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Contribution to the characterization of the physico-chemical and bacteriological quality of dairy cattle watering in the zone of El Tarf, Algeria.

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Article Info	Abstract
Keywords : Water Quality Physico-chemical Bacteriological Dairy cattle *Correspondance : kahina_houd_chaker@yahoo.fr Reçu le 02 mai 2018, Révisé le 10 juin 2018, Accepté le 11 juin 2018.	The objective of this study is to evaluate the physico-chemical and bacteriological quality of water from some watering sources of dairy cattle in the wetlands of El Tarf. Our study was carried out on water samples from different dairy cattle farms. Water samples were analyzed during the period from January to June of 2016. The study implies physico-chemical and bacteriological analyzes of various parameters related to the control of water quality in dairy farms. The results obtained have shown that the water has a satisfactory quality in terms of pH, temperature, salinity and can be considered as eligible and does not pose any threat for ruminant's consumption. However, nitrite concentrations exceed the drinking water standards recommended for dairy cattle. The bacteriological quality of the waters is poor and reveals groundwater table contamination by nearby pollutions (agricultural land, cattle breeding, existence of septic tanks), which presents a real threat to dairy cattle

1. Introduction

Water quality has been a topic for many years, covering many aspects, such as the environment, human health and breeding. Water is one of the essentials of biological life, not only it is a vital nutrient, but also it participates in many basic physiological functions such as digestion, absorption, thermoregulation, waste disposal and Others [1]. Its availability and quality are key parameters in the health and livestock production [2]. Multiple qualitative parameters, such as pH, salinity, odor, etc, can have an impact on the taste of the water. A decline in livestock food consumption due to poor water quality can have a negative impact on the performance [3]. All surface or ground raw water, holds microorganisms.

The main health risk of drinking water is probably the microbiological contamination, but the total count, which represents an estimate of the total number of bacteria contained in water, is not sufficient to assess the threat, all depends on The nature of germs [4].

The objective of our contribution is to define the quality via the physico-chemical and bacteriological composition of the main sources used for dairy cattle watering in the town of Boutheldja and El Tarf in order to assess opportunities and risks associated with the use of such sources.

2. Materials and methods

2.1. The study area

The study was conducted in a dairy pool in the area of El Tarf, which is located to the northeast of Algeria (8 ° 11 'longitude and 36 ° 47' latitude). Climatically speaking, the region is located in the bioclimatic stage in sub-humid to warm-dampclimatic zone, with mild winters and dry summers. Climatic surveys over the last 10 years indicate an average annual rainfall of 800 to 1200 mm, characterized by a great intra-annual irregularity. Monthly precipitation varies between a maximum in December and January (134.34mm and 136.42 mm respectively) and a minimum in July and

August (3.97mm and 13.34mm). The average annual temperature is 19.24 °C with a maximum in August (27.35 °C) and a minimum in January (12.96 °C) [5] et [6].

2.2. The choice of breeders and sampling frequency

This contribution is part of a research project on the supply of water from watering sources of dairy cattle in the wetlands of El Tarf. This program aims to identify sources of high health animal risk in order to plan a sensible and targeted program for water quality prevention and control. Among the most responsive breeders who have agreed to cooperate with us in the town of El Tarf and Boutheldja, we have selected different watering sources such as: well, source, wadi, public drinking water supplies and borehole water.

Three selected breeders were visited for dairy cattle watering withdrawal from January until June 2016 with a weekly frequency that to say 24 samples per station. This period coincides with the most important phase of milk yield in lactating cows (peak lactation). The samples taken from the seven selected different watering sources: two wells, one natural source, one public drinking water supply, one wadi and two boreholes. The samples were taken in sterile glass bottles of 500mL, which are immersed immediately after opening in the water point, the water is taken to a depth of 30cm below the surface by smoothing a volume of air about 1/10 of the vial volume; thereafter, the vials are filled without leaving any air bubbles.

Temperature, pH and salinity were measured in situ at each sampling using a multi parameter water quality analyzer. The pollution parameters were analyzed at the laboratory according to the analytical methods recommended by [7]. The microbiological parameters analyzed in this contribution are: total coliforms; Thermotolerant coliforms; *Escherichia coli* and faecal streptococci, the latter were analyzed in the laboratory following the analytical protocol of [7].

2.3. Statistical analysis

The results are presented on average $\pm$ standard deviation (SD), all the obtained results of the water quality were subjected to oneway analysis of variance (ANOVA) with the SAS system for generalized linear model (15) at the $p < 0.05$ level of statistical significance. The Student-Newman-Keuls test (SAS) (15) made it possible to seek homogeneous groups of averages.

3. Results and discussion

The turbidity of the water sources analyzed is not high; the waters are generally colorless or slightly

colored except for the two wells and El Kebir wadi where the waters are turbid. Vegetation cover is one of the factors capable of increasing the turbidity [8]. This turbidity would then be partly organic and may lead to a significant increase in chlorine doses during water treatment [8].

