.74 compared to the standard at 28.

Javaid *et al.* (2009) studied 125 milk samples (25 samples from each source) collected from five milk marketing agencies *viz.*, direct seller (DS), milk collection center (MCC), milk vendor shop (MVS), hotel (HT) and buffalo dairy farm (DF), which served as control. Viscosity, specific gravity and freezing point of milk procured from DS (1.48, 1.026 and -0.460 , respectively), MCC (1.58, 1.026 and -0.470 , respectively), MVS (1.34, 1.026 and -0.440 , respectively) and HT (1.46, 1.027 and -0.480 , respectively) were significantly ($P < 0.001$) lower than DF milk (1.86, 1.031 and -0.551 , respectively).

Yadav *et al.* (2010) reported that the quality of milk from organized dairy sectors such as RBS College, Ajanta Raj, Singhal dairy, and Parag dairy in Agra city, Uttar Pradesh, India. Milk was contaminated and adulterated by unorganized sectors, it is therefore suggested that standards for quality milk (flavour, colour, specific gravity, hydrogen ion concentration, acidity and percent milk fat) be made aware to consumers to ensure that they are protected from adulterated milk.

Menkudale *et al.* (2011) investigated the physico-chemical quality of raw milk marketed in Latur town from different dairy farms. The results indicate that the average specific gravity 1.031, 1.028 and 1.029, fat per cent 4.68, 4.55 and 5.10, solids-not-fat per cent 9.176, 8.983 and 9.330, total solids per cent 13.104, 12.316 and 12.936 in dairy farm I, dairy farm II, dairy farm III respectively.

Akther *et al.* (2012) conducted the experiment at the Dairy Science Laboratory of the Department of Dairy and Poultry Science,

Chittagong Veterinary and Animal Sciences University. A total 25 samples of market milk of brands (Arong, Milk vita, Pran, RD, Farm and fresh) *i.e.* 5 samples of each brand on the basis of date / batch of production were collected for this study. Mean specific gravity of farm milk non-brand packaged milk and brand milk such as Pran, Milk vita, Arong, RD, Farm and fresh were 1.026, 1.025, 1.028, 1.029, 1.023 and 1.024 respectively.

Jadhao (2012) conducted the study on physico-chemical quality of milk in Nagpur tahsil and reported that out of total 100 samples tested during the investigation, 15.00 % samples showed specific gravity below 1.028, 72.00 % samples showed specific gravity between 1.028 to 1.030 and 13 % samples showed specific gravity above 1.030.

Kandpal *et al.* (2012) observed out of 60 samples of milk collected from various sources in Dehradun, only 12 samples (20%) had specific gravity of 26 and more which is considered as undiluted milk while 48 (80%) had specific gravity of less than 26 clearly indicating the dilution of milk with water. The maximum diluted milk which had specific gravity of 12 was being sold by twenty milk vendors whereas the best milk which had specific gravity of 32 was being sold only by two vendors.

Bashir *et al.* (2013) conducted a study 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.

Mayuri (2015) studied the quality of milk sold in Sakoli Town in Bhandara district and observed out of total of 80 milk samples the highest per cent of milk samples for specific gravity level below 1.028 found in milk vendor (75.00%), the lowest per cent of milk samples for

specific gravity level below 1.028 were found in private dairy (50.00%), which are not satisfying as prescribed legal standard.

Bhutekar *et al.* (2016) conducted a study on quality of milk sold in Nagpur city and reported that a total of 80 raw cow milk samples were collected from milk producer, milk vendor, organized dairy and private dairy and analyzed for physico-chemical quality and detection of adulteration in milk. The results indicated that the highest per cent of milk samples for specific gravity level below 1.028 were found in private dairy (60.00%) and lowest per cent were found in organized dairy (20.00%).

Shatabdi (2017) studied physico-chemical quality of milk received by various sources in Amravati city and observed that total 100 milk samples the highest per cent of milk samples for specific gravity level below 1.028 found in private dairy (70.00%), the lowest per cent of milk samples for specific gravity level below 1.028 were found in milk producers (30.00%), which are not satisfying prescribed legal standard.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and observed out of total of 100 milk samples the highest per cent of milk samples for specific gravity level below 1.028 found in private dairy (65.00%), the lowest per cent of milk samples for specific gravity level below 1.028 were found in milk producers (25.00%).

2.1.2 Fat and SNF

Patil (1996) examined the quality of milk received at Government milk scheme, Akola. He collected 96 samples from 4 sources and noted the following observations

Sr. No.	Sources	No. of samples	Per cent of samples in 3 group of fat levels.		
			3.5-4.5	4.6-5.5	5.6-6.5
1	Individual producer	24	50.00 (12)	37.50 (9)	12.50 (3)
2	Co-operative	24	62.50	25.00	12.50

	society		(15)	(6)	(3)
3	Chilling centre	24	91.66 (22)	8.33 (2)	00.00 (00)
4	Receiving dock	24	100.00 (24)	00.00 (00)	00.00 (00)

(Figures in parenthesis indicate no. of samples)

Kothawade (1999) examined total 192 milk samples collected from organized dairies in Nagpur city and obtained the following results.

Type of milk	No. of samples	Avg. fat per cent	Avg. SNF per cent
Cow milk	120	3.532	8.427
Full cream milk	48	5.574	9.191
Standardized milk	24	4.470	9.760

Kolhe *et al.* (2003) collected a total of 100 milk samples, 10 each from 10 different agencies from local market. These samples were compared with known unadulterated 10 cow milk samples collected from cattle breeding farm, Nagpur Veterinary College, Nagpur as control samples. All the samples were subjected for determination of fat (per cent) and solid not fat (per cent). The average fat and solid not fat per cent ranged between 1.88 ± 0.5 to 5.87 ± 0.10 percent and 6.41 ± 0.10 to 8.76 ± 0.19 , respectively.

Mankar (2003) analysed 100 milk samples collected from different levels of milk procurement at Government milk scheme Nagpur and analysed for fat levels and noted the following observations.

Sr. No.	Sources	No. of samples	Per cent of samples in 3 group of fat levels.		
			3.5-4.5	4.6-5.5	5.6-6.5
1	Government milk scheme	100	75	18	7

Sr. No.	Sources	No. of samples	Per cent of samples in 4 group of SNF levels.			
			8.0-8.4	8.5-8.9	9.0-9.4	> 9.5
1	Government milk scheme	100	19	55	21	5

Upadhyay *et al.* (2003) collected milk samples in Uttar Pradesh, India and analysed for chemical parameters like fat percentage. All milk samples collected from the organized sector showed highest mean fat percentage (6.1%). Milk collected from the unorganized sector showed the lowest mean fat percentage (3.20%).

Venkateswarulu *et al.* (2004) studied the quality of milk sold in the markets of Chennai city, India. 104 milk samples (64 toned milk and 40 standardized milk) were analysed for fat and solids not fat (SNF). The fat percentage of toned milk samples met the PFA standards, except for group V. All toned milk samples met the PFA standards for SNF. 37.5% of the samples were positive for neutralizers as an adulterant.

FSSAI (2006) given the standards of different classes of milk in the table below. Milk shall conform to both the parameters for milk fat and milk solids not fat, independently as prescribed in columns of the table:

Class of Milk	Fat per cent	SNF per cent
Cow Milk	3.5	8.5
Buffalo Milk	6.0	9.0
Goat or Sheep Milk	3.0	9.0
Mixd Milk	4.5	8.5
Standardized Milk	4.5	8.5
Toned Milk	3.0	8.5

Double toned Milk	1.5	9.0
Skimmed Milk	Not more than 0.5	8.7
Full Cream Milk	6.0	9.0

(Food Safety and Standard Authority of India)

Ayub *et al.* (2007) conducted the study in the Dairy Technology Laboratory, National Agriculture Research Centre (NARC) Islamabad, Pakistan during 2005 to evaluate different buffalo milk samples of different dairy farms located in Chack Shehzad (S₁), Dhoke Chaudhery (S₂), Abphara (S₃), Margallah Town (S₄) and Satellite Town (S₅) of Islamabad and Rawalpindi. These samples were analyzed for composition and adulteration. Results showed that maximum fat, observed in samples S₁ (7.35%). Minimum values of fat was observed in samples S₄ (6.98%). Maximum total solids were recorded in sample S₁ (17.2%), while minimum in sample S₅ (15.2%).

Deogade *et al.* (2007) collected a total of 100 milk samples comprising 10 each of 6 different brands and 3 vendors from the local market of Parbhani, Maharashtra, India, were analyzed and compared with fresh samples from the Cattle farm, college of veterinary and animal sciences in Parbhani as control samples. All the samples were subjected for determination of fat and solids not fat. The average fat per cent ranged between 3.12 to 4.53±0.18 per cent, where sample D contained the lowest fat per cent as 3.12 and vendor 3 (4.53 per cent) had the highest fat content. Solids not fat ranged between 7.74 to 8.53 per cent in which the sample from vendor 1 (7.74 per cent) contained the lowest and sample D (8.48 per cent) had the highest SNF.

Singh and Singh (2008) analyzed milk samples collected from different agencies. They observed that milk samples collected from milk producers had the highest fat percentage (6.23 per cent) and SNF (9.58 per cent) and lowest fat (3.86per cent) and SNF (7.95 per cent) from organized dairy. It is suggested that consumer of small town should collect milk directly from milk producers and dairy plants and

take adequate precautions to ensure supply of milk meeting legal standard.

Yadav *et al.* (2010) reported on how the quality of milk from organized dairy sectors such as RBS College, Ajanta Raj, Singhal Dairy, and Parag Dairy in Agra City, Uttar Pradesh, India can be contaminated and adulterated by unorganized sectors, it is therefore suggested that standards for quality milk (like percent milk fat) be made aware to consumers to ensure that they are protected from adulterated milk.

Menkudale *et al.* (2011) investigated physico-chemical quality of raw milk marketed in Latur town from different dairy farms. The results indicates that the average fat per cent 4.68, 4.55 and 5.10 and solids-not-fat per cent 9.176, 8.983 and 9.33 in dairy farm I, dairy farm II, dairy farm III respectively.

Akther *et al.* (2012) conducted the experiment at the dairy science laboratory of the department of dairy and poultry science, Chittagong veterinary and animal sciences university, during the period from August 2010 to January 2011 for analyzing SNF per cent and fat per cent in milk. A total 25 samples of market milk of brands (Arong, Milk vita, Pran, RD, Farm and fresh) *i.e.*, 5 samples of each brand on the basis of date / batch of production were collected for this study. From the chemical analysis, it was found that fat % and SNF % of farm milk, non-brand packaged milk, brand milk such as Pran, Milk vita, Arong, RD Farm and fresh were (4.88% and 8.53%), (3.9% and 8.01%), (2.82% and 7.91%), (2.96% and 8.23%), (3.46% and 8.17%), (1.76% and 7.86%) and (1.52% and 7.78%) respectively.

Jadhao (2012) conducted study on physico-chemical quality of milk in Nagpur tahsil and reported that out of total 100 samples tested during the investigation, 77.00 % samples showed the fat level between 3.5 to 4.5 per cent, 16.00 % samples showed the fat level between 4.6 to 5.5 per cent and only 7.00 % samples showed the fat

level between 5.6 to 6.5 per cent. Also 13.00 % samples showed SNF content between 8.0 to 8.49 per cent, 68.00 % samples showed SNF content between 8.5 to 8.99 per cent, 14.00 % samples showed the SNF content between 9.0 to 9.499 per cent and only 5.00 % samples showed the SNF content above 9.5 per cent.

Mayuri (2015) studied the quality of milk sold in Sakoli town and examined that out of total 80 samples tested during the investigation, the highest per cent of milk samples for fat level group of 3.5 to 4.5 were found in milk producer (55.00%) which were satisfying prescribed legal standard. The highest per cent of milk sample for SNF level group of above 8.5 per cent were found in milk producer (45.00%), which were satisfying prescribed legal standard.

Bhutekar *et al.* (2016) conducted study on quality of milk sold in Nagpur city and reported that out of total 80 samples tested during the investigation, for the fat level group, highest per cent of milk samples in group of 3.5 to 4.5 were found in organized dairy (85.00%), the lowest per cent were found in private dairy (45.00%) and for the SNF level group, highest per cent of milk samples showing the SNF level group of above 8.5 were found in milk producer (45.00%) and the lowest per cent were found in private dairy (15.00%).

Shatabdi (2017) studied on physico-chemical quality of milk received by various sources sources in Amravati city and observed that total 100 milk samples tested during the investigation, the highest per cent of milk samples for fat level group of 3.5 to 4.5 were found in milk producers (55.00%) which were satisfying prescribed legal standard. The highest per cent of milk sample for SNF level group of 8.5 to 9.0 per cent were found in milk producers (65.00%), which were satisfying prescribed legal standard.

