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Energy Content of Seeds of Switchgrass (*Panicum virgatum*) in the Diet of Mourning Doves (*Zenaida macroura*) in Southeastern New Mexico

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Running Title: Energy Content of Seeds of Switchgrass in the Diet of Mourning Doves

Abstract

Switchgrass (*Panicum virgatum*) is a common forage plant that grows over much of the United States. It has drawn interest as a possible feedstock for biofuels, is used as forage for livestock, is planted for soil conservation, and is a component of the diet of some species of wildlife. We analyzed the energy content of seeds of switchgrass obtained from the crops of mourning doves (*Zenaida macroura*) collected from plains-mesa sand-scrub in Lea and Eddy counties, New Mexico. Seeds were removed from crops and dried for 48 hours at 60°C to remove moisture and standardize masses. Seeds were then analyzed for gross caloric value (i.e., energy content) in an oxygen bomb calorimeter. Energy content of seeds of switchgrass from New Mexico averaged 18.4 J/kg (4.4 kcal/g—standard deviation, 0.7 J/kg [0.2 kcal/g]) and was lower than that of most other food items previously reported from the diet of mourning doves.

Introduction

Switchgrass (*Panicum virgatum*) is a widespread grass in the family Poaceae that grows in a variety of habitats and soils, including sand-scrub habitats. Its seeds mature in late summer and early fall (Stubbendieck et al. 1997). A study of feeding habits of mourning doves in southeastern New Mexico determined that seeds of switchgrass made up a small portion (3.7%) of the total mass of crop contents, but were present in 56.3% of the crops; 38 different food items were present in amounts <1% of total mass (Hunt 1999). Seeds of switchgrass are also reported to be a food item of other birds, such as northern bobwhites (*Colinus virginianus*—Hunt and Best 2001*a*) and scaled quail (Hunt and Best 2001*b*). Although energy content of commercially obtained switchgrass seeds and of seeds of wild switchgrass from Kansas has been measured (Saunders and Parrish 1987; Heffron and Parrish 2005), no such measurements have been conducted on seeds of *P. virgatum* from sand-scrub habitat of New Mexico.

Knowledge of the energy content of food items is critical to understanding why an animal might choose one food item over another, and is necessary for conservation and management of game species (Robel et al. 1974). While feeding habits of mourning doves (*Zenaida macroura*) are well studied, daily energy requirements have not been determined (Otis et al. 2020). One study (Schmid 1965) has measured the energy content of food of free-living mourning doves, and another (Shuman et al. 1988) measured some known and potential food items of mourning doves in conjunction with determination of how well captive mourning doves metabolized various food items. A study associated with the current one of energy content of Texas doveweed (*Croton texensis*) in the diet of mourning doves has been conducted with birds from sand-scrub habitat of New Mexico (Hunt et al. 2019), but no other such studies have been performed in the area.

We used an oxygen bomb calorimeter to determine the energy content of seeds of switchgrass from Eddy and Lea counties in New Mexico.

Methods and Materials

This study is an offshoot of long-term studies of lead poisoning of game birds (Best *et al*. 1992*a*; 1992*b*) and studies of feeding habits of game birds in southeastern New Mexico (Hunt 1999; Hunt and Best 2001a; Hunt and Best 2001*b*). The study area is at the

Waste Isolation Pilot Plant in eastern Eddy County and western Lea County (centered at 32°22'18"N, 103°47'37"W). All mourning doves were collected in uncultivated, shinnery oak-honey mesquite (*Quercus havardii-Prosopis glandulosa*) habitat, part of the plains-mesa sand-scrub vegetation type (Dick-Peddie 1993). A number of studies of the feeding ecology of mourning doves have been conducted in the area (Davis 1974; Best and Smartt 1985; Hunt 1999). The study site is heavily grazed by cattle.

In late summer and autumn in 1988, 150 mourning doves were collected by shooting as encountered. Collected birds were placed on ice within 10 minutes of shooting to minimize effects of post-mortem digestion (Dillery 1965; Farner 1960; Sedinger 1986); no effect of digestion on crop contents was observed and no residue from containment within the crop was detected. Crops were removed, placed into plastic vials, and frozen. Contents of crops were later thawed, separated by type of food, and placed into envelopes for drying. Food items were dried for 48 hours at 60°C to remove moisture. Food items were identified by comparison with samples of plants collected at the study site, and by using identification manuals (Davis 1993; Martin and Barkley 1961). We used seeds thus collected rather than raw seeds from the habitat to ensure that the samples included food actually consumed by mourning doves.

