*Journal of Avian Medicine and Surgery 37(4):297–313, 2023*

*Summarized by MR*

Parrot Dietary Habits and Consumption of Alternate Foodstuffs

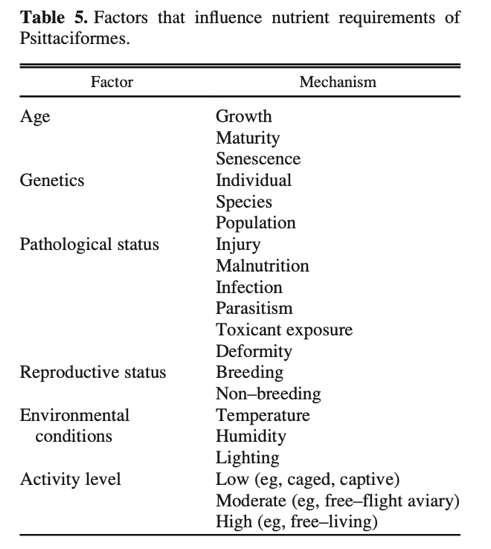
Elise V. Voltura, Donald J. Brightsmith, Juan Cornejo, Ian Tizard, Christopher A. Bailey, and J. Jill Heatley

Abstract: **Inappropriate diets cause many of the health problems commonly reported in parrots** by psittaculturists and veterinarians. The dietary management of captive parrots would benefit from information derived from studies of dietary habits of wild parrots; however, it is unclear how complete this body of knowledge is at this time. Documentation of parrots’ dietary habits appears to have grown dramatically over the past century. Reports of parrots consuming a number of foodstuffs beyond the reproductive parts of plants (alternate foodstuffs) have increased. The extent of alternate foodstuffs in parrot diets is currently unknown. We used Google search engines (ie, Scholar, Videos, Images) to determine how well psittaciform dietary habits have been studied to date and to **quantify reports of alternate foodstuffs consumption among genera of Psittaciformes. We found that the dietary habits of over 43% of parrot species are poorly resolved.** The dietary habits of 71.5% of parrot species classified by the International Union for Conservation of Nature as at risk of extinction are not well resolved. Parrots’ consumption of alternate foodstuffs occurred at the following rates at the genus level: 91.2% foliage, 76.9% terrestrial invertebrates and fine earthen materials, 74.7% wood, 44% pure minerals, 34.1% vertebrates (9.9% dung), 29.7% sap, 19.8% roots, 17.6% charcoal, 18.7% epiphytes, 16.5% coarse earthen materials, 8.8% algae, and 6.6% aquatic invertebrates. Of these reports, 79.1% involved observations of wild parrots. **Many parrot species may be more omnivorous than previously realized.** Alternate foodstuffs are generally absent from current veterinary-based dietary recommendations for captive parrots. Future studies are needed to determine whether providing alternate foodstuffs to captive parrots can be used as a means to improve their diets and thus their health, welfare, and reproductive success.

**Background:**

* 4% of total bird species diversity in Psittaciformes – by conservation status, one of the most threatened bird orders
* Poultry-based nutrition models remain primary influences because they have been well studied whereas all psittacines are not – important note that goals of poultry based nutrition include high meat and egg-yielding that do not meet the goals of parrot health based on their differences in anatomy and physiology
* Alternate foodstuffs are defined as items beyond reproductive plant parts: seeds, fruits, nectar.

**Summary:**

* Study goals: determine how often alternate foodstuffs have been reported, examine nutrient content
  + Reviewed documentation by literature search/database search of various parrot species to determine the level of resolution of knowledge of dietary habits of various species: unresolved – 1, poorly resolved, acceptably resolved, well resolved – 4.
  + Database search: species name + diet and feeding ecology
  + Reviewed IUCN red list to correlate conservation status to diets that were poorly resolved or unresolved
* Alternate foodstuffs: minerals (ex. salt, ocean water), earthen materials (silt, clay, grit), coarse earthen materials (pebbles, stones, gravel), charcoal, wood, sap (resin, latex, manna), roots, foliage, algae. Epiphytes, terrestrial inverts, aquatic inverts, vertebrates
* Poorly resolved in 44%
* 68% of species classified as (critically) endangered had diets that were not well resolved
* Members of 92.3% of genera consumed more than one type of alternate foodstuffs
* Geophagy, the consumption of earthen materials, including pure minerals, was documented in over 100 parrot species across 58 genera in the wild.
* Psittaciformes engage in insectivory, herbivory, and geophagy.
* Some Psittaciformes also engage in exudativory (eg, sap), lichenivory, fungivory, bryophytivory (eg, moss), molluscivory (eg, molluscs, and snails), crustacivory, carnivory, and coprophagy.
* Zoopharmacognosy: Some consumption may serve medicinal purposes (e.g., toxin binding by clay, charcoal for detoxification, or bark with high mineral content).
* Parrots rely on plants for a considerable portion of their diet, however, not all plants are safe to eat and few plants provide all required nutrients year-round: nutrient profiles vary by time of year, species, growth medium type and quality, geography, time of year.
* Wild vs. captive reports: The majority (79.2%) of detections came from wild parrots, with fewer from captivity (16.1%)
* Intra- and inter- annual variability have not been determined: consumption of alternate foodstuffs reflects resource availability, nutrient needs during growth/repro/molting, adaptation to diversity in habitat

**Take Home Points:**

* More than 2/3 of psittaciform dietary habits were not well resolved – particularly neotropical and afrotropical parrot genera are poorly resolved, Cacatuoidea are the least well resolved
* Alternate foodstuffs often provide nutrients lacking in fruits and seeds: proteins, minerals, water
  + consumption of alternate foodstuffs reflects resource availability, nutrient needs during growth/repro/molting, adaptation to diversity in habitat
* Psittaciformes consume a wide variety of foodstuffs beyond the reproductive parts of plants: insectivory, herbivory, geophagy common – based on the variety, **psittacines are much more omnivorous than generally recognized**
  + Strategy is best described as **polyphagous omnivory:** includes plant, animal and mineral matter.
* At this time, captive diets generally exclude alternate foodstuffs, incorporation may improve health, welfare (behavioral), breeding success

*Journal of Avian Medicine and Surgery 38(2):108–115, 2024*

*Summarized by MR*

Prevalence, Anatomical Distribution, and Risk Factors of Adipocytic Tumors and Xanthomas in Psittaciformes: 1096 Cases (1998–2018)

Lucyanne Megan, David Sanchez-Migallon Guzman, Kevin Keel, and Hugues Beaufrere

Abstract:Adipocytic tumors are mesenchymal tumors that are commonly reported in psittacine birds; however, large-scale studies evaluating their prevalence and associated risk factors are lacking. A retrospective study of adipocytic tumors in psittacine birds was performed by **reviewing pathology submissions from the University of California**, Davis–Drury Reavill Pathology Database, containing **26013 submissions from psittacine birds (1998–2018)**. Age, sex, genus, anatomic distribution, and pathological diagnosis were collected for each case when available. The prevalence, risk factors, and association with other lipid-accumulation disorders were reported. A total of **450 cases of lipoma, 129 cases of myelolipoma, 35 cases of hemangiolipoma, 31 cases of liposarcoma, and 451 cases of xanthoma were identified**. The **prevalence** of adipocytic tumors and xanthomas **on necropsy was 1.3%** (158/11 737, 95% confidence interval [CI]: 1.1–1.6). Adipocytic tumors were identified in 27 genera. *Amazona* (odds ratio [OR] = 1.93, 95% CI: 1.24–2.99, p = 0.004), *Myiopsitta* (OR = 2.3, 95% CI: 1.0–5.2, p = 0.041), *Melopsittacus* (OR = 3.4, 95% CI: 2.1–5.5, p < 0.001), and *Agapornis* (OR = 3.5, 95% CI: 2.0–6.1, p < 0.001) had significantly higher odds of developing adipocytic tumors compared with other genera, whereas Ara had significantly lower odds (OR = 0.5, 95% CI: 0.3–0.9, p = 0.030). **Age was also a significant risk factor** for many types of adipocytic tumors. There was **no significant association between general adipocytic tumor formation and atherosclerosis or hepatic lipidosis**. **Xanthomas were associated with atherosclerosis** (OR = 1.88, 95% CI: 1.01–3.51, p = 0.048), but not hepatic lipidosis (p = 0.503). On necropsy, the trunk and air sacs were the most common sites of xanthoma formation, whereas the trunk and liver were the most common sites of lipoma and myelolipoma formation, respectively.

