PERFORMANCE OF LAYING HENS PROVIDED WATER FROM TWO SOURCES

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SUMMARY

The effect of drinking water source (well vs. city water) on laying hen performance was evaluated using 48 commercial layers (64 wk of age) housed in an environmentally controlled facility at a density of two birds per cage (12" × 18"). After a 10-day adjustment period, four replicate groups (six hens each) were provided water from a commercial egg production farm (drilled well) and the other four groups were provided city water for 4 wk of egg production.

The results indicated that water quality differed between the two water sources. A water analysis revealed that the farm well water had sodium and chloride concentrations of 190 and 210 ppm, respectively, compared to sodium and chloride concentrations of 29 and 80 ppm, respectively, for the city water. Average water consumption for the 4-wk experiment was significantly lower for hens consuming well water. Hen-day egg production and egg yield was also lower for hens consuming the well water. Egg weight, feed consumption, feed efficiency, egg specific gravity, and manure moisture were not affected by water source. These results indicate that the quality of drinking water may affect layer performance.

Key words: Drinking water, laying hens, performance

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DESCRIPTION OF PROBLEM

The quality of drinking water for poultry and its effect on performance have been of concern to poultry producers and topics of research for many years. Water is a critical nutrient for poultry, because it makes up from 55 to 75% of a chicken's body and about 65% of an egg. It is therefore very important not to overlook the importance of good water quality for optimum poultry performance.

The safe levels of substances found in drinking water have been documented by Vohra [1]. Even at levels apparently safe for poultry, previous research has shown that various substances found in drinking water can have a negative impact on performance. Barton [2] reported that the drinking water quality of commercial broiler and turkey farms negatively affected performance. In the broiler study, nitrate and magnesium in drinking water depressed performance. In the

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turkey study, phosphate and ammonia were detrimental to feed conversion. With laying hens, water quality studies have focused on the concentrations of mineral salts and their effect on performance and egg shell quality. The type of mineral found in drinking water has been shown to affect layer performance. Jensen *et al.* [3] showed that elevated concentrations of calcium, magnesium, and sodium were associated with the incidence of fatty liver syndrome in commercial layers. Zhang *et al.* [4] reported that layers consuming water supplemented with 2000 mg NaCl/L had significantly lower egg production, more defective eggshells, lower hatchability, and a higher rate of embryonic mortality than hens consuming 41 and 35 mg/L of Na and Cl, respectively. In addition, Balnave and Yoselewitz [5] and Yoselewitz *et al.* [6] showed that increasing the drinking water concentration of NaCl from 200 to 2000 mg/L for layers resulted in an increase in the percentage of shell defects from 11.3 to 52%.

In the commercial layer industry, many production units supply drinking water from drilled wells. The quality of water from these wells may be poorer than that of water from a city water source due to increased mineral deposits in the water. In the present study, a commercial layer farm experiencing less than optimum peak egg production, egg weight, and eggshell quality wanted to determine whether their drinking water (well water) was the cause. Their well water contained a much higher level of NaCl than our city water. To our knowledge, only one previous study has reported depressed egg production occurring as a result of hens drinking water with increased NaCl concentration (Zhang *et al.* [4]). The present study was designed to determine whether their well water, which contained a high level of NaCl, negatively affected production performance of layers. The study compares their performance to that of hens provided a water source having a low level of NaCl.

Materials and Methods

To determine the effect of drinking water source on performance of laying hens, a total of 48 commercial White Leghorn hens (64 wk of age) were moved from a commercial-type caged layer facility and housed in an environmentally controlled building at a density of two birds per cage. The facility consisted of 24 cages arranged in two groups of four rows (double-deck stair-step design) located adjacent to one another. Each cage row consisted of three side-by-side cages measuring 12" × 18" (30 × 46 cm). Thus, the birds were housed in eight replicate groups of six birds per group. All hens were fed a standard layer ration (16% CP, 2865 ME kcal/kg) formulated to meet or exceed NRC [7] requirements, and provided water for *ad libitum* intake. A 17-hr daily photoperiod and a constant thermoneutral temperature of 21°C was maintained throughout the experiment.

After the hens were moved to the environmentally controlled building, they were supplied city water for an initial adjustment or pre-test period of 10 days. Egg production, egg weight, egg yield, and egg specific gravity were recorded. During the pre-test period, water was supplied to each of the eight groups of hens from 3-gallon jugs suspended from the ceiling of the facility. This method of water delivery allowed the recording of weekly water consumption during the 4-wk study. Trigger-type cups provided drinking water to each cage. At the start of the pre-test period, city water was dispensed into each water jug and extra city water was stored in an environmental chamber maintained at a constant 4°C. The birds' rate of consumption required that the water jugs attached to the ceiling of the facility be refilled from the extra jugs every 3rd day.

