



Research Article

IN-VIVO NUTRITIONAL EVALUATION OF DATE PALM LEAVES IN TOTAL MIXED RATION FOR ADULT MARWARI SHEEP

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Abstract- The study was conducted to evaluate the effect of incorporation of dried and green date palm (*Phoenix dactylifera* L. [Arecaceae]) leaves in total mixed ration (TMR) comprising of 30:70 concentrates: Jowar hay as maintenance ration of adult Marwari sheep. Twenty-one adult Marwari sheep of similar body weight were randomly allotted to three groups, seven in each and were individually fed for 15 days preliminary feeding and 60 days experimental period to meet their energy and protein requirements as per ICAR 1998 standards. The sheep were fed TMR without Date palm leaves (T₁); TMR with ADPL replacing 40% of jowar hay (T₂) and TMR with GDPL replacing 40% of jowar hay on dry matter equivalent basis (T₃). The TMR comprising of either air dried or green date palm leaves replacing jowar hay at 40% DM equivalent basis, had no any adverse effect on voluntary feed intake and body weights of adult Marwari sheep. The three groups also did not differ from each other with respect to digestibility coefficients for dry matter, organic matter, crude protein, crude fiber, ether extract, neutral detergent fiber and acid detergent fiber.

Keywords- Total Mixed Ration, Date palm leaves, Dry matter.

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Introduction

Date palm serves as the foremost fruit crop in arid and semi-arid regions of the globe. In the state of Gujarat also, the rangeland of Kutch area is dominated by date palm trees. It covers around 16693 hectares of land [1]. A date palm tree annually produces approximately 20 kg of leaves [2-4]. They have concluded that date palm leaves could be used as an acceptable alternative to barley straw for feeding of for lactating cows [2]. Based on that conclusion, they were used date palm leaves in Murciano-Granadina Spanish goats for feeding [3]. Thus it can add to the alternative source of poor quality straw in arid or semiarid regions in Ruminant's ration.

Date palm leaves is one of the most abundant agricultural by products in Iran. Recently, date palm leaves has been used in the total mixed rations for lambs and dairy goats, there was no any adverse effect on feed intake, growth and feed conversion efficiency rumen and blood parameters) and The milk yield and milk constituents (fat, protein and lactose) [5,6].

Materials and Methods

The trial was conducted for 60 days at ANRS farm, College of Veterinary Science and Animal Husbandry, AAU, Anand. Twenty-one adult Marwari sheep were divided into three equal groups of seven animals in each group. The experimental Marwari sheep of T₁ and T₂ groups were fed TMR in pellet form. Whereas, animals of T₃ group were fed TMR in mash form. The nutrient requirement of all the groups were met as per ICAR [7] standard. Individual feeding of all the sheep were followed. The daily feed intake was recorded for each experimental sheep during the entire feeding trial. The experimental sheep were weighed every fortnight for two consecutive days in the morning (8.00 a.m.) before feeding and

watering during entire experimental period using electronic weighing balance.

After 40 days of experimental feeding, a digestion trial was conducted on all the twenty one experimental sheep to delineate nutrient utilization. The arrangement for quantitative collection of faeces was made during the trial period of 6 days. A proper record of feed consumed and faeces voided by each animal was maintained during the trial period. The quantity of faeces voided by individual sheep was collected and weighed quantitatively after every 24 h at 8.00 a.m. 1/10th part of total faeces was taken for acid faeces in clean plastic beaker (commercial grade sulphuric acid was added as preservative) for dry matter content. Sample taken for determination of dry matter content was kept in previously weighed petri-dish and dried in hot air oven at 80 ± 20 °C. The dried material obtained was subsequently pooled, ground and secured for further analysis. At the end of collection period, plastic beakers were weighed, mixed thoroughly and 2 g sample was taken in Kjeldahl's flask for digestion and estimation of nitrogen in faecal samples. During experimental feeding, quantity of TMR offered and total faeces voided by the experimental animals were recorded on 24 h basis. The samples of the TMR and faeces were collected and preserved in air tight bags, for further analysis. The samples of TMR offered and faeces were analyzed for proximate principles as per [8] and for fiber fractions as per [9].

Results and Discussion

Average Daily Feed Intake

The average daily feed intake [Table-1] of treatment groups T₁, T₂ and T₃ was found to be 1180.63 ± 47.97, 1186.03 ± 47.23 and 1639.76 ± 65.83 g/d/head. The daily feed intake in T₁ and T₂ groups was statistically not different from each other. Whereas, the daily feed intake in treatment group T₃ was found to be

statistically ($P < 0.05$) higher compared to the other two groups. However, average daily feed intake by the lambs to be, 918, 986, and 1035 g/d, respectively found [5], for the treatment groups with DPL as 8%, 16% and 24% of total mixed ration.

