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Original Research Article
Study the best performance of cow milking time and analyze the different chemical quality parameters

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ABSTRACT

A study was conducted to analyze the chemical qualities of raw cow milk at a mini dairy farm in Chitrakoot-Satna, Madhya Pradesh. The objective was to determine the compositional quality of cow's milk focusing on fat, protein, lactose, ash, water, specific gravity (sp. gr.), solid not fat (SNF), and total solids (T.S.) under the full-hand diagonal method of milking. Statistical analysis was performed using analysis of variance (F-test), a widely accepted method for assessing differences among groups. The protein content was determined using the Kjeldahl method for nitrogen determination, as nitrogen is a characteristic element of protein. The findings revealed that the morning milk (M1) exhibited the highest levels of protein (%), specific gravity (cc), fat (%), lactose (%), total solids (%), and solid not fat (SNF) (%). In contrast, it had the lowest levels of ash (%) and water (%). The evening milk (M3) and noon milk (M2) followed in terms of quality, but their values were generally lower compared to the morning milk.

Key Words: Dairy , Lactose , Milk , Protein , Raw , Specific ,

Introduction

Milk, a vital component of human nutrition, is the physiological secretion produced by the mammary glands of mammals. It encompasses essential nutrients including proteins, fats, peptides, amino acids, fatty acids, carbohydrates, vitamins, and minerals, all of which are necessary for a balanced and complete diet (Fox and Mc Sweeney, 1998; Nickerson, 1999; Kittivachra *et al.,* 2006).

The composition of milk and its standardization are essential processes to guarantee the quality of milk ingredients and have greatest importance for the dairy industries (Swensson and Lindmark- Mansson, 2007; Cetin and Ozcan, 2009).Milk is defined as the whole, fresh, clean, lacteal secretion obtained by complete milking of one or more healthy animals excluding that obtained within fifteen days before or five days after calving or such periods as may be necessary to render milk practically colostrums free and containing the minimum prescribed percentage of milk fat (3.5%) and solids not fat (8.5%) (Goff and Hill, 1993). Milk, if present in its natural

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form has high food value. It supplies nutrients like good quality proteins, fat, carbohydrate, vitamins and minerals in significant amount than any other single food (Neumann *et al*., 2002).

Milk fat is one of the principal milk solids. Its' content greatly changes throughout the lactation period and also within a single day. It is a rich source of the saturated fatty acids. Milk fat consists of triacylghycerol, phospholipids, non-esterifies fatty acids, and glycerol (Tousova *et al*., 2013).Milk is considered as a nearly complete food since it is good source for protein, fat and major minerals. Also milk and milk products are main constituents of the dairy diet, especially for vulnerable groups such as infants, school age children and old age. (Davies, *et al.,* 1996). Several studies have reported the distribution and occurrence of the essential components in various animal milks. (Kholif, Alamy, *et al.,* 1994, Abou-Arab, 1997).

Milk is used throughout the world as human food in at least one form or more. Because of its high nutritive value, milk is considered as one of the most important diet items of many people (Mehari, 1998). Nutritionally, Milk has been defined as "the most nearly perfect food." The demand of consumers for safe and high quality milk has placed a significant responsibility on dairy producers. Retailers and manufacture to produce and market safe milk and products (Adesiyun *et al*., 1995). The Livestock industry in developing countries like Tanzania faces a number of challenges including poor production due to poor animal husbandry, disease, and poor genetic potential as compensatory mechanisms; farms administer a number of veterinary drugs to live stock for prophylaxis and growth promoters. (A.A.S. Katakweba, *et al.,* 2012)

Milk is among the most perishable farm products and is highly susceptible to microbial growth. Fresh milk can quickly deteriorate, making it unsuitable for processing and consumption if not handled correctly. Improper handling can lead to milk contamination by microorganisms at any stage of production and consumption, making it a potential source of foodborne pathogens (Bereda *et al.,* 2012).

