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Physico-chemical quality and incidence of adulteration in paneer sold in Wardha city

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Abstract
In all 60 samples of paneer were examined during the course of investigation which were collected from different regions *viz*., east, west, north and south region of Wardha city from each region, 15 samples were collected and analyzed during three fortnights. These paneer samples were collected by adopting stratified randomization technique and analyzed them for their physico-chemical quality and adulteration in paneer at Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur during year 2021-2022. Chemical quality and possible adulteration was analyzed in laboratory by legal method prescribed in ISI Hand book and FSSAI Hand book. East (T_1), west (T_2), north (T_3) and south (T_4) region paneer samples contained on an average moisture 52.32, 53.27, 50.85 and 53.82 percent, fat 23.12, 25.95, 24.03 and 24.54 percent, protein 20.46, 18.61, 18.32 and 19.70 percent, ash 1.76, 1.68, 1.77 and 1.62 percent, total solids 47.62, 46.72, 49.16, 46.17 percent, respectively. During present study, it was found that paneer marketed in North region had better physico-chemical qualities than east, west and south paneer, which were fair but fullfill standards of FSSAI (2006). Adulteration of starch was more or less found in all regions paneer samples. However, south and north region paneer gives lowest adulteration percentage. Whereas, adulteration of coal tar dyes was found in east, west and north regions. However, south region paneer gives negative test for coal tar dyes. Hence, south region paneer found superior over other in respect to starch and coal tar dyes adulteration.

Keywords: Paneer, cottage cheese, chemical quality, adulteration, starch and coal tar dyes

Introduction
Paneer is a heat-acid coagulated milk product obtained by coagulating standardized milk with the permitted acids at specified temperature. The resultant coagulum is filtered and pressed to get the sliceable curd mass. Paneer has a firm, close, cohesive and spongy body and smooth texture. It is mainly prepared from buffalo milk and used for large number of culinary dishes. According to Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), milk production was 209.96 million tons (MT) during 2020-21 against 198.44 MT in 2019-20. India accounted for 21 percent of the global output (Anonymous, 2022) [2].

Paneer means the product obtained from the cow or buffalo milk or a combination there of by precipitation with sour milk, lactic acid, or citric acid. It shall not contain more than 70% moisture and milk fat content shall not be less than 50% of the dry matter. Milk solids may also be used in the preparation of paneer. Low fat paneer shall contain not more than 70% moisture and not more than 15% milk fat on dry matter basis. Microbial standards suggested by (Food Safety and Standard Regulation Act) FSSR-2011 and BIS though originally it was localized in Northern part of India but now it is preferred almost all parts of the country. Paneer is generally sold as blocks or slices, it is also referred as Indian fresh cheese. It is reported that about 5% of the milk produced in India is converted into paneer and paneer production is growing annually at the rate of 13% (Anonymous, 2012) [3].

As paneer has high nutritive value it has been largely adulterated with starch, coal tar etc. for more profit. Starch is added to make up the density of milk and milk products, it gives thick, rich texture. Consumption of high amount of starch causes diarrhoea due to the adverse effects of undigested starch in the colon. (Reddy *et al*., 2017) [15]. Coal tar dyes are generally formed as a by-product of hydrocarbon solvents. They are used to dilute bituminous coal – a form of coal that is often used in the steel-making process. When the coal is diluted with these hydrocarbon solvents, it produces a variety of colors. Coal tar dyes are known to contain small amounts of other heavy metals additives (such as aluminum). Ingesting them over a continuous amount of time can potentially cause brain damage or speed up the progression of

brain diseases like Alzheimer's (Backe, 2018) [9].

The broad consumption of milk and dairy products makes these foodstuffs targets for potential adulteration with financial gains for devious producers (Nicolaou *et al*., 2011) [14]. Keeping these in mind, paneer focused on adulteration of paneer sold in Wardha city.