Table-1 The average daily feed intake

Sr. No.	Control	Air-dried DPL	Green DPL
1	935.56	966.67	1404.22
2	1155.56	1133.33	1404.22
3	1155.56	1155.56	1672.44
4	1200.00	1200.00	1704.00
5	1200.00	1200.00	1704.00
6	1280.00	1280.00	1711.89
7	1337.78	1366.67	1877.56
Mean	1180.63 ^b	1186.03 ^b	1639.76 ^a
±SE	47.97	47.23	65.83
P value	0.000		
^{ab} Means with different superscripts in columns for a parameter differ significantly (P<0.05)			

Dry Matter Intake of Marwari sheep

The average daily DMI [Table-2] of sheep in T1, T2 and T3 groups during digestion trial was 1080.67 ± 43.91 , 1093.80 ± 43.55 and 1057.32 ± 42.45 g/day and when expressed as kg/100kg BW was 3.28 ± 0.05 , 3.31 ± 0.05 and 3.30 ± 0.05 , respectively, the same in terms of g/kg w0.75 was recorded as 78.40 ± 0.14 , 79.09 ± 0.18 , and 78.33 ± 0.19 , respectively. The DM intake of experimental sheep did not differ significantly between the groups. However, average daily DMI in Saanen dairy goats to be 2055, and 1794 g/d, respectively found [6], of the TMRs containing 20% DPL and 20% ensiled DPL on dry matter basis.

Digestibility of Nutrients

Besides the physiological form, qualitative and quantitative attributes of feed, digestibility of nutrients present in the feed are considered very important in assessing the nutritional worth of feed. The digestibility coefficients (%) of TMRs obtained for different nutrients in the control and treatment groups are presented in [Table-3].

Table-2 The average daily DM intake of experimental animals during digestion trial

Sr. No	g/d			kg/100kg BW			g/kg W ^{0.75}		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	856.35	891.49	905.44	3.57	3.57	3.48	78.98	79.74	78.64
2	1057.72	1045.20	905.44	3.31	3.37	3.48	78.62	79.56	78.64
3	1057.68	1065.69	1078.39	3.31	3.33	3.27	78.61	79.21	78.32
4	1098.41	1106.68	1098.74	3.23	3.25	3.23	78.01	78.60	78.03
5	1098.41	1106.68	1098.74	3.23	3.25	3.23	78.01	78.60	78.03
6	1171.63	1180.46	1103.83	3.17	3.19	3.20	78.10	78.69	77.54
7	1224.52	1260.39	1210.65	3.14	3.23	3.19	78.46	79.24	79.10
Av.	1080.67	1093.80	1057.32	3.28	3.31	3.30	78.40	79.09	78.33
±SE	43.91	43.55	42.45	0.15	0.05	0.05	0.14	0.18	0.19
P value	0.835			0.953			0.059		

Table-3 The average digestibility coefficients (%) of nutrients

Attributes	T1	T2	T3
DM	58.56 ± 0.27	59.02 ± 0.19	59.18 ± 0.69
OM	60.83 ± 0.32	60.73 ± 0.20	60.27 ± 0.19
CP	68.75 ± 0.25	68.63 ± 0.35	68.44 ± 0.27
EE	69.65 ± 0.27	69.62 ± 0.27	69.26 ± 0.24
CF	59.15 ± 0.31	59.40 ± 0.16	59.01 ± 0.41
NFE	60.48 ± 0.55	60.12 ± 0.34	59.48 ± 0.58
NDF	48.69 ± 0.24	48.51 ± 0.34	48.86 ± 0.19
ADF	45.06 ± 0.40	45.00 ± 0.40	44.90 ± 0.13

Dry Matter Digestibility

The average DM digestibility coefficient (%) of experimental sheep in T1, T2 and T3 groups was 58.56 ± 0.27 , 59.02 ± 0.19 and 59.18 ± 0.69 , respectively. The DMD did not differ significantly between the groups. 53.9% Dry matter digestibility of DPL, when fed alone was reported [3].

Organic Matter Digestibility

The average OM digestibility coefficient (%) of experimental sheep in T1, T2 and T3 groups were 60.83 ± 0.32 , 60.73 ± 0.20 and 60.27 ± 0.19 , respectively. The values of OMD did not differ significantly between the groups. 55.6% OM digestibility of DPL, when given as sole feed was reported [3].

