Effect of neutral electrolysed water (NEW) in laying hens

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SUMMARY

The experiment was conducted to determine effect of neutral electrolysed water (NEW) in laying hens. 75 Lohmann Brown layers were divided into 3 groups (C, E1 and E2) with 25 layers/group, fed the basal diet. Poultry drinking water was administrated ad-libitum to laying hens, at three levels: 0 (C), 2(E1) and 3% NEW (E2) for 9 weeks. The layers had free access to the feed and water. The daily feed intake of the groups E1 (131.93 ± 5.08 g/day/layer) and E2 (133.97 ± 5.72 g/day/layer) were significantly ($P < 0.05$) higher than the group C (126.20 ± 5.71 g/day/layer). Egg production and average egg weight were similar among groups. Feed conversion ratio was higher ($P < 0.05$) for E2 (2.07 ± 0.05 g feed/g egg) than the control group (1.95 ± 0.08 g feed/g egg). Significant difference ($P < 0.05$) was noticed at the weight of the egg yolk 17.64 ± 1.17 g in group E1 compared to 18.92 ± 0.81 g in group C. Egg white and yolk pH, yolk colour intensity and the Haugh unit were not different among groups. The addition of NEW up to 3% to drinking water did not affect egg production, egg weight and egg quality, yolk weight except.

Keywords: layers, neutral electrolysed water, performance

INTRODUCTION

Many studies presented in the literature show that the electrolysed water can be used in poultry farms for several purposes: to improve bird performances, to disinfect the areas populated with birds, diarrhoea treatment, enhance and develop bird metabolism, reduce mortalities, microbial decontamination of eggs, all these having a positive environmental impact.

Yoshifumi (2003) showed that the slightly acid electrolysed water (SAEW) has an active form of the chloride compounds close to the hypochlorous acid (HOCl), with very powerful action over the microbes. Guentzel *et al.* (2008)

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showed that the application of SAEW may enhance the antibacterial activity maximised by the hypochlorous acid, reducing the corrosion effect, minimising the chlorine effect on humans. Deza *et al.* (2005) showed that the NEW was efficient when used on stainless steel surfaces from poultry rearing areas inactivating the pathogens: *Escherichia coli, Listeria monocytogenes* and *Staphylococcus aureus.* During the commercial processing of the eggs, they are usually cleaned with an alkali detergent then rinsed with a licensed chemical disinfectant to remove the dirt and pathogens.

The chloride agents and the products containing chloride are most commonly used against microbes in egg processing, both because of their availability and for their low cost and high efficiency. The strength of the disinfecting process, given by the concentration of available chloride or equivalent, must not be lower than 50 mg chloride/l and not more than 200 mg chloride/l. The high chloride concentrations may be detrimental to egg quality and they have not been completely accepted because of their limited effects on pathogens population and to their different detrimental environmental effects.

Efficient use of neutral electrolyzed water (pH 2.1-2.7, ORP = 1150mV) for decontaminating eggs of *S. Enteritidis and Escherichia coli* were studied (Russell 2003; Bialka et al. 2004). The experimental results have shown that neutral electrolysed water decreased the pathogen population on egg surface. Kim et al. (2005), Huang et al. (2006) and Hricova et al. (2008) have shown that electrolyzed water could be used as disinfectant in the food industry in animal food processing, to reduce the pathogen load of the working areas and instruments. The use of NEW is a promising method of disinfection because it would allow decreasing the amount of free chloride used as disinfectant in the food industry. The production technology for NEW deserves attention to hygienize the food industry equipment and to decontaminate foods, as part of a system of food safety and human health (Abadias *et al.* 2008).

The purpose of this paper is to evaluate the effects of introducing different percentages of NEW in poultry drinking water on layer performances and egg quality poultry.

Material and Methods

The NEW was produced by using an ENVITOLYTE EL 400 unit. A solution of 25% sodium chloride and tap water was simultaneously pumped into unit to obtain neutral electrolysed water with the following characteristics: pH = 7.42 was adjusted by the quantity of catholyte evacuated as residue; oxidation-reduction potential (ORP) = 845 mV and free available chlorine = 400 mg/l was adjusted by keeping the amperage in cell to a value between 23 - 25 A.

