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The Effect of Magnetic Water on Growth and Quality Improvement of Poultry

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Abstract: We have investigated the effect of magnetic water treatment on growth and quality improvement of poultry. Some of poultry characteristics have been studied for about 100 chicken samples, including the nonmagnetic samples (drinking by ordinary water) and magnetic samples (drinking by magnetic water). Based on the results of our experiments, magnetic samples have about 200 gr meat more than the nonmagnetic samples. The magnetic samples have also shown other advantages like, increasing in meat fat ratio, livability and European production efficiency, a decrease in mortality, sick case and feed reduction and a high quality of final product. Statistical calculations are in fair agreement with our experimental results.

Key words: Magnetic water treatment % Poultry improvement % Mortality % Feed reduction

INTRODUCTION

The magnetic technology has been cited in the literature and investigated since the turn of the 19th century, when Lodestones and naturally occurring magnetic mineral formations were used to decrease the formation of scale in cooking and laundry applications. Today, advances in magnetic and electrostatic scale control technologies have led to their becoming reliable energy savers in certain applications [1-4].

For example, magnetic or electrostatic scale control technologies can be used as a replacement for most water-softening equipment. Specifically, chemical softening (lime or lime-soda softening), ion exchange and reverse osmosis, when used for the control of hardness, could potentially be replaced by non-chemical water conditioning technology. This would include applications both to cooling water treatment and boiler water treatment in once-through and recirculating systems [5-6].

The operating principles for the electrostatic units are much different. Instead of causing the dissolved ions to come together and form non-adherent scale, a surface charge is imposed on the ions so that they repel instead of attract each other. Thus the two ions (positive and negative, or cations and anions, respectively) of a kind needed to form scale are never able to come close enough together to initiate the scale-forming reaction. The end result for a user is the same with either technology; scale formation on heat exchange surfaces is greatly reduced or eliminated [7].

Donaldson emphasizes that in order to understand the effect, you first need to know what the scale is. Salt being heated, cooled and mixed with chemicals in all sorts of heating and processing plants are not necessarily well-behaved [8].

For example, in desalination, an increase in temperature causes the following sequence:

$$2HCO_3^- \rightarrow CO_3^{2-} + CO_2 + H_2O$$
$$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3(calcite)$$
$$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3(aragonite)$$

The lime scale problem in hard water arises because the solubility of $CaCO_3$ decreases with increasing temperature [9].

Despite its ubiquity, there is relatively little scientific literature on magnetic water treatment. It is not clear now or even if, it works. Unlike chemical water, softening, magnetic treatment should have no direct effect on water chemistry (unless the magnets are in contact with the water) yet, it is claimed to alter the morphology and adhesion of calcium carbonate scale [10]. Published data are often contradictory. For example, there is some dispute as to whether the deposits of calcium carbonate from

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Fig. 1: The magnetic instrument and stainless steel strainer

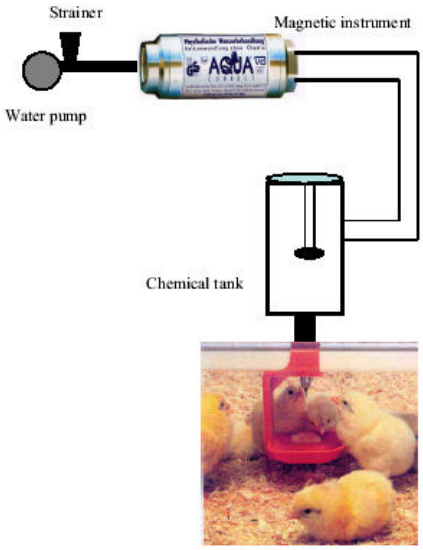


Fig. 2: Installation of Aqua Correct on the pipeline system

magnetically treated water are predominantly calcite or aragonite. These are the two common natural forms of $CaCO_3$, with rhombohedral and orthorhombic crystal structures, respectively [10-11].

The efficacy of magnetic treatment is reported to last from tens of minutes to hundred of hours; there is a review of the literature by Baker and Judd [12]. The authors claim the important factors which promote magnetic forces (responsible for the changes in crystallization) are the conductivity of the solution, the linear flow velocity of the fluid and the flux density of the field.

