

Characterization of Cattle Urine : An Alternative to Plant Nutrient Sources in Sustainable Agriculture

H. Yogeeshappa, C. A. Srinivasamurthy, D. Krishnamurthy

Received 2 August 2016; Accepted 7 September 2016; Published online 22 September 2016

Abstract The characterization with respect to concentration of nutrients in urine from different categories of cattle (Holstein Friesian, local cow, ox) and including buffalo were conducted in this study with an objective of characterized cattle urine and to study the changes in nutrient composition of cattle urine when stored under open and closed condition. The collected urine samples of about ten sample size from each category from different farm cattle sheds during early morning hours have been performed in laboratory and pilot scale. The parameter tested were major

plant nutrients (viz. total N, Pand K), secondary plant nutrients like Ca, Mg, S and also Na and the anions like CO_3 , HCO_3 and Cl, the cationic micronutrients like Cu, Zn, Mn and Fe. An incubation study was conducted by kept the some portion of the samples of cattle urine under open and closed condition. After 30 and 60 days after incubation (DAI) draw the urine sample and subjected for characterization to know the changes in the chemical transformation as well as loss from the stored urine samples.

Initially the pH of the urine from all four categories was acidic in reaction viz. 6.04, 5.97, 6.09 and 6.17 for HF, cow, ox and buffalo urine samples respectively. The electrical conductivity recorded 7.65, 7.36, 7.55 and 7.58 dSm^{-1} for HF, cow, ox and buffalo urine samples respectively. The concentration of nitrogen varied from 0.20 to 0.34, 0.21 to 0.35, 0.22 to 0.35 and 0.21 to 0.37% with an average value of 0.28, 0.26, 0.28 and 0.28% respectively. Later on 30 and 60 DAI all the samples from different categories recorded alkaline in reaction. The loss of nitrogen content was recorded in case of openly incubated condition as compared to closed condition.

Keywords Cattle, Buffalo, Urine, Nutrients, Incubation.

Introduction

India is endowed with huge livestock population. In 2003, it had over 464 million livestock heads. This vast number is deployed primarily to produce food (milk and meat), fiber (wool) and energy for work.

H. Yogeeshappa*

Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Horticulture, Munirabad (Koppal) 583233, UHS Bagalkot, Karnataka, India

C. A. Srinivasamurthy

Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Gandhi Krishi Vigyan Kendra, Bangalore 560065, Karnataka, India

D. Krishnamurthy

Assistant Professor, Department of Agronomy, College of Agriculture, UAS Raichur, Karnataka, India
e-mail : yogeeshappa@gmail.com

*Correspondence

Dr H. Yogeeshappa, Assistant Professor,
Department of Soil Science and Agricultural Chemistry, College of Horticulture, Munirabad (Koppal) 583233, Karnataka, India

However, in the process of food production some by-products are also produced. Urine is an important by-product of livestock, it is used as manure. Traditionally organic farming has been the agricultural practice in India, Intake of toxic substances in human beings and animals has increased due to chemical inputs in agriculture. People are now seriously concerned with the protection of our environment and even more about safe guarding their health.

As the world is becoming sensitive towards issues of environment, ecology and chemical in agriculture, the new era has come to think the alternative for chemical fertilizers, pesticides, petroleum products and environment destruction parameters. The average production of cow urine/day/cow is 5-6 liters. In total approximately 95-102 crore liters of cow urine is produced every day. Proper management of cow dung and cow urine can save precious foreign exchange and provide with pollution free energy and thereby maintaining ecological balance. Cow urine has been described to be the most effective substance or secretion of animal origin with innumerable therapeutic values as well as its nutritive values.

Long term studies indicated that the balanced use of only NPK fertilizers could not maintain high yield levels because of emergence of other secondary and micro-nutrient deficiencies and deterioration in soil physical eco-system.

These threats are erosion of biodiversity and change of climate marching towards desertification and environmental, soil, air, water and food pollution. Hence, there is now a great concern to maintain soil health and protect environment by popularizing eco-friendly and cost effective organic manures.