**Background:**

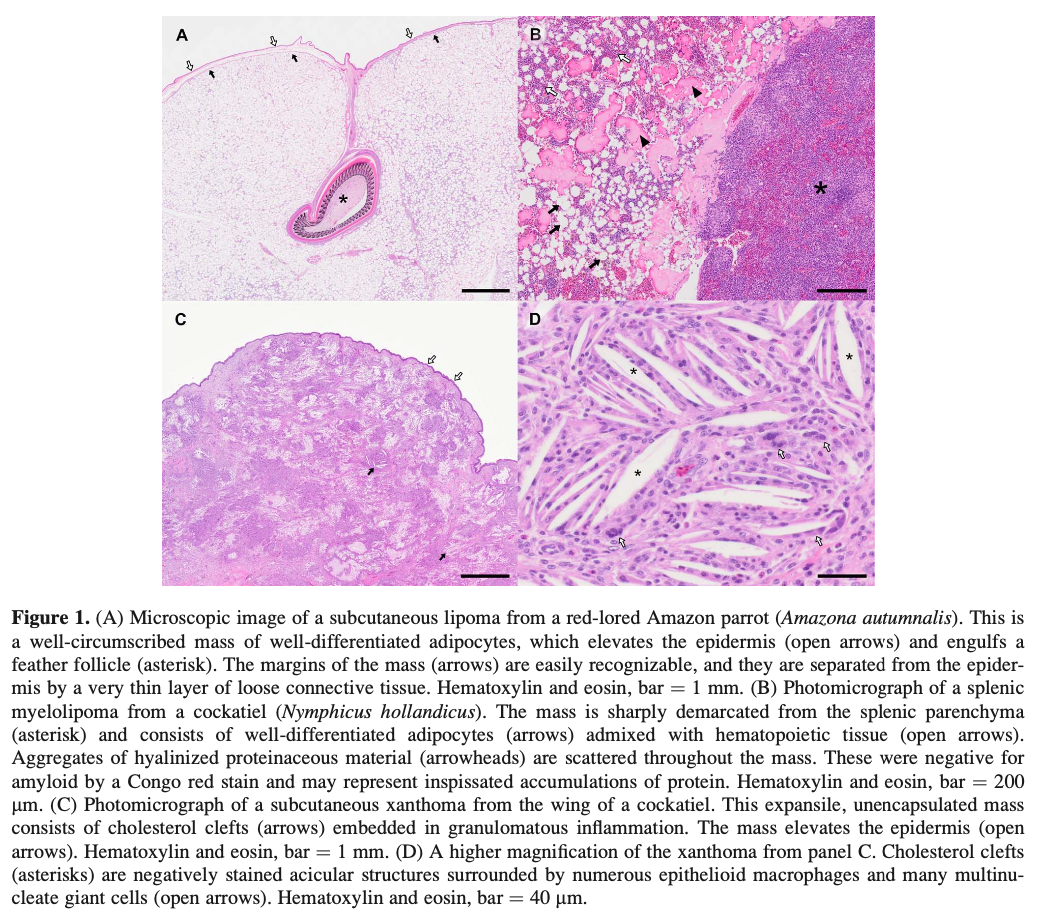
* Lipid accumulation disorders are commonly reported in psittacines: adipocytic tumors, hepatic lipidosis, atherosclerosis, xanthomatous lesions
* Lipomas most commonly reported: over the keel, ventral abdominal musculature, and peri-cloacal region
  + Budgerigars, galah, Amazons, cockatiels thought to be most commonly affected
* Xanthomas are non-neoplastic masses of lipid-laden macrophages, compared to atherosclerosis which is a vascular xanthomatous condition.

**Summary:**

* Describe prevalence, anatomical distribution, and risk factors for adipocytic tumors and xanthomas, and evaluate associations with age, sex, genus, hepatic lipidosis, and atherosclerosis.
* Reviewed a pathology database 1998-2018 for psittacine necropsies (>1 tissue examined), biopsies, or cytology: 26,013 submissions
* Logistic regression model used to assess risk factors for adipocytic tumors or xanthomas (age, sex, genus, concurrent lipid disorders)
  + Evaluated odds ratios, 95% CI
* Tumor location categorized: head/neck, trunk, wing, internal organs
* Overall prevalence of 1.3%
* Age was a significant risk factor for all tumors except myelolipomas, sex had no significant effect
* *Amazona, Myiopsitta (Quakers), Melopsittacus*, and *Agapornis* (Lovebirds) had higher odds; *Ara* had lower odds.
* Lipomas associated with hepatic lipidosis
  + Lipomas and hemangiolipomas most common on trunk
* Myelolipomas most frequent in liver, found on necropsy
* Liposarcomas most frequent on wing, found on biopsy or cytology
* Xanthomas associated with atherosclerosis
  + Most common on trunk and air sacs when diagnosed on necropsy, versus wing and conjunctiva when diagnosed on biopsy/cytology
* No general association between adipocytic tumors and other lipid disorders

**Take Home Points:**

* Older age and specific genus are major risk factors for adipocytic tumors (Amazons, Quakers, Budgerigars, lovebirds)
* Tumor locations align with previous descriptions (trunk for lipomas, liver for myelolipomas, wing for liposarcomas)
* Xanthomas showed significant association with atherosclerosis (similar to humans with hypercholesterolemia)
* Hepatic lipidosis linked to lipomas



*Journal of Avian Medicine and Surgery 39(1):2–11, 2025*

*Summarized by MR*

Determining the Fecal Microbiome of Healthy Cockatiels (*Nymphicus hollandicus*) Fed Seeds Versus Formulated Pelleted Diets by Next-Generation DNA Sequencing

Lucyanne Megan, David Sanchez-Migallon Guzman, Kevin Keel, and Hugues Beaufrere

Abstract: **Fecal samples were collected from 34 clinically healthy cockatiels** (*Nymphicus hollandicus*), with 15 consuming a commercially available seed diet and 19 on a formulated pelleted diet. Next-generation DNA sequencing was used to analyze the samples, revealing a **diverse microbial landscape**. A total of 179 **bacterial** species from 94 genera and 244 **fungal** species from 156 genera were identified across both diet groups. Although **no significant differences in microbial diversity were observed** between the 2 groups, distinct microbial compositions were noted. Notably, *Corynebacterium kroppenstedtii* and *Enterococcus durans/faecium* were enriched in the pellet-fed group, whereas *Lactobacillus oris* and a species in the Brevinemataceae family were more abundant in the seed-fed group. In the mycobiome, *Aspergillus penicillioides, Meyerozyma sp*, and *Fusarium sp* were enriched in the pelleted diet group, whereas *Bulleribasidium oberjochense* was more prevalent in the seed diet group. These findings highlight the nuanced effects of diet on the fecal microbiome of cockatiels, providing valuable insights for avian health management and **potential probiotic interventions**.

**Background:**

* Pelleted diets recommended over seed diets for balanced nutrition in psittacines, lack of research on different diet effects on GI microbiome

**Summary:**

* Establish a baseline understanding of GI microbiome in these birds using DNA sequencing
* Fecal samples collected from n = 34 healthy cockatiels (as defined by examination)
  + N = 19 on a pelleted diet
  + N = 15 on a seed mix diet
* Next generation DNA sequencing used to analyze DNA for bacterial and fungal species
* NSD in overall microbial diversity of either bacterial or fungal populations
* Significant differences existed in the abundance of specific microbial species
  + Pelleted diet group
    - *Corynebacterium kroppenstedtii* and *Enterococcus durans/faecium* were significantly more abundant in pelleted diet group
    - *Aspergillus penicillioides, Meyerozyma sp*, and *Fusarium sp* were enriched in the pelleted diet group
  + Seed mix group
    - *Lactobacillus oris* and a species in the Brevinemataceae family were more abundant in the seed-fed group
    - *Bulleribasidium oberjochense* was more prevalent in the seed diet group
  + *Lactobacillus alvi* and *Ureaplasma* sp, were found to be part of the shared core microbiome between both diet groups.
  + *Cladosporium* sp was identified as a core fungal species shared between both diet groups.
* The Enterococcus observed in the pelleted diet group considered a beneficial bacterial, used commonly in probiotics
* Brevinemataceae in seed diet group warrants further research to determine significance
* The prevalence of Aspergillosis (re: fungal diseases in psittacines) warrants further investigation as well, however, environmental ubiquity and previous descriptions of high prevalence in the avian GI tract should be taken into consideration.
* Limitation was variability of diets despite best efforts to standardize them

**Take Home Points:**

* Diet composition had a notable impact on fecal microbiome in this study, and can inform probiotic interventions

*2024 American Journal of Veterinary Research 85.7*

**The pharmacokinetics of single-dose oral atorvastatin and its metabolites support therapeutic use in cockatiels (*Nymphicus hollandicus*)**

Michaela Mitchell, David Sanchez-Migallon Guzman, Heather Knych, Hugues Beaufrère

Objective: To evaluate the plasma concentrations and determine the pharmacokinetic parameters of atorvastatin and its primary active metabolites (para- and orthohydroxyatorvastatin) after administration of a single oral dose in cockatiels (*Nymphicus hollandicus*).