Crude Protein Digestibility

The average CP digestibility coefficient (%) of experimental sheep in T1, T2 and T3 groups were 68.75 ± 0.25 , 68.63 ± 0.35 and 68.44 ± 0.27 , respectively. The values did not differ significantly ($P < 0.05$) between the groups.

Crude Fiber Digestibility

The average CF digestibility coefficient (%) of experimental sheep in T1, T2, and T3 groups were 59.15 ± 0.31 , 59.40 ± 0.16 and 59.01 ± 0.41 , respectively. The values of CF digestibility did not differ significantly between the groups. The value of CF digestibility for DPL, when fed as alone feed, was reported as 43.44% [3].

Ether Extract Digestibility

The average EE digestibility coefficient (%) in T1, T2, and T3 groups were 69.65 ± 0.27 , 69.62 ± 0.27 and 69.26 ± 0.24 , respectively. Similar to the digestibility of other nutrients the EE digestibility also did not differ significantly between the groups. However, Low digestibility of EE (43.06) reported [3], when DPL was fed alone.

Nitrogen Free Extract Digestibility

The average NFE digestibility coefficient (%) of experimental sheep under T1, T2 and T3 groups was 60.48 ± 0.55 , 60.12 ± 0.34 and 59.48 ± 0.58 , respectively. The treatment groups did not differ statistically from each other. Similar findings (59.49) was also reported [3], when DPL was fed alone..

Neutral Detergent Fiber Digestibility

The average NDF digestibility coefficient (%) of experimental sheep in T1, T2 and T3 groups was 48.69 ± 0.24 , 48.51 ± 0.34 and 48.86 ± 0.19 , respectively. The treatment groups did not differ statistically from each other. found values 52.22% of NDF digestibility for DPL when fed alone reported [3].

Acid Detergent Fiber Digestibility

The average ADF digestibility coefficient (%) of experimental sheep under T1, T2 and T3 groups were 45.06 ± 0.40 , 45.00 ± 0.40 and 44.90 ± 0.13 , respectively.

They did not differ significantly from each other. However, 52.5% ADF digestibility, when DPL was fed alone reported, [3].

Digestible Nutrients Intake

The digestible nutrients intake in Total Mixed Rations is given in [Table-4].

Table-4 Average daily nutrient intake of experimental Marwari sheep during digestion trial

Attributes	Treatments			P value
	T ₁	T ₂	T ₃	
Digestible DM				
g/day	632.73±25.43	645.99±25.33	629.18±26.90	0.897
kg/100 kg BW	1.92.03	1.95±0.03	1.96±0.03	0.607
g/kg W ^{0.75}	46.19±0.24	46.68±0.21	46.58±0.25	0.316
Digestible OM				
g/day	591.71±22.51	594.83±23.23	572.72±22.83	0.763
kg/100 kg BW	1.80±0.03	1.80±0.03	1.79±0.03	0.975
g/kg W ^{0.75}	42.95±0.26	43.02±0.21	42.43±0.13	0.111
CP				
g/day	101.37 ± 4.12	100.74 ± 4.01	100.04 ± 3.45	0.790
g/100 kg BW	307.48 ± 5.05	304.18 ± 4.82	304.67 ± 4.51	0.872
g/kg W ^{0.75}	7.35 ± 0.01	7.31 ± 0.03	7.30 ± 0.02	0.145
DCP				
g/day	69.65±2.70	70.73±1.52	68.18±2.29	0.716
g/100 kg BW	211.43 ± 4.00	208.84 ± 4.31	208.37 ± 3.36	0.956
g/kg W ^{0.75}	5.03±0.03	4.98±0.03	4.99±0.02	0.583
TDN				
g/day	618.35±23.55	643.99±14.95	613.27±19.70	0.727
kg/100 kg BW	1.88±0.04	1.87±0.02	1.86±0.02	0.871
g/kg W ^{0.75}	44.89±0.26	45.29±0.21	44.84±0.16	0.219

Average Daily Digestible Dry Matter Intake

The average daily DDMI of T₁, T₂ and T₃ groups, during digestion trial was 632.73 ± 25.43, 645.99 ± 25.33 and 629.18 ± 26.90 g/d, respectively and the same when expressed as kg/100kg body weight was 1.92 ± 0.03, 1.95 ± 0.03 and 1.96 ± 0.03, respectively, and in terms of g/kg W^{0.75} was recorded as 46.19 ± 0.24, 46.68 ± 0.21 and 46.58 ± 0.25, respectively. The treatment groups did not differ statistically from each other in term of g/day, kg/100 kg body weight and metabolic body weight in the experimental sheep.

