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STUDY OF THE EFFECT OF ELECTROLYZED REDUCED WATER (CATHOLYTE) ON THE INDICES PRODUCTIVITY OF DUCKS

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ABSTRACT

The effect of catholyte taken per os, *ad libitum* (for 1 month period) on the productivity of ducks (White Pekin duck breed) at 8 weeks of age was studied. The indices live weight, length of the tarsometotarsal bone, length of the beak were measured periodically – at the beginning of the experiment, on the 15th day of watering with catholyte and on the 30th day. The same measurements were made on animals in the control group, had been watering *ad libitum* with tap drinking water. The following indices productivity are determined: weight development and growth, fodder consumption, energy, crude protein – accepted fodder and nutrients; accepted feed, energy, protein per day per bird; utilization of energy and protein; weight development and average daily gain per bird for the ducks in the experimental and control groups. The analysis of the results shows higher values of the productivity indices of the ducks from the experimental group (drinking catholyte) compared to those from the control group (watered with tap water).

Key words*:* electrolyzed reduced water, catholyte, indices productivity, *White Pekin duck*.

Introduction

Pollution of the environment with chemicals used to control pathogens – microorganisms, viruses, pathogenic fungi, parasites in all spheres of human activity – is growing. This leads to unwanted changes in the ecological balance and biodiversity in nature. Nutrition, public health, environmental protection are global issues, and a key task of both European and global scientific strategy. The use of hormonal preparations, antibiotics and other chemicals aimed at increasing growth and biomass production poses serious challenges to the health of the consumer, increasing the risk of anxiety with the acquisition of antibiotic resistance of several microorganisms (WHO, 2019) as well as a serious polluter of the living environment. Electroactivated water – catholyte and anolyte is a relatively new concept that is increasingly used in agriculture, animal husbandry, medical sterilization, disposal of sewage and basin water (Bakhir, 2009), in the food industry (Gurgulova et al. 2011) and its application is increasingly expanding its boundaries due to its efficiency (Ashbach, 2008; 2014) environmental friendliness and harmlessness, without leading to resistance building, due to their nature and mechanism of action (Atanasov et al.2014; Ignatov et al. 2015).

During the last decade of this century, experiments were intensively conducted to study the effect of the use of electrolyzed water. There are a few studies using electrolyzed water both as a disinfectant and *per os.* The results obtained are related to a positive effect on health status. However, research related to the effect of catholyte on indexes productivity in farm animals are limited.

The aim of the study was to determine whether electrolyzed reduced water (catholyte), taken *per os ad libitum* as the only drinking water, has a stimulating effect on growth, development and some of the indices productivity of ducks, as no similar data have been found in the scientific literature.

Materials and methods

Experimental animals – 20 birds of the White Pekin duck breed were used, sex – female, age – 8 weeks, origin – farm for mother flocks. Live weight when betting on the experience – for the experimental group (10 birds) an average of 1,636 ±0,0918 kg for the control group (10 birds) – an average of 1,6902 ±0,102 kg. The sample of the two groups was equalized by the average live weight of a bird in the group at the time of the experiment, with a predominance of 0,0542 кg ($P > 0{,}05$) for the average weight of a bird in the control group (the difference is negligible and within the tolerance). Live weight measurement was performed with scales model: PCB 6000-1, max 6000g d = 0.1g.

Catholyte. The experimental group of animals was watered with catholyte (electrolyzed reduced water, produced by drinking tap water without added salt), obtained by activation of the 3rd degree in the apparatus (water tap related model) Aschbach – ionisiertes Wasser, with average parameters pH 9.29 (± 0,03), ORP -139 (± 0) mV (Manual multi-parameter analyser Consort C1010 (Consort bvba, Belgium) for pH, mV, temperature measurement). The catholyte was given *ad libitum* for 1 month. The control group of animals under the same conditions (*ad libitum*) received tap drinking water (pH 7).

