Iran Aagicultural Research 14:99-110 (1995)

NOTE
WATER CHARACTERISTICS OF POULTRY FARMS IN SHIRAZ SURROUNDINGS[1]

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(Recieved November 29, 1993)

ABSTRACT

Water for poultry production must be free from pathogenic organisms and chemical substances which cause adverse physiological effects on the chickens. Therefore, microbiological, physical and chemical analyses of water in the poultry production farms in Shiraz area was carried out. Water samples were taken from water wells of 22 broiler farms in shiraz suburbs and surroundings and subjected to a number of biological, physical and chemical analyses. In general, 16 of the sites were contaminated with *Escherichia coli (E. coli)* bacteria. *Klebsiella* and *Proteous* organisms were also detected from 5 and 9 of the contaminated sites, respectively. The presence of *E. coli* indicated the contamination of well waters with sewage. How ever, *Salmonella* organisms were not found in any of the water samples; therefore, salmonellosis cases reported on the farms, might be originated from sources other than drinking

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water. The pH values of all the water samples tested were in acceptable range (7.6 to 8.1) therefore, the water pH could not affect viral vaccine. Twenty three percent of the water sources had EC values higher than 1.25 dS m^{-1} @ 25° C. Total dissolved solids of these water samples were also more than 1600 mg l^{-1}. Water analyses of all the sites showed calcium contents more than the standard levels. Potassium (K^+) concentration was low in all the water samples. Zinc (Zn^{2+}) ion was higher than the standard level in 32% of the samples. Chlorine (Cl^-1) ion level was not higher than the standard level in 21 water sources. Also in one case, the bicarbonate content was more than 500 mg l^{-1}. Carbonate (CO_3^{2-}), ferrous (Fe^{2+}), ferric (Fe^{3+}), manganese (Mn^{2+}) and nitrite (NO^{2-}) ions were not detected in the water samples. But NO_3^- was detected in all the samples, indicating probable contamination of the water supplies by household sewage and chicken manures. Twenty seven percent of the water samples contained more than the recommended sulfate level which in conjunction with Na^+ and Mg^{2+} caused chronic diarrhea in the chickens. The hardness of the water samples was more than the recommended level(180 mg l^{-1} equivalent to $CaCO_3$), consequently all the sites needed water softening and chlorination due to high contamination with household sewage.

تحقیقات کشاورزی ایران
۱۴: ۹۹-۱۱۰ (۱۳۷۴)

بررسی کیفیت آب مرغداری های اطراف شیراز

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چکیده

آبی که برای مرغداری ها مورد استفاده قرار می گیرد باید عاری از عوامل بیماری زا و مواد شیمیایی مؤثر بر فیزیولوژی بدن جوجه ها باشد. بنا براین انجام آزمایشات میکروبیولوژی، فیزیکی و شیمیایی روی آب مورد استفاده مرغداری ها لازم است. به همین منظور از هریک ازمنابع آب ۲۲ مرغداری(تولید گوشتی) حومه شیراز وشهرستانهای نزدیک آن برای مطالعات میکروبیولوژی، فیزیکی و شیمیایی آب نمونه برداری شد. بطورکلی۱۶مرکزاز۲۲مرکزموردمطالعه به باکتری *E. coli* آلوده بودند. باکتری های *Klebsiella* و *Proteous* نیزبه ترتیب درآب ۵ و ۹ مرغداری آلوده به *E. coli* مشاهده شدند. وجود *E. coli* نشانگر اختلاط فاضلاب های خانگی باآب آشامیدنی طیوردر مناطق مورد مطالعه است. باکتری *Salomnella* در آب های مناطق مورد بررسی وجودنداشت، لذا بیماری **Salmoneliosis** موجوددرمرغداری های مورد مطالعه احتمالا منشاء دیگری غیرازآب آشامیدنی دارند. مقادیرpH آب های مورد مطالعه در محدوده قابل قبول ۷/۶ تا۸/۱ بوده که این pH اثری روی ویروس واکسن های مورد استفاده در مرغداری ها ندارد. هدایت الکتریکی (EC) ۲۲ درصد از آب منابع مورد استفاده از $1/25\ dS\ m^{-1}$ بالاتربود. باقیمانده خشک (TDS) نمونه آبهای مذکوربیشتراز$1600\ mg\ l^{-1}$ بود. مقدار کلسیم آب تمام مرغداری ها ازحد استاندارد بالاتر، درحالی که غلظت پتاسیم در کلیه نمونه های موردآزمایش پائین بود. در ٪۲۲نمونه ها مقدار روی بیشتر از حد مجاز و مقدار کلر در ۲۱ مرغداری کمتر از حد مجاز بود. فقط در یک مرغداری مقدارHCO_3^- از حد مجاز بیشتر بود. مقادیر یون هایCO_3^{2-} , Fe^{2+}, Fe^{3+}, Mn^{2+} و NO_2^- قابل اغماض بودند. وجود یون نیترات(NO_3^-) بیش از حد مجاز در آبهای مناطق مورد بررسی همراه با *E. coli* بار دیگر اختلاط فاضلاب های خانگی با آب آشامیدنی طیور را تائید می نماید. بیست و هفت درصد آب های مورد بررسی مقدار بیش از حد مجاز از یون های سولفات (SO_4^{2-})، سدیم (Na^+)، و منیزیم (Mg^{2+}) را داشته اند که این یون های همراه هم می توانند در طیور ایجاد اسهال مزمن نمایند. همچنین سختی آب آشامیدنی از مقدار مجاز $180\ mg\ l^{-1}$ بیشتر بود. بطور کلی نظر به بالا بودن سختی آب و همچنین آلودگی اکثر آنها به فاضلاب های خانگی، تصفیه شیمیایی و گند زدائی آب با کلر در تمام مناطق مورد مطالعه پیشنهاد می گردد.