To determine the effect of well drinking water on performance, well water was shipped from the commercial egg farm to the experimental research facility one day prior to the start of the 4-wk experimental test and each week thereafter. On the 1st day city water was provided, it was dispensed into enough water jugs to supply the birds designated to receive city water for 1 wk. Both water sources were dispensed into the suspended water jugs and stored in the controlled environmental chamber each week in the same way. After the pre-test period of 10 days, one half of the birds (four groups of six hens per group) received the well water, while the other half were provided city water for 4 wk. Prior to the start of the test period, four replicate groups were assigned to receive either city or well water based on their pre-test egg production and egg weight. Thus, each treatment was comprised of four groups having relatively equal egg weight and egg production. During the 4-wk experiment, daily egg production, egg weight, and egg yield were recorded and summarized for each week. Feed consumption, feed efficiency, and water consumption were recorded weekly. Egg specific gravity was determined from all eggs laid on 2 consecutive days each week. Manure moisture was determined by collecting excreta from each group during the last day of each week for a 4-hr period from 10:00 to 14:00 hr and drying it in an oven at 40°C.

All data were analyzed by ANOVA using the General Linear Models procedure of SAS software [8]. For each variable measured, the mean responses to city and well water were compared during the pre-test week, each of the 4 experimental weeks, and pooled over the 4 wk.

Results and Discussion

No mortality occurred throughout the pre-test and 4-wk experimental test periods. Table 1 depicts water analysis results for both the city and well drinking water, which was performed only one time during the middle of the 4-wk study. The city water used in this study was determined to have a consistent level of dissolved salts and other quality factors throughout the year. The city water was more basic than the well water (pH of 8.4 vs. 7.8). In addition, the sodium and chloride concentrations of the well water were both higher than those of the city water (190 vs. 29 ppm sodium; 210 vs. 80 ppm chloride). No detectable levels of nitrates and sulfates were found in either water source, while hardness (ppm) was the same for each. This analysis indicates that the well drinking water had a higher concentration of dissolved salts than the city water; that is, the well water was of poorer quality than the city water.

Tables 2 and 3 depict the performance and manure moisture results for birds provided city and well drinking water. In both tables, the pre-test week data represent responses for the last 7 days of the 10-day adjustment period. During each of the 4 experimental weeks, there were no significant differences ($P > .05$) for egg production, egg weight, egg yield, and egg specific gravity (Table 2). When data from all 4 experimental weeks were averaged, egg production and egg yield tended to be greater ($P = .06$) for hens provided city drinking water. In the present study, the negative effect of well drinking water on egg production agrees with the results reported by Zhang *et al.* [4]. Previous conversations with the egg producer from whom the well water originated revealed that their flocks would not reach satisfactory peak egg production, produced low case egg weights, and had a higher incidence of egg loss than was indicated by the breeders' guides. The present study suggests that their production problems were due at least in part to inferior water quality. Average egg weight and egg specific gravity were unaffected ($P > .05$) by drinking water treatment. Similar results were obtained for weekly and overall feed consumption and feed efficiency. The results obtained herein for eggshell quality do not completely agree with earlier reports [4, 5]. In those studies, it was reported that increased eggshell defects (broken and cracked eggs) occurred for hens provided drinking water with NaCl concentrations of up to 2000 and 600 mg/L. The concentrations of sodium and chloride in the well drinking water were much higher than in the city water in our study, but they were not as high as in those previous reports. Therefore, even though the sodium

TABLE 1. Chemical analysis of city and well water[A]

VARIABLE	CITY WATER	WELL WATER
pH	8.4	7.8
Chlorides (ppm)	80	210
Nitrates (ppm)	0	0
Sulfates (ppm)	0	0
Hardness (ppm)	60	60
Sodium (ppm)	29	190

[A]Chemical analysis of city and well water was performed one time during the middle of the study.

TABLE 2. Effect of drinking water source on egg production, egg weight, egg yield, and egg specific gravity of laying hens[A]