Combined feed. Combined feed for ducklings was used – Grower (8 – 9 weeks of age) with composition: wheat 20%, corn 50%, sunflower meal 6.55%, soybean meal 17%, sunflower. oil 1%, monocalcium phosphate, 1.1%, calcium carbonate, 1.1%, sodium chloride 0.25%, bran 3%. 1 kg of feed contains: Crude protein 16.8%, Crude fat 4.6%, Crude fiber 4.1%, crude ash 5.3%, Calcium 1.1%, Phosphorus 0.6%, Sodium 0.1%, Metabolic energy 3060 kcal/kg, Lysine 1.0%, Methionine 0.5%, Iron 98 mg/kg, Copper 6.4 mg/kg, Zinc 32 mg/kg, Manganese 23 mg / kg, Iodine 0.03 mg/kg, Selenium 0.02 mg/kg. (Viand AD – Clone, Id. № αBG2230075).

The animals were kept in cages of 4 and 3 birds per cage (equally situated in subgroups in the main experimental and control group), observing all zoohygienic requirements for area according to the Low of the veterinary medical activity and the Internationally recognized guidelines for animal welfare. (Permission to use animals in experiments № 277 / 02.07. 2020, valid till 20.07.2025, Institute of Animal Science, Kostinbrod).

Experimental staging and sampling. The birds from the two groups – experimental and control were divided into 3 cages for each group, respectively with 4, 3, 3 ducks for each group. On the 15th day of the experimental period it was necessary to regroup the animals in the groups due to the loss of birds (leg trauma of 2 birds from the control group) and in order to equalize the groups, respectively 8 birds divided into 2 cages with 4 birds each for experimental and control group (ducks were equalized by the average live weight/bird for each group in the beginning of experiment, with a predominance of 0.054 g for average live weight of bird in the control group – the difference is negligible and within the tolerance). The compound feed for both groups was given *ad libitum*, and before it's lying the weight was measured daily and respectively the next day the remainder for each cell of both groups was counted daily. Water and catholyte are also presented for *ad libitum* consumption, poured into plastic drinkers, and for an experimental and control group to meet the requirement that the catholyte not encounter a metal surface, as the metal inactivates it.

In the experiment, measurements were made of live weight of each bird, measuring the length of the tarsometatarsal bone, beak length from base to tip, beak length from nostril to tip for each bird of the two groups. On the 15th day of the experiment, the same measurements were made, and blood samples were taken from each bird for biochemical and immunological examination of the blood.

The same measurements and blood samples were taken on the 30th day (end) of the experimental period.

Statistical analysis was performed using *Microsoft®Office Professional Plus Excel 2013 (15.0.4569.15060).* The results were processed mathematically and were calculated mean values (AV) and standard deviation (SD). To test statistical reliability of the results, Student's t-test analysis for independent samples was applied. The level of statistical significance (P) was assigned to be 0.05.

Results

Tables 1, 2 and 3 present the results for feed, energy, crude protein consumption, respectively – average daily per bird for both groups, the corresponding growth for experimental and control birds, as well as feed, energy, crude protein consumption for kilogram gain. On figure 1 are shown the dynamic of growth in length of the tarsometatarsal bone, beak length from base to tip, beak length from nostril to tip.

Table 1: Consumption of feed (g), energy (kcal) and crude protein (g) on average per bird.

Indicators / groups	Experimental group (catholyte)	Control group (water)
Accepted fodder /g/ mean daily/bird for the period	**363 g ± 23.82 g**	**354 g ± 39.16 g**
Energy intake /kcal/ mean daily/bird for the period	**1110 kcal**	**1082 ckal**
Adopted crude protein /g/	**60,8 g**	**59,4 g**

The feed was given on equal portions of feed/bird of the two groups of ducks after being weighed daily, and the rest of it per cage was measured on the next day for each day of the experimental period. The average values of the difference feed-residue for each cage of the respective group, divided by the number of birds in a cage and divided into 30 days, were calculated, and average results were obtained. The slightly lower values of the average daily intake of feed per bird from the control group are because the birds from this group show higher values of residue from the set feed. Based on the obtained values for the average daily intake of feed/duck, the average values of energy intake and crude protein were calculated.

Table 2: Weight development and growth, kg.