In 2021, samples of seeds of *Panicum virgatum* were analyzed for gross caloric value (i.e., energy content) in an oxygen bomb calorimeter (Model 1341, Parr Instrument Company, Moline, Illinois). Samples of seeds came from 12 individual mourning doves with crops that contained enough seeds for analysis; each sample weighed 0.5-1.0 g. Seeds were combusted in the oxygen bomb; after combustion, the bomb was washed and bomb washings were titrated with sodium carbonate to allow adjustment of results for nitrate content, which can skew results due to creation of nitric acid that combusts differently (Jessup 1960), but these effects were negligible. Results are reported in J/kg; kcal/g are given in parentheses for comparisons with previous studies.

Results

The 12 samples analyzed contained an average of 18.4 J/kg (4.4 kcal/g—range, 17.1-19.6 J/kg [4.1-4.7 kcal/g]; standard deviation, 0.7 J/kg [0.2 kcal/g]—Table 1).

Table 1. Gross caloric value (energy content) of seeds of switchgrass (*Panicum virgatum*) in the crops of mourning doves (*Zenaida macroura*) collected from Eddy and Lea counties, New Mexico, summer and autumn, 1988.

Sample No.	Energy in J/kg (kcal/g)
MD001-8803a	17.1 (4.1)
MD001-8803b	18.0 (4.3)
MD004-8805	18.0 (4.3)
MD009-8805a	18.4 (4.4)
MD009-8805b	18.7 (4.5)
MD011-8802a	19.3 (4.6)
MD011-8802b	18.8 (4.5)
MD022-8801a	18.0 (4.3)
MD022-8801b	17.7 (4.2)
MD022-8801c	17.7 (4.2)
MD045-8801a	19.6 (4.7)
MD045-8801b	17.7 (4.2)

Discussion

Our study demonstrates that seeds of switchgrass have an energy content less than many food items from previous studies. In a study of 9 food items collected from crops of mourning doves in North Dakota, Schmid (1965) found that 4 of the 9 items tested contained more energy than the Palmer's pigweed measured in this study, while the other 5 contained similar amounts or slightly less energy. Likewise, Shuman et al. (1988) tested 8 varieties of seeds that were considered to be potential food items for mourning doves in Kansas, and found all but two had greater energy content than the switchgrass tested in our study; wheat (*Triticum vulgare*) and cracked corn (*Zea mays*) had an energy content equivalent to switchgrass in our study. Studies conducted on other species of birds measured greater energy content on some other food items that are sometimes used by mourning doves. For example, Robel and Harper (1965) reported an average of 24.7 J/kg (5.9 kcal/g) for seeds of common sunflowers, and 23.0 J/kg (5.5 kcal/g) for seeds of giant ragweeds (*Ambrosia trifida*) collected in Kansas as part of a study of food items of northern bobwhites (*Colinus virginianus*). A study of potential food items for greater prairie-chickens (*Tympanuchus cupido*—Heffron and

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Parrish 2005) listed 13 different commercial feeds and seeds that had energy content equal to or greater than that which we measured for switchgrass; the energy content in that study for seeds of switchgrass was approximately equivalent to that in our study. A study of seeds of Texas doveweeds (*Croton texensis*) in crops of mourning doves conducted at the same study site as the current study (Hunt et al. 2019) reported an average energy content of 21.8 J/kg (5.2 kcal/g). Davison (1958) categorized switchgrass as "choice" food plants for northern bobwhites, meaning they were easily digestible or easily available. Conversely, our study seems to indicate that switchgrass may be inferior because of lower energy content. However, other factors such as behavior, energy demand, nutrient content, and availability of switchgrass and other seeds may play a role in their use (Hayslette and Mirarchi 2001; Molokwu et al. 2011).

Switchgrass is widely distributed across the United States, including much of eastern New Mexico. It is increasing in popularity as a feedstock for biofuels (David and Ragauskas 2010), is considered to be useful as forage for livestock, and its seeds are available from commercial suppliers for use as pasture control, as a landscape ornamental plant (Allred 2005), and in ecological restoration (Flint et al. 2018). It is also positively associated with disturbance (Gibson 1989) and is often found on roadsides (Powell 1994). Much of southeastern New Mexico is heavily grazed by cattle, and much of the landscape has been highly modified by building of roads for extraction of petroleum and natural gas (Hunt 2004), so that switchgrass grows abundantly. We believe that availability of seeds of switchgrass helps explain their occurance in the diet of mourning doves (Hunt 1999) and other granivorous birds of the area, despite the relatively poor energy content demonstrated herein.

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