Wankhede (2017) studied the quality of milk sold in Gadchiroli town and observed that total 100 milk samples tested during the investigation, for the fat level group, highest per cent of milk samples in

group of 3.5 to 4.5 were found in milk producers (70.00%), the lowest per cent were found in private dairy (20.00%) and for the SNF level group, highest per cent of milk samples showing the SNF level group of 8.5 to 9.0 were found in milk producers (70.00%) and the lowest per cent were found in private dairy (30.00%).

2.1.3 Acidity:

Colinet *et al.* (2010) revealed that the objective of the study was the feasibility of prediction of titratable acidity directly in bovine milk using mid-infrared spectrometry. In order to maximize the variability in the measurements of titratable acidity. The milk sample were collected on the basis of several criteria. The titratable acidity was recorded was dornic degree. The calibration and cross validation coefficients of determination were 92.25 per cent and 89.88 per cent respectively.

Bashir *et al.* (2013) conducted the study to evaluate the quality of milk from Rawalakot and its surroundings. Milk samples were collected from house hold animal, milkman and restaurant in order to assess the hygienic status of raw milk, which was collected from three different parts of the cities, Rawalakot, Azad, Jammu and Kashmir, Pakistan. 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.

Singh *et al.* (2014) studied thirty milk samples, both open and branded were qualitatively analyzed for adulteration. These samples were tested for alkalinity, neutralizers, skimmed milk powder (SMP) and presence of various sugars. All the samples were found to be alkaline showing various degree of alkalinity. The present study was conducted to detect the presence of some common adulterants in milk procured from Delhi and NCR.

Singulurai and Sukumaran (2014) collected a total of 50 samples from different localities in Hyderabad, India and tested for

determination and extent of adulteration. All the samples collected for the test showed positive result for acidity.

Kumar *et al.* (2015) collected fifty milk samples from Godaulia and Pandeypur milk mandi of Varanasi district. A standard milk adulteration kit manufactured by HIMEDIA laboratories, Mumbai (India) was used for present study. In second group, 80% of the samples tested were found positive for acidity/alkalinity.

Brinda *et al.* (2017) studied adulteration of milk with various additives to increase its marketability. This study explain in detail about the hygienic status of cooperative societies, local vendor and private sector packed milk, samples are collected in and around Thuraiyur district of Tamil Nadu, India and tested for determination of adulteration. The significant observations of the study reveals cooperative societies acidity and heat stability 23%, local vendor show acidity and heat stability 40%.

2.2 Test for detection of adulteration:

Under the Prevention of Food Adulteration Act, 1954, adulteration is defined as intentional addition or substitution/abstraction of substances which adversely affect the nature, substance and quality of foods. Adulteration tests indicate that the common adulterants used to adulterate the milk like cane sugar, sodium bicarbonate, starch, urea, salt, skim milk powder and detergent, etc.

2.2.1 Cane sugar

Mankar (2003) analysed 100 milk samples collected from different levels of milk procurement at government milk scheme Nagpur and analyzed for sucrose. Out of total 100 samples tested during the investigation, maximum milk samples adulterated with sugar were observed at individual producers level (24 %) while minimum milk samples adulterated with sugar were observed at receiving dock (8 %) and overall 16 per cent samples were found to be adulterated with sugar.

Arora *et al.* (2004) analyzed the 254 milk samples collected from U.P. Out of the total adulterated samples; 13 contained more than one adulterant (Neutralizer, formalin, sugar, salt, starch, and urea). They also conducted a survey to detect adulteration in milk (n=996) in some states of northern India (Rajasthan, Delhi, Uttar Pradesh, Haryana and Punjab), using a rapid test kit, developed at NDRI, Karnal. They found the prominent adulterant was sugar.

Jha and Matsuoka (2004) reported the adulteration of natural milk by synthetic milk, prepared by mixing appropriate amount of vegetable oil, urea, detergent powder/shampoo, caustic soda, sugar/salt and skim milk powder to water. Detection of adulterants is difficult by a single method and sometimes more than two methods are required to confirm the presence. The potential of near-infrared spectroscopy (NIRS) in the wavelength range of 700-1124.8 nm for the purpose were investigated.

Naik (2007) collected 151 Milk samples from 866 dairies and check the adulteration of milk with cane sugar. 25 per cent milk samples were found to be adulterated in Maharashtra state.

Praneeta *et al.* (2008) discussed a review on the different methods and techniques of detecting contamination and adulteration in milk. Emphasis focused on detection of cane sugar in milk.

Sharma *et al.* (2009) described a high performance liquid chromatography method for the detection of adulteration of milk with soymilk, based on separation of sugars on NH₂ column and their detection by refractive index detector. Sugars were extracted with acetonitrile in the presence of Carrez solutions and quantified. Recovery of added raffinose to soymilk was 96.3 per cent. Owing to relative high concentration of lactose in milk or adulterated milk, lactose peak was very broad and spread to retention time corresponding to sucrose and raffinose.

Afzal *et al.* (2011) reviewed the adulteration of chemicals in milk like cane sugar during transport from the point of production to

consumers and processing plants by middlemen to increase their profit of margin. This addition decreases the nutritive value of milk.

Chandrashekhar and Kumar (2011) collected 120 buffalo milk samples from Faizabad and Sultanapur districts of Poorvanchal region of Uttar Pradesh. These samples were analyzed for different physico-chemical parameters and various types of adulterants. Out of these, only 20 samples from Milkipur fulfill the requirements of PFA standards, whereas, 100 samples from other regions were found unsatisfactory. Among all samples, 50.83 per cent milk samples were found adulterated with sugar.

Wadekar *et al.* (2011) examined the milk samples from Government milk scheme, Nanded in three different seasons *viz.*, summer, rainy and winter. A total number of 120 samples were collected and analyzed for different adulterants. 20.00 per cent in summer, 12.00 per cent in rainy and 3.00 per cent in winter samples were found to be adulterated with sugar.

Jadhao (2012) reported that out of total 100 samples tested during the investigation in Nagpur Tahsil, maximum milk samples adulterated with cane sugar were observed at individual producers level (24.00%) and co-operative society (20.00%) while minimum milk samples adulterated with cane sugar were observed at Govt. milk scheme (12.00%) and not a single sample was found to be adulterated with cane sugar.

Chanda *et al.* (2013) detect the type of adulterants and preservatives added to the incoming fluid milk from rural areas to the Barisal city of Bangladesh. The results indicated that, 100% of the milk samples were adulterated with water irrespective of collection points and months. Cane sugar, powdered milk and starch were detected as 26.0, 14.0 and 12.0% in the milk samples, respectively.

Singuluri and Sukumaran (2014) examined a total 50 samples of milk collected from different areas of Hyderabad, India, from which 22 per cent samples were adulterated with canesugar.

Deepti (2014) examined different milk samples collected from various dairies of Akola, Maharashtra, India and analysed that majority of the milk samples were adulterated with sugar.

Ashwini (2015) studied that the quality, adulteration in the milk of Amravati city. Seven samples taken from nearby area of institute the result were obtained on the test of adulteration carried out for the adulterant like starch, urea, sugar, salt, maltose, glucose. On the basis of result obtained from the milk sample, small traces of adulterants were found in some milk samples.

Mayuri (2015) conducted the study on quality of milk sold in Sakoli town in Bhandara district and concluded that a total of 80 samples tested for adulteration, none of the sample was adulterated with sugar.

Ramaya *et al.* (2015) revealed that a total of fifty samples were collected from retail outlets, nearby chilling centres and different localities in and around Proddatur of YSR Kadapa District, A.P., India and tested for the determination and extent of adulteration from which 40 per cent milk samples were adulterated with sugar.

Bhutekar *et al.* (2016) studied on quality of milk sold in Nagpur city and observed that out of total 80 samples tested during the investigation nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water in milk producers, milk vendor, organized dairy and private dairy. Hence, not a single sample was found to be adulterated with cane sugar.

Shatabdi (2017) studied physico-chemical quality of milk received by various in Amravati city and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sugar.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sugar.

2.2.2 Sodium bicarbonate

Patil (1996) conducted a survey on quality of milk received at Government milk scheme, Akola. He collected the 96 milk samples from four different sources and analysed them for sodium bicarbonate test and recorded following observations.

Sr. No.	Sources	No. of samples analysed	Percent samples positive to sodium bicarbonate test
1	Individual milk producer	24	12.50 (3)
2	Co-operative society	24	16.66 (4)
3	Chilling centre	24	04.16 (1)
4	Receiving dock	24	12.50 (3)

(Figures in parenthesis indicate no. of samples)

Kothawade (1999) analyzed total 192 samples collected in Nagpur city, out of which 30 (15.62 per cent) samples were found to be adulterated with sodium bicarbonate.

Das *et al.* (2003) shown that all the milk samples except two double toned milk (DTM) and one toned milk (TM) samples from organized dairies of Kolkata confirmed to the prescribed legal standard. Neutralizer was detected in 13% of the samples obtained from milk vendors. Only 3 samples from organized dairies contained neutralizer.

Mankar (2003) analysed 100 milk samples collected from different levels of milk procurement at Government milk scheme Nagpur and analyzed for sodium bicarbonate. Out of total 100 samples tested during investigation, maximum milk samples were found to be adulterated with sodium bi-carbonate at co-operative society (20%) and receiving dock (16%) while, minimum milk samples were found to be adulterated at chilling centre (8%) and overall 14 per cent samples were found to be adulterated with sodium bi-carbonate.

Upadhyay *et al.* (2003) collected the milk samples in Uttar Pradesh, India, and analysed for physical parameters including colour,

flavour, specific gravity and pH, and chemical parameters including acidity and fat percentage and for adulteration. Almost all milk samples from unorganized sector contained some amount of thickening agents and preservatives (*i.e.* starch, urea, detergents, formalin, sodium bicarbonate, etc.).

Jha and Matsuoka (2004) reported the adulteration of natural milk by synthetic milk, prepared by mixing appropriate amount of vegetable oil, urea, detergent powder/shampoo, caustic soda, sugar/salt and skim milk powder to water. Detection of adulterants is difficult by a single method and sometimes more than two methods are required to confirm the presence. The potential of near-infrared spectroscopy (NIRS) in the wavelength range of 700-1124.8 nm for the purpose were investigated.

Saxena and Agrawal (2004) collected 81 milk samples procured from the government dairy (Jaipur Dairy), from private dairies located in different areas of Jaipur city, and from vendors coming to Jaipur from nearby places were analyzed for their nutritional composition and adulteration in Rajasthan State, India. Jaipur dairies milk samples were not found to be adulterated. Neutralizer was found to be a major adulterant among private dairies and vendor's milk samples.

Yadav *et al.* (2006) collected the milk samples in Kanpur city and analysed for adulteration. Almost all the milk samples from unorganized sectors were found to contain some amount of thickening agents and preservatives *i.e.* starch, urea, detergents, formalin, sodium bicarbonate, etc.

Arya (2008) conducted the study to determine the percentage of milk adulteration with synthetic milk during summer season in Haryana, India. 10 milk samples from 12 districts and two samples each from milk vendors, dairies, milk suppliers, polypacks and bulk milk were collected between 10 and 28 June 2002 and analysed. A total of 32.3 and 26.9% milk samples contained formaldehyde and

carbonate, respectively. It is suggested that milk is adulterated in the two districts of Haryana due to the presence of carbonate and formaldehyde.

Chandra Shekhar and Kumar (2011) collected a total of 120 buffalo milk samples from Faizabad and Sultanpur districts of Poorvanchal region of Uttar Pradesh. These samples were analyzed for different physico-chemical parameters and various types of adulterants. Out of these, only 20 samples from the Milkpur fulfill the requirements of PFA Standards, whereas, 100 samples from other regions were found unsatisfactory results. Among all samples, 50.83% samples were found adulterated with starch, formalin, sucrose or sodium bicarbonate.

Wadekar *et al.* (2011) collected the milk samples from Government milk scheme, Nanded in three different seasons *viz.*, summer, rainy and winter. A total number of 120 samples were collected and analyzed for different adulterants. 8.00 per cent in summer, 18.00 per cent in rainy and 27.00 per cent in winter samples were found to be adulterated with carbonates/bicarbonates.

Jadhao (2012) conducted study in Nagpur tahsil and reported that out of total 100 samples tested during the investigation, maximum milk samples were found to be adulterated at individual producer (16.00%) and co-operative society (12.00%) while minimum milk samples were found to be adulterated at Govt. milk scheme (8.00%) and not a single sample was found to be adulterated with sodium bicarbonate.

Mayuri (2015) conducted the study on quality of milk sold in Sakoli town of Bhandara district and concluded that a total of 80 samples tested for adulteration, none of the sample was adulterated with sodium carbonate.

