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Impact of Infectious Avian Coryza in a Layer Farm in Villa Clara Province, Cuba

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Abstract **Original Research Article**

Infectious coryza is an infectious contagious disease of bacterial origin that affects the upper respiratory system of poultry. The objective of the study was to evaluate the impact of poultry infectious coryza in a poultry farm in Villa Clara province, Cuba, during the epizootic period of the disease. For the study, clinical examinations and necropsies were performed, and samples were sent to the laboratory. An analysis of the existing information in the Integral Registration System of the unit was carried out. Egg production indicators and epizootic indexes were evaluated and economic losses were determined. The main epizootic indexes in the layer population affected by an episode of avian infectious coryza showed moderate mortality and lethality, as well as considerable losses due to negative selection or culling. The main clinical symptoms were mucous oculo-nasal secretion, sneezing, feather soiling in the anterior region of the neck, swollen heads and decreased egg production. Upper respiratory tract lesions prevailed and there was evidence of secondary invasion by other germs causing panophthalmia and purulent exudates. The economic losses generated by the outbreak were associated with the trend in the decrease of egg production and viability.

Keywords: Avibacterium Paragallinarum, Laying Hens, Poultry Distemper, Villa Clara.

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INTRODUCTION

Poultry farming in Cuba has a favorable situation with respect to the incidence of diseases of great diffusion power and magnitude, however, the lack of material and financial resources to improve biosecurity conditions and disease prevention programs have had a negative impact on the main health indicators and epizootiological surveillance (Boado et al., 1991; Colás et al., 2011; Lazo et al., 2015).

The poultry industry has been developing at an astonishing pace during the last decades (Chen et al., 1998; Jacobs et al., 2003; Abd El-Ghany, 2011). This development has been favored by improvements in the genetic selection of the different layer poultry strains (Blackall et al., 1994; Chen et al., 1998; Jacobs et al., 2003). Remarkable advances have also been made in nutrition, intestinal welfare and management (Soriano & Terzolo, 2004; Mendoza et al., 2009; Gamieta, 2019). The combination of all these processes and their optimization have allowed poultry farming to respond to the important demand for feed worldwide (Abd El-Ghany, 2011; Cuellar, 2021; Gh, 2021).

Avian infectious coryza is an infectious-contagious disease of bacterial origin with acute course that primarily affects the upper respiratory system of birds, characterized clinically by producing nasal catarrh (coryza) and edema with facial swelling (face). The causal agent is the bacterium *Avibacterium paragallinarum*, ex *Haemophilus paragallinarum*. Its presentation is seasonal and although it can affect birds, it occurs much more in chickens and hens of any age, the most important clinical manifestations are observed in adult birds, the most notorious clinical sign is severe facial edema, accompanied by a marked decline in egg production in laying hens (Abd El-Ghany, 2011; Gamieta, 2019; Lorenzoni, 2021).

The economic impact of this disease lies in the losses it causes to poultry farming, due to the drop in egg laying production, weight loss of affected birds, growth retardation, increase in the number of culled birds and predisposition to complicated chronic respiratory disease. In laying hens, egg production can be considerably reduced, reaching values between 10 and 40% of laying (Shane, 2005; Patil et al., 2018; Deresse et al., 2022).

Poultry health and biosecurity, together with genetics, nutrition and management, are the main pillars on which poultry production is based, both in intensive or highly technical and large-scale systems and in non-intensive and low-scale systems such as small family and subsistence production (Jacobs et al., 2003; Abd El-Ghany, 2011; Rahway, 2022). It is of vital importance to prevent birds from thermal stress as a way to maintain productive levels and flock health (Gabarrou & Ezanic, 2021).

Poultry in Cuba have historically been an important complement to the domestic economy, and diseases often put these family productions at risk, so implementing adequate prevention and control measures is essential to make these farms sustainable and sustainable over time (Rosete, 2008; Colás et al., 2011; Cruz, 2018).

The objective of the study was to evaluate the economic-sanitary impact of avian infectious coryza in the "Marrero" poultry farm.

