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Passerines (songbirds) and softbills (toucans and mynahs) are increasingly presented for veterinary care as pet owners and aviculturists recognize that successful medical and surgical treatment can be performed, even in these often tiny patients. Many veterinarians are relatively unfamiliar or even uncomfortable with passerines and softbills. The aviculture, diagnostic procedures, common diseases, and treatment have been discussed in recent publications. 

This article presents a short introduction to these two large groups of birds. The order Passeriformes contains over 5700 species, with body weights ranging from 4.8 g to 1350 g. Toucans and mynahs are often grouped together but are from different taxonomic orders. Toucans are members of the family Ramphastidae (order Piciformes); mynahs are members of the family Sturdidae (order Passeriformes). The most commonly kept mynahs are the *Gracula* species (hill mynahs).

Diseases in these birds are very much influenced by nutrition, environment, and stress. For an optimal approach to veterinary problems, including diagnosis and treatment, one must become familiar with the aviculture, housing, and husbandry of these species. Supportive care and measures to minimize stress are often needed to maintain or increase the host’s defense mechanisms.

Medicating these small pet birds is accomplished by the same methods of administration used in mammals and psittacines but with several special points borne in mind. These small birds have a high metabolic rate and therefore antibiotics and chemotherapeutics are eliminated.
quickly; this means drug application at short intervals (inducing stress) or at high levels (causing toxicity). Treating flocks of these birds gives rise to practical problems.

**BASIC INFORMATION**

Passerines (perching- or songbirds) constitute more than one half of the species of birds of the world, presently comprising approximately 5700 species assigned to 1161 genera. They represent a diverse, species-rich, monophyletic order of mostly small land birds. The commonest representatives of the passerines in captivity are canaries, finches, and mynahs.

The canary (*Serinus canaria*) is the most well-known representative of the songbirds. Canaries have been domesticated for a long time (since 1600) and are bred and kept for their song (e.g., Roller canary, American singer), their colors (colored canaries), or their build and shape. Their weight is 15 g to 25 g. The sexes are alike, and their lifespan is 6 to 16 years.

There are almost 1000 species of finches and weaver relatives that comprise Old World granivorous and insectivorous birds, including weaverbirds and estrildine finches; the ground-living wagtails, pipits, and accentors; the nectar-feeding sunbirds and flower peckers; sugarbirds and a few Australasian taxa; and the New World wood warblers, tanagers, and blackbirds, recognized by a strongly reduced tenth primary. The more domesticated species have been bred in captivity for many decades, but many finches are still imported from Asia and Africa. There is a fair amount of disparity in size between the common finch pets (smallest: gold-breasted waxbill 7 g; largest: Java rice sparrow, 20 g). The commonest finches belong to the family Fringillidae and Estrildidae.

Mynahs (*Gracula* spp.) and starlings are members of the family Sturdidae (Passeriformes); a family of insect- and fruit/berry-eating songbirds comprising over 110 species. They are commonly referred to as grackles. The mynahs are kept mainly because of their ability to mimic the human voice. The commonest species is the Hill mynah (*Gracula religiosa*), which has seven subspecies and originates in Southeast Asia. The veterinary approach to these pet birds is comparable to that for the psittacine birds. They are kept mostly as single pet birds. The starlings include the Pagoda starling (*Temenuchus pagodarum*), superb glossy starling (*Lamprospreo superb*), and purple glossy starling (*Lamprotornis purpureus*). These birds are predominantly kept as aviary birds. The average body weight of the lesser Indian Hill mynah (*Gracula religiosa indica*) is 110 g to 130 g, that of the Java Hill mynah (*G. r. intermedia*) is 150 g to 200 g, and that of the Greater Hill mynah (*G. r. religiosa*) is 210 g to 270 g.
Toucans, or ramphastids, are neotropical birds and are grouped in three general categories: the large toucans, the smaller toucanettes, and the small and slender aracaris. Ramphastids are distinguished by a large, elongated bill, which varies in coloration from black to multicolored. Only a few species are seen in captivity, including the Toco toucan (*Ramphastos toco*) and the sulphur-breasted or keel-billed toucan (*R. sulfuratus*).

**METABOLIC CONSIDERATIONS**

Even with the increasing amount of pharmacokinetic data in birds, the use of extrapolated drug regimens continues to be common practice for these species. This extrapolation, using allometric scaling from human, mammalian, and avian drugs to passeriformes and softbills, is complicated and has its limits. Most of the patients belonging to the passeriformes and softbills (nonpasserine) have a low bodyweight (BW). This low BW, combined with these birds' high basal metabolic rates (BMRs), make accurate dosage of therapeutics important.

Most formularies for pet birds are based on information derived from studies in poultry, parrots, or pigeons. The advised individual dosages and drinking water concentrations can be considered to be based on an average bodyweight of 400 g to 500 g and a drinking water intake of 40 to 60 mL/kg BW for birds of about 500 grams. Average BMR is expressed by the formula BMR (kcal) = K(W kg ^ 0.75). The BMR of the passerine bird (K = 129) is 50% to 60% higher than those of nonpasserines (K = 78) of the same body size. This knowledge should be used to calculate a dosage regimen; in this article the dosages are expressed in mg/kcal. For a quick reference, the conversion of BW (g) to basal metabolism (kcal/day) is presented in Table 1.

The calculation of the concentration for drinking water medication should be based on the daily water intake. Although some desert passerines (e.g., zebra finches) have been known to survive months without drinking water, the smallest passerine birds drink from 250 to 300 mL/kg BW daily and can eat up to 30% of their BW daily. This is much more than the generally advised 40 to 60 mL/kg BW for larger parrots. For an average parrot of 500 g with a basal metabolism of 46 kcal/day, the amount is about 0.5 mL/kcal/day. It might be wise to use this amount of total water intake as a starting point for these small birds. Using the dose in mg/kcal and a drinking water intake of 0.5 mL/kcal, the drug concentration per liter will be independent of the species and therefore the same for all birds (Tables 2 and 3). This is a good starting point when no experimental data are available. The daily water consumption, however, is very much influenced by environmental temperature, type of diet (e.g., fruits), and original habitat of the bird (desert). When using this information for calculating the drinking water concentration for the treatment of flocks of finches, the owner should always...
Table 1. CONVERSION OF BODY WEIGHT (g) TO BASAL METABOLISM (kcal) FOR PASSERINES (Pass) AND NONPASSERINES (N-pass).

