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Water Management as A Key Nutrient for Broiler Chickens Performance at CV. Berkah Putra Chicken

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ABSTRACT

Water is one of the essential nutritional components that is very important in broiler chicken maintenance. Chicken drinking water consumption can indicate health or good/bad maintenance management practices. Causes of decreased water consumption include chickens being infected with a disease, environmental conditions that are too cold, uneven number and distribution of drinking places, dirty chicken drinking places, and poor water quality, especially seen from the physical water (clarity and color of the water). Observations were made by collecting data through direct observation in the field with data collection instruments in the form of observation and interviews. Observations were carried out by collecting data through direct observation in the field with data collection instruments in the form of observation, interviews and variables measured, namely testing drinking water for chickens, body weight (g/head), feed consumption (g/head), depletion (%) feed conversion, performance index and profit. Observation results showed that water quality and quantity were proven to have a significant impact on chicken productivity according to the age and body weight of the chicken. The results obtained after water treatment were that the *E.coli* and salmonella levels in nipple water were below the *E.coli* standard <50/ml Salmonella <0/ml and the performance index obtained at the Mansur farm was 501, the Khomer farm was 413 and the palm oil farm was 471 as well as profits produced with good water quality is greater IDR. 8,623 per head, while water quality that is not good gets a smaller profit of IDR 1,973/chicken.

Keywords: Water, quality, management, performance, chicken

ABSTRAK

Air adalah salah satu komponen nutrisi esensial yang sangat penting dalam pemeliharaan ayam broiler. Konsumsi air minum ayam dapat menjadi indikasi kesehatan ayam atau baik/buruknya praktek manajemen pemeliharaan. Penyebab konsumsi air munurun diantaranya yaitu ayam sedang terinfeksi suatu penyakit, kondisi lingkungan terlalu dingin, jumlah dan distribusi tempat minum yang tidak merata, tempat minum ayam kotor, kualitas air jelek terutama terlihat dari fisik air (kejernihan dan warna air). Pengamatan dilakukan dengan cara pengumpulan data yang dilakukan melalui pengamatan langsung di lapangan dengan instrumen pengumpulan data berupa observasi, wawancara dan variabel yang diukur yaitu pengujian air minum untuk ayam, bobot badan (g/ekor), Konsumsi pakan, (g/ekor), Deplesi (%) konversi pakan, Indeks peforma dan keuntungan. Hasil pengamatan menunjukan kualitas dan kuantitas air terbukti memiliki dampak signifikan terhadap produktivitas ayam sesuai dengan umur dan bobot badan ayam. Hasil yang didapatkan setelah dilakukan treatment air yaitu kadar *E.coli* dan salmonella pada air nipple berada di bawah standar *E.coli* <50/ml Salmonella<0/ml dan indeks peforma yang didapatkan pada farm mansur 501, farm khomer 413 dan farm sawit 471 serta keuntungan yang dihasilkan pada kualitas air yang bagus lebih besar Rp. 8,623/ekor sedangkan kualitas air yang tidak bagus mendapatkan keuntungan lebih kecil Rp. 1,973/ekor.

Kata kunci: Air, kualitas, manajemen, performa, ayam

INTRODUCTION

Water is one of the essential nutritional components crucial for maintaining broiler chickens (North and Bell 1990). Like other nutrients such as protein, carbohydrates, fats, vitamins, and minerals, water supports broilers' health, productivity, and growth performance. In broiler farming, optimal water consumption significantly impacts metabolism, digestion, and body temperature regulation (Leeson and Summers 2001). Therefore, proper water management is essential to maximize production performance.

Water serves several critical functions in the broiler's body. It is the most significant component of a chicken's body (Leeson and Summers 2001), plays a role in body temperature regulation (Brian and Casey 2015), supports digestion (Watson and Tabler 2024), respiration (Dingle 1991), and waste excretion (Aranti *et al.* 2023).

There are several drinking water requirements for broiler chickens, including chemical, physical, and biological standards. If the drinking water provided does not meet these standards, various issues may arise, affecting the health and productivity of the chickens (Vasant 2023). Potential problems include dehydration, digestive disorders, weakened immune systems, reduced productivity and feed efficiency, and the spread of diseases. This study aimed to know effective water management techniques in broiler chicken cultivation and identify the impact of water management on the growth performance and health of broiler chickens.

MATERIAL AND METHODS

This engineering practice was conducted from January 2024 to October 2024 at Mansur Farm, Sawit Farm, and Khomer Farm, owned by CV Berkah Putra Chicken, located in Candali Village, Rancabungur District, Bogor Regency.

The engineering practice involved data collection through direct field observation and interviews. Once issues affecting broiler performance were identified, solutions were implemented based on engineering competencies in poultry farming.