MATERIALS AND METHODS

The retrospective epizootiological study was carried out in the poultry farm for laying production purposes, belonging to the Basic Business Unit (UEB) "Marrero", of the Poultry Enterprise Santa Clara, located in the city of Santa Clara, capital of Villa Clara province, Cuba. During the epizootic period of an infectious outbreak of "avian infectious coryza", which occurred from June 7 to September 16, 2021. Clinical examinations and necropsies were performed on birds, as well as the sending of bird heads to the Provincial Center of Epizootiology and Veterinary Diagnosis of Villa Clara to corroborate the presumptive field diagnosis.

An analysis was made of the existing information in the UEB's Integral Registration System (incident book, necropsy control, production plans and programs, daily operating reports and the information issued by the OVUX on a decennial and monthly basis). Egg production, laying percentage, eggs per bird and viability indicators were evaluated. Months were considered as repetitions and the monthly epizootic mortality and lethality indexes were found, applying the following formulae:

Viability: (Final Stock + Outputs) / (Initial Stock + Inputs) X 100.

Mortality: No. Dead + Culled Birds / Average Stock X 100.

Lethality: No. Dead Birds / No. Sick Birds X 100.

To determine the economic losses in the months in which the birds were affected by the outbreak of infectious avian coryza, data from the Directorate of Economics were compiled with the monthly closure of key indicators.

Statistical processing of the data

The mean and median central tendency statistics were calculated and an absolute and relative frequency distribution of symptoms and lesions was calculated. The total egg production indicator was compared using a simple rank analysis of variance, and when differences were found, multiple comparison test of means was used (Dunnett, 1955). The egg per bird and feed consumption per bird indicators were compared using the Kruskal-Wallis test (Kruskal and Wallis, 1952). The comparison of the proportion of birds killed and culled by infectious coryza with respect to birds killed and culled in total was made by a multiple ratio comparison test. The statistical package STATGRAPHICS PLUS version 5.1 was used.

Ethical Aspects

The results of this study were only used for scientific purposes. The research was approved by the research ethics committee of the institution where the study was conducted (Basic State Unit (BSU) "Marrero"). The research was governed by the ethical principles of biomedical research and the provisions of the Declaration of Helsinki (WMADH, 2024).

RESULTS AND DISCUSSION

In the sanitary characterization of the unit, it was appreciated that the houses complied with the geographical orientation established in the Poultry Breeding Manual, an acceptable management, so it was considered a protected unit, which complied with the sanitary quality parameters. As essential positive elements, it was found that the sanitary filter and disinfection boxes were activated and the workers complied with the general biosecurity measures, as well as the daily change of clothes and footwear. The warehouse was in perfect condition and organization. All the protective covers of the sheds were intact and with adequate diameter in the cavities. It had an integrated perimeter fence. The unit was perfectly whitewashed, as well as its corridors and halls (Rosete, 2008; Colás et al., 2011; Lazo et al., 2015).

The epizootiological analysis evidenced that the increase in mortality due to respiratory syndrome was associated to several predisposing factors related to inadequate handling of the birds, unfavorable climatic-environmental conditions, nutritional deficiencies, beak cuts, overcrowding, inadequate transfers and transport, besides the persistence of flocks with subclinical infections, which compromise the immune system and the high prevalence of the disease, which coincides with the results obtained by authors in different geographical latitudes (Sandoval et al., 1994; Soriano & Terzolo, 2004; Abd El-Ghany, 2011).

In relation to the predisposing factors that favored the genesis of the outbreak, we agree with Cigoy et al. (2016), who point out that the overcrowding and stress of these rearing systems increase the susceptibility of the birds and the contagion. Furthermore, we agree with Gabarrou & Ezanic (2021), who state that environmental stress induced by some management factors contributes to the development of avian infectious coryza and other diseases.

The epizootic process/outbreak of avian infectious coryza started on June 7, 2021, with 9,500 susceptible birds and 1,500 sick birds. The treatments applied as clinical therapeutic indications were mainly based on antimicrobial drugs in the following doses, routes of administration and frequencies:

Aivlosin (tylvalosin tartrate) in doses of 25 g/200 L of drinking water for three days. Aivlosin plus Chlortetracycline, 1 kg and 600 g/Ton of feed (Ton) for seven to ten days. Aivlosin plus Oxytetracycline, 1 kg and 600 g/Ton of feed for seven to ten days. Labionor 10 mg/kg b.w. for seven days (50 mL/100 L of water). CTC HCL 10% at a rate of 800 mg/kg b.w. orally. Tylobel 0.3 - 0.5 ml/kg b.w. (1.5 mL/bird) for three days and every 24 hours. Streptopenicillin (unproductive birds) 2 mL/bird intramuscularly for two days and every 24 hours.