Bhutekar *et al.* (2016) revealed from the study on quality of milk sold in Nagpur city and observed that total 80 samples tested during

the investigation nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water sold by milk producers, milk vendor, organized dairy and private dairy. Hence, not a single sample was found to be adulterated with sodium carbonate.

Shatabdi (2017) studied on physico-chemical quality of milk received by various sources in Amravati city and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sodium carbonate.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sodium carbonate.

2.2.3 Starch

Das *et al.* (2003) detected starch in 3.5 per cent of the milk samples obtained from milk vendors in Kolkata.

Mankar (2003) observed that total 100 samples tested during the investigation 100 milk samples at Government milk scheme, Nagpur, not a single sample was found to be adulterated with starch at any level of milk sample procurement.

Arora *et al.* (2004) conducted a survey to detect adulteration in milk (n=996) in some states of northern India (Rajasthan, Delhi, Uttar Pradesh, Haryana and Punjab), using a rapid test kit, developed at NDRI, Karnal. The prominent adulterant detected was starch.

Yadav *et al.* (2006) collected the milk samples and detected the common preservatives and adulterants to know the quality of milk supplied in the market. Almost all the milk samples from unorganized sectors were found to contain some amount of thickening agents. *i.e.* starch, urea, detergents, formalin, sodium bicarbonate etc.

Upadhyay *et al.* (2003) collected the milk samples in Uttar Pradesh, India, and analysed for preservatives and adulterants present

in milk. Almost all the milk samples from unorganized sector contained some amount of thickening agents and preservatives like starch.

Naik (2007) collected 151 Milk samples from 866 dairies and check the adulteration of milk with starch. 25 per cent milk samples were found to be adulterated in Maharashtra state.

Kumar *et al.* (2008) examined 150 milk samples from different markets in Kanpur city, India, for adulteration. 14.66 per cent of the samples were adulterated by starch. These results show that the majority of milk sold in Kanpur are substandard in quality.

Praneeta *et al.* (2008) reviewed on the different methods and techniques of detecting contamination and adulteration in milk is discussed. Emphasis focused on the detection of starch in milk.

Adam (2009) investigated the adulteration of marketable fresh milk adulterated with water and starch at Khartoum state. Three hundred samples from Khartoum, Omdurman and Bahri were collected. All samples were chemically examined and analyzed to observe their quality. The research concluded that the adulteration at Khartoum state is due to addition of water (35.3%) rather than starch.

Afzal *et al.* (2011) reviewed the adulteration of chemicals in milk like starch during transport from the point of production to consumers and processing plants by middle men to increase their profit margin. This addition decreases the nutritive value of milk. The present study was conducted in various parts of Pakistan.

Chandra Shekhar and Kumar (2011) collected a total of 120 buffalo milk samples from Faizabad and Sultanpur districts of Poorvanchal region of Uttar Pradesh. These samples were analyzed for different physico-chemical parameters and various types of adulterants. Out of these, only 20 samples from the Milkipur fulfill the requirements of PFA Standards, whereas, 100 samples from other regions were found unsatisfactory. Among all samples, 50.83%

samples were found adulterated with starch, formalin, sucrose or sodium bicarbonate.

Wadekar *et al.* (2011) collected the milk samples from Government milk scheme, Nanded in three different seasons *viz.*, summer, rainy and winter. A total number of 120 samples were collected and analysed for different adulterants. 2.00 per cent milk samples during rainy season were found to be adulterated with starch.

Shaikh *et al.* (2013) studied twenty market milk samples from different sale points of Hyderabad city and its surrounding areas and similar number (20) of whole buffalo milk (control) from different dairy farms of the vicinity of Hyderabad were examined at the laboratory of Institute of Food Sciences and Technology/ Department of Animal Product Technology, Sindh Agriculture University, Tandojam and 30per cent samples were found to be adulterated with starch.

Singh *et al.* (2014) conducted a study to detect the presence of some common adulterants in milk procured from Delhi and NCR. Thirty milk samples, both open and branded were qualitatively analyzed for adulteration. These samples were tested for alkalinity, neutralizers, skimmed milk powder (SMP) and presence of various sugars and starch were absent in all the samples.

Deepti (2014) examined the different milk samples collected from various dairy of Akola, Maharashtra, India from which not a single sample is adulterated with starch.

Ashwini (2015) studied that the quality, adulteration in the milk of Amravati city. Seven samples were taken from nearby area of institute. The results were obtained on the test of adulteration carried out for the adulterant like starch, urea, sugar, salt, maltose, glucose. On the basis of result obtained from the milk sample small traces of adulterants were found in some milk sample.

Mayuri (2015) conducted the study on quality of milk sold in Sakoli town in Bhandara district and concluded that a total of 80

samples tested for adulteration, none of the sample was adulterated with starch.

Ramaya *et al.* (2015) conducted experiment in YSR Kadapa district of Andhra Pradesh and analyzed 50 milk samples and revealed that 8 per cent samples were adulterated with starch.

Kumar *et al.* (2015) studied 50 milk samples from Varanasi district and found that 20% samples were positive for starch.

Bhutekar *et al.*(2016) conducted study in Nagpur city and reported that out of total 80 samples tested during the investigation and reported that nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water in milk sold by milk producers, milk vendor, organized dairy and private dairy. Hence, not a single sample was found to be adulterated with starch.

Shatabdi (2017) studied on physico-chemical quality of milk received by various sources in Amravati city and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with starch.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with starch.

2.2.4 Urea

Das *et al.* (2003) detected urea in 4.1 per cent of the samples obtained from milk vendors in Kolkata.

Upadhyay *et al.* (2003) collected the milk samples in Uttar Pradesh, India, and analysed for physical parameters including colour, flavour, specific gravity and chemical parameters including acidity and fat percentage and adulteration. Almost all milk samples from unorganized sector contained some amount of thickening agents and preservatives (*i.e.* starch, urea, detergents, formalin, sodium bicarbonate, etc).

Mankar (2003) analyzed 100 milk samples collected from different levels of milk procurement at Govt. milk scheme Nagpur, and analyzed for urea. Out of total 100 samples tested during investigation, maximum milk samples were found to be adulterated with urea at receiving dock (12%) and individual producer or co-operative society as same (8 %) while, minimum milk samples were found to be adulterated at chilling centre (4%) and overall 8% per cent samples were found to be adulterated with urea.

Arora *et al.* (2004) conducted a survey to detect adulteration in milk (n=996) in some states of northern India (Rajasthan, Delhi, Uttar Pradesh, Haryana and Punjab), using a rapid test kit, developed at NDRI, Karnal. The prominent adulterant detected was urea.

Jha and Matsuoka (2004) reported milk samples in Pakistan adulteration of natural milk by synthetic milk, prepared by mixing appropriate amount of vegetable oil, urea, detergent powder/shampoo, caustic soda, sugar/salt and skim milk powder to water.

Sadat *et al.* (2006) carried out the study by keeping in view the recently emerging concern of the adulteration of the natural milk with the synthetic milk. Synthetic milk is prepared by emulsifying vegetable oils with appropriate amount of detergent and urea. Samples of the natural milk with synthetic milk were analyzed by the method of electrical admittance spectroscopy.

Yadav *et al.* (2006) collected the milk samples in Kanpur analysed for physical parameters like colour, flavour, specific gravity and pH and chemical parameters like acidity and fat percentage. The common preservatives and adulterants were also detected to know the quality of milk supplied in the market. Almost all the milk samples from unorganized sectors were found to contain some amount of thickening agents and preservatives *i.e.* starch, urea, detergents, formalin, sodium bicarbonate, etc.

Arya (2008) conducted the study to determine the percentage of milk adulteration with synthetic milk during summer season in Haryana, India. 10 milk samples from 12 districts and two samples each from milk vendors, dairies, milk suppliers, polypacks and bulk milk were collected between 10 and 28 June 2002 and analysed. Results revealed that the urea concentration of milk varied between 21.5 to 838.5 ppm.

Kumar *et al.* (2008) examined 150 milk samples from different markets in Kanpur city, India, for adulteration. 18 per cent of the samples were adulterated by urea. These results show that the majority of milk sold in Kanpur are substandard in quality.

Praneeta *et al.* (2008) discussed a review on the different methods and techniques of detecting contamination and adulteration in milk. Emphasis focused on the detection of urea in milk.

Afzal *et al.* (2011) examined the adulteration of chemicals like urea in milk. This addition decreases the nutritive value of milk. The present study was conducted in various parts of Pakistan.

Wadekar *et al.* (2011) collected the milk samples from Government milk scheme, Nanded in three different seasons *viz.*, summer, rainy and winter. A total number of 120 samples were collected and analysed for different adulterants. None of the milk samples were found to be adulterated with urea.

Kandpal *et al.* (2012) observed that all the milk samples including double toned milk collected from different places showed the presence of urea as common adulterant.

Shaikh *et al.* (2013) studied twenty market milk samples from different sale points of Hyderabad city and its surrounding areas and similar number (20) of whole buffalo milk (control) from different dairy farms of the vicinity of Hyderabad were examined at the laboratory of Institute of Food Sciences and Technology/ Department of Animal

Product Technology, Sindh Agriculture University, Tandojam and 25 per cent milk samples were found to be adulterated with urea.

Shrishti *et al.* (2013) studied the 100 milk samples collected from different regions of Dehradun and concluded that out of 100 samples thirty 05.00 per cent milk samples were adulterated with urea.

Singulurai and Sukumaran (2014) examined a total 50 samples from different localities of Hyderabad, India from which 60 per cent samples were adulterated with urea.

Ashwini (2015) studied that the quality and adulteration in the milk of Amravati city. Seven samples taken from nearby area of institute. The result were obtained on the test of adulteration carried out for the adulterant like starch, urea, sugar, salt, maltose, glucose. On the basis of result obtained from the milk sample, small traces of adulterants were found in some milk sample.

Mayuri (2015) conducted the study on quality of milk sold in Sakoli town in Bhandara district and concluded that a total of 80 samples tested for adulteration, none of the sample was adulterated with urea.

Kumar *et al.* (2015) revealed that the 50 samples collected from Varanasi district and were found to be adulterated with urea by 60 per cent.

Bhutekar *et al.* (2016) conducted study in Nagpur city on quality of milk and reported that out of total 80 samples tested during the investigation and reported that nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water in milk sold by milk producers, milk vendor, organized dairy and private dairy. Hence, not a single sample was found to be adulterated with urea.

Shatabdi (2017) studied physico-chemical quality of milk received by various sources in Amravati city and concluded that a total

of 100 samples tested for adulteration, none of the sample was adulterated with urea.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with urea.

2.2.5 Sodium Chloride (NaCl)

Rao *et al.* (2002) collected 20 samples of milk from the major market sources in Hyderabad city and analyzed for chemical quality and adulteration. All the samples from Andhra Pradesh Dairy Development Cooperative Federation met the legal standards and majority of the samples from private dairies also met the standards.

Arora *et al.* (2004) conducted a survey to detect adulteration in milk (n=996) in some states of northern India (Rajasthan, Delhi, Uttar Pradesh, Haryana and Punjab), using a rapid test kit, developed at NDRI, Karnal. The prominent adulterant detected was common salt.

Saxena and Agrawal (2004) in Rajasthan state, India, procured 81 milk samples procured from the government dairy (Jaipur Dairy), and private dairies located in different areas of Jaipur city, and from vendors coming to Jaipur from nearby places were analyzed for their nutritional composition and adulteration. Jaipur Dairy milk samples were not found to be adulterated.

Khattar *et al.* (2005) described the use of the milk adulteration test (MAT) and other techniques to analyse the composition of milk and to determine the presence of water, sweetening agents, nitrogenous compounds, neutralizers, fats, salt, preservatives, emulsifiers, alkalis, skim milk powder and other adulterants.

Huppertz and Fox (2006) investigated the influence of added NaCl (75-850 mmol L⁻¹) on some physicochemical properties of 2x or 3x concentrated milk (18 or 27per cent, w/v, total solids, respectively).

Adding NaCl did not influence average casein micelle size, but reduced the net-negative charge on the casein micelles and milk pH.

Praneeta *et al.* (2008) discussed a reviews on the different methods and techniques of detecting contamination and adulteration in milk. Emphasis focused on the detection of salt in milk.

Wadekar *et al.* (2011) collected milk samples from Government milk scheme, Nanded in three different seasons *viz.*, summer, rainy and winter. A total number of 120 samples were collected and analysed for different adulterants. 8.00 per cent in summer, 4.00 per cent in rainy and 3.00 per cent in winter samples were found to be adulterated with salt.

Shrishti *et al.* (2013) studied the hundred milk samples collected from different regions of Dehradun and concluded out of 100 sample 51 per cent milk samples were adulterated with salt.

Singulurai and Sukumaran (2014) collected a total 50 samples from different localities of Hyderabad, India from which 82 per cent milk samples were adulterated with salt.