Upon reviewing the Literature, we arrived at the conclusion that most reported successful applications of Aqua Correct have occurred in continuously recirculating systems enabling repeated treatment of the process water (specially in the industrial boilers)[13].

Experimental: To have a permanent magnet in a compact form a unit called Aqua Correct is used (Fig. 1). This equipment has a coaxial permanent system which can produce a magnetic field strength as high as 6000 G. Aqua Correct has a free and smooth internal flow which exclude the presence of turbulence. The function is pure magnetic physical. So the crystal structure of lime scale will change and can easily remove it.

Fig. 3: Effective factors in the magnetic field
A: Lines of the magnetic field
B: Direction of the fluid

The equipment was connected to a pipeline system from one end and the other end to the water pump (Fig. 2).

In our experiment water had to flow through a coaxial magnetic gap, with a magnetic field area about 1.25 cm^2. The flow rate of water was checked before the installation. The direction of flow of water was adjusted to be perpendicular to the field. A stainless steel strainer was placed inside the equipment to capture the suspended impurities present in the water.

The general operating principle for the magnetic technology is a result of the physics of interaction between a magnetic field and moving electric charge, in this case in the form of ion. When ions pass through the magnetic field, a force is exerted on each ion. The forces on ions of opposite charges are in opposite directions. The redirections of the particles tends to increase the frequency with which ions of opposite charge collide and combine to form a mineral precipitate, or insoluble compounds. Probably this reaction takes place in installation of poultry drinking water fed. In other words, magnetic fields interact with a resultant force generated in a direction perpendicular to the plan formed by the magnetic and electric field vectors (Fig. 3).

This forces acts on the current carrying entity, the ion. Positively charged particles will move in a direction in accord with the right-hand rule of Lorantz. Negatively charged particles will move in the opposite direction. The result of these forces on the ions is that, in general positively ions (Calcium and Magnesium primarily) and negatively charged ions (Carbonate and Sulfate primarily) are directed toward each other with increased velocity. The increased velocity should result in an increase in the number of collisions between the particles, with the result being formation of insoluble particular matter. Once a precipitate is formed, it serves as a foundation of further growth of the scale crystal. The treatment efficiency increase with increasing hardness since more ions are present in solution, thus each ion will need to travel a shorter distance before encountering as ion of opposite charge (Fig. 4).

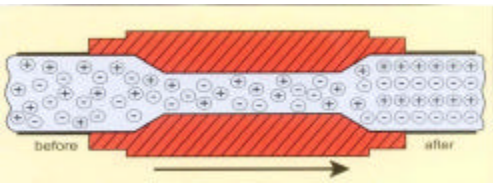


Fig. 4: Configuration of ionic particles in magnetic field

When the scale-forming reaction take place within a poultry's pipeline, the mineral form of the most common scale is called Calcite. Calcite is an adherent mineral that causes the build-up of the scale on the pipeline surface. When the reaction between positively charged and negatively charged ions occurs at low temperature, relative to a pipeline surface, the mineral form is usually aragonite. Aragonite is much less adherent to pipeline surfaces and tends to form smaller grained or softer scale deposits, as opposed to the monolithic sheets of scale common on poultry's pipeline surfaces. These smaller grained or softer scale deposits are stable upon heating and can be carried through out a pipeline while causing little or no apparent damage. This transport property allows the mineral to be moved through a system to a place where it is convenient to collect (in a strainer) and remove the solid precipitate.

Before installation, the conditions of the poultry as well as the physical, microbiological and chemical properties of water were carefully studied. About 300 days after installation, the filter was checked. Now, the effect of magnetic water on the improvement of poultry was being examined. To this end, 100 chicken samples, including 50 being the nonmagnetic samples and 50 magnetic samples were selected at the corner of flocks by the same conditions. On the basis of over one year of research in this field, we have reached the following conclusions:

- The magnetic water treatment will require a sufficiently fast, continuous flow of fluid. If magnetohydrodynamic forces are responsible for the action of the device, continuous fluid flow is required to generate these forces.
- The magnetic field must be of sufficient strength and oriented $90^{\circ}c$ relative to the direction of fluid flow (Fig. 3.).
- The new pipeline fitted with the Aqua Correct was found to be well protected from scale formation and internal corrosion; whereas the pipe without the equipment was badly damaged by scale formation and internal, corrosion occurred inside the pipe (Fig. 5).
- After installation of the magnetic instrument pipelines system were automatically cleared and the solid material became loose and fell off. Thus, the life span of the system could be increased [14-16].

