Antimicrobial Stewardship with Eggs

ANTIMICROBIAL STEWARDSHIP (54): USA, EGGS
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Very few data exist globally regarding the use of antimicrobials in the table egg industry. Antimicrobial use data from broiler chickens and turkeys cannot be used as a surrogate of layer chickens because of the fact that table eggs for human consumption are produced daily by laying hens. To avoid the possibility of antimicrobial residues in the eggs, there are very few antimicrobials approved for use in layers in the U.S. The objective of this study was to collect on-farm antimicrobial use data from the U.S. table egg industry and to have it be representative of the national layer flock. Participation was voluntary. Data were collected for the period [2016] through [2021] and are reported on a calendar year basis. Using production statistics from USDA:NASS as a denominator, the data supplied by participating companies accounted for 3,016,183 140 dozen eggs (~40% of national egg production) in [2016] and 3 556 743 270 dozen eggs (~45% of national egg production) in [2021]. All of the replacement chicks placed on pullet farms during the study period were estimated to have received 0.2 mg/chick gentamicin at the hatchery. Most of the antimicrobial administration in U.S. egg production is via the feed. The ionophores

monensin and salinomycin were used in the pullets, bacitracin was used in both pullets and layers (primarily for control of necrotic enteritis), and chlortetracycline was used primarily in layers for the treatment of _E. coli_-related disease. In the layers, between 0.1 and 0.19% of total hen-days were exposed to chlortetracycline. Only 2 water-soluble administrations were recorded during the entire study period, both involving lincomycin to pullet flocks for the treatment of necrotic enteritis. Overall, antimicrobial use in the U.S. layer industry was focused mainly on controlling necrotic enteritis in the pullets and treating _E. coli_-related disease in the laying hens.

Discussion

This report describes the first industry-wide effort to capture antimicrobial use data in the U.S. table egg industry. The study period was 2016 to 2021. Thanks to the voluntary participation of many of the major table egg companies of the U.S., participation rates were high; ~45% of 2021 U.S. egg production as reported by USDA:NASS was included in this analysis (Table 1). Overall, very little antimicrobial is used in the U.S. layer industry. The main antimicrobials used in layer production are the NMI antimicrobial bacitracin (used as bacitracin methylene disalicylate, BMD) and the MI antimicrobial CTC. Both of these in-feed administrations have a zero-day withdrawal for eggs. The use of gentamicin in the hatchery and CTC in the feed of pullets and layers were the only 2 MI antimicrobials used in this dataset covering 6 years of production. The data in this study straddle the [January 2017] date when changes to the in-feed and water-soluble uses of antimicrobials in U.S. animal agriculture were fully implemented. Beginning in [2017], CTC use required veterinarian approval through a VFD. BMD and the ionophores, however, are NMI antimicrobials in the U.S. and therefore do not require veterinary oversight or a VFD, although many companies assign the responsibility of all antimicrobial administrations to the veterinary group.

Necrotic enteritis is primarily caused by _Clostridium perfringens_ and remains an important cause of morbidity and mortality in the pullet phase of production. The disease is characterized by sudden onset, high mortality, and necrosis of the mucous membrane of the small intestine (9) and is sometimes exacerbated by co-infection with coccidia. In the layer phase of production, disease related to _E.

coli_ is the main reason for CTC use. However, there are other disease challenges that the pullets and layers face, including infectious coryza, which is an acute respiratory disease of chickens caused by the bacterium _Avibacterium paragallinarum_ (10).

For these rapidly progressing diseases, such as infectious coryza and some _E. coli_ infections, some veterinarians in this study expressed a concern that there are no water-soluble antimicrobials approved in the U.S. that have a zero-day withdrawal. In Australia, for example, there are zero-day withdrawal approvals of water-soluble CTC, amoxicillin, and lincomycin-spectinomycin combination product (11). Without an approved water-soluble administration in the U.S., the use of water-soluble CTC would have a minimum one-day withdrawal and would result in the destruction of many eggs, leading companies to select the approved in-feed CTC administration. Having approved water-soluble options is desirable, as sick birds are likely to continue drinking but may stop eating (12). Further, water-soluble antimicrobials can be easier to administer to a single barn instead of having to mix a specific medicated ration for a small number of birds.

There are limited published data regarding antimicrobial use in table egg production, but the data that are available make it clear that usage estimates cannot be compared across countries. The British Egg Industry Council (BEIC) is one of the only national AMU datasets that includes data on the table egg industry (13). For [2021], the reported data represented ~90% of the industry, where the national flock is estimated to include 43 million hens. The report estimated that 0.47% and 0.33% of total hen-days were exposed to an antimicrobial in [2020] and [2021], respectively (13). While the data in this U.S. study had a lower estimate of exposure frequency in layers (ranging from 0.1 to 0.19%), the U.S. estimates do not include the use of BMD in the layers due to lack of granular data for this antimicrobial. The UK data reports that the main MI antimicrobial class used was the tetracyclines, similar to the U.S. data. However, the UK report also states that other classes used in the laying hens included pleuromutilins, macrolides, penicillins, aminoglycosides, fluoroquinolones, polymyxins, sulfonamides, lincosamides and combination products (13). Some of these compounds are illegal to use in U.S. layers, and none of these classes was used in U.S. layers, in part because of the lack of water-soluble options in the U.S. with zero-day withdrawal.