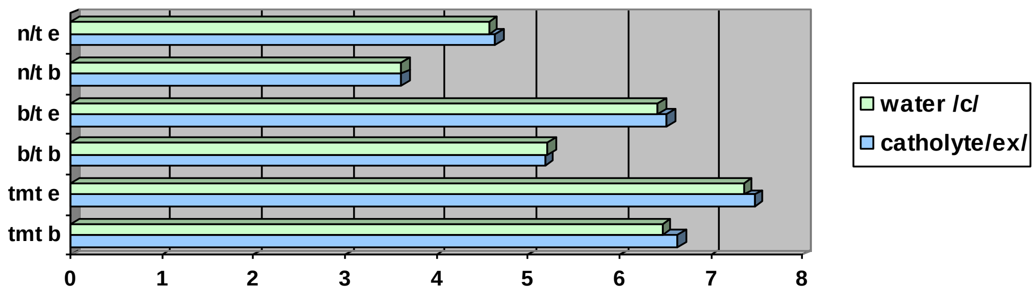
Indicators	Experimental group (catholyte)	Control group (water)
Live weight in the beginning of the experimental period /kg/ (n=10)	**1,636 kg ± 92 g**	**1,691 kg ± 102 g**
Live weight on the 15th day of the experimental period /kg/ (n=10)	**2,83 kg ± 199 g**	**2,75 kg ± 161 g**
Live weight in the end of the experimental period /kg/ (n=8)	**2,88 kg ± 166 g**	**2,76 kg ± 125 g**
Growth for the period /kg/ (n=8)	**1,26 kg ± 187 g**	**1,07 kg ± 86 g**

Table 2 shows that at the beginning of the experimental period there is a slight predominance in the average live weight values for the animals from the control group, while at the end of the period the average live weight values in the birds from the experimental group have an overtaking and predominance over those in the control group. Based on live weight at the beginning and end of the experimental period, the birds from the experimental group – drinking catholyte give higher values of average daily growth for the period – an average of 42 g/day, while those from the control group (drinking clean water) – on average 36 g/day increase, and the statistically processed results are reliable (P <0.05). When calculating the results, we included the weight of 8 birds from each of the two groups, as in the middle of the period (15th day) it was necessary to equalize the number of birds in a group due to leg trauma of two of the birds from the control group. When calculating the average daily feed intake, we have considered these changes, as well as we have excluded the live weight of the excluded birds with the corresponding number.

Table 3: Utilization of feed, (kg/kg growth), energy (kcal/kg growth) and protein (g/kg growth).

Indicators	Experimental group (catholyte), n=8	Control group (water) n=8
Feed consumption, kg/kg growth	8,6 kg	9,8 kg
Energy consumption, kcal/kg growth	26 417 kcal	30 052 kcal
Protein consumption g/kg growth	1448 g	1650 g

Table 3 shows that although the same amount of feed/bird from both groups was get, the birds from the experimental group showed a higher average growth for the period, as the feed consumption per kilogram of growth was lower by 1,2 kg than the feed consumption per kilogram of growth of birds in the control group. Accordingly, the values of energy consumption and crude protein consumption per kilogram of growth are higher in birds from the control group.



Legend: ***tmt b*** *– tarsometatarsal bone beginning,* ***tmt e*** *– tarsometatarsal bone end,* ***b/t b*** *– beak base-tip beginning,* ***b/t e*** *– beak base-tip end,* ***n/t b*** *– beak nostril- tip beginning,* ***n/t e*** *– beak nostril-tip end.*

Figure 1: Mean values for tarsometatarsal bone length, sm; beak length from base to tip (b/t) , sm; beak length from nostril to tip (n/t), sm of experimental and control group at the beginning and end of the study.

Figure 1 shows that the increase in the indicators in the animals of both groups (mean values) are almost symmetrical, with a small predominance in the values of the length of the tarsometatarsal bone at the end of the period in the birds of the experimental group (6,5 sm. ± 0,4 c. : 6,6 sm. ± 0,3 ex. *beginning*; 7,4 sm.± 0,2 c. : 7,5 sm. ± 0,2 ex. *end*) similarly with those at the length of the beak from the base to the tip (5,2 sm. ± 0,2 c.: 5,2 sm. ± 0,1 ex. *beginning*; 6,2 sm. ± 0,2 c.: 6,4 sm. ± 0,2 ex. *end*) and from the nostril to the tip(3,5 sm. ± 0,1 c. : 3,6 sm. ± 0,2 ex. *beginning*; 4,5 sm. ± 0,1 c.: 4,6 sm. ± 0,2 ex. *end*), and there is no reliability of the data in the reported results (P> 0.05).