Animals: 14 adult cockatiels (7 male, 7 female) around 2 years of age.

Methods: A compounded oral suspension of atorvastatin 10 mg/mL made with an oral suspending agent and an oral sweetener was administered via oral gavage at 20 mg/kg to each bird. Blood samples were collected at 7 different time points from 0.5 to 24 hours post administration in a balanced incomplete block design with 3 blood samples per bird and 6 replicates per time point. Plasma concentrations of atorvastatin, parahydroxyatorvastatin, and orthohydroxy-atorvastatin were determined by liquid chromatography–tandem mass spectrometry. Pharmacokinetic analysis was performed using noncompartmental analysis.

Results: The estimated time to maximum concentration (tmax) for atorvastatin, parahydroxyatorvastatin, and orthohydroxyatorvastatin was 3 hours for each. The estimated maximum plasma concentration (Cmax) for atorvastatin, parahydroxyatorvastatin, and orthohydroxyatorvastatin was 152.6, 172.4, and 68.8 ng/mL, respectively. The terminal half-lives were 4, 6.8, and 4.6 hours, respectively.

Clinical revelence: These results support the therapeutic use of atorvastatin at the dose evaluated in this species based on human pharmacokinetic data. A starting dose of 20 mg/kg PO every 12 to 24 hours could be used to treat lipid disorders in cockatiels pending more data on multidose use and hypolipidemic efficacy

Key Points

* Psittacine predisposed to lipid disorders: atherosclerosis, hepatic lipidosis, xanthomas, obesity, adipocytic tumors
  + Female birds more prone to atherosclerosis/reproductive-associated chronic dyslipidemia
  + Increased plasma cholesterol levels associated with increased risk of atherosclerosis (buildup of fat, cholesterol, plaque in arteries)
* In humans, statin drugs are best drugs against atherosclerosis and hypolipidosis
* Atorvastatin: competitive inhibitor 3-hydroxy-3-methyglutaryl-coenzyme A (HMG-CoA) reductase in liver (rate-limiting enzyme involved in early cholesterol synthesis that converts HMG-CoA to mevalonic acid, a cholesterol precursor) 🡪 decrease endogenous cholesterol production 🡪 lower plasma cholesterol, specifically low-density lipoprotein (LDL-C)
  + Atorvastatin generally metabolized in liver
  + Atorvastatin has two active metabolites: orthohydroxy- and parahydroxyatorvastatin acid (dominant metabolites detected in plasma)
  + Generally safe with 50% lethal dose in mice > 5000 mg/kg
  + Main side effect of statin treatment: rhabdomyolysis
* Study: Gavaged oral atorvastatin 20mg/kg directly into crop
* Atorvastatin: Cmax 152.6 ng/ml, tmax 3 hours, t1/2 4 hours, AUC 1,080 h x ng/mL
* Parahydroxyatorvastatin: Cmax 68.8 ng/ml, tmax 3 hours, t1/2 4.62 hours, AUC 455.5 h x ng/mL
* Orthohydroxyatorvastatin: Cmax 172.4ng/ml, tmax 3 hours, t1/2 6.78 hours, AUC 1,737 h x ng/mL
* Half-life of parahydroxyatorvastatin and orthohydroxyatorvastatin longer than atorvastatin supporting that these metabolites may prolong HMG-CoA reductase ability in cockatiels by staying in blood longer than parent drug
* Parahydroxyatorvastatin had higher Cmax,longer t1/2, and higher AUC: suggests might be primary metabolite in cockatiels
* For dosing: atorvastatin and active metabolites above 10 ng/ML at 12 hrs and measurable but only 2ng/mL at 24 hrs, recommend 20mg/kg PO q12 hr to treat lipid disorders in cockatiels
* Compared to other species atorvastatin
  + Higher Cmax than humans on hemodialysis (28.6 ng/mL), but shorter t1/2 (11.8 h)
  + Higher Cmax than orange-winged parrots (82.6 ng/mL), higher AUC (327.5) but lower t1/2– administered same dose; cockatiels have better oral bioavailability
  + Higher Cmax than Amazon parrots (7.35 ng/mL for orthohydroxyatorvastatin; 34.1 ng/mL for parahydroxyatorvastatin), AUC 68.3 ng/mL for ortho and 347.2 in para; cockatiels have better oral bioavailability
* Possible cause of increased oral bioavailability: inclusion of compounded atorvastatin with inclusion Ora-Sweet (could improve absorption)

*2024 American Journal of Veterinary Research 85.1*

**Pharmacokinetics of single-dose oral atorvastatin and its metabolites support therapeutic use in orange-winged Amazon parrots (*Amazona amazonica*)**

Michaela Mitchell, David Sanchez-Migallon Guzman, Heather Knych, Hugues Beaufrère

Objective: To evaluate the plasma concentrations and determine pharmacokinetic parameters of atorvastatin and its primary active metabolites (para- and ortho-hydroxyatorvastatin) after administration of a single oral dose in orange-winged Amazon parrots (*Amazona amazonica*).

Animals: 8 adult orange-winged Amazon parrots (4 male, 4 female) of varying ages.

Methods: A compounded oral suspension of atorvastatin 10 mg/mL was administered via oral gavage at 20 mg/kg to each bird. Blood samples were collected at 10 different time points from 0 to 30 hours postadministration to evaluate plasma levels of atorvastatin, para-hydroxyatorvastatin, and ortho-hydroxyatorvastatin. Pharmacokinetic analysis was performed using noncompartmental analysis and commercially available software.

Results: Mean ± SD atorvastatin half-life, tmax, and Cmax were 5.96 ± 11.50 hours, 1.60 ± 0.80 hours, and 82.60 ± 58.30 ng/mL, respectively. For para-hydroxyatorvastatin, the half-life, tmax, and Cmax were 6.46 ± 54.20 hours, 5.00 ± 2.51 hours, and 34.10 ± 16.00 ng/mL, respectively, and 5.58 ± 9.92 hours, 3.38 ± 2.10 hours, and 7.35 ± 3.96 ng/mL for ortho-hydroxyatorvastatin.

Clinical Relevance: The plasma concentrations and pharmacokinetic profile shown support the therapeutic use of atorvastatin at the dose evaluated in this species based on human pharmacokinetic data. While 20 mg/kg PO q24 hours could be used as a starting dosage until further studies evaluating multiple dose administration and efficacy in this species become available, the high interindividual variability results warrant monitoring of the treatment response to make dosing adjustments if needed