| BW (g) | Pass | N-pass | BW (g) | Pass | N-pass | BW (g) | Pass | N-pass |
|--------|------|--------|--------|------|--------|--------|------|--------|
|        |      |        |        |      |        |        |      |        |
| 10     | 4    | 2      | 155    | 32   | 19     | 480    | 74   | 45     |
| 11     | 4    | 3      | 160    | 33   | 20     | 490    | 76   | 46     |
| 12     | 5    | 3      | 165    | 33   | 20     | 500    | 77   | 46     |
| 13     | 5    | 3      | 170    | 34   | 21     | 520    | 79   | 48     |
| 14     | 5    | 3      | 175    | 35   | 21     | 540    | 81   | 49     |
| 15     | 6    | 3      | 180    | 36   | 22     | 560    | 84   | 50     |
| 16     | 6    | 4      | 185    | 36   | 22     | 580    | 86   | 52     |
| 17     | 6    | 4      | 190    | 37   | 22     | 600    | 88   | 53     |
| 18     | 6    | 4      | 195    | 38   | 23     | 620    | 90   | 54     |
| 19     | 7    | 4      | 200    | 39   | 23     | 640    | 92   | 56     |
| 20     | 7    | 4      | 210    | 40   | 24     | 660    | 94   | 57     |
| 25     | 8    | 5      | 220    | 41   | 25     | 680    | 97   | 58     |
| 30     | 9    | 6      | 230    | 43   | 26     | 700    | 99   | 60     |
| 35     | 10   | 6      | 240    | 44   | 27     | 720    | 101  | 61     |
| 40     | 12   | 7      | 250    | 46   | 28     | 740    | 103  | 62     |
| 45     | 13   | 8      | 260    | 47   | 28     | 760    | 105  | 63     |
| 50     | 14   | 8      | 270    | 48   | 29     | 780    | 107  | 65     |
| 55     | 15   | 9      | 280    | 50   | 30     | 800    | 109  | 66     |
| 60     | 16   | 9      | 290    | 51   | 31     | 820    | 111  | 67     |
| 65     | 17   | 10     | 300    | 52   | 32     | 840    | 113  | 68     |
| 70     | 18   | 11     | 310    | 54   | 32     | 860    | 115  | 70     |
| 75     | 18   | 11     | 320    | 55   | 33     | 880    | 117  | 71     |
| 80     | 19   | 12     | 330    | 56   | 34     | 900    | 119  | 72     |
| 85     | 20   | 12     | 340    | 57   | 35     | 920    | 121  | 73     |
| 90     | 21   | 13     | 350    | 59   | 35     | 940    | 123  | 74     |
| 95     | 22   | 13     | 360    | 60   | 36     | 960    | 125  | 76     |
| 100    | 23   | 14     | 370    | 61   | 37     | 980    | 127  | 77     |
| 105    | 24   | 14     | 380    | 62   | 38     | 1000   | 129  | 78     |
| 110    | 25   | 15     | 390    | 64   | 38     | 1020   | 131  | 79     |
| 115    | 25   | 15     | 400    | 65   | 39     | 1040   | 133  | 80     |
| 120    | 26   | 16     | 410    | 66   | 40     | 1060   | 135  | 81     |
| 125    | 27   | 16     | 420    | 67   | 41     | 1080   | 137  | 83     |
| 130    | 28   | 17     | 430    | 69   | 41     | 1100   | 139  | 84     |
| 135    | 29   | 17     | 440    | 70   | 42     | 1120   | 140  | 85     |
| 140    | 30   | 18     | 450    | 71   | 43     | 1140   | 142  | 86     |
| 145    | 30   | 18     | 460    | 72   | 44     | 1160   | 144  | 87     |
| 150    | 31   | 19     | 470    | 73   | 44     | 1180   | 146  | 88     |

measure the actual intake and adjust the concentration to reach the desired average drug intake per kcal for the birds being treated.

**HUSBANDRY CONSIDERATIONS**

When designing a treatment plan for passeriformes and softbills, one should consider housing and husbandry. In many situations it is not feasible or economically possible to recommend a treatment that prescribes all birds in a flock to be dosed individually three or four times a
day. Therefore, information about numbers of birds, combination of different species, time in the (breeding) season, and housing are essential for designing a good treatment plan. Also catching and treating softbills several times in a row can be stressful for both the owner and the birds.

The small passeriform birds are kept in captivity as individual pet birds and as flocks in aviaries. Two types of aviaries can be distinguished: mixed ornamental aviaries and breeding aviaries. The former is usually located outside, and different species are kept in it together, mostly for ornamental purposes. In the latter, large numbers of the same species are kept mostly indoors for breeding and selecting. These fanciers often go to shows and competitions, where there is an exchange of birds (and possibly pathogens).

In mixed aviaries, the population (consisting of couples of different species) is less dense, and species-specific diseases are restricted to only a few of the occupants of the aviary. The birds are in the aviary all year with a shed for shelter and a fly-pen outside. Planted aviaries are popular for these passerines because the vegetation provides observers a more natural view of a bird’s behavior. Disease control in planted aviaries presents difficulties related to controlling microorganisms and medicating individual birds. Natural vegetation, however, is often necessary to obtain good breeding results.

In breeding aviaries (located in a garden house or in a loft), housing depends on the season. Canaries are mostly bred indoors. In the breeding season, the birds are mostly kept in couples in small boxlike cages (50 x 40 x 40 cm). Normally the fancier breeds two to three rounds. The weanlings are housed in communal flights with or without outside quarters. In the winter season (resting season) the male and female birds are housed as separate groups in pens. For treatment purposes, this means that all birds are the same species and have the same average BW and water intake. They are also sensitive to the same infectious agents, and all birds must therefore be treated at the same time. The movement of birds in and out the aviary for shows includes the risk of introducing outside infection. Adequate cleaning of the facility, because of many small cages, is sometimes difficult. Owners must therefore be educated about proper hygiene.

The mynahs are mostly kept in aviaries because of their need for mobility (rather than housing them in an indoor cage). Mynahs make a mess of their food and produce much, and often fluid, droppings, which makes them less suitable as indoor house pets.

The toucans and other ramphastids are most commonly kept in captivity as breeding pairs in large flights with numerous, variably sized perches. Like the mynahs, they are active, inquisitive birds that are carnivorous, and if housed in mixed aviaries, they can consume smaller aviary inhabitants or intruding sparrows.

The large amount of moist food that these birds (mynahs and toucans) consume results not only in the production of voluminous and malodorous excrement but also makes treatment through the drinking water difficult. This is possible only when the amount of moist food is
### Table 2. CONVENTIONAL DOSAGE REGIMENS FOR ANTIMICROBIAL DRUGS IN PET BIRDS

| Routes | Dose (mg/kcal) | Dose (mg/kg) | Interval (hr) | Remarks |
|--------|----------------|--------------|---------------|---------|
| **Antibiotics and Chemotherapeutics** | | | | |
| **Betalactams** | | | | |
| Cloxacillin | IM | 2.16 4.31 | 100 200 | 24 | Gram-positives |
| Ampicillin-Na | IM | 3.50 | 150 | 12-24 | Gram-positives |
| Ampicillin-trihydrate | PO | 0.58 | 25 | 12-24 | Gram-positives |
| | PO | 2.80 4.08 | 120 175 | 12-24 | Gram-positives |
| Amoxicillin-Na | IM | 1.17 | 50 | 12-24 | Gram-positives |
| | PO | 5.83 | 250 | 12-24 | Gram-positives |
| | PO | 2.55 4.46 | 100 175 | 12-24 | Gram-positives |
| AX.-long-acting | IM | 2.33 | 100 | 48 | Gram-positives |
| | PO | 2.33 | 100 | 8-12 | Gram-positives |
| | IM | 2.33 | 100 | 8-12 | Gram-positives |
| | PO | 2.33 | 100 | 8-12 | Gram-positives |
| Amoxicillin-trihydrate | PO | 0.47 | 20 | 12-24 | Gram-positives |
| | PO | 2.55 4.46 | 100 175 | 12-24 | Gram-positives |
| Carbenicillin | IM | 2.55 5.10 | 100 200 | 8-12 | Intestinal infections |
| Ticarcillin | IM, IV | 3.82 5.10 | 150 200 | 2-4 | Pseudomonas infection |
| Cefotaxime | IM, IV | 1.62 2.16 | 75 100 | 6-8 | Synergistic with aminoglycosides |
| Cefoxitin | IM, IV | 1.08 1.62 | 50 75 | 6-8 | Synergistic with aminoglycosides |
| Ceftriaxone | IM, IV | 1.62 2.16 | 75 100 | 6-8 | Synergistic with aminoglycosides |
| Cefazidime | IM, IV | 1.62 2.16 | 75 100 | 6-8 | Synergistic with aminoglycosides |
| Ceftiofur | IM | 1.08 2.16 | 50 100 | 6 | Synergistic with aminoglycosides |
| Cephalothin | IM, IV | 2.16 | 100 | 6-8 | Synergistic with aminoglycosides |
| Cephalexin monohydrate | PO | 1.08 2.16 | 50 100 | 8 | Synergistic with aminoglycosides |
| | PO | 0.16 0.23 | 35 50 | 2-6 | Synergistic with aminoglycosides |
| Cephradine | PO | 0.75 1.08 | 35 50 | 6 | Synergistic with aminoglycosides |
| Piperacillin | IM, IV | 4.31 | 200 | 6-8 | Synergistic with aminoglycosides |
| | IM | 1.91 2.55 | 75 100 | 4-6 | Synergistic with aminoglycosides |
| **Polymyxins** | | | | |
| Polymixin B | PO | 1078.07 | 50000 | 12 | |
### Aminoglycosides

