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Physicochemical Composition of the Main Water Sources for Broiler Chickens in the Eastern Region of Algeria

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ABSTRACT

The present study was carried out in order to determine the quality of the water via the physicochemical composition of the main sources used for the watering of broiler chickens (then, borehole and natural source) in addition to a comparison between the quality physico-chemical of the water from these sources and the water from the pipes inside the livestock buildings in the Morsott area (Wilaya of Tébessa) in order to determine the possibilities and risks of using these sources.

The study includes physicochemical analyzes of the various parameters relating to water quality control (PH, conductivity, salinity, Na^{++}, K^{+}, Ca^{++}, Cl^{-}) and certain zootechnical performances (IC, GMQ, Pv, etc.) in poultry farms.

The results obtained showed that the water has a satisfactory quality from the point of view of conductivity, salinity, Na^{++}, Ca^{++}, Cl^{-}. While the pH of the borehole and the K^{+} rate at the drinking troughs does not meet the recommended standards

In addition, the best zootechnical performance of this study was recorded in the livestock building supplied with water from the well

Key words: Chicken, water, breeding, performance, consumption, physico-chemical.

Introduction

Water is an essential nutrient involved in all basic physiological functions of the body, such as digestion, absorption, thermoregulation, elimination of waste and others (Kirkpatrick and Fleming, 2008).

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Livestock water needs and consumption may vary according to species and breeds, the condition of the animals, their mode of production, and the environment or climate in which they live. All these parameters are related, either directly or indirectly, to several aspects of water metabolism and physiology (Zaki et al, 2004).

Chickens generally consume twice as much water as feed. Water represents about 70% of the weight of the chick (but it can represent up to 85% at hatching). Consequently, any reduction in water supply can lead to a drop in viability (Fbrice , 2015), and poor drinking water is often a factor contributing to the drop in consumption, the risk that the contaminants it contains reach a harmful level increases (Andrew and Olkowski, 2009).

Broiler is the main type of poultry consumed in many countries of the world, including Algeria. They represent a valuable source of animal protein of great biological value (Van Eekeren et al, 2006). At the same time, poultry farming represents a means of rapidly increasing meat production to meet the protein needs of the populations; this is due to its industrial nature and its technical and economic particularities such as the very short production cycle (Tossou et al, 2014).

Due to the essential role of water on health, biological resources and performance, it is essential to ensure that the distribution of clean water is correctly carried out in buildings (Akouango et al, 2010).

The objective of this study is to define the water quality via the physico-chemical composition of the main sources used for broiler watering in the eastern region of Algeria.

Materials and methods

Study zone

The 3 experienced farms are located in the commune of Morsott wilaya of Tébessa which is part of the large regional group of the eastern highlands.

Biological materials

Field survey and choice of farms

A preliminary survey on the conditions of avian breeding in the region of Morsott imposed in order to select three breeding buildings using the different sources of watering namely: well, borehole and natural source.

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Livestock buildings

The unit contains three centers each of which includes 10 buildings of the dark type under controlled atmosphere, as it meets the requirements of the breeding mentioned in the bibliographical part, with a capacity of 9000 subjects per building.

Results and discussion

Results of the physico-chemical analysis of drinking water

With regard to the physico-chemical analyses, a total of three springs were sampled once, namely a natural spring, a well and a borehole, in addition to the three drinking troughs and the water tanks distributed among three farms.

The results of the chemical analysis of the waters are presented in table 01

Table 01: Chemical composition of water

Samples / Parameters	Drilling			well			Standards OMS
	Source	Water cover + line	Trough	Source	Water cover + line	Trough	
pH	8,10	8,02	7,57	7.07	7.10	7.06	6,5 - 9,5
Conductivity (µS/cm)	1758	1747	1748	1080	1073	1080	2500
Salinity (g/l)	0.8	0.8	0.8	0.4	0.4	0.4	< 1
Na^+ (mg/l)	27	30	36	16	16	17	< 150
K^+ (mg/l)	05	08	13	12	12	15	<12
Ca^{2+} (mg/l)	44	48	49	42	44	45	< 100
Cl^- (mg/l)	152	145	147	109	99	101	<250

The results reported in Table 01 show that the pH of the samples is generally neutral for the wells vary between 7.06 and 7.10. Nevertheless, there is no great difference between the watering sources analyzed and the water from the corresponding drinking troughs. On the other hand, the most important hydrogen potential is recorded at the level of the borehole where the water is considered as basic at the level of the borehole and neutral at the level of the waters of the well.

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The electrical conductivity analysis shows relatively high values for the borehole waters analyzed especially at the source of the borehole (1758 µS/cm), in parallel with moderately high values for the well waters

Nevertheless, the conductivity of the water from the borehole shows that the well water is very salty and mineralized.