Discussion

A lack of oxygen leads to incomplete oxidation; the body cannot remove the under-oxidized products from the reactions, changes in the blood flow rate occurred and this causes an aggregation of the erythrocytes. Such changes in the properties and characteristics of the blood, cause slowing of the blood flow, increasing in the aggregation of the erythrocytes, decreasing in the supply of tissues with oxygen. It leads to the fact that the body does not receive enough nutrients, vitamins, oxygen; slags are not removed from the cells. In Germany, studies by Dr. Irlacher show the influence of catholyte on the properties of the blood and the treatment with reduced water showed that the use of the catholyte prevents the blood from thickening. (www.dr-ada-fischer.de/dunkel.html; Aschbach, 2014). Of the entire number of vitamins, minerals and others, the body absorbs it best in ionic form. In the catholyte, minerals are found in the form of energized ions (for a certain time, after which they, interacting with each other, are neutralized and combined into neutral molecules). In fact, the process of electrolysis converts indigestible inorganic salts into digestible ones (Ashbach 2014). Lee et al. (2009) investigated the immunological effect of catholyte on animal immunity by consumption by mice, and the results showed that catholyte ingestion could affect the local immune response (Th-1 type cytokines such as IL-1b, TNF-a) in the small intestine, but not on the systemic immune response. Reactive oxygen species are highly reactive and directly attack surrounding biomolecules, worsening cell and tissue functions. Meanwhile, free radicals also serve as signaling mediators to regulate proinflammatory cytokine expression. Such cross interference between free radicals and inflammatory reactions leads to a chain reaction of negativity and causes the progression of several chronic pathologies. Molecular hydrogen preferentially removes cytotoxic hydroxyl radicals and peroxynitrites and prevent cell and tissue damage. Catholyte can suppress the response of stress-related oxidative stress and increase the level of IL-1b *in vivo* and that its intake is effective in controlling stress responses through its antioxidant potential (Hu et al. 2021). Nelson et al. (1998) studied two groups of autoimmune disease-prone mice to determine the spontaneous disease process and longevity. Longevity has been reported following catholyte administration, which most likely correlates with changes in free radicals and antioxidant enzyme levels. According to Ichinohe et al. (2005) catholyte is a functional water and has the effect of maintaining the normal function of the rumen and a higher degree of absorption in the gastrointestinal tract of ruminants. The authors investigated the effects of ingested catholyte on water absorption, rumen environment parameters, microbial yield and nitrogen balance in sheep. Mineral water (control) and catholyte were provided to the animals *ad libltum* with additional intra-ruminal infusion for 25 days. The results showed that in animals drinking catholyte the rate of water absorption was significantly higher, microbial protein supply was greater, and retention of absorbed nitrogen was lower than in control animals ($P<0.05$). The results showed potential positively influence of the rumen environment in ruminants by drinking catholyte. Ducks are known to have primarily intestinal nutrition and it is possible that, among other effects of catholyte on the body's metabolism, it also exhibits a gut-stimulating effect similar to that in the rumen (for ruminants). Furthermore, Tanaka Y. et al. (2021) reported an association between *Bifidobacterium* spp. and defecation in humans (drinking 500 ml of purified tap water or catholyte daily for 2 weeks), investigating the hypothesis that ingestion of alkaline electrolyzed water, believed to have antioxidant properties, increased the number of *Bifidobacteria* and improved stool hardness and gastric -intestinal symptoms. The gut microbiota is deeply connected to health through a symbiotic relationship. A study by Higashimura Y. et al. (2018) investigated effects of catholyte on the intestinal environment in mice (drunk catholyte for 4 weeks). The results showed that the relative abundance of 20 taxa differed significantly in catholyte-watered mice. These data indicate the possibility that catholyte administration may influence the microbial composition of the gut and have beneficial health effects in terms of cholesterol metabolism and liver protection. In patients with gastrointestinal symptoms, drinking catholyte, has been found to be effective in relieving them. A study by Tanaka Y. et al. (2018) aimed to evaluate health effects, including gastrointestinal symptoms, in people taking catholyte on a daily basis over a four-week time period. A large part of the studied patients testify to an improvement in sleep and a general feeling of well-being.

Conclusion

The results show that electroactivated water – catholyte, taken for one month as the only drinking water from ducks at 8 weeks of age, has a stimulating effect on their growth and development in terms of live weight, growth of the tarsal-metatarsal bone and beak. The birds watered with catholyte showed better utilization of the feed and showed more growth effect on the base of the eaten feed. Whether this trend persists over time is the subject of future research, as well as the dependence of the effect of stimulating growth and development with the onset of catholyte – from hatching, for example. It is subject to future scientific research and the effect of catholyte on other types of farm animals – not only birds but also mammals.