The experiment used 75 Lohmann Brown layers aged 45 weeks, with an initial body average weight of 1.850 kg/bird, for 9 weeks. The layers were assigned to 3 groups: control (C), experimental 1 (E1) and experimental 2 (E2), with 25 birds per group, 5 cages /group, respectively, 5 birds/cage. The layers were housed in three-tier digestibility cages (60 cm width x 60 cm length x 40 cm height) which allowed the daily recording of the feed intake, excreta and egg production. The microclimate factors were according with the physiological needs of this specie, respectively: the environmental temperature was maintained at 29^0C, relative humidity was between 60 – 70% and the lighting program was 16 hours daily, throughout the experimental period.

Table 1. Basal diet formulation

Ingredient	%
Ground corn (%)	42.74
Wheat (%)	10
Rice waste (%)	10
Soybean meal (%)	20
Corn gluten (%)	5
Monocalcium phosphate (%)	1.4
Calcium carbonate (%)	9.2
Salt (%)	0.3
Methionine (%)	0.16
Lysine (%)	0.15
Choline (%)	0.05
Vitamin-mineral premix* (%)	1
Total	100

* Content/Kg diet: vitamin A, 13500 IU; vitamin D_3, 3000 IU; vitamin E, 27mg; vitamin K_3, 2mg; vitamin B_1, 2mg; vitamin B_2, 4.8mg; pantothenic acid, 14.85mg; nicotinic acid, 27mg; vitamin B_6, 3mg; vitamin B_7, 0.04mg; vitamin B_9, 1mg; vitamin B_{12}, 0.018mg; vitamin C, 25mg; Mn, 71.9mg; Fe, 60mg; Cu, 6mg; Zn, 60mg; Co, 0.5 mg; I, 1.14 mg; Se, 0.18 mg.

The layers received a basal diet - BD (21.68% crude protein, 4.12% ether extract, 4.47% crude fibre and 17.18 MJ/kg gross energy) consisted of ground corn, wheat, rice waste, soybean meal and corn gluten (Table 1).

The composition of the basal diet was calculated, using a mathematical model (Burlacu et al., 1999) according to the feeding requirements recommended for the intensive rearing of this category of poultry. In the same time, feed ingredients and basal diet were analysed, to establish the main nutrients (Table 2).

The neutral electrolysed water (NEW) treatment of the drinking water differentiated the groups in terms of free available chlorine content:

- Control group (C) fed on the basal diet (BD) + regular poultry drinking water (0% NEW);
- Experimental group 1 (E1) fed on the basal diet (BD) + poultry drinking water with 2% NEW (8 mg free available chlorine /l water);
- Experimental group 2 (E2) fed on the basal diet (BD) + poultry drinking water with 3% NEW (12 mg free available chlorine /l water).

Table 2. Gross chemical composition of the feed ingredients and basal diet

Item	Dry matter (%)	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Ash (%)	Gross energy (MJ/kg)
Ground corn	87.96	12.05	2.90	3.53	2.03	16.50
Wheat	87.10	12.75	2.58	3.27	2.13	16.30
Rice waste	87.83	12.66	11.86	6.98	6.23	17.87
Soybean meal	88.84	46.19	1.98	6.67	6.34	17.98
Corn gluten	91.55	72.35	0.55	0.78	3.33	20.21
Basal diet (BD)	90.05	21.68	4.12	4.47	14.15	17.18

Feeding was done twice per day (first half of ratio was given at 8.00 a.m. and the second half of ratio was given at 3.00 p.m.). The layers had free access to the water. The water administration has been done using a dropping system, therefore it was not possible the soaking of the beak. In this way feed waste was avoided.

Throughout the experiment we monitored the average feed intake (g/day/layer); egg production (eggs/day/layer); average egg weight throughout the experimental period (g) and feed conversion ratio (g feed/g egg). Egg samples were collected throughout the experimental period, in two batches, on weeks 3 and 7 from the beginning of the experiment, for 5 days, from all three groups. A total of 72 samples (24 per group) were formed and separated as egg white, yolk and egg shell.

The dry matter was determined with the gravimetric method– SR ISO 6496:2001, with Sartorius analytical scale (Gottingen, Germany) and BMT stove ECOCELL Blueline Comfort (Neuremberg, Germany); crude protein was determined using the Kjeldahl method– SR EN ISO 5983-2:2009, with a semiautomatic KJELTEC auto 2300 – Tecator system; ether extractives by extraction in organic solvents– SR ISO 6492:2001, with a SOXTEC 2055 – Tecator system; crude fibre by hydrolysis in alkalis and acids– SR EN ISO 6865:2002, using the FIBERTEC 2010–Tecator system and ash with the gravimetric method, calcinations at 550^0C–SR EN ISO 2171:2010, with a Caloris CL 1206 oven (ASRO, 2010).

