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Feeding behavior of goat kids fed diets containing peach palm meal

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ABSTRACT. The aim in this study was to evaluate the feeding behavior of goat kids fed diets containing peach palm meal replacing corn (0, 10, 40, 60, and 85 % on a dry matter basis). Thirty crossbred Boer kids, with 90 days old and initial body weight of 16.7 ± 3.5 kg were distributed in a completely randomized design with six replicates. Diets were daily supplied *ad libitum* to allow 10-20 % leftovers. Three collections were performed every 28 days. Diets were isoenergetics and isonitrogenous, composed of corn, soybean meal, peach palm meal, mineral supplement and Tifton 85 hay, with roughage: concentrate ratio of 30:70. There was a linear reduction in the intakes of dry matter (DM) and neutral detergent fiber (NDF) with a respective decrease of 35.7 % and 58.8 % comparing the diet with 85 % replacement and the control diet. The rumination and chewing times increased in diets with peach palm meal. The feeding and rumination rates decreased with reducing intakes of DM and NDF. The peach palm meal affects the feeding behavior and decreases the feed intake in response to palatability, fat and fiber composition, and it is recommended until 10 % replacing corn.

Keywords: boer; feed; feeding rate; ethology; idle; rumination.

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Introduction

Nutritional management is an important parameter to be considered in animal production, since feeding is responsible for the greater part of the costs of the activity.

Peach palm (*Bactris gasipaes* Kunth) has become an agricultural species in the humid tropical region of Brazil (Conceição et al., 2018). Besides the heart-of-palm with excellent market value, its fruit can be used for the extraction of seeds. The expansion of cultivation and renovation of already established areas associated with the prohibition to import seeds provided an increase in the agricultural demand (Rombola et al., 2010). The heart-of-palm industry directs part of the cultivation area to the production of fruit for extraction of seeds. Hence, the pulp is a waste that could be used for the production of peach palm meal as alternative feedstuff for ruminants (Santos et al., 2016b).

Peach palm meal is an ingredient with great potential for use in animal feed and can be converted into commercial products, but for that it is necessary to know inclusion levels that guarantee animal productivity. The use of unconventional feedstuff can lead to changes in the ingestive behavior of ruminants (Syperreck et al., 2016). In addition, new feeding techniques can promote sensorial and metabolic changes in the gastrointestinal tract, reflecting on the animal feeding behavior.

The literature mentions nutritive value and bioactive compounds of peach palm fruit for humans and animals and it can be incorporated at high levels in the diet without affecting the health (Leterme et al., 2005). Authors report oil contents ranging from 20 to 620 g kg^{-1} DM, antinutritional factors, such as trypsin inhibitors, lectins, and Ca oxalates. Although these constituints are not present in great concentrations and are thermolabile, studies showed limitation of dietary intake by the monogastric animals (Gómez, Vargas, & Quesada, 1998; Murillo, Kroneberg, Mata, Calzada, & Castro, 1983; Murillo, Zumbado, Cooz, & Espinoza, 1991). Mora-kopper, Mora-Urpi, and Mata-Segreda (1996) mentioned possible problems of rancidness of oil

and Leterme et al. (2005) related a bitter taste of peach palm.

The evaluation of the use of peach palm meal replacing corn in diets for feedlot lambs showed that it has the potential to be used as an ingredient in supplements (Santos et al., 2016a), but its use in goat feeding has not been studied. Thus, the objective of the present study was to evaluate the feed intake and the feeding behavior of weaned kids fed diets containing peach palm meal replacing corn.

Material and methods

The Ethics Committee of the State University of Southwest Bahia (UESB), Itapetinga Campus, protocol 11-2012, approved the experimental procedures of this study. The experiment was conducted in the Centro de Ensaios Nutricionais de Caprinos e Ovinos – UESB. Thirty Boer crossbred kids, with approximately 90 days old and initial body weight of 16.7 ± 3.5 kg, were distributed in a completely randomized design with five treatments (0, 10, 40, 60, and 85 % peach palm meal replacing corn in the concentrate) and six replicates. The experimental period lasted 84 days, with 14 days for adaptation and three 28 day periods for data collection.

