



Study of fungal and bacterial pollutants in the air of broiler barns in some farms in Al-Marj city

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ABSTRACT

Keywords:

bacteria, thermophile, fungi, lifespan, broiler barns.

The aim of this paper was to assess the level of air contamination by bacteria and fungi in broiler houses. The numbers of bacteria (mesophile, staphylococci, streptococci and gram-negative) and fungi were determined in broiler houses with chicken of different ages (1-6 weeks old). The results showed high levels from bacterial contamination in broiler houses air. The mean number of bacteria ranged between 2×10^6 – 9.81×10^6 cfu/m³ for the total number of mesophilic bacteria, between 1.20×10^6 – 5.59×10^6 cfu/m³ for staphylococci, between 0.13×10^6 – 0.97×10^6 cfu/m³ for streptococci, and between 0.086×10^6 – 0.423×10^6 cfu/m³ for gram-negatives. The mean fungi levels were middle and ranged between 88×10^3 to 145×10^3 cfu/m³. The proportions of bacterial groups within the total mesophilic bacteria number were: 46.6 - 60 % staphylococci, 2.3 - 28.5 % streptococci and 1 - 7.4 % gram-negative. In general, the number of Bacteria increased with poultry age and it was high in the mid-fattening period but the number of fungi did not increase with the chicken's age. The results indicate the necessity for increased ventilation and for air disinfection during the chicken's fattening period.

Introduction

The poultry industry is one of the mainstays of human and animal society, both in terms of food and the economy and labor it provides. Before 1950, poultry production relied on traditional methods. However, in recent years, with the increasing global population explosion and the increased demand for poultry meat and eggs, the poultry industry has made amazing progress, especially with the emergence of genetically improved species by companies specializing in poultry production, both in the field of broilers and broiler breeders [1].

Scientific and economic studies have also begun to attempt to increase profits by reducing labor costs and increasing meat conversion capacity and egg production, which has led to the emergence of intensive farming systems that have become a cause of increased air pollutants in the atmosphere of the barn and the emergence of respiratory problems, both among poultry and workers working within the barn [2]. The quality and health of the air in poultry barns are important and necessary for the health of the birds, workers, and the surrounding environment [3]. (Working in poultry barns is considered a profession with high respiratory risks. In a study conducted in northern Germany on 1,861 workers, it was found that approximately 13-15% of poultry barn workers suffer from respiratory problems, mainly due to biological pollutants (germs)[4]. And fungi present in the air of the barn, and the most important of these problems are asthma - chronic bronchitis - allergy symptoms biological pollutants bacteria and Fung)

or aerosols released from poultry barns are a source of concern and disturbance to the surrounding environment. The main reason for concern about these pollutants is the belief that they affect the health and respiratory condition of the residents who live near that barn in the first place [5]. And the possibility of the transmission of pathogenic elements to the surrounding barns [6].

Modern poultry farming systems have begun to focus on studying air and its sources of pollution, emphasizing the factors that maintain the cleanliness of the barn environment [7]. They have also begun to study bacterial and fungal pollutants in the air of poultry barns, identifying their composition, types, and impact on the health of poultry and workers. (Germs and fungi are naturally present in the air of poultry houses, but their concen-





trations exceeding the natural limits cause health problems for birds and workers, whether as a result of their direct impact or through the toxins of some of them. The source of aerosols in the air of poultry houses comes from the animal itself, the feed, and the materials used in the bedding [8]. (In this research, we will study the types and concentrations of the most common germs in the air of poultry houses [9]. Until now, the available information about the types and concentrations of germs and fungi in the air of poultry houses is still limited, and we also have little information about their role in the high rate of respiratory diseases among workers in the poultry sector, which has prompted Europe to focus on this research. Directing efforts to control bacterial and fungal air pollutants in production farms [10]. Interestingly, many studies related to this topic indicate high concentrations of bacterial, fungal, and dust pollutants in the air of broiler barns, which negatively impacts the performance and health of poultry and workers. It was stated that the recommended value for the bacterial level in broiler barn air is 50.2×10^3 colony forming units/m³, while one researcher suggested that this value should be 10^3 colony forming units/m³. The bacterial concentration in the air of the barn should be between 6×10^3 colony forming units/m³.

Most references indicated that the vast majority of bacteria found in the air of poultry houses are Gram-positive bacteria, while the percentage of Gram-negative bacteria was very high. The researcher [11]. attributed the high air pollution in the house to the inefficiency of the ventilation systems used and the work carried out within the house.