The practice of a potent synergy with the combination of two antibiotics, Aivlosin at a dose of 2 kg per ton of feed, plus chlortetracycline at a dose of 6 kg per ton of feed for seven days, did not show the expected results, since incidence, morbidity and mortality were not considerably reduced as expected. Therefore, it was decided to administer Labionor (norfloxacin) at a dose of 50 mL per 100 L of drinking water for seven days, but the lethality and mortality per bird killed were considerable.

In view of this unfavorable result, a possible co-infection of bacteria as secondary invaders of the primary process was suspected, probably *Pasteurella multocida* and/or *Escherichia coli*, so it was decided to administer CTC HCL at 10% in the drinking water at a rate of 800 mg/kg live weight for ten days, achieving better productive results and the incorporation of many birds to laying, results that agree with those obtained by other authors (Gambieta, 2019; Cuellar, 2021; Deresse et al., 2022).

Since there was a high incidence of birds with respiratory symptoms and high prevalence (many birds with recurrence of the disease), it was decided to administer a Tylobel intramuscular antibiotic at a dose of 0.5 mL/bird, IM (pectoral muscles of the breast region), every 24 hours, for three days.

At this stage of the disease the birds had lost a lot of weight and it was assessed that they were with an average weight of 1000 gr/bird. Birds in negative selection whose recovery was very compromised and whose production was null (assessed by clinical inspection), were administered intramuscular antibiotics; but in this case Streptopenicillin at a dose of 2 mL/bird, IM, every 24 hours, for two days, which contributed favorably to the closure of the outbreak.

The epizootiological analysis allowed the identification of some sanitary breaches related to an inopportune flock movement and inadequate location of birds with multiple ages. In addition, it was evident the absence of previous antibiogram tests necessary to optimize and increase the effectiveness of the treatments to be applied and the sanitary zootechnical principle all full all empty (Sakamoto et al., 2012; Cruz, 2018; Gabarrou & Ezanic, 2021).

On the other hand, there was little effectiveness of the therapeutic treatments applied with oral antibiotics, especially in the feed, since it was not possible to perform the pre-mixing homogenized correctly in the feed mill, and this performed manually in the unit, did not always have the same effectiveness, which coincides with other results obtained in this regard (Atker et al., 2016; Dwivedi et al., 2018; Lorenzoni, 2021).

In relation to the inadequate placement of birds with multiple ages, we agree with the criteria of Cigoy et al. (2016), who state that *Avibacterium paragallinarum* does not persist for long in the environment, and therefore the main reservoir of the infection are birds that have become sick and, once cured, do not show any signs of the disease, but continue to host the bacterium in a chronic way. These carrier birds remain apparently healthy for a long time, but infect new young susceptible birds that are introduced in the farms. Therefore, rearing birds on multi-age farms is not recommended.

We agree with Cruz (2018), Lorenzoni (2021) and Rahway (2022) when they state that birds that recover from the disease can harbor the A. paragallinarum bacteria for a long time, even for life and without showing any clinical signs (asymptomatic carriers); for this reason, it is quite difficult (or impossible) to eliminate this disease in farms where an "All in - All out" system is not practiced.

The authors of this study consider that, upon suspicion of respiratory processes of infectious nature in birds, it is necessary to act promptly and corroborate the presumptive diagnosis in the field, with laboratory tests including antibiogram. In addition, permanent negative selection is essential to eliminate sources of primary infection, the correct management of birds to avoid stress, aspects that constitute very effective preventive and recuperative measures to avoid an increase in morbidity (Sandoval et al., 1994; Abd El-Ghany, 2011; Lorenzoni, 2021).

It was demonstrated that in the conditions of the epizootiological scenario where the study was carried out, when concomitant infections or microbial synergism in respiratory processes with bacterial etiology were suspected, the most effective therapeutic treatment was the intramuscular administration of Tylobel at a dose of 1 mL/bird for three consecutive days, without implying economic losses due to egg seizure, which is in agreement with what was obtained by other authors in this regard (Mendoza et al., 2009; Guo et al., 2022; Rahway, 2022).

As shown in Table 1, the main clinical symptoms observed were mucous oculo-nasal discharge, sneezing, feather soiling of the anterior neck region, swollen heads and decreased egg production.