Deepti (2014) examined different milk samples collected from various dairy of Akola, Maharashtra, India and analysed that none of the milk samples are adulterated with salt.

Ashwini (2015) analyzed the milk adulteration sold at different dairies regions of Amravati. Seven random raw milk samples were collected from dairy owners at different regions of Amravati. Out of seven milk samples analyzed for adulteration, salt in small traces found in some milk samples.

Kumar *et al.* (2015) studied the 50 samples collected from Varanasi district from which 80 per cent samples were found to be adulterated with salt.

Mayuri (2015) conducted the study on quality of milk sold in Sakoli town in Bhandara district and concluded that a total of 80

samples tested for adulteration, none of the sample was adulterated with salt.

Ramaya *et al.* (2015) revealed that the total 50 samples collected from various sources and out this 54 per cent samples were found to be adulterated with salt which were collected from YSR Kadapa district of Andhra Pradesh.

Bhutekar *et al.* (2016) conducted study in Nagpur city and reported that out of total 80 samples tested during the investigation and reported that nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water in milk sold by milk producers, milk vendor, organized dairy and private dairy. Hence, not a single sample was found to be adulterated with sodium chloride (NaCl).

Brinda *et al.* (2017) studied adulteration of milk with various additives to increase its marketability. This study explain in detail about the hygienic status of cooperative societies, local vendor and private sector packed milk, samples are collected in and around Thuraiyur district of Tamil Nadu, India and tested for determination of adulteration. The significant observations of the study reveals cooperative societies Sodium chloride 16%, local vendor show sodium chloride 13% and private sector milk shows only 3% for sodium chloride.

Shatabdi (2017) studied physico-chemical quality of milk received by various sources in Amravati city and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sodium chloride.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with sodium chloride.

2.2.6 Skim Milk Powder:

Shrishti *et al.* (2013) studied 100 milk samples collected from different regions of Dehradun and concluded that out of 100 samples 58 percent milk samples were found to be adulterated with salt.

Deepti (2014) examined the different milk samples from various dairy of Akola, Maharashtra, India and showed the absence of skim milk powder.

Singh *et al.* (2014) conducted the study to detect the presence of some common adulterants in milk procured from Delhi and NCR. 30 milk samples, both open and branded were qualitatively analyzed for adulteration and 10% of the total samples were found to be adulterated with skim milk powder.

Singuluri and Sukumaran (2014) examined a total 50 samples from different localities of Hyderabad, India from which 80 per cent of milk samples were found to be adulterated with skim milk powder.

Kumar *et al.* (2015) revealed that 82 per cent milk samples found to be adulterated with skim milk powder out of 30 milk samples collected from Varanasi district.

Ashwini (2015) analyzed the milk adulteration sold at different dairies in the regions of Amravati. Seven random raw milk samples were collected from dairy owners at different regions of Amravati. Out of seven milk samples analyzed for adulteration, skim milk powder was absent in the milk samples.

Ramaya *et al.* (2015) revealed that total 50 milk samples collected from various sources from YSR Kadapa district of Andhra Pradesh were found to be adulterated with skim milk powder by 2 per cent.

Shatabdi (2017) studied physico-chemical quality of milk received by various in Amravati city and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with skim milk powder.

Wankhede (2017) studied the quality of milk sold in Gadchiroli Town and concluded that a total of 100 samples tested for adulteration, none of the sample was adulterated with skim milk powder.

2.3 Sale price of milk:

In the present study, efforts were made to estimate the sale price of milk from randomly collected raw milk samples from various sources in Wardha city.

Singh *et al.* (2012) analyzed the milk combination to dairy co-operative, producers share in consumer rupee and cost of milk production in Bihar. Per litre cost of milk production was varied from Rs. 10.12 for crossbred cows to Rs.13.90 and Rs.13.57 buffalo and local cows, respectively.

Serma *et al.* (2013) studied the cost and returns of urban milk production in Tamil Nadu and found the corresponding net returns per milking cow were Rs.46.89 for small farmer and Rs. 54.78 for medium farmer.

Kaware and Yadav (2014) conducted the economic analysis of milk production in Western Maharashtra and found that per litre cost of milk production was worked out to Rs. 9.61 and 19.47 for cow and buffalo milk respectively.

Sujatha *et al.* (2015) studied the milk marketing in co-operative sector and private sector in Andhra Pradesh, India and revealed that the overall producer's net price was Rs.32.16/ lit. and overall purchase of consumer was Rs.40.10/lit.

Rajeshwaran and Naik (2016) reported that the consumer price of standardized milk in various parts of India varies from Rs.37 to Rs.49 per litre and also revealed that the prices of milk are increasing day by day.

Jadhav (2016) observed the sale price of cow milk at dairy farm, Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur was Rs.35/lit during his study on the preparation of yoghurt drink by utilizing honey.

Priyanka (2016) revealed that the price of cow milk was Rs. 35/lit. at dairy farm, Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur during her study on the preparation of flavoured milk.

Ramageswari *et al.* (2017) conducted study on the economics of milk production in Tamil Nadu and revealed the cost per litre of crossbred milk production was higher in the case of large farmers (Rs.18.24) as compared to marginal farmer (Rs.17.24). Whereas, it ranged between Rs. 31.36 (small) to Rs. 33.09 (large) in the case of local cow while in the case of buffalo, it stretched between Rs. 24.71 (marginal) to 28.71(landless).

Snehalata (2016) reported that Chief Judicial Magistrate of Wardha Mr. Gadekar had awarded one year jail term to four partners of a firm owned by former Member of Parliament from Bhandara Shishupal Patle for selling substandard milk in Wardha.

Acharya and Sarvankar (2017) invented the adulteration determining milk scale by which milk can be tested at home. Milk adulterated with urea, glucose, salt, hydrogen peroxide, alkali, detergent, etc can be detected with the help of this milk scale.

Shatabdi (2017) concluded that sale price is based on fat content of milk and increased from a point of procurement of milk to another point *viz.*, milk producers (above Rs.40/lit.) to the private dairy (below Rs.35/lit.).

Chapter III

MATERIAL AND METHODS

The present investigation entitled, “**QUALITY OF MILK SOLD IN WARDHA CITY**”. The analysis of milk samples collected from various sources in Wardha City was carried out in the section of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur.

3.1 Material required

3.1.1. Material

Raw milk samples collected from the following sources in Wardha city.

1. Milk producers
2. Milk vendors
3. Hotel and restaurants
4. Co-operative Societies

3.1.2 Chemicals used for analysis

1. Concentrated sulphuric acid (98.08%)
2. Amyl alcohol
3. Concentrated hydrochloric acid (98%)
4. Resorcinol powder
5. Rosalic acid solution (1%)
6. 1% Iodine solution
7. Ethyl alcohol
8. 1.6% Para-dimethylamino benzaldehyde (DMAB).
9. 0.134% Silver nitrate
10. 10% Potassium chromate
11. Conc. Nitric acid
12. Methylene blue dye

Analytical grade chemicals were used for chemical analysis

3.1.3 Instrument and equipments used

1. Milk sample bottle (200 ml)
2. Thermometer
3. Lactometer (Zeal)
4. Lactometer jar

5. 10 ml, automatic tilt measure
6. 1 ml, automatic tilt measure
7. 10.75 ml capacity milk pipette
8. Hot water bath
9. Gerber centrifuge machine 1000-1200 rpm
10. Gerber butyrometer (0-10 per cent)
11. Butyrometer stand
12. Lock stopper
13. Stopper key
14. Test tubes, Test tube stand
15. Pipettes
16. Bunsen burner
17. Petri plates
18. Beaker
19. Measuring cylinder
20. Glass rods
21. Digital weighing balance

Above equipments and instruments were used for analysis as

3.2 Methods adopted

3.2.1 Collection of raw milk sample

The raw milk samples were collected from the following sources in Wardha city.

1. Milk producers
2. Milk vendors

3. Hotel and Restaurants

4. Co-operative Societies

Twenty samples from each sources of milk procurement were collected randomly and total 80 samples were examined for the quality of milk.

The raw milk samples were collected aseptically as per the method recommended in BIS Handbook of Food Analysis in SP: 18 (part – XI) 1981 from various sources of milk procurement for determining the physico-chemical quality and adulteration of milk.

3.2.2 Sampling procedure

The milk samples from different sources such as milk producers, milk vendors, co-operative societies, hotel and restaurants were purchase and take in sterile sample bottles (200 ml milk) and transferred to the laboratory for analyzing the quality of milk aseptically.

The sample bottle were labeled properly viewing the source of milk sample procurement. These samples were preserved by added formalin (36 %) @ 0.1ml for 25 ml of milk and transferred to the laboratory for determining the quality of milk.

3.3 Analysis of milk samples

3.3.1 Physico-chemical tests

1. Determination of specific gravity

The specific gravity of milk was determined by the procedure described in BIS Handbook of Food Analysis in SP: 18 (part XI) 1981.

Procedure:

1. Adjusted the temperature of milk sample to measuring temperature prescribed for lactometer (Zeal) at 84°F.
2. Mixed the sample well avoiding incorporation of air or foam formation.

3. Poured sufficient milk into the glass or steel cylinder to allow free floating lactometer.
4. Placed the lactometer in the milk and allow it to float till it stops and assumes a constant level.
5. Recorded the lactometer reading and temperature of milk at the same time.
6. Taken another reading by flapping the top of the lactometer stem and when it again assumes constant level.
7. Taken average of two reading. Get corrected value (CLR) from the standard table for corresponding temperature.(Appendix X)

$$\text{Specific gravity} = \frac{\text{CLR}}{1000} + 1$$

Where,

$$\text{CLR} = \text{LR} \pm \text{CF}$$

CLR = Corrected Lactometer Reading

LR = Lactometer Reading

CF = Correction Factor

CF (+) = 0.1 × difference in temperature above 84⁰F

CF (-) = 0.1 × difference in temperature below 84⁰F

2. Determination of fat

The fat content (per cent) of milk was determined by Gerber method, adopting standard procedure prescribed in IS: 1223 (part-1) 1970.



Plate no. 1. Determination of Specific gravity



Plate No. 2. Determination of Fat

Procedure:

1. Transferred 10 ml of sulphuric acid (Gerber acid) into milk butyrometer (range 0-10%) using automatic tilt measure.
2. Mixed well the sample of milk and drawn 10.75 ml with the help of milk pipette. Transferred the milk slowly from the side of butyrometer wall taking care not to wet the neck of butyrometer.
3. Added 1.0 ml of amyl alcohol using automatic tilt measure, clean and dry the neck of butyrometer with cotton if it is wet.
4. Stopped the butyrometer with a lock stopper, using the key and shake the content well.
5. Kept the butyrometer in water bath at 65°C for 5 min.
6. Placed the butyrometer in Gerber centrifuge, balance the machine and centrifuge the content for 5 min. at 1100-1200 rpm.
7. Kept the butyrometer in water bath at 65°C for 5 min.
8. Read the fat content, (colourless column) on the butyrometer stem.

3. Determination of SNF

The SNF content of milk was determined by using Zeal's lactometer at 84°F by adopting standard procedure prescribed in IS-1183 (1965).

Procedure:

1. Adjusted the temperature of milk sample to measuring temperature prescribed for lactometer 84°F.
2. Mixed the sample well avoiding incorporation of air or foam formation.
3. Poured sufficient milk into the glass or steel cylinder to allow free floating lactometer.
4. Placed the lactometer in the milk and allow it to float till it stops and assumes a constant level.

5. Recorded the lactometer reading and temperature of milk at the same time.
6. Taken another reading by flapping the top of the lactometer stem and when it again assumes constant level.
7. Taken average of two reading. Get corrected value (CLR) from the standard table for corresponding temperature (Appendix –X).
8. Calculated solids not fat (SNF) content by using Richmond formula by using zeal lactometer calibrated at 84°F.

$$\text{SNF \%} = \frac{\text{CLR}}{4} + (0.20 \times \text{fat \%}) + 0.50$$

Where,

$$\text{CLR} = \text{LR} \pm \text{CF}$$

CLR = Corrected Lactometer Reading

LR = Lactometer Reading

CF = Correction Factor

CF (+) = 0.1 × difference in temperature above 84°F

CF (-) = 0.1 × difference in temperature below 84°F

4. Determination of Acidity:

The acidity of milk expressed on per cent lactic acid was determined by the method described in IS: 1479 (Part II) 1961.

Procedure:

1. The burette was filled with N/10 NaOH solution.
2. The milk sample mixed thoroughly by avoiding incorporation of air.
3. 10 ml milk with pipette transferred in porcelain dish.
4. Equal quantity of distilled water added.
5. 3-4 drops of phenolphthalein indicator added and stirred with glass rod.



