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List of research paper Publications

Sr. No.	Name of the author	Title of the paper	Year of publication	ISSN/ISBN no.
01	**R. D. Pawar**	Ultrasonic velocity,density viscosi binary liquid mixtures of 1- Butanol and 1- petanol with O-nitrotolune at 303.15 and 313.15 K	2022	2349-5163
02	**R. D. Pawar**	STUDY OF MOLECULAR INTERACTIONS OF BINARY MIXTURES OF ALCOHOL WITH O-NITRO TOLUENE AT TWO TEMPERATURES	**2022**	**0030-5324**
03	H. G. Bhangale	SYNTHESIS AND ELECTRICAL CONDUCTIVITY STUDIES OF BENZENE SULFONIC ACID-DOPED POLYANILINE	2022	002-3301
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05	S.M. Sonawane	Comparative study on nutritive properties and compositions of milk of Sangamneri Goats, Nimari Cow and Surti Buffalo	2022	2319-2372
06	S.M. Sonawane	Role of digital Technologies in Livestock Management	2022	2319-2380
07	S. R. Gaikwad	Numerical Solution of Steady Heat flow problems using Finite Element Method	2022	0972-6306

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08	R.D. Pawar	MOLECULAR INTERACTION AND ULTRASONIC VELOCITY STUDIES OF ALCONOLS WITH O-NITROTOLENE AT GIVEN TEMPERATURES	2021	2394-7780
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11	S.R. Gaikwad	On Differentiability and Integrability of Rings	2020	2319-7064
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14	S.R. Gaikwad	Flow in Constricted Tube of Varying Cross Section with Permeable Wall	2018	2319-7064

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Ultrasonic velocity, Density and Viscosity of binary liquid mixture of 1-butanol and 1-pentanol with O-Nitrotolune at 303.15 and 313.15 K.

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Abstract:-

Ultrasonic velocity, density and viscosity were reported for binary mixture of 1-butanol and 1-pentanol with O-nitro toluene over an entire range of composition at 303.15 and 313.15 K. The experimental data were used to calculate the excess molar volume, viscosity deviation and deviation in isentropic compressibility. The result was interpreted in terms of molecular interaction studies between the components of binary mixture. The deviation in ideal mixing law in most of calculated parameters are negative. This reveals the nature and magnitude of intermolecular interaction between unlike molecules and electron donating alkyl group.

Key Words: - Ultrasonic velocity, Density, Viscosity Excess molar volume, viscosity deviation, Isentropic Compressibility.

INTROCTION:-

The measurement of ultrasonic velocity, density and viscosity find wide applications in physic-chemical properties of liquid mixtures .It is also understanding in the molecular interaction studies of pure liquids and binary liquid mixtures[1-3]. The ultrasonic measurement can be used to provide information about physical nature and strength of molecular interactions in liquid mixtures[4-6]. The ultrasonic velocity is mainly related to binding forces between atoms or molecules.

The physic-chemical properties of pure liquids and of their binary liquid mixture at different temperature of whole composition are useful for the understanding the thermodynamics and transport properties as well as practical chemical engineering purposes The excess thermo-dynamic properties are applicable for the interaction between components of mixtures [7-10].

Where x_i and V_i are mole fraction and molar volume of ith component in the mixture

RESULT AND DISCUSSION:-

Determination of ultrasonic velocity and viscosity of alkanols with O-Nitro toluene gives reliable information about molecular interaction. In pure state alkanol get itself associate. The association of alkanols decreases with increase in chain length of alkanols .When alcohols are mixed with O-nitro toluene then there is interaction between individual functional groups .The presence of electron withdrawing nitro group deceases the electron densities. The polarity of alcohol is less hence degree of self association is less.

The experimental values of density (ρ) viscosity (η) ultrasonic velocity (U), Excess volume (V^E), viscosity deviations and ($\Delta\eta$), deviation on isentropic compressibility (Δk_S) for binary Systems of 1-butanol and 1-pentanol (1) with o-nitro toluene(2) at 303.15 and 313.15 K are reported in Tables1 and 2 respectively. The variation of excess parameters with mole fraction of alkanols at 303.15 and 313.15K are plotted in Figure 1-4.The figure 1-4 shows that curve for ultrasonic velocity,excess molar volume ,viscosity deviation and deviation in isentropic compressibility are plotted against mole fractions at 303.15K formixture of 1-butanol and 1-pentanol with O-nitrotolune. Figure 2-4 shows that curve for excess molar volume ,viscosity deviation and deviation in isentropic compressibility are negative over entire mole fraction of alkanols at given temperature.In studied work the excess molar volume (V^E) values have been observed negative which attributed strong molecular interaction between the unlike molecules. Generally when two solvents are mixed the molecular interaction held will be depend upon the type and nature of molecules. The positive excess volumes attribute structure breaking interactions while negative excess volumes attribute structure making interactions [13] .

The observed V^E values may be analysed in terms of several effects which may be categorised as physical, chemical and geometrical contributions [12].The physical interactions compromise mainly dispersion forces and non specific physical interaction giving positive contribution. The chemical interaction involves the charge transfer complexes, resulting in contraction of volume, geometrical or structural contribution arising from the geometrical fitting of one component into other .[8] The negative, viscosity deviation and deviation in isentropic compressibility may be attributed to existence of dispersion dipole forces between unlike molecules and related to the difference in size and shape of molecules [14]. Increase of temperature disturbs hetero and homo association of molecules which increase the fluidity of the liquid. The values of viscosity deviation are more negative for 1-pentanol which provides additional evidences for existence of interaction of weak magnitude like dipole –induced dipole type between components of liquid[15]. The magnitude of viscosity deviation and deviation isentropic compressibility the sign and extent of deviation of these properties from idealist depends upon the strength of interaction between unlike molecules. According to fort

Table.2. Values of densities,viscosities,ultrasonic velocity,Excess molar volumes and Deviation in viscocity and deviation in isentropic compressibility for binary system of 1-pentanol and O-nitrotolune at 303.15 and 313.15 K.

Temp K	X_1	P (gm /cm^3)	$\eta 10^3$ (Nsm^{-2})	U (M S^{-1})	$V^E x10^6$(m^3/mole)	$\Delta \eta x10^3$(Kg m^{-1}s^{-1})	$\Delta ksx10^{11}$ (m^{2}N^{-1})
303.15	0.0000	0.81920	3.10600	1498.0	0.0000	0.000	0.00
	0.0670	0.83110	2.68220	1532.1	0.9875	-33.327	-16.32
	0.1387	0.85890	2.48580	1549.9	-0.0046	-43.246	-28.50
	0.2160	0.88780	2.19330	1596.8	-0.9770	-62.016	-54.92
	0.3004	0.93700	2.13260	1599.8	-4.1935	-56.643	-62.21
	0.3913	0.95130	1.98690	1613.6	-3.0901	-58.889	-57.27
	0.4907	0.98410	1.87870	1616.8	-4.0094	-56.232	-53.03
	0.6005	0.99640	1.63810	1635.4	-2.3462	-65.405	-46.04
	0.7197	1.13500	1.82470	1670.2	-14.1357	-30.584	-84.10
	0.8526	1.13330	1.78870	1677.2	-11.0451	-16.166	-63.47
	1.0000	1.06470	1.75020	1631.2	0.0000	0.000	0.00
313.15	0.0000	0.81160	2.59240	1467.0	0.0000	0.000	0.00
	0.0670	0.82310	2.22710	1468.4	1.6681	-27.967	10.23
	0.1387	0.85080	2.07240	1549.9	1.3216	-34.246	-43.57
	0.2160	0.87900	1.83510	1558.1	1.1243	-48.067	-42.63
	0.3004	0.92840	1.76310	1599.5	-1.4090	-44.448	-67.03
	0.3913	0.94250	1.66890	1600.0	0.5707	-42.215	-49.08
	0.4907	0.97510	1.63260	1610.4	0.5686	-33.103	-41.79
	0.6005	0.98770	1.41110	1613.8	3.2333	-41.178	-20.09
	0.7197	1.12520	1.59070	1653.4	-7.5474	-7.938	-53.63
	0.8526	1.12360	1.55540	1664.3	-3.1863	5.569	-24.68
	1.0000	1.13740	1.31050	1682.4	0.0000	0.000	0.00

Fig. 1) Ultrasonic velocity against mole fraction for 1-butanol and 1-pentanol at 303.15 K

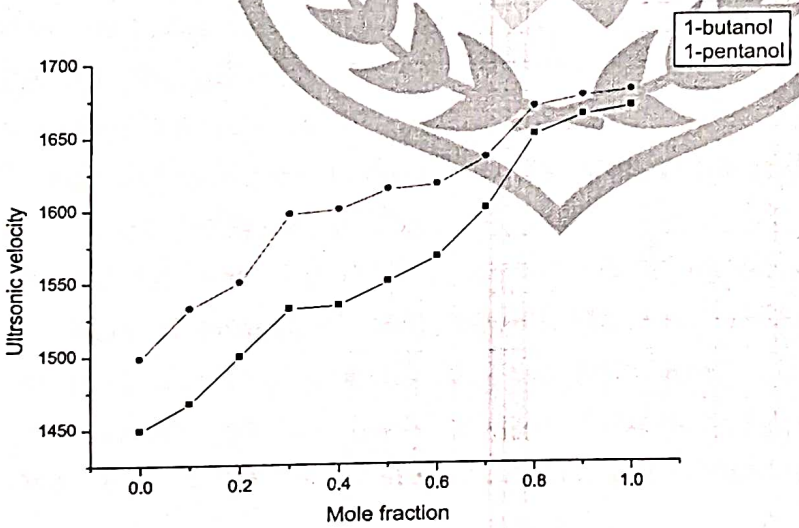
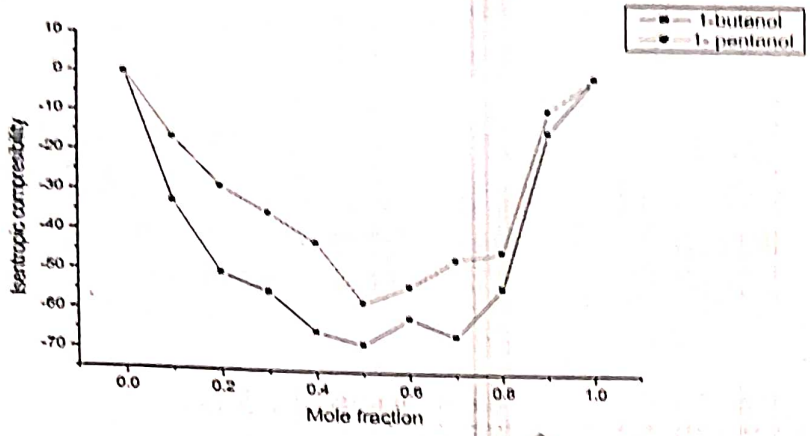


Fig. 4 ΔKs against mole fraction for 1-butanol and 1-pentanol at 303.15 K



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STUDY OF MOLECULAR INTERACTION OF BINARY MIXTURES OF ALCOHOLS WITH O-NITRO TOLUENE AT TWO TEMPERATURES.

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Abstract :
Molecular interaction parameters and sound velocity of binary mixture of 1- pentanol and 1-hepternal with O-Nitro toluene at 303.15 and 313.15 K temperatures is studied.. The viscosity, density and ultrasonic velocity of binary mixture where measured at given temperatures. These experimental analysis data have been used to calculate viscosity deviation, excess molar volume, and deviation in isentropic compressibility and excess of free length. The values of isentropic compressibility and intermolecular free length are negative over and entire range of mole fraction for given by the mixtures. These results have been explained on the basis of intermolecular interaction between components in liquid mixture and correlation among the parameters is discussed.

Key word:– Ultrasonic velocity, Viscosity, Density, Excess molar volume (V^E), Viscosity deviation ($\Delta\eta$) ,Excess free length (L_f^E).

Introduction:-

The physical properties like density, viscosity and ultrasonic velocity measurement are identify the strength of intermolecular interaction in binary mixtures of solutions.[1-6] In certain manufacturing binary liquid mixtures are used for distribution instead of single component and product formulation. [7-14] The intermolecular free length is important physical property of binary mixture dependent on ultrasonic velocity.[15-18] The study announced the finding of intermolecular interaction between ultrasonic velocity, viscosity and density of alcohols with O-Nitro toluene at given temperatures [19-24]. The observed values have been used to predict various excess parameters. In present research work the O-Nitro toluene contain two bulky groups such as nitro group and methyl group on the six membered rings. Nitro group is an electron withdrawing group that increases the polarity of solvent so it cause molecular interaction between bulky groups of nitro group and methyl group with alcohol. This study is well interprets the volumetric and isometric effect between solvent and solute.

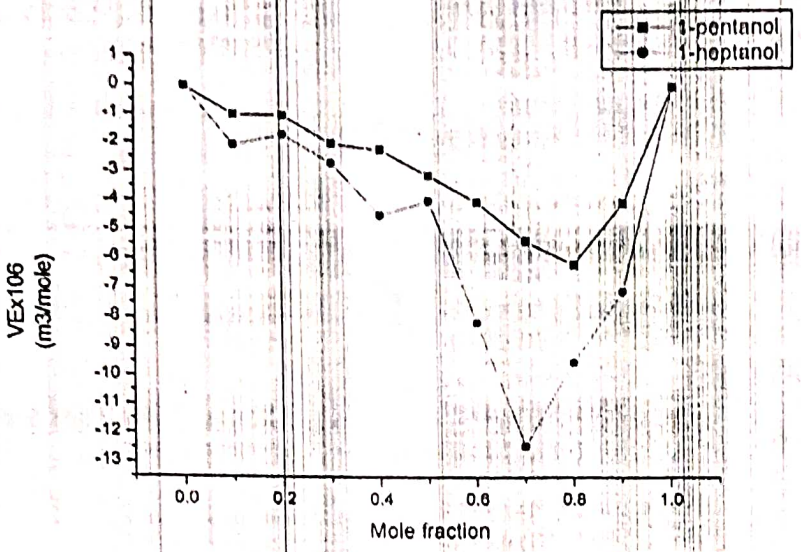
Experimental –

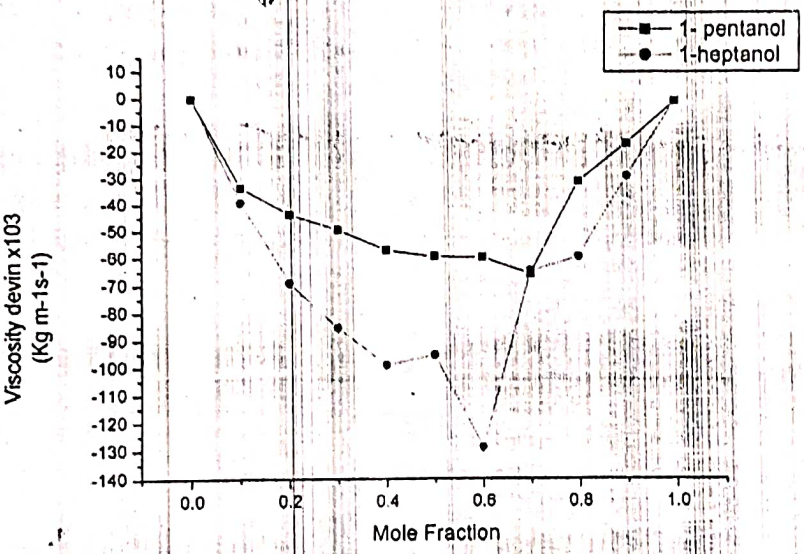
The chemicals used are of A.R. grade with minimum assay of 99.9% obtained from Sigma Aldrich or s. d. fine chemicals India. Bi-capillary pycnometer (10ml) was used to measured densities. An airtight stopper bottles were used to prepare and store the binary liquid mixtures of different known concentrations. The shimatzu electronic digital balance (±0.1mg.) was used to measured weights of the samples. The Ubbelohde viscometer (20ml) was used to measure the viscosity. The efflux time was determined using a digital clock to within ±0.015sec. The ultrasonic

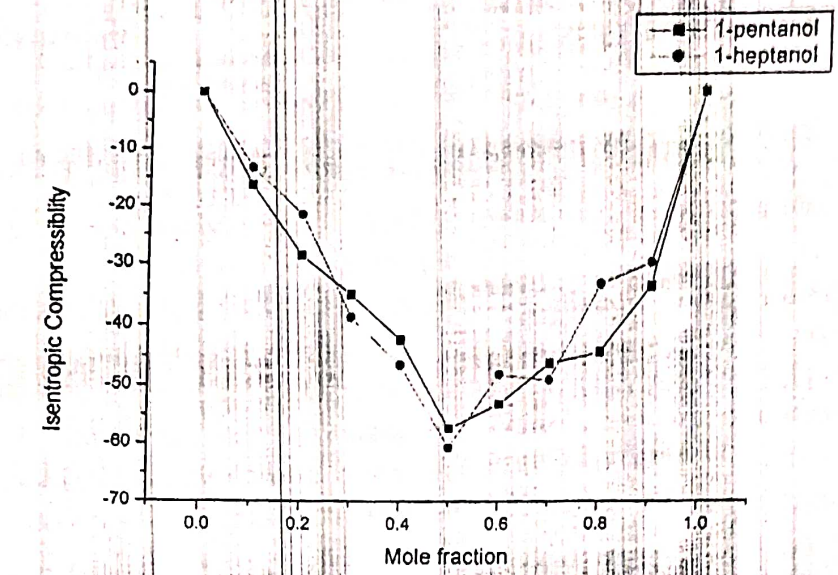
	0.4300	0.93700	2.13260	1599.8	-2.1935	-56.643	-42.21	-0.031
	0.5191	0.95130	1.98690	1613.6	-3.0901	-58.889	-57.27	-0.029
	0.6090	0.98410	1.87870	1616.8	-4.0094	-59.232	-53.03	-0.028
	0.7100	0.99640	1.63810	1635.4	-5.3462	-65.405	-46.04	-0.025
	0.8019	1.13500	1.82470	1670.2	-6.1357	-30.584	-44.10	-0.016
	0.9126	1.13330	1.78870	1677.2	-4.0451	-16.166	-33.47	-0.005
	1.0000	1.06470	1.75020	1631.2	0.0000	0.000	-0.000	0.00
313.15	0.0000	0.81160	2.59240	1467.0	0.0000	0.000	0.000	0.00
	0.1067	0.82310	2.22710	1468.4	-1.6681	-27.967	-10.23	-0.005
	0.2138	0.85080	2.07240	1549.9	-1.8216	-34.246	-23.57	-0.011
	0.3216	0.87900	1.83510	1558.1	-2.9243	-42.067	-24.63	-0.019
	0.4300	0.92840	1.76310	1599.5	-4.4090	-44.448	-36.03	-0.021
	0.5191	0.94250	1.66890	1600.0	-3.5707	-46.215	-49.08	-0.022
	0.6090	0.97510	1.63260	1610.4	-3.5686	-44.103	-41.79	-0.019
	0.7100	0.98770	1.41110	1613.8	-2.2333	-41.178	-30.09	-0.017
	0.8019	1.12520	1.59070	1653.4	-1.5474	-27.938	-23.63	-0.016
	0.9126	1.12360	1.55540	1664.3	-1.1863	-15.569	-14.68	-0.013
	1.0000	1.13740	1.31050	1682.4	0.0000	0.000	0.000	0.00

Table.2. Values of densities viscosities, ultrasonic velocity, Excess molar volumes and Deviation in viscosity and deviation in isentropic compressibility for binary system of 1-heptanol and 2-nitrotolune at 303.15 and 313.15 K

Temp K	X_1	ρ (gm /cm^3)	η10^3 (Nsm^{-2})	U(MS^{-1})	V^Ex10^6 (m^3/mole)	Δ ηx10^3 (Kg m^{-1}s^{-1})	Δksx10^{11} (m^{2}N^{-1})	L_f^E x 10^{-10} m
303.15	0.0000	0.81720	4.96600	1553.2	0.0000	0.000	0.00	0.00
	0.1086	0.84900	4.29940	1596.9	-2.0413	-38.957	-13.24	-0.011
	0.2175	0.86750	3.71500	1598.8	-1.6770	-68.873	-21.47	-0.013
	0.3266	0.89560	3.25850	1610.3	-2.6587	-85.195	-38.54	-0.016
	0.4360	0.93120	2.81730	1620.9	-4.4593	-98.862	-46.35	-0.019
	0.5058	0.95240	2.54040	1662.9	-3.9656	-95.165	-60.63	-0.026
	0.6259	1.01060	1.87810	1665.4	-8.1137	-128.787	-47.93	-0.031
	0.7140	1.07640	2.18920	1679.3	-12.4328	-64.201	-48.89	-0.028
	0.8011	1.08150	1.89450	1705.4	-9.4805	-59.069	-33.11	-0.022
	0.9184	1.09250	1.83760	1710.4	-7.0519	-28.581	-29.66	-0.021
	1.0000	1.06470	1.75020	1631.2	0.0000	0.000	0.00	0.00
313.15	0.0000	0.81040	3.78360	1533.1	0.0000	0.000	0.00	0.00
	0.1086	0.84170	3.35190	1583.0	-1.2156	-21.865	-15.17	-0.011
	0.2175	0.86000	3.90990	1593.8	-2.0159	-45.872	-24.84	-0.012
	0.3266	0.88760	2.60070	1597.0	-2.1176	-52.494	-33.19	-0.016
	0.4360	0.92290	2.33380	1601.2	-3.0560	-55.764	-43.40	-0.019
	0.5058	0.94410	2.15370	1610.7	-4.3236	-69.636	-37.62	-0.025
	0.6259	1.00190	1.57640	1617.1	-5.9310	-82.289	-32.56	-0.018
	0.7140	1.06690	1.86020	1640.1	-10.2920	-48.164	-31.77	-0.015
	0.8011	1.07210	1.68460	1646.5	-9.3289	-39.114	-22.44	-0.012
	0.9184	1.08320	1.58260	1650.7	-7.1456	-11.491	-10.79	-0.010
	1.0000	1.13740	1.31050	1682.4	0.0000	0.000	0.00	0.00


1-pentanol
1-heptanol
VEx106
(m3/mole)
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
0.0
0.2
0.4
0.6
0.8
1.0
Mole fraction


1- pentanol
1-heptanol
Viscosity devin x103
(Kg m-1s-1)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
0.0
0.2
0.4
0.6
0.8
1.0
Mole Fraction



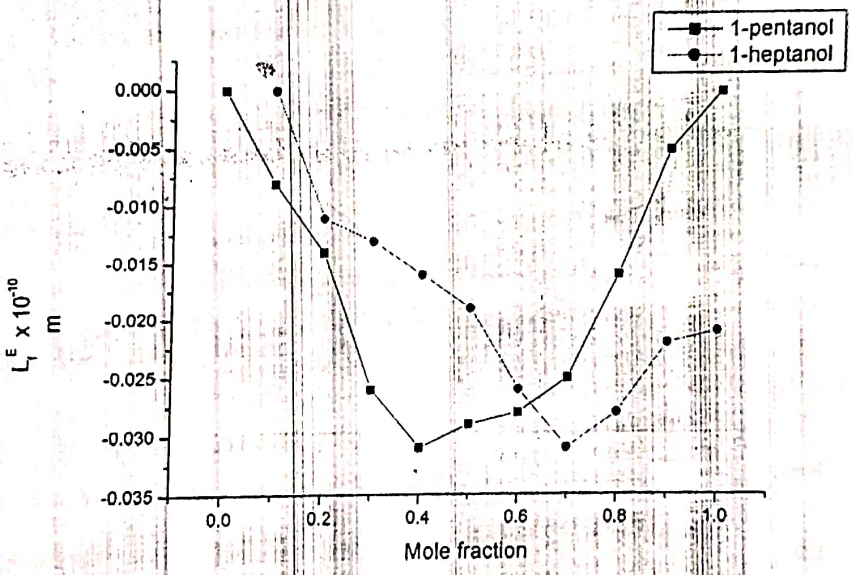


Figure-1. Excess molar volume (V^E) against mole fraction for t-butyl alcohol, 1-pentanol and 1-heptanol at 303.15 K

Figure- 2. Deviation in viscosity (Δn) against mole fraction for 1 t-butyl alcohol, 1-pentanol and 1-heptanol at 303.15 K

Figure -3. Isentropic compressibility deviation (ΔKs) against mole fraction for t-butyl alcohol, 1-pentanol and 1-heptanol at 303.15 K

Figure -4. Excess free length (L_f^E) against mole fraction for t-butyl alcohol 1-pentanol and 1-heptanol at 303.15 K

Result and Discussion:–

The measureed values such as density (ρ), viscosity (η), ultrasonic velocity (U), can calculate viscosity deviation ($\Delta\eta$) , excess molar volume (V^E), deviation in isentropic compressibility (ΔK_S) , and Excess free length(L_f^E). All measured and calculated values are given in Table-1 and, Table-2 respectively. Figure :- 1, 2, 3, and 4 shows Excess molar volume (V^E), Viscosity deviation ($\Delta\eta$) , Deviation in isentropic compressibility (ΔK_S) and Gibbs free energy(G^{*E}) against mole fraction for binary system of 1-pentanol and 1-heptanol at 303.15 K respectively. All these parameters show negative deviations. These parameters are negative this may be due to presence of stronger solute solvent interactions in between highly polar functional groups Nitro and -OH. This causes fitting of alkanol molecules in the voids of self associated nitro toluene solvent molecules resulting volume contraction than ideal. With increase in temperature all these parameters becomes less negative showing less salvation effect at higher temperature.

Summary:-

From experimental data ultrasonic velocity (U), density (ρ) and viscosity (η) have been measured for binary system at 303.15 and 313.15 K. The data have been used to compute the parameters $\Delta\eta$, V^E, ΔK_S, and L_f^E, . It is a well justified that most of values are negative due to presence of polar functional groups on aromatic ring and alkanols which increases salvation effect in solution so it shows structure making interactions between solvent and solute.

