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Evaluation of Physical Parameters of Drinking Water for Livestock

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ABSTRACT: Watering is an important management aspect in livestock farming. A study was conducted to assess the physical parameters of water for livestock in Vellore district. A total of four villages, Sholingur (V1) and Kodaikkal (V2) from Sholingur block and Manthangal (V3) and Pulianthangal (V4) from Walajah block were selected for the study. Water samples of 500ml capacity collected in leak proof pet bottles from tap, bore well, pond, open well and lake were tested at University Training and Research Centre, Vellore for testing for physical parameters using water testing Kit supplied by State level water listing lab, Tamil Nadu Water and Drainage Board (TWAD, 2015) Chennai – 600 005 to find out their suitability as drinking water for livestock. It was observed that the tap water, bore water and well water were clear in appearance, whereas pond water was slightly brownish and lake water was slightly greenish and brownish in appearance. All the water samples were hard invariable of season. Majority of the samples from pond possessed algal smell. Tap, bore and well water were clear and pond water was slightly turbid. The pH was by and large within the BIS standards. Pond water and lake water evinced algal and slightly objectionable odour. The livestock farmers must be educated on livestock water supply systems.

Keywords: Livestock, drinking water, physical quality, standards.

INTRODUCTION

Water is essential for sustaining all forms of life, food production, economic development and for general well being (Beede, 2005, 2006 and 2009). It is impossible to substitute its uses, expensive to transport, and it is truly a unique gift to mankind and livestock from nature.

Water quality has become a global concern due to over increasing population and developmental activities that had over exploit and polluted the water resources available to us (Gupta *et al.,* 2009). Ground water pollution has become a growing threat to human society and natural ecosystems from the past two decades (Shivapur and Basarikatti 2016).

Water is used in body for different purposes, almost in everybody function (Olkowski, 2005), including thermoregulation, lubrication, medium for chemical reactions, digestion, absorption, lactation, carrier, support, cushion, mineral balance and help for other nutrients to complete their functions (Lardner *et al.,* 2005; Hersom *et al.,* 2008). The hydro resource plays a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities, etc. Apart from various water resources the groundwater is an important source of water for drinking, irrigation, and livestock use etc. It accounts for about 80% of domestic water requirement and more than 45% of the total irrigation in the country. The remaining water available for livestock is polluted in various forms, making the water unfit for livestock consumption. Brew *et al.,* (2009) explained a positive response in the performance of livestock when provided with wholesome water.

There are a number of physical, chemical, and microbiological parameters which are interrelated to define the water quality (Barik and Thorat 2015). The effect of these properties may have either direct or indirect effect on health or may cause decrease in overall water intake indirectly lowering the growth and production of animals (Brew *et al.,* 2009). Hence an attempt was taken to study the various physical parameters of drinking water for livestock in Vellore district of Tamil Nadu.

MATERIALS AND METHODS

The study was carried out in four villages of Vellore district in Tamil Nadu, namely Sholingur (V1), Kodaikkal (V2), Manthangal (V3) and Pulianthangal (V4). The water samples were collected from shallow water sources comprising lakes, ponds and river bed and underground water sources comprising open well, bore well and tap water which formed the drinking water sources for livestock. Eight samples were collected from each source in a village once during winter (December, January and February) and summer (March, April and May), respectively. Thus a total number of 96 water samples were collected and were subjected to various physical analysis. The data collected were subjected to statistical analysis as per the method of Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The appearance, odour and turbidity of water samples collected from tap, bore well, pond, open well and lake are presented in Table 1. It is observed that tap water, bore water and well water were clear in appearance, whereas the pond water was slightly greenish and slightly brownish (50%). The water sample collected from lakes were slightly greenish (75%) and slightly brownish (25%). As per the BIS (2012) standards, colourless and clear water is ideal for drinking purpose. Pond and lake water were slightly greenish and slightly brownish in appearance. This may be due to the presence of suspended particles like sand and clay which tend to give brownish tint and presence of blue green algae and other aquatic plant organisms which gives greenish tint to the water. This is in agreement with Beede (2006) who reported that colour of water helps to assess the organoleptic properties of water and Curren (2014) opined that suspended matter in water including silt, organic matter, blue green algae and chemical pollutants significantly affects livestock. In the present situation, there is no control over the source of pollution in shallow water bodies like lakes and ponds and hence it may be reason for the appearance of colours like brown and green in water.