The pulp of the pitted fruit (pericarp and mesocarp) was supplied by Indústria de Alimentos no Mercado de Palmitos (INACERES), located in Uruçuca, State of Bahia. The peach palm meal was produced in a flour mill at Instituto Federal Baiano (IFBAIANO), Uruçuca Campus, State of Bahia. The obtained pulp was dried in the sun for three consecutive days, turning over the material three times a day until its moisture content was reduced by half. Subsequently, it was disintegrated in a cassava grinder, and then the ground mass was roasted in a mechanized flour roaster. This roasting procedure lasted 30 - 40 min, with the mass being turned over using wooden squeegees until its final drying, at approximately 13 g kg^{-1} moisture.

Diets were balanced according to National Research Council (NRC, 2007) requirements for goat kids in the growing phase for a weight gain of 200 g day^{-1}. Proximate and chemical compositions of the diets are listed in Table 1. Diets were supplied daily as complete mix, at 0700 and 1600 h, *ad libitum*, so as to allow for 10-20 g kg^{-1} leftovers. The daily voluntary intake was calculated as the difference between the total feed supplied and the leftovers, which were collected and weighed in the morning and afternoon, during the 84 experimental days.

Table 1 Ingredient composition (g kg^{-1} DM) of the diets, chemical composition of the Tifton 85 hay, peach palm meal (PP) and experimental diets.

Ingredient			Level of substitution (% DM)				
			0	10	40	60	85
Tifton 85 hay			300	300	300	300	300
Ground corn			507	456	297	203	76
Soybean meal			178	178	178	178	178
Peach palm meal			0	51	210	304	431
Mineral supplement[a]			15	15	15	15	15
Total			100	100	100	100	100
Chemical composition			Experimental diets				
	Tifton 85 hay	PP	0	10	40	60	85
Dry matter	928	932	918	927	928	927	929
Organic matter	916	971	942	938	939	934	933
Ash	84	29	58	62	61	66	67
Crude protein	88	78	154	153	149	146	142
NDIP[b]	405	116	481	453	450	464	560
ADIP[c]	275	197	251	226	176	192	197
Ether extract	14	115	24	29	45	51	61
Non-fiber carbohydrates	39	658	261	303	319	319	329
NDFap[d]	737	105	466	417	401	378	375
Acid detergent fiber	404	45	236	237	202	217	219
Lignin	20	11	7	6	7	9	11
Total digestible nutrients	586	806	727	728	723	722	724
ME (Mcal kg^{-1}) [e]	--	2.30	2.80	2.80	2.80	2.80	2.80

[a]Amount kg^{-1} of product: Calcium (max) 240 g; Phosphorus 71 g; Copper, 400 mg; Iron 250 mg; Cobalt 30 mg; Iodine 40 mg; Manganese 1,350 mg; Selenium 15 mg; Zinc 1,700 mg; Fluorine (max) 710 mg; Vitamin A 135,000 IU; Vitamin D3 68,000 IU; Vitamin E 450 IU; [b]Neutral detergent insoluble protein, g kg^{-1} CP; [c]Acid detergent insoluble protein, g kg^{-1} CP; [d]NDF corrected for ash and protein; [e]Metabolizable energy, estimated according to NRC (2001).

In each experimental period, samples of the feed supplied (roughage and concentrate) and leftovers were placed in labeled plastic bags and stored in a freezer at –20ºC. After thawing, samples were predried in a forced-air oven at 65 ºC. Next, these were ground in a Wiley knife mill with a 1 mm sieve. For feed, it was made a composite sample per period and for leftovers, a composite sample was formed per animal and

period, and labeled for subsequent laboratory analyses.