With regard to water salinity, the concentration is remarkable in borehole water (0.8 g/l) compared to that of wells (0.4 g/l). Indeed, the value remains fixed for the 3 samples from the same source.

The results of the K^+ ion content analyses; Na^+ from the two water sources analyzed, and the water at the drinking troughs show that the borehole water is rich in Na^{++} with an average of 31 mg/l and the well water in K^+ with an average of 13 mg/l ml

At the same time, note that the concentrations of K^+ and Na^+ are more or less high in the water from the drinking troughs of the two springs.

However, the Ca^{++} concentration is considerable and almost identical for both water sources. While the important content of Cl^- is a little higher in the waters of the borehole compared to that of the well

Nevertheless, the fluctuations in the values of Ca^{++}, Cl^- ions from the same source are very small during the study period.

Zootechnical parameters studied

Mortality rates of the farms studied

The experimental breeding buildings began with 9000 subjects at the level of the buildings fed by the waters of the borehole and the spring and by 4000 subjects at the level of the building fed by the waters of the well.

The calculation of the mortality rate begins only after the 3rd day of the placement of the chicken (until the disappearance of the effect of travel stress).

Table 02: Mortality rate (%) recorded at the level of the three farms

Age (Semaine)	1	2	3	4	5	6	7	Total %
EXP. Source	0.71	0.60	0.20	0.13	0.45	0.64	0.66	**3.39**

EXP. Puits	1	0.70	0.53	1.07	0.54	0.72	0.62	**5.18**
EXP. Forage	1.14	0.99	1.32	0.97	1.07	0.85	0.77	**8.11**

EXP. *Source: exploitation fed by the waters of the natural source.* ***EXP. Wells:*** *exploitation fed by the waters of the well,*

EXP. *Borehole: exploitation fed by water from the borehole.*

The analysis of the results of the different mortality rates of the three farms studied shows values varying between 3.39% and 8.11%. This rate exceeds the acceptable standard of 6% for the BIG FAST strain in buildings that have been supplied with water from the well and the natural spring. On the other hand, it exceeds the standards for those fed by water from the borehole. Nevertheless, we also note more or less significant fluctuations in weekly mortality rates (high at the start (1st and 2nd week) as well as in the finishing phase (6th and 7th week), and this for all the farms studied.

Food Consumption

The evolution of chicken consumption according to drinking water is presented in Figure 01.

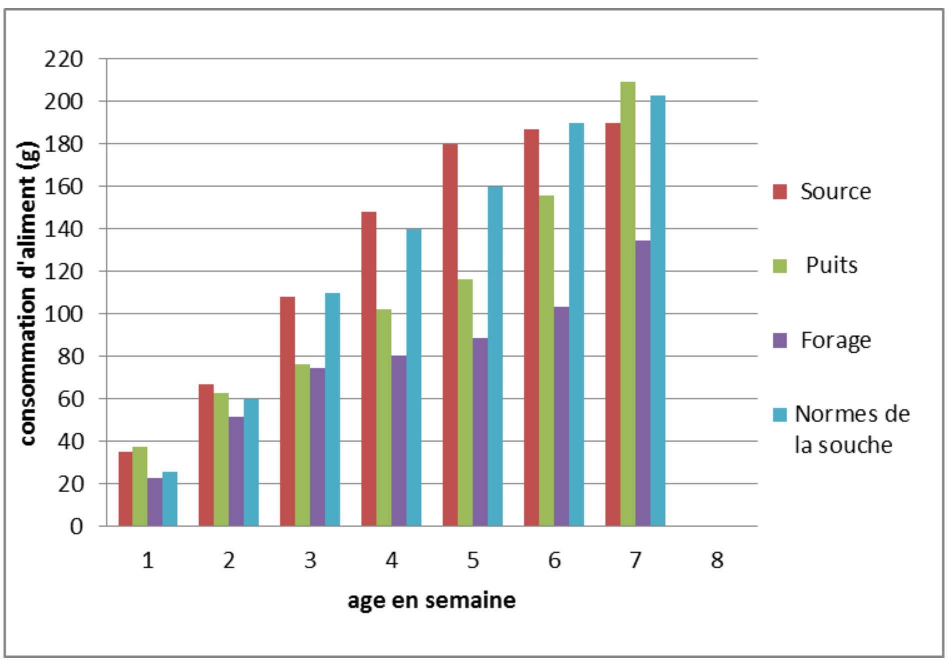

Figure 01: Evolution of consumption according to age and drinking water quality.

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The results of feed consumption per subject and day at the level of the three farms in question reveal that for all the farms, the feed consumption recorded remains below the standards allowed for our strain in the borehole, but the consumption of registered food remains close to standards in the building supplied by water from the well and spring. So, the most important consumption is recorded at the level of the building fed by the waters of the well and the spring in comparison with the two farms.