RESULTS AND DISCUSSION

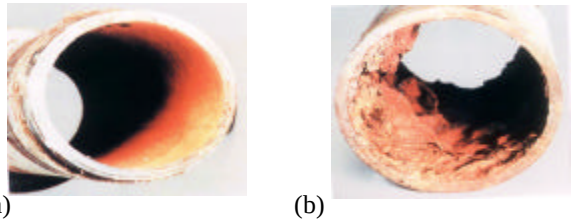
The chemical properties of magnetic water on poultry characteristics before and after the magnetic instrument was studied. They were weighted by an analytical balance at the end of every week. This method was applied to the magnetic and nonmagnetic groups in a period of sixty days. After weighting all samples for each group the medium weight were calculated (Table 1).

The compared curves in two ways are shown in figures 5 and 6. Repeatability of above mentioned method was examined during two years (Figs. 5 and 6). Using water without additives and applying the magnetic treatment technology resulted in no traces scale deposits on the surface of the poultry's pipelines and installation. The old poultry's installation system on which the instrument had been previously installed, without the Aqua Correct, demonstrated a badly internal corrosion in pipeline and because of the formation of a thick coating of insoluble salts, before its being connected to the equipment. After being connected with the magnetic apparatus, the installation system and pipeline were automatically cleared and the solid material became loose and fell off. Thus the life span of the installation system of poultry expectantly increased.

The magnetic device never affected the properties of the water. Its properties and qualities unchanged and pH had no effect on the scale formation due to the use of the equipment. Thus, the poultry can take benefit some of the following advantages when it is being connected to the magnetic device,

Table 1: Results obtained during using magnetic and nonmagnetic water

	Normal water	Magnetic water
Date/day	Medium Weight/gr	Medium Weight/gr
1	34	34
2	37	38
9	108.17	118.05
16	156.07	204.8
23	366	393.5
30	580.28	665.75
37	1072	1168.11
44	1480	1570
51	1575	1809.24
58	1700	1900



(a) (b)

Fig. 5: (a) Before installation the magnetic apparatus
(b) After installation the magnetic apparatus

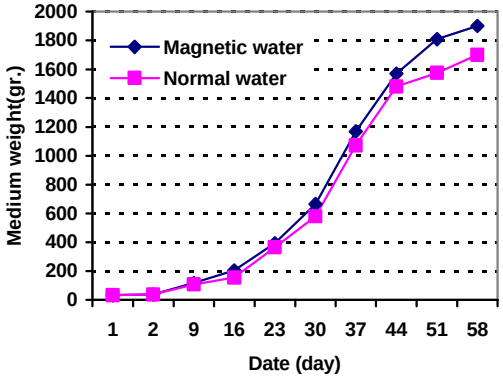


Fig. 6: The effect of magnetic water on the improvement of poultry during sixty days

- The increase of meat fat ratio and sheen of fur in poultry.
- Mortality and sick cases among flock decreases significantly.
- It is possible to reduce the time necessary for chickens reaching the required weight.
- Poultry's become more energetic which in fact is first of all, the sign of their health.
- Magnetic water is able to increase the solubility of minerals, thus facilitating the better transfer of the nutrients to all parts of the body of poultry via the membrane.
- Reduce the feed of poultry.
- To get biologically active water which exerts favorable effect on the poultry improvement because in nonmagnetic water, dissolved particles do not settle down, that is the reason why the water is dirty. This fact is conductive to increase the amount of bacteria. But in magnetic water which we have examined all dissolved particles and salts down very quickly and the water becomes clean, biologically active and all pathogenic bacteria is destroyed.
- Statistical calculations shows variance of two group chicken is not equal, so if s_1^2 and s_2^2 are sample variance of magnetic and nonmagnetic groups Fisher's statistics shows