Dry matter (DM) (method INCT - CA G - 003/1), mineral matter (MM) (method INCT - CA M - 001/1), crude protein (CP) (method INCT - CA N – 001/1) and ether extract (EE) (method INCT - CA G - 004/1) contents were determined according to Detmann et al. (2012) in the samples of leftovers and supplied feed. For the sequential analyses of neutral (NDF) and acid (ADF) detergent fiber, samples were treated with thermostable alphaamylase, without sodium sulfate, and corrected for residual ash (Mertens, 2002). The NDF correction for nitrogen compounds and estimates of the neutral (NDIN) and acid (ADIN) detergent insoluble nitrogen compounds were carried out according to Licitra, Hernandez, and Van Soest (1996). Lignin (method INCT - CA F - 005/ 1) was obtained based on the methodology described by Detmann et al. (2012), with the ADF residue treated with 72 % sulfuric acid. Non-fiber carbohydrates (NFC) content were calculated according to Hall, Hoover, Jennings, and Webster (1999) with modifications, utilizing NDFap. Total digestible nutrients (TDN) were calculated according to Weiss, Conrad, and Pierre (1992). The lipid fraction of the experimental diets was determined at the Center for Chromatographic Analyses of UESB, according to the method of Bligh and Dyer (1959). Peak areas were determined by the normalization method using ChromQuest 4.1 software. Peaks were identified by comparison of the retention times of fatty acid methyl esters (Sigma, USA), and after determining the equivalent chain length (Table 2).

Table 2. Lipid fraction (g 100 g^{-1} DM) of the experimental diets.

Lipid fraction (g 100g^{-1} DM)	Level of substitution (% DM)				
	0	10	40	60	85
Total lipids	3.25	3.52	4.37	4.87	5.54
Total saturated	0.92	0.94	1.00	1.03	1.08
Total unsaturated	2.34	2.59	3.37	3.83	4.46
Monounsaturated	0.03	0.11	0.34	0.48	0.67
Polyunsaturated	2.30	2.48	3.03	3.36	3.80

In the evaluation of the feeding behavior, animals were subjected to visual observation periods in the three experimental periods. Goat kids were observed for 24 h, in five-minute intervals, for the evaluation of the feeding, rumination, and idle times (Martin & Bateson, 1993). During the nocturnal observations, the environment was maintained under artificial illumination, and animals were previously adapted.

To record the mean values of the number and time of chews per ruminal cud, a digital stopwatch was used for each animal, adopting the visual observation of the animals in the intervals of 10h00 to 12h00, 14h00 to 16h00, and 18h00 to 20h00. The results referring to feeding behavior-related factors were obtained by the following equations (Bürger et al., 2000):

$$FE = \frac{DMI}{FT}$$

$$RRDM = DMI/RT$$

$$RRNDF = NDFI/RT$$

$$TCT = FT + RT$$

$$RC = RT/ChTRC$$

where FE (g DM h^{-1} and g NDFap h^{-1}): feeding rate; DMI (g DM day^{-1}): DM intake; FT (min day^{-1}, min kg^{-1} DM, and min kg^{-1} NDF): feeding time; RR_{DM} and RR_{NDF} (g DM h^{-1}, g NDF h^{-1}): rumination rate; RT (min day^{-1}, min kg^{-1} DM, and minkg^{-1} NDF): rumination time; TCT (min day^{-1}, min kg^{-1} DM, and min kg^{-1} NDF): total chewing time; RC (n^o day^{-1}): number of ruminal cuds; ChTRC (s cud^{-1}): chewing time per ruminal cud.

The number of feeding, rumination, and idle periods was counted as the sequential number of activities observed in the annotation spreadsheet. The average duration of these periods of activities was calculated by dividing the total duration of each activity (feeding, rumination, and idle, in min day^{-1}) by its respective number of discrete periods. The intake of DM and NDF per feeding period was calculated from the division of daily intake by the number of feeding periods.

Data were analyzed by the MIXED procedure of SAS software (Statistical Analysis Softw [SAS], 2004). Polynomial contrasts were tested to compare the means of the diet containing only corn (0 % peach palm meal) and diets substituting corn with peach palm meal (10, 40, 60 and 85 %) (A). Linear (L) and quadratic (Q) order effects as a function of substitution of corn with peach palm meal were broken down into

polynomial contrasts. The following statistical model was used:

$Yijk = (\beta 0 + \beta 1Tr + \beta 2Tr2) + \varepsilon ijk; NID (0; \sigma^2)$

where: Y= estimated value according to the diets; β_0 = intercept; β_1 and β_2 defined the variation of Y according to the level of substitution; and Tr = level of substitution (0, 10, 40, 60, and 85 % peach palm meal). For all statistical procedures, the critical probability level for type-I error was set at 0.05.