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SYNTHESIS AND ELECTRICAL CONDUCTIVITY STUDIES OF BENZENE SULFONIC ACID-DOPED POLYANILINE*

BY

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Abstract— In this present work, A series of benzene sulfonic acid-doped polyaniline (PANI) were synthesized by chemical oxidative polymerization. The formation of benzene sulfonic acid-doped polyaniline (PANI-BSA) composited was characterized by various methods like, UV– visible absorption spectroscopies, Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM) respectively. And the effects of benzene sulfonic acid (BSA)-doping concentration on the electrical conductivity's were discussed. The effect of dopant on the kinetics of polymerization has been studied by UV–VIS spectroscopy. The presence of oxalic acid in the polymer has been studied by FT-IR, and morphology by SEM. The results display that an increase in benzene sulfonic acid -doping concentration will lead to a trend of first increase and then decrease in the electrical conductivity. The maximum electrical conductivity can reach 3.89×10^{-2} S.cm^{-1} when benzene sulfonic acid-doping concentrations is 0.75 M. It was found that the conductivity of PANI-BSA composites is higher than undoped polyaniline

Keywords— dopant, benzene sulfonic acid, polyaniline, conductivity

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1. Introduction

Nowadays, the conducting polymers have emerged as a new class of materials because of their unique chemical, electrical and optical properties. By proper doping the conductivity of these conducting polymers can be changing from semiconducting to metallic phase, which suggestions new concept of charge transport mechanism. Among different conducting polymers, conductive polyaniline has been studied widely because of its environmental stability its easy of synthesis in aqueous media, special electrical, optical and other properties. The conductive polyaniline is a suitable

candidate for a variety of technological applications such as electromagnetic shielding, solar cells, sensors and electrodes for rechargeable batteries. [1–13].

In this work, we report the electrical conductivity by two-probe method of these synthesized samples (doped polyaniline and undoped polyaniline) has been studied. The FT-IR spectra UV-visible absorption spectroscopies, SEM have been carried out to characterize these samples.

2. Experimental details

2.1 Synthesis of undoped polyaniline (UPANI)

Undoped Polyaniline has been synthesized by in situ oxidative polymerization of aniline and APS as oxidant. The oxidant monomer ratio is 1: 1.25. An APS and aniline were dissolved in 200 mL round bottom flask and stirred 12 hrs well. After that the green precipitate was filtered, washed with distilled water and acetone for several times respectively and finally dried in oven for 60°C at12 h.

2.2. Synthesis of doped polyaniline at different benzene sulfonic acid concentrations (PANI-BSA)

The PANI samples were prepared by chemical oxidative polymerization. A 0.25 M aqueous solution of ammonium persulfate (APS) and 0.2 M of aniline were dissolved in 50 mL and 20 mL benzene sulfonic acid (BSA) solution of certain concentration (0.25 M, 0.5 M, 0.75 M, 1.0 M, and 1.5M) respectively. Then, the mixture was stirred 12 hrs. After that the green precipitate was filtered, washed with distilled water and acetone for several times respectively and finally dried in oven for 60°C at12 h.

3. Results and discussion

In the UV–vis spectra as shown in Figure 1, the undoped sample exhibits two strong absorption peaks at 327 nm and 610 nm, corresponding to the □- □* transition of benzenoid rings and quinoid rings respectively [44]. For the doped PANI, these two peaks redshift to 330 nm and.

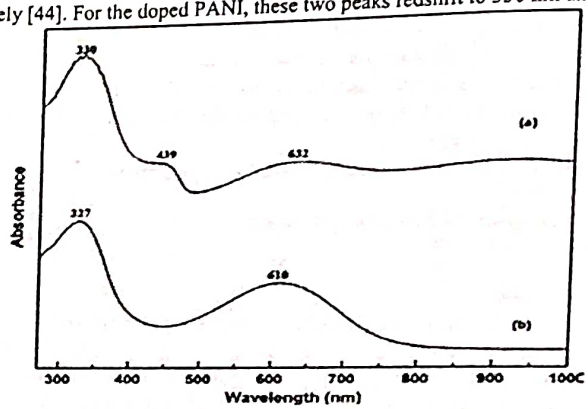

Fig. 1. UV–vis spectra of (a) doped PANI with BSA concentration at 0.75M and (b) undoped PANI

632 nm respectively with the intensity of the latter peak decreasing dramatically, which further the confirms occurrence of the protonation at the imine nitrogen sites [45]. Moreover, both the new

absorption peak at 439 nm in the doped sample are assigned to the polaron band transition [46] caused by doping

Figure 2 shows FT-IR spectra of the UPANI and PANI doped with different concentration (0.75M, PANI- BSA).

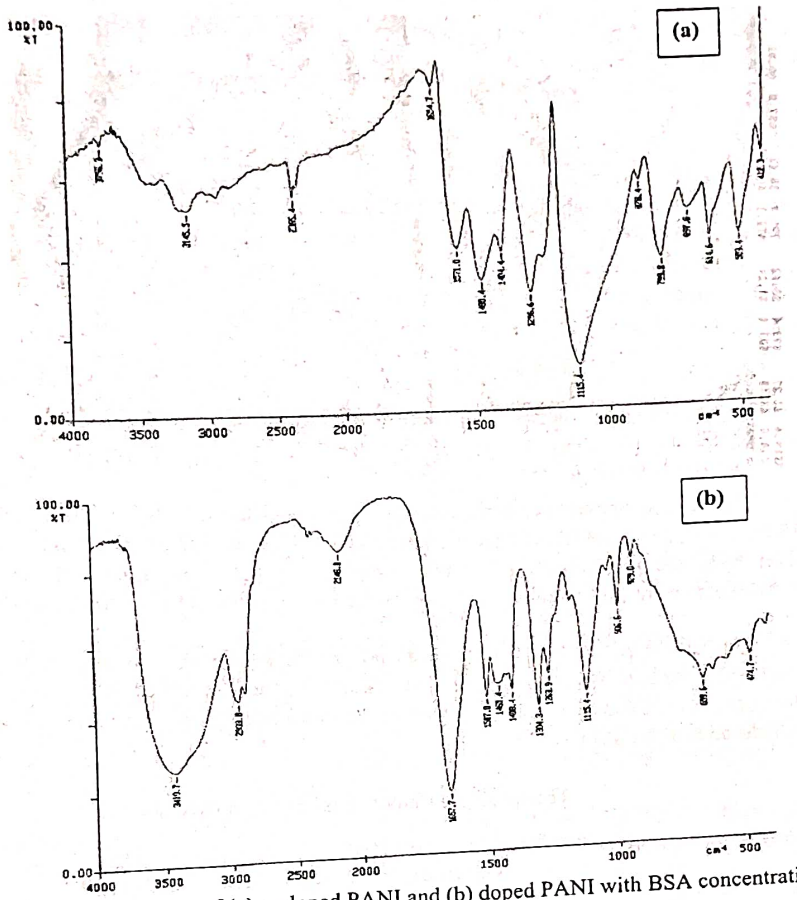

Fig. 2. FTIR spectra of (a) undoped PANI and (b) doped PANI with BSA concentration at 0.75 M

The FT-IR spectroscopy is a powerful instrument for analyzing the oxidation state of PANI and the molecular structure [14, 15]. As can be seen from Figure 1, for both the samples, the absorption peak positions of 3165-3443 cm^{-1}, 1560-1570 cm^{-1}, 1480-1490 cm^{-1}, 1302-1304 cm^{-1}, 1243- 1245

cm^{-1}, 1108-1119 cm^{-1}, 800-805 and 819-822 cm^{-1} are the same. The absorption band observed at 1587 cm^{-1} is related to the quinone structure and that at 1471 cm^{-1} is characterized via benzene ring stretching. An intensity ratio of the absorption peak position at 1587 cm^{-1} to that at 1471 cm^{-1} is a quantitative measurement of the oxidation state of PANI [14].

Figure 3 displays the SEM image of the doped PANI powder synthesized at 0.75 M BSA concentration. It can be observed that plate shaped PANI particles are gained with the diameter of 100 nm and length of 300–400 nm.

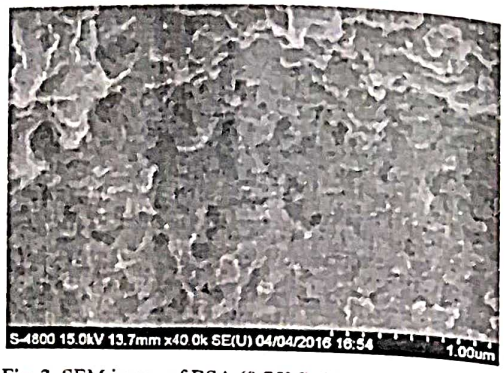

Fig. 3. SEM image of BSA (0.75M) doped PANI powder

Before Conductivity measurement, the all samples (doped PANI prepared at 0.25 M, 0.5 M, 0.75 M, 1.0 M, and 1.5M BSA concentration and UPANI) were pelletized at 7 tons for 1 min using a Carver hydraulic press. Sufficiently thin samples of ~1 mm were derived. The conductivity measurements were carried out by a two-probe technique recorded by a multimeter (Keithley model 2001).

Conductors generally show ohmic behavior wherein the voltage across the material varies linearly with the current and the I-V plot has a constant slope, which is the resistance of a material. This means that the current density linearly increases with the applied electric field. It can be observed that resistance of the samples.

The specific resistivity has been evaluated as,

$$\rho = RA/L \quad (1)$$

$$\text{OR conductivity, } \sigma = 1 / \rho \quad (2)$$

Where ρ is its resistivity, A is the cross sectional area of the sample and L is its thickness. The effect of dopant ion on the overall conductivity behaviour of polyaniline was observed. This indicates that all samples behave as ohmic conductors. Shown in Table 1 are values of the electrical conductivity of undoped and doped polyaniline samples.

Ob no	M (BSA)	Conductivity (S/cm)
1	undoped sample	0.09×10^{-4}
2	0.25	0.9×10^{-2}
3	0.50	2.15×10^{-2}
4	0.75	3.89×10^{-2}
5	1.0	1.56×10^{-2}
6	1.5	1.05×10^{-2}

Table 1. PANI conductivity values of BSA with various concentrations.

The differences in conductivity values are due to the effect of dopant ions. As can be seen, the undoped sample has conductivities in the range of 10^{-4}, which makes the sample highly insulating typical of a normal polymer. The highest conductivity (3.89 S/cm) was obtained for the BSA -doped sample; the lowest conductivity (0.09 S/cm) was exhibited by the undoped sample. The room temperature conductivity for undoped sample was found to be 0.09×10^{-4} S/cm for undoped samples while it increased to a value of 3.89 S/cm for BSA doped samples

4. Conclusion

The Doped PANI were synthesized with addition of hydrochloric acid by chemical oxidative polymerization. The doped state was confirmed by a combination of IR spectra and UV–vis spectra. The optimum BSA doping concentration in polyaniline is 0.75 M with a conductivity value of 3.89 $x10^{-2}$ $S.cm^{-1}$

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THERMAL STUDIES ON COPPER DOPED BARIUM TARTRATE SINGLE CRYSTALS BY SILICA GEL TECHNIQUE

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Abstract: In the present research work, the single crystals of copper doped Barium tartrate were grown by single diffusion technique. The optimum growth conditions of copper doped Barium tartrate were optimized by varying various parameters such as pH of the gel solution, gel concentration, gel setting time, concentration of the reactance. The platy shaped crystals were obtained in silica gel at room temperature. The effect of copper doping on the Barium tartarate has been studied. The XRD pattern shows that Copper doped barium tartarate crystals are polycrystalline, having orthorhombic structure. Thermo gravimetric analysis (TGA) and Differential thermal analysis (DTA) curveshows the percentages of the weight loss in the different stages of decomposition of barium tartrate. Differential scanning calorimetry (DSC) curveshows the phase transformation due to loss of water molecules and formation of stable anhydrous $CuBaC_4H_4O_6$ crystals.

Keywords:Crystal growth techniques Single diffusion, XRD, TGA, DTA and DSC.

1. INTRODUCTION

In the present work, doped and undoped barium tartrate crystals were grown by silica gel method using single diffusion technique. Copper is used as dopant. However, there is not a single research paper available in the literature survey on the growth and characterizations of these barium tartrate crystals.

We have turned our attention towards the tartarate crystals as these crystals are having good application and can be synthesized by gel technique. Commercially, the tartrate compound can be used in various applications like antimony in urinary drugs, ferroelectric applications of sodium-potassium tartrate [1], potassium-chromium tartrate in medicine [2] and so on. Many people studied various tartrate compounds like calcium-strontium mixed levo tartrate [3], zinc tartrate [4] and cadmium tartrate [5] with respect to their properties such as dielectric, magnetic, ferroelectric, piezoelectric, and optical and other pertinent characteristics. Crystal habits of various crystals, grown under different conditions and also by different methods were described by Buckley [6], Hartman [7], Kern [8], Chernor [9], Burton [10] and Mullin [11]. A number of factors such as degree of saturation, type of solvent [12], pH of the gel media [13, 14], presence of impurities [15,16] and the change in growth temperature also presumably affect significantly the morphology of the crystal [17]. The crystals, which can't satisfactorily grow from melt and vapor, are grown successfully by using this method [18- 20]. Barium tartarate is a quite interesting compound as they are having good applications. Hence in the present course of investigation it has been decided to synthesize and characterize Copper doped Barium tartarate crystals by silica gel method. The grown crystals are characterized by XRD, TGA, DTA and DSC techniques.

2. MATERIAL AND METHODS

Table 1: Optimum condition for growth of strontium-

doped barium tartrate crystals.

Sr. no	Optimum growth Conditions	Single diffusion
01	Density of sodium meta silicate solutions (Na_2SiO_3)	1.05 g/cm³
02	Concentration of acetic acid (CH_3COOH)	1M
03	pH of mixture	4.3
04	Temperature	Room Temp.
05	Concentration of ($BaCl_2$)	1M
06	Dopend Concentration of $CuCl_2$)	0.05M
07	Concentration of supernatant ($C_4H_6O_6$)	1M
08	Gel setting time	2days
09	period of crystals growth	6 weeks

10All chemicals used were of AR grade. The chemicals used for growth of single crystal were acetic acid (CH_3COOH), sodium meta silicate (Na_2SiO_3), tartaric acid ($C_4H_6O_6$), Copper Chloride ($CuCl_2$) and barium chloride ($BaCl_2$). Different molar mass was tried to determine the optimum growth conditions. The gel was prepared by mixing the solutions (CH_3COOH), (Na_2SiO_3), ($BaCl_2$) and ($CuCl_2$) having different pH values varying from 4.0 to 4.3. The prepared gel was transferred in glass tube of diameter 2.5cm and 15cm in length. The mouth of tube is covered by cotton plug and kept for the setting. After setting the gel, it was left for aging. After two days the supernatant ($C_4H_6O_6$) of 1M concentration was poured over the set gel by using pipette and kept undisturbed by covering the cotton plug on the mouth of tubes.

Hydro silica gel is very good medium for growing better quality doped and undoped crystal of barium tartrate. The 0.05M concentrations of $CuCl_2$ in an aqueous solution were used to grow Cu doped barium tartrate crystals. To grow well defined crystals of Copper-doped barium tartrate, several experiment were performed by varying growth parameters like gel pH, gel age, gel density, and molarities of lower and upper reactions, in order to establish the optimum condition for the growth.The optimum growth conditions for high quality crystals established by varying various parameters are given in Table 1.

3. RESULTS AND DISCUSSION

3.1 X-ray powder diffraction analysis (XRD)

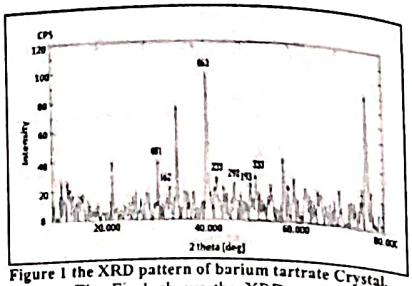


Figure 1 the XRD pattern of barium tartrate Crystal.

The Fig.1 shows the XRD pattern of barium tartrate whereas Fig.2 shows the XRD pattern of $SrBaC_4H_4O_6$ crystals. The XRD study reveals that barium tartrate crystal belongs to orthorhombic system and the incorporation of the dopant has not changed the structure of the parent crystal. The slight shift of XRD peaks, variations in intensity and lattice parameters of doped Barium tartarate crystals indicated that dopend are really doped into the $BaC_4H_4O_6$ structure. Table 2 shows the XRD data of barium tartrate and Table 3 shows the XRD data of Sr doped barium tartrate crystals. The calculated h k l values were found to be in good agreement with the JCPED card no. 26-0192 and 04-0836.

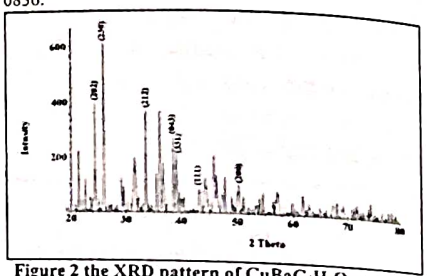


Figure 2 the XRD pattern of $CuBaC_4H_4O_6$ crystals (0.05M.)

Table 2. The XRD data of barium tartrate crystal (λ =1.54056Å).

Observed data values			Standard data values			
2θ	d-value	Int en.	2θ	d-value	Inte n.	h k l
32.400	2.7609	39	32.375	2.7630	16	0 8 1
34.800	2.5758	21	34.864	2.5709	25	1 6 2
42.600	2.1204	10 3	42.590	2.1210	4	0 6 3
44.600	2.0299	28	44.692	2.0260	2	2 3 3
48.200	1.8864	25	48.402	1.8790	4	2 9 2
51.600	1.7698	24	51.563	1.7710	1	1 9 3
52.600	1.7384	30	52.584	1.7391	2	3 3 3

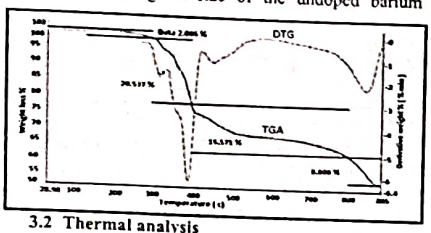
Table 3. The XRD data of Cu doped barium tartrate crystals (λ =1.54060Å).

observed values from XRD				standard data values		
Sr. No	2θ values	d values	Inten.	2θ values	d values	h k l
1	24.600	3.6159	323	24.606	3.6149	2 2 0
2	26.000	3.4243	873	26.009	2.4230	2 3 0
3	33.700	2.6574	525	33.718	2.6560	2 1 2
4	37.500	2.3964	151	37.459	2.3970	3 0 1
5	38.900	2.3133	159	38.889	2.3140	0 4 3
6	39.200	2.2963	137	39.204	2.2960	3 3 1
7	43.400	2.0883	179	43.290	2.0883	1 1 1
8	50.400	1.8091	120	50.431	1.8081	2 0 0

The slight shift in the position of diffraction peaks to lower value reflecting a slight elongation along a, b and c axes. Lattice parameters values and the grain size of doped and undoped barium tartrate crystals are given in the Table 4. The grain size data for grown crystals was derived by using Scherrer formula. The grain size of the undoped barium tartrate crystals is around 35.44 nm while average grain size is around 49.28 nm. It was observed that the grain size of the undoped barium tartrate crystal increases with Cu doping and subsequent doping shows the increasing tendency in grain size.

Table 4. Calculated Comparative study of lattice parameters and grain size of doped and Undoped $BaC_4H_4O_6$ crystals.

Comparative study	Lattice Parameters			Grain size (nm)
	A	B	C	
Undoped ($BaC_4H_4O_6$) crystals (1M)	7.590	23.780	7.536	35.44
Doped ($BaC_4H_4O_6$) crystals with Cu (0.05M)	8.868	24.729	8.421	43.95



3.2 Thermal analysis

Figure 4. TGA & DTG curve of barium Tartrate crystals.

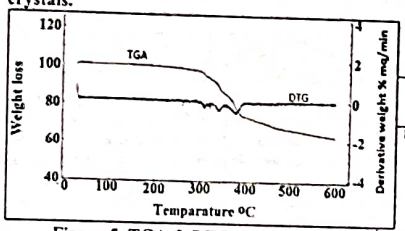


Figure 5. TGA & DTG curve Cu doped $BaC_4H_4O_6$Crystals (0.05 M).

The percentages of the weight loss in the different stages of decomposition of **doped and undoped barium tartrate crystals** are presented in table 5. There is a good agreement between the observed and calculated weight losses. Copper barium tartrate is water coordinated compound. Therefore, there is a possibility that this crystal may lose some of its water molecules while heating. TGA of Copper barium tartrate showed clearly four stages of decomposition as dehydration, Copper barium tartrate.

Table 5. TGA data of doped and undoped barium tartrate crystals.

Crystals	Step	Temperature range (°C)	Observed % weight loss	Calculated % weight loss	Probable loss of molecules
$BaC_4H_4O_6$ (1M)	I	29- 292	2.09	03.05	-0.5H_2O
	II	292-393	20.53	20.38	-2$Co2H_2$
	III	393- 799	15.57	16.30	-Co_2
	IV	799- 883	8.80	09.51	-Co
$CuBaC_4H_4O_6$ (0.05M)	I	27-200°C	2.45	2.51	-0.5H_2O
	II	200-365°C	17.34	16.76	-2Co & H_4
	III	365-383°C	12.72	12.29	-Co_2
	IV	383-599°C	8.11	7.82	-Co

3.3 Derivative Thermo Gravimetric Analysis (DTG):

In figure 5.9 shows the decomposition peaks and studies as follows.

I. In the first stage of decomposition, major endothermic peak at 190°C is attributed to loss of $0.5H_2$. The peak observed in the DTG curve corresponds to the weight loss 2.45% in the TG curve.

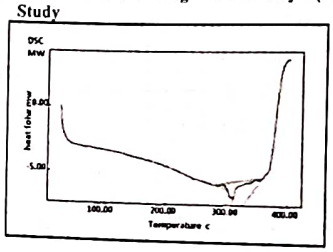
II. There are two endothermic peaks at 345°C and 360°C in the second stage of decomposition is attributed to loss of 2CO and H_4. The peak observed in the DTG curve corresponds to the weight loss17.34% in the TG curve.

III. The endothermic peak at 385°C in the third stage of decomposition is attributed to loss of CO_2.The peak observed in the DTG curve corresponds to the weight loss 12.72% in the TG curve.

IV. In the fourth stage there is no endothermic peak; decomposition is attributed to loss of CO. The peak observed in the DTG curve corresponds to the weight loss 8.11% in the TG curve.

Beyond the temperature 599°C, the reaction proceeds and finally stable residue Cu: $BaC_4H_4O_6$ remains up to the end of analysis.

3.4 Differential scanning Calorimetry (DSC) Study



The differentials scanning calorimetry (DSC) analysis of the grown crystals was recorded between 20°C to 400°C in the nitrogen atmosphere using Metals TA 4000I. Instrument. The initial weight of sample was 0.100mg and heating rate was maintained at 10°C/min. The Fig.6 (a) shows the DSC curves of Barium tartrate crystals. The initiation temperature is 302.77°C phase change complete at peak end-down temperature of 310.90°C. The temperature at which the sample and the reference come to thermal equilibrium by thermal diffusion. The peak appeared in the DSC curve at 318.06°C indicates the phase transformation due to loss of water molecules and formation of stable anhydrous BaC4H4O6 crystals. This is in good agreement with the TGA curve.

Table 6. The DSC data of barium tartrate Crystals.

Peaks	Temperature	On set	End set	Heat
Endothermic	310.90°C	302.77°C	318.06°C	-166.33mj

Fig 6(b) The two stages of DSC curve under study are as follows.

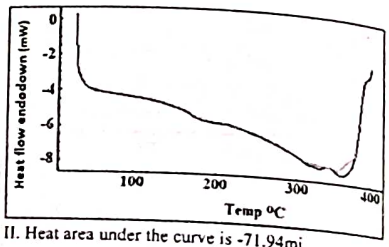
Stage-I

The initiation temperature is 310.29°C and initiation of phase change to starts completed at peak end-down temperature of 328.94°C. The temperature at which the sample and the reference come to thermal equilibrium by thermal diffusion. The peak appeared in the DSC curve at 336.46°C indicates the phase transformation due to loss of water molecules and formation of stable anhydrous Cu: $BaC_4H_4O_6$ crystals. This is in good agreement with the TGA curve.

II. Heat area under the curve is -22.44mj

Stage-II

The initiation temperature is 350.85°C and initiation of phase change to starts completed at peak end-down temperature of 359.55°C. The temperature at which the sample and the reference come to thermal equilibrium by thermal diffusion. The peak appeared in the DSC curve at 377.72°C indicates the phase tar formation due to loss of 2CO andH_4 formation of stable Cu: BaC_2O_4 cupper crystals.



II. Heat area under the curve is -71.94mj

Figure 6 (b) *Cu doped barium tartrate Crystals*

Table 7. DSC data of Cu 0.05M doped barium tartrate Crystals

Table 7. DSC data of Cu 0.05M doped barium tartrate Crystals

Peaks	Temperature	On set	Endset	Heat
Endothermic	328.94°C	310.29°C	336.46°C	-22.44mj
Endothermic	359.55°C	350.85°C	377.72°C	-71.94 mj

4. CONCLUSIONS

Thesilica hydro gel is suitable for growing the crystals of copper-doped barium tartrate bySignal diffusion method. The colourless, translucent, spherulitic, good quality crystals are obtained.The size of the doped crystals is increases with the increase in the concentration of Cu dopant.Lattice constant a, b and c, the unit volume is sensitively affected by the dopant concentrations.The powder X-ray diffraction study confirmed that grown crystals are very much crystalline in nature having orthorhombic structure and incorporation of the dopant has not altered the structure of the parent barium tartrate crystal.As a result of Cu doping, the XRD peak values shifted toward lower angle, indicating that an increase in the value of lattice constants.TheTGA, DTG and DSC, analysis suggests that the thermal stability of Barium tartrate crystal increases due to copper doping.The residual Copper

barium oxide (CuBaO) identified from TG analysis confirms the presence of strontium barium (CuBa) in the grown crystals.

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Comparative study on nutritive properties and omposition of milk of Sangamneri Goat, Nimari Cow and Surti Buffalo

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bstract
ilk is the essential component of our daily diet, especially for young ones. So the present research paper ıdies contents and nutritive properties of milk of livestock. For this study physico-chemical analysis applied. ilk samples of Surti Buffalo had higher pH, titratable acidity, total solids, solid not-fat (SNF), ash, fat, protein, ctose, total Nitrogen and some selected minerals viz., Calcium, Phosphorous and Chloride content than mari cow and Sangamneri goat. Whereas Sangamneri goat milk samples were having higher water and ıgnesium content than that of milk samples collected from Nimari cow and Surti buffalo. Milk of Surti buffalo ıs rich source of macro nutrients (fat, protein, lactose and selected minerals than that of Nimari cow milk. rti buffalo milk was more energetic, than that of milk of Nimari cow and Sangamneri goat.

ey Words: *pH, S.N.F, goat milk, titratable acidity, macro nutrients*

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I. Introduction

verview of Jalgaon District in Maharashtra-Jalgaon district is located in the north-west region (N latitudes)°15' and 21°25' and E longitudes 74°55' and 76°28) of the state of Maharashtra and is bounded by Satpuda ountain ranges in the north, Ajanta Mountain ranges in the south. Jalgaon district is having area of 11757 sq. ns. With 15 tehsils (Figure1.2). Jalgaon district is bounded by Madhya Pradesh state to the north, and by the stricts of Buldhana to the east, Jalna to the southeast, Aurangabad to the south, Nashik to the southwest, and hule to the west. Fifteen tehsils are included in Jalgaon districts namely 1. Jalgaon, 2. Jamner, 3. Erandol, 4. harangaon, 5. Bhusawal, 6. Bodwad, 7. Yawal, 8. Raver, 9. Muktainagar, 10. Amalner, 11. Chopda, 12. arola, 13. Pachora, 14. Chalisgaon, and 15. Bhadgaon.

