Global Veterinaria 13 (4): 534-543, 2014
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2014.13.04.8646

A Potential Approach for Monitoring and Evaluation of Drinking Water Sources and Quality for Livestock Animals at Beni-Suef Province

Asmaa N. Mohammed

Department of Animal Hygiene, Management and Zoonoses,
Fac. Vet. Med., Beni-Suef University, Egypt

Abstract: An adequate supply of clean drinking water is important requirement for the health and productivity of livestock animals and remains a challenge particularly in rural areas. To monitor and evaluate the hygienic quality of three different water sources commonly used for animal drinking (Surface, underground and tap water) in study area and quality for livestock and food safety. A representative water samples (n =120) were collected from different water sources as well as water troughs in two dairy farms and small holder cattle farmers and subjected to physico-chemical, heavy metals and bacteriological analysis. The obtained results revealed a significant increase at ($P < 0.05$) of the mean values of surface water turbidity, alkalinity, ammonia, nitrite and nitrate (6.2±1.0 NTU, 301.7±2.0 mg/l, 0.5±0.18 mg/l, 1.3 ±1.3 mg/l and 9.0±1.7 mg/l resp.,) compared to underground water which had a significant increase ($P < 0.05$) in electrical conductivity, total dissolved solid (TDS) and total hardness (965.3±6.4 µS/cm, 620.7±3.5 mg/l and 587.7±28.4 mg/l resp.,). On the other hand, the mean values of tap water estimated parameters were within the recommended guideline of (WHO) at both levels of dairy cattle farms and small holder cattle farmers. Heavy metals concentrations; e.g., lead (pb) and iron (Fe) in both underground water and surface water were exceed the maximum permissible limits of drinking water for cattle whereas lead (pb) (0.07±0.0 and 0.11±0.02 mg/l resp.,) and iron (Fe) (3.02±1.4 and 0.7 ±0.05 mg/l. resp.,). Regarding, total viable count, total coliforms and faecal coliforms (CFU/100ml) in surface water were higher than other two sources in both main sources and water troughs (2.03×10^5 ±.38, 134.0±8.6 CFU/100ml and 9.2±0.78 CFU/100ml resp.,) and (3.77×10^7 ±0.24, 320.0±18.4 CFU/100ml and 14.6±2.2 CFU/100ml resp.,) at levels above (WHO) maximum control level for drinking water. From the above results it can be concluded that both underground and surface water intended for animal drinking in investigated area were subjected to various types of chemical and microbial pollution which can alter animal health and food safety, regular monitoring and treatment of drinking water sources is highly recommended. The people and animal owners should be alerted of the potential health hazards.

Key words: Livestock Animals · Drinking Water · Sources · Quality

INTRODUCTION

Water is an important resource for the wellbeing and survival of people with a wide range of uses. Specifically in the rural areas of developing countries, water is used for both domestic purposes and other livelihood productive activities such as livestock farming [1]. In this respect, water provision in rural areas should ideally take into account such multiple uses of water [2].

The interactions among livestock, water and rural communities are very complex [3], while livestock are the foundation of rural livelihoods, they can also degrade the environment and contaminate water sources with their excreta, subsequently risking human health [4]. The health risk could be very high in areas where livestock and people share the same micro-environments and have several points of interfaces [5].

The increasing problem of water scarcity and poor quality is specifically very serious in many developing

Corresponding Author: Asmaa N. Mohammed, Department of Animal Hygiene, Management & Zoonoses, Fac. Vet. Med., Beni-Suef University, Egypt.

countries attributed to the predominance of over utilization and mismanagement of water resource [6, 7]. Noteworthy to mention is that poor quality water can affect the productive performance of livestock, for example, in terms of reduced milk production [8] or poor weight gain in growing animals [9, 10].

Water quality is based on microbiological or physicochemical parameters, affects both human and livestock in various ways. The concern of low quality water is either due to direct health impacts from drinking or a reduction in the palatability for humans and animal consumption [10,11]. Low microbiological quality water is one of the major health concerns and causes of high morbidity and mortality in developing countries [11- 13]. Exposure to elevated levels of chemicals in water is also responsible for various human and animal health problems [11]. In addition to the impact through drinking, use of contaminated water in food production and/or processing can be a significant source of pathogens with subsequent adverse health effects [14].

The drinking water supplies in many rural areas severely suffer from lack of quality monitoring [15] and the quality is checked to the best only once, when water supply schemes are installed [16]. A present study was planned to monitor and evaluate the hygienic quality of drinking water at sources and livestock animals levels at Beni-Suef provinces.

MATERIALS AND METHODS

Study Area and Period: This study was conducted in three different district at Beni-Suef province (Al-wasta, Naser and Beni-Suef center) during February, 2014 until August, 2014. The topography of a study area is located between latitudes 28°45' and 29°25'N and longitudes 30°45' and 31°15'E, occupying a part of the lower Nile Valley. Three sampling sites were used in each study district.

Study Design: A cross-sectional study was conducted to assess the hygienic quality of drinking water from three different sources (tap, surface and underground water) intended for animal consumption under field conditions. A Structural questionnaire were prepared and distributed on stakeholder to identify available water source, health problem resulting from drinking water and treatment methods if applied followed by a survey for monitoring the hygienic quality and risk indicators of drinking water contamination at level of dairy cattle farms and small holder dairy farmers. One hundred and twenty Water samples were collected from both main sources of water supplies as well as water troughs intended for drinking of cattle in dairy farms (n=2) and small holder cattle farmers (n=40). Water sources were subjected to local and topographical inspection to determine their availability followed by sampling collection for physic chemical analysis and microbiological investigation.