INTRODUCTION

Water is one of the most essential compounds for all living organisms. Physiochemical properties of water enable it to form a medium in which

metabolic reactions, transport of essential and toxic materials, regulation of temperature, and equalizing the chemical forces in the body take place.

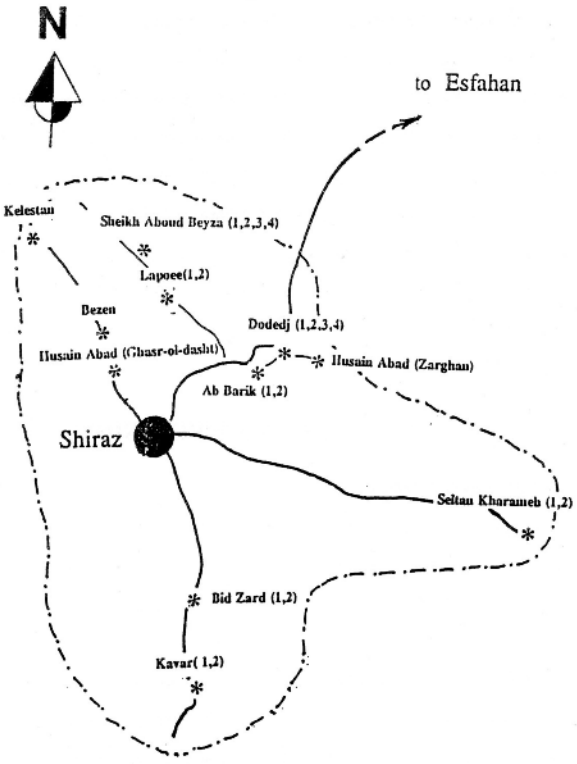
Presence of chemicals at more than the recommended levels in water causes high osmotic pressure in living organisms such as chickens (8,9,12). The high osmotic pressure causes stress in chickens and consequently results in weight loss, followed by chronic sickness or death of the birds (9,12) and thus water characteristic is very important in poultry production. This will lead, in a large scale, to find out many of the poultry problems which are not related to water quality and guides the specialist to have a better judgment of the poultry production problems (9,10). Since much work has yet been done to analyze the water quality used for chicken production in Iran, specially in the southern region, this study was undertaken, to analyze water characteristics of 22 poultry farms selected randomly in shiraz area.

MATERIALS AND METHODS

Two liters of water was collected separately from drinking water supplies for chickens from 22 poultry farms around Shiraz (Fig. 1). The samples were immediately stored in a mixture of ice and water to prevent any probable chemical changes. Standard procedures were used for sampling, and microbiological, physical and chemical analyses of these samples (1), except for specific methods which are indicated in the parentheses.

The bacteriological tests were: Coliform (MPN)[1] ; Coliform determination, especially *E. coli* (IMViC)[2]; and *Salmonella* isolation (Na

1. Most Probable Number. This term is actually an estimate of microorganisms (e.g. *E. coli*) based on certain probability formulas (1).
2. Indole, methyl red, Voges-proskduer, and sodium citrate; often referred to collectively as IMViC (1). A test for differentiation of group into *Escherichia coli, Enterobacter (Aerobacter) aerogenes*, and *Citrobacter (Escherichhia) freundic* species.



Scale 1:1,000,000

Shiraz

Boundary

Poultry farm (sampled) Dodedj (1,2,3,4)

First Class Road

Second Class Road

Fig. 1. Location of 22 poultry farms under study in Shiraz suburb.

tetrathionate agar; *Salmonella - Shigella* agar; TSI; Triple sugar iron agar; Urease; Citrate; Mobility; MR-VP; Lysine Amino acid).

