# The Assessment of the Quality of Water Offered to Animals in Rural Households and Farms

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**Abstract**
The aim of this paper was to assess the quality of water consumed by animals in rural households and farms. The water quality was determined based on indicator parameters (pH, ammonia, sulphates, iron, chlorides, organic substances, overall hardness, total number of germs, number of Coliform bacteria) and chemical parameters (nitrites, nitrates), by collecting and analyzing 40 water samples (from 20 households and 20 farms). The results were compared to the provisions of the Laws 458/2002 and 311/2004. Three water samples (15%) from rural households had nitrates exceeding the threshold levels. Within the indicator parameters, the following ones showed alterations: ammonia (20% from samples), sulphates (40% from samples), chlorides (35% from samples), overall hardness (60% from samples), organic substances (20% from samples), total number of germs (all of the samples) and the number of Coliform bacteria (90% from samples), respectively. The water used in farms had no alterations of the chemical parameters. Within the indicator parameters, the following showed divergences from the legal provisions: overall hardness (85%), the total number of germs (50% from samples) and the number of Coliform bacteria (35% from samples). The obtained results indicate a better quality of water consumed by animals in farms in comparison with water consumed by them in rural households.

**Keywords**: ammonia, coliforms. drinking water, nitrate, water quality.

## 1. Introduction

Water is the most important nutrient for livestock and poultry [1]. Animals need an abundant source of good and clean water for all metabolic processes essential for life, growth and reproduction. The quantity of water that animals consume is affected by many factors including growth, pregnancy, lactation, activity, diet composition, feed intake and environmental temperature. The quality of water offered can also affect consumption and performance.[1] Livestock should be provided with free-choice access to clean, quality water at all times. Water quality is often overlooked, even though research clearly shows that growth and reproductive performance are decreased when certain components of water quality reach threshold levels. Poor water quality also affects consumption, which may limit food intake and animal health [2, 3]. In relation to all these aspects, the recurrent monitoring of the quality of water consumed by animals is needed both in rural households and in farms. According to our country's recommendations, the water used for animal consumption should meet the requirements of the drinking water quality standard (Law 458/2002 modified and completed by the Law 311/2004). Usually, the farms are supplied with drinking water and therefore the water quality is higher than that in rural households, where animals are given water from the nearby sources, i.e. rivers, wells etc. The water which does not fulfil the quality requirements of drinking water should not be used for animal consumption, because its negative consequences

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sometimes cost more money than the harnessing of a new water source.
The aim of this work was to assess the quality of the water consumed by animals in rural households and farms.

## 2. Materials and methods

Fourteen water samples were taken and analyzed, twenty from rural households and twenty from cattle farms, from Cluj and Alba counties. The sampling was made by using sterilized recipients, with a 2 L capacity, from water troughs and watering systems (in farms), the water sources being different (well, spring, main system). The water quality was appreciated based on indicator parameters (pH, ammonia, sulphates, iron, chlorides, organic substances, overall hardness, total bacteria count, number of Coliform bacteria) and chemical parameters (nitrites, nitrates). The estimates for the majority of the indicator and chemical parameters were made using a Hanna analyzer. The total number of germs was determined by inoculation on culture medium in Petri dishes and 48 hours incubation on 37 °C. In the case of the samples derived from local sources (well, spring) decimal dilutions were made previously in culture tubes. After incubation the grown colonies were calculated by a mechanical optic colony counter and the total number of germs was calculated with the help of a formula [4]. The number of Coliform bacteria was determined through the membrane filtration method [4]. The results were compared to the values set out by the Law 458/2002 modified and completed by the Law 311/2004.