Study Animal Population: The present study was carried out in dairy cattle farms (n=2) located in Beni-Suef province and a total of (n= 40) individually owned cow sheds located in Al-wasta, Naser and Beni-Suef center at Beni-Suef province of traditional type commonly found in the countryside in Egypt. Cattles of dairy farms were kept in separate yards and each yard is provided with manger and water trough located under sheds. The animals were left free in a yard with area of about 8-10 square meters per head. Yards were not provided with drainage system resulting in accumulation of manure. Water was available at all time from public net for the purposes of drinking, washing and milking hygiene. Tape water was main source. Cows are drinking from common water troughs located at yard side. The hygienic measures prevailed in these farms were fair. Meanwhile in small holder cattle farmers, the density of each shed was ranged from 5 to 15 cows. Sheds were poorly constructed from block bricks with a wooden door and windows on both sides of the shed. Ceilings were mainly made from wooden bars covered with straw and in winter season they were covered with plastic sheets. The floor was of dirty soil type, where removal of excreta was done manually and in irregular manner. Water was supplied by different sources such as tap water, ground water and surface water (canals). Cows were housed in the same place all the day and milking was done manually by house wives.

Water Sampling: A representative water samples were collected equally from three different main water sources (n=60) and water troughs (n=60) before water change whereas (tap water (n= 60), underground water (n= 30) and surface water (n= 30), according to standard guidelines [17]. Samples were collected in sterile glass bottle of 250 ml capacity for bacteriological investigation and another one liter sample was taken for physico-chemical examination that were washed and rinsed thoroughly three times, Few drops of nitric acid were added only to the samples analyzed for heavy metals. The time between sample collection and analysis not exceed 6 hours and 24 hours is considered the absolute maximum and delivered to a Faculty of Veterinary Medicine lab for bacteriological investigation meanwhile some physico-chemical examinations were done at station of drinking water and sewage at Beni-Suef province.

Physico-Chemical Examination of Water Samples: All physical and chemical analyses of water samples were measured according to A.P.H. A. [17]. Water samples from both main sources and water troughs were analyzed for physico-chemical parameters were pH, electrical conductivity, Total dissolved solids (TDS), turbidity, total hardness, ammonia, nitrite (NO_2), nitrate (NO_3). pH was measured by pH meter (Model Digital pH meter 335)., electrical conductivity of water and Total dissolved solids (TDS) were determined with the help of Conductivity meter (Model Inolab Cond 720) and expressed in terms of µS/cm for conductivity while alkalinity expressed in mg/l. Turbidity was determined with a Micro T100 Laboratory Turbid Meter (HF Scientific, Fort Myers, Fla.). Hardness was measured by the EDTA titrimetric method [18]. Ammonia, nitrite (NO_2), nitrate (NO_3) were measured with an ion selective electrode (Cole-Parmer, Vernon Hills, Ill). Heavy metal estimation such as Lead (pb), Cadmium (Cd), Copper (Cu), iron (Fe), zinc (Zn) and Chromium (Cr) were done by SL-176, Double beam atomic absorption spectrophotometer, ELICO.

Detection and Enumeration of Bacteria in Water Samples: The samples were analyzed for the detection and enumeration of the total viable count (TVC) by pour plate technique on plate count agar (PCA) and counting the colonies developed after the incubation at 37°C for 24 hours [17]. The total coliforms and faecal coliform were enumerated by using conventional membrane filtration (MF) technique as described by A.P.H. A. [17].

Statistical Analysis: The primary data were analyzed for descriptive statistics using one-way ANOVA analysis and Duncan's multiple range tests. The statistical analyses were calculated, using Statistical Package for Social Sciences (SPSS version 20.0). The data values were expressed as [mean concentration (±) SE standard error]. P< 0.05 was the accepted significance level.

RESULTS

The estimated physico-chemical parameters and heavy metals values (mean±SE) in three different Water sources in (Table 1). It revealed a significant increase at (P<0.05) of the mean values of surface water turbidity, alkalinity, ammonia, nitrite and nitrate were (6.2±1.0 NTU, 301.7±2.0 mg/l, 0.5±0.18 mg/l, 1.3 ±1.3 mg/l and 9.0±1.7 mg/l resp.,) as compared with underground water (1.4 ±0.14 NTU, 248.7±4.2, 0.06 ±0.02, 0.11±0.0 mg/l and 0.0±0.0 mg/l resp.,) and tap water was found to have the lowest estimated parameters mean values in both cattle farms and small holder dairy farmers (0.6±0.27 NTU, 118.0±2.6 mg/l, 0. 03 ±0.01 mg/l, 0.02± 0.0 mg/l and 0.0±0.0 mg/l resp.,) and (1.0±0.25 NTU, 124.0±3.6 mg/l, 0.01 ±0.01 mg/l, 0.01 ±0.0 mg/l and 0.0±0.0 mg/l resp.,). Tap water of cattle dairy farms and small holder cattle farmers was found to have mean pH values of (6.6 ±0.15 and 6.7 ±0.05) respectively, meanwhile (6.8±0.17) in underground water and (7.5± 0.31) in surface water which is on the high side of the acceptable optimum range of 6.5-8.5 is recommended. The estimated parameters in tap water source were within the recommended guideline (turbidity 0-4 NTU, alkalinity 180mg/l, ammonia 0.5mg/l, nitrite 3 mg/L and nitrate 0-45mg/l) (WHO, 2011) at both level of dairy cattle farms and small holder cattle farmers at (P <0.05) significant difference compared with the other two sources whereas the mean alkalinity, mean turbidity values and ammonia level in surface water were exceeded WHO recommended standard. Regarding The mean Electrical conductivity and total dissolved solid (TDS), total hardness values of underground water in main source were significantly (965.3±6.4 µS/cm, 620.7±3.5 and 587.7±28.4 mg/l resp.,) higher than in surface water (775.0 ±1.4 µS/cm, 584.0 ±2.3 and 476.3±33.9 mg/l resp.,) at (P <0.05). Moreover, in tap water of both small holder cattle farmers and dairy cattle farms were (645.0±2.7µS/cm, 154.3±3.5 and 192.5±22.0 mg/l resp.,) and (627.7±13.8 µS/cm, 148.3±2.4and 171.83±6.7 mg/l resp.,) which generally, within the acceptable limit standard (2000 µS/cm & < 500 mg/l resp.,) meanwhile mean total hardness values can be considered very hard especially in ground and raw surface water whereas total hardness values were above 200 mg/L $CaCO_3$ as recommended by WHO standard limit.

