

## A SHORT OVERVIEW OF BROILER CHICKENS' DRINKING WATER SUPPLY

**BODNAR KAROLY\*<sup>1</sup>, BODNAR ERIKA SKOBRÁK<sup>2</sup>**

<sup>1</sup>*Szent Istvan University, Tessedik Campus, Szabadsag 1-3. H-5540 Szarvas, Hungary*

<sup>2</sup>*Hodagro Zrt., Csokasi puszta 63. H-6800 Hodmezovasarhely, Hungary*

\*Corresponding author's e-mail: bodnarkaroly.dr@gmail.com

***Abstract:** One of the basic conditions for producing broiler chickens is the continuous supply of good quality drinking water for the animals provided by the farm management. The aim of this paper was to give a short conceptual overview on the drinking water supply of broiler chickens from the viewpoint of animal welfare, water quality and technical background. The authors carried out a review of international scientific literature sources. Due to the reasons of limited volume the administration of water-soluble substances to drinking water has not been discussed.*

***Key words:** broiler chicken, drinking water, animal welfare, water quality, drinkers*

### INTRODUCTION

Before the Directive [9], there were no species specific welfare requirements for broiler chickens and only the general requirements of Directive 98/58/EC5 concerning the protection of farm animals applied, with its overall principles for housing, food, water and care adequate to the needs of the animals. In 2005 a study assessed that more than 40% of EU citizens mentioned broiler chickens as one of the farm animals most in need of developments in terms of animal welfare and protection.

Water is essential for all physiological processes. About 70% of the body composition of broiler chickens is water, so water plays a key role in body weight production. It can be stated that water is one of the most important feed components. The water needs of broiler chickens are covered primarily by drinking water, secondarily by water generated during intermediate metabolic processes - about 15% of its total needs - and thirdly by the feed consumed. The water requirement of a chicken relative to body weight decreases with age.

The aim of the authors was to prepare a short review on the water quality, water supply and drinkers in broiler chicken production by the existing sources.

### MATERIALS AND METHODS

A literature review of drinking water supply in broiler chicken production was presented in this paper. Different scientific research results in the topic, and collected data for requirements for chickens were studied by the authors. The paper was induced by a discussion on animal welfare and the water requirement and supply of the broiler chicken farming. The selection of publications was made by the subjective choice of the authors due to limited extent, but it was based on the scientific results of relevant authors.

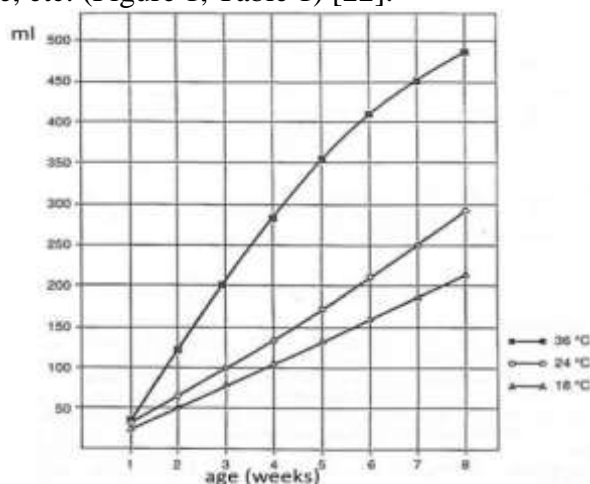
### RESEARCH RESULTS

#### **Consumption of drinking water**

In the case of drinking water demand of broiler chickens, the improvement in efficiency from 1930 to 2010 is extremely significant (1930: 7.8 l/kg live weight of broiler chicken, 1960: 4.3 l/kg and 2010: 3.0 l/kg) [16].

The daily water consumption of a group is useful information for the farm manager in supporting to diagnose broilers' performance and e.g. wet litter problems. Water meters are perfect tools to detect leaking drinkers and/or fractures in the water lines. In addition, water intake data is necessary to predict the medications per bird when added to the drinking water [5].

Water intake is highly correlated to the quality and amount of feed a group consumes which, and it is also associated with the age of the birds, their body weight, and environmental temperature, etc. (Figure 1, Table 1) [22].



**Figure 1. The effect of barn internal temperature on the water consumption of broiler chickens depending on age**

Source: Based on North and Bell, 1990

**Table 1.**

**Factors affecting water consumption [22]**

Broiler chicken	Water quality	Feed quality	Housing/environment
Genetics	Hardness	Feed type	Water temperature
Sex	Nitrate level	Feed intake	Water pressure
Control of body temperature	Total dissolved substances	Feed composition and suitability	Leakage of drinker system
Age	Bacterial contamination	Mycotoxin contamination	Spillage by birds if there is jostling at the drinkers
Health/disease			Type of drinker system
			Poorly installed regulators on drinker lines
			Drinker height
			House temperature
			Air velocity
			Air humidity

From the data of Pesti et al. [27] it is clear that chickens will consume twice the weight of water as of feed would overrate water consumption for these animals. Chickens in these research averaged only 1.77 g water intake for each gram of feed consumed. Although there is remarkable variation in water:feed proportions, the 2:1 figure was only approached in the warmest season of the year. The water intake of broilers of any age can be predicted precisely by multiplying the age in days by the adequate coefficient (5.28 ml overall). Additional refinements come by using seasonally modified values - circa 5.1 ml/day of age in the cooler, and 5.7 ml/day during the warmest months. There was no significant differences were found between housing types. The amount of water could be measured with water meter and the consumed concentrates of the stock with scale, but the effectiveness of both could be measured regularly and even at the individual level through the weight gain of the birds with a digital scale (e.g. Opticon poultry weighing system with OptiLink ver. 7.1.4. software).