Engineering practice methods are carried out by conducting engineering practices and direct observation on the farm and measured variable.

Body Weight (Fadilah 2013)
Body weight (g/tail) was weighed per week and the cumulation were calculated by the formula:

$$\frac{Weighning\ Weight\ (g) - Basket\ Weight\ (Kg)}{Number\ of\ chicken\ (kg)}$$

Feed Intake (Fadilah 2013)
Cumulative feed intake (g/tail) was calculated used the following formula:

$$\frac{Total\ Feed\ per\ day\ (g)}{Total\ of\ live\ chicken\ (ekor)}$$

Depletion (Fadilah 2013)
Cumulative depletion (%) was calculated daily using the following formula:

$$\frac{\text{Number of dead chickens+culling (tails}}{\text{Initial population (tail)}} \text{ x } 100\%$$

Feed Conversion Ratio (Fadilah 2013)
Feed Conversion Ratio was calculated by the formula:

$$\frac{\text{Feed Intake (kg)}}{\text{Body Weight (kg)}}$$

Index Performance (IP) (Fadilah 2013)
Index performance was calculated at the end of maintenance:

$$\frac{\text{live population (\%)x body weight}}{\text{FCR X age of chicken}} \text{x} 100$$

RESULTS AND DISCUSSION

Water Quality and Sources at CV Berkah Putra Chicken

The water used for broiler chicken consumption at CV Berkah Putra Chicken comes from a deep well that is regularly treated. This deep-healthy system is also more economical for the farm in the long run, despite requiring additional processing. Water quality is measured based on several parameters, such as pH, Total Dissolved Solids (TDS), microbial content, and harmful chemicals. The pH of the water ranges from 6.8 to 7.5, and TDS is found to be below 500 ppm.

Table 1. Water Suitability Based on Total Dissolved Solids (TDS) Concentration

TDS concentration (ppm)	Notes
< 1.000	The water is very suitable for all types of poultry and may cause watery droppings, but it does not affect the health or performance of the chickens.
1.000 – 2.999	The water is suitable for all poultry types but may cause watery droppings. However, it does not affect the health or performance of the chickens.
3.000 – 4.999	The water is not suitable for all types of poultry and may cause watery droppings, increased mortality, and hinder growth.
5.000 – 6.9999	The water is unsuitable for all types of poultry and may lead to several issues, especially reduced growth and production, with noticeable increases in mortality.
7.000 – 10.000	The water is no longer suitable for poultry, but it might still be usable for other livestock.
> 10.000	The water is unsuitable for poultry and other livestock.

Source: Cobb (2021)

The problem regarding water is that the microbiological test results conducted before the engineering practice showed positive results for *Escherichia coli* and *Salmonella*. The water test results from Mansur farm, Khomer farm, and Sawit farm can be seen in Tables 2, 3, and 4, respectively, along with the performance of the chickens that consumed this poor-quality water, which is presented in Table 5.

Based on the data from the table, the production performance with substandard water quality shows significantly lower results than the company's established standards. The company's established standards require a final body weight of 2.50 kg and an FCR of 1.45.

Handling Drinking Water Contaminated with *E. coli*

Handling drinking water contaminated with *Escherichia coli* (*E. coli*) in broiler farms is crucial for maintaining the health and productivity of the poultry. Here are the detailed steps to manage *E. coli* contamination in drinking water:

a. Identifying the source of *E. coli* contamination, cleaning and sanitizing the water distribution system by flushing or thoroughly rinsing the water pipes within the distribution system to remove any remaining contaminated water and sediment that could serve as a breeding ground for *E. coli.*
b. Disinfection (sterilization) of air must be carried out using disinfectants to clean the air distribution system.

Table 2. Results of microbiological water examination at Mansur farm

Sample	Total Bacteria / *E. coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. coli* / *Salmonella* (/ml)*	Conclusion
Source Water	3,0.103/2,0.102/0	<102/<10/<0(/ml)	Total bacteria and *E. coli* exceed the standard
Water Tower	3,0.102/3,0.102/0	<102/<10/<0(/ml)	Total bacteria and *E. coli* exceed the standard
Nipple Water 1	3,0.103/3,0.102/0	<103/<50/<0(/ml)	Total bacteria and *E. coli* exceed the standard
Nipple Water 2	3,0.103/3,0.102/0	<103/<50/<0(/ml)	Total bacteria and *E. coli* exceed the standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 3. Results of microbiological water examination at Khomer farm