In fact, organic agriculture is a holistic way of farming with an aim of conserving the natural resources through the agronomic practices and the use of locally available low cost inputs in order to maintain soil fertility and conserve the rich bio-diversity to provide safe clean water, air and to achieve economical sustainability.

Due to the prohibitive cost of chemical fertilizers, majority of Indian farmers who are mostly mar-

ginal and small, do not apply the recommended dose of fertilizers. They are using indigenous organic manures as sources of nutrients.

The nutrients in urine are in the forms which are readily available to plants. The nitrogen is in the form of urea which readily degrades to ammonium and nitrate forms and phosphorus, potassium and sulfates are in ionic forms. This makes urine a unique biogenic fertilizer.

The greatest challenge facing mankind in the world in the twenty first century is to produce the basic necessities of food, fodder, fiber, fuel and other raw materials from 0.14 ha or less land per capita. The nutrient turn over in soil plant continuum concept is considerably high under intensive cropping; neither the chemical fertilizers nor the basic or biological sources alone can achieve production sustainability. The judicious use of naturally available resources like cattle urine help in maintaining yield stability through correction of marginal deficiencies of secondary and micro-nutrients, enhancing efficiency of applied nutrients and providing favorable soil chemical and physical conditions and reducing the environmental pollution.

Materials and Methods

In order to assess the nutritive value of cattle and buffalo urine and their changes in composition when incubated under open and closed conditions were conducted during the year 2011-12. The urine samples were collected from farm house at GKVK, University of Agricultural Sciences, Bangalore and Doddaballapura area. The sample size was taken from all the categories of cattle.

After collection, the urine samples were subjected to analyzed for all the quality parameters on the initial day itself, then 50% sample of the volume of cattle urine (indigenous cow, crossbreed cow, ox and buffalo) were kept in closed containers at room temperature in 1000 ml poly propylene screw capped containers and the remaining 50% of the samples were kept under open condition to monitor the changes in the chemical properties of urine under closed and open conditions. The samples from the containers incu-

Table 1. Chemical composition of urine samples from different types of cattle at initial stage. *Average of ten samples; HF-Holstine Freshian.

Sl. No.	Parameters	Mean values*				Range			
		HF	Indigenous			HF	Indigenous		
			Cow	Ox	Buffalo		Cow	Ox	Buffalo
1.	pH	6.04	5.97	6.09	6.17	6.69-7.10	5.23-6.35	5.37-6.65	6.69-7.16
2.	EC (dS/m)	7.65	7.36	7.55	7.58	7.52-9.10	6.75-8.19	6.69-8.38	7.52-9.17
3.	N (%)	0.28	0.26	0.28	0.28	0.20-0.34	0.21-0.35	0.22-0.35	0.21-0.37
4.	P ₂ O ₅ (%)	0.17	0.18	0.18	0.17	0.13-0.21	0.15-0.23	0.15-0.23	0.12-0.21
5.	K ₂ O (%)	0.22	0.21	0.22	0.22	0.19-0.25	0.19-0.23	0.18-0.26	0.02-0.22
6.	Na (%)	0.19	0.20	0.19	0.13	0.09-0.30	0.09-0.39	0.09-0.30	0.09-0.19
7.	Ca (meq/l)	22.80	19.60	20.60	22.60	16.00-12.00	16.00-22.00	16.00-24.00	16.00-30.00
8.	Mg (meq/l)	49.78	43.26	31.19	48.40	41.48-61.23	33.58-51.36	26.29-37.43	35.56-59.26
9.	S (%)	0.077	0.08	0.08	0.07	0.06-0.09	0.07-0.10	0.067-0.11	0.06-0.09
10.	CO ₃ (meq/l)	-	-	-	-	-	-	-	-
11.	HCO ₃ (meq/l)	10.62	9.73	10.50	11.01	6.40-15.36	6.40-14.08	6.40-15.36	7.68-15.36
12.	Cl (meq/l)	32.17	30.39	31.19	32.44	27.18-36.98	26.29-37.87	26.29-37.43	28.07-37.87
13.	Zn (mg/l)	18.2	17.66	18.32	18.20	19.40-16.40	16.40-19.80	15.80-19.80	16.4-19.8
14.	Fe (mg/l)	121.68	121.6	121.38	121.56	118.2-127.2	118.80-125.80	117.80-124.60	117.8-125.8
15.	Mn (mg/l)	21.78	21.72	22.48	22.86	17.40-25.40	17.40-26.60	17.80-25.40	17.40-25.40
16.	Cu (mg/l)	35.49	35.85	34.21	35.39	29.22-39.84	29.22-39.84	31.22-37.96	29.08-39.70