Jalgaon district is known for its advances in horticulture. The soil which is found in Jalgaon district is ell suited for cotton production. Its production of bananas and cotton, especially by resorting to drip irrigation, as created a role model for cultivators in other parts of India. The district is very famous for the production of anana's in the country also known as banana capital of the country. Bananas grown in the district are exported utside the State and to other countries. Jalgaon is also famous for gold. It is a major business center for tea, old, pulses, cotton and bananas due to which the city is developing rapidly. The famous, Jain irrigation systems roducing solar product is situated in Jalgaon. The other different types of industries like coal products, hemical products, metal products and parts, food products, dairy products, gold and silver, silk, sugar, cotton, rigation instruments, pipes and many more are helping in the development of the city. There are total 63 large cale 128 medium scale and 3303 small scale industries in Jalgaon. There are local farmers, Kathiyawadi people nd Animal Farm Houses in Jalgaon district are having cattle raised for milk and meat.

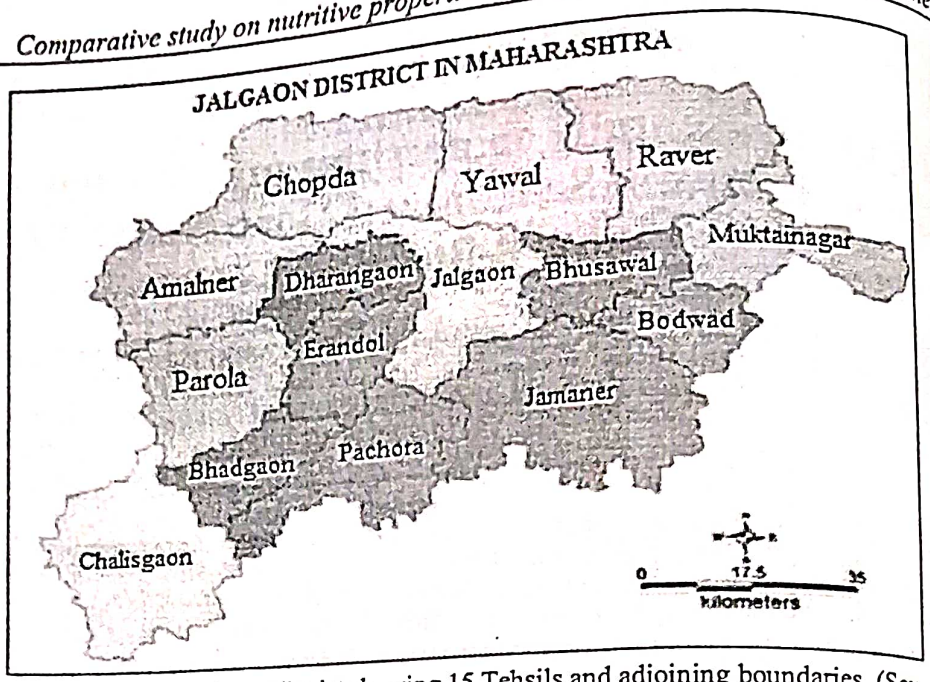

Figure 1.2. Map of Jalgaon district showing 15 Tehsils and adjoining boundaries. (Source: www.mapsofindia.com)

Milk is considered as nearly complete human food and it is considered as the first food for newlyborn offspring. Milk is an almost ideal food having high nutritive value. It supplies body building proteins, bone forming minerals and furnishes energy giving lactose and milk fat. Besides supplying essential fatty acids, it contains the above nutrients in an easily digestible and assimilable form (Vishwesh and Krishnaiah, 2005).

World milk production derives from cows, buffaloes, goats, sheep, and camels, with buffalo milk the second most consumed type after cow's milk. Both buffalo and cow's milk are highly nutritious and provide a great amount of vitamins and minerals, but buffalo milk packs more nutrients and calories per serving. Buffalo milk is extremely rich in calcium, and is a good source of minerals like magnesium, potassium, and phosphorus. It contains less cholesterol, more fat, and more calories. It is good for healthy bones, dental health, cardiovascular health, and weight gain. It has 100% more fat content than cow's milk and can be preserved longer. Whereas cow's milk has lower in fat than buffalo milk and preserved for less time. Cow's milk is rich in a variety of minerals, vitamins, and proteins, it is also an excellent source of calcium. More cholesterol, less fewer calories. It is beneficial for healthy bones, dental health, reducing obesity in children, protection thyroid diseases, and cardiovascular health (Sahin et al,2014; Navale and Gupta (2016).

There are nearly 500 breeds of goats in the world; however, only a half dozen are generally raised their milk purpose and about 600-700 million of dairy goats are present in the world (Kris, 2008). Goat is one the oldest domesticated animals. In ancient times also goat milk was valued the most. Goat milk still plays important role in human nutrition. All over the world riding on high profile or big budget campaign cow has been made very popular, however it doesn't mean that cow milk is the best with better quality than the milk. Goat milk offers a wide variety of health benefits such as better digestibility (Desjeux, 1993), alkalinity (Saini and Gill, 1991), less αs1 casein than cow's milk and is, therefore, less allergenic (Merin 1988). Goat milk also has antioxidant, antimicrobial, and medicinal property (Lopez et al, 1985; Rincon 1994). Goat milk contains a higher carotene (pro-vitamin A) having cancer-preventing properties. It is useful in the treatment of ulcers due to its more effective acid buffering capacity (Boros, 1989). Goat milk stronger flavour due to the liberation of short-chain fatty acids during rough handling, which gives off smell (Babayan, 1981; Haenlein, 1993). In fact 65% of the milk consumption worldwide is from goat milk is superior to cow milk in many aspects. (Mahmood and Usman, 2010; Kumar and Sharma, 2016).

Milk of different species contains the same kind of constituents but in varying in amount. With given species, genetic factors, environmental conditions and stage of lactation influence the composition of (Kanwal *et al*, 2004). Pertaining to available literature, comparative study between the nutritive quality composition of milk collected from Sangamneri Goat, Nimari Cow and Surti Buffalo raised in Jalgaon dist not available. Hence present investigation was carried out to compare the milk samples of goat, cow and buf from the point of view of its composition and nutritional values.

II. Materials And Methods

uipment/Apparatus

)t Air Oven

)t air oven (BST/HAO-1128, Bionics Scientific Technologies (P). Ltd. India) was used to evaporate the)isture content of milk samples.

ıalytical Balance

ıalytical balance (Smith Model: MO00440007) was used to weigh the milk samples and reagents.

:ntrifuge Machine

:ntrifuge machine (Tanco CEN-16, Medico Centrifuge, India) was used to centrifuge the milk samples during :termination of fat content of milk samples.

.icro Kjeldhal Digestion and Distillation Unit

.icro Kjeldhal digestion unit (BST/KDU-6, Bionics Scientific Technologies (P). Ltd. India) was used to digest e samples during determination of protein content of milk.

itration Kit

itration kits were used to titrate the samples after distillation during determination of protein content of milk.

luffle Furnace

luffle furnace (Biolinx Labsystems Pvt Ltd, Mumbai)) was used to ignite the milk samples during the :termination of ash content of milk.

utyrometer -Borosilicate Glass Butter Butyrometer (Hindustan Thermostat, India) were used to measure fat ontent of the milk samples.

H meter -SELTIX pH Test Meter ± 0.1pH was used to measure the pH of milk samples

'cynometer -Specific gravity of milk samples were measured using Pcynometer (Thomas Scientific, USA)

:OLLECTION OF MILK SAMPLES

'resh milk samples form Sangamneri Goat, Nimari Cow and Surti Buffalo were used (each type four samples). \ll these samples were collected from local famers, animal farm houses and Kathiyawadi people who have actating cattle in Jalgaon district of Maharashtra. The samples were kept refrigerated at 4°C and transported to he laboratory within 24 hours, prior to refrigeration. All the milk samples were stored at -20°C until analysis.

PHYSICO-CHEMICAL ANALYSIS OF MILK SMAPLES

Specific gravity

The specific gravity of the milk is measured using a Lactometer and the temperature deviation of milk is taken into considerationand correction applied, the lactometer is called CorrectLactometer Reading (CLR) with the formula. Specific gravity of milk can be calculated by the following formula:

$$\text{Sp. Gr.} = \frac{\text{CLR}}{1000} + 1$$

Corrected lactometer reading (CLR) = LR + CF

Where CF for Quevenne lactometer

CF (+) = 0.1 x difference in temperature above 60^0F

CF (-) = 0.1 x difference in temperature below 60^0F

Titratable acidity

Titratable acidity is the amount of alkali required to bring the pH to neutrality. This property of milk is used to determine bacterial growth during fermentations, such as cheese and yogurt making as well as compliance with cleanliness standards. Naturally, there is no lactic acid in fresh cattle milk, however, lactic acid can be produced by bacterial contamination, but this is not common. The titratable acidity is due to the casein and phosphates.

Titratable Acidity of Milk The alkaline range of the titration curve is important because of the widespread use of titratable acidity to characterize milk. The titratable acidity is the buffering capacity of milk between its own pH (6.6) and pH 8.3 (the phenolphthalein end point). The measurement of titratable acidity (usually expressed, somewhat arbitrarily, as percentage lactic acid) is useful for determining the freshness of milk and for controlling the manufacture of fermented dairy products. Thetitratable acidity of fresh milk seldom falls outside the range 0.14–0.16% (McCarthy, 2002).

- **Total Solids Content**

Total solids content (TS) was observed according to the method of Association of Official Analytical Chemists (AOAC, 2000). The milk sample (5g) was taken in a pre-weighed flat bottom dish. The dish was placed in hot air oven at101±1°C for 3 hrs and transferred to desiccator having a silica gel as desiccant. After 1 hr, the dish was weighed.The drying and desiccating were repeated till achieving the constant weight and calculation was made as per following formula.

$$\text{Total solids content (\%)} = \frac{\text{Wt. of dried sample (c-a)} \times 100}{\text{Wt of sample taken (b-a)}}$$

Where,
a = weight of empty dish
b = weight of sample + dish
c = weight of dried sample + dish

Solids Not Fat (SNF)

Solid not-fat is an important criterion of milk selection for further processing. Milk solids non-fat would include the nitrogenoussubstances, milk sugar and mineral matter. Whole fluid milk contains a minimum 8.25 percent SNF. The determination of solidnon-fat is done by taking lactometer reading at 40°C. Solids-not-fat (SNF) content was determined by the following formula (HarrisandBachman, 2003).

SNF content (%) = TS (%) – Fat (%)

Fat Content

Fat content was determined by Gerber method as described by James (1995). Milk sample (11 ml) was mixed with 90 % sulfuric acid (10 ml) and amyl alcohol (1 ml) in butyrometer and closed with rubber cork. The butyrometer was placed in a Gerber centrifuge machine and centrifuge for 5 min at 1100 rotation per minute (r.p.m). The fat percentage was noted on the butyrometer scale.

Protein Content

Protein content was determined according to the method of British Standards Institution (BSI, 1990). The sample (5g) was digested using Micro Kjeldhal digester in the presence of catalyst (0.2 g of copper sulfate and g of sodiumsulfate) where sulfuric acid (30 ml) was used as an oxidizing agent. The digested sample was diluted with distilled water (250 ml). Then 5 ml portion from the diluted sample was distilled with NaOH (40 %) using Micro-Kjeldhal distillationunit, where steam was distilled over 2 % boric acid (5 ml) containing an indicator for 3 minutes. The ammonia trapped in boric acid was determined by titrating with 0.1N HCl. The nitrogen percentage was calculated using following formula:

$$N\% = \frac{1.4\,(V_1-V_2) \times \text{Normality of HCl} \times 250}{\text{Wt. of sample} \times \text{Vol. of diluted sample}}$$

Where,
V1 = Titrated value of milk sample
V2 = Titrated value of Blank sample

While protein content was calculate from the N% by multiplying with conversion factor i.e. 6.38 as reported by James (1995).

Lactose Content

Lactose content was determined by subtracting the sum of total percent of fat, protein and ash contents from thatof total solids content of milk.

Ash Content

Ash percentage was determined by Gravimetric method as described by AOAC (2000) using muffle furnace. The milk sample (5g) was taken in pre-weighed crucible, and transferred to muffle furnace (550°C) for 4±1 h. Ignitedsample was transferred to desiccator having silica gel as desiccant. After 1 hr. the crucible was weighed and the content wascalculated by following formula:

$$\text{Ash (\%)} = \frac{\text{Wt. of ignited sample} \times 100}{\text{Wt. of sample taken}}$$

Calorific Values of milk samples

Calorific/energy values were calculated from the proximate analysis results using the following generalized equation:

Kcal 100g-1 = (% protein × 4) + (% fat × 9) + (% lactose × 4)

Selected minerals content

Calcium and magnesium were determined simultaneously in milk by complexometric method of Davies & White (1962) using disodium salt of ethylenediaminetetraacetic acid.

Phosphorous was determined by the colorimetric method of Fiske and Subbarow (1925).

The chloride content of all the milk sample of milk was determined by Hammer and Bailey (1917) using $AgNO_3$.

Statistical Analysis

A computerized statistical package of GraphPad Prism (Analytical software, San Diego, CA 92108) was used to analyse the data. The data so obtained was tabulated and analysed with statistical procedure of summary statistics, under which descriptive statistics and frequency distribution test, were applied to observe

variability within same character of milk among different samples and their frequencies. The data were further analysed through statistical procedure of analysis of variance (ANOVA) to observe the significant differences among the variables and in case of significant difference exist, the mean were further computed using least significant difference (LSD) at 5 % level of probability.

OBSERVATIONS

Based on the survey of dairy farms and analysis of milk samples collected in Jalgaon district (Figure 1.6) the following obervations were noted.

Table 1.1: Phenotypic Characters of Sangamneri goat

1	Colour	PredominantlyWhite
2	Ears	Pendulous, in some goats horizontal & erectears
3	Horns	Average 8-12% are polled and remaining arehorned. Horns are curved (69.35%) or straight (30.65%)
4	Forehead	The Sangamneri goats had convex (87.75%),straight (10.14%)& concave (2.10 %) forehead.
2. Weights		
1	Wt.at birth	Male 2.43+0.11 kg Female2.08+0.092 kg
2	Wt.of full grown Female	23.72+0.71kg
3	Wt.of full grown Female	24.21+037kg
3.Reproductive Characters		
1	Age at Maturity	245.19+7.42 Days
2	Age at 1st pregnancy	287.09+10.16 Days
3	Age at 1st kidding	432.18+12.77 Days

III. Results And Discussion

pH of the milk samples: Milk has acidic properties inside of mammals due to the presence dissolved carbon dioxide. But the milk has alkaline properties outside of the mammals because of losing carbon dioxide to the air.The negative log of hydrogen ion concentration (pH) of the milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo is summarized in table 1.2. The pH of the milk was measured at the time of sampling using portable pH meter. The results showed that pH values were in the range of 6.48 to 6.65 in goat milk, 6.54 to 6.71 in cow milk and 6.52 to 6.95 in buffalo milk. The pH of buffalo milk were significantly ($p<0.05$) higher than that of cow and goat. Whereas, the pH of cow and goat were not significantly different form each other ($p>0.05$). The pH value of buffalo found the present investigation is in agreement of the findings of Kanwal et al (2004). Cow and goat milk shown pH in accordance with pH reported by Abay and Kebede (2016).

Table 1.2: The pH values of milk samples of goat, cow and buffalo

	pH value			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	6.48	6.65	6.56	0.06
Nimari cow	6.54	6.71	6.62	0.05
Surti Buffalo	6.62	6.98	6.73	0.08
Significance				
Goat milk v/s Cow milk	n.s			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = $p < 0.001$, * = $p < 0.05$, n.s. = $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

Specific gravity of milk samples:

Fat present in the milk causes the specific gravity slightly higher than the water. Alteration in the composition of milk can reflect in change in the specific gravity of milk. If the fat is removed form milk, its specific gravity can be increased because ofthe weight of fat is much lower than the water. Milk adulterated with water converts milk into less nutritive and its quality becomes substandard. The lactometers are normally standardized at a particular temperature (say 60°F or 15.6° C). If the temperature is above or below the standard temperature of 60°F, the lactometer reading should be corrected by adding 0.1 to the lactometer reading or

0.0001 to the specific gravity for each °F above 60°F and vice versa for lower temperatures (Aware and Kshirsagar, 2017).

Table 1.3 represents the LR and specific gravity of milk samples taken from Sangamneri goat, Nimari cow and Surti buffalo. Results showed in the present study that Nimari cow's milk has highest specific gravity and LR i.e.29.9 and 1.03 respectively. These figures are followed by Sangamneri goat and lowest specific gravity and LR were noted for the milk sample of Surti buffalo. The results obtained during this study were resembling the findings of Getanch et al (2016). Values of Mean LR and Mean specific gravity of goat and buffalo were no significantly differ from each other while these figure significantly with that of cow's milk. Normal milk rarely has the specific gravity at (60°F) less than 1.03 (LR=30), hence lower LR may be due to adulteration of milk.

Table 1.3: Lactometer reading (LR) and Specific gravities of goat, cow and buffalo milk samples

Source	LR (Range)	LR (Mean)	Sp.Gravities (Range)	Sp. Gravities (Mean)
Goat	27-29	28.7	1.02- 1.03	1.02
Cow	28-33	29.9	1.02- 1.03	1.03
Buffalo	26-29	28.3	1.02- 1.02	1.02

Mean having same figures are statistically not significantly differ from each other (P<0.05).

Titrable acidity:

Table 1.4 shows the values of titratable acidity (%) of milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo. The results indicated the titratable acidity were fluctuated between 0.14 to 0.17% in goat milk, 0.14 to 0.17% in cow milk and 0.15 to 0.20% in buffalo milk.The mean value of titratable acidity (%) of buffalo milk were higher than that of goat milk and it showed highly significant differences at p<0.05 level. Whereas, it was observed that differences in mean values of titratable acidity (%) of goat milk and cow milk as well as of the cow milk and buffalo milk were significant (p<0.05).

Table 1.4: Values of titratable acidity (%) of milk samples of goat, cow and Surti buffalo.

	Titratable acidity (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	0.14	0.17	0.155	0.02
Nimari cow	0.14	0.19	0.165	0.01
Surti Buffalo	0.15	0.20	0.175	0.03
Significance				
Goat milk v/s Cow milk	*			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = p < 0.001, *= p < 0.05

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The mean value of the titratable acidity (%) in Sangamneri goat was in accordance with result Kumar and Sharma (2016). Whereas the milk of Nimari cow showed resembling figure of titratable acidity that of Mahboba and Zubeir (2007).The Surti buffalo milk was similar as reported by Sahin et al (2014).

Total Solids (TS) in milk samples:

Total solids are measured to ensure the quality of milk samples. The total solids in milk can determined from the specific gravity and fat content from lactometer reading. Besides carrying out the solids percentage from the indirect method of using lactometer reading, a direct method of gravimetric an can also be useful. This method involves accurately weighing a few grams of the material and subjecting heat until all moisture has been driven off on a water bath. The dry residue is weighed, its percentage calc as total dry solids. TS of milk samples were measured as per the method of AOAC (2000) and give in table

Table 1.5: Concentration of total solids in milk samples collected form goat, cow and buffalo.

	Total solids (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	12.86	13.65	13.25	0.62
Nimari cow	11.46	14.65	13.05	0.56
Surti Buffalo	15.59	19.44	17.52	0.85
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The results illustrated that the concentration of total solids were fluctuated in the range of 12.86 to 13.65% in the milk samples of Sangamneri goat, 11.46 to 14.65% in milk samples of Nimari cow and 15.59 to 19.44% in the milk samples of Surti buffalo. The concentration of total solids in buffalo milk was higher than that of the values noted in milk samples of cow and goat and showed highly significant differences at $p<0.001$ level. Whereas, TS values in goat and cow milk samples were not significantly differ from each other ($p>0.05$).

Solid not fat (SNF)

Results regarding solid not-fat (SNF) in milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo are shown in table 1.6. Statistical analysis indicated that source of milk has significant ($p < 0.05$) influence on SNF content. The SNF of milk samples were in the range of 6.97 % (Sangamneri goat) to 8.93 % (Surti Buffalo).

The differences in percentage of SNF in goat and buffalo milk samples as well as in cow and buffalo milk samples were highly significant ($p < 0.001$) whereas SNF% in goat milk sample and cow milk sample were not significantly differ from each other at $p>0.05$. Rasheed et al (2016) reported similar results of SNF% in the milk samples of various sources of milk.

Table 1.6: The percentage of SNF in milk samples of goat, cow and buffalo.

	Solid Not Fat (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	6.97	7.05	7.01	0.04
Nimari cow	7.24	7.98	7.61	0.07
Surti Buffalo	8.23	8.93	8.58	0.12
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

On the other hand, results reported by Pandya and Ghodke (2007) were slightly different and this might be due to the variation in breed, diet and animal health and environmental conditions (Zicarelli, 2004; Ahmad et al. 2008). Hence, concluded that SNF content not only depends on source of milk but also depends on various factors such as breeds, animal feed and season.

Ash-Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence ofoxidizing agents, which provides a measure of the total amount of minerals within a food. Analytical techniques for providinginformation about the total mineral content are based on the fact that the minerals can be distinguished from all the othercomponents within a food in some measurable way. The most widely used methods are based on the fact that minerals are notdestroyed by heating and that they have a low volatility compared to other food components. The main analytical techniquesused to determine the ash content of foods are based on this principle: dry ashing, wet ashing and low temperature plasma dryashing. By dry ashing method its percentage in the milk samples were calculated.

The percentage of ash content in the milk samples of Sangamneri goat, Nimari cow and Surti buf in table 1.7.

Table 1.7: Ash content in the milk samples collected from goat, cow and buffalo

Ash (%) Source of milk	Min.	Max.	Mean	SD (±)
Sangamneri goat	0.57	0.98	0.77	0.11
Nimari cow	0.38	0.79	0.58	0.09
Surti Buffalo	0.70	0.97	0.83	0.05
Significance				
Goat milk v/s Cow milk	***			
Goat milk v/s Buffalo milk	n.s.			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The milk samples from Surti buffalo shown the highest ash content (0.83%) and its values w between 0.70 to 0.97%, followed by goat milk (0.77%) in which its values showed range between and the lowest ash content (0.58%) was noted in milk samples collected form Nimari cow, where fluctuated between 0.38 to 0.79%. The differences in values of ash content in goat milk and cow as well as in cow milk and buffalo milk samples were highly significant ($p<0.001$), whereas the significant ($p>0.05$) difference between values of ash content in milk samples collected form goat a

The amount of ash content in Surti buffalo milk samples were similar to that were reported by (2008). There was resembling reports noted by Bhosale et al (2009) so far the ash content va samples of collected form Sangamneri goat were concerned. The percentage of ash content in mi Nimari cow were in accordance with results obtained by Javaid et al (2009) and Sreedhar et al (200

Fat content

The results related to fat content in milk samples collected from Sangamneri goat, Nimari cow and are shown in table 1.8.The results related to fat content (%) indicated that maximum mean value (7. in milk samples of Surti buffalo, followed by Nimari cow (4.59). Whereas milk sample taken from cow showed lowest percentage of fat (3.86).

Table 1.8: Fat content (%) in milk samples of goat, cow and buffalo

Fat (%) Source of milk	Min.	Max.	Mean	SD (±)
Sangamneri goat	3.45	4.27	3.86	0.48
Nimari cow	3.98	5.21	4.59	0.53
Surti Buffalo	6.89	8.12	7.50	0.42
Significance				
Goat milk v/s Cow milk	**			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, ** = $p < 0.01$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

There were highly significant differences ($p<0.001$) between goat and buffalo milk samples in in cow and buffalo milk samples. The differences in fat content (%) between goat and cow significantly differ ($p<0.01$).Mean fat content 5.25% in buffalo milk and 4.04% in cow milk were Salman et al (2014).

Fats in milk are called butterfat and occur as suspended globules, which are easily seen th power microscopes. Cattle milk derives many of its most distinctive properties from its lipid fracti average total fat content in the milk is similar to that found in other ruminant species, despite report

percentage of fat in goat's milk exceeds that of the cow (Getaneh et al, 2016). Such a controversy most likely derived from the fact that the average percentage of milk fat, as with cow's milk fat, is a variable component, often ranging between 3.0 and 6.0 percent. There are also distinct breed differences in fat composition. It should be remembered, however, the quality and quantity of feeds, genetics season, stage of lactation, etc. all influence the average percentage of goat milk fat. According to analytical results obtained by Garry et al (2000) in terms of cholesterol, goat's milk appears to offer a specific distinction in comparison to cow's milk, cow's milk typically contains about 14 to 17 mg cholesterol per 100 g milk, while goat's milk is more usually recorded at 11 to 25 mg per 100 gram of milk.

Protein content

Milk protein is mainly in the form of casein, lactoalbumins and lactoglobulins. About 82 percent of the protein in milk is casein and the remaining proteins are whey proteins, which are lactoalbumin and lactoglobulin. Casein binds with calcium in milk and forms the calcium caseinate complex, which is present in the colloidal form. Acid, rennet, alcohol and heat can precipitate this complex. The protein content (%) in the milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo are shown in table 1.9.

The results indicated that the value of mean protein in Surti buffalo milk was highest (4.46%) as compared to that of cow milk (3.44%) and goat milk (3.02%). The values of protein content of buffalo milk with that of goat milk and cow milk were differ highly significant ($p<0.001$) whereas differences in protein content in goat milk and cow milk were not significant ($p>0.05$).

Table 1.9: Protein content (%) in milk samples of goat, cow and buffalo

Source of milk	Protein (%) Min.	Max.	Mean	SD (±)
Sangamneri goat	2.49	3.55	3.02	0.24
Nimari cow	2.93	3.96	3.44	0.28
Surti Buffalo	4.11	4.82	4.46	0.22
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s. = $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The proteins in milk contain all the essential amino acids, and elements that our bodies cannot produce. It is important to remember that proteins are the building blocks of all living tissue. Milk proteins have roughlythe same composition as the egg protein, except for the amounts of methionine and cysteine, significantly lower. Indeed, thesulphur amino acids are the limiting factors in milk. Casein and, even more, the complex milk protein contains good proportionof all amino acids essential for growth and maintenance (Ghada, 2005). The amino acids present in the milk can be precipitated by acid, rennet or alcohol. The denomination crude protein (CP) includes protein (TP) andnon-protein nitrogen (including urea). The protein content is an important feature of the milk (Arora et al, 2013).