Sample	Total Bacteria / *E. coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. coli* / *Salmonella* (/ml)*	Conclusion
Source Water	3,0.102/28/0	<102/<10/<0	Total bacteria and *E. coli* exceed the standard
Water Tower	102/15/0	<102/<10/<0	Total *E. coli* exceed the standard
Nipple Water 1	3,0.103/3,0.102/0	<103/<50/<0	Total bacteria and *E. coli* exceed the standard
Nipple Water 2	3,0.103/3,0.102/0	<103/<50/<0	Total bacteria and *E. coli* exceed the standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 4. Results of microbiological water examination at Sawit farm

Sample	Total Bacteria / *E. coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. coli* / *Salmonella* (/ml)*	Conclusion
Source Water	3,0.102/30/0	<102/<10/<0	Total bacteria and *E. coli* exceed the standard
Water Tower	3,0.102/15/0	<102/<10/<0	Total bacteria and *E. coli* exceed the standard
Nipple Water 1	1.5.103/70/0	<103/<50/<0	Total bacteria and *E. coli* exceed the standard
Nipple Water 2	3,0.103/3,0.102/0	<103/<50/<0	Total bacteria and *E. coli* exceed the standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 5. Average Production Performance with Substandard Water Quality

Farm	Population (head)	Harvest (kg)	Mortality (%)	Body Weight (kg/head)	Feed Conversion Ratio (FCR)	Feed Intake (g/head)	Performance Index
Mansur	40.000	36.621	8.45	1.71	1.76	3036	255
Khomer	27.000	25.344	6.13	1.69	1.58	2669	323
Sawit	45.000	39.631	11.94	2.13	1.71	3654	319

According to the instructions, disinfection is carried out using a solution of chlorine or hydrogen peroxide at a safe concentration. Air sterilization is carried out using safe techniques involving disinfectants. At CV Berkah Putra Chicken, air sterilization is carried out using chlorine or other disinfectants at safe doses (generally around 2-4 ppm). Chlorine or other disinfectants are effective at eradicating pathogenic bacteria such as E. coli. It is important to ensure that the chlorine is distributed evenly, and repeat measurements should be made to ensure proper concentration. Water sterilization often also uses hydrogen peroxide 20% as a disinfectant, with a dosing tool. The types of disinfectants that can be used, along with their doses and benefits, are listed in Table 6.

Tabel 6. Disinfectant products used for water sterilization at CV Berkah Putra Chicken

Product	Amount per ton of water	Effects on channels & drinking water quality
Organic acids	0.5-1	Inhibits the growth of bacteria, fungi and crust formation.
Hydrogen peroxide 50%	0.25 -0.5	Inhibits the growth of bacteria and mold. Eliminates biofilm.
Hydrogen peroxide 20% + peracetic acid 5%	0.2-0.4	Inhibits the growth of bacteria and fungi. Removes biofil and scale.

Source: Mensana (2024)

c. The sterilization process successfully reduced harmful microbial content in drinking water, minimizing the risk of diseases and enhancing poultry welfare. The use of dosing equipment as shown in Figure 1.

Figure 1. Dosing equipment using hydrogen peroxide disinfectant

d. Improve the water source and install water filters at the source (well) that can filter harmful microorganisms, such as ultrafiltration filters. This filter is very effective in removing very small microbial particles. This filtration ensures that the water coming from the water source is clean. Ensure there are no leaks or seepages from the surface that could allow *E. coli* to enter the water source.

e. Conduct regular water quality testing. CV Berkah Putra Chicken can reduce the risk of digestive diseases and infections by ensuring optimal water quality, allowing the chickens to consume water comfortably and without significant health risks. The results of water testing in the laboratory after improvements can be seen in Tables 7, 8, and 9.

The quality of the water, which has been improved, was then tested at the laboratory of PT New Hope Indonesia. The final results showed that all water samples from all farms were below the standards set by the PT New Hope Indonesia laboratory.

Water Quality and Its Relationship with Poultry Productivity

The monitoring results show that with the correct quantity of quality water, broiler chickens at CV Berkah Putra Chicken experienced a decrease in mortality rate from approximately 8.84% to 4.6%. The average body weight at harvest ranged from 2.6 to 3 kg per bird, increasing about 900 grams or 47% compared to the previous period. Meanwhile, the FCR ranged from 1.45 to 1.55, a decrease of 0.36 points (22%) compared to the previous period. The Production Performance Index (IP) ranged from 413 to 510, a significant improvement compared to the previous period's range of 255 to 323. The performance of the broiler chickens after water management improvements can be seen in Table 10. Quality water consumption contributes to digestive effectiveness and metabolism, thus enhancing growth rate and feed conversion efficiency.

Conduct Training for Employees on Proper Water System Management

Conduct sanitation training to ensure that workers in the poultry house understand the importance of cleanliness and sanitation of drinking equipment, as well as the correct procedures for cleaning and disinfecting the water system. Introduce the signs of water shortage or quality issues: Teach workers to recognize early signs of water shortages or poor water quality, such as behaviors in chickens indicating dehydration or visibly cloudy water.