bated under both closed and opened conditions were drawn on 30 and 60 days after incubation and analyzed the chemical properties.

The pH was determined by potentiometric method using pH meter with glass electrode as described by Manivasakam [1]. Electrical conductivity was determined by using digital conductivity bridge [1]. The total nitrogen was determined by Kjeldahl digestion and distillation method as described by Piper [2], the total phosphorus in urine samples estimated by diacid digestion and vanadomolybdate yellow color method [2] and the total potassium and sodium by diacid digestion and flame photometer method [2]. The secondary nutrients like calcium and magnesium determined by versenate titration method where as sulfur by turbidimetry [1]. Anionic parameters like carbonate and bicarbonate by titration method using phenolphthalein indicator, chloride by Winkler's method using potassium chromate as indicator as described by Manivasakam [1]. The cationic micro-nutrient like Fe, Zn, Cu and Mn were estimated by atomic absorption spectrophotometry as described by Manivasakam [1].

The analysis and interpretation of the data were done using simple statistical methods like range, av-

erage or mean of the data. A repeated measurement analysis of variance was thus performed on the data. As in 2010-2011, the effects of types of animal, duration of incubation, day of collection and their first-order interaction on urine containing plant nutrient concentration were determined. In the single urine collection during 2010-2011, the data were analysed according to a one-way analysis of variance to determine the effect of type of animal on urine containing plant nutrient concentration.

Results and Discussion

The chemical composition of cattle urine samples of HF (Holstein Friesian), local cow, ox and buffalo was found to vary to some extent.

The urine samples from different categories of cattle viz. HF, cow, ox buffalo showed the pH ranging from 6.69 to 8.10, 5.23 to 6.35, 5.37 to 6.65 and 6.69 to 8.16. The electrical conductivity ranged from 7.52 to 9.10, 6.75 to 8.19, 6.69 to 8.38 and 7.52 to 9.17 dS m⁻¹ for HF, cow, ox and buffalo's urine samples respectively which is due to the presence of more salts in the grasses they consume (Table 1). There was slight difference in the concentration of nitrogen among the different types of cattle (0.28, 0.26, 0.28 and 0.28% in

Table 2a. Changes in chemical composition of urine samples from different types of cattle incubated under open condition. Values in the parentheses are average of ten samples; DAI-Days after incubation; HF - Hostine Freshian.