Consumption Index

Table 03: Consumption index (g/subject/d) recorded at the level of the three farms

Age (week)	**Consumption Index (g/sujet/j)**			
	EXP. Source	**EXP. Well**	**EXP. drilling**	**Strain standard**
01	1,66	1,6	2,00	0,98
02	1,68	2,38	1,55	1,30
03	1,88	0,81	1,51	1,78
04	2,13	2,01	1,36	2,34
05	2,43	1,50	1,47	1,22
06	2,57	1,40	1,14	2,09
07	2,72	2,19	1,87	2,81

The results of the evaluation of the consumption index during the rearing period of the three farms studied: show that in general, an evolution compared to the norm of the consumption indices during the start-up period (1st and 2 week) for the three springs, on the other hand, we exceeded the standards allowed for the building supplied by the water from the spring during the seven weeks of follow-up.

Average Live Weight

The evolution of the live weight of chickens according to the drinking water is presented in Figure 02.

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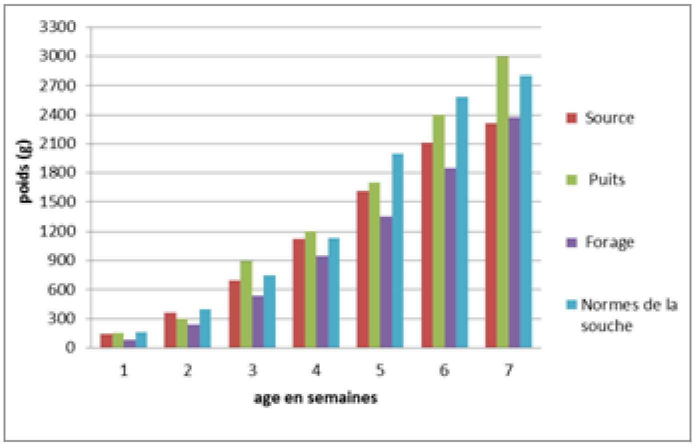

Figure 02: Evolution of live weight according to age and drinking water quality.

According to figure 02 of the evolution of the average live weight of the three farms studied, fluctuations in the average live weight are recorded at the levels of the three farms, it is noted that in the start-up period the average live weight does not reach the objective and this for all farms, and in the growth period the average live weight reaches the target in the well and does not reach the source and borehole.

It is noted that towards the end of the breeding, the average live weight does not reach the objective of 2800g at the level of the breeding fed by the waters of the drilling (2250g) and at the level of the breeding fed by the waters from the source (2318g). On the other hand, the breeding fed by the waters of the well, the average live weight exceeds the objective of 2800g.

Average Daily Gain

The evolution of the average daily gain of chickens according to the drinking water is presented in figure 04.

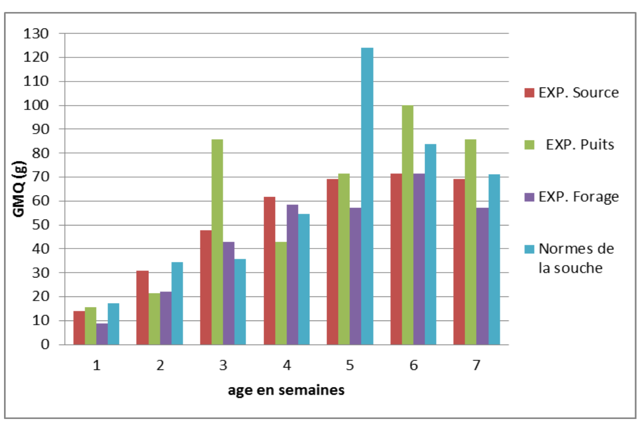

Figure 04: Evolution of the average daily gain according to age and drinking water quality.

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The results of the evolution of the ADG during the breeding period at the level of the three farms in question reveal that for all the farms, the ADG recorded remains below the standards, and this for the first two weeks of monitoring.

However, the average gain margin between the reality at the level of the farms and the standards are very important during the two periods of start and growth, but towards the third period of completion, the results reveal lower margins in terms of ADG in the borehole 57.14g and in the source 69.33g. But the GMQ continues to push into the 85.71g pit.

Discussion

In Algeria, there are currently no drinking water standards for animals. Human drinking standards are therefore the only reference. You should know that the quality of water is looked at from a physico-chemical and bacteriological angle. We can report reference values proposed by WHO for poultry farms, as water quality standards for watering this category of animals.