India is the largest producer of milk in the world, with an annual production exceeding 176 million tons. However, the future of the Indian dairy industry needs to be built upon sustainable practices to benefit our society (Shukla *et al.,* 2017).

MATERIALS AND METHODS

Collection of Raw Milk Samples -

Estimation of Protein:-

The most widely used method for determining protein content is by Kjeldahl method for nitrogen determination. Since nitrogen is a characteristic element in protein, by its accurate determination, protein concentration can be calculated. In 1883, Johann Kjeldahl developed the basic procedure to analyze organic nitrogen. The method involves two major steps. In the first step, the protein is digested using concentrated sulphuric acid in presence of a catalyst. In this step all the organic

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material is oxidized except nitrogen, the reduced form of which is retained in digest as ammonium sulphate. Neutral salts such as potassium sulphate are used in the digestion step to raise the boiling point of the reaction mixture and thereby effectively increase the digestion rate. Metallic catalyst such as copper sulfate is used to hasten the digestion and clearing the reaction mixture. The digest is neutralized with alkali to liberate ammonia.

In the second step, ammonia is distilled off, collected in boric acid and titrated with standard acid. Boric acid provides the most convenient absorbent for ammonia in that, the need for a standard alkali in titration is eliminated, and neither the amount nor the concentration of boric acid needs to be precise, since the boric acid itself is not involved in the titration, but simply reacts with the ammonia to form an ammonium borate complex. The strongly basic ammonium-borate that is formed is titrated directly with acid in the presence of a methyl red-bromocresol green indicator until the green distillate changes through colourless to pink.

Add to the clean and dry Kjeldahl flask, 5 – 10 boiling aids, 15 g K2SO4, 1.0 ml of the copper sulfate solution, approximately 5 ml of milk sample and add 25 ml of concentrated sulfuric acid. Use the 25 ml acid also to wash down any copper sulfate solution, K2SO4 or milk left on the neck of the flask. Gently mix the contents of the Kjeldahl flask. Turn on the fume extraction system of the digestion apparatus prior to beginning the digestion. Heat the Kjeldahl flask and its contents on the digestion apparatus using a heater setting low enough such that charred digest does not foam up the neck of the Kjeldahl flask. Digest at this heat-setting for at least 20 min or until white fumes appear in the flask. Increase the heater setting to half way to the and continue the heating period for 15 min. At the end of 15 min period, increase the heat to maximum. After the digest clears (clear with light blue-green colour), continue boiling for 1 h. to 1.5 h. at maximum setting. The total digestion time will be between 1.8 – 2.25 hourse.

At the end of digestion, the digest shall be clear and free of undigested material. Allow the acid digest to cool to room temperature over a period of approximately 25 min. If the flasks are left on hot burners to cool, it will take longer to reach room temperature. The cooled digest should be liquid or liquid with a few small crystals at the bottom of the flask at the end of 25 min cooling period. Do not leave the undiluted digest in the flask overnight. The undiluted digest feb. to march crystallize during this period and it will be very difficult to get that back into the solution to avoid this situation.

After the digest is cooled to room temperature, add 300 ml of water to 500 ml Kjeldahl flask or 400 ml of water when using 800 ml Kjeldahl flask. Use the water to wash down the neck of the flask too. Mix the contents thoroughly ensuring that any crystals which separate out are dissolved. Add 5 - 10 boiling aids. Allow the mixture to cool again to room temperature prior to the distillation. Diluted digests Feb. to march be stoppered and held for distillation at a later time.

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Titrate the boric acid receiving solution with standard hydrochloric acid solution (0.1 N) to the first trace of pink colour. Take the burette reading to at least the nearest 0.05 ml. A lighted stir plate feb. to march aid visualization of the end point.

$$Wn = \frac{1.4007 \times (Vs - VB) \times N}{W}$$

Where,

W_n = Nitrogen content of sample, expressed as a percentage by mass.

V_S = Volume in ml of the standard hydrochloric acid used for sample.

V_B = Volume in ml of the standard hydrochloric acid used for blank test.