It is observed from the Table 1, that all samples from tap, bore and pond water were possessing odour. Most of the samples collected from pond had algal smell and six had slightly objectionable smell. Only six samples collected in lake water were odourless and the rest of the samples from other sources had algal smell. As per BIS (2012) potable water must be odourless. Suspended matters, aquatic plants and pollutants may be the cause for odour in stagnant water like lakes and ponds. Except pond and lake water, the rest of the samples collected from other water sources were clear in consistency. Turbidity is an indicator of solid matter suspended in water. Umar *et al*. (2014) suggested that the suspended matter may be inorganic, organic and microorganisms which significantly affects the health of livestock. The factors influencing turbidity in water include domestic pollution, stagnation for long time and algal bloom (Curren, 2014). Sharma *et al*., (2013) found a negative co-relation between transparency and turbidity values of water samples in their study.

The mean ± SE (mg/L) of hardness, total dissolved solids (TDS) and pH in water samples collected is presented in Table 2. In summer hardness ranged between 133.36± 5.57 and 847.51 ±15.49 and in winter between 126.50 ± 9.15 and 850.00 ± 97.38. In both the seasons the hardness was minimum in the tap water in V3 and lake in V2, respectively. Open wells in V2 had highest hardness in summer. Significant difference ($p<0.5$) was observed between the water sources in V2 in summer and highly significant difference ($p < 0.01$) were noted between water sources in V1 and V2 during winter. During summer between the villages significant difference in hardness was noted only among bore wells. No difference was observed in winter among villages between the water sources. Almost all the water samples collected and tested in the study area except open well in V2 during both the seasons were above the permissible limit of BIS (2012) which states that maximum hardness for potable water must be less than 600 mg/L.

Valtorta *et al.* (2007) opined that the abiotic factors have their own influence on water quality and ultimately on animal growth and performance. Salinity or TDS is basic of them. Excessive salivation, diarrhea, vomiting, blindness, seizures, ataxia, disorientation, and paralysis are the acute effects of excessive salinity. Hardness is a measure of concentration of divalent metallic cations dissolved in water and is generally expressed as sum of calcium and magnesium expressed as equivalent to calcium carbonate (Higgins *et al.,* 2008). The hardness values observed in the present study were comparable with the findings of Sharma *et al.,* (2013). In summer the TDS was found to be least in tap water (413.20 ± 11.82) and highest in open wells (2681.76 ± 273.10). Except lake water, significant difference in TDS was observed among all water sources in summer between villages. Among the villages, difference was observed between sources in V1, V2 and V4 in summer and in winter in V1 and V3. In all the water sources studied, except in open well in V2 TDS were within the maximum permissible limit of 2000mg/L according to BIS (2012).

The pH was found using the pH paper strip and the colour change was compared with the pH chart. The pH ranged between 5.50 ± 0.50 and 6.40± 0.16 in summer and 5.70± 0.30 and 7.00± 0.00 during winter season in the study area. In summer lowest pH was observed in lakes and highest in both tap and lake water. Whereas in winter pH was lowest in open well and highest in the entire water source in V1 and V2. Highly significant ($p<0.01$) difference was observed in pH among the water sources in V4 in summer, whereas no significant difference was observed between sources in all the villages during winter. Among the villages, pH of tap water differed significantly, whereas in winter highly significant difference was observed in pH within water sources. As per BIS (2012) report, pH ranging between 6.5 and 8.5 is permissible for drinking water. Wright (2007) discussed that pH level accepted for livestock drinking water is 6-8. The pH less than 5.5 causes acidosis, a potential problem of weight loss and production. Other than these ranges pH may cause reduced water and feed intake, digestive alteration, diarrhoea, poor feed conversion as observed by Wright (2007); Zimmerman *et al*., (2002). The pH seems to effect by changing taste, efficiency of chlorination, corrosive potential and many other properties of drinking water. All chemical reactions depend on pH of water, which is nothing but the concentration of hydrogen ions. The low pH can affect the mucous membrane and high pH can affect digestive system. Beede (2006); Higgins *et al.,* (2008) reported that drinking water for dairy cattle with pH between 5 and 9 is considered as acceptable. Similar water pH values were reported by other workers in different water sources (Prabhakar *et al.,* 2012; Arora *et al.,* 2013; Sharma *et al*., 2013; Gupta *et al.,* 2011).

Table 1: The appearance, odour and turbidity of water samples in the study area.

Source	Appearance (%)			Odour (%)		Turbidity (%)	
	Clear	Slightly Greenish	Slightly Brownish	Algal Smell	Slightly Objectable	No Turbidity	SlightlyTurbid
Tap	100	-	-	-	-	100	-
Bore	93.75		6.25	-	-	100	-
Pond	-	50	50	62.5	37.5	-	100
Open Well	100	-	-	-	6.25	100	-
Lake	-	75	25	37.5	25	50	50

Table 2: Mean ±SE (mg/L) of hardness, Total Dissolved Solids (TDS) and pH of water source/village.