Sl. No.	Parameters	HF			Cow		
		Initial	30 DAI	60 DAI	Initial	30 DAI	60 DAI
1.	pH	6.69-8.10 (6.04)	8.57-9.21 (8.93)	8.74-9.39 (9.11)	5.23-6.35 (5.97)	8.49-9.23 (8.89)	8.66-9.41 (9.07)
2.	N (%)	0.20-0.34 (0.28)	0.16-0.27 (0.22)	0.16-0.27 (0.22)	0.21-0.35 (0.26)	0.17-0.27 (0.22)	0.17-0.27 (0.22)
3.	P ₂ O ₅ (%)	0.13-0.21 (0.17)	0.14-0.19 (0.16)	0.14-0.19 (0.16)	0.15-0.23 (0.18)	0.15-0.21 (0.18)	0.15-0.21 (0.18)
4.	K ₂ O (%)	0.19-0.25 (0.22)	0.17-0.19 (0.18)	0.19-0.21 (0.20)	0.19-0.23 (0.21)	0.17-0.20 (0.18)	0.18-0.22 (0.20)
5.	CO ₃ ⁻ (meq/l)	-	10.00-24.00 (16.60)	11.63-27.91 (19.30)	-	10.00-24.00 (16.40)	11.63-27.91 (19.07)
6.	HCO ₃ ⁻ (meq/l)	6.40-15.36 (10.62)	37.31-56.42 (51.23)	34.98-52.90 (48.03)	6.40-14.08 (9.73)	47.32-58.24 (52.60)	44.36-54.60 (49.31)
7.	Zn (mg/l)	19.40-16.40 (18.2)	13.28-15.55 (14.69)	12.48-14.61 (13.81)	16.40-19.80 (17.66)	2.80-16.04 (14.84)	12.03-15.07 (13.94)
8.	Fe (mg/l)	118.2-127.2 (121.68)	95.74-103.03 (98.56)	89.97-96.82 (92.61)	118.80-125.80 (121.6)	95.42-100.93 (98.32)	89.66-94.84 (92.39)
9.	Mn (mg/l)	17.40-25.40 (21.78)	14.09-20.57 (17.64)	13.24-19.33 (16.58)	17.40-26.60 (21.72)	14.42-20.57 (18.21)	13.55-19.33 (17.11)
10.	Ca (mg/l)	29.22-39.84 (35.49)	23.67-32.27 (28.75)	22.24-30.32 (27.01)	29.22-39.84 (35.85)	25.29-30.75 (27.71)	23.76-28.89 (26.04)

urine from HF (Holstein Friesian), cow, ox and buffalo's respectively) whereas the phosphorus (0.17, 0.18, 0.18 and 0.17%) and potassium content (0.22, 0.21, 0.22 and 0.22%) in urine samples were not found to differ much among the types of cattle. Similar findings were also observed by Hoogendoorn et al. [3] and Yawalkar et al. [4]. The calcium content was slightly more in urine samples of HF (Holstein Friesian) and buffalo (22.80 and 22.60 meqL⁻¹) when compared to cow and ox (19.60 and 20.60 meqL⁻¹). This might be due to the quantity of food consumed by these animals. It also contains high amount of magnesium (49.78, 43.26, 31.19 and 48.40 meqL⁻¹ respectively) and sodium (0.19, 0.20, 0.19 and 0.13% respectively). The cattle urine had appreciable amount of anions like sulfate, carbonate, bicarbonate and chloride. The concentration of micronutrients like zinc, manganese, iron and copper were also found to be in appreciable quantity which may be because of consumption of mineral salts along with the feed and excess of which was discharged through urine.

In open condition, the pH ranged from 8.57 to 9.21, 8.49 to 9.23, 8.52 to 9.19 and 8.64 to 9.24 with a mean value of 8.93, 8.89, 8.85 and 8.92 in samples from

HF, cow, ox and buffalo respectively. In closed condition, the pH ranged from 8.48 to 9.12, 8.40 to 9.14, 8.43 to 9.10 and 8.55 to 9.15 with mean value of 8.84, 8.80, 8.76 and 8.83 for urine samples of HF, local cow, ox and buffalo respectively. The pH of urine samples from different categories of cattle viz. HF (Holstein Friesian), cow, ox and buffalo has increased slightly and was alkaline in reaction. There was a gradual increase in pH of urine samples with increase in duration of incubation. This may be due to conversion of uric acid to ammonia during incubation and also formation of carbonate compounds. Similar findings were reported by Liu Zhigang et al. [5] (Tables 2a and 2b).

In open condition the concentration of nitrogen varied from 0.16 to 0.27, 0.17 to 0.27, 0.16 to 0.28 and 0.17 to 0.29% with an average value of 0.22, 0.22, 0.21 and 0.22%. The phosphorus concentration varied from 0.14 to 0.19, 0.15 to 0.21, 0.15 to 0.21 and 0.14 to 0.19% with mean value of 0.16, 0.18, 0.18 and 0.16% respectively for samples from HF, cow, ox and buffalo respectively. The potassium content varied from 0.17 to 0.19, 0.17 to 0.20, 0.17 to 0.20 and 0.17 to 0.19% with an average value of 0.18% in urine samples of all the four categories of cattle (Tables 2a and 2b). The nitro-

Table 2b. Changes in chemical composition of urine samples from different types of cattle incubated under open condition. Values in the parentheses are average of ten samples; DAI- Days after incubation.