Results and discussion

The DMI showed a negative linear effect ($p < 0.0001$) for the replacement levels of peach palm meal with mean values of 734.3, 594.6, 615.0 and 471.0 g day^{-1}, respectively, for levels 10, 40, 60 and 85 %. There was a reduction in DMI by 35.7 % in the diet with 85 % replacement of corn in relation to the diet without peach palm meal (Table 3). For each unit percentage of peach palm meal replacing corn, a reduction of 3.23 g day^{-1} in DMI was observed. Results for NDFI were similar to DMI, with a decrease of 2.07 g day^{-1} for each unit percentage of peach palm meal, and a reduction by 58.8 % in the diet with 85 % replacement of corn compared to the control diet (Table 3).

Table 3 Intakes of dry matter (DMI) and neutral detergent fiber (NDFI), and feeding, rumination, chewing, and idle activities according to levels of substitution of corn by peach palm meal in feedlot goat kids.

Item	Level of substitution (% DM)					SEM	P value		
	0	10	40	60	85		C	L	Q
				Intake (g day^{-1})					
DMI	732.9	734.3	594.6	615.0	471.0	20.8	0.000	0.000[a]	0.158
NDFI	353.3	285.0	215.1	221.1	145.6	13.9	0.000	0.000[b]	0.159
				Feeding					
Min day^{-1}	302.8	314.1	446.9	421.9	565.3	21.9	0.001	0.000[c]	0.358
Min kg^{-1} NDF	625	807	1221	1176	1852	18.4	0.000	0.000[d]	0.074
				Rumination					
Min day^{-1}	394.3	462.5	462.0	420.2	438.8	8.9	0.016	0.417	0.046[e]
Min kg^{-1} DM	539.9	632.4	778.0	696.3	916.4	28.0	0.000	0.000[f]	0.841
Min kg^{-1}NDF	1118	1628	2185	1971	2897	23.0	0.000	0.000[g]	0.910
				Chewing					
N cud^{-1}	57.2	55.2	51.3	52.0	55.9	1.2	0.223	0.488	0.103
Seg cud^{-1}	63.0	61.4	58.7	58.8	62.8	1.1	0.387	0.715	0.170
Min day^{-1}	615.5	691.7	726.0	680.2	706.0	13.1	0.008	0.055	0.082
Min kg^{-1} DM	843	946	1225	1118	1505	46.7	0.000	0.000[h]	0.287
Min kg^{-1}NDF	1743	2433	34061	2971	4641	19.0	0.000	0.000[i]	0.184
				Idle					
Min day^{-1}	824.5	748.3	714.0	759.8	734.0	13.1	0.008	0.056	0.082

C Contrasts between the diet containing only corn vs. diets with levels of substitution of corn by peach palm meal, *SEM* standard error of the mean, *L* linear, *Q* quadratic; Significant $^{*}(p < 0.0001)$; $^{**}(p < 0.001)$; $^{***}(p < 0.01)$; $^{****}(p < 0.05)$; ^{a} $Y = 744.52 - 3.2311 X*$ $^{b}Y = 320.38 - 2.0696 X*$ $^{c}Y = 295.86* + 2.8932 X*$ $^{d}Y = 638.23* + 13.3434 X*$ $^{e}Y = 414.65* + 1.8991 X**** - 0.02032 X2****$ $^{f}Y = 572.72* + 4.1286 X*$ $^{g}Y = 1171.21* + 20.5682 X*$ $^{h}Y = 862.32* + 7.4901 X*$ $^{i}Y = 2010.04* + 31.2408 X*$

In view of the results described for DMI, there was a greater acceptability by the animals of the concentrate containing corn. This was clearly noticeable when checking the leftovers from the control diet troughs that had homogeneous remains of the roughage and concentrate. For the diets containing peach palm meal, total intake of the roughage was found, and the leftovers contained only concentrate. The intake composition is consistent with this observation showing a change to 48.2, 38.8, 36.2, 35.9, and 30.9 % in the respective proportions between DMI and NDFI, when compared to the diet supplied.