Lactose-Chemically lactose is disaccharide made up of glucose and Galactose. It is main component of milk. Except for the milk of mammals, lactose is rarely found in other whole, unprocessed foods. Infants use it as an important energy source during their first year of life (Silanikove et al., 2015). It also supports the development of probiotic bacteria in gastrointestinal tract, which helps protect them from infections (Fassio et al., 2018).In cows, lactose is synthesized in the mammary gland from about 20% of the glucose in the bloodstream. It makes up an estimated 4.7% of the total nutrient content in a cow's milk, typically more by weight than even fat or protein (Costa et al., 2019).

Lactose content in the milk samples collected fromSangamneri goat, Nimari cow and Surti buffalo are given in table 1.10.

Table 1.10: Lactose content in milk samples of goat, cow and buffalo

Source of milk	Lactose (%) Min.	Max.	Mean	SD (±)
Sangamneri goat	3.76	4.42	4.09	0.28
Nimari cow	4.44	5.32	4.88	0.31

Surti Buffalo	4.68	5.37	5.02	0.44
Significance				
Goat milk v/s Cow milk	*			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = $p < 0.001$, * = $p < 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The results of the present investigation reveals that lactose (%) is highest in milk samples of S buffalo, in which values ranged between 4.68 to 5.37%. It then followed by milk samples of Nimari cow which the percentage of lactose were lower (4.88%) than Surti buffalo and higher than that of Sangamneri g Lactose content in goat milk fluctuated between 4.44 to 5.32%. The lowest lactose content were noted in mil Sangamneri goat (4.09%), where the values showed the range between 3.76 to 4.42%. The differences in va of lactose content between milk samples of goat and cow as well as in cow milk and buffalo milk w moderately significant from each other at $p<0.05$ level. While, differences in values of lactose content in s samples of goat and buffalo were highly significant at $p<0.001$ level.

Pertaining to the results obtained, it important to mention that Kapadiya et al (2016) repo resembling values of lactose content during their studies on the gross composition, nitrogen distribution, selected mineral content ingoat milk, and its comparison was made between cow and buffalo milk. T resembling results were also noted by Imran et al (2008) and Bhosale et al (2009). Variationin lactose con might be due to the differencesin the breed, feeding and environmental conditions (Pandya and Ghodke, 20 Ahmad et al, 2008).

Water content -Water content of milk samples of Sangamneri goat, Nimari cow and Surti buffalois give table 1.11. Results illustrated that average water contentof goat, cow and buffalo milk samples were 88.3, 8 and 84.3 %, respectively. Statisticalanalysis showed a significant ($P < 0.05$) differencebetween the water con of goal and buffalo as well as in milk samples of cow and buffalo.

Maximum water content was observed for goat milk (88.3 %), while minimum value was recorded buffalo milk (84.3 %). Abdelgawad et al (2014) and Rasheed et al (2016) observed higher water content in g ofgoat and cow milk. Cow milk contains a considerable amount of water that ranged from 87.2 to 87.4% (A and Kebede, 2018). Health of animal, stage of lactation, breed and somehow animal age has signifi influence on water content of milk (Park, 2007).

Table 1.11: Water content in milk samples of goat, cow and buffalo

	Water content (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	87.7	88.9	88.3	0.11
Nimari cow	86.7	87.8	87.2	0.09
Surti Buffalo	83.9	84.8	84.3	0.08
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	*			
Cow milk v/s Buffalo milk	*			

Significance: * = $p < 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

Nitrogen distribution

Total nitrogen (TN) content of all the milk samples of Sangamneri goat, Nimari cow and Surti buf determined using the micro Kjeldahlmethod of nitrogen estimation as described in BIS handbook and give table 1.12.

Table 1.12: Nitrogen distribution in milk samples of goat, cow and buffalo

Types of milk	Parameters (%)		
	TN	NCN	NPM
Goat	0.536±0.021^{a} (0.498-0.548)	0.153±0.015^{a} (0.132-0.167)	0.029±0.007^{a} (0.019-0.036)
Cow	0.547±0.028^{a} (0.499-0.568)	0.124±0.013^{b} (0.103-0.136)	0.054±0.014^{a} (0.036-0.074)
Buffalo	0.702±0.046^{b} (0.644-0.743)	0.140±0.020^{c} (0.118-0.157)	0.051±0.024^{a} (0.023-0.082)
SEM	0.015	0.007	0.007
CD	0.05	0.022	-
Test	*	*	NS
CV%	5.62	11.64	37.003

a-c Values with different letters within a column are significantly different at 5% level of significant (i.e., $p<0.05$). SEM=Standard error of mean, CD=Critical difference, CV=Coefficient of variance, NS=Not significant, TN=Total nitrogen, NCN=Non-casein nitrogen, NPM=Non-protein nitrogen

Non-casein nitrogen (NCN) contentand non-protein content of all the milk samples were determined using Rowland's analytical scheme for nitrogen fractions of milk as described in a laboratory manual on chemical analysis of milk protein byKumar et al, 2012.

Selected mineral content of milk

The selected mineral content of Sangamneri goat, Nimari cow, and Surti buffalo milk is mentioned in Table 1.13. The values of calcium content ranged between125.2 to 138.5 mg/100 ml with a mean value of131.8 mg/100 ml in milk samples of Sangamneri goat. Similarly, in Nimari cowmilk, range of calcium was 112.5 to 134.8 mg/100 ml with a mean value of 123.6 mg/100 ml. Onthe other hand, calcium content ranged between164.8 to 182.7 mg/100 ml with a mean value of173.7 mg/100 ml in Surti buffalo milk. The calcium contentof buffalo milk was statistically higher than that of the goat milk as well as cow milk. The differences in calcium content in milk samples of goat and buffalo as well as in milk samples of cow and buffalo were highly significant ($p<0.001$) while calcium content values of goat and cow milk differ from each other at $p<0.05$.

Table 1.13: Calcium, Magnesium, Phosphorous and Chloride content in milk samples of goat, cow and buffalo.

Milk source	Calcium (mg/100ml)	Magnesium (mg/100ml)	Phosphorous (mg/100ml)	Chloride (%)
Goat (G)	131.8 ± 8.32 (125.2 to 138.5)	18.72 ± 1.56 (17.27 to 20.18)	94.85 ± 11.32 (80.21 to 109.5)	0.11± 0.04 (0.09 to 0.13)
Cow (C)	123.6 ± 5.68 (112.5 to 134.8)	13.41 ± 2.14 (11.58 to 15.24)	87.26 ± 9.02 (75.96 to 98.57)	0.12 ± 0.02 (0.10 to 0.14)
Buffalo (B)	173.7 ± 6.89 (164.8 to 182.7)	17.79 ± 1.94 (15.47 to 20.12)	106.9 ± 9.02 (92.33 + 121.5)	0.12 ± 0.03 (0.11 to 0.13)
Significance				
G v/s C milk	*	**	*	*
G v/s B milk	***	n.s.	**	*
C v/s B milk	***	**	***	n.s.
Significance: *** $p<0.001$ **= $p<0.01$ * $p<0.05$ n.s. $p>0.05$				
Each figure is Mean ± Standard Deviation of 6 observations. n.s. =non-significant. Figures in bracket are range of parameters.				

The magnesium contents in milk samples of Sangamneri goat fluctuated between 164.8 to 182.7 mg/100 ml with a mean value of 18.72 mg/100 ml. Similarly, in Nimari cow milk, range of magnesium was 164.8 to 182.7 mg/100 ml with a mean valueof 13.41 mg/100 ml. On the other hand, magnesium content fluctuated between 15.47 to 20.12 mg/100 mlwith a mean value of 17.79 mg/100 ml in buffalomilk. These results are in accordance with Kapadiya et al (2016). The magnesium content of goat milk was significantly higher than that of the Nimari cow and Surti buffalo milk.The differences in magnesium content in milk samples of goat and cow as well as cow and buffalo milk were significant at $p<0.01$ level, while there no significant different in calcium content values of goat and buffalo milk samples ($p>0.05$).

In relation to range of phosphorous content in the milk samples of Sangamneri goat were 80.21 to 109.5mg/100 ml with a mean value of94.85 mg/100 ml. While in milk samples of Nimari cow, phosphorous content fluctuated between 75.96 to 98.57mg/100 ml witha mean value of 106/9 mg/100 ml in Surti buffalo milk.The mean value of phosphorous content in Surti buffalo milk was significantlyhigher than that of the Sangamneri goat and Nimari cowmilk. The differences in phosphorous content in milk samples of goat and cow

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were significant at $p<0.05$ level, in milk samples goat and buffalo were significant at $p<0.01$ and in milk samples of cow and buffalo were highly significant at $p>0.001$.

The values of chloride content in the milk samples of Sangamneri goat were fluctuated between0.09% 0.13% with a mean value of 0.11% in goatmilk. Similarly, in Nimari cow milk, range of chloride was0.10% 0.14% with a mean value of 0.12%. On the otherhand, chloride content ranged between 0.10% and0.12% with mean value of 0.12% in Surti buffalo milk.The chloride content of goat milk samples were significantly higher ($p<0.05$) than that of the cow and buffalo milk samples, while there in no significant difference ($p>0.05$) in chloride content of cow and buffalo milk samples. These results differed from the findings of Kapadiya et al. (2016), which might be due to differences in species and environmental conditions including physiochemical parameters of water used for cattle (Guzeler et al., 2010). Asif and Usman (2010) compared the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep and recorded higher levels of physicochemical parameters in buffalo and sheep milk than cow and goat. They noted comparatively higher values of specific gravity, titratable acidity, ash and protein content in sheep than that in buffalo milk but the estimated values of pH, total solids, fat and lactose in sheep milk were lower than that in milk samples of buffalo in addition to findings that all tested parameters were similar in cow and goat milk except ash which was higher in milk samples of goat under study.

IV. Conclusion

Milk samples of Surti Buffalo had higher pH, titratable acidity, total solids, solid not-fat (SNF), ash, fat, protein, lactose, total Nitrogen and some selected minerals viz., Calcium, Phosphorous and Chloride content than Nimari cow and Sangamneri goat. Whereas Sangamneri goat milk samples were having higher water and magnesium content than that of milk samples collected from Nimari cow and Surti buffalo.

The results of the present part of investigation help to conclude that milk of Surti buffalo was rich source of macro nutrients (fat, protein, lactose and selected minerals than that of Nimari cow milk. Surti buffalo milk was more energetic, than that of milk of Nimari cow and Sangamneri goat.

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Role of Digital Technologies in Livestock Management

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Abstract
Farm and farmers' characteristics associated with digital technology adoption in cow, buffalo and goat farming were assessed using regression analysis. The effects for the implemented and new technologies in farm houses in Jalgaon district slightly differed. The regression analyses showed that the type of production (organic or conventional), the working time (full- or part-time business) and the agricultural area were not related to the adoption of digital technologies in ruminant farming in study area. However, farmers with larger numbers of livestock units were more likely to adopt both types of technologies than farmers keeping fewer livestock. On the other hand, age was negatively and significantly correlated to the adoption of new digital technologies: farmers were less likely to adopt this type of technology with increasing age. The zone, the main farm type, the region, the enterprise and the barn system mattered for adoption. More specifically, compared with the base category river valley, a small negative effect on the adoption of implemented digital technologies could be found for hill and mountain zones and a strong negative effect on the adoption of new technologies for the mountain zone. Farmers with animals in tie stall barns and farmers who had a combination of loose housing and tie stall systems were less likely to have implemented technologies compared with the base category loose housing. Dairy biotechnology related to cross-breeding technology, increasing disease resistance in livestock, scientific feeding of cows, embryo transmit technology, artificial insemination, development of new molecules and vaccines for prevention and disease management of animals, dairy enzymes/proteins/probiotics, food-grade bio-preservatives, etc. have perspective role livestock management in Jalgaon district and Maharashtra in special and India in general. Lack of good indigenous software, lack of management awareness, lack of computer awareness and cost of the digital technology are the factors that affect process of incorporation of technology in livestock rearing and management.

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I. Introduction

Since the inception of human civilization, animal husbandry and dairying activities, along with agriculture, continue to be an integral part of human life. These activities have contributed not only to the food basket and draught animal power but also by maintaining ecological balance. Owing to conducive climate and topography, Animal husbandry and Dairying Sectors have played prominent socio-economic role in India. Traditional, cultural and religious beliefs have also contributed in the continuance of these activities. They also play a significant role in generating gainful employment in the rural sector, particularly among the landless, small and marginal farmers and women, besides providing cheap and nutritious food to millions of people.

Growing population, changing lifestyles, expanding urbanization and accelerated climate changes are creating new challenges in Bovine breeding systems. In the past, the challenge was to ample feed, but now it is to provide essential nutrients to promote health especially reproductive health; and in the future, the challenge would be to provide optimal nutrients based on an animal's genetic profile and productivity. Fortunately, along with challenges, the developments in science are creating new avenues for tackling the challenges.

Further, biodiversity of livestock, which is so crucial for sustaining long-term productivity, is also under jeopardy. The genetically uniform systems are vulnerable to external shocks under extreme weather conditions, emerging diseases and pathogens. In livestock sector, due to continued focus on exotic germplasm based cross breeding, the number of indigenous breeds with better adaptability, disease-resistance and feed efficiency ratio is declining. The situation is made worse by unregulated blood levels in the crossbred progeny, in attempts to increase milk yield indiscriminately. Hence it is the need of the hour to conserve and improve the productivity of Indian indigenous breeds. For accomplishing this task, the department is now therefore focusing on 100 percent Artificial Insemination coverage along with the application of advanced cutting-edge reproductive technology developments.

In this context, India is blessed with a huge biodiversity of 43 indigenous cattle breeds and 13 Buffalo breeds which have survived over last hundreds of years in respect of their suitability for specific purposes in the concerned local environment. The Department's strategy is thus to enhance the average productivity of milk of select breeds from the overall available breed types (e.g. Gir for high milk productivity) from the present level of 4.85 kg per day to 6.77 kg per day per indigenous animal.

As per 19th Livestock census, there are 88 million In-Milk animals whose records are unavailable on an annual basis even. Records of those in breeding stage, their productivity, treatment and vaccination are also not properly maintained by State Animal Husbandry Departments (SAHD). This is because the system for maintaining records on the above aspects has not yet evolved in complete shape due to lack of prioritization. Impediments like lack of animal identification and traceability, inability to meet sanitary and phyto sanitary conditions also need to be addressed in this connection. In this context, an initiative has been taken namely, "E-PashuHaat", the e-market portal for bovine germplasm which provides real time data on availability of high quality germplasm along with identification and traceability of germplasm sold through e-market, connecting breeders, State agencies and stake holders. A modern technology like sexing of semen is being taken up to regulate the sex ratio and to produce large number of progenies with one sex. In advanced dairy nations, female sex sorted semen is made available to farmers to produce more number of high genetic merit heifers to increase milk production and profitability of dairy farming

The increased world population is demanding more reliable quality livestock products the number of farms is decreasing but the number of animals for per farm and animal production is increasing. In addition to this trend livestock production problems also increasing. The solution of these problems comes from multidisciplinary studies from very different fields such as technology. In large enterprises it is not possible to obtain the expected performance without using technology and automation systems from animals with very high genetic values. Daily work on livestock farming is simple in and standard application routinely Data monitoring in the modern dairy farm enables the ongoing control of production, animal health, and welfare (Ipema et al,2012). However, as the number of animals increases, error burden and work load increase. Successful livestock farmers will be capable of rapidly adapting their infrastructures to exploit changes in technology for better production. Mechanism and automation systems offer options in front of the user in intense competition for convenience. Currently, most data is extracted manually, yet manual observation is gradually being replaced by many milking systems by automated recording (milk yield, milk conductivity, activity recording and body weight measurements) leading to better data, both in quantity and quality. The number of farms automation systems has increased rapidly since 1980. Almost any medium- to large-sized farmers can benefit from enhanced automation (Thornton, 2010). There are many opportunities for facilities in automation technologies and systems. Today livestock farmers increasingly use robots on production or algorithms to optimize their farm management decisions. Technological developments are creating a new automation system in which smarter and more flexible work possibilities in livestock production (Kearney, 2017). The automation of animal husbandry and integration of on-farm systems and processes have a key role to play in facilitating the process of meeting each of important challenges for competitive market (Cornou, 2009). The main technologies are electronic recording, milking, heat detection auto-weighing, auto-drafting, genetic improvement, feeding, barn optimization, and health monitoring, livestock housing and equipment designs. These technologies provide to dairyman many opportunities to make easier and more convenient their decisions about dairy future plans.

The potential of India's huge livestock resources is grossly under utilized, necessitating more rapid progress towards boosting per unit productivity, quality of products and exports. Whereas, the demand for, and production of livestock and livestock products in less developed countries (LDCs) is expected to double over the next 20 years (Delgado et al.,1999). The overall growth rate in livestock sector is steady and is around 6% and this has been achieved despite the fact that investment in this sector was not substantial (Bhat and Das, 2002). But in terms of productivity, India's huge livestock resources are one of the poorest in the world. For instance, the milk yield of a cow in India is 900 kg, which is about 20% of the world average (Birthal and Jha, 2005).

According to Department of Animal Husbandry, Dairying and Fishery (DAHDF), the milk productivity per lactation is only 987 kg in India as against world average of 2,038 kg. Thus, the poor productivity as well as the quality of production and products remains a cause of concern in Indian livestock sector. For productivity improvement, technology generation (Research), technology dissemination (extension), technology users (farmers) and support mechanisms (inputs supply, market credit etc) have to be geared up. The functioning of various livestock development agencies especially the State Departments of Animal Husbandry (SDAH) in relation to the extension education activities performed by them need to be analyzed so as to ascertain a paradigm for livestock extension service suitable to India. To this end, it would be pertinent to review various extension mechanisms currently in operation in India and their role in delivering livestock related information to the farmers and feedback from them.

The Animal Husbandry Department (AHD) at the state level is the major stakeholder as far as livestock development is concerned. The AHD with its huge infrastructure, however, is primarily involved in treatment of animals for which it has a clear mandate. With more effective control of serious diseases such as rinderpest

(now eradicated from India) and Newcastle disease and more easily available treatment for many other conditions, animal health constraints are gradually being overcome (Morton and Matthewman 1996). But the demand for information on different aspects of livestock production is growing; as also the great numbers of livestock are now kept by people without traditional background causes distinct pressure on AHD to educate the owners. It is expected that farmers' education and extension contacts enable them to acquire, receive and decode new information to evaluate benefits of alternative sources of economically useful information and to have earlier access to such information (Duraisamy, 1992; Adeokun and Akinyemi, 2003). This necessitates a system through which farmer can receive desired information. However, there is no organized system of providing extension messages to the farmers especially with regard to improved animal husbandry. The activities relating to livestock extension are sporadic and spread over time and space and do not meet the requirements of a vast majority of farmers (Lehmann et al. 1994). The problem is further compounded with the neglect of policy makers and by researchers towards livestock production extension (Morton and Matthewman, 1996; Sen, 2003; GOI 2002) since the animal health extension gets precedence over production extension in India.

II. Material And Methods

Data collection

The design of experiment was done with specific objective to assess the current state of mechanisation and automation used in cattle farms located in Jalgaon district of Maharashtra. For this purpose, specific questionnaires for 12 different types of cattle farms were visited during the study period. The questionnaires contained different numbers of questions and answer options, which are relevant to use of technology in animal farm and dairy bussiness. Because our study focused on digital technology adoption on livestock farms, questionnaires were related to dairy cattle specifically buffaloes, cows and goats. For most questions, multiple answers were possible. The answer options included various sensors and applications from the thematic areas of feeding, animal behaviour and activity, animal monitoring and identification and, if applicable, milking technologies. To better understand the adoption process, farm and farmers'characteristics related to the adoption of digital technologies in Jalgaon district farming were examined. Relevant farm variables linked to the respective farms from the questionnaires. The following variables were considered for further analyses: the continuous variables 'age', 'agricultural area' and 'number of livestock units', the dichotomous variables 'gender (male/female)', 'production system (conventional/organic)' and 'on-farm working time (part-time/full-time)'. Furthermore, the barn systems 'loose housing' and 'tie stall' were included in the analyses as well as 'both' if both systems were in use on the farm:

Statistical analysis

In the first part, frequencies of digital technology adoption were calculated for all livestock-related farm house. In the second part, farm and farmers' characteristics associated with digital technology adoption in catlle farming were assessed using regression analyses to better understand the adoption process.

Based on the results from the first part, the digital technologies were divided into implemented ones that have been already proven in practice and new ones that make farmers pioneers in their use. Thus, three categories were created: The category of implemented technologies includes all technologies used by at least 10% of the farmers surveyed. The category of new technologies includes all technologies used by less than 10%. Because multiple answers were possible, individual farmers can occur in both groups. The third group comprises the non-adopters.

Two binary regression analyses were done to evaluate correlations between farm and farmers' characteristics and the adoption of implemented and new digital technologies, each compared with the group of non-adopters. For both cases, the dependent variable was the adoption decision (0/1) and the independent variables included the farm and farmers' characteristics. Estimated marginal changes (dF/dx) in the regression results indicate the change in the probability of adoption when the respective independent variable (clustered at the enterprise level) changes by one unit while keeping all other variables at their averages. The livestock units and age variables are presented in standardised form that is, expressed in standard deviation differences from the overall sample mean. This presentation allows a meaningful interpretation because the variables contain comparatively large numeric values, so that single unit changes represent only incrementally small changes compared with the overall spread of the distribution. Results were analysed with the statistical software R Version 4.0.5 using the package 'mfx' (Fernihough, 2019).

III. Results

The farm and farmers' characteristics were described for all respondents and for ruminants including cows, buffaloes, and goat farming in Table 1.1. The farmers were on average 40 years old and predominantly male.

Table 1.1 Animal Farm and farmers' characteristics non-respondents and all livestock respondents and of respondents to ruminant farming in Jalgaon district.

Variable	Non-respondents (livestock)	All respondents (livestock)	Respondents to ruminant farming
Number (n)	986	1589	674
Age (Mean ± SE)	40±4	40±6	41
Total agricultural area (ha) (Mean ± SE)	18±2	22±4	21±3
Livestock units total (Mean ± SE)	24±3	32±3	35±4
Gender : Male (0)	972	1545	642
Female (1)	14	44	32
Production system: Conventional (0)	879	1385	589
Organic (1)	107	204	85
Working time Part-time (0)	69	176	58
Full-time (1)	917	1413	616
Zone: River valley	489	978	387
Hill	35	176	158
Mountain	462	435	129
Main farm types: Specialist field crops	12	22	8
Specialist permanent crops	4	8	5
Specialist ruminant livestock	668	1174	547
Mixed cropping	14	17	10
Mixed livestock	176	237	48
Mixed crops-livestock	112	131	56
Enterprise: Dairy Cows	302	481	192
Dairy Buffaloes	485	898	380
Dairy Goats	199	210	102
Husbandry system* Loose housing	-	-	559
Tie stall	-	-	78
Both	-	-	37

Mean values ± SD are shown for numeric variables and total numbers are shown for categorical variables
*Information from questionnaires. SE = standard error.

All respondents had an average agricultural area of 20 ha and on average 32 livestock units per farm but with high deviations from the mean values. The majority of all respondents managed the farm conventionally and full-time. About half of the farms were located in the villages belonging to tehsil viz Chopda, Yawal, Raver, Muktainagar of Jalgaon district along the footsteps of mountains and hills of Satpud ranges at the border of Maharashtra and Madhya Pradesh. The characteristics of farmers with ruminants differe only slightly from those of all farmers: most of the ruminant farms were located in the mountains, followed b river valley and hills. Whereas most of the cattle farmers (559) kept their animals in loose housing systems, 7 kept them in tie stall barns and 37 had both husbandry systems.

As a result of survey of dairy farm houses offline and online, it was noted that some of the technologie (Figure 1.1 to 1.4) are already in practice in Maharashtra and rest of the India, albeit the adoption is still quit low while many others are yet to penetrate the industry. Nevertheless, there is no doubt that technology i playing a key role in modernising the Indian dairy industry. Let's take a look at some key new-age dair technologies:

Health Tracking Devices for Cattle

Health disorders reduce the productivity, longevity and reproductivity of cattle. Every year, farmers cough up huge amounts of money on their cattle's health and wellness. However, thanks to wearable animal gadgets which are akin to human fitness trackers, farmers can track, monitor and manage cattle's health, nutrition, behaviour, pregnancy, milking frequency, milk production anomaly and activity level in real-time. These smart animal trackers can be implanted in the cattle's ears, tail, legs, neck or any part of the body.Last

year, Maharashtra government had implanted GPS-enabled digital chips in the ears of 56 lakh animals across the state to track their health and early diagnosis of medical condition. Some of the companies that have developed smart cattle health tracking devices are SmaXtec, Cowlar, Moocall, Smartbow, Stellapps, etc.

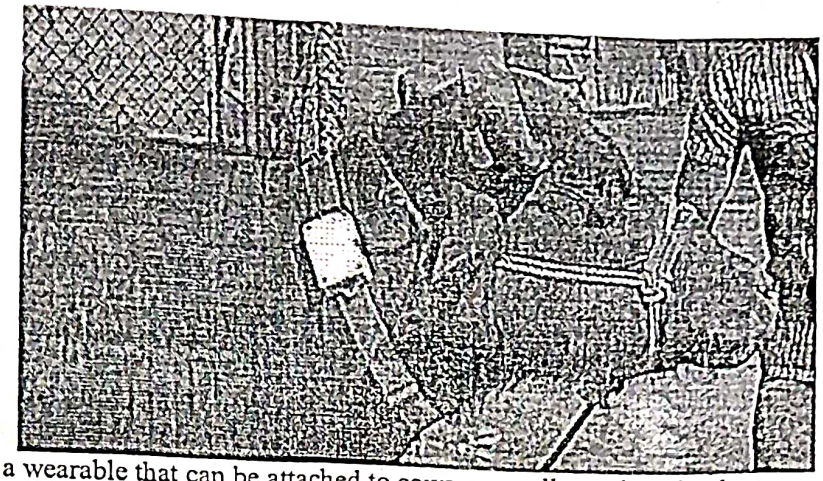

Figure 1.1 Cowlar, a wearable that can be attached to cows on a collar and used to better manage a herd of dairy bovines.