Plate no. 3. Determination of Acidity

6. The initial reading of the alkali in the burette at the lowest point of meniscus was taken.
7. Rapidly titrated the contents with N/10 NaOH solution, continuously added alkali drop by drop and stirring the content with glass rod till first definite change to pink colour which remains constant for 10 to 15 seconds.
8. Completed the titration within 20 seconds.
9. Noted down the final burette reading.

$$\% \text{Lactic acid} = \frac{\text{No. of ml. of 0.1N NaOH solution req. for Neutralization} \times 0.009}{\text{Weight of sample}} \times 100$$

Where,

Weight of sample = volume of milk + specific gravity

3.3.2 Tests for detection of adulteration

1. Cane Sugar

The test for detection of adulteration of milk with sucrose was carried out by the standard procedure described in IS: 1479(Part-II) 1961.

Procedure:

1. Taken 10 ml of milk in a test tube.
2. Added 1 ml of concentrate hydrochloric acid and mixed well.
3. Added 0.1 g of resorcinol powder and mixed thoroughly.
4. Placed the tube in a boiling water bath for 5 min.
5. Observed the colour of the contents.
6. Development of red colour indicated presence of cane sugar in milk.

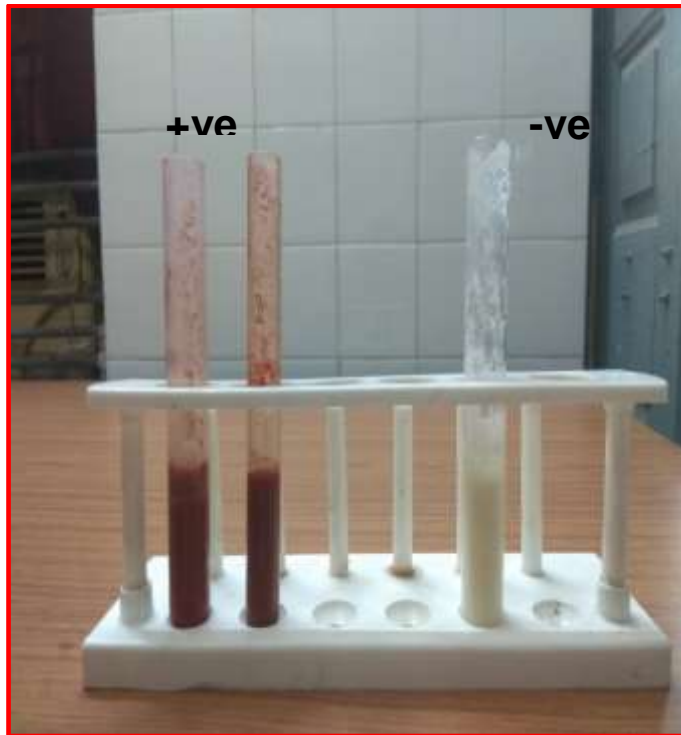


Plate no. 4. Determination of Cane sugar

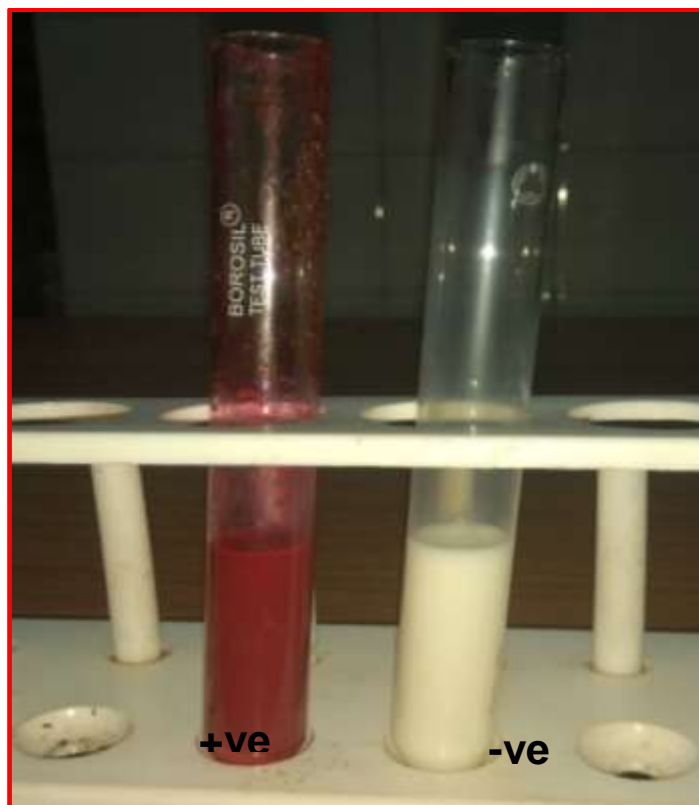


Plate no. 5. Determination of Sodium bicarbonate

2. Sodium bicarbonate

The test for detection of adulteration of milk with sodium bicarbonate were carried out by the standard procedure described in BIS Handbook of Food Analysis in SP: 18 (Part XI) 1981.

Procedure:-

1. Transferred 5 ml of milk in test tube.
2. Added equal amount of ethyl alcohol (5ml).
3. Added few drops of 1% aqueous solution of Rosalic acid.
4. Mixed well and observed the colour.
5. Presence of rose red colour indicated addition of carbonate in milk.

3. Starch

Determined by methods recommended by IS: 1479 (Part 1) 1960.

Procedure:

1. Taken about 3 ml of well – mixed milk sample in test tube.
2. Boiled the contents over Bunsen burner.
3. Cooled and added one drop of 1% iodine solution
4. Mixed well and observed the colour.
5. Development of intense blue or bluish violet colour indicated presence of added starch.

4. Urea

The test for detection of adulteration of milk with urea was carried out by the standard procedure described in BIS Handbook of food analysis in SP: 18 (Part XI) 1981.

Procedure:

1. Taken 5 ml of well mixed sample in a test tube.

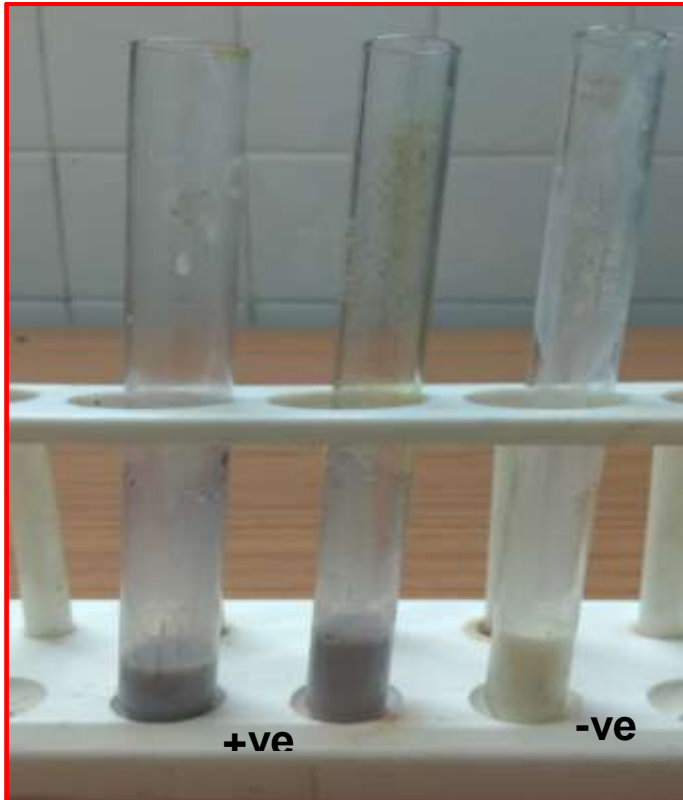


Plate no. 6. Determination of Starch

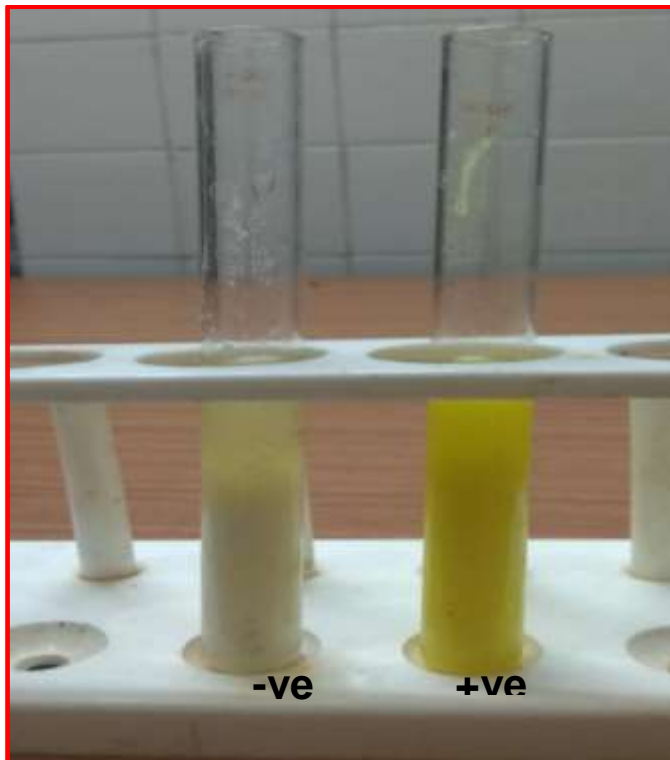


Plate no. 7. Determination of Urea

2. Added 5 ml of 1.6% Para-dimethyl aminobenzaldehyde solution.
3. Mixed well and observed the colour.
4. Development of intense yellow colour indicated presence of urea.

5. Sodium chloride

The test for detection of adulteration of milk with sodium chloride was carried out by the standard procedure described in BIS Handbook of food Analysis in sp 18 (Part XI) 1981.

Procedure:

1. Taken 5 ml of 0.134 per cent silver nitrate solution in a test tube.
2. Added 1 drop of 10 per cent potassium chromate solution.
3. Added 1 ml of milk.
4. Mixed well and observed the colour.
5. Development of yellow colour indicated presence of sodium chloride.

6. Skim Milk Powder:

The test for detection of adulteration of milk with skim milk powder was determined according to the method as reported by Khaskheli (2010).

Procedure:

1. Taken 5 ml raw milk sample as collected from various sources in a glass tube.
2. Added conc. Nitric acid (10 drops) drop by drop in the test tube.
3. Development of orange colour in milk was presumed positive and the yellow colour for negative.

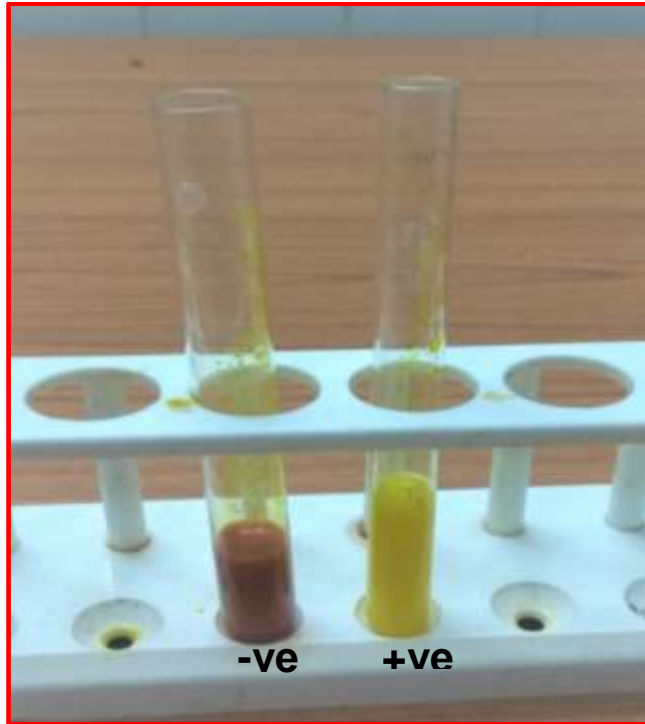


Plate no. 8. Determination of Sodium chloride (Salt)

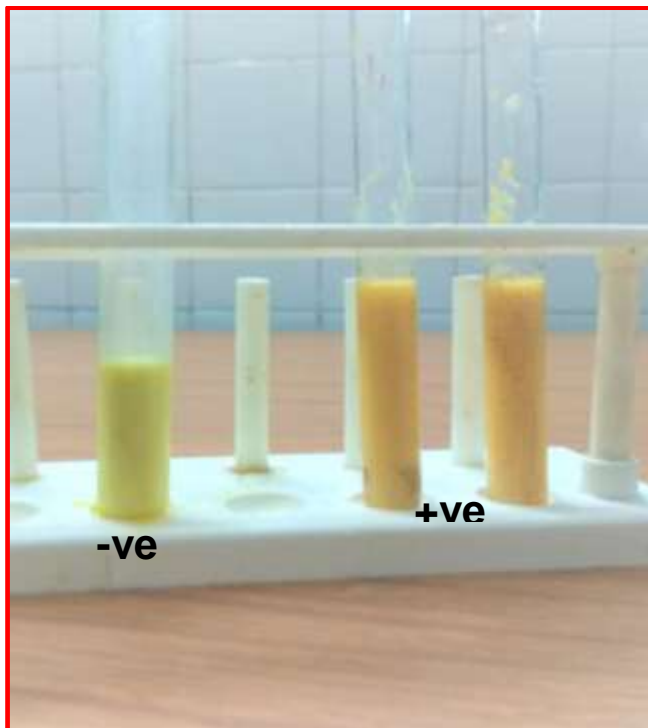


Plate no. 9. Determination of Skim milk powder

3.3.3 Sale price of milk:

1. The study was carried by collecting raw milk samples randomly from various sources such as milk producers, milk vendors, hotel and restaurants, and co-operative societies on Wardha city.
2. Twenty milk samples from each sources was collected and analyzed to determine the sale price of milk from the milk producers, milk vendors, owner of hotel and restaurants and of co-operative societies.
3. The samples were categorized according to their prices for various sources of milk.