The pH depends on the origin of the water, the geological nature of the substrate and the watershed crossed [9]. This parameter can have more significant impacts on animals. In ruminants, consumption of water with a pH less than 5.5 is associated with metabolic acidosis, whereas alkaline water with a pH above 8.5 may be the source of an increased risk of metabolic alkalosis [1]. Nevertheless, observed values indicate that the pH of all analyzed sources is neutral and therefore remains within drinking water standards for dairy cattle, except for the second well where the trend is alkaline. These values could be explained by the shallow depths of the wells and the geological characteristics of the terrain [10].

Conductivity is proportional to the amount of dissolved ionizable salts and is a good indication of mineralization of the water. The measured range from $130.4 \pm 4.8 \mu\text{S/cm}$ to $2515 \pm 35 \mu\text{S/cm}$. This reveals a significant variation between watering sources with strong mineralization associated with high salinity for certain points (borehole 2 and Well 2). Nevertheless, our results can be considered acceptable from conductivity and salinity points of view. Moreover, the analyzed waters are too hard, for all the points analyzed.

Analysis of the variance shows highly significant differences ($p < 0.001$) in terms of pH, turbidity, conductivity, salinity and hardness in the different analyzed sources, however, a significant difference ($p = 0.023$) is found in the sampling points in terms of temperature.

The results of the nitrate analyzes show that their contents range from $1.5 \pm 0.2 \text{ mg/l}$ to $15.23 \pm 2.3 \text{ mg/l}$ during this study period with highly significant differences ($p < 0.001$). All stored values do not exceed the recommended standards of 50mg/l. The quantities of nitrates in well water can vary abruptly, and depend on many climatic, environmental and agricultural factors; these results are consistent with those found by [11].

On the basis of the results achieved, nitrite concentrations show highly significant differences with values ranging from $0.01 \pm 0.006 \text{ mg/l}$ to $3.83 \pm 0.8 \text{ mg/l}$ for the second well water. However, the concentration of this element remains high compared to the standard of 0.1 mg/l and this for a significant number of our sampling points, which foretells an anthropogenic pollution.

A high nitrite content in ground and surface water is often associated with excessive use of nitrogen fertilizers, excessive manure application, runoff from livestock collecting areas. It often happens that water sources close livestock farms contain high levels of nitrite. Generally, high

concentrations of nitrite are found only when the source is polluted with organic waste and very low oxygen levels [12]. For phosphorus, all recorded values do not exceed standards ($p = 0.637$), these results are consistent with those found by [11].

Excess sulphates and chlorides cause corrosion but also give an unpleasant taste to water with a risk of under-consumption and can cause diarrhea [13]. According to the results of the samples analyzed, the concentrations of sulfate ions range from 82.92 ± 31.5 mg / l to 188.3 ± 40.2 mg / l. These values remain below the OMS value (VG = 500mg/l) of the water quality standards for livestock

watering and do not constitute any danger. A similar result was observed for chlorides except for the second well and the second borehole where concentrations exceed international recommendations by 400mg / l. The analysis of variance shows very significant differences ($p = 0.003$) for sulphates and highly significant for chloride between sampling points.

Table. 1: Results of physicochemical watering parameters

Parameters	Turbidity (UNT)	pH	Conductivity ($\mu\text{S}/\text{cm}$)	Salinity	Temperature ($^{\circ}\text{C}$)	Hardness ($^{\circ}\text{F}$)
Source	$14.09^b \pm 6.5$	$7.08^c \pm 0.02$	$271.66^f \pm 43.4$	0.1^c	$16.8^a \pm 3.1$	$83.3^d \pm 20.8$
Well 1	$51.26^a \pm 14.4$	$7.09^c \pm 0.05$	$574.66^c \pm 39.6$	0.3^c	$19.7^a \pm 2.1$	$143.3^c \pm 5.7$
Well 2	$79.6^a \pm 8.6$	$8.1^a \pm 0.1$	$1430.6^b \pm 60.4$	$1.17^b \pm 0.2$	$15.43^a \pm 0.3$	$854.8^a \pm 47.2$
Public Drinking Supplie	$15.33^b \pm 5.8$	$7.72^b \pm 0.15$	$390.66^e \pm 20$	0.1^c	$18.03^a \pm 0.6$	$116.7^{cd} \pm 5.4$
Wadi	$57.23^a \pm 36.2$	$7.07^c \pm 0.07$	$511^d \pm 27.22$	$0.23^c \pm 0.05$	$19.06^a \pm 3.05$	$193.3^b \pm 11.5$
Borehole 1	$2.47^b \pm 2.07$	$7.01^c \pm 0.04$	$130.43^g \pm 4.8$	0.1^c	$17.6^a \pm 1.34$	$31.6^e \pm 2.8$
Borehole 2	$5.33^b \pm 2.08$	$7.99^a \pm 0.17$	$2515^a \pm 35$	$1.6^a \pm 0.05$	$15.43^a \pm 0.3$	$847.3^a \pm 21.4$
P	0,001***	0,001***	0,001***	0,001***	0,023*	0,001***

ns: non significant *significant ($P < 0.05$) **very significant ($P < 0.01$) ***highly significant ($P < 0.001$)