Instead of helping to improve a cow's health via exercise, the Cowlar tracks metrics such as eating, sleeping, mating and even its temperature. All of these aspects are important to farmers hoping to increase how much milk each cow produces, how long it will live and its mating patterns. The Cowlar sends this information to solar-powered base station up to four kilometres away where it can then be relayed to the farmer in a number of ways. They can receive a SMS alert, an automated phone call.

Robotic Milking Machines

Traditionally, cows have always been milked manually by hands. This is not only a time-consuming activity but also has labour cost associated with, thereby increasing the price of milk. Robotic milking machines are enabling farmers toeliminate the pressure on physical labour, maintain a hygienic milking process, milk the cows anytime of the day instead of following a fixed schedule and improve the milk production.

The robotic milking machines have arms or cups with sensors that can be attached individually to cows' teats. The sensors can detect whether the cow or which of its teat is ready for milking or not. Once the milking starts, the machines can also identify impurities, colour and quality of milk. If the milk is not fit for human consumption, it is diverted to a separate container. The machines can also automatically clean and sanitize the teats once the task is over.

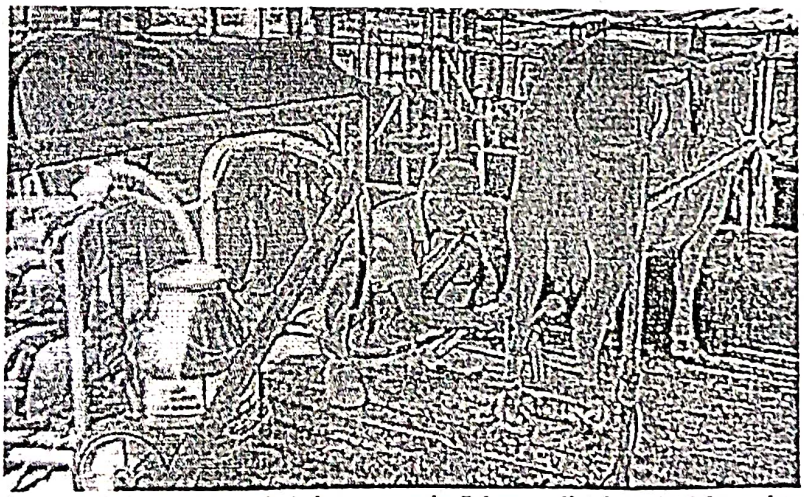

Figure 1.2 Automation in Diary cows in Jalgaon district of Maharashtra

Raghava Gowda from India has developed a low-cost, non-electric milking machine for cows. Some other startups which have introduced automated milking systems are miRobot, GEA, DeLaval, Fullwood Packo and Lely among many others.

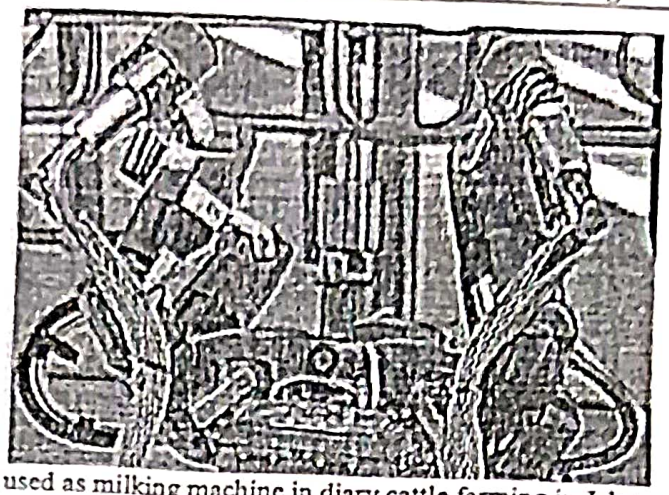

Figure 1.3 The miRobot used as milking machine in diary cattle farming in Jalgaon district of Maharashtra

The miRobot is developing the next-generation automatic robotic milking system for cost-effective, hig performance milking in medium and large dairy farms (150 to >1,000 cows). Designed as an add-on conventional milking parlor equipment, miRobot's system comprises fully automatic robotic arms installed each milking stall. The robotic arms perform cleaning, stimulating, attaching the milking cluster, and por milking routines to enable a milking procedure that is very high quality and uniform.

The miRobot multi-stall system will allow farmers to –

- Establish big data infrastructure in the milking parlor
- Milk dozens of cows simultaneously with only one supervisor, compared to current operations, whic requires three to six operators

Cattle Monitoring Drones

Farmers are required to keep a manual vigilance whenever the livestock moves out of the farm for grazing There are high chances of the cattle getting lost, stolen or being attacked by other animals. The cattle monitoring drones can keep track of the cattle and herd them back from fields to barns. Some drones are equipped with thermal sensing technology, which helps to track the cattle from the heat of their bodies. Drones can also capture the pictures of pasture areas and relay information as to whether these are suitable for cattle grazing. A number of companies such as TRITHI Robotics, Dronitech, Sagar Defence Engineering, DJI Enterprise and Sunbirds have made headway in building commercial drones for various purposes, including for agriculture and livestock management.

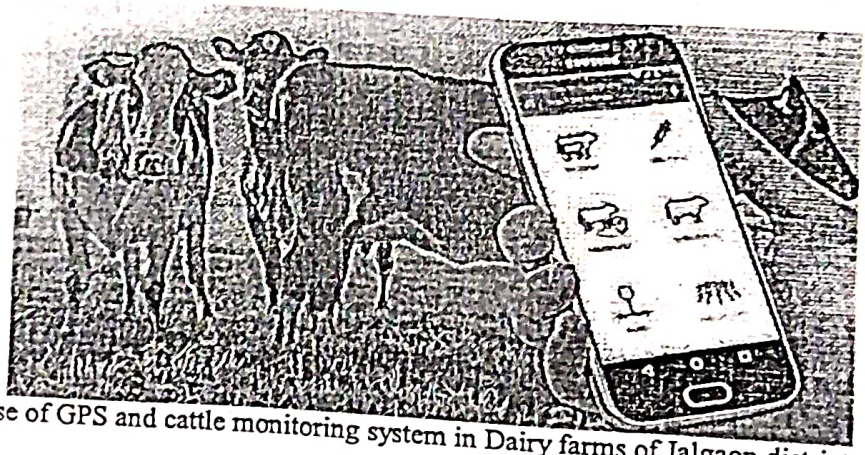

Figure 1.4 Use of GPS and cattle monitoring system in Dairy farms of Jalgaon district of Maharashtra

Product Traceability for Customers through Blockchain

These days, customers like to know the journey of their dairy products from farm to table. This calls for end-to-end supply chain transparency to enhance the trust of customers. An increasing number of dairy manufacturers, suppliers and other stakeholders are leveraging blockchain technology to give real-time data about their products to customers. This is done by putting a QR code on the packaging which customers can scan on their

mobile devices to get information on the origin of the milk – how and where it was collected and packed, how old it is, what kind of transportation and cold milk chain facilities were used, etc.

The Maharashtra and Kerala government in India is leveraging blockchain technology to streamline purchase and distribution of milk, fish and vegetable in the state. The international food giant Nestle has tied-up with Australian startup OpenSC to deploy blockchain technology in to improve its dairy supply chain. French supermarket Carrefour sells its micro-filtered full-fat milk in bottles with a QR code. Some of the startups operating in food biotech are StaTwig, Ripe, AgriLedger, TE-Food and Foodcoin.

Milk Freshness

Milk is a highly perishable product. In spite of treating it with pasteurization, freezing and preservation processes, it has a tendency to go stale. Millions of tons of milk turns stale before timely consumption and goes waste. Efforts are also being consistently made to increase the shelf life of milk without adding additives or preservatives.

Technology is now making it possible to detect the freshness of milk and store it for a longer period of time. Australia-based food technology company Naturo has developed a technology that can keep natural milk fresh in the refrigerator for at least 60 days without using any additives or preservatives. US scientists have pioneered a new pasteurization technique which increases shelf life of fresh milk from 13 days to 40 days without changing its taste or nutritional value. Back home in India, IIT Guwahati scientists have developed a smartphone-app aided paper sensor kit that can test the freshness of milk and inform how well it has been pasteurized. This kit can come quite handy in large kitchens, milk collection centres and milk bars.

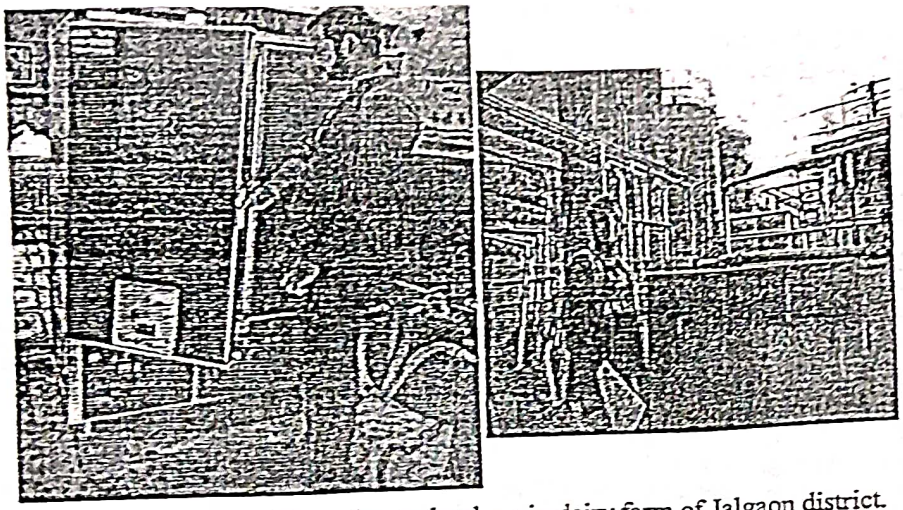

Figure 1.5 Milk fresher technology in dairy farm of Jalgaon district.

Automated Cattle Traffic Management

It can be an extremely tedious task to manage and move cattle to milking stalls and back to barns. There is also a risk of injuries to the cattle. Automated cattle traffic management system has computer-controlled gates which opens and closes electronically. These gates can sort the livestock on the basis of their readiness to milk. The livestock ready to be milked is moved to the milking area while the others are either put in the waiting area or returned to the barns. Companies like Delmer, Bump Gates, Fullwood Packo and Lely are known for their automatic cattle traffic systems.

Feed Management

The feed requirement of cattle depends on their health and weather. For example, a sick or pregnant cow may need more nutrition. Hot and humid weather means that cattle need more glucose in their feed.There are a number of feed technologies that produce formulated feed additives, supplements, premixes and base mixes to maintain optimal milk production throughout the year. For example, the National Dairy Development Board (NDDB) has developed bypass protein technology to produce specially treated protein supplements that can be fed to cattle to increase milk yield and quality.

Then, there are also digital feed monitoring solutions which can help farmers detect the quality of feed, manage feed inventory and understand cattle's feeding pattern. In fact, feed monitoring solution can help design customized diet for each cow based on the assessment of their body weight, milk quality and yield, and thereby

improve fertility and productivity per cow. Some of the companies providing feed management solutions are Godrej Agrovat, DeLaval, Dairy Margin Tracker, etc.

Ecommerce Market places

Several online B2B marketplaces such as AgroStar and Gold Farm have been launched in India to make modern equipment and advisory services available at the doorstep to farmers and dairy manufacturers on their smartphones. Many B2C platforms such as FreshVnF, WayCool and FarmLink have also emerged at a rapid pace – they pick fresh produce from farms and deliver them at the doorstep of retail customers, hotels, restaurants and cafes.

Supply Chain Technology

The Indian dairy industry supply chain is quite complex owing to its dependency on a number of factors such as storage temperature, cold chains availability, weather, perishability/shelf life, first and last-mile distance, packaging, etc. The fact that the Indian dairy industry is unorganized and fragmented also adds to the supply chain woes. However, a number of technological innovations are taking place in the dairy supply chain in India. Take, for example, India-based supply chain startups such as Stellapps, MilkManApps and Trinetra Wireless. Under supply chain, cold chain technology is expected to progress by leaps and bounds. The coming years will witness the rise of energy-efficient and cost-effective cold chain warehouses, cold boxes, Phase Changing Material (PCM) pads, temperature-controlled cold chain packing, refrigerated vehicles, cold chain pallet shippers, and other advanced cooling technologies. Tessol and Warehouse-India startups are making their mark in cold chain infrastructure in India.

Farm Management Technology

From accounting, finance and labour management to livestock and supply chain management, a dairy farm is to ensure that all its operations run seamlessly. Farm management software can help automate and digitize end-to-end production and operations activities. It can give a holistic view of all farm activities, manage records, generate reports and detect inefficiencies. Stellapps, Milc Group, My Dairy Dashboard and Nedap are some of the smart farm management solutions that exist currently.

Frequencies of digital technology adoption in ruminant farming

Dairy farms located in various tehsils of Jalgaon district were surveyed through personal visits and based on the information obtained Table 1.2 shows the three questions concerning the adoption of technologies related to: (1) Electronic sensors measuring devices namely Pasture growing measurement, Roughage intake, Animal tracking systems, Rumination sensors, Activity sensors, Electronic ear tags, Electronic weighing system, Camera monitoring ,Milk conductivity sensor,Concentrate feed intake, Milk temperature sensor, Transponder collar, Milk flow sensor and Digital milk meter used in diary farming (2) Electronic controls like Automatic feeding system, Selection gates, Automatic calf feeder and Concentrate feeding station used in animal farms and (3) Electronic data-processing options like Body condition scoring with camera system, Pasture management, Disease detection, Feed ration planning, Oestrous detection, Data transfer into herd management systems, Concentrate feed allocation depending on milk yield are adopted. Compared with farmers in all other cattle farm houses, farmers with dairy buffalo used digital technologies the most, which is illustrated by the answer option 'none' being ticked by 35.7%, 31.3% and 47.3% for electronic sensor measuring devices, electronic controls and electronic data-processing options used respectively.

Table1.2 Frequencies (%) of adoption of electronic sensors and measuring devices, electronic controls and data processing options in cattle farms of Jalgaon district in Maharashtra

Electronic sensors and measuring devices used	Dairy Cow (n=347)	Dairy Buffalo (n=553)	Dairy Goat (n=210)	Percentage total
None	112	159	98	35.7
Others	4	8	3	2.9
Pasture growing measurement	1	2	0	2
Roughage intake	2	4	1	3
Animal tracking systems	2	7	1	4
Rumination sensors	1	2	0	2
Activity sensors	3	5	0	4
Electronic ear tags	2	6	2	5
Electronic weighing system	4	6	1	5

Camera monitoring	15	54	4	24
Milk conductivity sensor	4	12	NA	7
Concentrate feed intake	6	18	1	8
Milk temperature sensor	2	8	NA	5
Transponder collar	8	24	2	11
Milk flow sensor	12	42	0	18
Digital milk meter	18	47	NA	22
Electronic controls Used	Dairy Cow (n = 325)	Dairy Buffalo (n = 527)	Dairy Goat (n = 198)	Percentage total
None	102	128	78	31.3
Others	4	7	5	5
Automatic feeding system	2	6	1	3
Selection gates	2	8	1	5
Automatic calf feeder	8	14	NA	7
Concentrate feeding station	12	24	1	12
Electronic data-processing options adopted	Dairy Cow (n = 296)	Dairy Buffalo (n = 489)	Dairy Goat (n = 178)	Percentage total
None	156	178	97	47.3
Others	3	0	2	2
Body condition scoring with camera system	2	2	NA	3
Pasture management	1	3	NA	1
Disease detection	1	5	NA	2
Feed ration planning	3	6	0	3
Oestrous detection	10	15	1	8
Data transfer into herd management systems	5	12	0	5
Concentrate feed allocation depending on milk yield	2	8	NA	3

NA = not applicable.

Dairy cattle farmers most commonly applied easy-to-use digital technologies related to the milking process. For example, digital milk meter was the most frequently used technology in dairy buffalo, with 47%, followed by 18% in dairy cow farms. Likewise, transponder collar, milk flow sensor and concentrate feed intake were ticked by more than 18% of the dairy cattle farmers. Digital milk meters were also the most frequently used sensors for dairy cow and buffalo but most of the dairy goat farms are without the same technology. The surveillance by digital cameras were the most likely adopted electronic system by dairy goat with 4% followed by dairy cow with 15% and its highest percentage (54%) was found in dairy buffalo. Electronic controls in the form of Automatic feeding system, Selection gates, Automatic calf feeder and Concentrate feeding station were adopted by Dairy cow and buffalo farms with significant percentage.

Expert autoamatic feeding system, dairy goat farms also had Selection gates, Automatic calf feeder and Concentrate feeding station. In relation to electronic data processing system, dairy cow and buffalo farms located in various tehsils of Jalgaon district adopted statistically significant Body condition scoring with camera system, Pasture management, Disease detection, Feed ration planning, Oestrous detection, Data transfer into herd management systems, Concentrate feed allocation depending on milk yield.

Farm and farmers' characteristics associated with digital technology adoption in cow, buffalo and goat farming were assessed using regression analyses. The effects for the implemented and new technologies in farm houses in Jalgaon district slightly differed. The regression analyses showed that the type of production (organic or conventional), the working time (full- or part-time business) and the agricultural area were not related to the adoption of digital technologies in ruminant farming in study area. However, farmers with larger numbers of livestock units were more likely to adopt both types of technologies than farmers keeping fewer livestock. On the other hand, age was negatively and significantly correlated to the adoption of new digital technologies: farmers were less likely to adopt this type of technology with increasing age. Furthermore, the results indicated that female farmers were less likely to adopt any type of digital technology compared with male farmers. The zone, the main farm type, the region, the enterprise and the barn system mattered for adoption. More specifically, compared with the base category river valley, a small negative effect on the adoption of implemented digital technologies could be found for hill and mountain zones and a strong negative effect on the adoption of new technologies for the mountain zone. Farmers with animals in tie stall barns and farmers who

had a combination of loose housing and tie stall systems were less likely to have implemented compared with the base category loose housing.

IV. Discussion

In the past few years, the Indian dairy industry has received a tremendous boost through driven products, services and solutions, the credit for which deservingly goes to agricultural ecosystem. The differences in adoption pattern between the animal species show that there are areas where branches in which the use of digital technologies is already commercially implemented. This is true in the dairy sector. Compared with other livestock sectors, the dairy cattle sector has by far technologies available (Stachowicz and Umstätter, 2020). The milking process is time-consuming a high physical workload, so that the expected advantage of using digital technologies apparent. User-friendly technologies that are integrated for example, in the milking parlour have rates in practice than technologies that collect additional data on the animal or in the barn, for disease detection and that may be bought separately. An exception is the electronic data processing transfer into herd management systems, which was ticked by more than 10% of the farmers groups. However, the usage has a direct benefit because many animal-related parameters have to general for quality assurance and documentation purposes and are therefore essential for economic production. It can be therefore concluded that political incentives can also lead to increased adoption

Results of the present study confirmed the results from other countries for which the technologies in dairy production has been investigated. A study from New Zealand showed that related to the milking process itself are used more than information collection technologies for disease detection or heat detection (Edwards et al., 2015). Gargiulo et al. (2018) evaluated different patterns according to herd sizes among Australian farmers and found that larger farms adopt more dairy technologies than smaller ones. In our study, the number of livestock units was also positively to the adoption of digital technologies

However, results moted in the present study also show that there are still dairy farms that almost without or with sporadic use of digital technologies. This is especially the case for enterprises that have a low production value per se or where the workload per livestock unit is low. But even in the dairy sector a considerable share of farmers did not use digital technologies regard to the high workload for milking, this is a surprising result for a country where dairy farming widespread. On the other hand, it is also possible that farmers stated using none of the surveyed technologies that certain technologies are automatically integrated, for example, into the milking parlour, so there always an active decision to have them and use them.

Barkema et al. (2015) investigated the worldwide commercial implementation of milking robots comparative study. Their results showed that the use of milking robots varies between 5% in Canada 20% in Sweden and Denmark. Almost 4% of the surveyed farmers used a milking robot in practice Jalgaon district is in the lower international range here. Nevertheless, milking robots are not standard because they contain a large number of sensors and measuring systems that automatically record data, even if the farmer may not use all available information (Ordolff, 2001). However, the share using robots on their farms is still very small and mainly limited to dairy farming.

None of the participating farmers in our study indicated using pasture growth measurement 1% stated using data-processing options for pasture management. Also, Gargiulo et al. (2018) adoption rates for automated pasture measurement in Australia, possibly because it is very time-consuming difficult to apply. An international survey regarding the use of precision livestock farming technologies dairying showed that mastitis, nutrition and reproduction were high-priority research topics while farming and grassland management ranked as lower priority (Palczynski, 2016). Animal diseases have wide range of biophysical and socio-economic impacts that may be both direct and indirect, and may localized to global. The economic impacts of diseases are increasingly difficult to quantify, largely because the complexity of the effects that they may have, but they may be enormous: the total costs of foot disease in the UK may have amounted to $18–25 billion between 1999 and 2002 (Bio-Era 2008).

In the developing world, there have been relatively few changes in the distribution, prevalence impact of many epidemic and endemic diseases of livestock over the last two decades, particularly with a few exceptions such as the global eradication of rinderpest. Over this time, there has also been decline in the quality of veterinary services. A difficulty in assessing the changing disease status in developing world is the lack of data, a critical area where progress needs to be made if disease monitoring and impact assessment are to be made effective and sustainable. Globally, the direct livestock diseases are decreasing, but the total impacts may actually be increasing, because in a highly interconnected world, the effects of disease extend far beyond animal sickness and mortality Sones, 2009).

Ryan and Wilson (1991) reported that, the 'National Disease Control Information System' (NDCIS) of New Zealand, consists of a set of independent computers database on animal diseases such as tuberculosis and brucellosis, which is a good example of possible applications of digital technologises in improving the animal health. Jalvingh et al. (1995) and Sanson et al. (1999) reported that, because of their economic importance, contagious animal disease outbreaks require rapid identification and elimination of all virus sources. For managing the vast amount of data and for help in setting the correct priorities, the use of computerized decision support systems (DSS) seems to be promising.

However, worldwide comparison or ranking of adoption rates for digital technologies is difficult because there is no uniform survey method and almost no representative study. For example, several studies used voluntary online surveys with the selection bias that participants may be relatively technically inclined farmers who use computers and the Internet in general (Gargiulo et al., 2018). Furthermore, the sampling procedure should be representative and cover as far as possible all size classes of farms in order not to over esti mate or underestimate the adoption rate. As an example, in a multidisciplinary study by Gargiulo et al. (2018), an online questionnaire was distributed using a snowball method among industry contacts and their network. Although 301 questionnaires were received, there were no selection criteria for the survey sample. In our study, we considered almost all Swiss farms for random sampling and stratified the sample for each farm type to ensure that farms of different size classes were addressed. This approach makes this study more significant and representative than most available studies.

Overall, our findings show that production-intensive livestock farming enterprises such as dairy cattle, breeding pigs or poultry often use digital technologies, even if it is not possible to deduce the entire adoption from example technologies for pigs and poultry. However, although only example technologies were surveyed for these two enterprises, trends can still be identified. Considerably more farmers used electronic ear tags for breeding pigs than for fattening pigs. This difference could be due to the different production systems. Breeding pigs are very labour intensive and require a higher level of management, whereas pig fattening involves fewer work processes.

Farm and farmers'characteristics in Jalgaon district

In the present study, an increase in age was associated with a decrease in the likelihood to adopt new technologies, whereas no correlation could be found for technologies already implemented. The number of livestock units as proxy for farm size was positively correlated with both types of technologies even though the effect was stronger for implemented than for new technologies. The agricultural area did not matter for adoption. These findings confirm the inconsistent results from the literature for age and farm size. For example, age and farm size were not associated to the adoption of electronic identification tools for gaot, whereas the likelihood of adoption of nutrient abatement technologies increased with increasing farm sizes and decreased for older farmers (Lima et al., 2018; Konrad et al., 2019). Furthermore, a recent study investigated the adoption of digital technologies among crop, dairy and livestock producers in the USA with the results that size (expressed as hectares and numbers of animals) was positively correlated with Internet access and level of usage and gender (women), farm income and education level (Drewry et al., 2019). In our study, however, female farmers were less likely than male farmers to adopt digital technologies, but the sample included only very few female farmers. Interestingly, our results further showed that farmers using tie stall barns adopted less technology, both implemented and new, compared to farmers using loose housing systems, likely because many technologies do not bring an added value in tie stall barns, where cows cannot express their behavior freely.

The finding that the zone correlated with technology adoption was to be expected and confirms the results of a recent study on the adoption of precision agricultural technologies on Swiss crop farms (Groher et al., 2020). Mountain farms in particular often generate less income (FSO, 2019b) and have to cope with difficult production conditions, which may explain the strong negative correlation on new technology adoption. However, small and inexpensive technologies can also support these farms. For example, activity sensors, electronic identification tools or animal tracking can be used to remotely monitor animal behaviour or location. Moreover, precise pasture management could help to use existing resources more efficiently. Apart from the many opportunities that the use of digital technologies offers, some studies have explored the barriers in the adoption of digital technologies in agriculture (Wathes et al., 2008; Drewry et al., 2019). For instance, a major challenge is the interpretation of the recorded data because the time-varying and individual behaviour of each animal makes an interpretation difficult (Palczynski, 2016).

An additional barrier in the adoption of technologies can be the insufficient robustness of sensors (Wathes et al. , 2008). Additionally, systems of different manufacturers may be incompatible and a combination of data received from different sensors must be transformed into usable information (Van Hertem et al., 2017). Certainly, the financial advantage is one of the major determinants in the adoption decision (Reichardt and Jürgens, 2009; Pathak et al., 2019). The farmers' view seems to be that the use of modern technologies and smart farming is very expensive and only profitable for larger farms, maybe due to the perception of high costs

and the complexity. However, there are other technologies that are inexpensive, easy to use and do not enormous costs (Schrijver et al., 2016). Interestingly, Lima et al. (2018) found that users of digital technol are more likely to see the technologies as useful and practical than non-adopters showing that far perceptions and beliefs are also important determinants in technology adoption.

Role of Biotechnology in cattle dairy farming

Biotechnology is a relatively emerging field in the dairy industry. However, it is being touted as o the most disrupting dairy technology of the future. The potential of dairy biotechnology lies in the areas su cross-breeding technology, increasing disease resistance in livestock, scientific feeding of cows, e transmit technology, artificial insemination, development of new molecules and vaccines for prevention disease management of animals, dairy enzymes/proteins/probiotics, food-grade bio-preservatives, etc.