Key Points

* Previous studies on atorvastatin
  + Chickens (Atorvastatin 2mg/kg/day PO): associated with reduced hepatocellular damage and steatosis, and regression of hyperlipidemia-associated renal disease
  + Amazon parrots (Atorvastatin 10mg/kg POq24) failed to show statistically significant hypolipidemic effect on plasma cholesterol, triglycerides, lipoproteins and other lipids
  + Quaker parrots (Atorvastatin 10mg/kg PO q12, 24hr; 20mg/kg PO q12) (Rosuvastatin (10mg/kg PO q12-24) failed to show statistically significant hypolipidemic effect on plasma cholesterol, triglycerides, lipoproteins and other lipids
  + Hispaniolan Amazon parrots (compounded rosuvastatin 10mg/kg PO, 25mg/kg PO): low plasma concentrations (not exceeding 6.74 ng/mL)
  + Rats (metabolic rate comparable to medium birds) doses as high as 80mg/kg create Cmax 23.44 ug/mL 2 hours after administration with 10 hour half-life
* Parrots gavaged 20mg/kg dose of atorvastatin
* Atorvastatin: Cmax 82.6 ng/ml, tmax 1.6 hours, t1/2 5.96 hours, AUC 327.5 h x ng/mL
* Parahydroxyatorvastatin: Cmax 34.1 ng/ml, tmax 5 hours, t1/2 6.46 hours, AUC 347.2 h x ng/mL
* Orthohydroxyatorvastatin: Cmax 7.35 ng/ml, tmax 3.38 hours, t1/2 5.58hours, AUC38.3 h x ng/mL
* Compared to other species with atorvastatin
  + Humans dose 2.5-80mg/day: Cmax 4.34-187 ng/mL within 1-2 hrs; t1/2 14 hr
  + Dogs 5-10mg/kg: Cmax 2.17 ng/mL within 1.5 hrs; t1/2 1.4 hr
  + Mice 5-10mg/kg: Cmax 419.2-85.8 ng/mL within 0.25 hrs; t1/2 3-5 hr
* Indicates orange-winged amazon parrots likely reach therapeutic levels though shorter t1/2 & tmax (given higher metabolism of birds)
* Longer half-life of metabolites para and ortho-hydroxyatorvastatin than atorvastatin mean they can provide HMG-CoA reductase inhibition after parent drug gone 🡪 important consideration for dosage and frequency of administration in clinical setting
  + Atorvastatin and metabolites measurable at 30hr timepoint 🡪 possibly dose q24
* Study recommends starting at 20mg/kg PO q24 until further studies completed

*2023 Journal of Avian Medicine and Surgery 37.2*

**Effects of Atorvastatin and Rosuvastatin on Blood Lipids in Quaker Parrots (*Myiopsitta monachus*)**

Hugues Beaufre`re, Trinita Barboza, Alysha Burnett, Ken D. Stark, and R. Darren Wood

Abstract: Statin drugs are the most effective class of hypolipidemic and antiatherosclerotic drugs, with atorvastatin and rosuvastatin being the most effective. While the use of statins would be a tremendous asset in the treatment of dyslipidemia and lipid-accumulation disorders in birds, there are only limited data available regarding their use and effectiveness in psittacine species. Two consecutive randomized crossover trials on Quaker parrots (*Myiopsitta monachus*) were performed to study the effect of atorvastatin and rosuvastatin. Ten birds were used in an initial balanced crossover experiment with 5 oral treatments (control; atorvastatin 10 mg/kg q12h and q24h; rosuvastatin 10 mg/kg q12h and q24h) for 2 weeks each. Plasma lipidomics and lipoprotein profiling were performed after each treatment. Twelve birds were used in a second experiment consisting of 2 parallel crossover studies, each with 6 birds either fed their regular diet or a 0.3% cholesterol diet. In the 2 parallel crossover studies, the treatment group was administered atorvastatin 20 mg/kg orally q12h and the control group a placebo suspension orally q12h. Plasma lipidomics, lipoprotein profiles, and 3-hydroxy-3-methylglutarylcoenzyme A (HMG-CoA) reductase activity were subsequently measured. Results were analyzed with serial linear mixed models and trends were assessed graphically. No statistically significant effect of any statin treatment was detected on plasma lipids, lipoproteins, creatinine kinase, or HMG-CoA reductase activity. In the first trial, all the rosuvastatin treatments led to some nonsignificant decreases in several triacylglycerol species, while in the second trial this was only observed in the birds on atorvastatin 20 mg/kg q12h being fed their regular diet. Quaker parrots may require much higher doses of statin drugs to show significant and clinically useful lipid-lowering effects

Key Points

* Atorvastatin and Rosuvastatin most effective statin drugs in humans: lower blood cholesterol and low-density lipoprotein cholesterol (LDL-C)
* In humans, hypolipidemic effects of statins don’t necessarily relate to plasma concentrations; require pharmacokinetic data with tissue (in this case liver) drug concentrations
* Crossover test with 5 oral treatments (control; atorvastatin 10 mg/kg q12h and q24h; rosuvastatin 10 mg/kg q12h and q24h) for 2 weeks each
  + Standard lipid, lipoprotein profile, and CK value did not change with any statin protocol
  + Not significant but noted generally rosuvastatin treatments decreased several triacylglycerol species, more so for twice daily treatment; and stains increased dihexosylceramide (one specific glycosphingolipid**)**
* 2 parallel crossover studies, 6 birds either fed regular diet or a 0.3% cholesterol diet; treatment group administered atorvastatin 20 mg/kg orally q12h control with placebo
  + 0.3% cholesterol diet leads to profound dyslipidemia with changes to plasma lipidome
  + Several triacylglycerol species decreased in birds on standard diet; not significant
  + Plasma HMG-COA activity levels and lipid panels did NOT change between control and atorvastatin regardless of diet
* Despite no observable effects on total triglycerides, several triacylglycerol species tended to decrease in normolipidemic parrots medicated with rosuvastatin or higher dose of atorvastatin
* No effect seen on cholesterol and cholesteryl esters, the primary target of statins
* Compared to other species
  + Chickens: statins have more pronounced plasma hypotriglyceridemic effect than a hypocholesterolemic effect 🡪 consistent with results in this study
  + Hispaniolan Amazon parrots: hypocholesterolemic effect observed 🡪 inconsistent with this study
* Dose may be higher than previously anticipated (> 20mg/kg)
* Main confounding factor: some Quaker parrot hens undergoing vitellogenesis (increases plasma triglycerides eg normal 2-3 mmol/L to > 30 mmol/L), difficult to compare between treatments

Main takeaway: Atorvastatin 10mg/kg PO q12-24, atorvastatin 20mg/kg POq12, and rosuvastatin 10mg/kg PO q12-24 led to minimal non-significant changes to plasma lipidome in Quaker parrots with no observable changes to plasma lipoproteins, even to those parrots fed elevated cholesterol diet. HMG-CoA reductase activity not decreased in plasma 12 hours after last administration of atorvastatin

**Outcomes and complications associated with caudal thoracic and abdominal air sac cannulation in 68 birds**

Byron-Chance D, Gomez L, Hollwarth AJ, Dutton TAG. J Avian Med Surg. 2023;37(2):144-154—reviewed by ALD

**Abstract**: Air sac cannulation is used both as an emergency procedure in avian patients with severe upper respiratory compromise, as well as a means of routine ventilation for surgery of the head and neck. The objective of this retrospective study was to describe and quantify the complications associated with air sac cannulation in birds. Medical records were retrieved for all patients that underwent caudal thoracic or abdominal air sac cannulation at a single center between August 2004 and October 2020. Patient signalment, indication for air sac cannulation, location of air sac cannula (ASC) placement, occurrence and category of complications encountered, and survival data were recorded. **Eighty-four ASCs were placed in 68 birds across 6 orders; 95.2% (80/84) of cases survived general anesthesia for initial ASC placement.** The side and position of ASC placement were known in 33.3% (28/84) and 21.4% (18/84) of cases, respectively. Survival to ASC removal was known in 91.3% (73/80) of cases; 43 (58.9%) of these 73 cases survived to ASC removal. **Complications were observed in 32.5% (26/80) of cases, and 11.5% (3/26) of cases died as a direct result of the complication. The most common reported ASC complication was loss of patency in 23.8% (19/80) of cases**. **Increased likelihoods for complications were seen in cases where exercise intolerance (P=0.04) or abnormal respiratory sounds (P=0.04) were reported at presentation. Increased likelihoods for survival to ASC removal were seen with intercostal placements (P=0.049) and peri-interventional antibiotic therapy (P=0.005).** **Decreased likelihood for survival to ASC removal was seen in cases where voice change was reported at presentation (P=0.02).** This study demonstrates a moderate risk of ASC complication, with a guarded overall prognosis for survival to ASC removal.