## 3. Results and discussion

In table 1 we presented the results for the water determinations of the samples from rural households and in table 2 those of the samples from farms. The obtained data analysis emphasise that in general the animals are forced to consume poor quality water, both in rural households and in farms. Three water samples (15%) from rural households had nitrates exceeding the threshold values (50 mg/l). From the indicator parameters, the following ones showed alterations: ammonia (20% of samples), sulphates (40% of samples), chlorides (35% of samples), overall hardness (60% of samples), organic matter (20% of samples), total number of bacteria (all of the samples) and the number of Coliform bacteria (90% of samples), respectively. The water used in farms showed no alterations of the chemical parameters (Table 2). Within the indicator parameters, the following ones were divergent from the legal provisions: overall hardness (85%), the total number of bacteria (50% of samples) and the number of Coliform bacteria (35% of samples). Our results are in accordance with those obtained in other studies, proving that the drinking water provided for the animals is often of a poor quality [5-8].
In water consumed by animals in rural households, the nitrates exceeded the recommended value (50 mg/l) in three of the samples (Table 1). The presence of nitrates in drinking water can affect the productive performance and health of the animals, depending on their concentration and the animal species. According to the researches of Grant [9], the nitrate concentrations exceeding 100-150 mg/l of drinking water can cause reproductive disturbances in mature cows and replacement heifers, which will show lower growing rates, but usually there are no significant milk production alterations at moderately raised nitrate levels in the drinking water. Ensley [5] took water samples from 128 dairy cattle farms in the State of Iowa in order to assess the water quality effects on the productive performances of dairy cows. His study's results indicate that high nitrate concentrations in drinking water cause longer calving intervals. Nitrate concentrations exceeding 180 mg/l in drinking water did not increase the concentrations of nitrates eliminated through the milk of dairy cows [10]. Seerly et al. [11] concluded that the drinking water containing about 300 mg/l nitrates does not affect the health of swine and ovine. Anderson and Stothers [12] reported, similarly, no morbidity in pregnant sows after the consumption over a 6 weeks period of water with a nitrate content of approximate 1300 mg/l. Sorensen et al. [13] did not demonstrate any effects on newborn or young piglets drinking water with nitrates exceeding 2000 mg/l. A national level monitoring of the swine farms in the United States showed no connection between the health or performance of the animals and the drinking of water containing more than 460 mg/l nitrates [14]. High nitrate concentrations in a water source indicate a possibly high nitrate

concentration in the forage cultivated in that area as well. The studies done on poultry showed that water containing more than 20mg/l nitrates has negative impact on their growth, feed change-over and egg production [15].

Ammonia is created through degradation of organic matter and of anorganic azotate fertilizers in water, its presence indicating a recent fecal pollution, increasing also the concentrations of the organic matter and of chlorides; this fact was also evident in our study. The water samples exceeding ammonia threshold levels (0.5 mg/l) had elevated contents in chlorides and organic matter (Table 1).

In our study 40% of the samples had sulphate concentrations exceeding the admitted limit values (250 mg/l). The results are comparable with those obtained by Socha et al. [6] in the United States, showing that sulphates exceeded the concentrations recommended for livestock in 15 - 30% of the assessed water samples. Wagner et al. [7] through monitoring the quality of the water consumed by beef cattle herds with 1000 heads or more, found that about 23% of the samples had sulphate concentrations exceeding 300 mg/l. The authors mentioned the fact that in one of the water sources they found a sulphate concentration higher than 1000 mg/l and that this caused, after consumption, high hydrogen sulphide levels in the ruminal gasses, the reduction of voluntary water consumption and a decrease in body mass gain. Similarly, very high concentrations of sulphates in drinking water (7200 mg/l) were associated with higher incidence of polioencephalomalacia in cattle [16]. The consumption of water with high quantities of sulphates can cause nutritional disturbances in animals [2].

Chlorides exceeded the recommended levels (250 mg/l) in 35% of the samples from rural households. Socha et al. [6] in a study conducted in the US showed that more than 40% of the analysed water samples contained chloride concentrations exceeding the admitted threshold values.

Although 57.5% of our samples had a total hardness below the value admitted by the Law 458/2002, this parameter does not represent a risk-factor for the health and production of the animals. Only a few studies were made about the impact of water hardness on animals and these indicate that this parameter has no effect on animal health or voluntary water consumption [17].