Breeds in animal husbandry has changed a lot with the use of breeding and gene technology. Till l livestock products demands have been met by breed substitution, cross-breeding, and within-breed selec But these demand in future is to be met using new techniques such as such as artificial insemination and specific selection techniques. Genomic selection provides more possibilities for the higher rate of genetic g the livestock sector. After all genomic breeding values will be calculated from the genetic marker, rather from pedigree and phenotypic information in near future. The genome maps for poultry and cattle is comple and these developments provide new opportunities for animal breeding and animal models (Lewin, 20 Leakey (2009) reported that DNA-based tests for genes or markers affecting traits that are difficult to me currently, such as meat quality and disease resistance, will be particularly useful. But genetic resources important for helping livestock adapt to changing the climate (Thornton, 2010). Native breeds are to ge insurance against future challenges. In combination with modern reproductive technologies, there is potenti use frozen and stored germplasm (genetic resource banks) to support conservation measures for the maintena of genetic diversity in threatened species. Besides the direct application of technologically adv reproductive procedures, modern approaches to non-invasive endocrine monitoring play an important ro optimizing the success of natural breeding programs (Holt and Pickard, 1999). A separate progeny-test categ may be developed for farms that collect all data electronically and have those data monitored clos Automated data collection along with parentage verification offers substantial opportunities for ge improvement of overall economic merit. Nowadays biological samples are sent laboratory for genetic analys identify the relevant genes responsible for productive parameters. Also, selective breeding can reduce the n for alternative methods.

Some of other examples of dairy biotechnology products that have made headlines are animal-fre cream by Perfect Day, livestock disease diagnostic tools by Advanced Animal Diagnostics, bovine gen breeding by Genus ABS India, etc. The above mentioned list of technologies is inclusive but not exhaust Currently, most dairy technologies face adoption barriers in India because a large percentage of the Indian da industry still comprises of small-scale and unorganised players who lack financial means, accessibility a expertise to deploy the technology. The good news is that dairy technological revolution has already begun India, and it's only a matter of time that these technologies become common.

Factors affecting technology adoption specifically in Maharashtra and in India as whole:

a) Lack of good indigenous software: Absence of commercially available software with technical suppo local terminology and availability in regional languages is the single foremost factor which has prevented l large-scale usage of herd management software in India.

b) Lack of management awareness: In most dairy farms, the only parameter in which the owner interested is the total milk yield produced by the herd every day; individual management records are rar maintained. Motivation to the farmers to take up computerized farm recording would be a major challenge.

c) Lack of computer awareness: With the compu becoming omnipresent from primary schools to financial institutions, this factor is not such an insurmountab one, especially given the fact that most modern dairy farms are located in peri-urban areas.

d) Cost factor: A dust-free room and stable power with adequate backup are essential that are n affordable for every farm owner.

Limitations and benefits of automation in dairy farms

The main focus of this study was to assess the state of automation and mechanisation in diary farms Jalgaon district of Maharashtra. Therefore, questions related to digitalization in agriculture were only onc many parts of the survey with limited scope. The selection of technologies were based on a literature researc always with regard to technologies that were known to be relevant for India. Although we thoroughly che these technologies based on these criteria, it is of course possible that some technologies were missed on the li Furthermore, personal motives to investigate the farmers' perceptions and possible barriers to adoption technology were not surveyed and are therefore a possible subject of future research, to further understand th adoption process. The presented results are mainly in line with the existing literature and low adoption rates o

as expected, which we now evidenced by research data. The present study extends the adoption literature by deriving knowledge from survey data combining a representative random sampling procedure with a considerably large response rate, which provides us a representative picture of the overall farming population in Switzerland. Technology adoption, especially of digital technologies, is evolving over time. Therefore, it is beneficial to study the overall adoption rate in different countries or regions to get an up-to-date view on current developments that can be used to derive knowledge on determinants for technology uptake.

V. Conclusion

The adoption of digital technologies in livestock farming in Maharashtra in general and Jalgaon district in special varies strongly between different agricultural groups and is most common on large specialist ruminant livestock farms. The industrial revolution has made a radical change in the production method and systems throughout the world. The net result has been the more comfortable animal, higher production, and decreased labor. The rapid penetration of these new age technologies will provide a further layer of sophistication of farm work and new strategies in animal production. Future disease trends are likely to be heavily modified by disease surveillance and control technologies.

In general, easy-to-use sensors and measuring devices, for example, integrated in the milking automated system is more widespread than data-processing technologies. The husbandry system also determines the use of digital technologies, with the result that farmers with tie stall barns are less likely to use digital technologies than farmers with loose housing systems. Studies of farmers' personal determinants of adoption and prospects of implementation can help identify further barriers to the adoption of digital technologies. Since most of the dairy farms are located in peri-urban areas, the economical status is main constrains for most of livestock of farm owners.

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3. The spreadsheet implementation

The spreadsheet implementation of the finite element numerical method consists of the following steps:

- Divide the solution region into a triangular FE meshes of elements

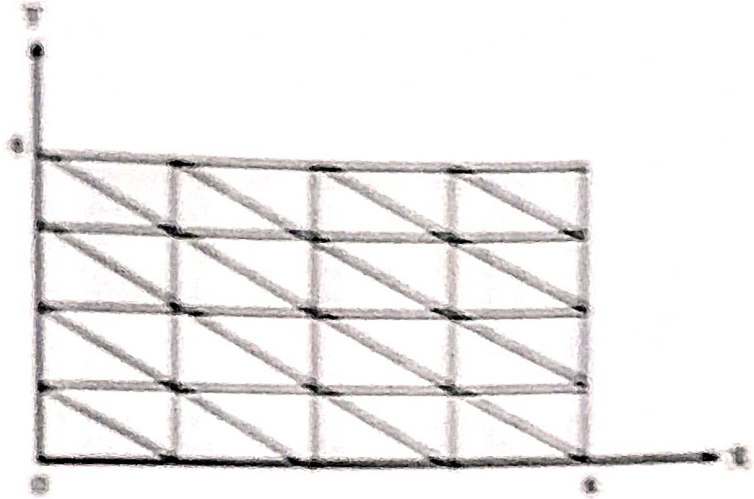

Figure 2: Finite element arrangement for heat flow problem

- Generate the input data and consists of three tables: global node x and y coordinates; global and local node correspondence for each element; and list of nodes with fixed temperature.
- For each element, the following operations are computed and obtain the element coefficient matrix

$$[A_e = A_e, B_e = B_e] \qquad [C_e = A_e, C_e = C_e] \qquad [D_e = A_e, D_e = D_e]$$

- The VLOOKUP function is invoked to extract global node coordinates and assembled for the global coefficient matrix C
- The matrices C_{ff} (free nodes) and C_{fp} (free and fixed nodes) are formed by extracting the appropriate rows and columns from the global coefficient matrix C
- The final solution is obtained by using the matrix capabilities of Microsoft Excel

4. Discussion and Result

As indicated in Table 1, the temperature at the free nodes computed by finite element numerical triangular grid method and given analytical solution of the heat conduction problem compared fairly well.

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Study of Molecular Inter ction and Sound Velocity of Alcohols with ONT at Different Temperatures

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Abstract: **The related parameters of molecular interaction and ound velocity studies of 1- butanol and 3- methyl, 1- butanol at 303. 15 and 313.15 K temperatures. The density, ultrasonic velocity and iscosity of binary mixtures were measured at given temperatures. These experimental analysis data have been used to calculate iscosity deviation (Δη) , excess molar volume (V^E), deviation in entropic compressibility (ΔKs) , Excess free length(L_f^E), and coustic impendence (Z^E). The values of excess intermolecular free ength and isentropic compressibility are negative over and wide ange of mole fraction for a given binary mixtures. These results ave been used to explain the nature of interaction between unlike olecules in terms of hydrogen bonding and dipole-dipole teractions.**

Index Terms: **Enter Ultrasonic velocity, Viscosity, Density, Excess olar volume (V^E), Viscosity deviation (Δη), Excess free length (L_f^E).**

I. INTRODUCTION

The formation of hydrogen bond in binary mixture solution and effect on physical properties of mixtures have received much ention. Hydrogen bonding plays an important role in industrial plications and fundamental sciences. Many theoretical and perimental studies have been understanding directing towards hydrogen bonding. Alcohols are widely used in variety of dustrial (Oswal. S. L., et al,1998; Kumar, H., et al.,2011) and nsumer applications and hence the knowledge of their physical operties are more importance for practical point of view. veral researchers (Zorebski, E., et al.,2008; Borun, A., et .2010; Satry, S. S.et al., 2013; Checoni, R. F. et al.,2010; S. ehari S.et al.,2014; Shastry, S. et al.,2014) have measured cosity, density and ultrasonic velocity for wide range of binary xtures containing alcohol as one of the components.

In present in investigation the liquid were chosen on basis of industrial importance alcohols are used as hydraulic ids in pharmaceutical (Resa. J.M., et al.,2007) and cosmetic. In given rk to determine thermodynamics and transport properties of bina liquid mixtures (S. Sharma. S., et al.,2011; Naidu., S., et al.,200 Narendra K., et al.,2011; Arnett E. M., et al.,1974; Santhi. N., et al.,2013). We report density (ρ), viscosity (η), ultraso ic velocity (U), viscosity deviation (Δη), excess molar volume (V^E), deviation in isentropic compressibility (ΔK_S), Excess free length (L_f^E), and acoustic impendence (Z^E) of the binary ixture of 1- butanol and 3- methyl, 1- butanol with o-nitro tu e at 303.15 and 313.15K temperature.

These results have been used to discuss the nature of interact on between unlike molecules in terms of hydrogen bondin, dipole interaction and dispersion forces. In given system alcohol are self-associated through hydrogen bonding of their hydrox l group. The present work was undertaken to determine the eff t of position of -OH group of an alcohol molecule that may i fluence both the sign and magnitude of various thermo ynamic functions when they mixed with o-nitro toluene as a sol ent.

II. EXPERIMENTAL

In The chemicals used are of A.R. grade with minimum assay of 99.9 % obtained from Sigma Aldrich or s. d. fine chemicals India. Bi-capillary pycnometer (10ml) was used to measured densities. An airtight stopper bottles were used to prepare and store the binary liquid mixtures of different known concentrations. The shimatzu electronic digital balance (± 0.1mg.) was used to measured weights of the samples. The Ubbelohde viscometer (20ml) was used to measure the viscosity. The efflux time was determined using a digital clock to within ±0.015 sec. The ultrasonic velocities (U) in liquid mixtures were measur d using an ultrasonic interferometer (Mittal, F-81, 2 MHz, ±0.1 m).

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Table.1. Values of densities viscosities, ultrasonic velocity, excess molar volumes, deviation in viscosity, deviation
compressibility, acoustic impedance and excess intermolecular free length for binary system of 1-butanol and O-nitro to
and 313.15 K

Temp K	X_1	ρ (gm /cm³)	η10³ (Nsm⁻²)	U(MS⁻¹)	V^Ex10⁶ (m³/mole)	Δ ηx10³ (Kg m⁻¹s⁻¹)	Δksx10¹¹ (m²N⁻¹)	Z^E xK s⁻¹ m⁻³
303.15	0.0000	0.80320	3.19400	1559.0	0.0000	0.000	0.000	0.000
	0.1066	0.83170	2.94090	1467.2	-1.1001	-15.697	-18.58	-14.41
	0.2138	0.86050	2.41230	1519.2	-2.0718	-58.234	-20.47	-22.06
	0.3212	0.88510	2.26620	1540.6	-2.3077	-61.583	-22.70	-26.46
	0.4301	0.94880	1.68600	1602.2	-3.0652	-97.489	-34.41	-42.39
	0.5091	0.95680	2.01510	1604.3	-5.0404	-81.412	-37.73	-63.03
	0.6149	0.99120	1.84900	1622.2	-5.9088	-63.641	-34.37	-61.70
	0.7159	1.08010	1.84460	1635.3	-6.3641	-48.373	-33.57	-52.34
	0.8203	1.09620	1.76970	1675.7	-5.8733	-38.465	-27.78	-32.57
	0.9128	1.11430	1.75290	1680.1	-4.4019	-21.015	-15.55	-22.60
	1.0000	1.06470	1.75020	1631.2	0.0000	0.000	0.000	0.000
313.15	0.0000	0.79520	2.52550	1417.7	0.0000	0.000	0.000	0.000
	0.1066	0.82370	2.39760	1449.6	-0.5131	-4.699	-25.23	-14.05
	0.2138	0.85240	1.96540	1503.1	-1.8367	-39.232	-29.68	-25.04
	0.3212	0.87670	1.85750	1528.2	-2.3237	-40.545	-36.59	-32.25
	0.4301	0.94000	1.39600	1584.1	-4.3521	-76.501	-38.59	-45.57
	0.5091	0.94710	1.67140	1596.1	-5.3420	-57.880	-48.61	-66.48
	0.6149	0.98210	1.53800	1604.0	-6.3806	-39.119	-46.67	-61.79
	0.7159	1.07070	1.68650	1625.8	-7.9138	-11.050	-37.16	-41.71
	0.8203	1.08650	1.65640	1656.2	-6.2481	-8.581	-25.04	-40.69
	0.9128	1.10450	1.55620	1668.4	-5.5105	-6.660	-12.59	-34.80
	1.0000	1.13740	1.31050	1682.4	0.0000	0.000	0.000	0.000

Table.2. Values of densities viscosities, ultrasonic velocity, excess molar volumes, deviation in viscosity, deviation
compressibility, acoustic impedance and excess intermolecular free length for binary system of 3-methyl, 1-butanol and O
at 303.15 and 313.15 K

Temp K	X_1	ρ (gm /cm³)	η10³ (Nsm⁻²)	U(MS⁻¹)	V^Ex10⁶ (m³/mole)	Δ ηx10³ (Kg m⁻¹s⁻¹)	Δksx10¹¹ (m²N⁻¹)	Z^E xKg s⁻¹ m⁻³
303.15	0.0000	0.80320	3.19400	1559.0	0.0000	0.000	0.000	0.000
	0.1066	0.83170	2.94090	1467.2	-1.1001	-15.697	-18.58	-14.41
	0.2138	0.86050	2.41230	1519.2	-2.0718	-58.234	-20.47	-22.06
	0.3212	0.88510	2.26620	1540.6	-2.3077	-61.583	-22.70	-26.46
	0.4301	0.94880	1.68600	1602.2	-3.0652	-97.489	-34.41	-42.39
	0.5091	0.95680	2.01510	1604.3	-5.0404	-81.412	-37.73	-63.03
	0.6149	0.99120	1.84900	1622.2	-5.9088	-63.641	-34.37	-61.70
	0.7159	1.08010	1.84460	1635.3	-6.3641	-48.373	-33.57	-52.34
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	1.0000	1.06470	1.75020	1631.2	0.0000	0.000	0.000	0.000
313.15	0.0000	0.79520	2.52550	1417.7	0.0000	0.000	0.000	0.000
	0.1066	0.82370	2.39760	1449.6	-0.5131	-4.699	-25.23	-14.05
	0.2138	0.85240	1.96540	1503.1	-1.8367	-39.232	-29.68	-25.04
	0.3212	0.87670	1.85750	1528.2	-2.3237	-40.545	-36.59	-32.25
	0.4301	0.94000	1.39600	1584.1	-4.3521	-76.501	-38.59	-45.57
	0.5091	0.94710	1.67140	1596.1	-5.3420	-57.880	-48.61	-66.48
	0.6149	0.98210	1.53800	1604.0	-6.3806	-39.119	-46.67	-61.79
	0.7159	1.07070	1.68650	1625.8	-7.9138	-11.050	-37.16	-41.71
	0.8203	1.08650	1.65640	1656.2	-6.2481	-8.581	-25.04	-40.69
	0.9128	1.10450	1.55620	1668.4	-5.5105	-6.660	-12.59	-34.80
	1.0000	1.13740	1.31050	1682.4	0.0000	0.000	0.000	0.000

III. Theory and Calculation

Following equations been used to calculate different parameters in binary solutions

a) The molar excess volume

$$V^E = \frac{M_1X_1+M_2X_2}{\rho_{12}} - \frac{M_1X_1}{\rho_1} - \frac{M_2X_2}{\rho_2} \quad (1)$$

b) The viscosity deviation

$$\ln\eta_m = X_1\ln\eta_1 + X_2\ln\eta_2$$

$$\Delta\eta_m = \eta_{12} - X_1\eta_1 - X_1\eta_2 \quad (2)$$

c) Deviation in isentropic compressibility (3)

$$\Delta k_S = k_S - \Phi_1 k_{S1} - \Phi_2 k_{S2}$$

Where k_{S1}, k_{S2} and k_S are isentropic compressibility of (4)

liquid mixtures and Φ is volume fraction of pure i^{th} component in the mixture and is defined as

$$\phi = \frac{(Xi\ Vi)}{(\Sigma\ Xi\ Vi)} \quad (5)$$

Where x_i and V_i are mole fraction and molar volume of i^{th} component in the mixture.

a) The excess free length

$$L_f^E = L_{fmix} - x_1L_{f1} - x_2L_{f2}$$

$$A^E = A_{exp} - A_{id} \quad (6)$$

(7)

Where $A_{id} = \sum Ai\ Xi$. Ai is any acoustical parameters and Xi

IV. Result and Discussion

The measured values such as density (ρ), viscosity (η), The measured values such as density (ρ), viscosity (η), ultrasonic velocity (U), viscosity deviation (Δη), excess molar volume (V^E), deviation in isentropic compressibility (ΔKs), Excess free length (L_f^E), and acoustic impendence (Z^E) are given in Table-1 and Table-2 respectively. Figure: - (A) and (B) shows Excess molar volume (V^E), and Deviation in isentropic compressibility (ΔK_S) against mole fraction for binary system of 1-butanol and 3-methyl, 1-butanol with O-nitro toluene at 303.15 K.

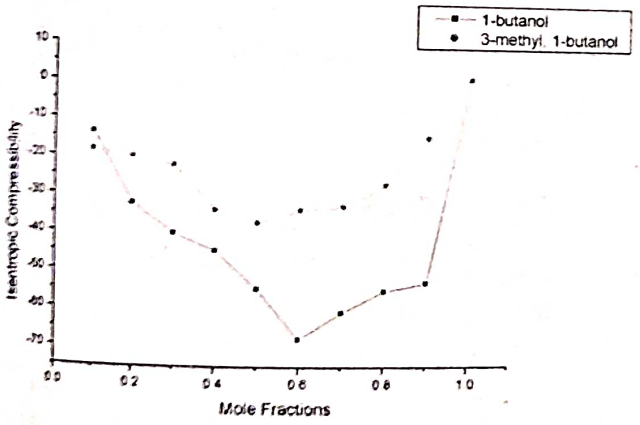

Fig.1. (A) Excess molar volume (V^E) against mole fraction for 1-butnol and 3- methyl, 1-butanol with o-nitro toluene at 303.15 K.

All these parameters show negative deviations with minima at about X_1= 0.6-0.8 this may be due to presence of stronger solute solvent interactions in between highly polar functional groups Nitro and -OH. This causes fitting of alkanol molecules in the avoids of self-associated solvent molecules resulting volume contraction than ideal. With increase in temperature all these parameters become less negative showing less salvation effect at higher temperature.

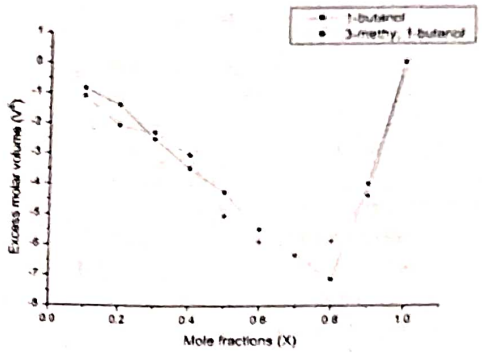

Fig.1. (B) Deviation in isentropic compressibility (ΔKs) against mole fraction for 1-butnol and 3- methyl, 1-butanol with o-nitro toluene at 303.15 K.

CONCLUSION

From experimental data ultrasonic velocity (U), density (ρ) and viscosity (η) have been measured for binary system at 303.15 and 313.15 K. The data have been used to compute the parameters Δη, V^E, ΔKs, L_f^E, and Z^E. It is a well justified that most of values are negative due to presence of polar functional groups on aromatic ring and alkanols which increases salvation effect in solution so it shows structure making interactions between solvent and solute.

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Jordan Ideals In prime Rings and Generalized Derivations

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Abstract : Let Rbe a 2-torsion free prime ring and J be a nonzero Jordan ideal of R. Let F and G be two generalized derivations with associated derivations f and g, respectively, the main result We that if $F(x)x - xG(x) = 0$ for all $x \in J$, then$R$ is commutative and $F = G$ or G is a left multiplier and $F = G + f$.

Index Terms **– Prime Ring, Jordan Ideal, Subring, Homomorphism.**

I. INTRODUCTION

Let R will be an associative ring and $Z(R)$ the centre of R. For any$x, y \in R$, the symbol $[x, y]$ and xoy denote the Lie product $xy - yx$and $xy + yx$respectively.We recall that a ring R is prime if for any $a, b \in R$, $aRb = \{0\}$ implies $a = 0$ or $b = 0$. An additive mapping $d: R \to R$is called a derivation if $d(xy) = d(x)y + xd(y)$hold for all$x, y \in R$.

In [4] Bresar introduced the definition of a generalized derivation: An additive mapping $F : R \to R$ is called a generalized derivation if there exists a derivation $d: R \to R$,called the associated derivation of F, such that $F(xy) = F(x)y + yF(y)$, $\forall x, y \in R$.The notion of generalized derivations covers both the notions of a derivation and of a left multiplier and an additive mapping satisfying $f(xy) = f(x)y$, $\forall x, y \in R$. A ring R is said to be n-torsion free, where $n \neq 0$ is a positive integer, if whenever $na = 0$, with $a \in R$, then $a = 0$. An additive subgroup $J$is said to be a Jordan ideal of Rif $uor \in J$ for all $u \in J$and $r \in R$. All ideal of $R$is a Jordan ideal of R but the Jordan ideal need not be ideal..Anadditive subgroup$U$ of R is said to be a Lie ideal of R if$[u, r] \in U$ for all $u \in U$ and $r \in R$. It is clear that if characteristic of R is 2, then Jordan ideals and Lie ideals of R are coincide.

Several authors have proved commutativity theorems for prime and semi-prime rings admitting derivations of generalized derivations. It is worth mentioning that the investigation in this direction started with Posner in his famous paper [1] (see also the interesting work of Bresar[2]). Recently, in [5], EI-Soufi and Aboubakr proved the following result:

Let R be a 2-torsion free prime ring, J be both a nonzero Jordan ideal and a subring of R, and F be a generalized derivation with associated derivation f. If one of the following properties holds:$(i)F(x)x = xf(x)(ii)F(x^2) = 2F(x)x$ For all $x \in J$ then $J \subseteq$ Z(R). $(ii)F(x^2) = 2xF(x)(iv)F(x^2) - 2xF(x) = f(x^2) - 2xf(x)$

In [5, Example 3.8], they gave an example showing that the above result is not true in general if we assume that J is only a subring of R. In this paper we show that in fact, then condition of J being a subring is redundant. Indeed we prove this fact in a more general context. First, we focus on the generalization of the first assertion which is in fact our main result in this paper. As consequence we get generalization of other assertions.

1. Preliminary results

Let us begin with the following lemmas which will sometimes be used without explicit mention.

Lemma 2.1 ([7], *Lemma* 2.4).If J is a nonzero Jordan ideal of a ring R, then
$$2[R, R]\, J \subset J \text{ and } 2J\,[R, R] \subset J.$$

Lemma 2.2([7], *Lemma* 2.6).Let R be a 2-torsion free prime ring and J be a nonzero Jordan ideal of R. If, for two elements $a, b \in R$, $aJb = (0), then$
$$a = 0 \text{ or } b = 0.$$

Lemma 2.3([7], *Lemma* 2.7).Let R be a 2-torsion free prime ring and J be a nonzero Jordan ideal of R.If $[J, J] = 0$,then R is commutative.

Lemma 2.4([6], *Proof of Lemma* 3).Let R be a 2-torsion free prime ring and J be a nonzero Jordan ideal of R. Then,$4\, j^2R \subset J \text{ and } 4R\, j^2 \subset J$, $\forall\ j \in J$.

Lemma 2.5([6], *Proof of Theorem* 2.12). Let R be a 2-torsion free prime ring and J be a nonzero Jordan ideal of R. Then,$4jRj \subset J$, $\forall\, j \in J$.

We will also make use of the following basic commutator identities:
$[x, yz] = y[x, z] + [x, y]z$ and $[xy, z] = x[y, z] + [x, z]y$

2. Main results

We prove the following particular case of our main theorem.

Lemma 3.1 Let R be a 2-torsion free prime ring and two generalized derivations$F$ and G associated with f and g, respectively. If $F(x)x - xG(x) = 0$ for all $x \in R$, then one of the following condition satisfy:

(1) R is commutative and $F = G$.