Table 1. Main clinical signs observed in 100 birds affected by avian infectious coryza at UEB Marrero.

Clinical symptoms	Percentage
Drowsiness	70
Hyperoxia	90
Sneezing	100
Nasal and ocular discharge	99
Increased volume in the head region	65
Ruffled feathers	85
Dirt on the feathers of the anterior neck region	100
Panophthalmia	20
Characteristic odor in the interior of the house*.	
Decreased egg-laying*.	

* Signs observed in the inspection of affected houses with the presence of sick hens.

We agree with Sánchez et al. (2010) who state that the characteristic signs of infectious coryza include serous or mucous nasal exudate, sneezing, inflammation of infraorbital sinuses, facial edema and conjunctivitis. Also, the results achieved in our study agree with those obtained by Dinev (2021), who points out that infectious coryza is manifested mainly by rhinitis and infraorbital sinusitis. In general, the first signs are rhinitis with seromucous discharges, often desiccated around the nostrils.

During the inspection of the flock, it was observed that there was a considerable volume of feed sweepings due to the birds' refusal to eat, and although consumption was adjusted weekly to avoid greater economic losses, the increase in the occurrence of sick birds on a daily basis considerably affected feed consumption. In addition, the decrease in laying was evident and a characteristic odor was detected by olfaction inside the house.

These results agree with Cigoy et al. (2016) who point out that, Infectious coryza causes a decrease in feed consumption; consequently, in the case of laying hens, laying is considerably reduced between 10 and 40%. Furthermore, they agree with Lorenzoni (2021) and Rahway (2022), who stated that the loss of meat and egg production is commonly high.

Table 2 shows the main lesions or anatomopathological findings identified in the necropsies performed in birds with clinical symptoms of avian infectious coryza.

The findings show typical lesions of different stages of the infectious process, with a prevalence of lesions in the upper respiratory tract and evidence of secondary invasion of other germs causing panophthalmia and purulent exudates.

Table 2. Anatomopathological lesions observed in 100 birds affected by avian infectious coryza in the UEB Marrero.

Injuries	Percentage
Edema in the subcutaneous tissue of the head region and cellulitis.	60
Sinusitis at the level of infraorbital sinuses with caseous exudate	65
Catarrhal laryngitis with petechiae on laryngeal mucosa	100
Mucopurulent exudate in nasal sinuses	99
Tracheitis and pneumonia	10
Panophthalmia	20

Table 3 shows that morbidity was 100%, and that viability was affected not only by the high mortality, but also by the sanitary slaughter, which was necessary as an anti-epizootic measure to eliminate birds that were highly affected or recurrent in the infectious process in order to control the outbreak.

Table 3. Main epizootic indexes found in the bird population of UEB Marrero during the outbreak of avian infectious coryza.

Susceptibles	Sick	Deads	Sacrificeds	Mortality (%)	Lethality (%)
109 489	109 489	9 324	2 795	11.06	8.51

These results coincide with Sánchez et al. (2010) who state that lethality is usually very low, although morbidity is very high.

Table 4 shows the economic-health impact in terms of economic losses as a result of dead birds, taking into account that the cost of one bird was valued at 60.00 CUP.

Table 4. Economic losses due to deaths at UEB Marrero during the outbreak of infectious avian coryza.

Deads	Cost /U	Losses (CUP)
9 324	60.00 CUP	559 440

Legend: CUP: Cuban peso.

Economic losses were generated by mortality, in addition to the decrease in egg production and the increase in the number of birds with pathological findings compatible with Cachexia and irreversible Osteomalacia. The number of dead and culled birds affected viability.

These results coincide with those reported by Sánchez et al. (2010), who point out that economic losses are based on a drop in egg production, which can be high at times. There can also be an increase in the number of culled birds due to complications caused by superimposed bacteria that complicate the situation and lead to chronicity.

Table 5 shows the productive behavior in the different periods (before, during and after the outbreak). Before the beginning of the outbreak, the number of susceptible birds (average stock) was lower than during and after the outbreak was closed ($p = 0.01$).

Table 5. Bioproductive indicators (averages) in the different periods of the year 2021.