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References

1. Ashbach D. S. (2014). *You are not sick – you are oxidized*. Parity Publishing House. ISBN: 978-619-153-040-3.
2. Ashbakh D.S. (2008). *Live and dead water – the newest medicine of our time*. Peter, St. Petersburg, ISBN: 978-5-388-00190-0.
3. Atanasov A., Karadzhov S., Ivanova E., Mosin O., Ignatov I. (2014). *Study of the Effects of Electrochemical Aqueous Sodium Chloride Solution (Anolyte) on the Virus of Classical Swine Fever Virus. Mathematical Models of Anolyte and Catolyte as Types of Water*. Journal of Medicine, Physiology and Biophysics 4: 1-26. www.iiste.org.
4. Bakhir V.M. (2009). *Fighting against microbes in water treatment and medicine: two sides of the same problem*. Water supply and Sewerage, b, 9, pp. 58–68.
5. Gurgulova, K., Karadzhov S., Gogov Y., Georgieva T., Yordanov I. (2011). *Application in veterinary medicine of anolytes obtained by electrochemical activation of aqueous solutions of alkali and alkaline earth salts*. Agricultural Academy, Anim Breeding Sci. XLVIII, 1/2011.
6. Higashimura, Y., Baba Y., Inoue R., Takagi T., Uchiyama K., Mizushima K., Hirai Y., Ushiroda C., Tanaka Y., Naito Y. (2018). *Effects of molecular hydrogen-dissolved alkaline electrolyzed water on intestinal environment in mice*. Med Gas Res. 8(1), pp. 6-11. doi: 10.4103/2045-9912.229597.
7. Hu D., Danxi L., Shigeta M., Ochi Y., Oka T. (2021). *Alleviation of the chronic stress response attributed to the antioxidant and anti-inflammatory effects of electrolyzed hydrogen water*. Biochemical and Biophysical Research Communications 535, 1e5.

8. Ichinohe, T., Gotou, M., Fujihara, T. (2005). *Influences of basic electrolyzed water on water absorption, ruminal environment, microbial yield and nitrogen balance in sheep*. Animal science journal (Japan), Vol. 75.

9. Ignatov, I., Gluhchev G., Karadzhov S., Miloshev G., Ivanov N., Mosin O. (2015). *Preparation of Electrochemically Activated Water Solutions (Catholyte/Anolyte) and Studying Their Physical-Chemical Properties*. Journal of Medicine, Physiology and Biophysics 11: 1-21. www.iiste.org, ISSN 2422-8427 (Online).

10. Lee K. J., Jin D., Chang B. S., Teng Y. C., Kim D. H. (2009). *The Immunological Effects of Electrolyzed Reduced Water on the Echinostoma hortense Infection in C57BL/6 Mice*. Biol. Pharm. Bull. 32(3), pp. 456—462.

11. Nelson D., Reddy Avula C. P., Jolly C., DeVierville J., G. Fernandes G. (1998). *Effect of electrolyzed water intake on lifespan of autoimmune disease prone mice*. FASEB journal, Vol.12 (5), pp. A794 – scholars.uthscsa.edu.

12. Tanaka Y., Kiuchi M., Higashimura Y., Naito Y., Koyama K. (2021). *The effects of ingestion of hydrogen-dissolved alkaline electrolyzed water on stool consistency and gut microbiota: a double-blind randomized trial*. Med Gas Res. 11(4), pp. 138-144. doi: 10.4103/2045-9912.318858.

13. Tanaka Y., Saihara Y., Izumotani K., Nakamura H. (2018). *Daily ingestion of alkaline electrolyzed water containing hydrogen influences human health, including gastrointestinal symptoms*. Med Gas Res.8(4), pp. 160-166. doi: 10.4103/2045-9912.248267.

14. World Health Organization (2019). *Antimicrobial Stewardship Programmes in Health-care Facilities in Lowand Middle-income Countries: a WHO Practical Toolkit*. World Health Organization. License: CC BY-NC-SA 3.0 IGO. https://apps.who.int/iris/handle/10665/32940.

15. www.dr-ada-fischer.de/dunkel.html.