Heavy metal estimation in (Table 1) revealed that the concentrations of lead (pb) and iron (Fe) in both surface and ground water samples were exceed the maximum permissible limits of drinking water for cattle Pb (0.11±0.02 and 0.07±0.0 mg/l resp.,) and Fe (3.02±1.4 and 0. 7 ±0.05 mg/l. resp.,) at (P < 0.05) significantly difference. Moreover, concentration of Pb in tap water of both dairy cattle farms and small holder cattle farmers was higher (0.11± 0.01 and 0.13±0.01 mg/l resp.,). Regarding to

Table 1: The estimated physico-chemical parameters and heavy metals values [mean ±SE] in the three different Water sources intended for animal drinking.

Water source			Tap water	
Water parameters	Surface water	Under ground water	Cattle farms	Small holder
Physico-chemical				
Turbidity (NTU)	6.2±1.0^{c}	1.4 ±0.14^{b}	0.6±0.27^{a}	1.0±0.25^{ab}
pH	7.5±0.31	6.8±0.17	6.6 ±0.15	6.7 ±.05
Alkalinity (mg/l)	301.7±2.0^{c}	248.7±4.2^{b}	118.0±2.6^{a}	124.0±3.6^{ab}
Electrical conductivity (µS/cm)	775.0 ±1.4^{b}	965.3±6.4^{c}	627.7±13.8^{a}	645.0±2.7^{a}
TDS (mg/l)	584.0±2.3^{b}	620.7±3.5^{c}	148.3 ±2.4^{a}	154.3±3.5^{a}
Total hardness (mg/l)	476.3±33.9^{b}	587.7±28.4^{c}	171.83±6.7^{a}	192.5±22.0^{ab}
Ammonia (mg/l)	0.5±0.18^{c}	0.06 ±0.02^{a}	0. 03 ±0.01^{b}	0.01 ±0.01^{ab}
Nitrite (NO_2) (mg/l)	1.3 ±1.3^{b}	0.11±0.0^{ab}	0.02±0.0^{a}	0.01 ±0.0 ^{a}
Nitrate (NO_3)(mg/l)	9.0±1.7^{a}	0.0±0.0	0.0±0.0	0.0±0.0
Heavy metals				
Pb	0.11 ±0.02^{ab}	0.07±0.0^{a}	0.11±0.01^{b}	0.13±0.01^{b}
Fe	0. 7 ±0.05^{b}	3.02±1.4^{c}	0.21±0.0 2^{a}	0.34±0.04^{a}
Cu	0.024 ±0.01^{a}	0.054±0.00^{b}	0.038±0.01^{a}	0.067 ±0.00^{b}
Cd	0.014±0.00^{ab}	0.034±0.02^{c}	0.011±0.00^{a}	0.017±0.00^{b}
Cr	0.009±0.01	Nil	Nil	Nil
Zn	0.02±0.01^{a}	0.12±0.01^{b}	0.023±0.01^{a}	0.11±0.0^{b}

The mean values with ^{a,b,c} superscript in the same raw are significantly different at ($P < 0.05$)

Table 2: Estimated physico-chemical parameters values [mean ±SE] of drinking water from troughs in dairy cattle farms and small holder dairy farmers

Water source			Tap water	
Water parameters	Surface water	Under ground water	Cattle farms	Small holder
Turbidity (NTU)	10.9±1.2^{c}	4.6 ±0.22^{ab}	4.1±0.28^{a}	5.6 ±0.44^{b}
pH	8.3±0.24	7.6 ±0.08	7.4±0.22	7.9±0.19
Alkalinity (mg/l)	428.6±12.9^{c}	378.7±10.2^{b}	152.2±4.2^{a}	171.5±1.7^{ab}
Electrical conductivity (µS/cm)	1283.7±22.7^{b}	1477±26.0^{c}	769.0±18.7^{a}	927.5±16.5^{ab}
TDS (mg/l)	698.7±15.9^{b}	832.2±10.5^{c}	265.7±10.9^{a}	318.0±5.2^{ab}
Total hardness (mg/l)	573.7±27.2^{b}	638.2±22.3^{c}	223.6±9.7^{a}	256.7±16.9^{a}
Ammonia (mg/l)	1.3±0.14^{c}	0.74±0.12^{a}	0.38±0.13^{ab}	0.54±0.18^{b}
Nitrite (NO_2) (mg/l)	3.02±1.1^{c}	0.16 ±0.05^{a}	0.11±0.07^{a}	0.16±0.08^{b}
Nitrate (NO_3) (mg/l)	12.0±2.0^{c}	6.3 ±1.3^{a}	3.1±1.7^{ab}	4.9±1.1^{b}

The mean values with ^{a,b,c} superscript in the same raw are significantly different at ($P < 0.05$)

Copper (Cu), chromium (Cr) and zinc (Zn) in water samples were within the acceptable limit (0.6, 0.05 and 5.0 mg/l resp.,) standard of WHO. On the other hand, concentration of cadmium (Cd) as a heavy metal was exceeds the permissible limit guidelines in both tap water and underground water of small holder cattle farmers (0.017±0.00 and 0.034 ±0.02 mg/l resp.,).