Season		Summer					Winter				
Source / Village		Tap	Bore	Pond	Open Well	Lake	Tap	Bore	Pond	Open Well	Lake
V 1	Hardness	220.24 ±15.49	307.21 ±46.11 ^{B}	196.33 ±16.30	261.20 ±31.50	156.60±16.23	305.21± 23.06 ^{a}	265.11± 20.45^{b}	278.57± 47.36^{b}	208.35± 26.56 ^{a}	170.00± 15.81^{a}
	TDS	632.10 ±50.43^{Bb}	933.60 ± 99.60^{Ac}	690.20± 75.15^{Ab}	918.80 ± 90.71^{Ac}	720.20 ±85.50^{A}	858.40± 72.90^{b}	715.40± 47.26^{b}	802.20± 97.66 ^{b}	710.85± 79.16^{a}	207.67 ± 36.70^{a}
	pH	6.40±0.16^{A}	6.10±0.10	6.30±0.21	6.20±0.13	6.40± 0.16	7.00±0.00^{A}	7.00±0.00^{A}	7.00± 0.00^{A}	7.00± 0.00^{A}	7.00 ± 0.00^{A}
V 2	Hardness	282.43 ± 64.67^{a}	478.41 ±56.64^{Cb}	262.51± 89.40^{a}	847.51 ±15.49^{c}	300.65 ±28.75^{a}	146.61±14.52	608.00± 50.28^{c}	482.52± 34.60^{b}	746.76± 57.41^{c}	126.50±9.15 ^{a}
	TDS	1100.2±154.50^{ab} ^{C}	1581.20±143.70^{B} ^{ab}	885.70± 121.30^{Ab}	2445.4± 130.11^{Cc}	852.10± 68.25^{aB}	1390.90±140.11	1456.10±144.21	732.70± 55.10	2681.76± 273.10	542.16± 53.16
	pH	6.00±0.00^{A}	6.00±0.00	6.00±0.00	6.00±0.00	6.00±0.00	7.00±0.00^{A}	7.00±0.00 ^{A}	7.00± 0.00^{A}	7.00±0.00^{A}	7.00 ± 0.00^{A}
V 3	Hardness	133.36 ±5.57	220.00 ±45.66^{A}	333.34±148.16	483.31 ±23.24	255.15 ±85.12	226.10±21.60	367.00± 45.25	256.00± 15.20	167.50 ± 45.71	273.00 ± 25.80
	TDS	413.20 ±11.82^{A}	612.90 ±98.10^{AB}	868.50±383.30 ^{B}	1267.10 ±118.67^{B}	690.40 ±92.90^{A}	440.30±31.24 ^{a}	976.80± 236.32^{c}	600.70± 68.81^{ab}	1534.10± 164.20^{ab}	668.00 ± 56.61^{ab}
	pH	6.10± 0.14^{AB}	6.00±0.00	6.00±0.00	6.00± 0.00	6.40± 0.16	6.00± 0.00^{B}	6.00± 0.00^{B}	6.00± 0.00^{B}	5.70± 0.30^{B}	6.00 ± 0.00^{B}
V 4	Hardness	259.26 ±16.22	675.26 ±18.28^{D}	330.12±30.00	480.36 ± 46.00	260.22 ±90.11	268.30± 19.04	523.00± 44.70	850.00± 97.38	352.85± 44.30	366.65± 41.30
	TDS	775.40 ±48.80^{aB}	2198.50 ±268.40^{Cb}	1266.60± 174.0^{abC}	1632.54±187.70 ^{Bb}	838.90± 76.30^{Ba}	1179.20±272.21	1676.50±410.31	1800.0±196.56	1223.0±118.50	1098.60± 98.30
	pH	6.00± 0.00^{Aa}	6.00±0.00^{a}	6.00±0.00^{a}	6.00± 0.00^{a}	5.50± 0.50 ^{b}	6.20± 0.12^{B}	6.00± 0.10^{B}	6.50 ± 0.50^{B}	6.50± 0.10^{B}	6.00 ± 0.00^{B}

Superscript in the same row and column differ significantly, **- significant

CONCLUSION

In the present study the drinking water for livestock was evaluated for physical standards in Vellore district and thus summarized. Except water hardness, all other parameters were within the standards.

FUTURE SCOPE

Water is highly inevitable for livestock. It is essential to create awareness among the farmers on livestock watering systems. Since the quality of water inflicts changes in productivity, the other parameters such as electrical conductivity, microbial assessment could be investigated further.

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Conflict of Interest. None.

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