N = Normality of the standard hydrochloric acid expressed to four decimal places.

W = Mass of test portion in g, expressed to nearest 0.1 mg.

Estimation of Specific Gravity:-

Measure 10 ml of sulphuric acid into a butyrometer tube, preferably by use of an automatic dispenser, without wetting the neck of the tube. Mix the milk sample gently but thoroughly and fill the milk pipette above the graduation line. Wipe the outside of the pipette and allow the milk level to fall so that the top of meniscus is level with the mark. Run the milk into the butyrometer tube along the side wall without wetting the neck, leave to drain for three seconds and touch the pipette's tip once against the base of the neck of the butyrometer tube. Add 1 ml of Amyl alcohol, close with a lock stopper, shake until homogeneous, inverting it for complete admixture of the acid. Keep in a water bath for 5 min. at 65±2°C taking care to have casein particles if any to dissolve fully, and centrifuge for 4 min. at 1100 rpm. The tubes should be put in centrifuge, so as to conform to radial symmetry, and as evenly spaced as possible, in order to protect bearings of the centrifuge. Allow the centrifuge to come to rest. Remove the butyrometer tubes and place in water bath for 5 min. at 65±2°C. Read the percentage of fat after adjusting the height in the tube as necessary by movements of the lock stopper with the key. Note the scale reading corresponding to the lowest point of the fat meniscus and the surface of separation of the fat and acid. When readings are being taken hold the butyrometer with the graduated portion vertical, keep the point being read in level with the eye, and then read the butyrometer to the nearest half of the smallest scale division.

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RESULT

Protein (%)

Table 1.0 and Fig. 1.0 furnish the data on Protein (%) in raw cow milk at three different milking times in ten replications. The results obtained showed that milking times M_1, M_2 and M_3registered mean Protein (%) as 4.03, 3.91 and 3.96, respectively, with overall mean of 3.97. The difference in these values due to milking times as well as due to replication, was significant , M_1 recorded maximum Protein (%)(4.03) followed by M_3 (3.96) while M_2 recorded the minimum (3.91).

Table 1.0 Protein (%) in Cow milk at different milking times

Replication		Milking time			Range		Mean
		M_1	M_2	M_3	Minimum	Maximum	
R_1		3.86	3.76	3.85	3.76	3.86	**3.82**
R_2		3.70	3.63	3.63	3.63	3.70	**3.65**
R_3		3.97	3.88	3.86	3.86	3.97	**3.90**
R_4		4.15	4.03	4.12	4.03	4.15	**4.10**
R_5		4.33	4.22	4.27	4.22	4.33	**4.27**
R_6		4.27	4.18	4.24	4.18	4.27	**4.23**
R_7		4.16	4.08	4.11	4.08	4.16	**4.12**
R_8		4.49	4.33	4.38	4.33	4.49	**4.40**
R_9		3.59	3.35	3.46	3.35	3.59	**3.47**
R_{10}		3.79	3.68	3.68	3.68	3.79	**3.72**
Range	Minimum	3.59	3.35	3.46			
	Maximum	4.49	4.33	4.38			
	Mean	**4.03**	**3.91**	**3.96**			**3.97**
					F- test		S
					S. Ed. (±)		0.01
					C. D. (P = 0.05)		0.03