$[r,s]yf(x^2)x^2 - [r,s]x^2yg(x^2) - [r,s]yx^2G(x^2) + [r,s]yG(x^2)x^2 = 0$ for all $r,s \in R, x,y \in J$ .....(4)

Subtracting (4) from (3), we get

$$[r,s]x^2yg(x^2) - x^2[r,s]yg(x^2) = 0$$
$$[[r,s],x^2]yg(x^2) = 0$$
$$\left[[r,s],x^2\right]yg\left(x^2\right) = 0$$

$\therefore [[r,s],x^2]Jg(x^2) = 0$ for all $r,s \in R, x \in J$ .....(5)

By the primness of R together with *Lemma* 2.2, we find $[[r,s],x^2] = 0$ or $g(x^2) = 0$. Clearly, in both cases, we arrive at $g(x^2) = 0$ for all $x \in J$. This implies that $g = 0$ (by [5, *Lemma* 3]). Now, replacing y by $2[r,uv]x$ in $yf(x)x - yxG(x) + yG(x)x = 0$ where $x,y \in J$ and $r \in R$, we get

$2[r,uv]xf(x)x - 2[r,uv]xxG(x) + 2[r,uv]xG(x)x = 0$ for all $x,y \in J, r \in R$

$[r,uv]f(x)x - [r,uv]xG(x) + [r,uv]G(x)x = 0$ for all $x,y \in J, r \in R$

$\therefore [r,uv]f(x)x - [r,uv]F(x)x + [r,uv]G(x)x = 0$ for all $u,v,x \in J, r \in R$ .....(6)

$\therefore [r,uv](f(x)x - F(x)x + G(x)x) = 0$ for all $u,v,x \in J, r \in R$ .....(7)

The fact that R is a non commutative prime ring forces that

$f(x)x - F(x)x + G(x)x = 0$ for all $x \in J$ .....(8)

The linearization of (8) gives

$f(x)y - F(x)y + G(x)y + f(y)x - F(y)x + G(y)x = 0$ for all $x,y \in J$ .....(9)

Replacing y by $2y[r,uv]$ in (9), we take, for all $u,v,x,y \in J$ and $r \in R$,

$f(x)2y[r,uv] - F(x)2y[r,uv] + G(x)2y[r,uv] + f(2y[r,uv])x - F(2y[r,uv])x + G(2y[r,uv])x = 0$ for all $u,v,x,y \in J, r \in R$

$f(x)y[r,uv] - F(x)y[r,uv] + G(x)y[r,uv]$
$+f(y[r,uv])x - F(y[r,uv])x + G(y[r,uv])x = 0$ for all $u,v,x,y \in J, r \in R$

$f(x)y[r,uv] - F(x)y[r,uv] + G(x)y[r,uv]$
$+f(y)[r,uv]x - F(y)[r,uv]x + G(y)[r,uv]x = 0$ for all $u,v,x,y \in J, r \in R$ .....(10)

Right multiplying (9) by $[r,uv]$ we obtain, for all $u,v,x,y \in J$ and $r \in R$ we get

$f(x)y[r,uv] - F(x)y[r,uv] + G(x)y[r,uv]$
$+f(y)x[r,uv] - F(y)x[r,uv] + G(y)x[r,uv] = 0$ for all $u,v,x,y \in J, r \in R$ .....(11)

Subtracting (11) from (10), we get,

$$\therefore f(y)[r,uv]x - F(y)[r,uv]x + G(y)[r,uv]x - (f(y)x[r,uv] - F(y)x[r,uv] + G(y)x[r,uv]) = 0$$
$$\therefore f(y)([r,uv]x - x[r,uv]) - F(y)([r,uv]x - x[r,uv]) + G(y)([r,uv]x - x[r,uv]) = 0$$
$$\therefore (f(y) - F(y) + G(y))([r,uv]x - x[r,uv]) = 0$$

$\therefore (f(y) - F(y) + G(y))[[r,uv],x] = 0$ for all $u,v,x,y \in J, r \in R$ .....(12)

Replacing x by $2x[s,t]$ where $s,t \in R$, we obtain

$\therefore (f(y) - F(y) + G(y))J[[r,uv],[s,t]] = 0$ for all $u,v,y \in J, r,s,t \in R$ .....(13)

Since R is a non commutative prime ring, we get

$\therefore f(y) - F(y) + G(y) = 0$ for all $y \in J$ .....(14)

Replacing y by $4ry^2$ in (14), where $r \in R$, we get

$\therefore f(4ry^2) - F(4ry^2) + G(4ry^2) = 0$ for all $y \in J, r \in R$

$\therefore (f(r) - F(r) + G(r))y^2 = 0$ for all $y \in J, r \in R$ .....(15)

$\therefore f(r) - F(r) + G(r) = 0$ for all $r \in R$

$\therefore F = G + f$

Case (ii) $Z(R) \cap J \neq \{0\}$

Let $0 \neq z \in Z(R) \cap J$ and replacing y by $2yz = y \circ z$ in $F(x)x = xG(x)$, we get

$yxf(z) = xyg(z)$ for all $x,y \in J$ .....(16)

Replacing y by $2[r,s]y$ in (16), where $r,s \in R$, we get

$[r,s]yxf(z) = x[r,s]yg(z)$ for all $x,y \in J, r,s \in R$ .....(17)

Left multiplication of (16) by $[r,s)]$ gives

$[r,s)]yxf(z) = [r,s)]xyg(z)$ for all $x,y \in J, r,s \in R$ .....(18)

Subtracting (18) from (17), we get

$x[r,s]yg(z) - [r,s)]xyg(z) = 0$ for all $x,y \in J, r,s \in R$

$[[r,s],x]yg(z) = 0$ for all $x,y \in J, r,s \in R$

$[[r,s],x]Jg(z) = 0$ for all $x \in J, r,s \in R$ .....(19)

Since R is a prime ring, Equation (19) forces that R is commutative of $g(z) = 0$.In this case where R is commutative we get, $F = G$. Otherwise, (16) forces that $f(z) = 0$. So replacing in (1) x by $2rz$, where $r \in R$, we get

$F(r)r = rG(r)$ for all $r \in R$ .....(20)

Therefore, using Lemma 3.1 together with (20), we get the desired result.

As consequence of our main result we extend some results of [4] in more then, for any homomorphism of right R-modules $h: R \to R$ and any nonzero integer α, $\alpha F + h$ is a generalized derivation associated to the derivation αf. Applying this to Theorem 3.2, we get the following.

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FLOW IN SINUSOIDAL TUBE OF VARYING CROSS SECTION WITH PERMEABLE WALL

MR. S.R. GAIKWAD

ABSTRACT

In this paper, we study the low Reynolds number steady flow in Sinusoidal tube of varying cross section with permeable wall. The fluid is assumed to be incompressible and Newtonian. The wall assumed to be rigid and permeable. The wall permeability is assumed to be a function of axial distance and obeys Starling's Law. We are interested to analyze the effects of Reynolds number and permeability on flow characteristics when the initial flux in the tube is prescribed. The effect of variable permeability of the wall on various parameters on flow characteristics is discussed.

KEYWORDS:

Numerical solution of differential equation, fluid m echanics, Reynolds number, Effect of wall permeability.

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1. INTRODUCTION

Flow in tubes of varying cross-section is a good area for research work due to its importance in physiological and engineering flow problems. In particular, it plays a significant role in understanding the flow in blood vessels. Most of these studies have considered the tube walls to be impermeable. Flow through tube of uniform cross section with permeable wall has been investigated due to its application in engineering flow problem . Berman(1953) [2] worked on flow through ducts with permeable wall as suction/injection problem where normal velocity of the fluid at the wall is prescribed and these studies suction/injection velocity prescribed at the wall is constant. Macey(1965)[11] prescribed flux as an exponentially decreasing function of axial distance to account for the fluid absorption of the wall. Friealman and Gill(1967)[6] have studied flow though cylindrical tube with permeable walls with reference to flow in the proximal renal tubes.. Manton(1971)[12] have studied for pulsatile flow for tubes of slowly varying

pressure at the initial cross section have been prescribed. We are interested to study the effects of Re and K on flow characteristics.

2. FORMULATION OF THE PROBLEM

Consider steady flow of a Newtonian incompressible fluid in an axisymmetric tube of varying cross-section with permeable wall. Using cylindrical polar coordinates (X, R, θ) where R = 0 is the axis of symmetry for the tube, the equations of motion and continuity are given as :

$U U_X + V U_R = -\frac{1}{\rho} P_X + \nu[U_{XX} + (R U_R)_R / R]$

(1)

$U V_X + V V_R = -\frac{1}{\rho} P_R + \nu[V_{XX} + \frac{1}{R}(R V_R)_R - \frac{V}{R^2}]$

(2)

$U_X + (RV)_R / R = 0$

(3)

Where (U, V) are the fluid velocity components in (X, R) directions respectively, P is the pressure, ν is the kinematic coefficient of viscosity and ρ is the constant fluid density.

We consider tube of slowly varying cross-section, and hence, the radius of the tube R = a (X) is given as:

$a(x) = S(\varepsilon X / a_0)$

$\varepsilon = a_0 / L \ll 1, \quad S(0) = 1$ (4)

Where ε is the wall variation parameter, a_0 is the tube radius at the initial cross-section, L is the characteristic length and $S(\varepsilon X / a_0)$ is an arbitrary function of X.

The fluid exchange across the permeable wall is given by Starling's law and the net external pressure acting on the surface of the wall is assumed to be constant. This gives the normal fluid velocity at the tube wall as :

$V - a_x U = K(P - P_{ext})$ at $R = a(X)$ (5)

The tangential velocity of the fluid at the wall is zero, hence,

$U + a_x V = 0$ at $R = a(X)$ (6)

The asymmetry of the flow implies

$U_R = 0$ $V = 0$ at $R = 0$. (7)

Further, we prescribe the mean pressure P_{mean} i. e. ,

$P_{mean} = \frac{1}{\pi a^2(x)} \int_0^{a(x)} 2\pi R\, P\, dR$ (8)

And the flux Q, $Q = \int_0^{a(x)} 2\pi R\, U\, dR$ (9)

At the initial cross-section (X = 0) as P_0 and Q_0 respectively, which gives

$P_{mean} = P_0$

$Q = Q_0$ at $X = 0$. (10)

The wall permeability is assumed to be a function of axial distance **K(X)=αk(1+αkX)**

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CALCULATION OF PRESSURE :

Here, the expressions for various flow variables are given in terms of $p^{(0)}$, $p^{(1)}$ and their derivatives. These flow variables can be determined once $p^{(0)}$ *and* $p^{(1)}$are evaluated. The equation governing pressure is obtained through Starling's law.
Thus, using conditions expression for$V^{(0)}$ *and* $V^{(1)}$, we get the following differential equations for $p^{(0)}$ *and* $p^{(1)}$,

$$p_{xx}^{(0)} + 4\frac{S_x}{S} p_x^{(0)} - 16\,\frac{k}{S^3}(p^{(0)} - p_{ext}) = 0 \quad (18)$$

$$p_{xx}^{(1)} + 4\frac{S_x}{S} p_x^{(1)} - 16\,\frac{k}{S^3} p^{(1)} = -\frac{R_e}{64} S^2 \left[3S^2 \left(p_x^{(0)^2} + p_x^{(0)} p_{xxx}^{(0)}\right) + 40S\, S_x p_x^{(0)} p_{xx}^{(0)} + 8 p_x^{(0)^2} (sS_{xx} + 7S_x^2)\right] \quad (19)$$

$$p^{(0)} = p_{in} \;, \quad p_x^{(0)} = -16 \quad (20)$$

$$p^{(1)} = 0 \;, \; p_x^{(1)} = 4\,R_e[3k\,(p^{(0)} - p_{ext}) + 4s_x] \quad (21)$$

The differential eqns. (21) and (22) with initial conditions form two point initial value problems for$p^{(0)}$*and* $p^{(1)}$ for a given tube geometry, these equations can be solved and the mean pressure drop ΔP at a given cross-section

$$\Delta p = p_{mean}^{(0)} - p_{mean}^{(1)} = p_{in} - p^{(0)}(x) - \varepsilon p^{(1)}(x) + O(\varepsilon^2) \quad (22)$$

:can be calculated.

4. NUMERICAL SOLUTION AND DISCUSSION:

In general, analytical solutions of the equations (18), (19) are not feasible and equations have to be solved numerically for a given S(x), however, in a particular case of S(x)=1+0.2*sin(2*3.1415*x), Sinusoidal tube .It is possible to find analytic solution for $p^{(0)}$ analytically. But in this case also, it becomes very tedious to solve for $p^{(0)}$ analytically. In view of this, fourth order R-K Method is used to evaluate $p^{(0)}$ and $p^{(1)}$numerically. Hence, we evaluate the expressions flow rate (Q) and wall shear stress $|Tw|$.
We have taken ϵ =0.05 in fig.1, fig.3, fig.5 and fig.7 variation of flow rate Q has been shown. The effect of Re and permeability K on flow rate (Q)have been shown in constricted .The flow flux decreases for this tube .The effect of increase in permeability is to decrease the flux.

In fig.2, fig.4 fig.6, fig.8 Variation of wall shear stress ITwI has been shown. The maximum value of wall shear stress is observed around the point of constriction. When permeability increases the wall shear stress decreases.

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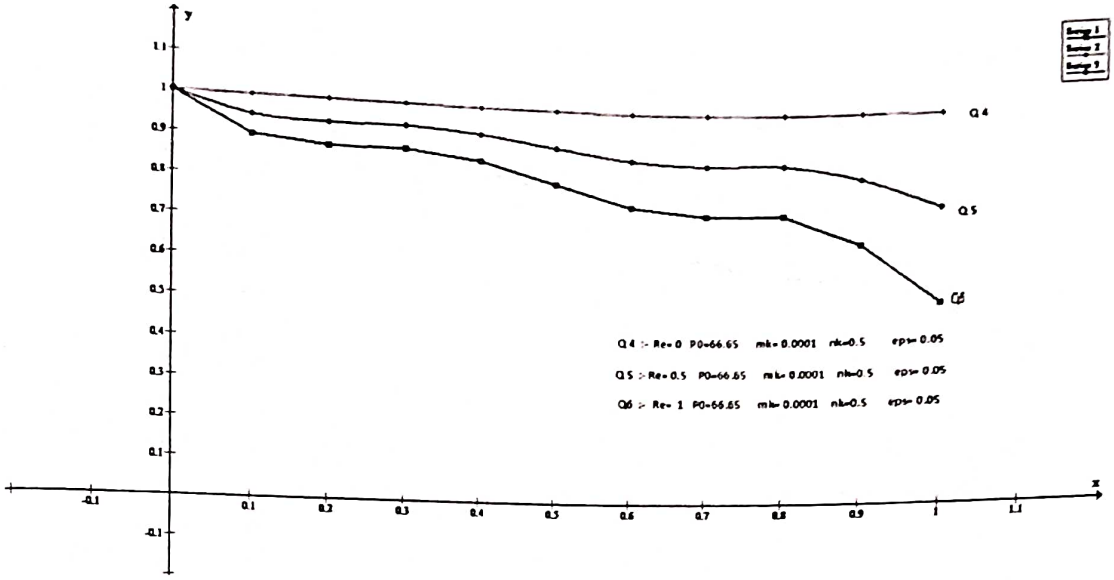

Fig.3) Flow rate Q vs axial distance X for Sinusoidal tube for Re=0, Re=0.5, Re=1,mk=0.0001, nk=0.5, eps=0.05

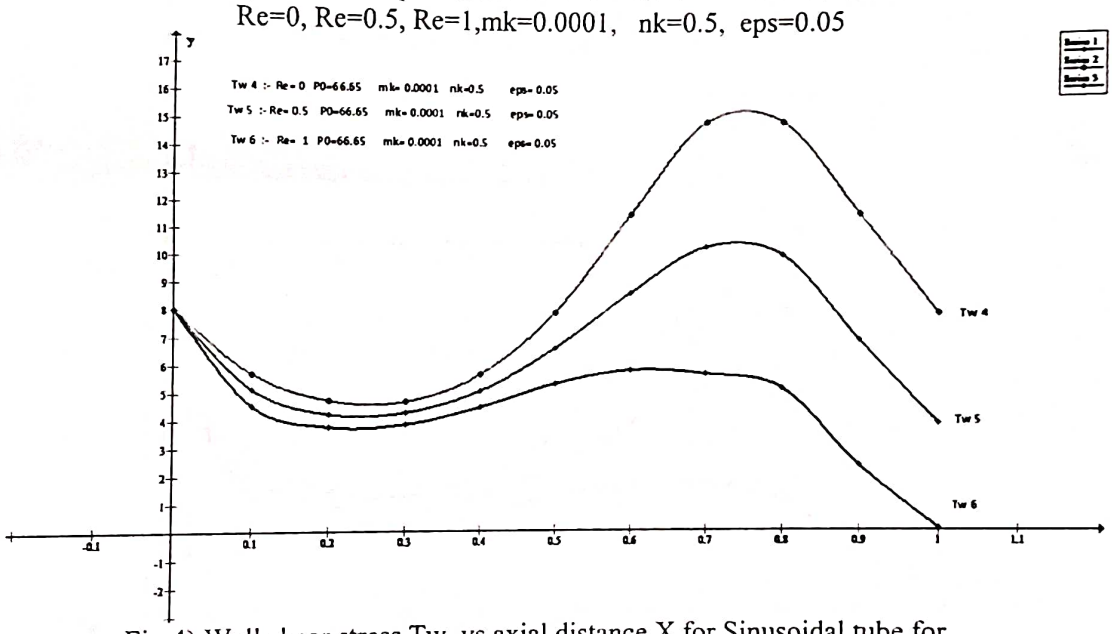

Fig.4) Wall shear stress Tw vs axial distance X for Sinusoidal tube for Re=0, Re=0.5, Re=1, mk=0.0001, nk=0.5, eps=0.05

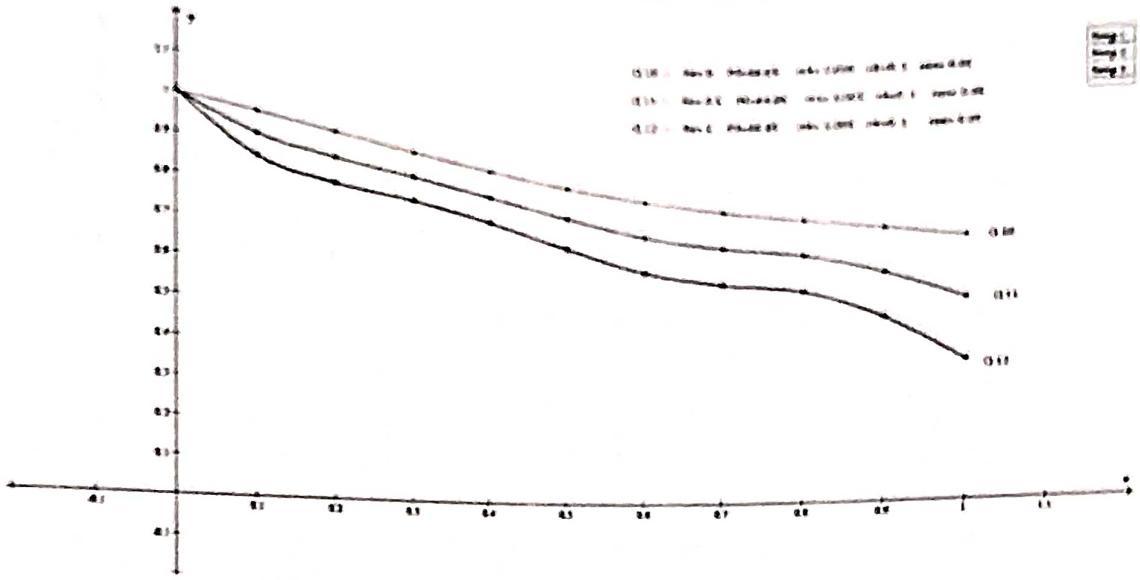

Fig.7) Flow rate Q vs axial distance X for Sinusoidal tube for
Re=0, Re=0.5, Re=1, mk=0.005 nk=0.5 eps=0.05

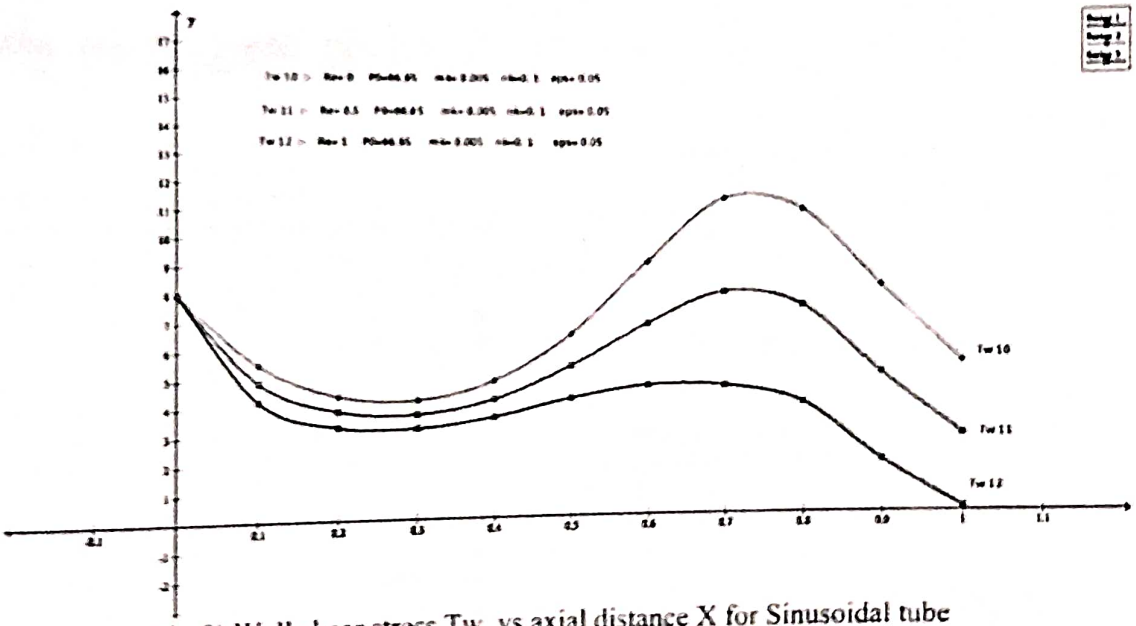

Fig.8) Wall shear stress Tw vs axial distance X for Sinusoidal tube
Re=0, Re=0.5, Re=1, mk=0.005, nk=0.5, eps=0.05

4. CONCLUSION

Using numerical values of $P^{(0)}$ and $P^{(1)}$ and their derivatives ,value of flow rate (Q) and wall shear stress

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On Differentiability and Integrability of Rings

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Abstract: *In this paper we study properties of the differential ideals of a ring R and of the iterated skew polynomial rings over R defined with respect to a finite set of commuting derivations of R. The concept of the integration of R associated to a given derivation of R is also introduced and some fundamental properties are studied. This new concept generalizes basic features of the indefinite integrals.*

Keywords: Derivations and integrations associated to derivations

1. Introduction

All the rings considered in this paper are with identity and they have characteristic zero. A derivation on a ring is a function which generalizes certain features of the traditional derivative operator. On the other hand the term integration is connected to the computation of an integral.

In the present work properties of the differential ideals of a ring R and of the iterated skew polynomial rings over R is defined with respect to a finite set of commuting derivations of R. The concept of the integration of R associated to a given derivation of R is also introduced and some fundamental properties of it are studied. This new concept generalizes basic features of the indefinite integrals.

2. Derivations and Differential Simplicity of Rings

We start by recalling the following definitions:

2.1 Definition: Let R be a ring. Then a map d:R $\rightarrow$ R is called a derivation of R, if and only if, d(x + y) = d (x) + d(y) and d(x,y) = xd(y) + d (x) y, for all x, y in R. Observe that d(1) = d(1.1) = 2d(1), therefore d(1) = 0. The set of all derivations of R is denoted by Deri(R) Given a non commutative ring R and an element s in R it is easy to check that the map d: R $\rightarrow$ R defined by d(r) = sr – rs is a derivation of R, called the inner derivation of R induced by s. For distinguishing between the two cases, a derivation of R which is not inner is called an outer derivation.

2.2 Definition: Let R be a ring and let d be a derivation of R. Then an ideal I of R is said to be a d-ideal, if d (I) $\subseteq$ I. If the only d-ideals of R are 0 and R, then R is called as d-simple ring and d is called a simple derivation of R. Non commutative d-simple rings exist in abundance; for example every simple ring is d-simple for any derivation d of R. On the other hand, there is not known any general criterion under which one can decide whether or not a commutative ring possesses simple derivations. Typical examples of such rings are the polynomial rings in finitely many variables over a field 1 and the regular local rings of finitely generated type over a field 2. More examples can be found in 1, whereas in 3 geometrical examples are presented of smooth varieties (algebraic sets) over a field with coordinate rings possessing simple derivations.

It is well known that if a commutative ring R is d-simple then R is an integral domain and also that if R has no non zero prime d-ideals, then R is a d-simple ring (4; Corollary 1.5).

Definition 2.2 can be generalized for a finite set D of derivations of R as follows:

2.3 Definition: Let D be a finite set of derivations of R. Then an ideal I of R is called a D-ideal if d (I) $\subseteq$ I for all d in D and R is called a D – simple ring, if it has no proper nonzero. D-ideals (differential simplicity of R). Obviously, if R is a d-simple ring for some d in D, then R is also a D-simple ring, but the converse is not true; e.g. this happens with the coordinate ring of the real sphere (5, Lemma 3.1).

2.4 Definition: Let R be a ring and let d be a derivation of R. Define on the set S of all polynomials in one variable x over R addition in the usual way and multiplication by the rule; xr = rx + d(r), for all r in R. It is well known then that S becomes a non commutative ring denoted by R [x, d] and called a skew polynomial ring (of derivation type) over R (e.g. sec 6, p.35).

Such rings, which are also known as Ore extensions, have been firstly introduced by O. Ore 7 to be used as counter examples. Note that skew polynomial rings can also be defined over R with respect to an endomorphism f of R and in a more general context with respect to f and an f-derivation d of R 6, which is a generalization of the concept of the ordinary derivation. We continue with the following useful Lemma:

2.5 Lemma: Let R be a ring, let d be a derivation of R and let S = R[x, d] be the corresponding skew polynomial ring over R. Let also d* be another derivation of R. Then d* extends to a derivation of S by d*(x) = 0, if, and only if, d* commutes with d.

Proof 8: Obviously d* extends to a derivation of S, if, and only if, d*(x) can be defined in a way compatible to multiplication in S. In other words, if d*(x) = h, then for all r in R we must have d*(xr) = d*(rx) +d* [d(r)] $\Leftrightarrow$ xd*(r)+hr =

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But, since $a_{n-1},\ldots,a_1$ are in $d^{-1}(P)$, we get that $d(a_{n-1}),\ldots, d(a_1)$ are in P. Therefore $r_o d(r)$ is in P, which implies that either r_o is in P or d(r) is in P. But, if r_o is in P, $d(r_o)$ is also in P, therefore r_o is in $d^{-1}(P)$. Thus equation (1) contradicts to the minimality of n in f(x). Consequently d(r) is in P, which shows that r is in $d^{-1}(p)$ and this completes the proof of the theorem.

Let now s = a+d(b) be an element of I + d(I), with a, b in the ideal I of R. Then d(rb) = rd(b)+d(r)b, therefore rs = ra + rd(b) = ra + [d(rb)-d(r)b]=[ra-d(r)b] +d (rb) is in I+d(I), for all r in R. Consequently I + d(I) is an ideal of R.

Assume now that R is a local ring, i.e. a Noetherian ring with a unique maximal ideal M. If M is not a d-ideal of R, then M + d(M) is an ideal of R containing properly M, therefore M +d(M) = R. On the other hand, it becomes clear that the ideal $M^k+d(M^k)\subseteq M$, for all integers k, $k \geq 2$. In particular, for k = 2 we shall prove the following result:

3.2 Theorem

Let R be a local ring with maximal ideal M and let d be a derivation of R such that M is not a d-ideal of M. Then $M^2+d\left(M^2\right)=M$.

Proof: Since R is a Noetherian ring, M is a finitely generated ideal of R. Therefore, we can write M = $(m_1, m_2,\ldots,m_k)$ for some positive integer k.

Since M is not a d-ideal of R, there exists at least one generator m_s of M such that $d(m_s)$ is not in M. We can write then $M = (m_1 + m_s, m_2+m_s,\ldots,m_k + m_s)$. Therefore, without loss of generality we may assume that $d(m_i)$ is not in M, for all i = 1, 2,…,k. Consequently $d(m_i)$ is a unit of R, because otherwise we should have that $(d(m_i))$ is a proper ideal of R, which implies that $(d(m_i)) \subseteq M$, or $d(m_i) \in M$, a contradiction. In other words, there exists r_i in R such that $r_i d(m_i) = 1$.