**Background**:

* Ventilation separate from gas exchange in bird—gas can enter resp system caudal to lungs and still participate in gas exchange
* Indications of ASC: airway obstruction cranial to lungs, air sac perfusion anes d/t sx of head and neck
  + Air sac perfusion anes: gas anes agent delivered directly to air sacs
* Current ASC rec: 1-1/3x diameter of trachea and length not exceed 2/3 coelomic width

**Methods/Results:**

* 84 cases in 68 birds, age 0.2-35.5y (6.5y med), bw 48-3410g (420g med)
* Presenting common CS: dyspnea, voice change
* Imaging in 67.9%: 40.4% had enlarged coelom not d/t ascites, concurrent air sac dz 28.1%
* ASC d/t airway dz in 98.8% of cases, most often d/t tracheal or syringeal granuloma (54.8%)
* ASC in place for 1-30d (3d med); prev ASC placed in 20.2% patients (range b/t 0-1185d, 5d med)
* Peri-ASC abx used in 93.8% of cases
* 4.8% died during recovery or placement
* 32.5% ASC complication: most freq loss of patency: 23.8% (17.5% d/t obstruction, 2.5% d/t dislodged, insufficient diameter 2.5%, positional patency 1.3%)
  + SQ emphysema 3.8%, infection 3.8%, minor hemorrhage 3.8%, gross contamination 2.5%, patient interference 2.5%, coelomic wall disease 2.5%, coelomitis 1.3%
* Med ST: 0-1454d (med 4d), 41.1% didn’t survive to removal, 12% died d/t ASC complication
* Inc likelihood of survival w/intercostal ASC placement, peri-interventional abx therapy
* Dec likelihood of survival w/voice change; inc likelihood of complication w/abn resp sounds or exercise intolerance at presentation

**Take aways:**

* 1/3 of cases of ASC had at least 1 complication, lower than dog & cat w/temporary trachs (>85%), obstruction most common. Moderate risk of complication w/guarded overall prognosis
* Rec intercostal location for placement—caudal thoracic air sac
* P size no effect on outcome but only 4 Ps were less than 100g
* Consider abx w/ASC but need further study, consider culture after removal
* Prognosis for guarded for tracheal/syringeal granulomas (voice change assoc w/worse outcomes)
* Increasing complication rates w/inc time ASC in place, rec remove by or before 7d
* **A white paper with black text

  AI-generated content may be incorrect.**Birds unlikely to interfere w/ASC and use of neck collar not often indicated

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**Resolution of egg binding is possible in most client-owned parrots when multiple treatment strategies are considered**

Vavlas A, Galusha H, Mayer J, Speer B, Di Girolamo N. J Am Vet Med Assoc. 2025;263(5):628-634—reviewed by ALD

**Objective***:* Egg binding is a common and potentially life-threatening disorder in avian species. The aim of this study was to **analyze the success rate and associated complications of different treatment approaches for egg binding in parrots.**

**Methods**: All parrots treated in an avian-exclusive veterinary practice for egg binding during an 11-year period (2009 to 2020) were eligible for inclusion in this retrospective study. The primary outcome of the study was resolution of egg bind­ing, defined as removal or laying of the egg and survival at 7 days from presentation.

**Results:**Of the 150 events that had complete follow-up, **109 (72.7%) resulted in a successful outcome**. A successful outcome was observed in **44 of 133 events (33.1%) that were initially managed medically without resorting to additional treat­ment strategies, in 31 events (86.1%) managed with mechanical assistance, in 20 events (60.6%) managed surgically, and in 12 events (85.7%) managed with ovocentesis. Time from presentation to resolution was a median of 36 hours (range, 1 to 240 hours; n = 119).** Multivariable logistic regression demonstrated **associations between higher body weight, administration of medical treatment and mechanical assistance, absence of administration of sedation or anesthesia, and absence of obtundation or stupor on presentation with a positive outcome.**

**Conclusions**: Overall, egg binding has a favorable outcome if multiple treatment strategies in addition to medical management are considered.

**Clinical Relevance:** We identified factors associated with resolution and outlined complications of egg binding in parrots, laying the foundation for additional prospective research on this complex condition.

**Background:**

* Common causes of egg binding: hypocalcemia, vit E and selenium deficiency, malformed egg, oviductal pathology, genetic predisposition, obesity, environmental stress
* CS of egg binding: dyspnea, uni or bilateral leg paresis, depression, lethargy, death
* Dystocia: subset of egg binding, mechanical obstruction or cloacal dysfunction

**Methods/Results:**

* Egg binding distinguished from normal gravid state d/t timing of egg retention, anorexia/systemic illness, multiple or misshapen eggs
* Budgies (21.5%) and cockatiels (28.2%) represented over half the events
* 145 total events, 14 had 2 events, 2 had 3 events
* Age: range 1-34yo, med 8y; weight: range 26-1187g, med 104g
* 17.8% first egg, 79.8% not first egg, 2.4% not specified; 3.7% had Deslorelin or leuprolide prior
* 144 events managed medically, 8 managed surgically, 1 mech assistance, 5 discharged w/o tx, 5 euth
  + Of the 144: 10 worsened: 3 euth, 7 discharged; 63 only med management, 40 mech assist, 25 sx, 16 ovocentesis
  + No oxytocin or prostaglandins used
* 150 had follow up: 109 successful outcome, 40 unsuccessful: 16 spontaneous death, 13 died periop, 10 euth, 1 unspecified
* 33.1% successful in cases initially managed medically w/o resorting to addt’l tx strategies
* 60.6% successful in cases managed w/sx; 85.7% successful in cases managed w/ovocentesis
* Time from presentation to egg removal: 1-240h, med 36h
* Successful outcome factors: budgies 0.4x odds of having pos outcome, birds w/medical tx had 7x odds of pos outcome, higher body weight and mechanical assistance had small inc in odds of success
  + no assoc w/sedation/anes
* obtunded or stupor 0.2x odds of successful outcome
* 12.4% had another event, 87.6% didn’t have recurrence

**Key Points:**

* Positive outcome assoc w/higher bw, medical tx and mechanical assistance, no sedation/anes, no obtundation or stupor
  + Think med management impactful b/c birds that didn’t get med management were sick on pres and needed immediate sx or further tx was declined🡪medical tx important but as a standalone may not be effective
* Same proportion of tiels and budgies as prev German study: could be d/t actual physiological predisposition to egg binding or confounding factors (prevalence in area)
* Arginine vasotocin (avian equiv of oxytocin) & prostaglandin E2 not commercially avail
* Ovocentesis is reasonable option (75-86% effective), mech assistance unpredictable when performed by non-avian practitioners even though assoc w/success here
* Sx poor success but could be d/t P being more critical when performed
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**Retrospective analysis of pelvic limb fracture management in companion psittacine birds (60 cases)**

Hollwarth AJ, Dutton TAG. J Avian Med Surg. 2023;37(2):165-174—reviewed by ALD

**Abstract**: Pelvic limb fractures carry significant morbidity in avian patients, and although management options are well researched, published data on long-term complication rates and mortality outcomes are limited. Here, we present **a cross-sectional study evaluating pelvic limb long bone fractures in companion psittacine birds presenting to an exotic-only veterinary hospital in the United Kingdom between 2005 and 2020, focusing on fixation techniques and long-term outcomes.** Of the 60 cases that met the inclusion criteria, 22 separate species were represented, with an age range of 8 weeks to 25 years and an even distribution of sexes, among those that had been sexed**. The majority of fractures (71.7%) were tibiotarsal;** femoral (15%) and tarsometatarsal (13.3%) bones represented the other fracture sites. Several different fracture management methods were used, including external coaptation, surgery, or cage rest. **Average time from fracture identification to healing was 33 days, with a median of 31 days and a range of 11–121 days. Satisfactory resolution of fracture repair was achieved in 85.5% (47/55) of cases that were able to be followed to conclusion. Complications were identified in 41.7% (25/60) of fractures of all pelvic long bones. Complications during fracture management were more common in cases treated with external coaptation.** The most common complication reported was patient interference with bandages, splints, or both. This study provides an overview of pelvic limb long bone fracture management outcomes, which should prove useful for avian practitioners in clinical practice.