The physico-chemical parameters values (mean±SE) of drinking water trough in cattle farms and small holder farmers (Table 2). Revealed that the mean turbidity, pH, alkalinity, ammonia, nitrite and nitrate values of surface water were (10.9±1.2 NTU, 8.3±0.24, 428.6±12.9 mg/l, 1.3±0.14mg/l, 3.02±1.1 and 12.0±2.0 mg/l resp.,) higher compared with main source it exceeds the WHO standard except the mean pH values was on the high side of the acceptable optimum range of (6.5-8.5) is recommended and followed by underground water (4.6±0.22 NTU, 7.6 ±0.08, 378.7±10.2 mg/l, 0.74±0.12 mg/l, 0.16±0.05 mg/l and 6.3±1.3 mg/l resp.,) meanwhile in tap water in both small holder cattle farmers and dairy cattle farms respectively were (5.6±0.44 NTU, 7.9±0.19, 171.5±1.7 mg/l, 0.54±0.18 mg/l, 0.16±0.08 and 4.9±2.0 mg/l resp.,) and (4.1±0.28 NTU, 7.4±0.22, 152.2±4.2 mg/l, 0.28±0.13 mg/l, 0.11±0.07 mg/l and 3.1±1.7 mg/l resp.,). The estimated water quality parameters in both surface and underground drinking water trough were exceed the acceptable limit of WHO recommended standard at ($P < 0.05$) significantly difference.

Regarding the mean electrical conductivity, total dissolved solid and Total hardness values of underground water trough were (1477±26.0 µS/cm, 832.2 ±10.5 mg/l and 638.2±22.3 mg/l resp.,) significantly higher

Table 3: The bacteriological results [mean ±SE] of the examined three water sources intended for animal drinking

Water source			Tap water	
Bacterial count	Surface water	Under ground water	Cattle farms	Small holder
Total viable counts (CFU/100ml)	$2.03x10^{5}$±. 38^{c}	$1.31x10^{2}$±0.18^{a}	$1.50x10^{3}$±0.23^{ab}	$1.80x10^{3}$±$.20^{b}$
Total coliform (CFU/100ml)	134.0±8.6^{c}	1.20±0.32^{a}	1.40±0.43^{a}	2.0±0.53^{b}
Faecal coliform (CFU/100ml)	9.2±0.78^{a}	0.0±0.0	0.0±0.0	0.0±0.0

The mean values with ^{a,b,c} superscript in the same raw are significantly different at (P < 0.05)

Table 4: The bacteriological results [mean ±SE] of the examined drinking water from troughs in dairy cattle farms and small holder farmers

Water source			Tap water	
Bacterial count	Surface water	Under ground water	Cattle farms	Small holder
Total viable counts (CFU/100ml)	$3.77x10^{7}$±0.24 ^{c}	$1.78x10^{4}$±0.23^{a}	$1.93x10^{5}$±0.28^{ab}	$2.35x10^{5}$±0.19^{b}
Total coliform (CFU/100ml)	320.0±18.4^{c}	5.7±1.2^{a}	6.80±0.95^{a}	19.3±2.5^{b}
Faecal coliform (CFU/100ml)	14.6±2.2 ^{c}	4.4±0.78^{a}	4.10±$0..82^{a}$	9.6±0.99^{b}

The mean values with ^{a,b,c} superscript in the same raw are significantly different at (P < 0.05)

than in surface water (1283.7±22.7 μS/cm, 698.7±15.9mg/l and 573.7±27.2 mg/l resp.,) at (P< 0.05) significantly difference moreover, in tap water of both small holder and dairy farms were (927.5±16.5 μS/cm, 318.0±5.2 and 256.7±16.9 mg/l resp.,) and (769.0±18.7 μS/cm, 265.7±10.9 mg/l and 223.6±9.7mg/l) respectively. The total dissolved solid values were exceed the acceptable limit standard (<500 mg/l). Regarding the mean values of total hardness in all water sources can be considered very hard especially in underground and surface water: total hardness values were above 180 mg/L $CaCO_3$ as recommended by WHO standard limit. Meanwhile the mean electrical conductivity values within the WHO recommended standard (2000 μS/cm) (Table 2).

Bacteriological findings (mean±SE) of the three water sources intended for animal drinking (Table 3). It revealed that the highest mean values of total bacterial count were ($2.03x10^{5}$±.38) in surface water followed by tap water in both small holder cattle farmers and dairy farms ($1.80x10^{3}$± 0.20, $1.50x10^{3}$±0.23 resp.,) and underground water ($1.31x10^{2}$±0.18) these results indicated that The total bacterial counts (TVC) for all the water samples were generally high exceeding the WHO limit of ($1.0X10^{2}$ cfu/ml) which is the standard limit of Total viable count (TVC) for drinking water. Application of analytical statistic using one way ANOVA revealed that there was statistical significant at (P < 0.05) for bacterial counts of the drinking water of both dairy farms and small holder cattle farmers in different sites of study districts. Moreover, Total coliforms in main water source were also higher than WHO standards, the mean value in surface water source was dominant (134.0±8.6^{c} CFu/ 100ml) followed by tap water in both small holder cattle farmers and dairy cattle farms respectively (2.0±0.53 and 1.40±0.43 CFu/ 100ml resp.,) and underground water was (1.20±0.32 CFU/100ml). faecal coliforms were set at zero in main water sources (tap and underground water) meanwhile in surface water (9.2±0.78 CFu/ 100ml) was exceed the permissible limit standard of WHO.