VARIABLE	DRINKING WATER SOURCE	WEEK[B]					MEAN[C]
		Pre-test	1	2	3	4	
Egg production, % hen-day	City	85.7±5.5	85.7±5.4	81.6±4.5	82.2±7.0	79.8±3.7	82.3±2.4[a]
	Well	83.3±4.1	78.0±7.8	74.4±4.8	72.6±6.8	76.2±1.0	75.3±2.6[a]
Egg weight, g/egg	City	62.0±1.1	61.7±1.1	60.3±0.8	60.8±0.9	61.5±0.9	61.1±0.4
	Well	61.5±0.5	62.1±0.8	61.0±0.6	60.6±0.8	60.6±0.7	61.0±0.4
Egg yield, g egg/hen/day	City	53.0±2.9	51.8±3.4	49.3±2.9	49.9±4.0	49.1±2.4	50.0±1.5[a]
	Well	51.3±2.6	48.2±4.5	45.3±2.6	43.8±4.5	46.1±2.3	45.9±1.6[a]
Egg specific gravity, g/cm^3	City	1.081±0.001	1.080±0.001	1.079±0.0004	1.080±0.001	1.079±0.001	1.080±0.0004
	Well	1.078±0.001	1.078±0.0003	1.080±0.001	1.079±0.0004	1.077±0.001	1.078±0.0005
Feed consumption, g/hen/day	City	ND[D]	92.0±3.3	96.1±4.9	84.2±5.3	94.0±5.4	91.6±2.4
	Well	ND	86.8±6.8	93.7±7.2	82.5±7.9	91.5±4.7	88.6±3.2
Feed efficiency, g egg:g feed	City	ND[D]	0.561±0.017	0.512±0.004	0.590±0.015	0.526±0.027	0.547±0.011
	Well	ND	0.556±0.026	0.486±0.013	0.534±0.031	0.508±0.028	0.521±0.013

[A]Values represent means ± SE for four replicate groups of six hens per group per drinking water treatment. Means without a superscript are not significantly different ($P > .05$).

[B]Pre-test week (last 7 days of 10-day adjustment period) represents values when all birds received city water. Groups were randomized according to equal egg weight and egg production means obtained during the pre-test week. One-half of the groups started receiving well drinking water at the start of Week 1 and continued through Week 4.

[C]Values are means of data obtained during Weeks 1 through 4.

[D]Feed consumption and feed efficiency were not determined for the pre-test week.

[a]Differences between means for overall egg production and egg yield had a probability value of $P = .06$.

TABLE 3. Effect of drinking water source on water consumption and manure moisture of laying hens[A]

VARIABLE	DRINKING WATER SOURCE	WEEK[B]					MEAN[C]
		Pre-Test	1	2	3	4	
Water consumption, mL/hen/day	City	ND[D]	202.9 ± 12.7^a	217.8 ± 17.7^a	212.3 ± 21.2^a	211.9 ± 20.7^a	211.2 ± 8.3^a
	Well	ND	182.7 ± 12.3^a	184.4 ± 9.6^a	187.2 ± 12.7^a	194.8 ± 9.2^a	187.3 ± 5.1^b
Manure moisture	City	ND[D]	76.6 ± 0.9^a	78.4 ± 2.1^a	77.0 ± 1.3^a	79.0 ± 2.1^a	77.7 ± 0.8^a
	Well	ND	75.0 ± 0.5^a	76.2 ± 0.4^a	76.9 ± 0.7^a	77.0 ± 0.8^a	76.3 ± 0.4^a

[A]Values represent means ± for four replicate groups of six hens per group per drinking water treatment.

[B]Pre-test week (last 7 days of 10-day adjustment period) represents values when all birds received city water. Groups were randomized according to equal egg weight and egg production means obtained during the pre-test week. Half of the groups started receiving well drinking water at the start of Week 1 and continued through Week 4.

[C]Values are means of data obtained during Weeks 1 through 4.

[D]Water consumption and manure moisture were not determined for the pre-test week.

[a,b]Means within a column and variable with no common superscript differ significantly ($P < .05$).

and chloride levels in the well water were much higher than in the city water, perhaps they were still not high enough to adversely affect eggshell quality. For manure moisture, drinking water treatment did not affect ($P > .05$) weekly or overall response; however, overall water consumption was greater ($P < .05$) for hens provided the city water compared to the well drinking water (Table 3). The results of this study indicate that water quality may negatively affect layer production performance as indicated by depressed egg production and egg yield. Also, inferior or poor water quality may depress water consumption. In this study, the increased amounts of dissolved salts in the well drinking water (sodium and chloride) may have contributed to the decreased layer performance. However, egg production and water consumption may also have been negatively affected by some other undetected or unmeasured substances found in the well water. Nevertheless, this study suggests that it is important to determine and monitor the quality of drinking water for laying hens, particularly if that water comes from a well.

Conclusions and Applications

1. This study demonstrated that drinking water quality may negatively affect performance (egg production, egg yield, and water consumption) of laying hens.
2. As was suggested by Barton [2], the quality of well drinking water for poultry should be analyzed and closely monitored. The results reported in this study further support the importance of providing high quality drinking water for laying hens.
3. Furthermore, egg producers should try to periodically check water quality every 6 to 12 months to make sure that water quality is constant.

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