The EE content, with major proportion of unsaturated fatty acids, was higher for the diets with 60 and 85 % of peach palm meal replacing corn, which also would explain the lower intake of these diets (Table 2). The peach palm meal during the experiment suffered from oxidation process, which was perceptible by the change in color and odor. The sensorial factor has been considered determinant in feed selection and ingestion. According to Hill (2007), palatability can be defined as the sensory perception of feed and can be influenced by smell, texture and nutrients.

The feeding times in min kg^{-1} DM and min kg^{-1} NDF presented, respectively, increments of 2.9 and 13.3 units for each percentage unit of peach palm meal level. Diets with the greatest content of peach palm meal provided a higher rumination time, being 438.8 min day^{-1}, 916.4 min kg^{-1} DM and 2897 min kg^{-1} NDF (Table 3). In this way, the contrast analysis corroborates these results, showing that the diets containing peach

palm meal for their various forms of expression presented higher times spent in rumination activity when compared to the control diet.

Considering rumination activities, in min day^{-1}, when analyzed according to peach palm meal levels, in this case, it can be verified that the regression equation presented a quadratic effect, being estimated a maximum value of 459.0 min day^{-1} in the rumination activity to a level of 46.7 % peach palm meal. In a sequence, it can be observed that the regression equation obtained for rumination activity, in min kg^{-1} DM and min kg-1 NDF, presented an increasing linear effect. It is verified that for each unit percentage of the peach palm meal replacing corn, there was an increase of 4.1 and 20.6 percentage units, respectively (Table 3).

Another inference is the high concentrate content associated with the increase of the fat content of diets containing the peach palm meal levels (Tables 1 and 2), which may have inhibited the action of microorganisms that degrade the fiber and thus compromise the digestibility and the rate of passage (Santos et al., 2016b).

The increasing levels of peach palm meal replacing corn in the diets did not interfere with the times spent in chewing activity per cud (Table 3). Thus, mean values of 53.0 and 60.6 for the dependent variables related to the chewing activity, expressed in number and second per cud, respectively. However, for the expressed chews, in min kg^{-1} DM and min kg^{-1} NDF, it was observed higher values for the diets containing peach palm meal, which presented an increasing linear effect. For each unit percentage of peach palm meal replacing corn, there wre increases of the order of 7.4 and 31.2 min units in the chewing activity per kg DM and NDF, respectively (Table 3).

Diets containing peach palm meal presented shorter time spent in idle when compared to the control diet, possibly because the animals spent more time with the feed selection, increasing feeding time. In addition, the peach palm meal levels increased the time required to reduce the particle size in the rumen, probably as a consequence of the increase in the unsaturated fatty acids content and lignin/NDF ratio, especially in the diets containing 85% peach palm meal replacing corn. Hence, as animals spent more time on rumination, a short time was spent in idle. This effect is related to the negative implications that lipids and bioactive secondary compounds have on ruminal fermentation and feed digestibility by inhibiting the microbial growth (Amira et al., 2014; Clement et al., 2004; Martinele, Eifert, Lana, Arcuri, & D'Agosto, 2008; NRC, 2001).

It is an established fact that lignin concentration is negatively correlated with fiber digestibility. Thus, possibly, the peach palm meal affected the fiber digestion in the rumen both by the action of the unsaturated fatty acids and by the wider range of phenolic acid cross-linkages with lignin, hemicellulose and celulose (Moore & Jung, 2001). Slowly digestible foods can be retained in the rumen and more chewed during rumination, this results in a decreased rate of feed intake.

In view of the relationship between feed digestibility, retention time in the rumen, and rate of intake, digestibility is likely to be an important parameter in food selection by ruminants. In this study, it was evidenced that there was feed selection, since the proportion of NDF in the ingested diet reduced with increasing levels of peach palm meal replacing corn.