Regarding the bacteriological results of the examined drinking water trough (Table 4). The results have shown high level of contamination of drinking water trough especially of small holder cattle farmers. The results were inter-operated based on international critical level (cut-off point) (100 CFU/ml). For instance, the highest mean values of bacterial viable counts in surface water ($3.77x10^{7}$±0.24) followed by tap water ($2.35x10^{5}$ ±0.19) and underground water ($1.78x10^{4}$ ±0.23) in small holder cattle farmers Comparing with mean bacterial counts of water trough in dairy farms ($1.93x10^{5}$±0.28). Meanwhile Total coliforms was higher comparing with in main water and WHO standards, the mean value in surface water trough was dominant (320.0±18.4 CFu/ 100ml) followed by tap water in both small holder cattle farmers and dairy cattle farms respectively (19.3±2.5 and 6.80±0.95 resp.,) followed by underground water was (5.7±1.2 CFU/ 100ml). Regarding water trough were loaded by faecal coliforms in surface water (14.6±2.2 CFu/ 100ml) followed by tap water of small holder cattle farmers (9.6±0.99), ground water (4.4±0.78 CFu/ 100ml) and lastly tap water of dairy farms (4.10±0..82 CFu/ 100ml).

DISCUSSION

Livestock animals are drinking from different water sources such as wells, rivers, town water, channels and recycled water with un questionable hygienic quality which subsequently resulting in emerging and public health events threatening animal performance. It is important to identify and correct water quality problems that may affect on-farm use and productivity. The presence of contaminants in water the supply has a significant impact on animal health and productivity [10]. Some of the common quality parameters which can affect the health and productivity of livestock are related to the physical properties of water (e.g. taste, smell, turbidity) and chemical constituents (e.g. pH, total dissolved solids, fluoride, sulphate, nitrate, chromium, lead, phosphates, copper, iron, magnesium, calcium, manganese) of water and presence of microbial agents in water [19]. Turbidity is used to indicate water quality and filtration effectiveness (e.g. whether disease causing organisms are present).The mean turbidity values in surface water (10.9±1.2 NTU) were exceeds the WHO standard. The elevated turbidity level was attributed to dead decaying organic matter from improper disposal of domestic waste has also contributed to increase the level. Higher turbidity levels are often associated with higher levels of disease causing microorganisms such as virus, parasites and some bacteria [20]. According to the WHO [11] although the turbidity is not necessarily a threat to health, it is an important indicator of the presence of the possible presence of contaminants that would be of concern for health, especially from inadequately treated or unfiltered surface water. It is therefore important that the water from the raw surface be filtered before it is used for drinking purposes.

The pH of water has no direct impacts on human or livestock health, but an extreme pH can be a cause of unacceptable taste. In addition to in livestock operations, an extreme pH of drinking water can reduce water intake with subsequent low performance [21, 22]. The overall pH mean values in (Table 1, 2) ranged from (6.6 ±0.15 to 8.3±0.24) in this study. It was found that water samples were within acceptable limit standard of WHO [11] These findings were supported by the results of Pandey and Tiwari [23] who reported pH of water samples ranging from 6.8 to 7.3. The pH of water ranged from 6.8 to 8.3 in a similar study conducted by Shittu *et al*. [24]. There were no significant differences in the observed pH range between different water sources. Regarding the mean alkalinity values of water sources, It was observed that underground and surface water samples were above 120 mg/l and exceeding the standard guide line of WHO [11]. These findings are not in line with the observation of Pandey and Tiwari [23] who recorded lower alkalinity of water samples ranging from (110 to 149 mg/l) respectively. However it does agree with the findings of Patil and Patil; Krishnan *et al*. [25, 26] who recorded higher alkalinity in underground water varying from 170 - 870 mg/l and 210- 910mg/l, respectively. The variation in alkalinity of water is due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium.

The electrical conductivity in the study area was generally acceptable. Underground water could have high conductivity due to the dissolution of some earth materials by infiltrating water. The results were in partial accordance with those of Devi and Premkumar [27] and Hacioglu and Dulger [28] who found the electrical conductivity of underground water and surface water were varying from 334-1640 µS/cm and 423-1197 µS/cm, respectively. These findings are not in conformity with the observation of Shittu *et al*. [24] who recorded lower conductivity of water samples ranging between 468-810 µS/cm. However, it does agree with the findings of Rao *et al.* [29] who recorded higher electrical conductivity ranging from 755 -1898 µ /cm and 386-2827 µÙ/cm respectively. The high electrical conductivity value might be due to the presence of high mount of dissolved inorganic substances in ionized form and will lead to a disturbance in the salt balance of the body [30]. Higher mean Total dissolved solids values were reported in underground water and surface water (832.2 ±10.5 and 698.7±15.9mg/l resp.,). The values were not alarming when compared with WHO [11] guideline value of 1000 mg/L. These results are not in line with Pandey and Tiwari [23] who reported TDS values ranged from 145 to 245 mg/l in underground water. However, the presence of high levels of TDS in water may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes. In addition to the interaction with sediments and soil, the direct infiltration of surface water (irrigation water and wastewater from drains), seepage from septic tanks, construction of water pipes, use of fertilizers and pesticides and evaporation processes during flood irrigation [31]. These finding were in partial accordance with those of Suresh and Kottureshwara [32] who recorded the TDS of underground water ranging from 240-1650 mg/l and Melegy *et al.* [33] reported that High contents of TDS exceeding 600 mg/l in raw surface water were only recorded in the northern part of the study district in El-Ibrahimia canal at El-Wasta center in Beni-Suef province. In spite of this relative increase in the TDS content, raw surface water in study area is generally considered to be good for drink (<1000 mg/l) which was a similar study area of these study. Livestock can tolerate water with a TDS concentration of up to 4000 mg/l and elevated levels would lead to a decrease in production, as animals would be reluctant to drink such water [34].