It is concerning that all water samples from rural households and 50% of the samples from farms were microbiologically contaminated. In addition, the presence of Coliform bacteria in the water indicates high morbidity risks following consumption. As it can be observed in tables 1 and 2, the water offered to the animals in rural households is much more contaminated than the water used in farms, in some cases the bacterial and coliform numbers being very high (e.g. 12360 cfu/ml total bacteria number, 1611cfu/100ml coliform bacteria). The farms wired up to the water-supply systems of the cities had good quality water, in accordance with the legal standards. The results of a large study on the drinking water of livestock in the US indicate that the water offered to the cattle is frequently of an improper quality from a microbiological point of view, with total coliform bacteria numbers and numbers of E. coli of about $10^5$ and $10^4$ cfu/l, respectively [18]. The authors concluded that the water troughs represent major sources of cattle exposure to the enteric bacteria action, including a certain number of pathogens derived from food, and the degree of bacterial contamination seems to be associated with potentially controllable factors. The group of researchers also discovered higher bacterial contamination in the water-troughs located closer to the feeder troughs. Adjacency of the watering troughs with the feeding ones can allow a certain quantity of food to get into the water trough, raising this way the contamination level and also providing a nutrient rich substrate for the bacterial growth at the bottom of the trough.

**Table 1.** Indicator and chemical parameters of the water samples from the rural households

| n | Indicator parameters | | | | | | | | | Chemical parameters | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | pH | $NH_3$ (mg/l) | Sulphate (mg/l) | Fe (mg/l) | Chlorides (mg/l) | Hardness (°dH) | mg $O_2$/l | TNG (cfu/ml) | Coliforms (cfu/100ml) | Nitrate (mg/l) | Nitrite (mg/l) |
| * | 6.5-9.5 | 0.50 | 250 | 0.2 | 250 | >5 | 5 | 0 | 0 | 50 | 0.50 |
| 1 | 7.68 | 0.1 | 500 | - | 378 | 14 | 1.12 | 939 | 172 | 11.07 | 0.03 |
| 2 | 9.03 | 20 | 500 | - | 460 | 3 | 4.15 | 1405 | 49 | 221.05 | - |
| 3 | 7.6 | 0.8 | 500 | - | 1500 | 48 | 44.03 | 2944 | 918 | 66.45 | 0.07 |
| 4 | 8.7 | 0.8 | 100 | 0.1 | 260 | 17 | 12.27 | 495 | 2 | - | 0.5 |
| 5 | 7.42 | 0.4 | 500 | - | 48 | 14.5 | 4.4 | 797 | 23 | - | 0.01 |
| 6 | 7.14 | 0.3 | 100 | 0.05 | 62 | 12 | 3.2 | 6091 | 136 | - | 0.01 |
| 7 | 7.5 | - | 10 | - | 16 | 5 | 0.55 | 4832 | 348 | - | - |
| 8 | 7.33 | - | 100 | - | 10 | 12.5 | 2.2 | 1030 | 109 | - | - |
| 9 | 7.7 | 0.8 | 500 | 0.1 | 445 | 16.2 | 10.74 | 1115 | 79 | 425 | 0.05 |
| 10 | 6.9 | 0.4 | 500 | 0.1 | 270 | 5 | 14.6 | 12360 | 1611 | 26.58 | 0.05 |
| 11 | 6.7 | - | 10 | - | 32 | 4.4 | 4.7 | 589 | 96 | 11.07 | 0.3 |
| 12 | 7.15 | - | 10 | - | 107 | 1.7 | 4.1 | 1475 | 130 | - | - |
| 13 | 7.3 | 0.3 | 10 | 0.1 | 152 | 14.7 | 2.5 | 8227 | 70 | - | - |
| 14 | 6.6 | - | 10 | 0.1 | 19 | 24.6 | 4.5 | 5239 | 240 | - | - |
| 15 | 7.5 | 0.4 | 500 | - | 330 | 4,8 | 3.9 | 453 | 276 | - | - |
| 16 | 7.2 | - | 10 | 0.2 | 17 | 14 | 4.3 | 1882 | 132 | - | - |
| 17 | 6.9 | 0.2 | 100 | - | 18 | 4.7 | 3.3 | 2619 | 74 | - | - |
| 18 | 8.4 | - | 500 | - | 123 | 26.8 | 4.8 | 1933 | 49 | - | - |
| 19 | 7 | - | 100 | - | 19 | 4.2 | 2,1 | 376 | 2 | - | - |
| 20 | 7.4 | - | 100 | - | 152 | 21 | 2.7 | 695 | 13 | - | - |