**Background**:

* Tibiotarsus (TT) prev reported as one of most commonly fx long bones in birds
* Retrospective studies: tape splints in birds <200g w/TT fx, IM pin tie in w/raptors

**Methods/Results**:

* Jan 2005-Dec 2020, excluded birds euth at presentation
* Satisfactory fx repair=adequate bony callus formation and fn of affected limb
  + Adequate bony callus=palpable, firm swelling w/assoc stability of bone on palpation or visible, mineralized endosteal and periosteal callus on rads
* Complications: post-op discomfort, interference w/implants, delay in fx heal, death d/t fx or fixation
* 60 cases, 22 spp, TT most common bone (sig more likely), no sig diff b/t femur or TMT fx
* No sig diff b/t sex; age: mean 6y, med 3y, range 8w-25y; weight: range 0.03-0.98kg, mean 0.29kg, med 0.32kg
* Closed, simple, and diaphyseal sig more likely than open, comminuted, and epiphyseal fx
* See chart for fx management methods: no inc likelihood in fx repair methods for femur, sig more likely to use tape splint or ESF-IM pin with TT fx, no inc likelihood in fx repair methods for TMT
* 25/60 cases had complications during healing: no sig diff b/t bones, most common self-inflicted damage at splint or bandage (sig more likely than other complications)
  + Aluminum foil backed splint and soft padded bandage had complication rate of 61.5%
    - Used instead of pinning d/t contamination, splinted first to assess viability prior to sx and then needed an amp, poor bone density, cost, size, sx not an option due to type of fx
  + Spica splint no complications, but only used in 1 case
* Amputation in 4 cases (3 d/t complications), sites healed well; 3 died and 1 euth during healing
* Healing time: 11-121d, mean 33d, med 31d—femoral shortest mean and med (27.2, 25d),TT longest mean (34.4d) but med (31.5d) same as TMT
  + Females shorter mean healing time but similar med; wt <490g faster mean and med than 500-1000g; Mean and med similar among ages
  + P w/complications had inc mean and med healing time
  + Delayed union in 4 cases
* 92% of cases w/follow up had no long-term complications, comp include ALD, podo contralateral, arthrosis (but resolved)

**Take aways:**

* TT fx common in captive birds—think d/t one length, prominence, and distance from torso
* Think closed fx more common due to lower forces than wild birds (also simple and diaphyseal more common too)
* Similar time to adequate bony callus formation in all 3 bones, similar TT callus form times as raptors
* Tape splint most common external coap method in 0.03-0.1kg birds but had high complication rate (>than previous study)
* Higher complication rate for external coap vs ESF-IM fixator—think d/t interacting w/splint and holding leg in uncomfortable position in splint
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Journal of Avian Medicine and Surgery, 38(4): 202-207, 2025

**Use of Haloperidol in Companion Psittacine Birds: 19 Cases (2012–2022)** - reviewed by HSS

Katharine E. Hausmann Farris, Grayson A. Doss

**Abstract:**

The antipsychotic medication **haloperidol** has been used for many years in avian medicine as a **pharmacologic therapy for refractory feather destructive behavior in pet parrots.** However, despite its common use, there are **no published studies evaluating its efficacy and adverse effects** in psittacine birds. The goal of this study was to report the **signalment, clinical presentation, dosing regimen, response to therapy, and adverse effects of companion psittacine birds prescribed oral haloperidol** therapy at a single veterinary referral hospital. Included cases were pet psittacine birds that were prescribed haloperidol between 2012 and 2022 and had sufficient follow-up information available to assess efficacy and adverse effects. Nineteen parrots met the case criteria for inclusion. Haloperidol was prescribed for **17 birds with feather destructive behavior, 1 bird for excessive sexual behavior, and 1 bird prophylactically after surgery of the uropygial gland**. The most common species prescribed haloperidol were grey parrots (n = 5) (*Psittacus erithacus*), umbrella cockatoos (n = 4) (*Cacatua alba*), and *Pionus* spp. (n = 2). **Most (12/18 [67%]) birds were classified as having a positive response** to haloperidol administration. The **initial median** (interquartile range) **total daily dose** for all birds in the study **was 0.24 mg/kg** (0.18–0.4 mg/kg). **Adverse effects were reported in 9/19 (47%) birds** with grey parrots being the most common species displaying adverse effects. The most common adverse effect reported was **lethargy in 5/19 (26%) birds. Some adverse effects were mitigated by adjusting dosing, and more severe adverse effects resolved after discontinuing haloperidol**. This study provides descriptive data for a commonly used antipsychotic medication to assist veterinarians treating avian patients.

**Key Points:**

* Recommendations for adjunctive pharmacologic therapy for feather destructive behavior are largely anecdotal with the most commonly recommended drugs including tricyclic antidepressants, selective serotonin reuptake inhibitors, and antipsychotic drugs
* Previously reported adverse effects of haloperidol in parrots include sedation, agitation, inappetence, incoordination, ataxia, severe depression, anorexia, vomiting, and hyperexcitability. Sudden death has also been anecdotally reported in 2 macaw species.
* Haloperidol is a butyrophenone-derivative that competitively blocks postsynaptic dopamine receptors and increases turnover of dopamine in the brain
* Nineteen birds met the criteria for inclusion in this study and included 5 grey parrots (*Psittacus erithacus*), 4 umbrella cockatoos (*Cacatua alba*), 2 *Pionus* spp., and single birds of numerous spp.
* Presentations for initiating oral haloperidol therapy included feather destructive behavior (n = 16), chronic cloacal prolapse (n = 1), excessive reproductive behavior (n = 1), and prevention of self-trauma postoperatively (n = 1)
* A total of 12/18 (67%) birds were classified as having a positive response to haloperidol (PAI) administration
* Overall, adverse effects were noted in a total of 9/19 (47%) birds in the study. These included lethargy (5/9 [55%]); vocalization at night, shaking, and increased feather picking (3/9 [33%]); hyporexia (2/9 (22%); and malodorous feces (1/9 [11%])
  + Lethargy resolved in all birds following discontinuation of haloperidol
* Quaker parrots and cockatoos are anecdotally reported to be more sensitive to haloperidol than other species, and lower dosages have been suggested; further research needed
* It is paramount to remember that psychoactive drug therapy is not considered a frontline therapy for feather destructive behavior in birds. For cases in which underlying medical causes have been ruled out and that are refractory to behavioral modification alone, it can be prescribed concurrently with an individual behavioral strategy plan, including behavior modification and environmental changes.

**Take-Home Message:**

* Most birds responded positively after starting haloperidol therapy although adverse effects were commonly reported (lethargy most common followed by vocalization at night, shaking, increased feather picking, hyporexia, and malodorous feces). Some adverse effects were mitigated by adjusting the dose, and more severe adverse effects resolved after discontinuing haloperidol.

Journal of Avian Medicine and Surgery, 39(2): 68-74, 2025

**Effects of Capromorelin, Mirtazapine, and Cyproheptadine on Food Intake in Budgerigars (*Melopsittacus undulatus*)** - reviewed by HSS

Caroline Titel, Grayson Doss, Christoph Mans

A close-up of a bird

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**Abstract:**

These studies aimed to evaluate the appetite-stimulating effects of capromorelin, cyproheptadine, and mirtazapine in budgerigars (*Melopsittacus undulatus*). **The effects of a single oral dose of capromorelin (10 and 40 mg/kg), cyproheptadine (0.5 and 2.5 mg/kg), and mirtazapine (1 and 5 mg/kg) on food intake in budgerigars (n = 12 per study) were evaluated** in 3 separate blinded, randomized, placebo-controlled complete crossover studies. Food intake was quantified in hourly intervals between 1 and 8 hours after administration and in a 4-hour interval between 8 and 12 hours. **Both doses of capromorelin significantly increased mean food intake in the first 12 hours** after administration (10 mg/kg: 66 ± 39 g/kg; 40 mg/kg: 71 ± 40 g/kg) compared with the control treatment (46 ± 30 g/kg). Administration at 10 and 40 mg/kg capromorelin resulted in a 1.5-fold increase (interval: 0.4–9) and 1.7-fold increase (interval: 0.7–5.5) in food intake, respectively. **Productive and nonproductive regurgitation after administration of capromorelin at 40 mg/kg occurred in 92% of birds within 1 hour of administration, compared with 42% of birds and 25% of birds who regurgitated in the 10 mg/kg and control treatments, respectively. Cyproheptadine and mirtazapine did not have a measurable appetite-stimulating effect in this study, and no significant adverse effects were recorded.**

