HEPATIC FATTY ACID, MINERAL, AND FAT-SOLUBLE VITAMIN CONCENTRATIONS IN CAPTIVE-REARED COMPARED WITH FREE-LIVING GREATER PRAIRIE-CHICKENS (*TYMPANUCHUS CUPIDO*)

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Abstract

The greater prairie-chicken (GPC, *Tympanuchus cupido*) inhabits tall and mixed grass prairies of the Central Great Plains, whereas the slightly smaller and highly endangered Attwater's prairie-chicken (APC, *T. c. attwateri*) is only found in 2, small, reintroduced populations in coastal Texas (apart from targeted captive-breeding efforts in TX and OK). Despite differences in physical and habitat characteristics, general feeding ecologies of the two subspecies appear similar, comprising plant materials (green shoots, buds and leaves), prairie flowers, mixed seeds, forbs, and insects (Korschgen, 1962; Mohler, 1952). The most detailed descriptions of dietary habits (APC in Texas, Cogar 1980; GPC in North Dakota; Rumble *et al*., 1987), conducted through fecal analyses, found high diversity and seasonality in diets. APC consumed foliage from 56 spp. of native forbs and grasses, seeds from 19 spp., and insects from 12 families; nonetheless, diets comprised mainly herbage through all seasons, with percentage seed and insect consumption increasing in summer, and peaking in autumn, but comprising relatively minor components of overall diets throughout the year. GPC consumed 34 different items over winter (mainly corn, sunflower and soybean seeds but also some green materials – mainly of agricultural origin), and up to 59 items spring through summer (primarily dandelion flowers, alfalfa/sweet clover, and increasing percentages of arthropods – the major food items of juveniles – later in the season). Although detailed studies of dietary nutritional content have not been published, GPC are used as model species for APC captive rearing programs. Due to unacceptably high captive-bred chick mortalities in recent years, diet and tissue nutrient concentrations are a current focus of detailed investigation (i.e. Morrow *et al*., 2019).

Materials and Methods

Twenty-two frozen liver samples from apparently healthy GPC that died from trauma or unknown causes were analyzed in this study. Samples from wild hatched and free-living birds were collected at hunter check stations in Nebraska in the fall of 2018 comprising twelve birds (3 adult/3 immature males and 3 adult/3 immature females). An additional 10 liver samples were analyzed from immature GPC (4 males, 6 females) that were produced, incubated, hatched and reared at the Sutton Avian Research Center (SARC), Bartlesville, OK in 2017 and 2018. Half of the captive-reared birds (n=5) had been released in Nebraska prior to finding dead intact, radioed carcasses; the remaining 5 birds from SARC were found dead following net collisions. Livers were stored frozen at -20°C prior to subsampling for analysis of fatty acid profiles and minerals through Zooquarius Analytical Laboratory (Ithaca, NY) and fat-soluble nutrients vitamins A (as retinol), E (as α-tocopherol), and a suite of carotenoids through the McGraw laboratory at Arizona State University (Tempe, AZ). Comparisons (t-test, with significance set at P=0.05) were conducted with sex, age, and locale as variables of interest.

Results and Discussion

Sex had no impact on hepatic fatty acid distribution in either free-ranging or captive birds in this survey study, but age differences were apparent in the free-living birds where immature GPC displayed higher liver saturated fatty acid concentrations than adults. Similarly, captive-reared birds (all immature; n=10) showed higher saturated fatty acid levels compared with free-range animals. When comparing just immature birds, free-ranging prairie chickens displayed significantly higher concentrations of essential fatty acids linoleic and linolenic, as well as total polyunsaturated fatty acids (P<0.001), and even EPA (P=0.07) and DHA (P=0.10) levels were numerically higher in wild-sampled birds, likely a dietary effect.

Regarding minerals, sex effects were not dramatic in either wild- or captive-reared GPC. Immature wild-sampled birds had wetter livers that contained more Na (P=0.01) and about half the concentrations of both Fe (P <0.001) and Mo (P <0.001) as older birds. Compared with domestic poultry, both free-range and captive-reared GPC liver mineral concentrations were, in general 2-5X higher, with the exceptions of Mo (>10X higher) and Co (similar or lower). Captive-reared immature GPC displayed lower hepatic Cu and S content, and higher Co levels compared with wild-reared birds, possible as an interaction with dietary Mo.

Most striking differences between groups were found in fat-soluble vitamin A, and select carotenoid concentrations. Captive female birds showed significantly (P<0.001) lower hepatic retinol values than males; free-living birds displayed liver retinol concentrations ~5X higher than those in captives (P<0.001), as well as significantly higher zeaxanthin (P=0.03) and ß-carotene (P=0.01).

These data, utilizing opportunistically-collected samples, provide useful information that can provide targeted direction for optimal dietary development and feeding management of captive populations of prairie chickens. In particular, oxidative status of bird populations, which can be impacted by interactions of dietary fatty acids, minerals and fat-soluble nutrients, should be investigated in more detail – particularly regarding effects on reproduction and immune function of captive animals. Future studies including analysis of native foods eaten by prairie-chickens may also be useful for comparison with captive diets being offered, as will direct comparisons between Greater and Attwater's Prairie-chicken tissue concentrations. While certainly a starting point, comparative values from (short-lived) domestic poultry appear to provide limited reference for nutritional assessment of prairie-chickens.

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