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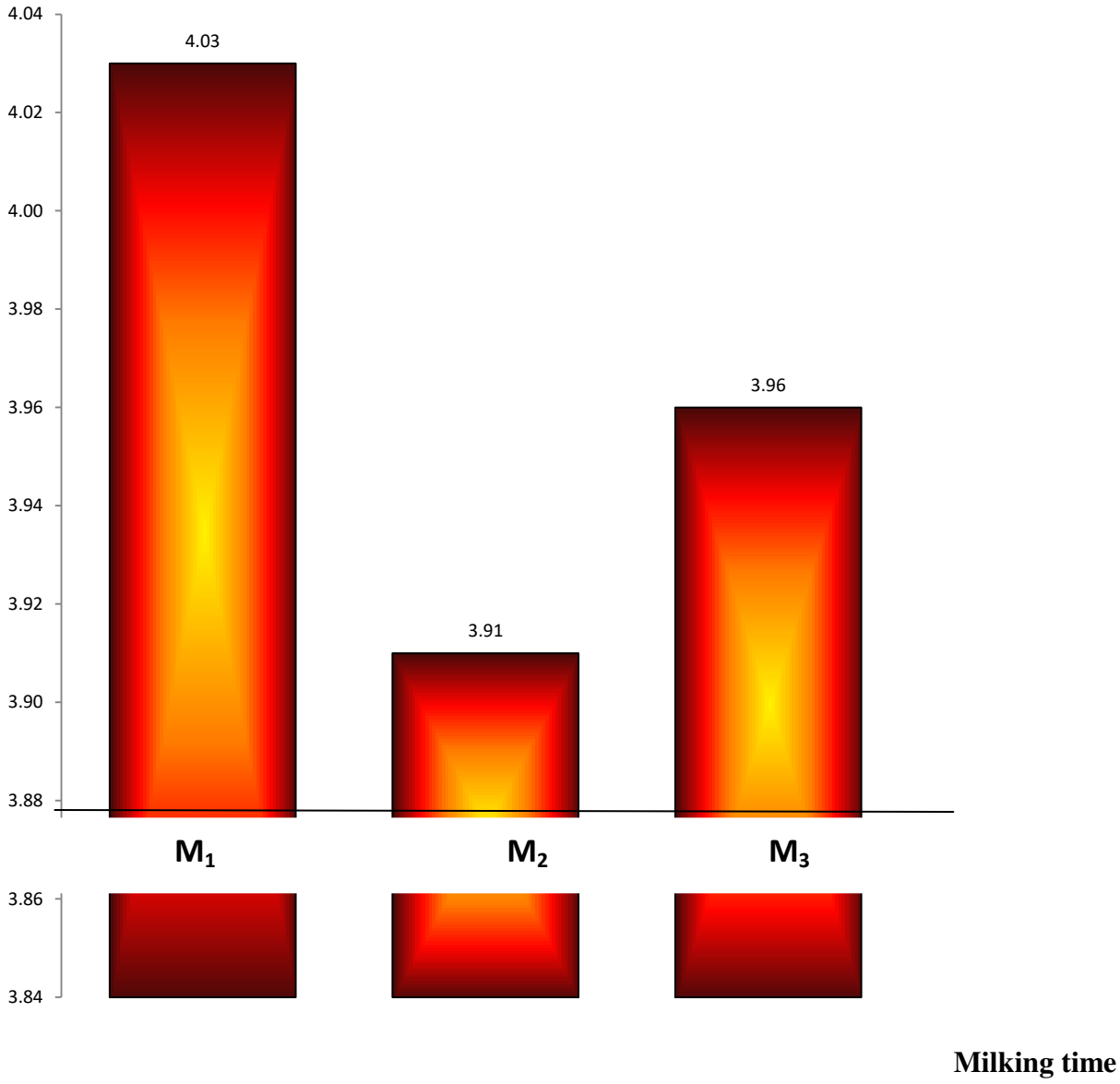

Fig. 1.0 Average Protein (%) in Cow milk at different milking times

Specific gravity (cc)

Table 2.0 and Fig. 2.0 presents the data on Specific gravity (cc) in raw milk of Cows at three different milking times in ten replications. The results obtained showed that milking time M_1, M_2 and M_3 registered mean Specific gravity (cc) as 1.088, 1.077 and 1.083, respectively, with overall mean of 1.082. The difference in these values due to milking time as well as due to replication, was significant , M_1 recorded maximum Specific gravity (cc)(1.088) followed by M_3 (1.083), whereas, M_2 recorded the minimum (1.077).