| Drug       | Route | Dose | Duration |
|------------|-------|------|----------|
| Neomycin   | PO    | 0.22 | 10       | 24       |
| Streptomycin | PO  | 0.64 | 50       | 100      | 24       |
|            | PO    | 2.33 | 100      | 200      | 24       |
|            | IM    | 0.22 | 10       | 30       | 8-12     |
| Kanamycin  | IM    | 0.22 | 10       | 20       | 12       |
| Gentamycin | IM    | 0.05 | 3        | 10       | 6-12     |
|            | PO    | 1.02 |          | 40       | 8-24     |
| Amikacin   | IM, IV| 0.38 | 15       | 20       | 8-12     |
|            |       | 0.51 | 20       | 40       | 12-24    |
| Tobramycin | IM, IV| 0.05 | 3        | 5        | 12       |

### Lincosamides, Macrolides, and Pleuromutilins

| Drug         | Route | Dose | Duration |
|--------------|-------|------|----------|
| Spectinomycin | IM, SC| 0.58 | 25       | 8        |
|              | PO    | 0.65 |          | 30       | 24       |
|              | PO    | 1.92 | 150      | 250      | 24       |
| Lincomycin   | PO    | 0.82 | 35       | 50       | 12-24    |
| Lincomycin/spectinomycin | PO | 1.08 | 50 | 24 |
| Clindamycin  | PO    | 2.33 | 100      |          | 24       |
| Erythromycin | IM    | 0.23 | 10       | 20       | 24       |
|              | PO    | 1.17 | 50       | 100      | 8-12     |
| Spiramycin   | IM    | 0.58 | 25       |          | 24       |
|              | PO    | 1.08 | 50       |          | 24       |
| Tylosin      | IM    | 0.22 | 10       | 40       | 6-8      |
|              | PO    | 1.08 | 50       |          | 24       |
| Tiamulin     | PO    | 0.54 | 25       | 50       | 24       |
| Oleandomycin | IM    | 0.58 | 25       |          | 24       |
|              | PO    | 1.17 | 50       |          | 24       |

### Chloramphenicol

| Drug         | Route | Dose | Duration |
|--------------|-------|------|----------|
| Chloramph-succinate | IM | 2.33 | 100 | 6 |
|              |       | 1.27 | 50 | 8-12 |
|              |       | 1.08 | 50 | 80 | 12-24 |
| Chloramph-palmitate | PO | 1.27 | 50 | 100 | 6-12 |

### Tetracyclines

| Drug         | Route | Dose | Duration |
|--------------|-------|------|----------|
| Chlortetracyclin | PO | 0.93 | 40 | 50 | 8 |
|              | PO    | 0.93 | 40 | 50 | 12 |
| Diet         |       | 0.25-1.0% | | 45 days | |
| Oxytetracyclin | IM, SC | 0.32 | 15 | 50 | 12-24 |

Table continued on following page
### Table 2. CONVENTIONAL DOSAGE REGIMENS FOR ANTIMICROBIAL DRUGS IN PET BIRDS (Continued).

| Routes                  | Dose (mg/kcal) | Dose (mg/kg) | Interval (hr) | Remarks               |
|-------------------------|----------------|--------------|---------------|-----------------------|
| OTC long-acting         | IM, SC         | 1.27 2.55    | 50 100        | 48–72                 |
| Tetracyclin             | PO             | 1.27         | 50            | 8                     |
| Doxycyclin              | PO             | 0.58         | 25            | 12                    |
|                         | PO             | 0.18         | 8             | 12                    |
| Doxycyclin (Vibramycin-IV) | IM, SC         | 1.75 2.33    | 75 100        | 5–7 days              |
| **Sulfonamides and Potentiators** |          |              |               |                       |
| Trimethoprim (T)        | PO             | 0.35 0.47    | 15 20         | 8                     |
| T + sulfadroxazole      | PO             | 0.23 1.17    | 10 50         | 12                    |
| T + sulfamethoxazole    | PO             | 0.23 1.17    | 10 50         | 24                    |
| **Fluoroquinolones**    |                |              |               |                       |
| Flumequine              | IM, PO         | 0.70         | 30            | 8–12                  |
| Ciprofloxacin           | PO, IM         | 0.32 0.43    | 15 20         | 12                    |
| Enrofloxacin            | IM, SC         | 0.12 0.23    | 5 10          | 24                    |
|                         | PO             | 0.23 0.47    | 10 20         | 12–24                 |
| Food                    |                | 250 1000     |               | 24                    |
| **Miscellaneous Antimicrobial Drugs** |          |              |               |                       |
| Furazolidone            | PO             | 0.35 0.47    | 15 20         | 24                    |
| Furaltadone             | PO             | 0.35 0.47    | 15 20         | 24                    |
| **Tuberculostatica**    |                |              |               |                       |
| Isoniazid               | PO             | 0.11 0.32    | 5 15          | 12                    |
| Rifampin                | PO             | 0.22 0.43    | 10 20         | 12–24                 |
| Rifabutin               | PO             | 0.38 1.15    | 15 45         | 24                    |
| Ethambutol              | PO             | 0.32 0.65    | 15 30         | 12–24                 |
| Streptomycin            | PO             | 0.51 1.02    | 20 40         | 24                    |
| Amikacin                | IM             | 0.38 0.76    | 15 30         | 12–24                 |
| Ciprofloxacin/enrofloxacin | PO           | 0.38 0.76    | 15 30         | 12–24                 |
| Clotrimazole            | PO             | 1.83         | 85            | 24                    |
| Clarithromycin          | PO             | 0.97         | 45            | 24                    |
| Azithromycin            | PO             | 0.97         | 45            | 24                    |
| **Antimycotic Drugs**   |                |              |               |                       |
| 5-flucytosine           | PO             | 0.76 1.27    | 30 50         | 6–12                  |
| Amphotericin B          | IV             | 0.03         | 2             | 8–12                  |