3.4 Statistical methods

Standard tabular method was used for analyzing the data.

3.5 Place / Time and Duration of Experiments

1. The experiments were undertaken at the Section of Animal Husbandry and Dairy Science, College of Agriculture Nagpur, during Dec. 2017 – May 2018.
2. The milk samples were collected from various sources of milk procurement from Wardha city.

Chapter IV

RESULTS AND DISCUSSION

The present study entitled “Quality of milk sold in Wardha city” was analyzed for physico-chemical quality and adulteration in milk sold by various sources such as milk producers, milk vendors, hotel and restaurants and co-operative societies. The results obtained during this investigation are presented in this chapter.

4.1. Physico-chemical quality of milk

4.1.1 Specific gravity of milk

4.1.2 Fat

4.1.3 Solids-not-fat (SNF)

4.1.4 Acidity

4.2 Detection of adulteration of milk

4.3 Sale price of milk

4.1 Physico-chemical quality of milk

For determining the physico-chemical quality of milk, four different tests were conducted. The results of each test have been tabulated and discussed under the following sub heads.

4.1.1 Specific gravity

The results pertaining to the specific gravity of various sources such as milk producers, milk vendors, hotel and restaurants and co-operative societies sold in Wardha city has been presented in Table 1 and graphically depicted in Fig. 1.

Table 1: Quality of milk in respect of specific gravity from different levels of milk procurement

Sr. No.	Sources of milk sample collection	No. of samples analyzed	No. of milk samples in each group		
			Groups of specific gravity levels		
			Below 1.028	1.028 to 1.030	Above 1.030
1	Milk producers	20	03 (15.00)	13 (65.00)	04 (20.00)
2	Milk vendors	20	12 (60.00)	08 (40.00)	00 (00.00)
3	Hotel and restaurants	20	11 (55.00)	08 (40.00)	01 (5.00)
4	Co-operative societies	20	08 (40.00)	11 (55.00)	01 (05.00)
5	Total	80 (100.00)	34 (42.50)	40 (50.00)	06 (7.50)

(Figures in parenthesis indicate percentage)

The raw milk samples were analyzed to determine the specific gravity of milk and the results are depicted in Table 1 and Fig 1. From the table it can be seen that the per cent milk samples showing specific gravity level below 1.028 were found highest in milk vendors (60.00%) and followed by hotel and restaurants (55.00%) and co-operative societies (40.00%). The lowest number of milk samples for specific gravity level below 1.028 were found in milk producers (15.00%).

The per cent of milk samples showing specific gravity level group of 1.028 to 1.030 were found highest in milk producers (65.00%) followed by co-operative societies (55.00%). The lowest number of milk samples for specific gravity level group of 1.028 to 1.030 were found in hotel and restaurants (40.00%) and milk vendors (40.00%).

However, in the last group *i.e.* per cent milk samples showing specific gravity level above 1.030 were found highest in milk producers (20.00%)

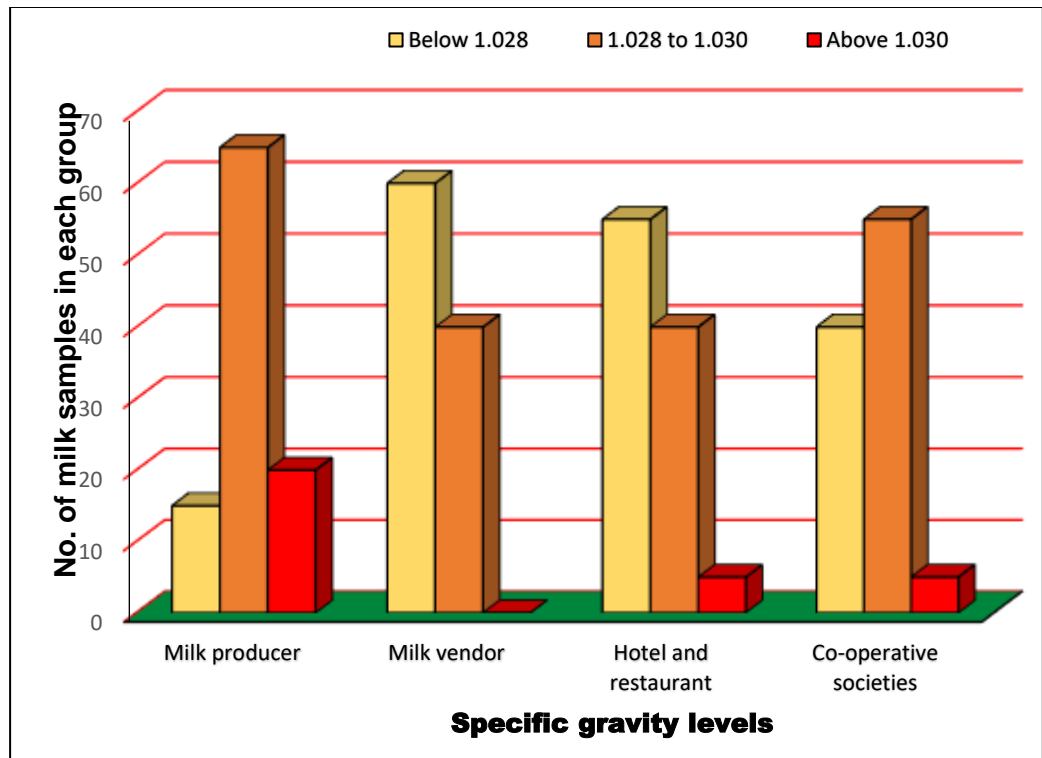


Fig. 1. Quality of milk in respect of specific gravity from different levels of milk

followed by hotel and restaurants (05.00%) and co-operative societies (05.00%).

The highest per cent of milk samples for specific gravity level below 1.028 were found in milk vendors (60.00%) which are not satisfying prescribed legal standard. It was also found that the specific gravity of milk decreased slightly with increasing temperature.

The observations indicated that milk vendors adulterated milk with water for increasing the quantity of milk and took advantage due to non-conduction facility of milk testing at co-operative society level. The standards prescribed for specific gravity of cow milk and buffalo in India by FSSAI (2006) *i.e.* 1.028 to 1.030 and 1.030 to 1.032 respectively. The increase in the specific gravity level above the prescribed recommended legal limit for cow milk *i.e.* 1.030 indicated that cow milk adulterated with other adulterants like sugar, urea etc. may be added into the cow milk for increasing the specific gravity *i.e.* lactometer reading of the milk samples. However, the variation in the specific gravity of milk samples of milk producers indicated that some animals may be producing milk containing lower SNF due to inadequate feeding.

Thus, it is revealed from the data in Table 1 that, out of total 80 samples tested during the investigation, 42.50 % samples showed specific gravity below 1.028, 50.00 % samples showed specific gravity between 1.0280 to 1.0300 and 7.50 % samples showed specific gravity above 1.030.

In accordance with the results obtained by Kolhe *et al.* (2003) concluded that the specific gravity ranged between 1.023 to 1.031. Likewise Mayuri (2015) also reported that the highest per cent of milk samples for specific gravity level below 1.028 in milk vendors (75.00%), the lowest per cent of milk samples for specific gravity level below 1.028 were found in private dairy (50.00%). Further Bhutekar *et al.*

(2016) reported that most of the samples from private dairy (60.00%) showed specific gravity below 1.028 followed by milk vendors (45.00%) and also concluded that good quality samples were found in the milk samples of milk producers.

Shatabdi (2017) also reveals that the highest per cent of milk sample for specific gravity level below 1.028 found in private dairy milk i.e 70.00 % and the lowest per cent of milk samples for specific gravity level below 1.028 were found in milk producers (15.00%).

4.1.2 Fat

Milk samples collected from different sources are evaluated laboratory and results obtained from the samples for fat percent are listed below in Table 2. and graphically presented in Fig. 2.

Table 2: Quality with respect to fat content of milk from different levels of milk procurement

Sr. No.	Sources of milk sample collection	No. of samples analyzed	No. of milk samples in each group		
			Groups of fat levels (%)		
			Below 3.5	3.5 to 4.5	4.5 to 6.5
1	Milk producers	20	05 (25.00)	12 (60.00)	03 (15.00)
2	Milk vendors	20	09 (45.00)	11 (55.00)	00 (00.00)
3	Hotel and restaurants	20	13 (65.00)	06 (30.00)	01 (05.00)
4	Co-operative Societies	20	09 (45.00)	10 (50.00)	01 (05.00)
	Total	80 (100.00)	36 (45.00)	39 (48.75)	05 (06.25)

(Figures in parenthesis indicate percentage)

Results obtained from Table 2 and Fig.2 that per cent milk samples in the fat level group of below 3.5 per cent were found highest in hotel and restaurants (65.00%) followed by milk vendors (45.00%) and co-operative societies (45.00%) and lowest in milk producers (25.00%).

The per cent milk samples in the fat level group of 3.5 to 4.5 per cent were found highest in milk producers (60.00%) as compared to

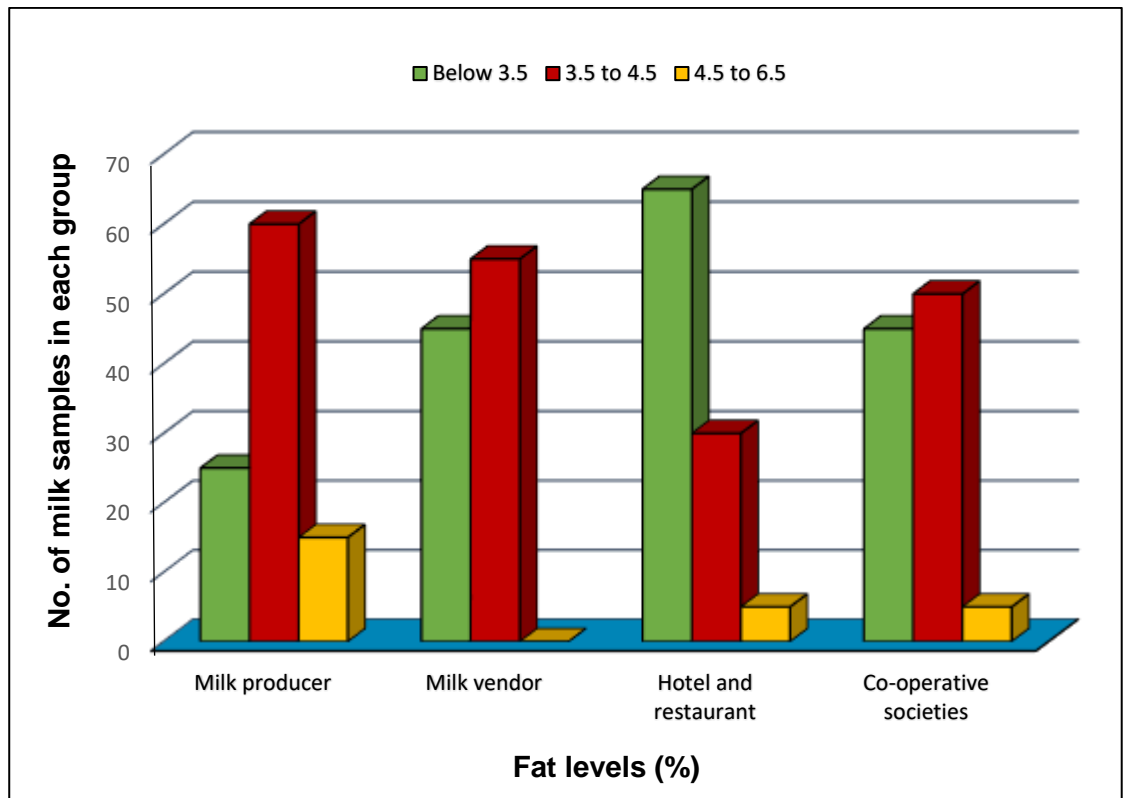


Fig 2. Quality of milk in respect of fat from different levels of milk

other sources viz., milk vendors (55.00%) and co-operative societies (50.00%). The lowest number of milk samples for fat level group of 3.5 to 4.5 per cent were found in hotel and restaurants (30.00%).