The InoLab pH-meter was used to measure: egg white pH and egg yolk pH. The Egg Analyzer^{TM}, type 05-UM-001 was used to measure the Haugh unit and

the egg yolk colour intensity. The Egg Analyzer™ is a compact system for automatic evaluation of quality of hen's eggs. The system detects, calculates and evaluates the quality of eggs by using a state of the art technology.

The results of this experiment are presented as average values with standard deviations. The main variables were the different levels of 2% and 3% of NEW added to poultry drinking water. The data were subjected to Origin 5.0 software for variance analysis, using t-Test (2 populations). Differences were considered statistically significant at P<0.05.

RESULTS AND DISCUSSION

Using NEW in poultry drinking water at 2% level for the experimental group E1 and 3% level for the experimental group E2, compared to 0% level at control group C, determined significant (P < 0.05) effects concerning the daily feed intake (Table 3). Therefore, at the experimental group E1, average daily intake was higher by 4.54% and at the experimental group E2 was higher by 6.16%, compared to control group C.

Table 3. Layer performance (average values) ($\overline{X} \pm S_{\overline{X}}$)

Parameter	C	E1	E2
Average daily feed intake - (g/day/layer)	126.20[b,c]±5.71	131.93[a] ±5.08	133.97[a] ±5.72
Average initial body weight (kg/bird)	1862±0.12	1840±0.14	1848±0.11
Average final body weight (kg/bird)	1943±0.15	1924±0.11	1936±0.13
Egg production – (eggs/day/layer)	0.87±0.07	0.90±0.03	0.91±0.04
Average egg weight (g)	64.95±1.47	64.39±1.34	64.51±1.67
Feed conversion ratio (g feed/ g egg)	1.94±0.08	2.04[a] ±0.07	2.07[a] ±0.05

[a] significant differences (P<0.05) from C; [b]significant differences (p<0,05) from E1; [c]significant differences (p<0,05) from E2.

In a similar study conducted on turkeys, Ramanauskaite -Pogoreloviene (2008) showed that the neutral anolyte, given regularly to the experimental group (1.5% neutral anolyte in the poultry drinking water) produced significant increases (P<0.05) in weight of females, compared to control group (0% neutral anolyte in the poultry drinking water). The microorganism load of the dropping samples was reduced by 85% on the experimental group.

Concerning the egg weight no significantly differences were registered on E1 and E2 experimental groups compare to control group. The daily egg production (calculated weekly and throughout the experimental period) was slightly higher in E1 and E2, but with no significant difference between groups.

Regarding the feed conversion ratio, these increased by 4.62% in the experimental group E1, respectively by 6.15% in the experimental group E2, compared with the control group C, with significant differences (P < 0.05). The

results show no significant differences between the experimental groups E1 and E2 for any of the surveyed parameters. No mortality was recorded in any of the groups.

The results in physical parameters of harvested eggs (Table 4), showed no significant differences between groups, except egg yolk weight. Yolk weight decreased significantly (P <0.05), with 6.76%, compared to the control group C.

Table 4. Data on the components and physical parameters of eggs collected (average values) ($\overline{X} \pm S_{\overline{X}}$)

Parameter	C	E1	E2
Egg white weight (g)	39.38±1.97	38.60±3.68	38.84±3.51
Egg yolk weight (g)	18.92[b]±0.81	17.64[a] ±1.17	18.14±0.87
Egg shell weight (g)	7.47±0.381	7.14±0.428	7.41±0.72
Egg shell thickness (mm)	0.32±0.02	0.32±0.03	0.31±0.04
Egg white pH	8.45±0.43	8.43±0.29	8.47±0.33
Yolk pH	6.03±0.16	5.74±0.76	6.01±0.17
Yolk colour intensity	6.63±1.03	6.87±1.04	6.80±1.04
Haugh unit	76.67±7.34	75.95±7.28	73.42±7.26

[a] significant differences (P<0.05) from C; [b]significant differences (p<0,05) from E1;

Also, the value of egg yolk weight at experimental group E2, lowered by 4.12%, but without any different significance compared to control group C. Regarding the values for egg white pH, yolk pH, yolk colour intensity and Haugh unit, they were no significantly different among groups.

CONCLUSIONS

The addition of NEW up to 3% to drinking water (12 mg free available chlorine /l water) did not affect egg production, egg weight and egg quality, yolk weight except. The quality of the administrated water to the laying hens represents an important factor which influences: laying hens health status and productive performances. NEW can be used efficiently, being considered a nontoxic product for poultry, as well, for the environment.

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