Grit: 5–7 days
| Drug                        | Route | Dose 1 | Dose 2 | Dose 3 | Duration |
|-----------------------------|-------|--------|--------|--------|----------|
| Amphoteracin B              | IT    | 0.02   | 1      | 8-12   |          |
| Amphoteracin B              | PO    | 0.11   | 5      | 24     |          |
| Caprillic acid              | PO    | 5.39   | 250    | 24     |          |
| Chlorhexidine               | PO    | 0.11   | 0.22   | 5      | 10       |
| Enilconazole                | Aerosol |      |        |        |          |
| Fluconazole                 | PO    | 0.04   | 0.11   | 5      |          |
| Griseofulvin                | PO    | 0.26   | 20     | 24     |          |
| Itraconazole                | PO    | 0.13   | 0.25   | 5      | 10       |
| Ketoconazole                | PO    | 0.51   | 0.76   | 20     | 30       |
| Miconazole                  | IM, IV| 0.22   | 0.43   | 10     | 20       |
| Nystatin                    | PO    | 2549   | 7647   | 100,000| 300,000  |
| Ronidazol                   | PO    | 0.4    | 31.2   | 8-12   |          |
| Toltrazuril                 | PO    | 0.09   | 7.02   |        |          |

**Miscellaneous Drugs**

| Drug                        | Route | Dose 1 | Dose 2 | Dose 3 | Duration |
|-----------------------------|-------|--------|--------|--------|----------|
| Deferoxamine                | IM    | 1.28   | 100    | 24     |          |
| Insulin                     | IM    | 0.006  | 0.013  | 0.5    | 1.0      |

**Antiparasitica (frequently used by the author)**

| Drug                        | Route | Dose 1 | Dose 2 | Dose 3 | Duration |
|-----------------------------|-------|--------|--------|--------|----------|
| Chloroquine                 | PO    | 0.216  | 0.539  | 10     | 25       | 24       |
| Clazuril                    | PO    | 0.108  | 0.216  | 5      | 10       |          |
| Dimetridazole               | PO    | 0.065  | 3      | 24     |          |
| Fenbendazole                | PO    | 0.032  | 2      | 24     |          |
| Ivermectin                  | IM, PO| 0.004  | 0.2    | 6      | wk       |
| Levamisole                  | PO    | 0.043  | 2      | 24     |          |
| Metronidazole               | PO    | 0.108  | 5      | 24     |          |
| Oxfenbendazole              | PO    | 0.862  | 40     | 24     |          |
| Praziquantel                | PO    | 0.270  | 0.539  | 13     | 25       | 24       |
| Pyrimethamine               | PO    | 0.011  | 0.022  | 1      | 2        | 24       |
| Ronidazol                   | PO    | 0.323  | 15     | 24     |          |
| Toltrazuril                 | PO    | 0.090  | 7      | 24     |          |

For the calculation of the metabolic dosage, the following body weights were used when pharmacokinetic studies were available: pigeon 450 g, parrot 400 g. Conversion from mg/kg to mg/kcal = dose/(KW^0.75).

Adapted from Dorrestein GM: Antimicrobial drug use in pet birds. In Prescott JF, Baggot JD (eds): Antimicrobial Therapy in Veterinary Medicine. Ames, IA, Iowa State University Press, 1993, p 490; with permission.
Table 3. DOSAGE REGIMENS FOR CHEMOTHERAPEUTIC, ANTIBIOTIC, AND OTHER AGENTS USED IN DRINKING WATER IN BIRDS

| Drug                          | Metabolic Dose (mg/kcal) | Calculated Water Conc (mg/L) | BW (g) | Passerine K = 129 (kcal/day) | Non-passerine K = 78 (kcal/day) |
|-------------------------------|--------------------------|------------------------------|--------|-----------------------------|---------------------------------|
| Amoxycillin (low level)       | 0.47                     | 940                          | 10     | 4                           | 2                               |
| Amoxycillin (high level)      | 2.55                     | 5100                         | 20     | 7                           | 2                               |
| Amoxycillin/clav. acid*       | 4.31                     | 8620                         | 30     | 9                           | 6                               |
| Ampicillin (low level)        | 0.58                     | 1160                         | 40     | 12                          | 7                               |
| Ampicillin (high level)       | 2.80                     | 5600                         | 50     | 14                          | 8                               |
| Chloroquine                   | 0.22                     | 431                          |        |                              |                                 |
| Chlorotetracycline (low level)† | 0.93                   | 1860                         | 60     | 16                          | 9                               |
| Chlorotetracycline (high level)† | 1.17                 | 2340                         | 70     | 18                          | 11                              |
| Dimetridazole†                | 0.06                     | 129                          | 80     | 19                          | 12                              |
| Doxycycline with grit†        | 0.58                     | 1160                         | 90     | 21                          | 13                              |
| Doxycycline without grit†     | 0.18                     | 360                          | 100    | 23                          | 14                              |
| Enrofloxacin§                 | 0.23                     | 460                          |        |                              |                                 |
| Erythromycin                  | 1.17                     | 2340                         | 150    | 31                          | 19                              |
| Fenbendazole                  | 0.03                     | 50                           | 200    | 39                          | 23                              |
| Furazolidone                  | 0.35                     | 700                          | 250    | 46                          | 28                              |
| Ivermectin§                   | 0.004                    | 9                            | 300    | 52                          | 32                              |
| Levasimole                    | 0.04                     | 80                           | 350    | 59                          | 35                              |
| Lincomycin                    | 0.82                     | 1633                         |        |                              |                                 |
| Lincospectine                 | 1.08                     | 2156                         | 400    | 65                          | 39                              |
| Ketoconazole                  | 0.51                     | 1020                         | 450    | 71                          | 43                              |
| Metronidazole                 | 0.11                     | 216                          | 500    | 77                          | 46                              |
| Neomycin                      | 0.22                     | 440                          | 550    | 82                          | 50                              |
| Nystatin (IU)§                | 2549                     | 5,097,889                    | 600    | 88                          | 53                              |
| Polymyxin (IU)§               | 1078                     | 2,156,145                    |        |                              |                                 |
| Ronidazole                    | 0.32                     | 647                          | 650    | 93                          | 56                              |
| Spectinomycin                 | 0.65                     | 1300                         | 700    | 99                          | 60                              |
| Spiramycin                    | 1.08                     | 2156                         | 750    | 104                         | 63                              |
| Sulphachlor-pyrazin§           | 0.07                     | 140                          | 800    | 109                         | 66                              |
| Sulphadimidine§               | 0.07                     | 140                          | 850    | 114                         | 69                              |
| Toltrazuril                   | 0.09                     | 180                          | 900    | 119                         | 72                              |
| Trim/sulpha§                  | 0.23                     | 460                          | 950    | 124                         | 75                              |
| Tylosin                       | 0.38                     | 760                          | 1000   | 129                         | 78                              |

Based on the dosage in mg/kcal (BMR = KW^75) and a water intake of 0.5 mg/kcal. The calculated dose should preferably be divided over water and food.

*Calculated for amoxycillin part only.
†In case of ornithosis for 30 days.
‡Metabolic dose estimated from drinking water concentration.
§In case of ornithosis for 21 days.
∥For the treatment of *Candida albicans* for 3 to 6 wk.
*This dosage is for the trimethoprim part alone.

heavily reduced or the medication is given through a finely chopped fruit mix.