However, per cent milk samples showing fat level group of 4.6 to 5.5 were found highest in milk producers (15.00%) followed by hotel and restaurants (05.00%) and co-operative societies (05.00%).

By observing the Table 2 it is revealed that, the maximum milk samples were found in the fat between 3.5 to 4.5 per cent at each level of milk procurement except hotel and restaurants, in which maximum milk samples were found the fat below 3.5 per cent. This trend of results may be due to the tendency milk procurement agencies to adulterate the higher grade milk with water to increase the quantity of milk and to obtain more profit. According to FSSAI (2011), the recent acceptable level for fat of cow milk in Maharashtra is 3.5 percent.

Thus, it is revealed from the data in Table 2, that, out of total 80 samples tested during the investigation 45.00 % samples showed the fat level below 3.5 per cent, 48.75 % samples showed the fat level between 3.5 to 4.5 per cent and 6.25 % samples showed the fat level between 4.5 to 6.5 per cent. The highest per cent of milk samples for fat level group of 3.5 to 4.5 per cent were found in milk producers (60.00%) which is satisfying prescribed legal standard.

Above result are in agreement with the result of Menkudale *et al.* (2011) also reported that average fat per cent 4.68, 4.55 and 5.10 in dairy farm I, dairy farm II and dairy farm III. Likewise, Mayuri (2015) also found that average the fat per cent ranges 3.5 to 4.5 is highest in milk producers (55.00%) and lowest in private dairy (10.00%).

Likewise, Bhutekar *et al.* (2016) revealed that highest per cent of milk samples in group of 3.5 to 4.5 per cent were found in organized dairy (45.00%) and the lowest per cent found in private dairy (15.00). Shatabdi (2017) also found that average the fat per cent ranges 3.5 to

4.5 is highest in milk producers (55.00%) and lowest in private dairy (35.00%).

4.1.3 Solids not fat

The quality evaluation in respect of solids not fat content of milk samples collected from different sources of its procurement was performed and results of per cent milk samples falling in different groups of SNF levels are tabulated in Table 3 and graphically depicted in Fig. 3.

Table 3: Quality with respect to solids not fat (SNF) content of milk from different levels of milk procurement.

Sr. No.	Sources of milk sample collection	No. of samples analyzed	No. of Milk samples in each group		
			Groups of SNF levels (Per cent)		
			Below 8.5	8.5 to 9	Above 9
1	Milk producers	20	04 (20.00)	14 (70.00)	02 (10.00)
2	Milk vendors	20	11 (55.00)	09 (45.00)	00 (00.00)
3	Hotel and restaurants	20	09 (45.00)	10 (50.00)	01 (05.00)
4	Co-operative Societies	20	09 (45.00)	11 (55.00)	00 (00.00)
5	Total	80 (100.00)	33.00 (41.25)	44 (55.00)	03 (03.75)

(Figures in parenthesis indicate percentage)

The above table shows that the per cent milk samples showing SNF level group of below 8.5 per cent were found highest in milk vendors (55.00%) followed by hotel and restaurants (45.00%) and co-operative societies (45.00%) and lowest in milk producers (20.00%). In the SNF

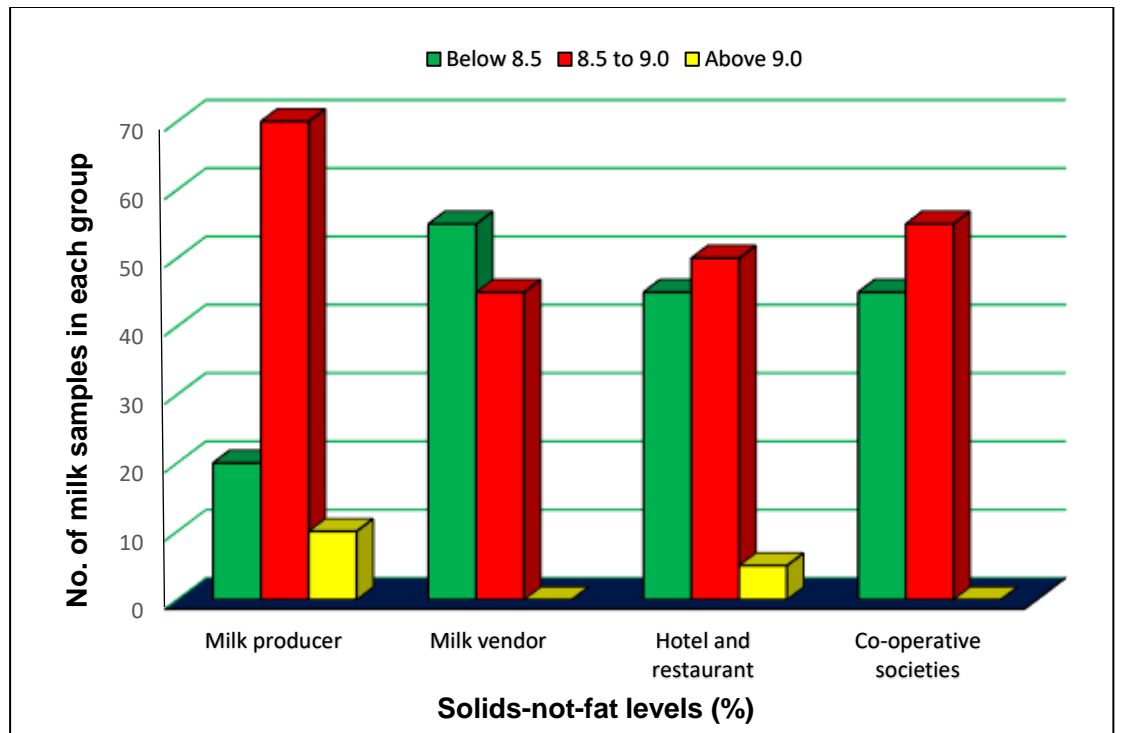


Fig 3. Quality of milk in respect of solids-not-fat from different levels of milk

level group of 8.5 to 9 per cent, milk samples were found highest in milk producers (70.00%) followed by co-operative societies (55.00%) and hotel and restaurants (50.00%) and lowest in milk vendors (45.00%)

However, in the last group *i.e.* per cent milk samples showing SNF level above 9 per cent were only found highest in milk producers (10.00%) followed by hotel and restaurants (05.00%). No other sample except milk producers and hotel and restaurants possess per cent SNF level above 9 per cent. According to FSSAI (2011), the cow milk in Maharashtra should contain minimum of 8.5 to 9.0 per cent solids-not-fat. Among the various sources of milk samples procurement, milk vendors showed the maximum samples below the 8.5 per cent. While, hotel and restaurants, co-operative societies and milk producers showed minimum milk samples below the recommended SNF content of 8.5 per cent.

Thus, it is revealed from the data in Table 3 that, out of 80 samples tested during the investigation, 41.25 % samples showed SNF content below 8.5 per cent, 55.00 % samples showed SNF content between 8.5 to 9.0 per cent and only 3.75 % samples showed the SNF content above 9.0 per cent. The highest per cent of milk sample for SNF level group of 8.5 to 9.0 were found in milk producers (70.00%), which are satisfying prescribed legal standard.

The results of the present study are similar to the results reported by Singh and Singh (2008). They reported that the milk samples collected from milk producers had the highest SNF percentage (9.58%) and lowest SNF per cent found in samples from organized dairy (7.59 per cent). Solids-not-fat increases the specific gravity of milk.

More or less similar results were inferred by Jadhao (2012). He reported that highest samples contain SNF in the range between 8.5 to

8.99 (68.00%) and lowest samples contain SNF range between 9.0 to 9.49 (14.00%). Mayuri (2015) also revealed that the highest per cent of milk samples for SNF level group of above 8.5 per cent were found in milk producers (45.00%), which were satisfying prescribed legal standard. Furthermore, Bhutekar *et al.* (2016) observed that the highest per cent of milk samples showing the SNF level group of above 8.5 per cent were found in milk producers (45.00%) and the lowest per cent were found in private dairy (15.00%)

4.1.4 Acidity

The quality evaluation in respect of solids not fat content of milk samples collected from different sources of its procurement was performed and results of per cent milk samples falling in different groups of acidity levels are tabulated in Table 4 and graphically depicted in Fig. 4.

Table 4: Quality with respect to acidity content of milk from different levels of milk procurement.

Sr. No.	Sources of milk sample collection	No. of samples analyzed	No. of Milk samples in each group		
			Groups of acidity levels (Per cent)		
			0.13 to 0.14	0.14 to 0.15	Above 0.15
1	Milk producers	20	11 (55.00)	09 (45.00)	00 (00.00)
2	Milk vendors	20	09 (45.00)	10 (50.00)	01 (05.00)
3	Hotel and restaurants	20	08 (40.00)	11 (55.00)	01 (05.00)
4	Co-operative Societies	20	10 (50.00)	09 (45.00)	01 (05.00)
5	Total	80 (100.00)	38.00 (47.50)	39 (48.75)	03 (03.75)

(Figures in parenthesis indicate percentage)

From the above given table 4 the result reveals that the per cent milk samples showing acidity levels 0.13 to 0.14 per cent where found highest in milk producers (55.00%) followed by co-operative societies

(50.00%), milk vendors (45.00%) and lowest acidity percentage found in the milk samples of hotel and restaurants(40.00%).

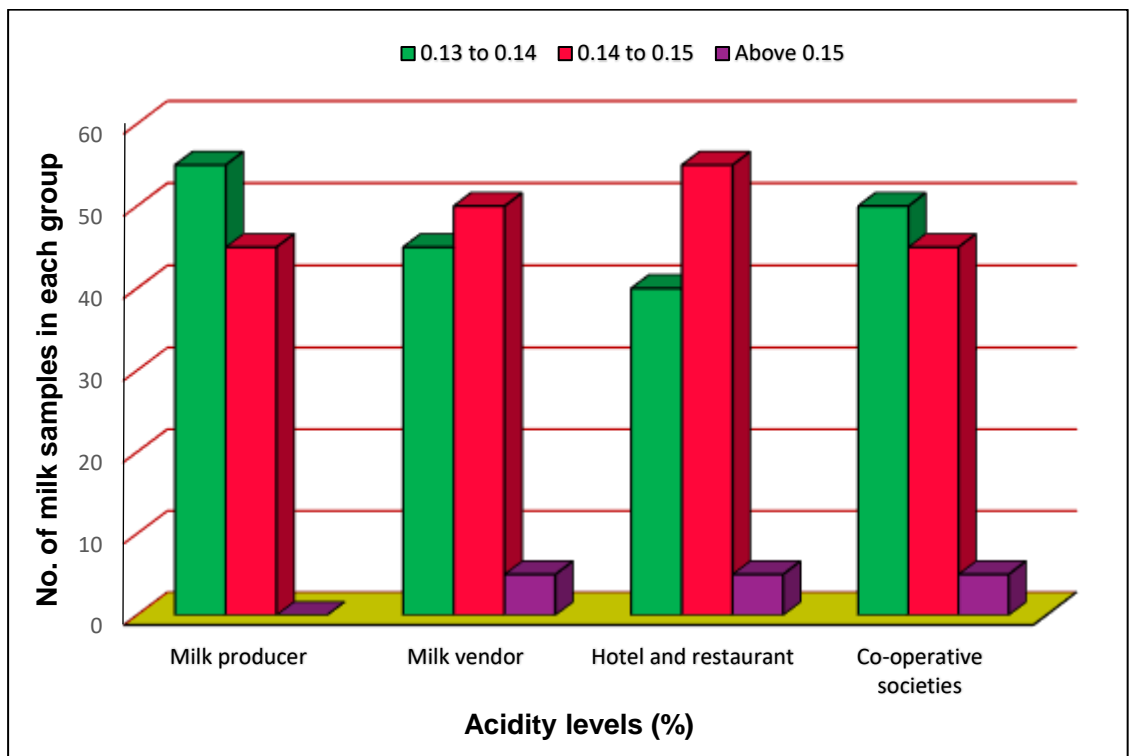


Fig 4. Quality of milk in respect of acidity from different levels of milk

In the acidity levels between 0.14 to 0.15 per cent, the milk samples found highest in hotel and restaurants (55.00%) followed by milk vendors (50.00%). Lowest in the sample from milk producers (45.00%) and co-operative societies (45.00%). However in the last group *viz.*, the samples showing acidity level above 0.15 per cent were found same in milk vendors, hotel and restaurants and co-operative societies (05.00%) whereas, milk producers samples not show acidity in this level.