The results of this training can be seen, where before the training, laboratory microbiological tests of water quality shown in Tables 2, 3, and 4 indicated total bacteria, E. coli, and Salmonella levels above the standards. After the training, the results of water tests from PT New Hope Indonesia microbiology laboratory showed that the water quality had improved, as seen in Tables 7, 8, and 9.

Evaluation and Long-Term Preventive Measures

CV Berkah Putra Chicken has developed a regular sanitation schedule, which includes routine water system cleaning, a schedule for replacing filters, and regular disinfection to ensure water quality is always maintained. Record and analyze contamination incidents, taking steps to address them. Analyzing contamination patterns can help identify and improve vulnerable points where bacteria may enter the water system.

Table 7. Results of microbiological water examination at Mansur farm

Sample	Total Bacteria / *E. Coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. Coli* / *Salmonella* (/ml)*	Conclusion
Source Water	85/9/0	<102/<10/<0	All test results are below standard
Water Tower	83/8/0	<102/<10/<0	All test results are below standard
Nipple Water 1	4,0.102/16/0	<103/<50/<0	All test results are below standard
Nipple Water 2	3,0.102/14/0	<103/<50/<0	All test results are below standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 8. Results of microbiological water examination at Khomer farm

Sample	Total Bacteria / *E. Coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. Coli* / *Salmonella* (/ml)*	Conclusion
Source Water	90/5/0	<102/<10/<0	All test results are below standard
Water Tower	98/7/0	<102/<10/<0	All test results are below standard
Nipple Water 1	4,0.102/0/0	<103/<50/<0	All test results are below standard
Nipple Water 2	3,0.102/0/0	<103/<50/<0	All test results are below standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 9. Results of microbiological water examination at Sawit farm

Sample	Total Bacteria / *E. Coli* / *Salmonella* (/ml)	Standard Total Bacteria / *E. Coli* / *Salmonella* (/ml)*	Conclusion
Source Water	0/0/0	<102/<10/<0	All test results are below standard
Water Tower	67/5/0	<102/<10/<0	All test results are below standard
Dudin's Nipple Water	0/0/0	<103/<50/<0	All test results are below standard
Ubay's Nipple Water	1,0.101/1/0	<103/<50/<0	All test results are below standard

Source: PT New Hope Indonesia Laboratory, Tangerang (2024)
*Standard Cobb 2021

Table 10. Average Production Performance with Quality Drinking Water Consumption

Farm	Population (head)	Harvest (kg)	Mortality (%)	Body Weight (kg/head)	Feed Conversion Ratio (FCR)	Feed Intake (g/head)	Performance Index
Mansur	36.000	33.928	5.76	3.04	1.45	4418	510
Khomer	27.000	25.673	4.92	2.62	1.55	4080	413
Sawit	45.000	44.506	3.25	2.68	1.49	3994	471

Revenue Analysis

Revenue or profit is the primary goal of poultry farming. Profit is achieved when total income exceeds total expenses. The more significant the difference between income and expenditure, the higher the profit, which indicates that the business is economically viable (Labatar *et al*. 2023). With poor water quality, production costs amounted to IDR 1,686,860,000; with good water quality, production costs increased to IDR 1,997,550,000. The higher production cost with good water quality is due to higher feed costs, reaching IDR 1,457,550,000, compared to IDR 1,187,360,000 with poor water quality. This increase indicates that chicken growth is more optimal with good water quality.

In terms of revenue, good water quality results in much higher earnings, totaling IDR 2,385,580,000, compared to IDR 1,775,634,000 with poor water quality. This difference indicates that the number of chickens harvested is more significant (96.75%) compared to the poor water quality (88.06%), and the weight of the chickens produced with good water quality is higher (2.68 kg) compared to poor water quality (2.13 kg).

The total profit for good water quality was IDR 388,030,000, or IDR 8,623 per chicken. The profit from good water quality is significantly higher than from poor water quality, with a total profit of IDR 88,774,000, or IDR 1,973 per chicken. Therefore, adequately managed water quality results in better performance and greater harvest weight, directly contributing to increased profit.

CONCLUSION

Good water management is positively correlated with the health and performance of broiler chickens. The results obtained after water treatment were that the *E.coli* and *Salmonella* levels in nipple water were below the *E.coli* standard <50/ml *Salmonella* <0/ml and the performance index obtained at the Mansur farm was 501, the Khomer farm was 413 and the Sawit farm was 471 as well as profits produced with good water quality is greater Rp. 8,623 per head while poor water quality results in a smaller profit of 1,973 per head, good chicken performance helps reduce production costs and increase company profits.

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