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# Effect of Environmental Temperature on Water Intake in Poultry

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## Abstract

Water is an essential nutrient in animal nutrition, makes about 70 to 80% of lean body mass and plays important roles in poultry metabolism and thermal homeostasis. Water provided as drinking water constitutes the largest proportion of water available to poultry followed by metabolic water and that available in feed. The intake of water by birds varies depending on the age, environmental temperature, relative humidity, certain diet constituents, type of drinkers used and rate of growth. An increase in environmental temperature tends to cause an increase in water intake while decrease in environmental temperature causes decrease in water intake. Hence, in addition to its nutritional role, water is more important for thermoregulation in chickens especially under hot conditions.

**Keywords:** water, poultry, homeostasis, temperature, thermoregulation

## 1. Introduction

Water is the most abundant and widely distributed chemical compound in the world [1]. Though water in the natural state is one of the purest compounds known, there is difficulty finding a freshwater source that has not been altered by man [2, 3]. The use of drinking water with high physical, chemical and microbiological qualities is vital in poultry production as one single water source serves several birds. Hence, any problem in water quality would affect a great number of birds [4–6]. Birds consume approximately 1.6–2.0 times as much water as feed on a weight basis [7]; therefore, any deviation in water quality could have more pronounced effect on poultry health and production than feed [7, 8].

Water is an essential nutrient in animal nutrition and plays roles in poultry metabolism including thermal homeostasis [9], food digestion and absorption, nutrients transport, and waste products elimination from the body [10]. It also makes up 70 to 80% of lean body mass by weight in birds [11–13].

## 2. Sources of water in poultry nutrition

### 2.1 Drinking water

Drinking water constitutes the greatest source of water to poultry and it is made available in drinkers [1]. It is of great concern to poultry producers due to its great variability in quality and potential for contamination [5]. It could be from tap, stored in rooftop tanks, or underground (well) water [7]. The physico-chemical parameters established as indicators of water quality include taste, color, odor, pH, electrical conductivity (EC), hardness, alkalinity, salinity, and presence of cations and anions [14]. High-quality drinking water has been defined as water that contains inclusions, which promote vitality and lack inclusions causing morbidity and mortality [15, 16]. Because no water in nature is 100% pure, different water sources will have varying degree of water inclusions, which directly or indirectly affect poultry performance and welfare [17].

### 2.2 Water in feed

This is the water available in the feed. However, feeding of wet mashes to poultry has not been recommended for use in large scale commercial poultry production, on the basis that it does not offer any nutritional advantage and is difficult to apply [18].

### 2.3 Metabolic water

Metabolic water refers to water created inside a living organism through their metabolism, by oxidizing energy-containing substances in their feed [19].

Production stage	Age/rate of production	Liters of water/1000 birds
Layer pullet	4 weeks	100
	12 weeks	160
	18 weeks	200
Laying hens	50% production	220
	90% production	270

**Table 1.**  
*Typical daily water consumption for layers at 21°C [22].*

Age (weeks)	Liters of water/1000 birds
1	65
2	120
3	180
4	245
5	290
6	330
7	355
8	370

**Table 2.**  
*Typical daily water consumption for broilers at 21°C (liters per 1000 mixed sex birds) [22].*

Age (weeks)	Galons of water/1000 birds	
	Toms	Hens
1	10	10
2	20	15
3	30	20
4	40	30
5	55	40
6	75	60
7	100	80
8	125	100
9	150	115
10	170	130
11	190	140
12	210	150
13	215	160
14	220	170
15	220	
16	220	

**Table 3.** Typical daily water consumption (galons) for turkeys at 21°C (liters per 1000 mixed sex birds) [23].

Birds excrete uric acid and can have a net gain of water from the metabolism of protein [20]. Migratory birds have been reported to rely exclusively on metabolic water production while making non-stop flights [21].

**Tables 1** and **2** [22] and **Table 3** [23] provided data on typical water consumption levels for layers, broilers and turkeys, respectively, at 21°C.

In quail chicks, the water requirement has been reported to change with increase in age, quantity and quality of feed dry matter. This has been documented to be 3:1–4:2 g/g body weight at 12–29 days of age following stabilization at around 2 g/g body weight. The water feed ratio for the above period are 2:0–2:3 respectively [24, 25].

### 3. Factors affecting water intake

Birds, like most mammals, are considered to be homeothermic, and they maintain their deep body temperature at about the same level over a wide range of ambient temperatures [26]. Water intake will vary depending on age, environmental temperature, relative humidity, certain diet constituents, type of drinkers used and rate of growth [27]. Water consumption can be limited if the water is too hot or is contaminated with excess minerals [28, 29]. Water and feed consumption rates are interdependent, so reduced water intake can also lead to reduced feed intake [30].

#### 3.1 Effects of environmental temperature on water intake

It has been reported that the thermoneutral temperature for broiler chicks up to 7 days of age ranges between 28 and 35°C, and that temperatures higher than these may induce hyperthermia and dehydration, leading to a lower feed consumption

and delayed growth [31–33]. On the other hand, a lower environmental temperature induces hypothermia and may lead to pulmonary hypertension in broilers.

Chicks exposed to low ambient temperature (20°C) had lower water intake than chicks brooded at high environmental temperature (35°C) as reported by Moraes et al. [34]. These were related to the heat conserving behavior of these birds, since at low ambient temperature (20°C) they clustered to maintain optimal heat thus reducing the frequency to the feeder and drinker. Similar decrease in water intake has been reported in birds above 2 weeks of age but with increased feed intake and metabolism patterns [35]. Since poultry are homeotherms that can live comfortably only in a relatively narrow zone of thermoneutrality [36], they are forced to increase feed consumption under low temperatures in order to balance their body temperatures [37].

Broilers subjected to acute heat stress have been reported to show higher water intake. The water intake increases in order to maintain thermoregulatory balance [38], as heat stress induces high water loss through the respiratory. This acts as a means to achieve efficient thermoregulation through evaporative cooling. In critical heat stress situations, water loss may cause marked changes in the thermoregulatory balance of poultry [39] and this may result in death.

#### **4. Conclusion**

Increase in environmental temperature tends to cause an increase in water intake while decrease in environmental temperature causes decrease in water intake. Hence, in addition to its nutritional role, water is more important for thermoregulation in poultry especially during hot conditions.

#### **Conflict of interest**

The authors declare no conflict of interest.

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