When heat stress constantly exists, water intake will double or quadruple and birds are consuming not less than 2.3 times more water than feed [4]. Chickens increase water

consumption approximately 7% for each °C increase in temperature [10]. The feed:water ratios are relatively permanent at a specified temperature, when birds have feed consumption, water intake will increase after the feeding. Inversely, if feed is restricted from the broilers, water consumption will at first decrease, thereby inducing a rise in body temperature during heat stress [18].

Broilers in temperatures below their thermal comfort zone have lower feed and water consumption than those kept within thermal comfort zone. In cold ambience, animals show a typical behavioral reaction, such as crowding to reduce heat loss through environment. So, the lower is ambient temperature, the longer is crowding, which means fewer visits to feeders and drinkers, consequently the reduction of intake [20].

Water intake can be objectively applied as an indicator of chicken health and welfare; and there is a relation among total water consumed, levels of rejectin and the occurrence of contact dermatitis [21].

As measuring drinking water consumption is a relatively simple function, it is certainly recommended to measure the daily water consumption of the birds and assess it regularly [15]. Precise water consumption data are significant in order to exactly provide medication via this route [12].

### **Quality of drinking water**

In the poultry farming, the application of water with adequate quality (physical, chemical and microbiological traits) has an essential importance [2]. Because all birds have access to the same drinking water source, quality anomalies will affect a great number of broilers. Necessary factors to prevent waterborne problems in broiler production are the protection of water sources, disinfection of water and the quality control of water characteristics.

The temperature of the drinking water is also a very important factor. Drinking water that is too hot or too cold in winter also results in lower water uptake [15].

Cumulative water intake significantly increased in broilers provided chilled water when compared to chicks provided ambient-temperature drinking water. Animals preferred chilled tap water under hot environment, but such a chilling of water did not caused significant advantages in live weight, total mortality, feed-to-weight gain ratio, or carcass production of birds. Chilling of the drinking water during the rearing period increased the cost of production and it is difficult to maintain water temperature with long pipelines and high ambient temperature [26].

In broiler a longterm exposure to high concentrations of nitrates in drinking water, even if it did not raise blood levels of methemoglobin, had histological effects. This may partly explain observations that broiler performance is improved by reducing levels of nitrates, even in the lack of obvious toxicity symptoms [24]. Liver, thymus, and spleen weights reduced as water nitrogen increased and pH of water decreased. So reduced organ weights may lead to lower immune resistance [14].

### **Restricted water consumption**

A trial was made on ROSS 308 male chickens to observe the effect of water restriction (0-40% of the ad libitum (control) group) on performance and behaviour of the animals. Feed was given ad libitum. The ambient temperature was in thermoneutral zone. 8.5 g weight loss was observed for each 1% water restriction at 21 days of age. There was no difference in the mortality rate by any water supply level. Reduction of water caused a decrease in feed intake and weight gain. The animals restricted to drinking water changed their behaviour: they became irritated and aggressive. When water restriction was carried out until the 21<sup>st</sup> day of age and the broilers received drinking water ad libitum between

22-28 days of age, groups showed a compensatory consumption of water, but it decreased when the animals adapted to the new facilities [32, 33].

Ad libitum drinking water consumption should be reduced (as it is possible) to prevent wet litter formation in broiler chicken houses, without the restriction of water supply. Efficiency of intestinal absorption of water is affected by health. Problems of intestinal integrity could cause diarrhea via the reduction of water absorption from the intestinal tract [31].

However, if water intake is naturally low, such as during dark periods when birds are inactive, limiting water supply can help to reduce unnecessary water leaks and the problems caused by litter. Any such restrictions should be handled with care; the amount of water provided to growing birds cannot be limited and a balance must be struck between growth, animal welfare and the risk of possible foot pad disease [3]. Insufficient water supply, either in terms of water volume or number of watering points, results in reduced vigor of growth. In order for the herd to receive sufficient water, the ratio of water to feed consumed per day must be monitored. Changes in water consumption are early signs of health and performance problems.

### **Water sources and drinking devices**

The composition of drinking water varies with geographical territory and source of water. Contamination of drinking water may occur if surface water can drain into a well. Farms should send water samples to an accredited laboratory for testing of water quality. Its result will help farmers to determine if and what kind of water treatment should be done. All poultry production processes are affected by water quality. Poor drinking water quality may have impact on digestion and next on bird performance [10].

The growth performance and rate of water consumption are depending on the water quality (sources). Better water quality cause better feed consumption rate [13].