**HANDLING AND RESTRAINT**

Even though many veterinarians like to treat the small passerines with drugs preferably in the drinking water, in many cases it is better to handle individual or small numbers of birds and apply the medication directly. The route can be oral or intramuscular.
A “lights out/perching out” approach to capture is often useful for small active birds. Birds generally do not move in a dark room and can be removed easily from an enclosure. The bird can be restrained by placing the head between two fingers so that the body rests in the palm of the hand, or it can be restrained by holding the head gently between the thumb and first finger. One must never interfere or restrict the movement of the sternum because this will kill the bird. The handling and restraint period must be as short as possible. One should be prepared to take samples and deliver treatment in one handling session. For anesthesia, only isoflurane is acceptable, and one should use an adapted mask to induce the anesthesia. Very active finches needing frequent treatments can be caught more easily in a small hospital cage (i.e., plastic-bottomed hamster cage). If such a cage is loaned to the owner, it can increase treatment compliance because it often reduces stress for the patient and the owner. It also increases the number of birds returning for follow-up.

Mynahs and toucans can be loud, active, and aggressive, particularly if untamed. Tame birds that are not given sufficient attention can also become aggressive toward their keepers. The birds are best restrained by initially removing them from the enclosure with a net or large towel. A toucan can then be controlled by holding the beak in one hand and using a towel loosely wrapped around the body to control the wings and feet. A mynah is controlled by holding the head gently between the thumb and first finger. The towel can be used as with toucans. Toucans should never be handled by the head and neck alone.\(^3\)

**ROUTES OF ADMINISTRATION**

**Parenteral Administration**

When there is a good indication, the right jugular vein and intraosseus catheterization can be used for administration of intravenous fluids using a 26-gauge needle. This is a seldom-practiced method of fluid administration in finches.\(^13\) In toucans, this approach is comparable to that used in psittacines.

For intramuscular (IM) or subcutaneous (SC) injections, a 27-gauge needle on a 1-mL insulin syringe is required, and even these can cause significant hemorrhage if not used with caution. Intramuscular injections into the pectoral muscle must be made more carefully than in other species. A small amount of alcohol with 10% glycerine is used for visualizing the site before attempting an IM injection. To minimize risk, the IM injection site should be located in the caudal third of the breast muscle. Aspiration should be performed prior to injecting any drug to ensure that a blood vessel has not been cannulated. After the needle has been removed, the site should be observed for hemorrhage, and pressure should be applied.
digitally if bleeding does occur. Drug dosing in small patients must be based on an exact BW (as determined by a gram scale) and should be delivered with precise microliter or insulin syringes to avoid overdose. There is little room for a dosing error in a small bird. The volume of the injected fluid must be carefully monitored in these small species; 0.1 mL in a canary of 20 g is comparable to 3 L in a cow of 600 kg.

**Oral Administration**

Direct oral application has the advantage of precise dosing, and, because many drugs are available as oral suspensions in flavored pediatric strengths, dosing is easy. When a sick bird requires handfeeding, these drugs can easily be added to the feeding formula. Remember that the smaller finches and canaries will die within 24 hours from hypoglycemia when they do not eat at all.7 Tablets or capsules are impractical for the small birds but can be used in toucans and mynahs.

Application of drugs in the drinking water is a common route of administration in small birds. In many cases the water intake will be substantially reduced. Normal water intake is irregularly spread over the day, which can result in irregular or even ineffective blood levels. This can cause disappointing therapeutic results and the development of resistance. Medication in water can be successful against mild infections of the gastrointestinal tract, in which the drug has a local effect in the gut. Administration of drugs in the drinking water is particularly not recommended in softbills and fruit-eating finches because they generally do not consume large quantities of water; instead, they obtain most of their daily fluid requirements from fruits. Oral administration in softbills (and some larger passerines) can be administered directly, by metal or rubber gavage tube, or by placement of a capsule or granules in the center of a grape.

In flock treatment of small passerines, better therapeutic results can be achieved by administering the drug at the same time in both drinking water and soft or egg food, resulting in self-medication several times a day. It is also possible to medicate nestling birds by adding medication to the soft food that is fed by the parents to their chicks.

Because the elimination is so rapid, there often are no measurable blood levels during the night, even after oral administration through the food and water. It is possible to increase water and food intake during the night by changing to a 24-hour light regimen, which results in more evenly distributed blood levels over a period of 24 hours. This change of day–night rhythm, however, disturbs breeding and can induce molting. Antibiotics must be administered for at least 7 days, and bactericidal antibiotics are preferred above bacteriostatics.

The calculation of the drinking water concentration should be based on the daily water intake (0.5 mL/kcal/day) and the dose (mg/kcal/day). The most commonly used medications are presented in Table 3,
relative to different BW ranges; however, the actual daily water intake should always be measured and the drug concentration adjusted to these results.

**Topical Administration**

Treatment of skin or leg lesions with ophthalmic ointments often results in intoxication and the death of the patient. Because a few drops swallowed during cleaning its feathers is sufficient to kill the bird, the owner should be instructed to apply the ointment sparingly or to put a collar on the bird.

Chlorhexidine topical cream is not recommended because it has been associated with adverse reactions in Mannihin species and parrot finches.

**TOXIC EFFECTS**

Some drugs (i.e., dimetridazole [Emtryl] and sulfadervatives) will, at poultry- or pigeon-dose levels, cause toxic signs.

**CRITERIA FOR SELECTING A DRUG**

For the optimal treatment of infectious diseases, the clinician must be certain of the diagnosis, sensitivity of the organism to the drug, and toxic properties, pharmacokinetics, and pharmacodynamics. Knowledge of husbandry practices and anatomic and physiologic differences of the species to be treated are also essential. Supportive care and minimizing stress are necessary to maintain the host's defense mechanisms.

Essential for the success of any therapy is to locate the source of the problem and eliminate or modify it. This can also include decontamination of the environment of the bird (e.g., cage or aviary).

Under optimal conditions, the selection of an antimicrobial therapy is based on sensitivity testing; however, it is becoming more obvious that the line between sensitive and insensitive in avian medicine could be different from the accepted standard in human and mammalian medicine. One reason for this is that the attainable blood levels for many drugs could be lower in birds than in mammals for the same drugs owing to short elimination half-lives, different bioavailability, or different administration routes. If a test indicates an organism to be susceptible, then treatment might be successful if drug concentrations similar to those in humans were achieved in birds. In avian medicine, the sensitivity of the microorganism should be reported as a minimal inhibitory concentration (MIC) in a dilution test, and, when the pharmacokinetics of the drug of choice and the concentration at the site of action are known, an effective therapy can be expected.

A therapeutic blood level (or a concentration above the bacterial
MIC) is important for bacteriostatic antibiotics during most of the dosage interval, which in these small birds is difficult to achieve for many of the selected drugs. There is therefore a preference for the use of bactericidal drugs, in which adequate peak concentrations have a good lasting therapeutic effect. In infectious disease cases, whether proved or suspected, or when there is bacterial involvement, it is essential to start treatment immediately, sometimes even before the results of the sensitivity test are known. When the results of the sensitivity test become available, it is sometimes necessary to switch to another drug.

Before any antimicrobial therapy is started the cause should be determined, whether gram-positive cocci, gram-negative bacteria, chlamydia, or yeast. A parasitic infestation—coccidia, flagellates, nematodes, cestodes, or trematodes—should be sought. A direct smear from the feces or impression smears from the organs at necropsy, air dried and stained with simple stains (e.g., Quick hematological stains) gives morphologic information of the microorganisms present. In many cases a parasitic infection can be diagnosed with simple wet-mount examination of a crop or cloacal swab. Table 4 displays treatment suggestions based on the results of these tests, the compiled result of the author’s diagnostic laboratory, and references from literature.

Antimicrobial susceptibility patterns vary geographically, so that these data might not be applicable to all areas.