Materials and Methods

The present investigation on evaluating physico-chemical qualities and to detect adulteration in paneer samples was carried out in the laboratory of Animal Husbandry and Dairy Science section, College of Agriculture, Nagpur during year 2021-2022. In all 60 samples of paneer were examined during the course of investigation which were collected from different regions *viz*., east, west, north and south region. From each region, 15 samples were collected and analyzed during three fortnights. These paneer samples were collected by adopting stratified randomization technique

Compositional analysis of paneer samples

The collected market paneer samples were subjected to the chemical analysis for moisture, fat, protein, ash, total solids.

Determination of Moisture

Moisture content of paneer samples were determined as per procedure prescribed in ISI Hand book of SP: 18 (Part XI):1981 [8].

Determination of Fat

Fat content of paneer was determined by the Soxhlet's extraction method as per procedure describe in A.O.A.C. (1990) [5].

Determination of Protein

Protein content of paneer samples were determined by micro Kjeldahal method as recommended in IS: 1165 (1967) [7].

Determination of Ash

The ash percent was determined by the method recommended in B.I.S Handbook of food analysis IS: 1165 (1967) [7].

Determination of total solids

Total solids content of paneer samples were determined by subtracting the moisture content in the samples as per the procedure given by SP: 18 (Part XI): 1981 [8].

Tests for detection of adulteration

Market samples of paneer were subjected to detection of starch and coal tar dyes.

Starch

Market paneer samples were tested for adulteration of starch. Starch was detected according to the method given in IS-1479 Part I (1960) [6].

Coal tar dyes

Market samples were tested for adulteration of coal tar dyes. Coal tar dyes was detected according to the method given by FSSAI.

Results and Discussion

The physico-chemical properties of paneer was initially good during production time and it will gradually deteriorate during storage and marketing. The data of physico-chemical quality presented in Table 1. Result with regard to adulteration of paneer sold in Wardha city and their respective sale price according to different zones are given in Table 2. and discussed below.

Physico- chemical analysis

Table 1: Average Chemical Composition of paneer sold in Wardha city

Sr. No.	Region	Chemical Composition				
		Moisture	Fat	Protein	Ash	T. S
1	East	53.32	23.12	20.46	1.76	47.62
2	West	53.27	25.95	18.61	1.68	46.72
3	North	50.85	24.03	18.32	1.77	49.16
4	South	53.82	24.54	19.70	1.62	46.17
SE(m) ±		0.84	0.67	0.95	0.01	0.78
C.D at 5%		1.73	1.54	--	--	1.66

Moisture

Result with regards to chemical quality of paneer sold in Wardha city. It is revealed from Table 1 that, the average moisture content of paneer sold in Wardha city ranged from 50.85 to 53.82 percent. The average values of moisture content of paneer samples sold in east, west, north and south region recorded as 52.32, 53.27, 50.85 and 53.82 percent, respectively. Moisture content of different sources showed significant differences. However, the maximum average moisture content recorded in south paneer and minimum in north paneer. North paneer was significantly superior over east, west and south in respect of moisture content. The moisture content of paneer was found to be in close agreement with the results reported by Bhandekar *et al*. (2018) [10] and Bhoyar *et al*. (2019) [11] found moisture content in paneer in the range of 50.53 to 54.49 in Nagpur and Gondia city. Similarly, Desale *et al.* (2009) [12] and Wangdare *et al*. (2017) [16] reported the moisture content of paneer samples were ranged from 38.51 to 67.00 percent in market of Ahmednagar and Bengaluru city.

Fat

The fat percentage of paneer sold in Wardha city ranged from 23.12 to 25.95 percent in which mean values of fat content of east, west, north and south regions paneer were recorded as 23.12, 25.95, 24.03 and 24.54 percent, respectively for this attributes. The maximum (25.95) fat content was recorded in west paneer collected samples followed by north (24.03), south (24.54).