Sl. No.	Parameters	Ox			Buffalo		
		Initial	30 DAI	60 DAI	Initial	30 DAI	60 DAI
1.	pH	5.37-6.65 (6.09)	8.52-9.19 (8.85)	8.69-9.37 (9.030)	6.69-8.16 (6.17)	8.64-9.24 (8.92)	8.81-9.42 (9.09)
2.	N (%)	0.22-0.35 (0.28)	0.16-0.28 (0.21)	0.16-0.28 (0.21)	0.21-0.37 (0.28)	0.17-0.29 (0.22)	0.17-0.29 (0.22)
3.	P ₂ O ₅ (%)	0.15-0.23 (0.18)	0.15-0.21 (0.18)	0.15-0.21 (0.18)	0.12-0.21 (0.17)	0.14-0.19 (0.16)	0.14-0.19 (0.16)
4.	K ₂ O (%)	0.18-0.26 (0.22)	0.17-0.20 (0.18)	0.18-0.22 (0.20)	0.02-0.22 (0.22)	0.17-0.19 (0.18)	0.18-0.21 (0.20)
5.	CO ₃ (meq/l)	-	10.00-22.00 (15.20)	11.63-25.58 (17.68)	-	12.00-24.00 (17.20)	13.95-27.91 (20.00)
6.	HCO ₃ (meq/l)	6.40-15.36 (10.50)	47.32-58.24 (52.60)	44.36-54.60 (49.31)	7.68-15.36 (11.01)	44.59-55.51 (51.05)	41.80-52.04 (47.86)
7.	Zn (mg/l)	15.8-19.8 (18.32)	13.28-16.04 (14.30)	12.48-15.07 (13.44)	16.4-19.8 (18.20)	13.28-16.04 (14.74)	12.48-15.07 (13.85)
8.	Fe (mg/l)	117.8-124.6 (121.38)	96.23-101.90 (98.50)	90.42-95.75 (92.55)	117.8-125.8 (121.56)	95.42-101.90 (98.46)	89.66-95.75 (92.52)
9.	Mn (mg/l)	17.8-25.4 (22.48)	14.09-21.55 (17.59)	13.24-20.25 (16.53)	17.40-25.40 (22.86)	14.09-20.57 (18.52)	13.24-19.33 (17.40)
10.	Cu (mg/l)	31.2-37.9 (34.21)	23.67-32.27 (29.04)	22.24-30.32 (27.29)	29.08-39.70 (35.39)	21.667-32.27 (28.69)	22.24-30.32 (26.96)

gen content was slightly less compared to initial value which might be due to loss of nitrogen as NH₃ due to volatilization at high pH during incubation. Similar findings were reported by Majumdar et al. [6] Hellstrom

et al. [7] and Jonsson et al. [8]. There was no variation in the phosphorus and potassium content of urine samples incubated under open condition. Similar results were recorded by Jonsson et al. [9].

Table 3a. Changes in chemical composition of urine samples from different types of cattle incubated under closed condition. Values in the parentheses are average of ten samples; DAI- Days after incubation; HF-Hostine Freshian.