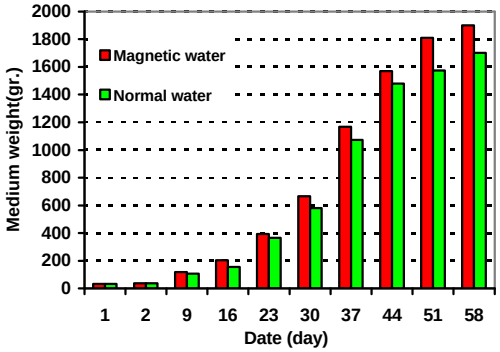


Fig. 7: The effect of magnetic water on the improvement of poultry during sixty days (column curve)

$$F_{calculate} = \frac{S_1^2}{S_2^2} = \frac{94442}{48877} = 1.93$$

Using Fisher's table it is found that $F_{critical} > F_{calculate}$. Also using Astevant statistics we can shows that population of two magnetic and nonmagnetic groups will not equal. Thus the magnetic water cause the meat weight of samples increased, bescuse we have

$$T_{calculate} = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} = \frac{1914 - 1728}{\sqrt{\frac{94442}{30} + \frac{48877}{30}}} = \frac{186}{\sqrt{4777}} = 2.7$$

with freedom degree of

$$d_f = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2}} = \frac{22821639}{330330 + 88454.7} \approx 55$$

Statistical calculations have also shown an increasing quality growth of chickens which drink with magnetic water. So this confirms the economical advantages of using magnetic water instead of ordinary water.

CONCLUSION

The new magnetic system fitted with the Aqua Correct was found to be well protected from scale formation and internal corrosion occurring inside the pipelines. The stainless steel strainer placed before the magnetic instrument collected the suspended impurities.Thus protecting the water from pollution. Other advantages are,

- Reduce mortality and sick cases of flock.
- Increase in the feed conversion coefficient.
- Increase in the performance efficiency factor.
- The European production efficiency factor and livability are increased significantly.
- Test results after two periods of poultry showed that magnetic instrument works satisfactory under Iran conditions and it fitted to the installation system of poultry, the life span of the pipeline could be increased. So the uses of advantages are above, consequently the magnetic device should be used to the pipeline system in poultry using water with different degrees of hardness. This water needs treatment.
- Statistical calculations are in good agreement with our results.

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REFERENCES

1. Lin, I.J. and J. Yotvat, 1990. J. Magn. Magn. Mater., 83(1): 525.
2. Laptev, V.A. and A.V. Tioutine, 1996. Rail Engineering International Edition, 2: 6.
3. Het, T., 1988. H_2O, 21(18): 517.
4. Welder, B. and E.P. Partridge, 1954. Industerial and Engineering Chemistry, 46: 954.
5. Smith, C., P. Coetzz and J. Meyers, 2002. Water SA, 29(3).
6. Szkatula, A., M. Balanda and M. Kopec, 2002. European Physical J. App. Phy., 18: 41-49.
7. Pilipenko, A.T., 1991. Methods of scale preventation in desalination of saline waters, Khimiya.i. Technologiya Vody, 13(11): 996.
8. Donaldson, 1990. Scaling down the water problem, Chemistry in Britain, pp: 209.
9. Strum, W. and J.P. Morgan, 1940. Aquatic Chemistry, Wiley, New York.
10. Eshaghi, Z. and M. Gholizadeh, 2004. Talenta, 64(2): 558.
11. Gholizadeh, M., H. Arabshahi and R. Benam, 2005. Int. J. App. Chem., 1: 84.
12. Coey, J.M.D., 2000. Magnetic Water Treatment. J. Magn. Magn. Mater. 209: 71.
13. Baker, J.S. and S.J. Judd, 1996. Water Res., pp: 247.
14. Baker, J.S. and S.A. Parsons, 1996. Industrial process Water Treatment., pp: 36.
15. Klaus, J. and Kronen berg, 1985. IEEE Transactions on Magnetic, 21(3): 2059-2061.
16. Quinn, C.J., C.W. Sanderson and T.C. Molden, 1997. Iron and Steel Engineer.