Feeding rate was directly influenced by the use of peach palm meal in diets for goat kids. Lower feeding rate was observed for diets containing peach palm meal when compared to the control diet. Since it was possible to observe reductions in the feeding rate, in g DM h^{-1} and NDF h^{-1}, respectively, of 36.6 and 84.6%, when compared the control diet and diets with peach palm meal (Table 4). The peach palm meal interfered with the rumination rate. There was a contrast effect between the diet containing only corn and those containing peach palm meal, in which the control diet presented better results for rumination rate (cuds day^{-1}, g DM cud^{-1}, and g NDF cud^{-1}).

The regression equation for the rumination rate showed a quadratic variation (Table 4), with a maximum value of 465.9 cuds day^{-1} estimated at the level of 40.8 % peach palm meal replacing corn. For the rates, in g DM cud^{-1} and NDF cud^{-1}, the equations showed a linear decrease ($P < 0.05$), whose values, respectively, were 0.007 and 0.004 units for each percentage of peach palm meal replacing corn. For rumination rate, it was detected the superiority of the control diet over the other diets. Thus, those containing 0, 10, 40, 60, and 85 % peach palm meal replacing corn had mean values, respectively, of 112.5, 96.2, 77.4, 88.9 and 64.2 g DM h^{-1} and 54.3 g, 37.3, 28.1, 32.1, and 19.9 g NDF h^{-1} (Table 4). In this way, there were reductions in rumination rate of 42.9 and 63.3 %, in g DM h^{-1} and g NDF h^{-1}, respectively, when comparing the control diet and that containing 85 % peach palm meal replacing corn. The linear regression equations estimated for each unit

percentage of peach palm meal showed reduction of 0.43 and 0.24 units in rumination rate expressed in g DM h^{-1} and g NDF h^{-1}, respectively.

Table 4. Feeding and rumination rates according to levels of substitution of corn by the peach palm meal for feedlot goat kids.

Item	Level of substitution (% DM)					SEM	*P value*		
	0	10	40	60	85		C	L	Q
Feeding rate									
gDM h^{-1}	202.1	196.8	141.7	145.7	107.9	8.4	0.000	0.000[a]	0.897
gNDF h^{-1}	97.3	76.1	49.9	51.8	33.1	4.5	0.000	0.000[b]	0.030
Rumination rate									
cud nº day^{-1}	379.8	454.4	475.0	430.3	427.9	11.7	0.020	0.355	0.023[c]
g DM cud^{-1}	2.0	1.6	1.3	1.5	1.1	0.1	0.000	0.000[d]	0.145
g NDF cud^{-1}	0.95	0.63	0.46	0.52	0.34	0.1	0.000	0.000[e]	0.003
g DM h^{-1}	112.5	96.2	77.4	88.9	64.2	3.6	0.045	0.000[f]	0.821
g NDF h^{-1}	54.3	37.3	28.1	32.1	19.9	2.3	0.000	0.000[g]	0.010

C Contrasts between the diet containing only corn vs. diets with levels of substitution of corn by peach palm meal, *SEM* standard error of the mean, *L* linear, *Q* quadratic; Significant $^{*}(p < 0.0001)$; $^{**}(p < 0.001)$; $^{***}(p < 0.01)$; $^{****}(p < 0.05)$; $^{a}\ Y = 203.50* - 1.1118X*^{b}\ Y = 87.1578* - 0.6346X*^{c}Y = 409.15* + 2.7838X**** - 0.03410X2\ ***^{d}\ Y = 1.6959* - 0.00701X*^{e}\ Y = 0.6752* - 0.00391X*^{f}\ Y = 100.02* - 0.4287X*$; $^{g}Y = 40.2828^{*} - 0.2405X^{*}$

The chewing time is directly proportional to DMI and to NDF content of the diet and is associated with the particle size (Macedo Júnior, Zanine, Borges, & Pérez, 2007). Differently, the DMI and the NDF content were greater for the control diet, but the peach palm meal levels provided longer chewing time. It could be associated, initially, with a preference of the animals to consume the hay and thus, a longer time to select the food.