**Key Points:**

* Capromorelin works as a ghrelin receptor agonist in the gastrointestinal tract of mammals
  + In chickens, capromorelin (6 and 12 mg/kg) administered consecutively for 5 days significantly increased daily food intake and daily weight gain with no adverse effects reported.
* Mirtazapine, an antidepressant, is a serotonin and alpha-2 receptor antagonist effective at stimulating appetite, most notably in cats.
* Cyproheptadine, a serotonin receptor antagonist, is an antihistamine that increases appetite in cats.
  + Multiple doses needed to reach steady state in cats. Chickens treated with cyproheptadine (0.15 and 0.32 mg/kg) q24h for 20 and 10 days, respectively, ate more food daily compared with controls, further supporting the need for repeated dosing of cyproheptadine in avian species to produce a hyperphagic response.
* Benzodiazepines, including midazolam and lorazepam, have been studied in psittacines and provide effective short-term appetite stimulation in budgerigars (*Melopsittacus undulatus*) → 1-2 hours
* Capromorelin caused regurgitation, mirtazapine caused regurgitation, cyproheptadine caused regurgitation, sedation, and dyspnea. Higher doses → greater percent of birds with regurgitation
* Both doses of capromorelin significantly increased total food intake in the 12 hours after administration compared with the control treatment. By 12 hours, birds receiving capromorelin had ingested, on average, 66 ± 39 g/kg (10 mg/kg dose, P = 0.005) or 71 ± 40 g/kg (40 mg/kg dose, P = 0.001) of millet compared with 46 ± 30 g/kg of millet in the control treatment.
  + No increase in food intake compared to lower dose, but a significant (P = 0.003) dose-dependent increased likelihood for regurgitation was observed with the 40 mg/kg dose
    - Occurred approximately 10 minutes after administration and subsided by 1 hour
* The administration of a single oral dose of cyproheptadine or mirtazapine at any of the evaluated doses had no statistically significant (all P > 0.05) or clinically relevant effect on food intake at any time point in the budgerigars in this study

A graph of a number of patients with their age

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A graph of a patient's blood pressure

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**Take-Home Messages:**

* Capromorelin significantly increased mean food intake in the first 12 hours after administration in budgerigars. Dose-dependent regurgitation occurred with capromorelin administration. Mirtazapine and cyproheptadine did not significantly impact food intake.

American Journal of Veterinary Research, 1.aop:1-6, 2025. **Maropitant citrate exhibits rapid absorption, short half-life, and fast clearance in orange-winged Amazon parrots (*Amazona amazonica*) following subcutaneous and intravenous administration**

Ariella Darvish, David Sanchez-Migallon Guzman, Hugues Beaufrère, Heather K. Knych, and Olivia A. Petritz**-** reviewed by HSS

A close up of a bird

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**Abstract:**

Objective

To determine **pharmacokinetic parameters after IV and SC administration of a single dose of maropitant**.

Methods

In this experimental study, **adult orange-winged Amazon parrots** were administered a single dose of maropitant (1 mg/kg) SC and IV with an 8-week washout period between experiments. Blood samples were collected at 0.5, 1.5, 2, 3, 6, 9, 12, and 24 hours after drug administration for the SC study. For the IV study, samples were taken at the same time points with additional collections at 5 minutes and 36 hours. Plasma maropitant was determined with LC-MS-MS, and pharmacokinetic parameters were calculated using a noncompartmental model.

Results

A total of 8 orange-winged Amazon parrots (2 female and 6 male) were used in this study. Mean ± SD **maximum concentration** after SC administration was 130.9 ± 24.6 ng/mL and **was reached at 0.5 ± 0 hours**. Combined terminal half-life after SC administration was 6.67 hours. Bioavailability after SC administration was 85%. Plasma concentration at 24 hours was negligible and nearly identical between SC and IV administrations.

Conclusions

A single dose of 1 mg/kg was well tolerated in all birds IV and SC. **Maropitant rapidly attained plasma concentrations following SC administration and had a relatively high bioavailability and short half-life.**

Clinical Relevance

The results of this study suggest that **the currently used doses and dosing intervals for maropitant in psittacine birds do not maintain above-target plasma concentrations considered therapeutic in dogs and may be insufficient to achieve systemic effects comparable to those observed in other species.**

**Key Points:**

* Vomiting and regurgitation are common in psittacine. This clinical presentation can be seen in birds with various disease processes, such as ingluvitis, proventriculitis/ventriculitis, peritonitis, gastrointestinal obstruction, neoplasia, toxicity, and other systemic disease. Birds may also experience regurgitation as a response to isoflurane anesthesia and after receiving chemotherapy drugs or other medications, such as tricyclic antidepressants and antipsychotics. Maropitant is used empirically; however no PK/PD in psittacines
* Maropitant citrate is a synthetic, nonpeptide neurokinin-1 receptor antagonist that selectively inhibits the effect of the neurotransmitter substance P, which is distributed in the CNS and GIT
* Additionally, maropitant has demonstrated analgesic effects in dogs, cats, and rabbits
* In chickens, doses of 1 mg/kg and 2 mg/kg SC every 12 to 24 hours achieved plasma concentrations > 92 ng/mL rapidly and maintained concentrations above this target for over 24 hours with no significant adverse effects No adverse effects
* Relatively high bioavailability (85% with SC administration), rapid absorption, a short elimination half-life, and fast systemic clearance in this species
  + While the Cmax in orange-winged Amazon parrots exceeded the target concentration for 30 minutes to 1 hour, chickens maintained this level for 12 to 24 hours.
  + The plasma elimination half-life of maropitant in orange-winged Amazon parrots following SC administration of 1 mg/kg was 6.67 hours

**Take-Home Message:**

* 1 mg/kg maropitant SC in OWAP rapidly attained plasma concentrations, and had a relatively high bioavailability and short half-life. Plasma concentrations exceeded target concentrations for 30 minutes to 1 hour (VERY different from chickens)

Journal of Avian Medicine and Surgery, 36(3): 250-261, 2022.  
**HEMATOLOGIC REFERENCE INTERVALS AND COMPARISON OF NATT-HERRICK TECHNIQUE AND SMEAR-BASED LEUKOCYTE ESTIMATION IN COCKATIELS (NYMPHICUS HOLLANDICUS)**  
Laura Martinelli

**Abstract:** Although cockatiels are among the most common avian species maintained as companion animals in the United States, information on standard hematologic reference values for this species is limited. The **objectives of this study were to establish hematologic reference intervals (RI) for cockatiels, compare methods using both the Natt-Herrick technique (NHT) and the smear-based estimation technique (SBT),** explore age and sex differences in the hematologic findings for this species, and **produce the first cockatiel RI for fibrinogen concentration and thrombocyte estimate.** Healthy cockatiels (60 males and 60 females, 2–11 years old) from a research colony were included in this study. Blood samples were placed in dipotassium ethylenediaminetetraacetic acid tubes, and erythrocyte counts and thrombocyte estimates were determined via automated analyzer (ADVIA 120) and SBT, respectively. Moreover, leukocyte concentrations were determined using both NHT and SBT to compare these common methods for measuring a complete blood count in cockatiels. Data were analyzed for outliers, distributions, descriptive statistics, and RI via Reference Value Adviser, a set of macroinstructions for Microsoft Excel (Microsoft, Redmond, WA, USA). **Lymphocytes were the predominant leukocyte across both methods.** According to the **NHT**, **females had significantly higher concentrations of total leukocytes, heterophils, bands, lymphocytes, basophils, and total plasma protein compared with males.** Significant inverse polynomial relationships were noted between total leukocyte count and age and lymphocyte counts and age for NHT. Total leukocyte count produced via NHT and SBT were compared using Passing-Bablok and Bland-Altman plots, and no significant constant or proportional biases were found. However, these methods showed wide limits of agreement. **While the RI were interchangeable between methods from a clinical standpoint, the same method should be used to assess changes in an individual.** The reported RI are uniquely robust given the sample size, balanced sex and age distributions, inclusion criteria, and control over sample collection.

**Key Points:**

* Toenail clip blood samples alter hematologic and biochemical results, and is largely discouraged in the veterinary community as a painful practice
* Manual methods for avian leukocyte quantification typically involve hemocytomoeter and combination of specific stains
  + Phloxine B = semidirect, only granules of heterophils and eosinophils stained, therefore total WBC count is measured mathematically from manual differential estimate
  + Natt & Herrick Solution (NHT) = direct, all leukocytes stained
  + Smear-based technique (SBT) with Wright-Giemsa-stained blood smear slides
* NHT results
  + Females have higher total leukocytes, heterophils, bands, lymphocytes, basophils, and TPP
  + Older birds had decreased total leukocyte count and lymphocyte count
* SBT results
  + Females have higher total leukocytes, heterophils, lymphocytes, and eosinophils
  + Males have higher thrombocytes
* Lymphocytes the predominant leukocyte within cockatiels
* Overall, no significant difference between NHT and SBT except for basophils. However, based on wide limits of agreement, although correlated, were not in acceptable agreement.
* K2-EDTA was the anticoagulant of choice for this study (has been reported that blood stored in lithium heparin can result in significantly higher lymphocyte counts and lower PCV compared to K2-EDTA; also, lithium heparin can also cause thrombocyte
* Study provides an RI for both the NHT and SBT, including the first RI for fibrinogen concentrations and thrombocyte estimates

**Take Home Point:** WBC estimation using the smear technique with Wright-Giemsa-stain is more accessible, affordable, and rapid compared to Natt & Herrick Solution in cockatiels. This species is predominantly lymphocytic and females have higher WBC, heterophils, bands, lymphocytes, basophils and plasma protein than males. Total WBC and lymphocytes decrease with age.