Sl. No.	Parameters	HF			Cow		
		Initial	30 DAI	60 DAI	Initial	30 DAI	60 DAI
1	pH	6.69-8.10 (6.04)	8.48-9.12 (8.84)	8.48-9.12 (8.84)	5.23-6.35 (5.97)	8.40-9.14 (8.80)	8.40-9.14 (8.80)
2.	N (%)	0.20-0.34 (0.28)	0.19-0.31 (0.25)	0.19-0.32 (0.26)	0.21-0.35 (0.26)	0.20-0.32 (0.25)	0.20-0.32 (0.26)
3.	P ₂ O ₂ (%)	0.13-0.21 (0.17)	0.15-0.20 (0.16)	0.15-0.20 (0.16)	0.15-0.23 (0.18)	0.16-0.19 (0.17)	0.15-0.18 (0.16)
4.	K ₂ O (%)	0.19-0.25 (0.22)	0.17-0.22 (0.20)	0.19-0.21 (0.20)	0.19-0.23 (0.21)	0.19-0.22 (0.20)	0.18-0.22 (0.20)
5.	CO ₃ (meq/l)	-	9.00-21.60 (14.94)	10.81-25.96 (17.95)	-	9.00-21.60 (14.76)	10.81-25.96 (17.74)
6.	HCO ₃ (meq/l)	6.40-15.36 (10.62)	34.70-52.47 (47.65)	33.23-50.25 (45.63)	6.40-14.08 (9.73)	44.01-55.01 (49.76)	42.15-52.68 (47.66)
7.	Zn (mg/l)	19.40-16.40 (18.2)	13.28-15.55 (14.69)	13.61-15.93 (15.05)	16.40-19.80 (17.66)	12.80-16.04 (14.84)	13.11-16.43 (15.20)
8.	Fe (mg/l)	118.2-127.2 (121.68)	97.40-104.81 (100-26)	94.82-102.04 (97.62)	118.80-125.80 (121.6)	97.07-102.67 (100.02)	94.50-99.96 (97.37)
9.	Mn (mg/l)	17.40-25.40 (21.78)	14.110-20.60 (17.66)	13.83-20.18 (17.31)	17.40-26.60 (21.72)	14.43-20.60 (18.23)	14.14-20.18 (17.86)
10.	Cu (mg/l)	29.22-39.84 (35.49)	23.71-32.33 (28.80)	22.44-30.60 (27.26)	29.22-39.84 (35.85)	25.33-30.80 (27.76)	23.98-29.15 (26.27)

Table 3b. Changes in chemical composition of urine samples from different types of cattle incubated under closed condition. Values in the parentheses are average of ten samples; DAI- Days after incubation.

Sl. No.	Parameters	Ox			Buffalo		
		Initial	30 DAI	60 DAI	Initial	30 DAI	60 DAI
1.	pH	5.37-6.65 (6.09)	8.43-9.10 (8.76)	8.43-9.10 (8.76)	6.69-8.16 (6.17)	8.55-9.15 (8.83)	8.55-9.15 (8.83)
2.	N (%)	0.22-0.35 (0.28)	0.19-0.32 (0.24)	0.19-0.33 (0.25)	0.21-0.37 (0.28)	0.19-0.34 (0.26)	0.29-0.35 (0.27)
3.	P ₂ O ₅ (%)	0.15-0.23 (0.18)	0.15-0.22 (0.19)	0.15-0.22 (0.19)	0.12-0.21 (0.17)	0.15-0.20 (0.17)	0.14-0.20 (0.16)
4.	K ₂ O (%)	0.18-0.26 (0.22)	0.18-0.22 (0.20)	0.11-0.22 (0.20)	0.02-0.22 (0.22)	0.18-0.22 (0.21)	0.18-0.22 (0.20)
5.	CO ₃ (meq/l)	-	9.00-19.80 (13.68)	10.81-23.79 (16.44)	-	10.80-21.60 (15.48)	12.98-25.96 (18.60)
6.	HCO ₃ (meq/l)	6.40-15.36 (10.50)	44.01-54.16 (48.92)	42.15-51.87 (46.85)	7.68-15.36 (11.01)	41.47-51.62 (47.48)	39.71-49.44 (45.47)
7.	Zn (mg/l)	15.8-19.8 (18.32)	13.28-16.04 (14.30)	13.61-16.43 (14.65)	16.4-19.8 (18.20)	13.28-16.04 (14.74)	13.61-16.43 (15.10)
8.	Fe (mg/l)	117.80-124.60 (121.38)	97.89-103.66 (100.20)	95.31-100.92 (97.55)	117.8-125.8 (121.56)	97.07-103.66 (100.17)	94.50-100.92 (97.52)
9.	Mn (mg/l)	17.8-25.4 (22.48)	14.110-21.57 (17.61)	13.83-21.14 (17.26)	17.40-25.40 (22.86)	14.110-20.60 (18.54)	13.83-20.18 (18.16)
10.	Cu (mg/l)	31.22-37.96 (34.21)	23.71-32.33 (29.09)	22.44-30.60 (27.53)	29.08-39.70 (35.39)	23.71-32.33 (28.74)	22.44-30.60 (27.20)