More or less similar observations for fat percent in paneer were also recorded by, Bhandekar *et al.* (2018) [10], noticed fat percent varied from 20.81 to 27.50 percent in paneer samples collected from Nagpur city. Similarly, Desale *et al.* (2009) [12], noticed fat percent in paneer collected from Ahmednagar city varied from 16 to 28 percent. Wangdare *et al*. (2017) [16] reported the fat percent in paneer collected from Bengaluru city varied from 13.5 to 24 percent.

Protein

The mean values of protein content of paneer sold in east, west, north and south regions were recorded as 20.46, 18.61, 18.32 and 19.70 percent, respectively. The maximum (20.46) average protein content of market paneer recorded by east region paneer while minimum (18.32) protein content was

recorded by north region's paneer. East paneer samples found to be superior over west, south and north in respect of protein content. However, protein values of east and south paneer were more or less similar.

Desale *et al.* (2009) [12] noticed protein content ranged from 15.06 to 20.33 percent in Ahmednagar city. Wangdare *et al.* (2017) [16] reported protein content range from 18 to 23 percent. Bhandekar *et al.* (2018) [10] reported protein content in marketed paneer ranged from 16.73 to 19.41 percent of Nagpur city. Also, Bhoyar *et al.* (2019) [11] noticed fat percent in paneer marketed in Gondia city ranged from 23.99 to 25.93 percent.

Ash

The mean values of ash content of east, west, north and south regions paneer were recorded as 1.76, 1.68, 1.77 and 1.62 percent, respectively. These differences were found to be non-significant for ash content. However, the maximum (1.77) ash content was recorded in north paneer collected samples followed by west, south and east paneer.

The findings of present investigation are collaborative with the findings of Bhandekar *et al.* (2018) [10], who recorded overall ash percent in paneer ranged from 1.81 to 2.02 percent marketed in Nagpur city. Similarly, Bhoyar *et al.* (2019) [11], also reported ash percent in paneer varies from 1.56 to 1.73 percent marketed in Gondia city.

Total solids

The average total solids content of paneer sold in Wardha city ranged from 46.17 to 49.16 percent in which mean values of east, west, north and south region paneer contributed as 47.62, 46.72, 49.16 and 46.17, respectively for total solids content. These differences were found to be significant for total solids content, from above content it was noticed that, north region paneer recorded maximum (49.16%) followed by east, west and south region paneer. North paneer was significantly superior over east, west and south paneer in respect of total solids content.

Bhandekar *et al.* (2018) [10] also reported that total solid content in paneer ranged from 45.51 to 50.33 percent in Nagpur city. Likewise, Bhoyar *et al.* (2019) [11] recorded total solid content in paneer from Gondia city varies from 46.30 to 47.64 percent.

Detection of Adulteration

Table 2: Average percent adulteration in paneer samples sold in Wardha city

Sr. No.	Region	No. of sample taken	Test for starch			Test for tar dyes		
			+ (ve)	- (ve)	Percent adulteration	+ (ve)	- (ve)	Percent adulteration
1	East	15	5	10	33.33	2	13	13.33
2	West	15	4	11	26.66	2	13	13.33
3	North	15	2	13	13.33	1	14	6.67
4	South	15	2	13	13.33	0	15	0.00

Starch

When market paneer obtained from Wardha city was tested for starch. The iodine test was positive for east, west, north and south region paneer which was sold in Wardha city for 5, 4, 2 and 2 samples, respectively out of 15 samples. Bhoyar *et al.* (2019) [11] noticed that, very few samples of paneer adulterated with starch in Gondia city. On contrary, Abhiram and Radha (2015) [1] when conducted adulteration test to detect starch in paneer they did not find the adulterant in tested sample of paneer.

Coal tar dyes

When market paneer obtained from Wardha city tested for coal tar dyes. The test was negative for south paneer while positive for east, west and north region for 2, 2 and 1 samples of paneer out of 15.

Navale and Gupta (2016) [13], analyzed adulteration present in milk products. They noticed that various adulterants like starch and coal tar dyes present in paneer (cottage cheese).

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