Materials and Methods

Samples were taken from an old-fashioned broiler farm. It consists of two open-range pens, each measuring approximately 500 m². The length is 36 m, the width is 14 m, and the height is 5.3 m. The pen can accommodate 5,000 Cobb birds at a stocking density of approximately 10 birds per m². Heating is provided by coal burners. Ventilation is provided through openings in the roof and windows distributed throughout the barn walls. The number of windows is 20, with a length of 5.2 m and a width of 5.1 m. Lighting is provided by natural and artificial lighting (15 neon lights are distributed evenly throughout the barn). The drinkers are jumbo-type. Feeding is manual (bucket-style), with feed provided to the broilers in multiple meals. The litter is 4 cm thick wood shavings.

The air sample was taken from the broiler barn using the All-Glass Impinger 30 (AGI-30[12] liquid medium method, which involves sucking air from the barn atmosphere (using a special device) and sending it at a speed of 2 liters per minute for 20 minutes into a sterile liquid medium contained in a small glass bottle (9% saline solution with 1.0% Tween 80 solution). When the air touches the surface of the liquid, the particles suspended in the air become incorporated into the liquid. The liquid is then taken directly, diluted, and cultured on a variety of selective and specific media, including:

- 1 - Nutrient agar: used to enumerate thermophilic bacteria.
- 2 - Chapman's medium: used to enumerate staphylococci.
- 3 - Edwards' medium: used to enumerate streptococci.
- 4 - Mackonkey's medium: used to enumerate gram-negative bacteria.
- 5 - Sabouroud's dextrose medium: used to enumerate fungi.

The germ cultures are incubated at 37°C for 24-48 hours, while the fungi are incubated at 22-25°C for 5 days. After incubation, the growing colonies are counted using an optical colony reader. By combining the number of colonies present in 1 ml of liquid with the amount of air dissolved in 1 ml of liquid, the concentration of bacteria and fungi per cubic meter of barn air (cfu/m³) is calculated. After taking the sample, the loss in the liquid during air withdrawal is calculated to ensure accuracy in calculating the amount of air dissolved in the liquid. Samples were taken from the air of the aforementioned barn at a rate of five samples in the middle of each week, starting from the first week until the sixth week of fattening. The five samples were taken from the four corners of the barn and from the center of the barn, taking care to avoid ventilation entrances and exits of the barn during the sampling. The sample was drawn from the air at a height of 50 cm above the ground level. Each sample was grown in three replicates, and then the average was taken. A statistical study of the samples was conducted using Statistic (1996): Analytical Software Version 1.0, USA. The study included the arithmetic mean, standard deviation, minimum value, and maximum value. The p value was calculated, as were the percentages of bacterial groups (staphylococci, streptococci, and Gram-negative bacteria) relative to the total count of thermophilic bacteria (general bacterial concentration). Temperature, humidity, light, and phase density were measured during sampling.

Bacterial Identification:

The isolated bacteria were identified by:

- 1 -The shape of the colonies growing on differentiation media.
- 2 The shape of the bacterial cells under a light microscope using Gram stain.
- 3 - The API approval of the cluster of cocci.

RESULTS

1 - Thermophilic bacteria (overall bacterial concentration): The concentration of thermophilic bacteria increased from 69.5×10^3 colonies/m³ in the first week to 81.9×10^3 colonies/m³ (maximum value) in the fourth week of



the birds' life. Then, the bacterial concentration decreased significantly to initial levels in the fifth and sixth weeks of 2×10^3 colonies/ m^3 (minimum value).

Greatest value	Minimum value	standard deviation	arithmetic mean	Age (week)
8.12	2.4	2.88	6.12	1
11.13	2.8	3.77	7.34	2
14.16	2.6	3.6	8.9	3
12.5	2.5	4.8	9.55	4
6.8	1.5	2.55	5.9	5
3.4	1.77	0.33	3.6	6

2- Staphylococcus:

The cluster gin is left from 2.86×610 colonies/ m^3 in the week

The first to 5.59×610 colonies/ m^3 in the fourth week) is the Great (and then van Low the cluster of the man-dar (1.20×610 colonies/ m^3) (Al -Duna)

3 - Streptococcus:

The leaving the decorative zipper is 0.13×610 colonies/ m^3) Al -Duna (in the first week to 0.97×610 colonies/ m^3 in the fourth week) the Great Ma

Greatest value	Minimum value	standard deviation	arithmetic mean	Age (week)
5.30	1.3	1.2	2.88	1
6.8	0.5	2.9	4.88	2
7.99	1.4	2.3	6.9	3
7.5	3.7	1.9	4.8	4
4.9	1.13	1.7	3.8	5
2.88	0.5	0.19	5.8	6

Hence, leaving the decorative decrease in the fifth and sixth week.