An alternative for the treatment of flocks infected with gram-negative bacteria (e.g., \textit{Salmonella} spp. or \textit{Yersinia pseudotuberculosis}) is enrofloxacin. For individual treatment, some additional antimicrobials are available for use in SC or IM injections. For gram-negative bacteria, one can use amikacin, cephalosporins, and piperacillin; for gram-positive bacteria, cephalaxin and cephalothin.

| Digestive problems without a high mortality rate: | Agent |
|-----------------------------------------------|-------|
| In a stained cloacal smear:                   |       |
| Bacteria (rods or cocci)                     | Neomycin |
| Campylobacter                                | Doxycycline |
| Yeasts                                       | Amphotericin B |
| Flagellates                                  | Ronidazole/metronidazole |
| In a wet mount:                               |       |
| Flagellates                                  | Ronidazole/metronidazole |
| Coccidia                                     | Sulfachlorpyrazine/amprolium |
| Nematodes                                    | Levamisole/ivermectin |
| Trematodes                                   | Praziquantel |

| The birds are seriously ill, and there is high mortality rate: |
|---------------------------------------------------------------|
| In the direct smear (feces and/or necropsy)                   |       |
| Cocci                                                        | Amoxycillin/clavulanic acid |
| Gram-negative rods                                            | Trimethoprim-sulfamethoxazole |
| Yeasts                                                       | Amphotericin B |

| Chlamydial infections (ornithosis)                           |       |
|--------------------------------------------------------------|-------|
|                                                              | Doxycyclin |
SPECIFIC TREATMENT PROTOCOLS

Metabolic and Nutritional Disorders

Nutritional problems, especially those resulting from an unbalanced diet, are often seen in mixed aviaries and individual pet canaries. All granivorous birds need a certain amount of supplementation by an egg food or softbill food because a deficient diet compromises the defense mechanisms and can lead to problems with Enterobacteriaceae (e.g., 

\[ Escherichia \text{ coli}, \text{ Klebsiella} \text{ spp. and \ Enterobacter \ spp.}\] 

and yeast infections (especially \textit{Candida albicans}) in these birds. Breeding results are also disappointing in birds with an unbalanced diet. A good starting point for therapy is controlled feeding of three parts of a seed mix supplemented with one part soft food, or changing to a complete pelleted food.

Vitamin Deficiencies

In small passerines, feeding rancid cod liver oil or mixing oil through the seed can result in encephalomalacia and fertility problems owing to vitamin E deficiency. Vitamin B deficiency can cause CNS disturbances, reduced hatching, stunting, and molting problems. Vitamin A deficiency in recessive white canaries is caused by a genetic defect that prevents the absorption of carotenoids from the intestine. For their supply of vitamin A, recessive white canaries depend completely on the presence of vitamin A in the food. It is essential to increase the levels of vitamin A from approximately 15,000 IU/kg egg food for “normal” canaries to approximately 20,000 IU/kg egg food, to prevent deficiency problems.

Vitamin C is not normally needed as a dietary source because most birds can synthesize sufficient amounts from glucose in the liver, kidney, or both. Some species of passeriformes lack the enzyme \textit{L-gulonolactone oxidase} and require a dietary source of vitamin C. Passerines, which depend on external sources for vitamin C (e.g., bulbuls, shrikes), when fed a deficient diet, develop symptoms within 15 days, including weight loss, behavioral changes, lethargy, feather loss, and hemorrhage in the liver and leg joints. The daily requirement is unknown, but beneficial responses have been seen at levels between 50 and 150 mg/kg dry matter.

Vitamin D\textsubscript{3} or calcium deficiency, or problems with the Ca:P ratio (resulting in rickets and osteomalacia) are incidentally seen in small passerines, but severe metabolic bone disease is often observed in ramphastid chicks. After changes in the bird’s diet have been made, most affected birds regain a fairly normal-appearing bill, with only slight structural modifications.

\textit{Hemochromatosis}, or iron storage disease, is the commonest noninfectious disease in softbills. In passeriformes, storage in hepatocytes is seen only in mynahs. In these birds, diets with more than 50 ppm to 60 ppm of iron can induce a liver iron storage problem. Therefore, diets with a
total iron intake of less than 50 ppm should be fed to mynahs and toucans. The daily intake of iron, in other words, should be 4 to 6 mg/kg for each bird per day. An effective treatment of weekly phlebotomies to remove a blood volume equivalent to 1% of BW is usually performed in conjunction with low iron diets. A less-invasive treatment is documented using deferoxamine (100 mg/kg q24hr, SC) combined with a low iron diet (65 ppm) for periods up to 4 months until the iron content in the liver of the toucan normalized.3

Diabetes mellitus is seen in toucans that demonstrate classic signs, and affected birds often respond to daily or intermittent insulin (0.1–0.5 U) injections.17

**Infectious Diseases**

Many infectious diseases are species specific, although salmonellosis and pseudotuberculosis are exceptions. Coccidiosis is often diagnosed in finches, but transmission of the infection between species is not very likely because most species appear to have their own coccidian species.

**Viral Diseases**

Reported viral infections in passeriformes or softbills are avian pox, polyomavirus, paramyxovirus (PMV-1, PMV-2, and PMV-3), herpesvirus and cytomegalovirus, influenza virus, adenovirus, coronavirus, and circovirus. In most cases, there is no specific therapy.

**Avian pox.** Avian pox is especially seen in passerines kept in captivity—almost exclusively in canaries and other *Serinus* sp.—but also in young, recently imported mynahs.12 Preventive vaccination is possible by the wing-web method, preferably in early summer. The vaccination must be repeated once every year. In case of an epidemic, all birds are to be caged individually, or, if this is impossible, in small groups. All clinically healthy birds should be vaccinated, and supportive treatment consists of the administration of antibiotics and multivitamin preparations. Two weeks after mortality has stopped, the birds can be housed again in the flypens.

**Paramyxovirus.** Several paramyxoviruses have been reported in mynahs and toucans, including PMV-1 (ND), PMV-2, and PMV-3.17 PMV-3 is often found in passeriformes. A preventive vaccination for PMV-1 with an inactivated vaccine is possible.

Treatment with acyclovir is possible for herpesvirus and cytomegalovirus. Dosage in small birds has not been tested, however.

**Bacterial Infections**

Common bacterial infections in passeriformes and softbills are *Escherichia coli* (and other Enterobacteriaceae), *Yersinia pseudotuberculosis*, *Salmonella* sp., *Campylobacter* sp., *Streptococcus* spp. and *Staphylococcus* spp.,
Pseudomonas and Aeromonas spp., Mycobacterium-avium-intracellulare-complex and M. genavense, Chlamydia psittaci, Mycoplasma spp., and megabacteria.

**E. coli (and Other Enterobacteriaceae).** In normal healthy passerines, E. coli (and other Enterobacteriaceae) are absent in the intestines. These bacteria, however, are often demonstrated by cytology and can be isolated from the feces or from the intestinal contents of diseased passerine birds, with and without diarrhea. In toucans, E. coli (and Staphylococcus sp. and Streptococcus serotype D) were found in the cloaca of 90% of clinically normal toucans. Other primary diseases can be present (e.g., atoxoplasmosis or coccidiosis). Cultures are necessary for diagnosis, and a sensitivity test is essential for treatment. Treatment does improve this condition but only temporarily; the clinician must search for the real cause.