During their underground circulation, their stay in the aquifer and their surface flow, the waters are charged, in contact with the different terrains crossed, with a certain number of soluble chemical elements, chlorides, carbonates, sulphates and others. These elements are most often of geological origin; however, they can sometimes be of anthropogenic origin and are then likely to significantly affect water quality (Mourad, 2017).

The pH is a very sensitive parameter to various environmental factors, it also depends on variations in temperature, salinity and dissolved CO2 levels. It also depends on the geological nature of the terrain (Haoua et al, 2019).

This parameter conditions a large number of physico-chemical balances between water, dissolved carbon dioxide, carbonates and bicarbonates which constitute buffered solutions giving aquatic life a favorable development. In most natural waters, the pH is usually between 6 and 8.5, while in warm waters, it is between 5 and 9 (Hceflcd, 2006).

In addition, the pH of the water can have a greater impact on the animals. For example, drinking water with a pH below 5.5 contributes to metabolic acidosis, while alkaline water with a pH above 8.5 can cause an increase in risk of metabolic alkalosis. While the values observed reveal that the pH of the waters analyzed from the borehole is high, and therefore, it remains dangerous for the potability of the broilers in parallel with the waters of the well which always remain

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neutral. These results are similar to those found by (El mustaine et al, 2013). He noted that the pH of the waters of the well oscillates between neutral and slightly basic (pH = 7.2 and 7.9)

The conductivity of the waters analyzed in this study is between 1073 and 1758 µS/cm, these values show that the water is highly mineralized either naturally by the presence of calcium, magnesium, sodium, potassium, chloride, sulphate and bicarbonate ions in a calcium region, or by pollutants. (Technical Guide 2016).

High salinity also means a large amount of dissolved ions in the water. It results in a refusal to consume water and therefore a lack of water. This results in weight loss or weight stagnation, even in extreme cases the death of the animal (Ndiaye, 2010). The values observed in our experiment show that the salinity of the sources analyzed is still within the norms. Therefore, it remains within potability limits for broiler chicken.

Potassium is a natural element essential for the growth of living things. However, its presence in excess in water is an indicator of pollution by agricultural effluents (slurry, etc.) or agri-food industries, which contain a lot of it. To a lesser extent, its origin can also be the use of fertilizers (and slurry) in the upstream catchment area. (Technical Guide 2016). This may explain the more or less high rate at the level of the drinking troughs of the experienced buildings.

The concentration of chloride in water can be higher or lower depending on the geology of the soils and their exposure to pollution. Chloride has health benefits. Drinking water must not exceed a value of 51.4 mg/l in comparison with the recorded values remaining below the WHO value (< 250mg/l) (Montiel, 2007).

Some water quality parameters which are not illustrated in this study and which have an influence on animal health such as sulphates and nitrates. Sulphates come from runoff or infiltration in gypsum land. They also result from the activity of certain bacteria (chlorothiobacteria, rhodothiobacteria, etc.) (Belghiti et al, 2013). This activity can oxidize toxic hydrogen sulfide (H2S) to sulfate (Hceflcd, 2006). Any excess in this element gives the water an unpleasant taste and can cause diarrhea problems. As well as for the quantities of nitrates depend on many climatic, environmental and agricultural factors (Mourad, 2017).

According to the results of studies that have already been carried out in the region of Tébessa commune of El Ogla by (Redjeb, 2015) indicates that the values of sulphate and nitrate remain below the standards requested by the WHO and that relating to the quality of water intended for poultry watering and does not present any danger.

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Another study by (Zaki et al, 2004) showed that in experimental animals given treatment for 5 months, nitrate levels of 150 and 500 mg/l resulted in a significant drop in the serum level of hormones thyroid. This therefore suggests that the presence of nitrates in the drinking water can alter the functions of the thyroid hormones, which can then have a negative impact on the growth rate. In addition to reproductive difficulties, nervous disorders and poor assimilation of minerals and vitamins (Villers et al, 2005).

Conclusion

The different physico-chemical parameters of the water have shown spatio-temporal variations. Indeed, the results of the measured water parameters can be considered admissible and present no danger for consumption in broilers (suitable for the recommended standard). However, the problem lies in the pH level of the borehole water, which is slightly basic, as well as in the potassium level, which is higher than at the level of the drinking troughs for the two sources.

Furthermore, the results of zootechnical performance recorded in this study showed that the livestock building supplied with water from the well is the only one that met the required standards, followed by the building that supplied water from the spring. On the other hand, the water supplied by the borehole is far from being up to standard.

The quality of drinking water on farms can have a significant impact on production and considerably influence the success of a farm and determines its profitability. In addition, poor quality water can not only cause numerous therapeutic failures, but also be a predisposing factor for a whole range of pathologies of various etiologies (chemical, bacterial, viral and parasitic). This is why the water intended for farm animals must be subject to regular analyses.

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