The use of peach palm meal levels to replace corn in the diets did not interfere with the results to the point of detecting differences between diets for the time spent in feeding and rumination periods. However, the group receiving diets with peach palm meal had a shorter idle period (Table 5). The lack of effect for the variables number of feeding periods, rumination, and idle, as well as the time spent per feeding and rumination periods, can be explained by the same proportion of concentrate and physical form of the experimental diets.

In the evaluation of the average intake per feeding period, there was effect and the diets containing peach palm meal presented lower intakes of DM and NDF per feeding period in relation to the control diet (Table 5). There was adjustment of regression equations with a decreasing linear effect, since for each percentage unit of the peach palm meal replacing corn, we observed a reduction of 0.0003 and 0.0002 units in the DM and NDF intakes per feeding period (Table 5).

Table 5. Number and average time spent per period on the feeding, rumination, and idle activities, and intakes of DM and NDFap per feeding period according to the levels of substitution of corn by peach palm meal in feedlot goat kids.

Item	Level of substitution (% DM)					SEM	*P* value		
	0	10	40	60	85		C	L	Q
Number of periods (nº day^{-1})									
Feeding	9.8	11.1	10.9	11.1	10.7	0.4	0.348	0.595	0.459
Rumination	19.7	19.2	20.4	19.7	21.8	0.4	0.548	0.090	0.285
Idle	26.2	26.1	27.2	27.5	27.5	0.4	0.457	0.239	0.903
Time spent per period (min)									
Feeding	22.9	21.6	22.5	23.8	24.1	0.8	0.974	0.465	0.617
Rumination	20.3	24.3	22.7	21.5	20.9	0.6	0.123	0.689	0.057
Idle	31.7	28.8	26.5	27.8	25.7	0.7	0.010	0.010[a]	0.337
Intake per feeding period (kg)									
DM	0.070	0.070	0.053	0.057	0.049	0.01	0.017	0.005[b]	0.471
NDF	0.037	0.027	0.018	0.020	0.013	0.01	0.000	0.000[c]	0.109

Contrasts between the diet containing only corn vs. diets with levels of substitution of corn by peach palm meal, *SEM* standard error of the mean, *L* linear, *Q* quadratic; Significant $^{*}(p < 0.0001)$; $^{**}(p < 0.001)$; $^{***}(p < 0.01)$; $^{****}(p < 0.05)$; $^{a}\ Y = 29.8341* - 0.04860****^{b}\ Y = 0.07478* - 0.00031X**^{c}\ Y = 0.03182* - 0.00022X*$

The amount of feed ingested within a time period is modified by the number of meals as well as the duration and speed of ingestion. However, there was no change in the number of periods and in the time spent per feeding period. Thus, the linear reduction in the amount of DMI and NDFI per feeding period is due to the restricting effect of voluntary intake of the peach palm meal. In this way, reductions of 18.2 and 52.7% were observed when the control diet and peach palm meal diets were compared, respectively (Table 5). These results are reinforced on regression equations that showed a decreasing linear behavior of these

variables with the substitution of corn in the diet. This response occurred as a function of the observed values for daily intake of DM and NDF, which decreased by the replacement of corn by increasing levels of peach palm meal.

The integration of factors can affect feed intake in small ruminants, with a direct effect on ingestive behavior, such as NDF content (Van Soest, 1994), fat content and physical form of the feed (Pulina et al., 2013). Consistently, the peach palm meal presents high EE content with oxidation feature and lignin in the fiber, both are factors that possibly contributed to restrict voluntary intake in level of palatability and ruminal digestion, respectively.

The lower feeding rate and shorter duration time for idle can be explained by the palatability and rumen digestion factors that affected voluntary intake before the requirements of goats were supplied by the diets containing peach palm meal. The ruminal digestion affected by the peach palm meal contributed to decrease the rumination rate and to increase the chewing time.

Conclusion

The use of peach paml meal in diets for feedlot goat kids promotes change in the ingestive behavior reducing the feeding and rumination rate and increasing the chewing time. The peach palm meal above 10 % replacing corn decreases the feed intake in response to poor palatability and rumen digestion.

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