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Table 2.0 Specific gravity (cc) in cow milk at different milking times

Replication		Milking time			Range		Mean
		M_1	M_2	M_3	Minimum	Maximum	
R_1		1.096	1.078	1.093	1.078	1.096	**1.089**
R_2		1.087	1.074	1.082	1.074	1.087	**1.081**
R_3		1.097	1.098	1.095	1.095	1.098	**1.097**
R_4		1.088	1.082	1.085	1.082	1.088	**1.085**
R_5		1.078	1.072	1.077	1.072	1.078	**1.076**
R_6		1.075	1.062	1.068	1.062	1.075	**1.068**
R_7		1.098	1.084	1.095	1.084	1.098	**1.092**
R_8		1.089	1.081	1.082	1.081	1.089	**1.084**
R_9		1.076	1.062	1.062	1.062	1.076	**1.067**
R_{10}		1.093	1.074	1.088	1.074	1.093	**1.085**
Range	Minimum	1.075	1.062	1.062			
	Maximum	1.098	1.098	1.095			
	Mean	**1.088**	**1.077**	**1.083**			**1.082**
					F- test		S
					S. Ed. (±)		0.002
					C. D. (P = 0.05)		0.004

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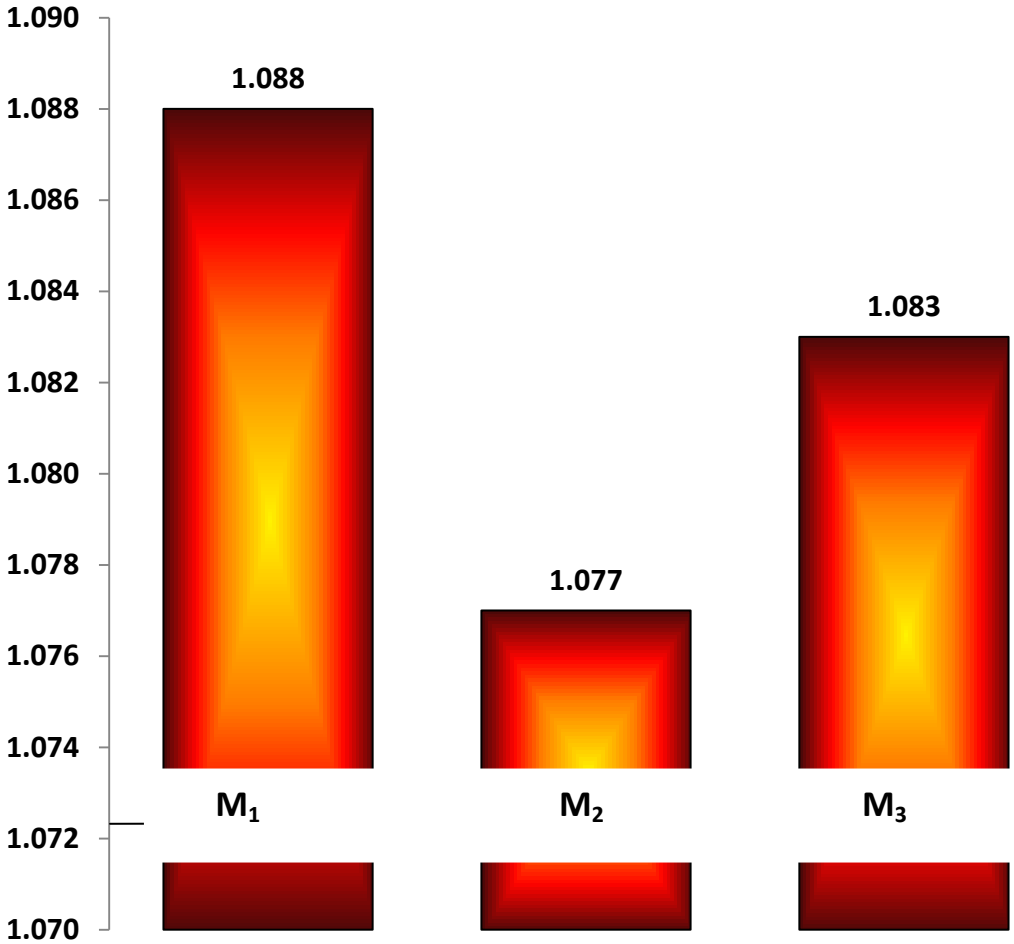

