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ORIGINAL PAPER

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Assessment of Drinking Water Quality at Poultry Farms in Al-Ahsa Province, Saudi Arabia

Abstract: Physiochemical analysis of drinking water obtained from poultry farms in Al-Ahsa province, Saudi Arabia revealed that levels of pH, chlorine and total hardness were in a higher range or exceeded the international accepted limits. These levels varied according to the source of water within the farm or location of the farm in the province. It is suggested that necessary steps should be taken to bring the levels to the accepted limits.

Keywords: Al-Ahsa, Poultry farms, Water quality, Assessment.

تقييم نوعية مياه الشرب في مزارع الدواجن
في محافظة الأحساء بالمملكة العربية السعودية

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المستخلص: تمت القياسات الفيزيوكيميائية لمياه الشرب من مزارع الدواجن في محافظة الأحساء بالمملكة العربية السعودية و أوضحت النتائج أن مستويات الأس الهيدروجيني والكلورايد وعسر الماء، قد كانت في حدها الأعلى أو زادت على الحدود الدولية المقبولة . يرجع اختلاف هذه المستويات إلى مصادر المياه داخل المزرعة وموقع المزرعة، في المحافظة .ويقترح البحث إتخاذ خطوات مهمة لخفض المستويات إلى الحدود المقبولة.

كلمات مدخلية: الإحساء، مزارع دواجن، نوعية مياة، تقييم.

Introduction

The general performance and reproductive ability of poultry may be affected by drinking water contaminants such as arsenic, cadmium, lead, benzene and trichleroethylene. The interaction of these mineral contaminants with the nutrients influenced general performance, egg quality and immune function and led to embryo toxicity in broiler chickens (Vodela *et al.*, 1997).

Water consumption significantly decreased in chickens provided with high concentrations of the chemical mixture, whereas feed consumption was not affected in any treatment (Vodela *et al.*, 1989). There was a linear relationship between increasing concentration of the chemical mixture in drinking water and the decreasing body weight of hens. Low concentration of the chemical mixture significantly decreased egg production and egg weight, and increased percentage of embryonic mortality. These results suggest that reproductive function in hens is sensitive to adverse effects of contaminated drinking water (Vodela *et al.*, 1997). Allen and Sansom, (1989) reported on the accidental contamination of the public water supplies of 20,000 people and many thousands of cows, sheep, pigs and poultry became poisoned with aluminum, copper, zinc and lead.

Concerning water hardness the World Health Organization (WHO, 1970) recommended a level from 100 to 500 mg/L $CaCO_3$ as a limit of total hardness in the drinking water. Above this limit there is a danger of excessive scale formation and if the level of hardness is below the recommended limit there is danger of dissolving heavy metals. A high level of hard water may affect the health of the bird and productivity (Jensen *et al.*, 1976).

The objective of this study was to assess drinking water quality in poultry farms in Al-Ahsa province, Saudi Arabia.

Material & Methods

1 - Poultry Farms.

A total of twelve poultry farms located in Al-Ahsa province were investigated in this study. Seven of them were egg producers while the remaining five were broiler producers. All farms were supplied from underground water sources. Before sample collection, each farm was fully described regarding type of housing system, water delivery system, number of houses, number of birds per house, age of birds and sampling frequency (Table 1).

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Table 1: Housing system, drinker system, number of houses, number of birds per house, age of birds and sampling frequency of the poultry farms

Farm No.	Type of housing system	Water delivery system(drinker)	Number of houses	Number of birds/houses**	Age of birds	Sampling frequency
(1)	Closed system *(D.L.S) broilers	Nipples	8	6000	10-41 day	3
(2)	Open system	Cup	6	4000	40-53 weeks	3
(3)	Open system	Pan & jar	6	6000	23-39 weeks	3
(4)	Open system	Cups	5	4000	30-49 weeks	3
(5)	Open system	Pan & jar	8	6000	40-50 weeks	3
(6)	Closed system	Bell-shape	12	6500	25-45 weeks	3
(7)	Closed system	Bell-shape	4	7500	0-9 dayss	3
(8)	Closed system	Nipples	3	2000	10-41 days	3
(9)	Closed system	Pan & jar	14	8000	10-41 days	3
(10)	Closed system	Pan & jar	6	5000	40-53 weeks	3
(11)	Closed system	Nipples	3	2500	24-41 weeks	3
(12)	Closed system	Pan & jar	7	4000	10-45 days	3

Total number of birds 467,500 birds *(D. L. S) = Deep litter system ** = Houses were of the same size

2 - Sample collection.