The mean values of total hardness were in both main water sources and water trough can be considered very hard especially in underground and surface water trough samples have total hardness of over 300 mg/L: as recommended by WHO standard limit: total hardness values were 200 mg/L CaCO3 and there were correlated with high water alkalinity. Water containing 290 ppm total hardness had no effect on milk production, weight gain, or water consumption. Based on these studies [35] concluded that milk production was not compromised by water sources with up to 290 ppm hardness. The highest mean value of ammonia in water samples were collected from surface water followed by tap water while the lowest mean value of ammonia level was recorded in underground water. These results were attributed to the contamination with feacal matter as well as the intensive use of nitrogenous fertilizers (ammonia, urea and nitrate) in agriculture lands at the area of this study. These results were lower than those reported by EPA [36]. Regarding nitrite level in water sources, it found low concentrations of nitrite in the water, but with large fluctuation between main sources and water trough. Quantity of nitrite in water varied significantly All values were much lower than the permissible limit (3.0 mg/L) Presence of nitrites in underground water was attributed to a criterion for water pollution with nitrogenous organic substances. It is likely the contamination of underground water be of manure at the farm when it is stored in a location close to the underground water sources. These results were in agreement with Kostadinova *et al.* [37]; Petkov *et al.* [38]; Stefanova *et al.* [39]. They reported for levels of nitrites in underground water of different livestock farms up to 0.13 mg/L and clarified that the content of nitrites in groundwater used for drinking and production purposes in livestock farms is not a problem, The over all mean values of nitrate level were below detection limit in the water sources studied (< 45 mg/L). However, it was detected in main source and surface water trough (9.0±1.7 and 12.0±2.0 mg/l resp.,). The nitrate values were below WHO set limit of 45 mg/L. The traces of nitrate in the raw surface water could come from fertilizers used by farmers and also from sewage and feedlots of animals that drain into the surface water. Nitrate comes into water supplies through nitrogen cycle rather than dissolved minerals. Other secondary sources of nitrogen compounds include fertilizer, manure, sewage and landfills [40]. High nitrate level in surface water contributes to algae blooms and may result in elevated levels of disinfection by-product in treated drinking water [41]. Though the nitrate level in the surface water was far below WHO standard limit and using it for drinking purposes may not be worrying to the health of animals, it would be more advisable to use the tap and ground water for drinking.

Consumption of heavy metals is linked to many serious health concern [42]. These metals are present in varying concentrations depending on prevailing factors such as temperature, pH, hardness and standing time of the water. Heavy metal [mean ±SE] estimation in this present study showed that the concentrations of pb and Fe were found more than the prescribed permissible limits (0.05 and 0.3 mg/l resp.,) of WHO [11] in both surface and underground water samples. The increase in the lead (Pb) level was indicated presence of old pipes and industrial pollution [43]. Iron is not hazardous to health but it is considered a secondary or aesthetic contaminant as it stains laundry and plumbing fixtures at levels above 0.3mg/L. It is essential for good health and also helps in oxygen transport in the blood [44]. The combination of naturally occurring organic material and iron can be found in shallow wells and surface water. This type of iron is usually yellow or brown but may be colorless [45]. Moreover, heavy metals such as lead and copper for example most commonly leached into water supplies through corrosion of household plumbing fixtures, pipes, fittings and solder. However, many heavy metals enter the water supply as groundwater dissolves rocks or soil from runoff due to environmental contamination [46]. The solubility of lead increases as the pH is reduced below 8 as there is substantial decrease in the equilibrium concentration [47]. Exposure to lead (pb) has been shown to be associated with wide range of effects, including neurological and behavioral effects, mortality (mainly due to cardiovascular disease), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes, delayed sexual maturation [11]. Meanwhile increasing the concentration level of cadmium (Cd) indicates the pollution of water bodies by industrial activities [48].

An adequate supply of good quality water for dairy cattle is extremely important for optimal production. The presence of high viable bacteria in drinking water troughs was an indication of the contamination at these sites; this agreed with Jeffrey, Thomas and Hancock [49] who reported that water offered to dairy cattle is often of poor microbiological quality. The extent of bacterial contamination observed in the drinking water troughs may demonstrate animal's daily exposure to bacterial infection from water source. Also water trough material was poor and the troughs were put directly on cattle house floor closely to the mud and faeces. In Addition outer troughs environment was very humid with cattle urine which increased contamination chances. Water samples from direct main source of water supply are completely free from coliform bacteria [50]. So water can be contaminated after being poured in troughs for the following reasons: 1. Bad hygiene measures in the farms. 2. Retention of water for long time in troughs. 3. Water troughs are not cleaned regularly. 4. Disinfectants are not used for washing troughs. The total viable count for bacteria showed that water samples were found most loaded; this may be logical because troughs are exposed to contamination from many sources like cattle while drinking, animal faeces, air, dust and feed stuffs, similarly from bacterial contamination and bad storage of water. In contrast, the main sources of water protected from direct contact, surface water usually treated with disinfectants and ground water is expected to contain minimum bacteria unless mixed with human sewage [51]. The presence of faecal coliform bacteria in water trough of different sources of study indicates that water is contaminated with faeces or sewage and it has the potential to cause disease [45]. Faecal indicator bacteria are typically not disease causing but are correlated to the presence of several water borne disease-causing organisms. Target water quality ranges for faecal coliforms are set at zero for domestic use, less than 200 cfu/100ml for livestock watering purposes and up to one cfu/100ml for water used for irrigation [30, 34, 52] Increased levels of more than 200 cfu/100ml would increase the chances of infectious disease transmission in animals.