Table and scheme 3 x (: Leaving the nodes 610 colonies/ m^3 (in the air of the barns Al -Farraj, * It means a - $p < 0.05$ ** It means a p

Greatest value	Minimum value	standard deviation	arithmetic mean	Age (week)
0.18	0.08	0.06	0.13	1
0.7	0.15	0.06	0.44	2
0.77	0.22	0.25	0.55	3
0.66	0.44	0.23	0.36	4
0.34	0.13	0.07	0.24	5
0.55	0.08	0.18	0.22	6



4 - The bacteria are negative gram:

The existence of fluctuation was observed in leaving the licking of a gram of gram. In the first week, 0.423 x 610 colonies / m³ b n as the dungeon was in the week The third 0.086 x 610 colonies / mTable and scheme 4 x (: Leaving the licking of a rg on 610 colonies/m³ (in airAl -Farouj Hands, * It means a - P

Greatest value	Minimum value	standard deviation	arithmetc mean	Age (week)
0.256	0.875	0.986	0.139	1
0.739	0.894	0.743	0.449	2
0.771	0.223	0.255	0.559	3
0.667	0.442	0.230	0.364	4
0.341	0.132	0.079	0.243	5
0.554	0.085	0.189	0.221	6

Fungi:

If he left fungi, I did not increase with age It ranges at 88 x 310 colonies / m³ fourth week (to 145 x 310) Fifth (colony/ m)

Table and scheme 5 x (: Leaving the fungi 310 colony/m³ (p broiler pens air, * It means a - p <0.05 ** I mean a p

Greatest value	Minimum value	standard deviation	arithmetc mean	Age (week)
234	26	29	156	1
134	34	48	356	2
245	27	55	167	3
243	39	29	245	4
245	18	77	145	5
276	25	28	177	6

Celsius of bacterial groups of general bacterial concentration (germs concentration Moderate heat (in the air of broiler pens):

The percentage of stifled halls represented 46.6 - 60 % of the general bacterial in the noma, the nodes of the nodes represented 2.3 - 28.5 % of the general bacterial leak.

The percentage of boundaries is a gram of gram. 1 - 7.4 % of it

Table and scheme 6: The percentage of the bacterial groups of the general bacterial bacterial in the air of the broilers:

The bold gram	Nodal	Code	arithmetc mean	Age (week)
7.3%	3.2%	7.6%	156	1
2.7%	2.8%	3.9%	356	2
3.9%	3.5%	3.5%	167	3
2.8%	2.5%	7.9%	245	4
3.8%	4.6%	4.7%	145	5
1.1%	7.8%	8.9%	177	6



Table 7: The results of the temperature, lighting, humidity, and the density of the day when taking Non

Density	Lighting	Moisture	temperature	Age (week)
30.6	43	47.9	25.6	1
22.9	50	78	22.8	2
21.9	53	77.9	23.9	3
23	44	66.9	21.8	4
26	48	79.9	19.9	5
35	46	80	27.6	6

Discussion

The leaving the bacterium is a moderate temperature) Fortune of Al -Faroura, I will go by) 2 x 610 - 9.81 x 610 (colony / m³ and cookies The cluster ranges from) 1.20 x 610 - 5.59 x 610 (colony / m³ and contracts It ranges from) 0.13 x 610 - 0.97 x 610 (colony / m³ and lumps a gram that ranges B n) 0.086 x 610 - 0.423 x 610 (colony / m³ and the level of bacterial pollution in the air of the broiler sheds is high Recommended for the level of bit [13]. that leaving the bacterium is an air Luck is a raw in n) 510 - 6 x 510 (colony/m³) The results have proven that leaving the bacterium is generally increased with the age The period of poisoning has been observed that it was noticed that the bacterium is left of 5.69 x 610 colonies/m³ in the first week for the Great Mi -Mi From the poisoning and then returned to the first and sixth level in the fifth and sixth week from the age of the day and perhaps the reason is that the leaving the bacterium is left in the end of the period of poisoning the moisture of the air and the weight of the cab is in the moisture of the mattress and the decrease in the movement Its size and weight in the end of the period of poisoning, all of this led to a decrease in the transmission of dust and luminous mm From the mattress to the atmosphere of luck, and this is compatible with the research conducted by[11] .The research conducted by a group of researcher N.[14]Notice more, leave the bacterium, with the age The Great Mainness was to leave the bacterium in the sixth week of life (The cluster of the cluster represented (46.6 - 60) % of the heat -infection The moderate) The general bacterium is (it was often more than the recommended to the recommended With regard to the general bacterial in the Nama, the contracting hooks represented 2.3 - 28.5 %, which were within the recommended water, and most of the health references assume that the percentage of associates[15]. The cluster must be less than 50 % of the whole number of spores in the moderate heat as for the nodes, it must be less than 25 % of the whole number of bit Moderate heat. [10] The results indicated Most of the boundaries are in the air of broiler pens, a gram of gram, and the reason is due to the reason These results to the casual resistance to the boundary are a gram that enjoy the wall of the nickname It is one of the factors of the capacity of the boundary, which is a gram of lower grams and not exceeding 1 - 7.4 %, and this is compatible with the researcher [12]. The numbers of breakfast were high and within the acceptable limits in the fortune of Al -Faruj Its ratio in the fortune of the broiler was ranging from (88 x 310 - 145 x 310 (which is the highest rate of leaving the breakfast that was recorded by a study of a limit on 6 pens for the broiler in Roman 16.7 x 310 - 81 x 310 Silvana et al I did not increase with age and this is compatible with Also with the researcher N Vucemilo [16].