**Enterobacteriaceae.** Enterobacteriaceae are regularly cultured from birds with diarrhea (usually in passerine nestlings, termed sweating disease). The antibiotics of choice are neomycin or spectinomycin because they are effective and not absorbed from the gut. The drug is administered in the soft food. In fledglings, extra water, in chopped greens and vegetables, prevents dehydration.

**Yersiniosis (Pseudotuberculosis).** In Europe, an infection with *Yersinia pseudotuberculosis* is regularly seen in winter in canaries and wild finches. Mynahs, but especially toucans, are very susceptible for yersiniosis, and the mortality rate can be high. Treatment of choice is amoxycillin in the drinking water or soft food. In softbills, individual treatment is advised. Once sensitivity test results are obtained, the antibiotic sometimes must be changed. Cleaning and disinfection are essential to prevent a relapse after therapy has been completed. In Europe, a formol vaccine is available that appears to be clinically effective in reducing the prevalence of infections.

**Salmonellosis.** The most effective antibiotics against salmonellosis are trimethoprim (with or without sulfa), amoxycillin, or enrofloxacin, given for 2 to 3 weeks. Therapy must be combined with strict hygiene. Three to six weeks after therapy, a bacteriologic examination of a pooled fecal sample in enrichment medium should be performed to evaluate the success of the therapy. When necessary, therapy and hygienic measures should be repeated until the bacteriologic control stays negative.

**Campylobacter fetus.** *Campylobacter fetus* (subsp. jejuni) is found very often in tropical finches, especially in Estrildidae. *Campylobacter* sp. have also been isolated from recently imported mynahs. Treatment can be attempted with several antibiotics, but hygienic measures are most important. Although campylobacteriosis is considered a potential zoonosis, no data are available of Campylobacter transmission from passerines to humans.

**Cocci Infections.** These infections are often demonstrated in passerines and ramphastids. Local and systemic treatment with ampicillin or amoxycillin is the therapy of choice.

**Pseudomonas and Aeromonas spp.** Treatment includes locating the source of the trouble and administering an antibiotic after performing a
sensitivity test. Until the results are available, the first-choice antibiotic in these cases is enrofloxacin. Painstaking hygiene is essential, because many strains are resistant to antibiotic treatment.

**Avian Tuberculosis.** Treatment of tuberculosis is not often practiced. There is a potential for zoonosis, although mostly in only immunocompromised persons. The cages must be cleaned and disinfected. The bacteria can survive in the infected soil for 2 years.

**Ornithosis (Chlamydiosis).** This is a relatively uncommon problem in passerines and softbills. Treatment with chlortetracycline (30 days), doxycycline (30 days), or enrofloxacin (21 days) in drinking water and (soft) food is clinically effective, but only when the birds continue to drink the normal amount of water and Ca$^{2+}$ is restricted.

**Mycoplasma spp.** Mycoplasma have been isolated from canaries, and many cases of conjunctivitis and upper respiratory disease in canaries respond to tylosin; however, there has been no conclusive work proving that Mycoplasma is associated with this syndrome. Tetracyclines and enrofloxacin are believed to be effective against many Mycoplasma spp. Clinical signs of conjunctivitis in house finches (Carpodacus mexicanus) associated with M. gallisepticum infection resolved following oral tylosin (1 mg/mL drinking water for at least 21 days) as the sole source of drinking water in conjunction with topical ciprofloxacin HCl ophthalmic solution for 5 to 7 days.

**Other Bacterial Infections.** The following bacteria are occasionally isolated from deceased passerine and softbill birds: Erysipelothrix rhusiopathia, Listeria monocytogenes, and Pasteurella multocida (from a cat bite?; first-choice antibiotic is amoxycillin/clavulanic acid).

**Megabacteria.** These are large, rod-shaped organisms that have fungal characteristics and have been found in the proventriculus or droppings of several avian species and are associated with wasting disease. Therapy must be aimed at improving the bird’s condition, including providing easily digestible food (egg food) and lowering the pH in the proventriculus (6 mL 0.1N HCl/L or citric acid 1 g/L) to activate pepsin. In vitro studies have shown that the organism isolated from budgerigars is sensitive to several antibiotics; in budgerigars oral amphotericin B and in European finches oral nystatin were both shown to be effective. After 6 weeks, birds can be returned to a normal diet, which should include regularly egg food as a supplement.

**Mycotic Infections**

Mycotic infections are not a significant problem in canaries but are much commoner in tropical finches, mynahs and, toucans.

**Candidiasis.** Identifying candida in fecal smears from passerines should be done with caution because many passeriformes are fed yeast products. The intestinal candidiasis is treated with nystatin for 3 to 6 weeks at a dose of 100,000 IU/L of drinking water and 200,000 IU/kg soft food. Eye lesions and dermatitis can be treated with IV and topical amphotericin B. Other predisposing factors (e.g., nutritional deficiencies, immune suppression) should be addressed as well.
Fungi. Aspergillosis is an uncommon finding in small passerines and piciformes. In captive mynahs, however, Aspergillus infections are much commoner. In some cases (e.g., syrinx aspergillomas or localized air sac involvement), surgery is indicated. In chronic cases, medical therapy has a poor prognosis. As preventive measures, adequate vitamin A supplementation and improvement in hygiene (including ventilation) are indicated.

Dermatomycosis. Dermatomycosis is occasionally reported in passerines and generally causes alopecia of the head and neck, or hyperkeratosis. Microsporum sp. and Trichophyton sp. are the commonest causes, but saprophytic fungi also can be involved. Zoonotic factors need to be considered. Treatment with ketoconazole and griseofulvin provides some improvement but does not always eliminate the infection.

Other Mycotic Infections. Other mycotic infections reported in passerines include Cryptococcus neoformans, though it is very rarely seen in these birds, and zygomycosis (mucormycosis), which is reported in the lung, liver, or brain of canaries and finches as multiple granulomas. The incidents were related to feeding damp, germinated seeds.13

Parasitic Infections

Protozoal Infections

The most important protozoal infections in canaries are atoxoplasmosis, coccidiosis, toxoplasmosis, and trichomoniasis. Atoxoplasma-like infections and cryptosporidiosis are found only occasionally in finches, starlings, and mynahs and are mostly restricted to individual birds. (In these birds it is seldom a flock problem.) Coccidiosis, cochlosomosis, and trichomoniasis are very common in finches. In softbills, Giardia spp. and coccidiosis are occasionally noted in fecal examination or postmortem.

Atoxoplasmosis (Isospora serini). This is a systemic coccidial disease in canaries and other finches. Atoxoplasmosis and hemochromatosis are the primary medical problems in captive Bali mynahs. The therapeutic agent of choice is sulfachlorpyrazine, 150 mg/L of drinking water, until after molting for 5 days a week. This treatment effects only the production of oocysts but does not influence the intracellular stages. Other measurements to improve health of young birds include feeding one part egg food and one part seed mixture until after molting, prevention of crowding, and better hygiene, especially cleaning and changing the floor coating. These measurements alone can prevent clinical outbreaks in infected canaries. This infection is also a common problem in other European finches kept in captivity (e.g., goldfinch, siskin, greenfinch, and bullfinch).

Coccidiosis. Coccidia, Isospora sp., and less common Eimeria sp. are frequently encountered in passeriformes and toucans. Therapy consists of strict hygiene measures and treatment with coccidiostatic drugs. Amprolium solution has been recommended for the treatment of coccidi-
Toxoplasmosis. In the acute phase of toxoplasmosis, the birds (canaries and mynahs) can show severe respiratory signs; in the chronic form, iridocyclitis or panophthalmitis are noted. No effective treatment is known, although some effect is claimed for toltrazuril.