CONCLUSION

An adequate supply of good quality water for dairy cattle is extremely important for optimal production. Both underground and surface water intended for animal drinking and other activities in investigated area were subjected to various types of chemical and microbial pollution which Can alter animal health and food safety, regular monitoring and treatment of drinking water sources is highly recommended. The people and animal owners should be alerted of the potential health hazards.

ACKNOWLEDGEMENTS

Author is thankful to Support unit and projects finance in Beni-Suef University, Egypt for providing the financial of the project and supporting the research.

REFERENCES

1. Makoni, F.S., G. Manase and J. Ndamba, 2004. Patterns of domestic water use in rural areas of Zimbabwe, gender roles and realities. Physics and Chemistry of the Earth, 29: 1291-1294.
2. Katsi, L., J. Siwadi, E. Guzha, F.S. Makoni and S. Smits, 2007. Assessment of factor which affect multiple uses of water sources at household level in rural Zimbabwe BA case study of Marondera, Murehwa and Uzumba Maramba Pfungwe districts. Physics and Chemistry of the Earth, 32: 1157-1166.
3. Upton, M., 2004. The role of livestock in economic development and poverty reduction. Pro-Poor Livestock Policy Initiative (PPLPI) Working. Food and Agriculture Organization (FAO), Rome, Italy, pp: 10.
4. Steinfeld, H., P. Gerbe, T. Wassenaar, V. Castel, M. Rosales and C. De Kann, 2006. Livestock's long shadow. Food and Agriculture Organization (FAO), Rome.
5. Mazet, J.A.K., D.L. Clifford, P.B. Coppolillo, A.B. Deolalikar, J.D. Erickson and R.R. Kazwala, 2009. A Aone health@ approach to address emerging zoonoses: The HALI project in Tanzania. PLoS Medicine 6(12): e1000190. doi:10.1371/journal.pmed.1000190.
6. Kakonge, J.O., 2002. Water scarcity and related environmental problems in parts of sub-Saharan Africa: the role of the transboundary environmental impact assessment convention. Impact Assessment and Project Appraisal, 20: 49-59.
7. Saravanan, V.S., P.P. Mollinga and J.J. Bogardi, 2011. Global change, wastewater and health in fast growing economies. Current Opinion in Environmental Sustainability, 3: 461-466.
8. Solomon, R., J. Miron, D. Ben-Ghedalia and Z. Zomberg, 1995. Performance of high producing dairy cows offered drinking water of high and low salinity in the Arava desert. Journal of Dairy Science, 78: 620-624.
9. Willms, W.D., O.R. Kenzie, T.A. McAllister, D.D. Colwell, Veira, J.F. Wilmshurst, T. Entz and M.E. Olson, 2002. Effects of water quality on cattle performance. Journal of Range Management, 55: 452-460.
10. Lardner, H.A., B.D. Kirychuk, L. Braul, W.D. Willms and J. Yarotski, 2005. The effect of water quality on cattle performance on pasture. Australian Journal of Agricultural Research, 56: 97-104.

11. WHO, 2011. Guidelines for drinking water quality. 4th Ed., World Health Organisation (WHO), Geneva.
12. Prüss, A., D. Kay, L. Fewtrell and J. Bartram, 2002. Estimating the burden of disease from water, sanitation and hygiene at a global level. Environmental Health Perspectives, 110: 537-542.
13. Ashbolt, N.J., 2004. Microbial contamination of drinking water and disease outcomes in developing regions. Toxicology, 198: 229-238.
14. Kirby, R.M., J. Bartram and R. Carr, 2003. Water in food production and processing: Quantity and quality concerns. Food Control, 14: 283-299.
15. Guppy, L. and A. Shantz, 2011. Groundwater quality in rural Cambodia: Measures and perceptions. Geographical Research, 49: 384-394.
16. Rossiter, H.M.A., P.A. Owusu, E. Awuah, A.M. MacDonald and A.I. Schäfer, 2010. Chemical drinking water quality in Ghana: Water costs and scope for advanced treatment. Science of the Total Environment, 408: 2378-2386.
17. A.P.H.A. (American Puplic Health Association), 2001. Standard methods for the examination of water and waste water. 22 th edn. A.P.H.A., Washington, D.C. USA.
18. A.P.H.A (American Public Health Association), 2005. American Water Works Association: Standard methods for the examination of water and wastewater. New York.
19. Beede, D.K., 2012. What will our ruminants drink? Animal Frontiers, 2: 36-43.
20. USEPA, 2009. Drinking Water Contaminants Guidelines, Geneva.
21. Manning, L., 2008. The impact of water quality and availability on food production. British Food Journal, 110: 762 -780.
22. Olkowski, A.A., 2009. Livestock water quality: A field guide for cattle, horses, poultry and swine. Agriculture & Agri-Food Canada. Available. http://www4.agr.gc.ca/resources/prod/doc/terr/pdf/lwq_guide_e.pdf. Accessed on 20 March 2011.
23. Pandey, S.K. and S. Tiwari, 2009. Physico-chemical analysis of ground water of selected area of Ghazipur city-A case study. Nature Science, 7(1): 17-20.
24. Shittu, O.B., J.O. Olaitan and T.S. Amusa, 2008. Physico Chemical and Bacteriological Analyses of Water Used for Drinking and Swimming Purposes in Abeokuta, Nigeria. African Journal of Biomedical Research, 11: 285-290.
25. Patil, V.T. and P.R. Patil, 2010. Physico-chemical analysis of selected ground water samples of Amalner Town in Jalgaun District, Maharastra, India. E- Journal of Chemistry, 7(1): 111-116.
26. Krishnan, R.R., K. Dharmaraj and B.D.R. Kumari, 2007. A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. Journal of Environmental Biology, 28(1): 105-108.
27. Devi, S. and K. Premkumar, 2012. Physico-chemical analysis of groundwater samples near industrial area, Cuddalore District, Tamil Nadu, India. International Journal of Chem. Tech. Research, 4(1): 29-34.
28. Hacioglu, N. and B. Dulger, 2009. Monthly variation of some physico-chemical and micribiological parameters in Big Stream (Biga, Canakkale, Turkey). African Journal of Biotechnology, 8(9): 1929-1937.
29. Rao, V.S., S. Prasanthi, K.J.V. Shanmukha and K.R.S. Prasad, 2012. Physico- chemical analysis of water samples of Najendle area in Gunter District of Andhra Pradesh, India. International Journal of Chem. Tech. Research, 4(2): 691-699.
30. Department of Water Affairs and Forestry (DWAF). 1996a. South African Water Quality Guidelines (second edition). Volume 1: Domestic Use. Pretoria, South Africa: Government Printer.
31. Melegy, A., A.M. Shaban, M.M. Hassaan and S.A. Salman, 2013. AGeochemical Mobilization of Some Heavy Metals in Water Resources and Their Impact on Human Health in Sohag Governorate, Egypt,@ Arabian Journal of Geosciences,. http://dx.doi.org/10.1007/s12517-013-1095-y.
32. Suresh, T. and N.M. Kottureshwara, 2009. Assessment of groundwater quality of borewells water of Hospettaluka region in Bellary district, Karnataka, India. Research Journal of Chemistry, 2(1): 221-233.
33. Melegy, A., A. El-Kammar, M.M. Yehia and M. Ghadir, 2014. Hydrogeochemical Characteristics and Assessment of Water Resources in Beni Suef Governorate, Egypt. Open Journal of Geology, 4(2): 14. Article ID: 43077.
34. Department of Water Affairs and Forestry (DWAF), 1996b. South African Water Quality Guidelines (second edition). Volume 5: Agricultural use: Livestock watering. Pretoria, South Africa: Government Printer.