The concentration of carbonates and bicarbonates has increased appreciably. Increase in concentration of carbonates and bicarbonates may be because of diffusion of atmospheric carbon dioxide into urine samples and its conversion to carbonates and bicarbonates. The micronutrients like zinc, manganese, iron and copper were found to decrease with time. This may be because of increase of pH of urine to the alkaline range and the conversion of Zn, Fe, Mn and Cu to insoluble carbonate salts [6, 8].

The loss of nitrogen was found to be slightly less in samples incubated under closed condition than open condition as there was less chance for hydrolysis reactions. There was no much variation in phosphorus and potassium content in urine samples of different age groups incubated under both open and closed condition at 30 and 60 days. Similar results observed by Palmquist, and Jonsson [10]. The carbonates and bicarbonates content were found to increase with time of incubation but the values were less when kept under closed condition compared to open condition as there was less scope for diffusion of carbon dioxide into urine and its conversion to carbonates and bicarbonates (Tables 3a and 3b).

Conclusion

The fresh urine from different categories of cattle were acidic in reaction, had appreciable amount of soluble salts, primary and secondary and micronutrients. The pH of urine samples of all categories turned to alkaline reaction with time. There was slight difference in the concentration of nitrogen among the different types of cattle. The calcium content was slightly more in urine samples of HF (Holstein Friesian) and buffalo when compared to cow and ox. The nitrogen content was slightly less compared to initial value under open condition which might be due to loss of nitrogen as NH₃ due to volatilization at high pH during incubation. There was no variation in the phosphorus and potassium content of urine samples during incubated periods.

References

1. Manivasakam N (1987) Physico-chemical examination of water, sewage and industrial effluent. Pragathi Prakashan, Merut.
2. Piper CS (1966) Soil and plant analysis. Int Sci Pub Inc, New York.
3. Hoogendoorn CJ, Betteridge K, Costall DA, Ledgard SF

- (2010) Nitrogen concentration in the urine of cattle, sheep and deer grazing a common ryegrass/cocksfoot/white clover pasture. *New Zealand J Agric Res* 53 : 235—243.
4. Yawalkar KS, Agarwal JP, Bokde S (2002) Manures and fertilizers. Ninth edn. Agric-Hort Pub House, Nagpur, Maharashtra, India 29 : 76—80.
 5. Liu Zhigang, Zhao Qingliang, Wang Kun, Lee Dunjong, Qiuwei Wang Jianfang (2008) Urea hydrolysis and recovery of nitrogen and phosphorus as MAP from stale human urine. *J Environ Sci* 20 : 1018—1024.
 6. Majumdar D, Patel M, Darbar R, Vyas M (2006) Short-term emissions of ammonia and carbon dioxide from cattle urine contaminated tropical grassland microcosm. *Environ Monit Asst* 122 : 9—25.
 7. Hellstrom D, Johansson E, Grennberd K (1999) Storage of human urine : Acidification as a method to inhibit decomposition of urea. *Ecol Engg* 12 : 253—269.
 8. Jonson H, Baky A, Jeppsoon U, Hellstrom D, Karrman E (2005) Composition of urine, faeces, greywater and biowaste for utilization in the URWARE model. Urban water report of the MISTRA Program. Chalmers Univ Technol, Gothenburg, Sweden.
 9. Jonsson H, Richert Stinzing A, Vinneras B, Salomon E (2004) Guidelines on the use of urine and faeces in crop production. *Ecol San Res Publ Rep* No. 24.
 10. Palmquist H, Jonsson H (2004) Urine, faeces, greywater, and biodegradable solid waste as potential fertilizers. In *ecosan –closing the loop. Proc the 2nd Int Symp on Eco Sani, Incorporating the 1st IWA Specialist Group Conference on Sustainable Sanitation, 7th - 11th Apr, Lübeck, Germany, pp 587—594.*