Periods	Existence	Egg production	Eggs per bird	Usage (gr/A/D)
Pre-epizootic	51 671	786 796^{b}	15.6	110.20^{a}
Epizootic	109 490	2 146 740^{a}	19.66	108.67^{b}
Post-epizootic	97 883	1 838 909^{a}	18.8	108.3^{b}

Unequal letters in the same column indicate statistically significant differences for $p < 0.05$ (Duncan, 1955).
Legend: Pre epizootic: January-March, Epizootic: June-September, Post epizootic: October-December, gr: grams, A: birds, D: days.

There were no significant differences in the average number of birds in the epizootic and post-epizootic periods. The same behavior was manifested in egg production, i.e., before the outbreak it was lower than during and after the outbreak ($p > 0.05$), and no significant differences were observed between the epizootic and post-epizootic periods. There were also no significant differences in the indicators: egg per bird and consumption, before, during and after the episode.

However, when using the Kruskal-Walli's test, we found that there were significant differences in the medians of feed consumption for each period ($p = 0.01$) with a tendency to decrease in the epizootic and post-epizootic periods. During the outbreak, total egg production is apparently not affected since the average stock of birds is higher and the yield in eggs per bird is statistically similar in t he three periods.

Table 6 shows the productive results and the main indicators of the "Marrero" UEB in the epizootic period from June to September 2021.

Table 6. Results of the productive indicators of the UEB "Marrero" during the infectious coryza outbreak in 2021.

Months	Initial Bird Stock	Production of eggs (U)			Posture Percentage (%)	
		Plan	Real	Compliance %	Plan	Real
June	115 278	59 633	85 463	143.3	66.50	74.10
July	116 026	83 645	62 123	74.3	68.60	53.50
August	109 653	54 545	76 108	139.5	72.31	69.40
September	104 476	80 180	60 841	75.8	71.06	65.90

During the epizootic period, there were always more than 100,000 head of birds in the initial stock. The highest production was obtained in June with 85,463 eggs, the month in which the outbreak began, and then in August there was a recovery, reaching 76,108 eggs. The laying percentage is an indicator closely related to the health status of the flock, so in June, when the infectious process began, the highest value of the sampling was obtained with 74.10%, and in July, when the highest number of deaths and culls (loss of birds) occurred, the lowest laying percentage was recorded with 53.50%.

As in many other diseases, there is a decrease in feed consumption, and laying hens in production experience a drastic reduction in laying (between 10-40%). Morbidity (proportion of affected birds) is high and it is common to observe clinical signs in most birds in a flock. We agree with Lorenzoni (2021), who states that, on the contrary, mortality is normally low, unless there are complications with other pathogens such as *Mycoplasma gallisepticum* or *Escherichia coli*.

Table 7 shows a comparison between the number of total dead and culled birds with respect to the number of birds killed and culled as a consequence of infectious avian coryza.

Table 7. Comparison between the total number of birds killed and slaughtered with respect to these indicators as a cause of the disease in the UEB "Marrero".

Months	Total deaths	Total eliminated	Coryza deaths (%)	Eliminated by coryza (%)
June	3 203	412	387 (12.08)^{c}	243 (58.98)^{c}
July	6 333	815	4 917 (77.64)^{b}	780 (95.0)^{a}
August	4 471	1 821	3 996 (80.38)^{a}	1 742 (95.6)^{b}
September	2 377	2 800	24 (1.00)^{d}	30 (1.07)^{d}
Total	16 384	5 848	9 324 (56.90)	2 795 (47.79)

Unequal letters in the same column indicate significant differences ($p \leq 0.01$) with respect to the global mean.

As can be observed, out of a total of 16,384 birds killed, 9,324 were due to the epizootic process of infectious coryza, representing 56.9% of the total mortality in the stage. Of the birds culled, 47.79% were due to infectious coryza. In August, by applying sanitary slaughter to a greater number of birds that due to their morpho-physiological characteristics and being in relapse of the disease, with very low body weights below 1,300 grams, the closing of the process and the recovery of the viability of the unit in the months following the outbreak was favored.

CONCLUSION

The main epizootic indexes in the layer population affected by an episode of infectious avian coryza in the UEB "Marrero" showed moderate mortality and lethality, as well as considerable losses due to negative selection or culling. The economic losses generated by the outbreak of infectious avian coryza in this unit were associated with the trend in the decrease of egg production and via bility.

Conflict of Interests

The authors declare no conflict of interest.

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