VARIATION IN VOLUNTARY INTAKE OF FEEDS BY CAPTIVE GIRAFFE (*GIRAFFA CAMELOPARDALIS*): IMPLICATIONS FOR MEETING NUTRIENT REQUIREMENTS

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Abstract

Data prompting evaluation of captive giraffe feed selection were obtained from a modified reversal study investigating the effects of dietary physical form and carbohydrate profile. Six non-lactating adult female giraffe (*Giraffa camelopardalis reticulata*) were used in seven 21-day periods. Supplements were: an experimental non-pelleted browser supplement (EF) and a mixture of 75% Mazuri Browser Breeder (PMI Nutrition International, LLC, Brentwood, MO) and 25% Omelene 200 (Ralston Purina Co., St. Louis, MO) (GF). Individually housed giraffe were offered *ad libitum* alfalfa hay, water, salt, and one supplement in each period. Intake of individual feeds was measured days 15 through 21. Average daily as-fed intake as a percentage of body weight (BW) varied widely for total intake (0.77% to 1.85% BW), alfalfa hay (0% to 0.67% BW), and supplement (0.54% to 1.60% BW). Hay to supplement intake ratios did not exceed 40:60. Review of additional giraffe intake studies revealed further evidence of individual animal variation. Animal-selected intakes differed from Nutrition Advisory Group recommendations for feeding (2% BW) and hay to supplement ratio (60:40 to 70:30). Physically effective fiber (peNDF), typically obtained from forage or browse, maintains chewing activity and ruminal pH. Intake of low peNDF and high concentrate proportions may negatively affect feed intake, diet digestibility, and animal health. To minimize potential negative effects of individual feed selection, blending all feedstuffs together in a form to minimize selection and facilitate intake of a balanced ration including peNDF should perhaps be considered for captive giraffe.

Introduction

A feeding study was undertaken at Busch Gardens, Tampa (BGT) to evaluate the effects of altering the carbohydrate profile and physical form of giraffe diets. The resulting intake values revealed noticeable individual animal variations in intake and low hay intake in most animals, prompting an examination of other giraffe feeding studies and current feeding recommendations for captive giraffe.

Methods

Six non-lactating adult female giraffe (*Giraffa camelopardalis reticulata*), ranging in body weight from 542 to 717 kg (average 633 kg), were used in a modified reversal study consisting of seven 21-day periods. Supplements, equivalent in crude protein, minerals and vitamins A, D and E, were: an experimental non-pelleted browser supplement developed and mixed by University of Florida researchers (EF) and a mixture of 75% Mazuri Browser Breeder (PMI Nutrition International, LLC, Brentwood, MO) and 25% Omelene 200 (Ralston Purina Co., St.

Louis, MO) (GF). Individually housed giraffe were offered alfalfa hay, water, salt, and one supplement *ad libitum* in each period, so that each giraffe received each supplement for at least one period. Intake of individual feeds was measured days 15 through 21 by weighing all offered and leftover feed amounts. Amounts from this study are reported on an as-fed basis.

Discussion

The Nutrition Advisory Group handbook recommends feeding large browsing ruminants alfalfa hay and low fiber pellets in a 60:40 to 70:30 ratio, at 2% of body weight.[10] Voluntary intake of the giraffe in the BGT study did not approach the recommended intake levels or hay: concentrate ratios. In four of the six animals, total as-fed intake was less than 1.6% of body weight. While on the traditional hay and concentrate diet (GF) one giraffe consumed a forage: concentrate ratio of 40:60. Ratios for the remaining 5 animals ranged from 8:92 to 19:81. A review of additional data on voluntary intake of captive giraffe reveals as-fed forage to concentrate ratios of 26:74 to 55:45, and total intakes of 1.15% to 1.61% body weight for non-lactating animals (Tables 1 and 2). Greater forage consumption was reported when giraffe were offered browse in addition to hay and concentrates (Table 1), but still varied among giraffe offered similar diets.[3] To consume 2% of body weight at a 60:40 hay: concentrate ratio, a giraffe would need to consume hay at 1.20% of body weight. However, captive giraffe intake of hay-only diets has been reported as 0.89% and 0.45% of body weight for alfalfa and grass hay, respectively, the lowest percentage body weigh intake of the 28 ungulate species in that report.[6] In the three aforementioned intake studies involving both hay and supplement, individual animal hay intake did not exceed 0.69% of body weight. Together, these studies demonstrate a discrepancy between the recommended feeding practices for large browsing ruminants and actual captive giraffe feed consumption.