Before collection of water samples, the main supplies were locally inspected regarding their construction and for detection of possible sources of pollution. Samples were taken from a tap on discharge after leaving water to run for 5 minutes. Samples were collected from reservoir tanks by holding the bottle near its bottom in the hand and pushing the bottle forward horizontally in a direction away from the hand.

3 - Chemical analysis of water.

Collected water samples were examined chemically for pH value by means of paper (Universal indicator pH-14, Merck, England). Totals for hardness, ammonia, nitrite, nitrate, phosphorous, and chloride were estimated by the standard method for examination of water according to the American Public Health Association (APHA, 1985).

4 - Statistical analysis.

The obtained data were statistically analysed using the Student *t* test (Snedcor and Cochvan, 1974).

Results and Discussion

The study started with a survey of twelve poultry farms, inspecting the husbandry systems and water sources. As shown in Table (1), most of the farms adopted the closed system with deep litters. The stocking density of birds differed from 2500—8000 birds per house among layers and broilers. It is known that crowding may affect feed and water intake, predispose to contagious disease and lower productivity (King, 1996). Different types of drinkers were used by the farms in the present study.

Results of physiochemical analysis of water are summarized in Table (2). Water pH values from different poultry farms ranged from 7.2 to 7.7. According to U.S. Public Health Service standards, this lies within the upper limit for alkalinity of a good water supply for humans (WHO, 1984). These results also agree with the findings of other workers (Vohra, 1980).

The mean value of chloride in different waters ranged from 311 mg/L in tanks to 323 mg/L in underground water and 328mg/L in drinkers. The WHO (1970) reported that levels above 100 mg/L may give rise to problematic taste. However, it is recommended that the level should not exceed 600 mg/L. Although the level of chloride in the present study lies within this limit, yet steps to lower this level are needed. Increasing salt in water has been reported to cause watery droppings, decreased feed consumption and increased mortality in poultry (Roush and Mylet, 1986).

Table 2: The level of pH, ammonia, nitrite, phosphate, chloride, and hardness of water collected from different sources at poultry farms

Parameter (mg/L)	Source of Water		
	Underground	Tanks	Drinker
pH	7.2 + 0.1 a	7.7 + 0.1 a	7.5 + 0.1 a
Ammonia	1.6 + 0.2 b	1.5 + 0.2 b	2.3 + 0.2 c
Nitrite	0.04 + 0.01 a	0.06 + 0.01 a	0.03 + 0.01 a
Nitrate	2.1 + 0.2 a	0.4 + 0.1 b	0.8 + 0.1 b
Phosphate	0.4 + 0.05 c	0.65 + 0.05 c	1.15 + 0.1 a
Chloride	323.0 + 6 a	311.0 + 7 a	328.0 + 6 a
Hardness	570.0 + 8 b	576.0 + 8 b	633.0 + 9 b

a - c Different letters indicate difference (P< 0.05) within rows.

Different farms have different levels of total hardness of water. The mean levels of total hardness ranged from 570 to 633 mg CaCO3/L in different farms (See,table 2). Some of the farms had levels well above the level recommended by the WHO, which is 500 mg $CaCO_3$/L (WHO, 1970). Such high levels have been mentioned by other workers (Mona, 1987; Abou Zeid, 1988). High levels of calcium in water may cause formation of crystals and lead to clogging of water pipes. Jensen *et al.*, (1976) studied the association of high levels of calcium and magnesium with fatty liver syndrome but gave no evidence that the water is the cause of the disease. The chemical analysis of water also showed different concentrations of ammonia, nitrite, nitrate and phosphate (See,table 2). The mean values of these elements varied in some farms according to the source (underground, tank or drinker water). Such variations could be explained by the nature of soil from which water was obtained. Another explanation could be that disposal of solid poultry waste may contaminate water sources (Chapman 1996, King 1996).

The studied farms were in different locations in the province and these variations could be explained by the nature of soil from which water was obtained. Another explanation could be improper disposal of poultry waste at some farms. Chapman (1996) reported that poultry waste could affect public water sources. He further suggested that chemical additives may be used to immobilize nitrogen and phosphorus in poultry manure. Poultry waste may be a source of environmental pollution and public water contamination with this waste should be avoided.

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