Table. 2: Results of parameters of organic pollution of drinking water

Parameters	Nitrates (mg/L)	Nitrites (mg/L)	Phosphorus (mg/L)	Sulphates (mg/L)	Chloride (mg/L)
Source 1	$5.16^c \pm 2.5$	$0.01^d \pm 0.006$	$0.17^a \pm 0.03$	$97.59^b \pm 25.9$	$56.8^c \pm 7.1$
Well 1	$1.5^d \pm 0.2$	$0.89^c \pm 0.1$	$0.10^a \pm 0.13$	$82.92^b \pm 31.5$	$125^c \pm 4.8$
Well 2	$15.23^a \pm 2.3$	$3.83^a \pm 0.8$	$0.22^a \pm 0.05$	$102.88^b \pm 27.6$	$749.3^b \pm 51$
Public Drinking Supplie 1	$2.88^{cd} \pm 1.3$	$0.07^d \pm 0.03$	$0.13^a \pm 0.05$	$119.9^b \pm 16.73$	$58.9^c \pm 4.6$
Wadi	$10.10^b \pm 0.9$	$2.03^b \pm 0.05$	$0.37^a \pm 0.4$	$99.78^b \pm 3.52$	$82.8^c \pm 8.2$
Borehole 1	$1.67^d \pm 0.2$	$1.63^{bc} \pm 0.4$	$0.27^a \pm 0.12$	$98.07^b \pm 11.26$	$45^c \pm 14.8$
Borehole 2	$13.4^a \pm 1.1$	$1.40^{bc} \pm 0.2$	$0.23^a \pm 0.03$	$188.3^a \pm 40.2$	$1131^a \pm 100.5$
P	0,001***	0,001***	0,637ns	0,003**	0,001***

ns: non significant *significant ($P < 0.05$) **very significant ($P < 0.01$) ***highly significant ($P < 0.001$)

Table. 3: Results of bacteriological parameters of drinking water:

	CT (UFC/100ml)	CF (UFC/100ml)	SF (UFC/100ml)	E.coli (UFC/100ml)
Source 1	$12^c \pm 8.2$	$16^c \pm 4$	0^c	0^c
well 1	$220^b \pm 208.1$	$150^b \pm 30$	$2^b \pm 1$	0^c
well 2	$840^a \pm 160$	$476.67^a \pm 68.07$	$100^a \pm 10$	$10.33^a \pm 2.5$
Public Drinking Supplie1	$20^c \pm 17.3$	$2^d \pm 2$	0^c	0^c
Oued	$216.7^b \pm 76.4$	$100^b \pm 30$	$103.3^a \pm 6.66$	$4.33^a \pm 2.5$
Borehole 1	$17.3^c \pm 15.1$	$21^c \pm 5.29$	0^c	0^c
Borehole 2	$7^d \pm 6.1$	$26^c \pm 7.21$	$1.33^b \pm 0.58$	0^c
P	0,001***	0,001***	0,001***	0,001***

ns: non significant *significant ($P < 0.05$) **very significant ($P < 0.01$) ***highly significant ($P < 0.001$)

The evaluation of the bacteriological quality of ruminant watering is based on the concept of germs known as indicators of fecal contamination [14]. The

more there is fecal bacteria in the water, the greater the risk of the presence of pathogens organisms is real [4].

Table 3 shows that the second wells as the most contaminated source of water with a total of 840 ± 160 UFC/100ml, however, the least contaminated watering point with a total of $7 \pm 6,1$ UFC/100ml in the second drilling. Nevertheless, the second well is characterized by the most important bacteriological loads, and this for all the bacteria. However, the results of *E. coli* reveal an absence of this bacterium in all the points except the waters of wadiofkebir and the second well. Analysis of the variance shows highly significant differences ($p = 0.000$) in the bacterial load of the studied sources. The high bacteriological contamination of the waters analyzed could be due to: poor protection of wells (open pits). Moreover, the waters of the study area have a high fecal contamination, which is in line with those found by [15] for the Marrakech aquifer. The surface waters laden with microorganisms seep through the soil into groundwater table without having had an efficient filtration, and causes many different point sources of pollution. [16,17] also mentioned that water from underground reservoir is all the more vulnerable as the top of the underground water table is close to the surface of the ground, that the land above aquifers is permeable and surface sources of pollution are important. In addition, shallow aquifers, with access via wells, appear to be highly contaminated with organic materials of human and animal origin.

4. Conclusion

This study reveals that the waters of the sources analyzed are highly mineralized, characterized by high salinity and high hardness; with detected nitric pollution. In addition, bacteriological analysis shows that the majority of our sources are highly contaminated with at least two bacteria, hence; the majority of the sources studied are unfit for dairy cattle consumption.

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