35. Beede, D.K., 2005. Assessment of water quality and nutrition for dairy cattle. Proceedings of the Mid-South Ruminant Nutrition Conference, April 27-28, 2005, Arlington, TX, USA.
36. EPA, 2002. List of Drinking Water Contaminants & MCLs. Health and Aesthetic Aspects of Water Quality, 816-F-02-013.
37. Kostadinova, G., G. Petkov, G. Mihaylova and S. Denev, 2003. The drinking water quality in dairy farm production systems. Ecology and Future, 2, 3: 25-30
38. Petkov, G., G. Kostadinova, G. Mihaylova and S. Denev, 2004. The Drinking Water Quality in a 4350 Capacity Pig-farm Production System. Ecology and Future, 3, 2: 10-16.
39. Stefanova, R., G. Kostadinova and N. Georgieva, 2012. Water quality assessment from own source at poultry farm located in rural region in South Bulgaria. Agricultural Science and Technology, 4(2): 143-147.
40. Ohio Department of Natural Resources (ODNR)., 2011. Ground Water Quality. Division of Soil and Water Resources, 2045 Morse Road Bldg. B-2, Columbus, Ohio 43229-6640.
41. Stewart, S., 2011. Nitrate in Drinking Water fact sheet. Water Quality Division, Drinking Water Protection Programs 811 SW6th Avenue, Portland, OR 97204.
42. Benham, B., E.B. Ling, Wright and K. Haering, 2011. Corrosive Household Water. Virginia Cooperative Extension publication #442-665. Also online @ http://pubs.ext.vt.edu/442/442-665/442-665.html.Accessed on 12-06-2011.
43. Gebrekidan, M. and Z. Samuel, 2011. Concentration of Heavy Metals in Drinking Water from Urban Areas of the Tigray Region, Northern Ethiopia., Momona Ethiopian Journal of Science, 3(1): 105- 121.
44. Nartey, V.K., R.K. Adaboh, J.R. Fianko and A. Donkor, 2005. Water quality Assessment of Streams Draining the Akuapim Ridge of Ghana. West African Journal of Applied Ecology, 8:35-46.
45. DHHS, N.C., 2009. Protect Yourself from Coliform Bacteria in Well Water. Water facts sheet @ www.ncdhhhs.org or www.ncpublichealth.com. Date Accessed: 10-12-2011.
46. Pedersen, T.L., 1997. Metals in Drinking Water, UCD EXTOXNET FAQ Team.
47. Anon., 1993. Guideline for drinking water quality. World Health Organization, Geneva.
48. Nassef, M., R.EL. Hannigan, K.A. Sayed and M.S. El-Tahawy, 2006. Determination of some heavy metals in the environment of Sadat industrial city. Proceeding of the 2nd Environmental Physics Conference, Cairo University Egypt., pp: 145-152.
49. Jeffrey, T., E. Thomas and D.D. Hancock, 2001. Cattle water troughs as reservoirs of *Eschereichia coli* 0157. Applied and Environmental Microbiology, 67: 3053-3057.
50. El Tom, A.M., 1997. Microbiology of Port-Sudan water supply, M.Sc. Thesis. University of Khartoum.
51. Alcano, E.L., 1997. Fund.Microbiol. 4th (ed.). The Benjamic Cuming Publishing Company Inc, Red Wood city.
52. Department of Water Affairs and Forestry (DWAF), 1996c. South African Water Quality Guidelines (second edition). Volume 4: Agricultural use: Irrigation. Pretoria, South Africa: Government Printer.