Thus, on the basis of the data in Table 4 observed that, out of 80 samples tested during the investigation, 47.50 % samples showed acidity percentage level between 0.13 to 0.14 per cent, 48.75 % samples showed acidity percentage between 0.14 to 0.15 per cent and only 3.75 % samples showed the acidity percentage above 0.15 per cent.

The results of the present study were similar to results reported by Shatabdi (2017) inferred that the per cent milk samples showing acidity levels below 0.15 per cent where found highest in co-operative societies (55.00%) followed by milk producers (50.00%), hotel and restaurants (45.00%) and milk vendors and lowest acidity percentage found in the milk samples of private dairy (35.00%).

Wankhede (2017) found that per cent milk samples in the acidity level group of below 0.15 per cent were found highest in private dairy (65.00%) followed by Co-operative societies (60.00%) hotel and restaurants (50.00%) milk vendors (40.00%). The lowest number of milk samples for acidity level group of below 0.15 per cent were found in milk producers (35.00%).

On contrary Bashir *et al.* (2013) recorded that the acidity of milk was recorded as 0.18 per cent in house hold milk, 0.21 for milkman

and 0.19 in restaurant milk. Singulurai and Sukumaran (2014) revealed that all the samples collected for the test showed positive for acidity.

4.2 Detection of adulteration in milk

The quality evaluation in respect of adulteration tests of milk samples collected from different sources of its procurement was performed and results of per cent of milk samples falling in different groups of adulterants are tabulated in Table 5.

Table 5. Quality with respect to adulteration tests of milk from different sources of procurement.

Sr. No.	Sources of milk sample collection	No. of samples analyzed	Adulteration in milk					
			Cane sugar	Sodium bicarbonate	Starch	Urea	Salt	Skim milk powder
1	Milk producers	20	-	-	-	-	-	-
2	Milk vendors	20	-	-	-	-	-	-
3	Private dairy	20	-	-	-	-	-	-
4	Hotel and restaurants	20	-	-	-	-	-	-
5	Co-operative Societies	20	-	-	-	-	-	-

The presence of added water in milk detected by use of lactometer. Since the water is lighter than milk, its addition would lower the specific gravity of milk and so low lactometer reading.

It was a good report for people of Wardha city that nobody added cane sugar, urea, starch, sodium bicarbonate and salt in their milk supply, except that they are adulterating milk with water.

As indicated by specific gravity, the highest per cent of milk samples adulterated with water were found in milk vendors (60.00%) followed by hotel and restaurants (55.00%) and co-operative societies (40.00%). The lowest per cent of milk samples adulterated with water were found in milk producers (15.00%).

Similar results were reported by Singh and Singh (2008) in Sikohabad town and reported that nobody added sugar, urea, starch and salt in milk, except that they are adulterating milk with water other than milk producers. Likewise, Mayuri (2015), Bhutekar *et al.*(2016), Shatabdi (2017) and Wankhede (2017) also observed the same results.

4.3 Sale price of milk

The sale price of milk considered by contacting with selected respondent from different sources *viz.*, milk producers, milk vendors, hotel and restaurants and co-operative societies and the results regarding sale price of milk are furnished in Table 6 and graphically depicted in fig. 5

Table 6: Quality with respect to Sale price of milk from different levels of milk procurement.

Sr. No	Sources of milk sample collection	No. of samples analyzed	Price of milk in each group per litre		
			Groups of milk types (Rs.)		
			Below 30	30 to 35	Above 35
1	Milk producers	20	14 (70.00)	04 (20.00)	02 (10.00)
2	Milk vendors	20	03 (15.00)	13 (65.00)	04 (20.00)

3	Hotel and restaurants	20	05 (25.00)	11 (55.00)	04 (20.00)
4	Co-operative Societies	20	12 (60.00)	05 (25.00)	03 (15.00)
5	Total	80 (100.00)	34 (42.50)	33 (41.25)	13 (16.25)

(Figures in parenthesis indicates percentage)

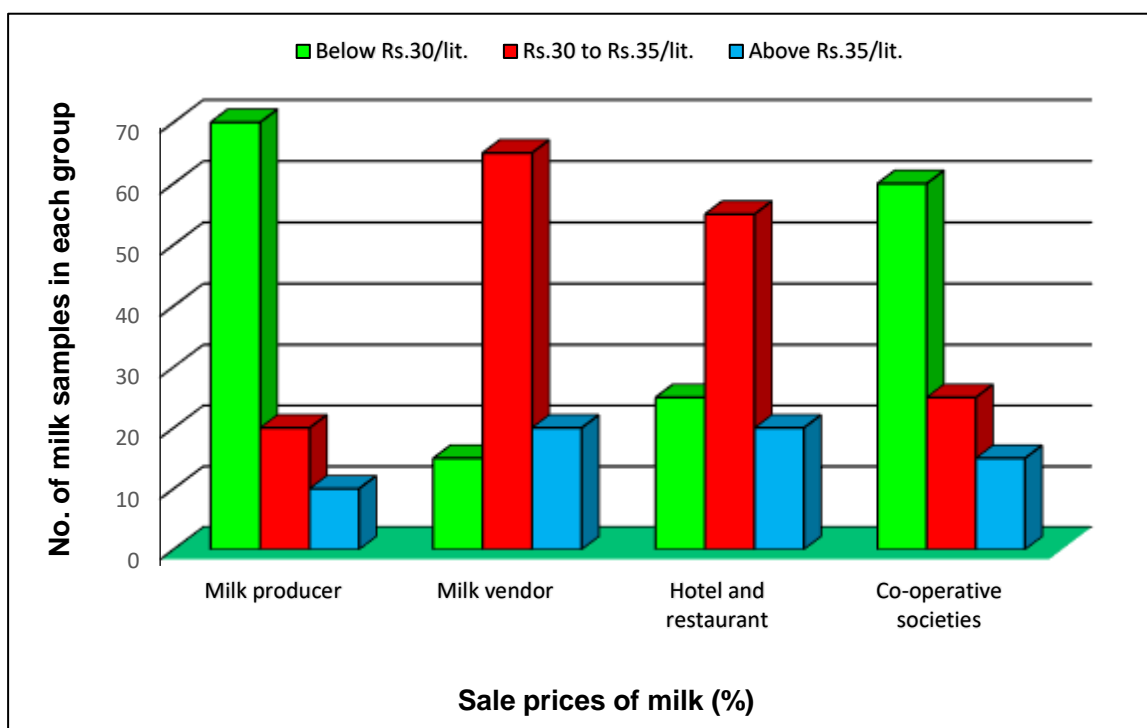


Fig 5. Quality of milk in respect with different sale prices levels of milk

It is inferred from Table 6 and Fig.5 that per cent milk samples in the sale price group of below Rs. 30/lit. were found highest in milk producers (70.00%) as compared to other sources *viz.*, co-operative societies (60.00%), hotel and restaurants (25.00%). The lowest number of milk samples for sale price level group of below Rs. 30/lit. were found in milk vendors (15.00%).

The per cent milk samples in the sale price level group of Rs.30 to Rs.35/lit. were found highest in milk vendors (65.00%) as compared to other sources *viz.*, hotel and restaurants (55.00%) and co-operative societies (25.00%).The lowest number of milk samples for sale price level group of Rs. 30/lit. to Rs. 35/lit were found in milk producers (20.00%).

However, in the last group *i.e.* per cent milk samples showing sale price level group of above Rs. 35/lit. were found highest in milk vendors and hotel and restaurants (20.00%), followed by co-operative societies (15.00%) and the lowest number of milk samples for sale price found in milk producers (10.00%).

It was observed from the Table 6 that, the maximum milk samples were accounted for the sale price level in group below Rs. 30/lit.

Basically the sale price of milk is depends on the fat content of milk but from the present study it can be seen that milk producers get lowest price as compare to other milk sellers *viz.* milk vendors and hotel and restaurants.

The findings of the present study were found to be more or less similar with the findings of Sujatha *et al.* (2015) who observed that overall producers net price was Rs. 32.16/ lit. and overall purchase of consumer was Rs. 40.10/lit. The results obtained in the present study are comparable with results reported by Rajeshwaran and Naik (2016). They reported that the consumer price of standardized milk in various parts of the country varies from Rs. 37 to Rs. 49 per litre and also revealed that the prices of milk are increasing day by day.

Jadhav (2016) reported that the price of raw cow milk was Rs. 35/lit. at dairy farm, Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur and Priyanka (2016) also reported the same results.

Shatabdi (2017) concluded that sale price is based on fat content of milk and increased from a point of procurement of milk to another point *viz.*, milk producers (above Rs. 40/lit.) to the private dairy (below Rs. 35/lit.).

Chapter V

SUMMARY AND CONCLUSIONS

The present investigation entitled “Quality of milk sold in Wardha city” was undertaken to investigate the physico-chemical quality of milk and adulteration in milk by various tests.

The milk samples were collected aseptically for the investigation from four different sources of milk procurement viz., milk producers, milk vendors, hotel and restaurants and co-operative societies. Eighty collected samples from Wardha city were analyzed for various physio-chemical quality and detection of adulteration in milk.

Results obtained in the present investigation were summarize and conclude in this chapter.

5.1 Physico-chemical quality of milk

5.1.1 Specific gravity

Result obtained from the total 80 samples tested during the investigation, 42.50% samples showed specific gravity below 1.028, 50.00 % samples showed specific gravity between 1.028 to 1.030 and 7.50 % samples showed specific gravity above 1.030.

The highest per cent of milk samples for specific gravity level below 1.028 were found in milk vendors (60.00%), the lowest per cent of milk samples for specific gravity level below 1.028 were found in milk producers (15.00%).

The highest per cent of milk sample for specific gravity level 1.028 to 1.030 were found in cow milk of milk producers (65.00%) which are satisfying prescribed legal standard.

5.1.2 Fat

Out of total 80 samples tested during the investigation 45.00% samples showed the fat level below 3.5 per cent, 48.75% samples showed the fat level between 3.5 to 4.5 per cent and only 6.25% samples showed the fat level above 4.5 per cent. The highest per cent of milk samples for fat level group of 3.5 to 4.5 were found in milk producers (60.00%) which were satisfying prescribed legal standard.

5.1.3 SNF (Solids-not-fat)

Result obtained from the total 80 samples tested during the investigation, 41.25% samples showed SNF content below 8.5 per cent, 55.00% samples showed SNF content between 8.5 to 9.00 per cent, only 3.75% samples showed the SNF content between above 9.00 per cent.

The highest per cent of milk sample for SNF level group between 8.5 to 9 were found in milk producers (70.00%), which are satisfying prescribed legal standard.

5.1.4 Acidity

Out of 80 samples tested during the investigation, 47.50% samples showed acidity percentage 0.13 to 0.14 per cent, 48.75% samples showed acidity percentage between 0.14 to 0.15, only 3.75% samples showed the acidity percentage above 0.15 per cent.

The highest per cent of milk sample for acidity level group between per cent 0.14 to 0.15 were found in hotel and restaurants (55.00%), which are satisfying prescribed legal standard.

5.2 Detection of adulteration in milk.

The milk is adulterated by various adulterants which deteriorate the quality of milk with the view of human health. Water is widely used as an adulterant in the milk than other adulterants. It is better report for human health of Wardha citizen that nobody added cane sugar, urea, starch, sodium bicarbonate, salt and skim milk powder in their milk supply from various sources.

Among the various sources of milk sample procurement, the milk vendors (60%) showed the maximum samples adulterated with water.

5.3 Sale price of milk

The sale price of milk considered by contacting with selected respondent from different sources viz., milk producers, milk vendors, hotel and restaurants and co-operative societies.

Out of total 80 samples tested during the investigation 42.50% samples showed the sale price level below Rs. 30/lit., 41.25% samples showed the sale price level between Rs. 30 to Rs. 35/lit. and only 16.25% samples showed the sale price level above Rs. 35/lit. The highest per cent of milk samples for sale price level group below Rs. 30/lit. were found in milk producers (70.00%).

Conclusions

Based on above investigations, it can be concluded that

1. The overall quality of milk samples as indicated by physico-chemical evaluation i.e. specific gravity, fat, SNF and acidity content were satisfying prescribed legal standard collected from milk producers in Wardha city. Other sources like milk vendors, hotel and restaurants and co-operative societies were either adulterating or not standardizing milk accurately.

2. The maximum adulteration with water were found in milk vendors (60.00%) followed by hotel and restaurants (55.00%) and co-operative societies (40.00%). The lowest per cent of milk samples adulterated with water were found in milk producers (15.00%).
3. The specific method of various sources for adulteration of milk by addition of little quantity of water for increase volume of milk. It is worthy to mention that they are not using different adulterants like cane sugar, sodium bicarbonate, starch, urea, salt and skim milk powder.

It is therefore suggested that consumers of Wardha city should collect milk directly from milk producers and dairy plants take adequate precautions to ensure supply of milk meeting legal standard.

Chapter VI

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