Physical characteristics, particularly of the fiber fraction, can influence the efficacy of a ruminant's diet. Proper rumen function is maintained by consumption of sufficient "physically effective fiber" (peNDF), which can be defined as the slowly digestible or indigestible fraction of feeds that is of sufficient size to enhance rumen function and chewing activity.[11] Forage and browse are generally regarded as the primary sources of peNDF for giraffe. Decreasing forage: concentrate ratios from 40:60 to 30:70 has been used to induce subclinical ruminal acidosis in dairy cattle, decreasing feed intake and efficiency of fiber digestion.[9] Clauss et al[4] have suggested that captive giraffe fed a traditional hay/ concentrate diet face a nutritional dilemma: consume a high proportion of hay, increasing ruminal fill and decreasing intake, or consume a high proportion of concentrates, increasing potential risk of ruminal acidosis. What is not clear is what the proper characterization of peNDF is for browsers, in terms of physical form, digestibility, and quantity required. It has been proposed that browser peNDF includes particles of polygonal shape similar to browse, rather than the needle-like fibers derived from grasses.[4]

The issues of appropriate peNDF for giraffe and voluntary selection of dietary components may have animal health implications. Numerous accounts of wasting and sudden death of suspected nutritional origin have been reported in captive giraffe.[1, 5, 7, 8, 12] It has been proposed[4] that such pathologies may be related to the physical form of fiber in captive giraffe diets. Although peNDF remains to be defined for browsers, an approach that might be considered to address the drastic differences in nutrient consumption among animals caused by diet selection is the use of total mixed rations (TMR). In TMR, all diet components are mixed together in a form to

decrease sorting of individual components. Success will vary depending upon the tendency and ability of the individual animal to sort for or against diet components. Total mixed rations are commonly used with domestic livestock to increase the likelihood that the diet consumed is close in nutrient content to the formulated ration.

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Table 1. Average individual giraffe intake (kg/day), derived from Clauss et al (2001), tables 2, 3 and 4.[3]

Giraffe	Body weight (kg)	Browser Breeder pellets	Total concentrate	Lucerne hay	Total forage *	Lucerne hay % body weight	Total intake % body weight	Forage*: concentrate ratio
Ellie [A]	700	3.0 (2.7)	4.54 (4.10)	4.4 (3.9)	5.4 (4.3)	0.63 (0.55)	1.42 (1.20)	54:46 (51:49)
Ellie[A,B]	700	3.6 (3.2)	5.14 (4.64)	4.1 (3.6)	6.1 (4.5)	0.59 (0.52)	1.61 (1.31)	54:46 (49:51)
Josie [D]	650	7.7 (6.9)	8.24 (7.43)	4.5 (4.0)	5.5 (4.4)	0.69 (0.61)	2.11 (1.82)	40:60 (37:63)
Kirk [A]	1200	8.5 (7.7)	10.04 (9.05)	2.9 (2.6)	3.9 (3.0)	0.24 (0.21)	1.16 (1.01)	28:72 (25:75)
Will	900	5.0 (4.5)	5.54 (5.00)	3.8 (3.3)	4.8 (3.8)	0.42 (0.37)	1.15 (0.98)	46:54 (43:57)
Will [B,C]	900	4.9 (4.4)	5.44 (4.91)	3.6 (3.2)	6.6 (4.5)	0.40 (0.35)	1.34 (1.05)	55:45 (48:52)

Values presented on as-fed basis. Dry matter values in parentheses.
All diets included 0.34 kg alkane pellets (n-alkane C_{36} treated pellets used as digestibility marker), 0.20 kg vitamin E pellets (Ele-Vit-E, Special Diets Services, Mazuri, Witham, Essex, UK), and 1.0 kg beech browse (*Fagus sylvatica*), consumed in total by all giraffe.
[A] Offered and consumed 1.0 kg linseed chips (Cargill Plc, Gladstone Dock, Bootle, UK).
[B] Offered and consumed 1.0 kg sycamore browse (*Acer pseudoplatanus*).
[C] Offered and consumed 1.0 kg hazel browse (*Corylus avellana*).
[D] Lactating
* Forage includes lucerne hay and all browse.

Table 2. Mean daily intake of two giraffe, derived from Baer et al (1985), tables 2 and 3.[2]

Feed amounts	Combined estimated body weight (kg)	Total concentrate (kg)	Alfalfa hay (kg)	Alfalfa hay % body weight	Total feed % body weight	Forage: concentrate ratio
Offered	1070	13.12 (11.54)	6.96 (6.00)	0.65 (0.56)	1.88 (1.64)	35:65 (34:66)
Consumed	1070	11.09 (9.74)	3.86 (3.33)	0.36 (0.31)	1.40 (1.22)	26:74 (25:75)

Values presented on as-fed basis. Dry matter values in parentheses. Diet consisted of alfalfa hay, pellets manufactured to National Zoological Park specifications (Zeigler Brothers Co., Gardners, PA), and Omelene 200 (Ralston Purina Co., St. Louis, MO).