Reports of AMU in the Netherlands (14) focus on the use of colistin in layers; this antimicrobial has never been approved for use in animal agriculture in the U.S. Other classes used in layer production in the Netherlands included polymixins, macrolides/lincosamides, penicillins, pleuromutilins, and a small amount of tetracyclines. Many of these classes were also used in layer pullets. The report from the Netherlands (14) does not detail the amounts of these classes used or the diseases targeted but instead reports the frequency of farms that used each antimicrobial class. In Denmark, national data are reported by DANMAP, but the report only includes sales data by species, which separates layers from broiler and turkeys (15). In [2021], penicillins and tetracyclines were the 2 primary antimicrobials sold for use, reported on a kg basis. These sales data provide no distinction between pullets and layers and also provide no information regarding diseases targeted by treatment. The DANMAP report includes usage data, but the data for poultry do not separate the individual poultry commodities. Finally, there are individual studies reporting antimicrobial use in layers in other countries, but these studies are not intended to be representative of national production. In Nigeria, there was reported use of gentamicin, tetracycline, enrofloxacin, ciprofloxacin, penicillin, streptomycin, chloramphenicol, erythromycin, and others in laying hens (16). According to this study, much of the use was prophylactic. In a study from Bangladesh, antimicrobials such as ciprofloxacin, amoxicillin, tetracyclines, macrolides, and others were used in layer production (17). Finally, a survey conducted in Brazil of veterinarians working with layers reported that fluoroquinolones and macrolides were 2 of the most common antimicrobials used (18). With different countries having different antimicrobial classes approved for use in layer chickens, and very few of the datasets including on-farm usage, it would seem ill-advised to make comparisons of AMU in the table egg industry across countries.

In this study, 100% of the chicks placed on pullet farms likely received gentamicin at a dose of 0.2 mg/chick at the hatchery. This is due, in large part, to the unique contractual arrangements between the day-old chick production companies who own the hatcheries and the commercial operations who source their replacement pullets from the day-old chick production companies. This administration of gentamicin to the chicks includes those that will be raised on operations that

will eventually sell their eggs as organic. Whereas, the organic rule in the U.S. prohibits all uses of antimicrobials in animals or animal products that will be marketed as organic (19), even if the animal is sick, the organic designation for poultry starts after 72 h (2nd day of life on the farm that is being managed as organic). Specifically, the organic rule in the U.S. states "Poultry or edible poultry products must be from poultry that has been under continuous organic management beginning no later than the 2nd day of life" (19). This rule, which prohibits the treatment of sick animals with antimicrobials and thus might seem contrary to the ideals of good animal welfare, is different than the organic rule in other locations, such as in Europe, where the rule states that "antibiotics may be used under the responsibility of a veterinarian" (20).

There were limitations to this first effort to collect antimicrobial use data from U.S. layer production. First, the effort targeted the major table egg companies that are included on the annual WATT Poultry USA list; although this list might miss some of the small producers, the majority of U.S. production is included in this list. Future efforts will seek to enroll more companies on this list and then expand to the small producers not included on the list. Second, the companies that were enrolled included different production types: conventional caged, cage-free, enriched colony, free-range and organic. Many of the companies produce eggs in more than one of these production systems. A limitation of the collected data is the inability to stratify the usage information by production type, as companies tend to use more than one production type. Antimicrobial usage information is only for flocks that were exposed to an antimicrobial, whereas the denominator information is for the entire company within a given year. Third, granularity in the data regarding the NMI antimicrobials (ionophores and bacitracin) was not as good as the data for CTC administrations. This is due, in large part, to the requirement that a VFD be completed for all in-feed administrations of MI antimicrobials. Going forward, this project will work with participating companies to improve the recordkeeping of all antimicrobial uses.

Overall antimicrobial use in the U.S. layer industry appears to be minimal, focused mainly on controlling necrotic enteritis in the pullets and treating _E. coli_-related disease in the laying hens. The only antimicrobials used in layer production were CTC, bacitracin, and

2 ionophores. Gentamicin was used in the hatchery. Regardless, there are still opportunities to improve antimicrobial stewardship, for example, by improving recordkeeping, ensuring that all uses of CTC are necessary and effective, and by helping veterinarians in the U.S. table egg industry obtain access to effective water-soluble therapies for key layer chicken diseases.

[The full journal article, including the table, figures, and references, is available at the source URL. - Mod.ML]

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