The method of supply and water quality can affect animal welfare: e.g. saline water from artesian well can be added to the salt intake in chickens and increase the incidence of ascites [7].

It is essential that broiler farms are equipped with water source to provide adequate drinking water volume for optimal chicken production. The broiler chickens' water consumption has significantly increased during the past 10 to 20 years. The broiler stocks raised under commercial conditions in consumed an average of 190.48 liter/1,000 birds per day (2010–2011), which was significantly higher than the consumption by broiler stocks in 2000–2001 or 1991 (160.54 or 140.33 liter/1,000 chickens per day, respectively). It is evidence that broiler farm drinking systems should be evaluated to ensure drinking water and keep up with the increasing water needs of the modern chickens [34].

During the years 2002-2003 in Finland drinking water consumption varied between 8,000 and 20,000 liter/day for 45,000-60,000 birds in broiler farms. The water sources of the poultry farms were usually private wells or municipal tapwater. Several farms had suffered from problems with water sufficiency particularly during dry seasons. Of those broiler farms which had water adequacy problems, 44% had only well as water supply and 56% had well and they were also attached to the community water system [30].

Nipple drinkers are the top-priority drinkers used in the production of broilerchickens. Nipple drinkers have some advantages including labor savings in cleaning, less water wastage, and reduced slaughter plant disapproval. Different nipple drinkers have different flow rates (WFR) (0.4 ml/s to 2.3 ml/s). Water consumption increased with increasing indoor temperatures from 20 to 35 °C. A lot of companies have increased WFR in their nipple waterer system above the level recommended by manufacturers, then make settings in WFR during the growing period [29].

During drinking broilers direct their beaks to nipple waterer and raise their heads when getting water [35].

The animals have to peck up to obtain drinking water, a position that is very different from the 'scoop' action of natural drinking act seen when chickens drink from bowls or troughs. This might suggest that the birds' welfare could be improved by the lowering of the drinker lines [17].

Broilers can learn easily to use nipple drinkers, because the birds mimic the behaviors of the other animals in the barn [1].

Two experiments, using a total of 3,200 broilers, were carried out to compare the effects of trough drinker versus three different heights on a nipple drinker system on body weight gain and feed:gain ratio. The birds were housed in temperature-controlled litter pens at 25-30 °C. An 8 feet long open trough was used. The heights of the nipple drinker were adjusted as

- 1) low (no neck stretch and drink from the side of the beak),
- 2) medium (stretch neck and drink from the end of the beak), and
- 3) high (first elevate breast, then stretch neck and drink from the tip of the beak) positions [19, 23].

The heaviest birds were produced by the open drinker. No significant differences were observed for feed:gain at 25 °C, but increased with increasing nipple height. These same results were observed at 30 °C, but statistically significant differences did occur. Drinking from nipple drinker is unnatural drinking position for birds, and the bigger the neck extension, especially in a heaving situation, the more disadvantaged effect on both body weight and feed:gain [28].

Daily drinking water consumption from nipple drinkers was always less than from bell drinkers. Water consumption from nipple waterers was often similar to that from bell drinkers during the lowest ambient temperatures, but it was less during the periods of highest indoor temperatures [23].

In tropical environment the use of wider and deeper drinkers is recommended during heat stress as they will let the immersion of not only the tip of beak, but the whole face and help eliminate more heat. Several research results show that water temperature, drinker type, height and shape have all been found to affect broilers performance under heat stress. A significant decrease was observed in drinking water intake from nipple waterers at high environmental temperature compared to bell drinkers [8].

Water intake behaviour should be considered when deciding on different types of waterers. Bell and nipple waterers are the most widely used in commercial broiler chicken production. Broilers houses were equipped with two different waterer types and raised at two different ambient temperatures (25 and 34 °C) to evaluate drinking behaviour and water volume. Birds' water intake behaviour was affected by drinker type. Broilers visited bell waterers less often, but showed higher total drinking water intake per visit to the waterer as compared to those consumed from nipple waterers. The results suggest that both birds' drinking behaviour and the consumed water volume should be taken into consideration when choosing on drinker type to install broiler houses [6].

Drinker systems that allow the leakage of water onto the litter may result poor litter quality, with the associated risk of foot pad diseases. Drinker nipples are often used to avoid water spillage onto the litter. The nipple cup system makes easy access to water possible and minimises spillage, too [7].

Drinker systems should be cleaned and disinfected among stocks. The watering system also should be flushed before the arrival of the stocks to ensure chicks have clean and fresh water from the first day [5].

Nipple waterer density had no significant effects on chicken performance or carcass traits. One nipple drinker per 20 broilers seemed to be sufficient to provide enough water to chickens to 6 weeks of age. Distribution of the nipple drinkers could be important; however, in some experiments, the broilers were unable physically to be farther more than 1.3 meter from the next water nipple [11].

### CONCLUSIONS

The literature on the topic is extremely diverse and often the results are difficult to compare with different experimental designs (breed, husbandry, feeding, microclimate, etc.), but all agree that drinking water of the right quantity and quality is an essential nutrient and changes in water consumption can directly indicate the health status of the herd and its response to changes in environmental factors.

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