n = number of the sample: * = maximum admissible values

**Table 2.** Indicator and chemical parameters of the water samples from the farms

| n | Indicator parameters | | | | | | | | | Chemical parameters | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | pH | $NH_3$ (mg/l) | Sulphate (mg/l) | Iron (mg/l) | Chlorides (mg/l) | Hardness (°dH) | mg $O_2$/l | TNG cfu/ml | Coliforms cfu/100ml | Nitrate (mg/l) | Nitrite (mg/l) |
| 1 | 7.1 | 0.1 | 10 | - | 31 | 2.8 | 5 | 1281 | 170 | - | 0.05 |
| 2 | 7.2 | 0.1 | 100 | 0.1 | 40 | 4.6 | 4.8 | 2504 | 333 | 26.58 | 0.2 |
| 3 | 7.4 | - | 10 | - | 35 | 4.5 | 2.2 | 20 | - | 21.2 | 0.01 |
| 4 | 7.6 | - | 10 | - | 22 | 4 | 1.7 | 4 | - | - | - |
| 5 | 7.2 | - | 10 | - | 102 | 3.8 | 3 | 55 | - | - | - |
| 6 | 7.5 | - | 10 | - | 61 | 4,3 | 2.5 | 19 | - | - | - |
| 7 | 7.2 | - | 100 | 0.2 | 167 | 4,5 | 4.4 | 2380 | 467 | 22.15 | 0.01 |
| 8 | 7.8 | - | 100 | 0.2 | 56 | 4,4 | 2 | 1583 | - | 14.5 | 0.01 |
| 9 | 7 | - | 10 | 0.1 | 23 | 4.2 | 1.6 | 356 | - | - | - |
| 10 | 7.6 | - | 10 | - | 47 | 3 | 3.4 | 2 | - | - | - |
| 11 | 6.8 | - | 100 | 0.2 | 186 | 4.7 | 5 | 1132 | 114 | 8.86 | 0.01 |
| 12 | 7.2 | - | 100 | - | 123 | 4.8 | 2 | 63 | - | - | - |
| 13 | 7.4 | - | 10 | 0.1 | 34 | 5 | 3.8 | - | - | - | - |
| 14 | 7.1 | - | 10 | - | 48 | 4.3 | 5 | 1965 | 275 | - | 0.01 |
| 15 | 7.5 | - | 100 | 0.2 | 36 | 4.1 | 4.3 | - | - | - | - |
| 16 | 7,4 | - | 10 | - | 28 | 5 | 4 | 2389 | 176 | - | - |
| 17 | 7.4 | - | 100 | 0.1 | 112 | 4.3 | 2,6 | 5347 | - | - | - |
| 18 | 7 | - | 10 | 0.2 | 108 | 4.4 | 1.4 | - | - | - | - |
| 19 | 7.6 | - | 10 | - | 45 | 5 | 2.5 | 891 | 140 | - | - |
| 20 | 7.4 | - | 10 | - | 67 | 2.3 | 3 | - | - | - | - |

n = number of the sample

## 4. Conclusions

The analysis of the results shows that the water offered for animal consumption has qualitative deficiencies both in rural households and in farms. None of the water samples from the rural households fulfilled the quality requirements of drinking water. Only half of the water samples from the farms had parameters within the legally admitted limits for drinking water. From the qualitative point of view, the water consumed by animals is of a better quality in farms than in rural households.

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