Then $d\left(m_i^2\right)=2m_i d\left(m_i\right)=2m_i\left(r_i^{-1}\right)$ is in $M^2+d\left(M^2\right)$, therefore $m_i=\frac{r_i}{2}\left[2m_i\left(r_i^{-1}\right)\right]$ is also in $M^2+d\left(M^2\right)$, which completes the proof.

We now introduce the following concept:

3.3 Definition: Let R be a ring and let d be in DerR. Then the integration of R associated to d is a map i: R → R such that d[i(x)] = x, for all x in R.
Next we shall prove:

3.4 Theorem: Let d be an injective derivation of a ring R and let i be the integration of R associated to d. Then i is a derivation of R, if, and only if,

$xy=-\left[i(x)d(y)+d(x)i(y)\right]$ For all x, y in R.

Proof: For all x, y in R we have by definition 2.2 that $d\left[i(x+y)\right]=x+y$. We also have that

$d\left[i(x)+i(y)\right]=d\left[i(x)\right]+d\left[i(y)\right]=x+y$

Therefore, since d is an injective map, we obtain that

$i(x+y)=i(x)+i(y)$

On the other hand, we have that
$d[i(xy)] = xy$ and
$d[xi(y) + i(x)y] = d[xi(y)] + d[i(x)y]$
$= x[d[i(y)]] + d(x)i(y) + i(x)d(y) + d[i(x)]y$
$= 2xy + d(x)i(y) + i(x)d(y)$

On comparing the last two equations we obtain that

$d\left[i(xy)\right]=d\left[xi(y)+i(x)y\right]$,

if, and only if,

$xy=2xy+d(x)i(y)+i(x)d(y)$.

This, combined to the fact that d is an injective map, it finally shows that

$\left[i(xy)\right]=xi(y)+i(x)y$,

if, and only if,

$xy=-\left[i(x)d(y)+d(x)i(y)\right]$

which, together with equation (2) completes the proof of the theorem.

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Study on Optical Properties of Green Synthesized Silver Nanoparticles for Surface Plasmon Resonance

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ABSTRACT

In the present study green, rapid, extracellular synthesis of silver nanoparticles was achieved under alkaline conditions using *Penicillium* species. The synthesis of silver nanoparticles is greatly influenced by the pH value of the reaction medium and studied visually as well as using UV-visible spectrophotometer. The SPR absorption bands appeared in the range between 408 nm and 415 nm confirm the formation of the silver nanoparticles. Silver nanoparticles prepared at pH value 10 were further characterized using XRD, SEM, TEM, photoluminescence spectroscopy. X-ray diffraction analysis exhibited the crystalline nature of the prepared silver nanoparticles with face centered cubic structure. The prepared silver nanoparticles were spherical in shape as revealed from SEM and TEM images with the sizes in the range between 11 to 19 nm. The emission spectra were recorded at 530 nm when excited at 400 nm in photoluminescence spectroscope. The prepared silver nanoparticles were evaluated for their catalytic activity in the reduction of MB by $NaBH_4$ and exhibit the excellent results.

1. Introduction

The electrical, optical, chemical properties of the metallic nanoparticles are functions of size and shape of the nanoparticles [1-4]. Interaction between incident light and free electrons on the surface of metallic nanoparticles causes the electrons to oscillate. Cloud of oscillating electrons on theses nanoparticle's surface is known as plasmon. Plasmons are the deep area of research and are the key driver of engineering at the nanoscale. When the frequency of incident light matches with the frequency of free electrons oscillations, resonance is established. This phenomenon is known as surface plasmon resonance. Colours exhibited by the metallic nanoparticles are due to this SPR [5]. Surface plasmon resonance exhibited by the metallic nanoparticles is the function of their size, shape and liquid medium in which particles are suspended. Shift in LSPR wavelength tolerates the nanoparticles for sensing the chemical and biological molecules [6]. For Nobel metal nanoparticles such as silver and gold SPR absorption band lies in visible region of the spectrum. Size dependent variation in colours was displayed by silver and gold nanoparticles [7].

Silver nanoparticles are reported for their size and shape dependent optical [8, 9], catalytic [10, 11] and antimicrobial activities [12]. Due to the size dependent nature of plasmon it might be possible to develop electronic or photonic devices based on excitation and detection of plasmon [13]. The intensity of the brown colour for silver nanoparticles was depends on the pH value of the reaction solution [7].

Several reports are available for the synthesis of silver nanoparticles by usual physical and chemical methods. But in these methods of fabrications, nanoparticles were achieved through the involvement and release of toxic chemicals which affect the environment. So, the green synthesis routes in which natural reducing and stabilizing agents used are preferred for the fabrication of silver nanoparticles. Fungi comprise large quantity of enzymes extracellularly due to which extracellular synthesis of nanoparticles is possible [14]. Fungi such as *Aspergillus flavus* [15], *Aspergillus niger* [16], *Trichoderma asperelum* [17] and *Penicillium* species [17-19]. Shown their potential for the production of silver nanoparticles.

Green synthesized silver nanoparticles were reported for their catalytic performance and hence might be applicable for the maintenance of the environment. Silver nanoparticles synthesized using Kashayam Guggulutiktham exhibit size dependent catalytic performance in the reduction of MB [20]. Silver nanoparticles of different shapes synthesized by simple solvothermal method exhibited their shape dependent catalytic activity for the oxidation of styrene [21].

Present investigation reports the fast, extracellular synthesis of silver nanoparticles using *Penicillium* species. Effect of pH values of the reaction solutions was studied on the optical property SPR revealed by the silver nanoparticles.

2. Experimental Methods

Chemicals $AgNO_3$ and 0.1 N NaOH were used of analytical grade. Fungal species *Penicillum* species NCIM 1313 was obtained from National Chemical Laboratory Culture Collection Centre, Pune.

2.1 Preparation of Fungal Filtrate

The fungal organism *Penicillium* species was grown in a sterile liquid media potato dextrose broth [22]. After 7 days of incubation under static condition at 30 °C, the mycelial mat was observed on the media. The mycelia were separated using Whatman No.1 filter paper. The mycelia harvested on the paper was washed extensively using deionized water to remove the trace of the media component. Fresh ten gram of mycelia was suspended in 100 mL deionized water and incubated at 30 °C under shaking condition at 110 rpm for 72 h. After incubation period fungal mycelia was separated by filtration through Whatmann No.1 filter paper and the obtained filtrate [23] was used for the production of silver nanoparticles.

2.2 Production of Silver Nanoparticles

Five flasks each containing equal amount of fungal filtrate and $AgNO_3$ solution with final concentration of 1 mM were adjusted at different pH values 7-11 and all these flasks were incubated at 30 °C under shaking condition at 110 rpm for 72 h. The pH value of the reaction solution was adjusted by using 0.1 N NaOH solution.

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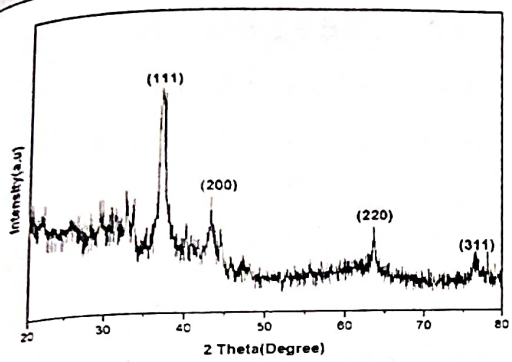
JCPDS No. 43-0649. Also, the samples' crystallite size was found to 16.69 nm (Table 1), which calculated by using Scherer equation from the full width at the half maximum (FWHM) peak broadening of the high-intensity peak (1 1 1) of the XRD graphs.

$$D(nm) = \frac{k\lambda}{\beta cos\theta} \quad (2)$$

where D is the crystalline size (nm); k is the shape factor, which is equal to 0.94 for sphere particles; β is the full width of the diffraction line at half of the maximum intensity measured in radians; λ is the X ray wavelength of Cu Kα = 0.154 nm; θ is Bragg angle.

Table 1 XRD analysis of synthesized Ag nanoparticles

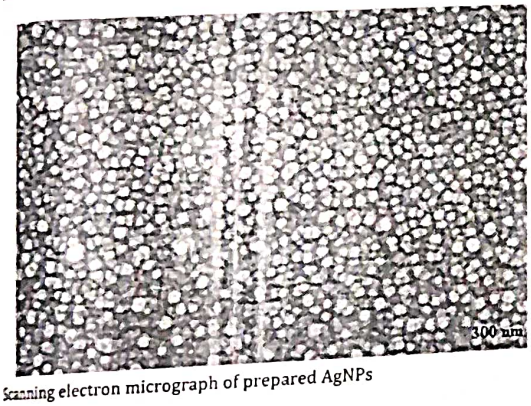
θ	cosθ	FWHM in radians	Size nm
19	0.946	0.0087	16.69



XRD pattern of AgNPs

Scanning Electron Microscopy

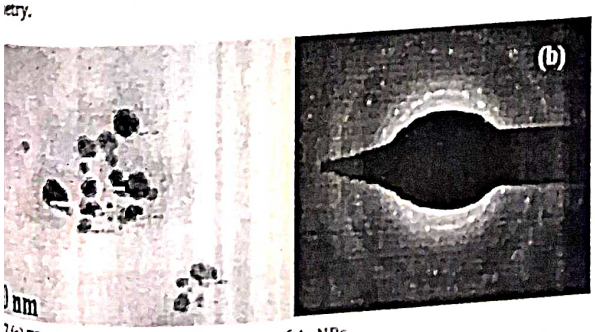
Scanning electron micrograph of the prepared silver nanoparticles is shown in the Fig. 6. It clearly indicates that the nanoparticles were spherical in shape with uniform distribution and in the size range between 5 to 15 nm.



Scanning electron micrograph of prepared AgNPs

Transmission Electron Microscopy

TEM images of the synthesized silver nanoparticles are depicted in Fig. revealed that the particles were spherical in shape. The size of the particles was in the range of 9 to 19 nm. Selected area electron diffraction pattern shown in Fig. 7(b) indicates that prepared particles possess crystalline nature with face centered cubic metry.



(a) TEM image and (b) SAED pattern of AgNPs

3.7 Photoluminescence Spectra

The PL spectra of prepared colloidal solution of silver nanoparticles are depicted in Fig. 8. The emission peak was obtained in the visible region at 530 nm when excited at 400 nm. The luminescence of the nanoparticles is due to the excitation of free electrons from occupied 'd' band into higher excited states above the Fermi level which is then followed by relaxation to lower level. The energy losses of the electron result in luminescence. The optical properties of the silver nanoparticles depend on the interband and intraband transition between electronic states [30].

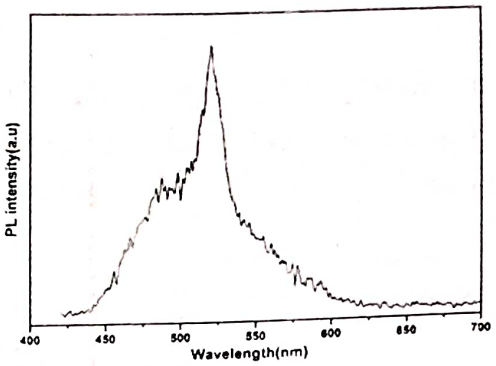


Fig. 8 PL emission spectra of AgNPs

3.8 Catalytic Activity

For the evaluation of the catalytic activity of prepared silver nanoparticles, the reduction of MB by $NaBH_4$ was studied [31, 32]. The reaction was carried in two tubes each contain 2ml of M.B. which is blue in colour. 0.5 mL $NaBH_4$ was poured in both tubes. Colloidal solution of 0.3 ml was added in solution of tube 2. The reaction was monitored visually as well as using UV-visible spectrometer. Immediately the reaction starts and, in few minutes, (2 minutes) the solution in tube 2 becomes colourless while the solution in tube 1 remained blue for several hours Fig. 9(a).

Fig. 9(b) shows that MB has a maximum absorbance at 663.5 nm but when the AgNPs solution was added in tube 2 the peak drops in few (two) minutes. This indicates the reduction of MB was catalyzed due to silver nanoparticles. One absorbance peak was observed at 400 nm which may be due to presence of silver nanoparticles.

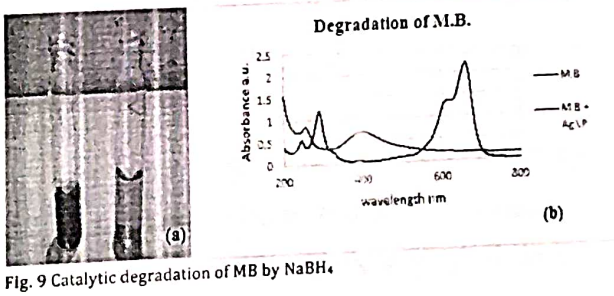


Fig. 9 Catalytic degradation of MB by $NaBH_4$

4. Conclusion

The optical properties of green synthesized silver nanoparticles were greatly influenced by the pH value of the reaction medium. The SPR curve sharpened and the peak was shifted towards blue end with increase in pH value. It is possible to produce large number of small, stable silver nanoparticles at a rapid rate under alkaline environment. Silver nanoparticles prepared using *Penicillium* species causes the reduction of MB in few minutes (120 seconds).

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Studies on thermodynamic stability constant of amino acids with Yb(III) complexe.

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Abstract

The thermodynamic stability constant of the complexes were also calculated. The formation of complexes has been studied by Job's method. The results obtained of stability constant were good agreement. The metal-ligand and proton–ligand stability constant of Gd(III) with amino acids (L-GLutamic acid + serine) were determined at various ionic strength in 1% potassium chloride solution by pH metric titration. $NaClO_4$ was used to maintain ionic strength of solution.

Key word: Amino acid, Stability constant, ionic strength.

Introduction

Glutamic acid is considered as the essential amino acid for the protein synthesis. Glutamic acid offers the several health benefits and maintains the healthy functioning of body. It supports the good health of immune system, digestive system as also aids in the energy production in the body. Nehete et al have studied the effect of ionic strength on stability of complexes[1]The effect of ionic strength of medium on stability constant of cu (II) complex of 2-amino-5- Chloro benzene sulphonic acid at 301K[2]. The stability constant of Co (III) with 1-Amidino-0-methylurea as primary ligand at different ionic strength [3]. The influence of ionic strength of medium on complex equilibria [4]. Association and dissociation constant of Pr (III) complexes with 3-(2-hydroxy-3-Iodo-5-methyl phenyl) 1, 5 diphenyl pyrazoline at different ionic strength[5]. Stability constant of vanadium with glycene at various ionic strength by potentiometric titration technique [6] . The stability constant of Mo (IV) with Iminodiacetic acid at different ionic strength maintain by using sodium per chlorate was investigated [7]. Effect of ionic strength and solvent effect on thermodynamic parameters [8]. They have also studied the mechanism of protonation and complex formation of binary complexes of La (III), Ce (III), Pr (III) and Nd (III) with aminopyridines. The apparent metal-ligand stability constants and confirmation of complexes studied [9] .The composition of complexes were confirmed by Job's method as modified by Vasburgh and Gold [10].

In this work, we have determined the pK, metal-ligand stability constant at different ionic strength. We have studied in the 1% potassium chloride. We have thought of interest to study the effect of ionic strength on thermodynamic parameters of complexes of L-GLutamic acid with Gd(III) metals in 1% sodium benzoate by pH metrically and spectrophoto metrically.

The conditional stability constant of amino acid–lanthanide metal complexe were determined for all systems by using equation.

$$K = x / (a_1-x)(b_1-x) = x / (a_2-x)(b_2-x)$$

K= stability constant, x = Concentration of complex, a_1 and b_1 were concentration of metal ion and ligand before dilution. a_2 and b_2 were concentration of metal ion and ligand after dilution. The values of 'x' were calculated from graph optical density Vs % composition of metal ions in solution.

From table-2, it was seen that the good agreement among thermodynamic constant obtained from pH metry and spectrophotometrically.

Table1. Proton–ligand (pK) and metal-ligand stability constant (Log K) value for Yb(III) with amino acids at various ionic strength(μ)

μ	√μ	√μ/1+√μ	[√μ/1+√μ] –0.3√μ	pK	$LogK_1$	$LogK_2$
L-GLutamic acid + **Yb(III)**						
0.02	0.1414	0.1239	0.0815	7.6167	6.15	3.50
0.04	0.2000	0.1667	0.1067	7.6458	5.50	3.25
0.06	0.2450	0.1968	0.1233	6.8842	5.35	2.75
0.08	0.2828	0.2205	0.1356	5.6448	4.70	2.60

Table 2. Metal-ligand stability constants (Log K) values obtained by pH-metry and Spectrophotometry technique (Ionic strength = 0.08m)

System	pH metry	Spectrophotometry
Yb (III)+ L-GLutamic acid	4.55	4.5257

Conclusion

The calculated values of stability constant at various ionic strength are high. From data the conclusion is, the complexes of amino acid with Gd (III) metal ion were quite stable at over all range of ionic strength. The values of conditional metal-ligand stability constant shows good agreement with the values determined by pH metrically.

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Flow in Constricted Tube of Varying Cross Section with Permeable Wall

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Abstract: *In this paper, we study the low Reynolds number steady flow in constricted tube of varying cross section with permeable wall. The fluid is assumed to be incompressible and Newtonian. The wall assumed to be rigid and permeable. The wall permeability is assumed to be a function of axial distance and obeys Starling's Law. We are interested to analyze the effects of Reynolds number and permeability on flow characteristics when the initial flux in the tube is prescribed. The effect of variable permeability of the wall on various parameter on flow characteristics is discussed.*

Keywords: Numerical Solution of Differential Equation, Fluid Mechanics, Reynolds number

1. Introduction

Flow in tubes of varying cross-section is a good area for research work due to its importance in physiological and engineering flow problems. In particular, it plays a significant role in understanding the flow in blood vessels. Most of these studies have considered the tube walls to be impermeable. Flow through tube of uniform cross section with permeable wall has been investigated due to its application in engineering flow problem . Berman(1953) [2] worked on flow through ducts with permeable wall as suction/injection problem where normal velocity of the fluid at the wall is prescribed and these studies suction/injection velocity prescribed at the wall is constant. Macey(1965)[11] prescribed flux as an exponentially decreasing function of axial distance to account for the fluid absorption of the wall. Frealman and Gill(1967)[6] have studied flow though cylindrical tube with permeable walls with reference to flow in the proximal renal tubes.. Manton(1971)[12] have studied for pulsatile flow for tubes of slowly varying cross section. Apelblat , Karzin-katchesky and Silberbarg (1974)[1] presented Mathematical analysis for the fluid exchange across the capillary wall using Sterling law. Quaile and Levy (1975)[16] investigated flow through ducts with permeable wall as suction / injection problem in these studies constant suction /injection velocity prescribed at the wall. Varma and Sachati (1975)[20] investigated flow of a power law fluid through circular tube with porous material by property defining the non slip conditions.

Radhakrishnamachrya (1978)[17] studied flow of a dusty fluid in constricted channel. Bestman (1981)[3] analyzed pulsatile flow of a Rivlin- Ericksen fluid at low Reynolds number non Newtonian flow in slowly varying cross section at asymmetrical tubes. Also Radhakrishnamachrya and Peeyush Chandra and Kaimel (1981)[18] the Hydrodynamical problem of flow in proximal renal tubule is investigated by considering axisymmetric flow of a viscous , incompressible fluid though long narrow tube of varying cross section with reabsorption at the wall. Chandra, Peeyush and Radhakrishnamachrya (1983)[4] worked on fluid exchange across converging/diverging tube walls. Colgan and Terril (1989)[5] presented first order solution for asymmetric flow through circular pipe of slowly varying cross section valid for arbitrary Reynolds number. Krishna Prasad and Peeyush Chandra (1990)[8] have worked on the low Reynolds number flow of a viscous incompressible fluid in channels of slowly varying cross-section with permeable boundaries has been studied. The effect of various parameters on the flow characteristics like wall shear stress, pressure drop and volumetric flow rate has been discussed. Krishna Prasad and Peeyush Chandra (1992)[9] have studied low Reynolds number flow of viscous incompressible Newtonian fluid in cylindrical tube of varying cross section with absorbing walls. Krishna Prasad and Peeyush Chandra have(1992)[10]have studied Pulsatile flow in circular tubes varying cross section with permeable wall .Sarin(1997) [19] fully developed steady laminar flow of an idealized elastic-viscous liquid through a curve tube with elliptic cross section. M.Zakaria (2002)[13]worked on the equation of a polar fluid of hydromantic fluctuating through a porous medium. M.A.A.Mahmoud and M.A.E.Mohmoud (2005) [14] have studied the boundary layer flow of power-law non Newtonian fluid over continuously moving surface in presence of a magnetic field. H.Beirao da Veiga (2008) [7] have studied the motion of non Newtonian fluid with shear dependent viscosity between two cylinders. Mario, Dannis and Amaru Gonzalez(2017) [15] have worked on eleasto - viscoplastic fluid in tubes of varying cross section. The fluid exchange across the wall is accounted for prescribing the normal velocity of the fluid at the wall. A perturbation analysis has been carried out for flow Reynolds number flows and for small amplitude of oscillation.

We consider steady flow of an incompressible fluid in a rigid tube of slowly varying cross-section with absorbing wall. The effect of fluid absorption through permeable wall is accounted by prescribing flux as an arbitrary function of axial distance .The fluid exchange across the tube wall is accounted either by prescribing normal fluid velocity at the wall which is equivalent to prescribing flow flux at different cross-sections of the tube or through Starling's law which states that normal velocity of the fluid at the wall is proportional to the pressure difference across the vessel

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$p^{(1)} = 0 \, , p_x^{(1)} = 4 \, R_e[3k \, (p^{(0)} - p_{ext}) + 4\varepsilon_x]$ ..... (21)

The differential eqns. (21) and (22) with initial conditions form two point initial value problems for $p^{(0)}$ and $p^{(1)}$ for a given tube geometry, these equations can be solved and the mean pressure drop ΔP at a given cross-section

$\Delta p = p_{mean}^{(0)} - p_{mean}^{(1)} = p_{in} - p^{(0)}(x) - \varepsilon p^{(1)}(x) + O(\varepsilon^2)$ ... (22)

can be calculated.

3. Numerical Solution and Discussion

In general, analytical solutions of the equations (18), (19) are not feasible and equations have to be solved numerically for a given S(x). However, in a particular case of S(x) =(2-exp(-(x-0.5)*(x-0.5)))/(2-exp(-0.25)) constricted tube .It is possible to find analytic solution for $p^{(0)}$ analytically. But in this case also, it becomes very tedious to solve for $p^{(0)}$ analytically. In view of this, fourth order R-K Method is used to evaluate $p^{(0)}$ and $p^{(1)}$numerically. Hence, we evaluate the expressions flow rate (Q) and wall shear stress IT_wI.

We have taken $\varepsilon = 0.1$ and 0.05 in fig.1 ,fig.3 , fig.5 and fig.7 variation of flow rate Q has been shown. The effect of Re and permeability K on flow rate (Q)have been shown in constricted .The flow flux decreases for this tube .The effect of increase in permeability is to decrease the flux.

In fig.2, fig.4 fig.6 , fig.8 Variation of wall shear stress IT_wI has been shown. The maximum value of wall shear stress is observed around the point of constriction. when permeability increases the wall shear stress decreases.

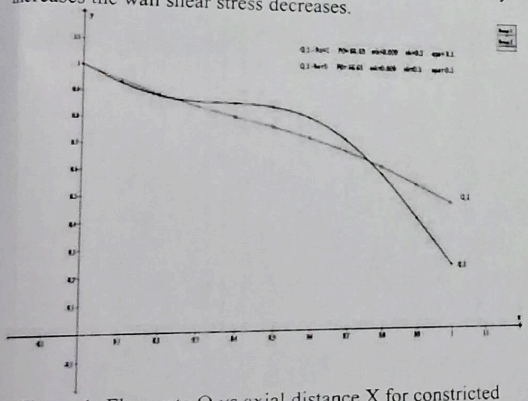

Figure 1: Flow rate Q vs axial distance X for constricted tube for Re=1,Re=5,mk=0.009 nk=0.1 eps=0.1

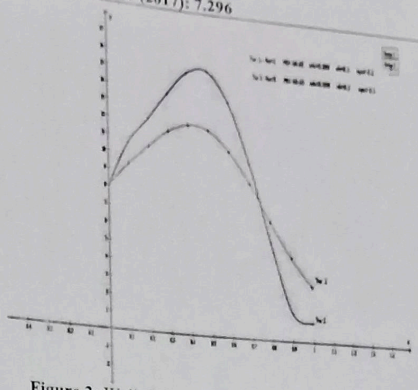

Figure 2: Wall shear stress Tw Vs axial X distance for constricted tube for Re=1 , Re=5, mk = 0.009 nk=0.1 eps=0.1

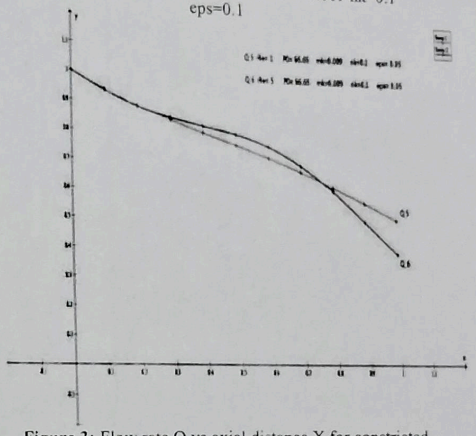

Figure 3: Flow rate Q vs axial distance X for constricted tube for Re=1 , Re=5, mk = 0.009 nk=0.1 eps=0.05

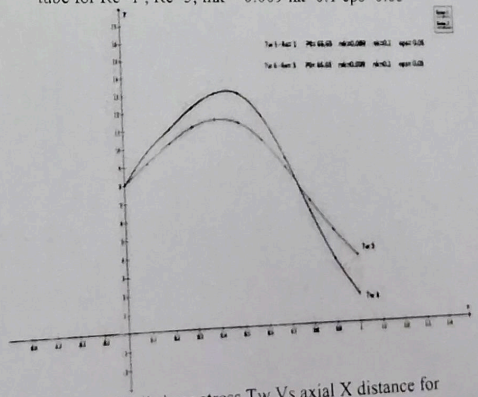

Figure 4: Wall shear stress Tw Vs axial X distance for constricted tube for Re=1, Re=5, mk = 0.009 nk=0.1 eps=0.05

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