Fig. 2.0 Average Specific gravity (cc) of Cow milk at different milking times

Fat (%)

The data on Fat (%) in raw milk of Cows at three different milking time in ten replications contained in Table 3.0 and Fig. 3.0 showed that milking time M_1, M_2 and M_3registered mean Fat (%) as 4.74, 4.38 and 4.49, respectively, with overall mean of 4.54. The difference in these values due to milking time as well as was due to replication was significant,

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Morning milk M_1 recorded maximum Fat (%)(4.74) followed by evening milk M_3 (4.49), whereas, noon milk M_2 recorded the minimum (4.38).

Table 3.0 Fat (%) in Cow milk at different milking times

Replication		Milking Time			Range		Mean
		M_1	M_2	M_3	Minimum	Maximum	
R_1		4.92	4.86	4.87	4.86	4.92	**4.88**
R_2		5.26	5.05	5.25	5.05	5.26	**5.19**
R_3		4.05	3.74	3.83	3.74	4.05	**3.87**
R_4		4.44	4.05	4.22	4.05	4.44	**4.24**
R_5		4.85	4.64	4.75	4.64	4.85	**4.75**
R_6		4.78	4.53	4.66	4.53	4.78	**4.66**
R_7		4.28	3.75	4.05	3.75	4.28	**4.03**
R_8		4.38	3.35	3.38	3.35	4.38	**3.70**
R_9		5.48	5.13	5.05	5.05	5.48	**5.22**
R_{10}		4.98	4.72	4.85	4.72	4.98	**4.85**
Range	Minimum	4.05	3.35	3.38			
	Maximum	5.48	5.13	5.25			
	Mean	**4.74**	**4.38**	**4.49**			**4.54**
					F- test		S
					S. Ed. (±)		0.07
					C. D. (P = 0.05)		0.16

SUMMARY

Results of the experiment are summarized below:

Maximum Protein (%) was recorded in the raw Cow milk at morning milk M_1 followed by evening milking $M_3$and the minimum in noon milking G_2.Specific gravity (cc) was recorded maximum in the raw milk of Cow at morning M_1 followed by evening milk $M_3$and minimum in noon milk G_2.Morning milk M_1 recorded the highest Fat (%) followed by evening milking M_3 and the lowest fat %) was found in the noon milk M_2.Maximum Lactose (%) was recorded in the morning milk M_1 followed by evening milking M_3 while the minimum remained in noon milk M_2.Minimum Ash (%) was found in the Cow milk of morning M_1 and the maximum in noon milk M_2 followed by evening milk M_3.Total solid (%) was recorded maximum in morning

milk M_1 followed by evening milk, whereas noon milk M_2 recorded the minimum.Water content in the raw milk of Cow was found in morning milking M_1 while the maximum was recorded in noon milk M_2 followed by evening milk M_3.Raw milk of Cow at morning M_1 recorded the highest Solid not fat (SNF) (%) followed by evening milk m_3 and the lowest SNF (%) was found in the noon milk M_2.Chemical quality of raw Cow milk at morning M_1 was found best, which contained maximum Protein (%), Specific gravity (cc), Fat (%), Lactose (%), Total solid (%) and Solid not fat (SNF) (%); and minimum Ash (%) and Water (%); followed by evening milk M_3 and noon milk M_2.

CONCLUSION

In view of the findings and results presented above, it may be concluded that the chemical quality of raw Cow milk at morning (M_1) was found best in terms of maximum Protein (%), Specific gravity (cc), Fat (%), Lactose (%), Total solid (%) and Solid not fat (SNF) (%); and minimum Ash (%) and Water (%); followed by evening milk (M_3) and noon milk (M_2).

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