Trichomonas. This and other flagellates are commonly seen in the crop of passerines. In mynahs, the lesions look like trichomoniasis in pigeons, with typical lesions in the beak. Treatment consists of ronidazole at 400 mg/kg of egg food and 400 mg/L of drinking water for 5 days. After a pause of 2 days, the regimen is repeated. This drug is relatively safe, and no toxic signs have been seen. If dimetridazole is used, the concentration should not exceed 100 mg active drug per liter for 5 days. A sign of intoxication is torticollis, which will disappear after the medication is stopped. Metronidazole has also been reported to cause toxicity in finches. Water containers should be disinfected and rinsed clean, and the aviary should be kept clean and dry.

Cochlosoma sp. This is a flagellate living in the intestinal tract of society finches. Cochlosoma can cause death among Australian finches fostered by these society finches. Treatment is the same as for other flagellates.

Giardia sp. Giardia sp. has been reported to be associated with gastrointestinal tract infections in finches. In toucans, Giardia is frequently identified in fecal samples but with no associated clinical disease. Treatment is the same as for other flagellates.

Blood Parasites. These can be detected on routine screening of apparently healthy passerines and ramphastids, but they are occasionally implicated as the primary cause of disease or death. The most commonly encountered parasites include Haemoproteus sp., Leucocytozoon sp., Trypanosoma sp., Plasmodium sp. (malaria), and microfilaria.

Plasmodium sp. The cause of avian malaria, Plasmodium sp. are mosquito-borne protozoa that occur worldwide. Treatment with chloroquine (250 mg/120 mL of drinking water for 1 to 2 weeks) or pyrimethamine is successful in some cases, but a lasting immunity does not occur. Another protocol is chloroquine 0.54 mg/kcal PO at 0 hour, then 0.33 mg/kcal PO at 12, 24, and 48 hours, with pyrimethamine 0.011 to 0.022 mg/kcal at 0 hour. Control of mosquito vectors is necessary to prevent infection.

Haemoproteus spp. These organisms are found worldwide but cause only mild or inapparent clinical symptoms. Treatment is seldom indicated and is identical to treatment for avian malaria.

Leucocytozoon sp. These organisms also occur worldwide and can infect either erythrocytes or leukocytes. Most infections are subclinical, although vague signs and even death have been reported.

Helminthic Infestations

Worms are usually of no significance in small passerines. Acanthocephalans, cestodes, and nematodes have mostly been reported in free-
ranging and captive large passerines such as thrushes, grackles, and starlings. Insect-eating species show more parasitic infections than granivorous finches do. The incident of internal parasites in captive ramphastids is quite low. Ascarides, *Capillaria* sp., and gizzard worms (*Tetrameres* sp.) are occasionally noted in toucans and mynahs.

**Nematodes.** Two main types of roundworms can affect passerines: *Ascaridia* sp., which have a direct life cycle, and *Porrocaecum* sp., which have indirect life cycles, with invertebrates such as earthworms as the intermediate host. Ascarides are also frequently encountered in toucans. Fenbendazole, piperazine, levamisole, and ivermectin, all orally supplied, are useful in treating ascarid infections.

*Capillaria* spp. These are cosmopolitan in their distribution and affect a range of passerines, including mynahs and ramphastids. Treatment can be more difficult than for ascarides. Aviary hygiene and removal of earthworms are important control measures. Anthelmintics are effective in some cases. In a cleaned, dry environment, the eggs lose their infectious capacity within 3 weeks without further disinfection.¹²

**Syngamus trachea.** *Syngamus trachea* (gape worm) is found as an infection in outdoor aviaries and is a serious problem in mynahs, corvids, and starlings. Ivermectin (injection 5 µg/kcal) and levamisole or fenbendazole are effective in treating this parasite, but caution should be exercised when treating birds with heavy infections, because the dead worms can obstruct the trachea. In such cases treatment with a low-dose anthelmintic, especially fenbendazole, over several days is an effective therapeutic plan.

**Spiruroids.** *Geopetitia aspiculata* is a parasite that lives in the proventriculus and has been reported in six avian orders, including Passeriformes (e.g., Emberizidae, Estrildidae, Fringillidae, Icteridae, Sturdidae [including a hill mynah]), and insect-eating Piciformes (e.g., barbets and woodpeckers). Infected birds were treated successfully with ivermectin (5 to 10 µg/kcal SC) or fenbendazole (0.032 mg/kcal PO for 3 days). Reduction of the intermediate host interrupts the development cycle of the parasite.

**Acuaria skrjabini.** Infections of the gizzard with mucosal necrosis were reported in adult finches in Australia. Oral treatment with levamisole 80 mg/L or fenbendazole 50 mg/L of drinking water for 3 days was effective. Feeding live food (e.g., maggots, mealworms, or termites) increases the risk because insects are the intermediate hosts for gizzardworms and tapeworms.

**Tapeworm (Cestoda) Infestations.** These are common in softbills and insectivorous finches. Effective treatment for passerines includes praziquantel and oxfenbendazole.

**Trematodes.** Trematodes are seen only occasionally in wild-caught passerines. *Schistosoma* sp. are trematodes that live in blood vessels and have been reported in North American goldfinches and cardinals. *Prosthogonimus* sp. are trematodes affecting the intestinal tract, cloaca, bursa, or oviduct. These parasites have been found worldwide in passer-
ines and are not particularly pathogenic. Praziquantel (0.25 mg/kcal) is useful in treating trematodes.

**Arthropods**

**Ectoparasites.** Ectoparasites, including blood-sucking mites (*Dermanyssus gallinae* and *Ornithonyssus sylviarum*), skin mites (e.g., *Backerichyela* sp. and *Neocheyletiella media*) and feather mites (e.g., *Epidermotidae*, *Derma* sp. and *Neckyssus sylviarum*) have been found in the calamus of the feathers. Mealmites (*Tyroglyphus farinae*) are not parasites, but their large number on a bird can cause unrest and irritation.

**Blood-Sucking Mites.** The red mite (*Dermanyssus gallinae*) and the white or Northern mite (*Ornithonyssus sylviarum*) can cause serious mortality among fledglings as well as adult birds. Treatment should be prompt and consists of dusting or spraying the victims with an insecticide and vacating and thoroughly cleaning the cage or room during the day. A relatively safe method for treating *Ornithonyssus sylviarum* is putting one drop of 0.1% ivermectin in propylene glycol on the bare skin (spot-on method); however, the mites are killed only after sucking blood.

Except some irritation or feather damage, other ectoparasites cause no real disease problems; however, they are considered a sign of inadequate hygiene and management.

**Quill Mites.** Quill mites have been described in passeresines. Treatment with ivermectin (spot-on method) is very effective.

**Knemidokoptes Pilae.** Knemidokoptes pilae infections, or scaly mites, are occasionally seen on the beak base of finches. Treatment with any oil or ivermectin applied locally cures the bird.

**Air Sac Mites (Sternostoma tracheacolum).** Found occasionally in canaries, these mites are seen mostly in Australian finches. They are not reported in softbills. Several therapeutic regimens have been described for air sac mite infestations. Pest strips make a reasonably good air sac mite preventive, provided that the bird cannot get to them, and only if the bird is not within a small enclosure. Ivermectin can be used for individual treatment by a spot-on method.

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