Conclusion

This study demonstrated that the air quality inside the broiler barns was characterized by a high microbial load, particularly during the mid-production cycle. The concentration of thermophilic bacteria increased progressively until the fourth week of rearing, reaching its maximum level, before decreasing in the fifth and sixth weeks. Staphylococcus species represented the largest proportion of bacterial contaminants (46.6–60% of the total bacterial count), while streptococci and Gram-negative bacteria contributed lower percentages that generally remained within recommended limits. Fungal contamination was also observed, with values ranging from 8.8×10³ to 14.5×10³ colonies/m³, which are relatively high but still comparable with levels reported in similar studies. Environmental conditions such as temperature, humidity, ventilation, and stocking density were found to strongly influence microbial concentrations in the barn air. The results highlight that poor ventilation, high moisture, and litter quality can significantly increase microbial contamination, which may pose risks to bird health and farm productivity. Overall, the findings emphasize the need for strict biosecurity measures, improved ventilation, regular litter management, and the possible use of air disinfection strategies to reduce airborne microbial loads in broiler production systems. Continuous monitoring of microbial air quality is recommended to ensure both animal health and food safety.

Acknowledgement

The authors would like to thank the Department of Internal Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Omar Al-Mukhtar University, Libya, for providing technical support and guidance during this work.



ETHICS

This study did not involve human participants or experimental animals that required ethical approval. The authors affirm that all procedures were carried out in accordance with institutional and scientific ethical standards.

Conflicts of Interest

The authors declare no conflicts of interest.

Author contributions: M.A. (Mohamed Abdel-Ati) conceived and designed the study, performed the experimental work, and analyzed the data. A.S.A. (Ahmed Saad Abraik) carried out sample collection, laboratory experiments, and contributed to data analysis. M.I. (Muhannad Idris) provided technical assistance and helped with data interpretation. I.A-S. (Ibrahim Al-Saadi) supervised the project and critically revised the manuscript.

Funding: This research received no external funding.

References

1. Swayne, D.E., Diseases of poultry. 2013: John Wiley & Sons.
2. Saif, Y., Diseases of poultry. 2009: John Wiley & Sons.
3. Chauhan, H., Poultry diseases, diagnosis and treatment. 1996: New Age International.
4. Pattison, M., et al., Poultry diseases. 2007: Elsevier Health Sciences.
5. Jones, P., et al., A review of the financial impact of production diseases in poultry production systems. *Animal production science*, 2018. 59(9): p. 1585-1597.
6. Bagust, T.J., Poultry health and disease control in developing countries. the role of poultry in human nutrition, 2013: p. 96.
7. Asfaw, Y.T., et al., Poultry disease occurrences and their impacts in Ethiopia. *Tropical Animal Health and Production*, 2021. 53(1): p. 54.
8. Abdisa, T. and T. Tagesu, Review on Newcastle disease of poultry and its public health importance. *J. Vet. Sci. Technol*, 2017. 8(3): p. 441.
9. Hall, W.J. and E.E. Wehr, Diseases and parasites of poultry. 1953: US Department of Agriculture.
10. Zhou, Z., B. Shen, and D. Bi, Management of pathogens in poultry, in *Animal agriculture*. 2020, Elsevier. p. 515-530.
11. Asfaw, M. and D. Dawit, Review on major fungal disease of poultry. *Br. J. Poult. Sci*, 2017. 6(1): p. 16-25.
12. Berg, T.P.V.D., Acute infectious bursal disease in poultry: a review. *Avian pathology*, 2000. 29(3): p. 175-194.
13. Humphrey, T., Are happy chickens safer chickens? Poultry welfare and disease susceptibility. *British poultry science*, 2006. 47(4): p. 379-391.
14. Fussell, L.W., Poultry industry strategies for control of immunosuppressive diseases. *Poultry Science*, 1998. 77(8): p. 1193-1196.
15. Kogut, M.H., Cytokines and prevention of infectious diseases in poultry: a review. *Avian Pathology*, 2000. 29(5): p. 395-404.
16. Pearl, R., F.M. Surface, and M.R. Curtis, Diseases of poultry: their etiology, diagnosis, treatment, and prevention. 1915: Macmillan.