The physical and chemical tests were: Electrical conductivity (electrical conductimeter); pH (pH meter); Determination of total dissolved solids, TDS (evaporation); Determination of hardness (EDTA); Ca^{2+} and Mg^{2+} (titrometry); Na^{2+} and K^{+} (flame photometer); Fe^{2+}, Mn^{2+} and Zn^{2+} (atomic absorption); CO_3^{2-}, bicarbonates and total alkalinity (titrometry), (4); Cl^{-} (Mohr method); SO_4^{2+} (turbiditimeter); and NO_2^{-} and NO_3^{-} (liquid chromatography).

RESULTS AND DISCUSSION

I. Microbiological Data:

The mean values of MPN of *E. coli* in the samples showed that the most contaminated water was in the north-west of Shiraz (Sheikh-Aboud) and the least contaminated samples were from the east part of Shiraz i.e. Kharameh as shown in Fig. 1. In general, water samples of 16 sites showed *E. coli* in which 87.5% were *E. coli* type I and 12.5% were *E. coli* type II and one site showed contamination solely by *Proteous* bacteria (Table 1).

Klebsiella and *Proteous* bacteria were also detected in 5 and 8 samples, respectively, of the 16 water samples which were also contaminated with *E. coli*. In the samples taken in present study the highest value of MPN was 1800 *E. coli* per ml (data are not shown), which is much higher than permissible MPN value for chicken drinking water of 50 *E. coli* per ml (11).

Seventy three percent of the farms had their drinking water contaminated by *E. coli*. The contaminated water sites were located in north-west and north regions of the area studied (Fig. 1 and Table 2). The wells of these farms were located in the vicinity of sewage wells of the housing lots. The topographic condition of the land causes the sewage wells to gain gradient

toward these wells and the open or half-open lids of the wells are responsible for contamination of the well water by the household sewage and chicken manure. All the water supplies with the bacterial contamination also showed high levels of nitrate (NO_3^-). In this research the *Salmonella* bacteria was not detected in the water samples. This indicates that the *Salmonella* cases probably were originated from sources other then drinking water.

Table 1. Well water samples showing various organisms.

Contaminating organisms	Number of contaminated sites	%
E. coli Type I	5	29.4
E. coli Type I + *Proteous*	5	29.4
E. coli Type I + *Klebsiella*	3	17.6
E. coli Type I + *Proteous* + *Klebsiella*	1	5.9
E. coli Type II + *proteous*	1	2.9
E. coli Type II + *Proteous* + *Klebsiella*	1	5.9
Proteous	1	5.9
Total	17	100

II. Physical and Chemical Data:

Results of physical and chemical analyses of the water specimens are presented in Table 2. Almost all the viruses can survive at pH of 5 to 9 (7). This is especially important for diluting viral vaccins in water solvent. Seventy five percent of the water samples had pH of 7.6 to 7.8 and 25% had pH 7.8 to 8.1. Therefore, the pH of these water samples might not affect the viral vaccination program.

The highest and lowest electrical conductivity of the samples belonged to the north-east and east of Shiraz, respectively. Twenty three percent of the

Table 2. Physical and chemical analysis of water samples from 22 poultry farms in shiraz area.

No.	Place	pH	EC ($ds\ m^{-1}$)	TDS	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Zn^{2+} ($mg\ l^{-1}$)	HCO_3^{-}	NO_3^{-}	Cl^{-}	SO_4^{2-}	Hardness†
1	Keleston	7.5	1.3	1153	290	18	47.6	2.3	2	237.9	8.1	53.2	500	800
2	Bezen(Coop. 110)	7.6	0.43	369	76	19.2	4.8	0.8	1.9	317.2	2.7	10.6	10	270
3	Hussin Abad(Ghas.)§	7.1	1.10	914	200	42	40.0	3.1	2.2	329.4	6.2	53.2	274	650
4	Dodedj(Zarghan) (1)	7.4	0.47	375	60	24	23.9	0.8	0.2	219.6	21.2	31.9	40	250
5	" (2)	7.7	1.37	921	100	66	80.5	3.5	0	408.7	63.7	106.5	200	525
6	" (3)	7.6	1.18	887	100	60	91.3	5.5	0.3	372.1	44.7	88.7	200	500
7	" (4)	7.6	2.93	2322	120	186	365.7	8.2	2.9	341.6	14	284	900	1075
8	Hussin Abad(Zarghan)	7.3	0.68	536	80	6	88.3	1.2	0.8	335.5	24	17.7	84.8	225
9	Ab- Barik (1)	7.6	0.87	716	80	48	77.0	9.4	0.5	372.1	22.2	74.5	100	400
10	" (2)	7.4	0.84	651	80	48	53.1	1.6	1	286.7	10.2	35.5	160	400
11	Seoltan(Khorsimeh) (1)	7.8	0.71	476	60	30	42.8	1.2	0	268.4	19.5	35.5	74.8	275
12	" (2)	8	0.81	550	90	36	27.6	1.6	0.8	225.7	15	35.5	140	375

† As $CaCO_3$

§ Ghasrod- dasht.