A collage of blood cells

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Journal of Avian Medicine and Surgery, 36(4): 345-355, 2023.  
**COMPARISON OF LIPOPROTEIN ANALYSIS USING GEL-PERMEATION HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AND A BIOCHEMISTRY ANALYZER IN NORMOLIPIDEMIC AND DYSLIPIDEMIC QUAKER PARROTS (MYIOPSITTA MONACHUS)**  
Laura Martinelli

**Abstract:** **Lipid accumulation disorders are common in psittacine** birds and can be associated with **changes in plasma lipoproteins**, most notably **low-density lipoprotein (LDL) and high-density lipoprotein (HDL)**. However, lipoprotein analysis by standard laboratory analyzers or an indirect method, such as the Friedewald formula, has not been validated in parrots. A research colony of 12 **Quaker parrots** (*Myiopsitta monachus*) were used to compare plasma values from the Roche Cobas c501 **biochemistry analyzer** for **total cholesterol, total triglycerides, LDL, and HDL** to **gel-permeation high-performance liquid chromatography** (GP-HPLC). To increase sample size and broaden the analytical range to include dyslipidemic samples, 2 cross-over studies were performed on a **0.3% cholesterol diet and a 20% fat diet.** Agreement between methods was assessed by linear mixed models and Bland and Altman plots. The LDL concentrations calculated by the Friedewald formula and alternative formulas, and the effects of triglycerides on the biases, were also evaluated. Forty-five plasma samples were used. **The cholesterol diet induced a marked increase in cholesterol and all lipoproteins, whereas the fat diet did not lead to dyslipidemia**. Direct and indirect LDL measurements obtained with the clinical analyzer were not in clinical agreement with GP-HPLC, whereas **HDL had acceptable agreement for normotriglyceridemic samples**. Hypertriglyceridemic plasma samples were found to interfere with lipoprotein measurements. This study found **LDL measured by the Roche Cobas c501 biochemistry analyzer and indirect estimations cannot be recommended in the Quaker parrot**, and non-HDL cholesterol should be used instead. **Lipoprotein panels obtained from hypertriglyceridemic samples should be interpreted with care.**

**Key Points:**

* Lipid accumulation disorders such as hepatic lipidosis, atherosclerosis, and obesity are common  in captive Psittaciformes.
* These disease conditions are frequently associated with dyslipidemic risk factors (plasma cholesterol and triglycerides concentrations or plasma lipoproteins). Because of avian lipoprotein differences with mammals, no lipoprotein diagnostic test has been validated in birds for routine use in practice.
* The objectives of this study were to compare the use of direct lipoprotein measurements obtained with a standard laboratory analyzer with GP-HPLC as a reference standard. We also aimed to assess the reliability of the Friedewald formula for indirect LDL-C measurement in Quaker parrots and propose a new species-specific formula.
* The cholesterol diet was confirmed to contain 0.316% cholesterol on a DMB, and the fat diet was confirmed to contain 20.3% fat on a DMB. The control diet contained 0.002% cholesterol and 11.4% fat on a DMB.
* Hypercholesterolemia was defined with plasma total cholesterol > 9 mmol/L (347 mg/ dL), and hypertriglyceridemia was defined at plasma total glycerides > 3 mmol/L (265 mg/dL) in the Quaker parrots.
* Of the total 45 plasma samples, 35.5% (16/45) were hypercholesterolemic, 22.2% (10/45) were hypertriglyceridemic, and 13.3% (6/45) were both.
* The cholesterol diet induced a marked increase in cholesterol and all lipoproteins, whereas the fat diet did not lead to dyslipidemia.
* There was acceptable clinical agreement for total cholesterol measured via direct biochemistry. There was acceptable clinical agreement for HDL for normotriglyceridemic samples.
  + HDL was found to have acceptable agreement between techniques for samples with plasma total glycerides less than 5.6 mmol/L (496 mg/dL).
* No method for LDL-C concentration measurement was found to be clinically equivalent to GP-HPLC, including a direct biochemistry method, the Friedewald formula, and other alternative formulas obtained by regression analysis.
* Because HDL-C was found to be reliable in this study in normotriglyceridemic plasma samples, calculating non–HDL-C should be considered (TC minus HDL-C). Non–HDL-C has been found to be a useful lipoprotein biomarker in humans and to perform better than LDL-C for predicting cardiovascular diseases. Total cholesterol/HDL-C ratio, also known as the atherogenic index, is widely used in humans and may also be a better risk factor than LDL-C.

**Take Home Point:** Using a combination of total cholesterol, non–HDL-C, and total cholesterol/ HDL-C can therefore be recommended for clinical psittacine patients for diagnosis and monitoring of risk factors, providing the patient is not hypertriglyceridemic. Because most hypertriglyceridemia in birds is likely related to a postprandial or female reproductive status, obtaining fasted samples on nonreproductive birds is also recommended.

Journal of Avian Medicine and Surgery, 37(4): 314-320, 2024.  
**MEASURING THE LEVEL OF AGREEMENT FOR LACTATE MEASUREMENTS IN HISPANIOLAN AMAZON PARROTS (AMAZONA VENTRALIS) AMONG 2 POINT-OF-CARE ANALYZERS AND A BENCHTOP ANALYZER**  
Laura Martinelli

**Abstract:** Lactate is an important biochemistry analyte used in human and veterinary medicine to assess tissue perfusion and can be used as a prognostic indicator for certain disease conditions. Whereas lactate is commonly measured using “patient-side” handheld meters, these meters have not been validated for companion avian species. The purpose of this study was to measure the level of agreement between 2 commercially available point-of-care lactate meters and a laboratory benchtop blood analyzer in Hispaniolan Amazon parrots (Amazona ventralis). Blood samples were collected from 20 adult parrots at Louisiana State University by drawing 1.5 mL of blood from the right jugular vein. One drop of whole blood was used for the **Lactate Plus analyzer** and the remainder of the sample transferred into a lithium heparin microtainer. From the blood in the microtainer, 0.2 mL whole blood was analyzed using the **epoc Blood Analysis System**, and the remaining sample was centrifuged to obtain plasma that was immediately frozen at -80C (-112F) and submitted to the Texas A&M University Clinical Pathology Laboratory for analysis on the **VITROS** 4500 benchtop analyzer. Bland-Altman agreement plots and Passing-Bablok regression were used to measure the level of agreement between the methods. **There was poor agreement between all 3 methods with mean percentage differences in lactate concentrations >22%** (epoc and Lactate Plus: 33.6% [95% CI: 27-40]; epoc and VITROS 4500: 55% [95% CI:52-58]; VITROS 4500 and Lactate Plus: 22% [95% CI:16-28]). **Based on these results, the point-of-care meters tested in this study are not interchangeable, and separate reference intervals were calculated for each method.** Blood lactate concentrations may have more utility in tracing lactate trends over time in an individual rather than being able to utilize this information at 1 time point for disease diagnosis and prognosis.

**Key Points:**

* Hyperlactatemia = elevated blood lactate concentration
* Lactic Acidosis = Elevated lactate concentration accompanied by decrease in systemic blood pH
* Lactate concentrations in Hispaniolan Amazon parrots had poor agreement between 2 handheld POC analyzers and laboratory benchtop analyzer
* Notably, the birds had lactate concentrations from 3 to 9.7 mmol/L as measured by the most conservative lactate analyzer tested (the VITROS 4500)
* In studies evaluating lactate concentrations of other birds, an increased length of time for capture in the American flamingos was associated with higher lactate concentrations

**Take Home Point:** Both POC analyzers and bench top analyzer used in this study were NOT interchangeable and had poor agreement for lactate measurement in Hispaniolan Amazon parrots.