(Table 2., Continued)

No.	Place	pH	EC (ds m^{-1})	TDS	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Zn^{2+}	HCO_3^{-} (mg l^{-1})	NO_3^{-}	Cl^{-}	SO_4^{2-}	Hardness*
13	Sheikh Aboud (Beyza) (1)	8.1	0.72	534	100	24	25.1	1.9	0.8	335.5	19.4	21.3	90	350
14	" (2)	8	0.65	481	100	18	23.2	1.2	0.5	311.1	16	17.7	66	325
15	" (3)	7.4	0.95	835	140	60	33.8	1.2	2.7	542.9	43.6	35.5	108	600
16	" (4)	7.7	0.81	668	120	36	37.3	1.6	0.7	366	45	35.5	116	450
17	Lepose (1)	7.5	2.41	1421	140	102	172.5	4.7	4	244	44.2	443.7	220	775
18	" (2)	6.9	1.70	1066	40	48	272.5	7.0	0.3	323.3	31.8	106.5	280	300
19	Bidzerd (1)	7.8	1.04	769	90	54	78.2	2.3	1.2	250.1	18	106.5	180	450
20	" (2)	7.6	0.87	692	90	48	46.2	1.9	0.3	298.9	11.3	71	154	425
21	Kavar (1)	7.5	1.10	919	100	78	56.6	1.7	3.7	317.2	20	71	300	575
22	" (2)	7.5	1.91	1487	170	132	85.6	3.9	1.7	347.7	21	106.5	600	975
	Standard of recommended level¶	6.8-7.5	-	-	60	125	32	-	1.5	-	25	250	250	180

* As $CaCO_3$.

¶ After Barton (2).

water samples had EC of 1.25 dS m^{-1} at 25°C or more. The total dissolved solids in 23% of the water samples were more than 1000 mg l^{-1}

All the water samples showed calcium content more than standard (60 mg l^{-1}). This is due to the presence of limestone in the regions under study. The recommended Mg level in water for poultry is 125 mg l^{-1} (2). Only the south-east and northern part of the research areas showed higher rates of Mg level. Sodium content in 77.3% of samples was more than the standard value of 32 mg l^{-1} (2), whereas concentration of potassium in all water samples was less than 10 mg l^{-1} . Zinc level was more than standard value of 1.5 mg l^{-1} (6, 14) for 32% of the samples from the western part of the study area.Ferrous, ferric and manganese ions were also found in traces in the water samples.

Carbonate is converted to HCO_3^- at pH of 6.35 to 10.33 (3,5). The range of pH of the water samples in this study was 6.9 to 8.1. This Could explain the absence of carbonate ions in the samples.

All the water samples showed higher values of NO_3^- than the standard levels of 25 mg l^{-1} (2). However, no NO_2^- was detected in water samples. The standard value of Cl^- for chicken is 250 mg l^{-1} (2). Only a single water sample from the north-west of Shiraz showed higher Cl^- concentration . The standard value for sulfate is 250 mg l^{-1} (2) and thus 27% of the poultry farms had drinking water with higher sulfate. The lowest level of sulfate belongs to north-east of Shiraz while the highest concentration is associated with south-east of Shiraz. Sulfate ion in drinking waters especially in conjunction with Na and Mg causes chronic diarrhea in chickens and is less potable. This condition happened during the entire growth period of chicken in Kavar region (south-east of Shiraz). This might be due to the high concentrations of SO_4^{2-} , Mg^{2+} and Na^+.

The water hardness of the poultry drinking water should be less than 180 mg l^{-1}, equivalent to $CaCO_3$ (2, 13). The water from all wells in Shiraz surrounding, and in almost all southern part of Iran, originates from limestone formation and therefore, have carbonate hardness. This might

explain as to why all the poultry farms had water more than 180 mg l^{-1} hardness (Table 2).

CONCLUSION

As all the water sources were contaminated with *E. coli* thus they need to be chlorinated. The seepage of sewage from households must be prevented. All the openings of the wells should be carefully sealed, and the sewage stored in confined septic tanks to prevent seepage to the wells.

The pH of the water samples tested indicates that it does not affect vaccination solutions of the chicken. The concentration of NO_2^-, Fe^{2+}, Mn^{2+} and K^+ were in trace amounts, less than the permissible standard levels. Only one farm contained SO_4^{2-} higher than standard sulphate concentration and thus the removal of excess sulphate from this water is recommended. One well showed more than 500 mg HCO_3^- l^{-1} and so water treatment is recommended with $Ca(OH)_2$ before use. The concentration of Na^+ and Zn^{2+} were more than the permissible values; and the removal of these ions from the chickens drinking water is recommended to prevent chronic diarrhea in them.

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