Average Daily Digestible Organic Matter Intake

The DDMI of T₁, T₂ and T₃ groups, was found to be, 591.71 ± 22.51, 594.83 ± 23.23 and 572.72 ± 22.83 g/d, respectively during digestion trial. Similarly, when expressed in kg/100kg body weight the values were 1.80 ± 0.03, 1.80 ± 0.03 and 1.79 ± 0.03 and in terms of g/kg W^{0.75} the values recorded were 42.95 ± 0.26, 43.02 ± 0.21 and 42.43 ± 0.13, respectively. The treatment groups did not differ statistically from each other in term of g/day, kg/100 kg body weight and metabolic body weight in the experimental animals.

Average daily Crude Protein Intake

The average daily CP intake of experimental sheep of T₁, T₂ and T₃ groups, during digestion trial was 101.37 ± 4.12, 100.74 ± 4.01 and 100.04 ± 3.45 g/d/head and 307.48 ± 5.05, 304.18 ± 4.82 and 304.67 ± 4.51 in terms of g/100 kg body weight and the same when expressed as g/ kg W^{0.75} it was found to be 7.35 ± 0.01, 7.31 ± 0.03 and 7.30 ± 0.02. The CP intake of all the three groups were statistically similar.

Average daily Digestible Crude Protein Intake

The daily DCP intake of experimental Marwari sheep of T₁, T₂ and T₃ groups, during digestion trial was 69.65 ± 2.70, 70.73 ± 1.52 and 68.18 ± 2.29 g/head and 211.43 ± 4.00, 208.84 ± 4.31 and 208.37 ± 3.36 in terms of g/100 kg body weight and the same when expressed as g/kg W^{0.75} it was 5.03 ± 0.03, 4.98 ± 0.03 and

4.99 ± 0.02. The DCP intake of all the treatment groups was found to be statistically similar.

Average daily Total Digestible Nutrient Intake

The average daily TDN intake of sheep of treatment groups T₁, T₂ and T₃ during digestion trial was 618.35 ± 23.55, 643.99 ± 14.95 and 613.27 ± 19.70 g/head, 1.88±0.04, 1.87 ± 0.02 and 1.86 ± 0.02 kg/100 kg body weight and in terms of g/kg W^{0.75}; it was recorded as 44.89 ± 0.26, 45.29 ± 0.21 and 44.84 ± 0.16, respectively. The TDN intake of all the three groups was statistically similar.

Nutrient density of Total Mixed Rations

The average nutrient density of TMRs as DCP and TDN% during digestion trial is given in [Table-5].

Table-5 The average DCP and TDN content of TMRs during digestion trial

Sr. No.	DCP%			TDN%		
	T ₁	T ₂	T ₃	T ₁	T ₂	T ₃
1	6.51	6.43	6.30	57.38	57.12	55.57
2	6.47	6.43	6.38	57.82	58.21	56.70
3	6.51	6.33	6.30	58.26	57.62	57.07
4	6.35	6.28	6.24	56.79	57.21	56.02
5	6.48	6.31	6.36	57.65	57.02	56.87
6	6.38	6.22	6.42	56.88	56.75	57.72
7	6.42	6.24	6.24	56.02	57.22	56.74
Av.	6.45	6.32	6.32	57.26	57.31	56.67
±SE	0.02	0.03	0.03	0.28	0.18	0.26
P value	0.006			0.157		

The DCP content of TMRs for the groups T₁, T₂ and T₃ was found to be 6.45 ± 0.02, 6.32 ± 0.03 and 6.32 ± 0.03 %, respectively. They did not differ significantly from each other. Similarly, the TDN content of TMRs was found to be, 57.26 ± 0.28, 57.31 ± 0.18 and 56.67 ± 0.26% for the groups T₁, T₂ and T₃, respectively. Similar to the DCP content, the TDN content of all the three TMRs was also found to be statistically similar.

Table-6 Average Cumulative intake of DM, DCP and TDN (kg/head/60 days)

Animal No.	DMI	DCPI	TDNI
	T ₁		
1	51.38	3.34	29.48
2	63.46	4.11	36.69
3	63.46	4.13	36.97
4	65.90	4.19	37.43
5	65.90	4.27	37.99
6	70.30	4.49	39.98
7	73.47	4.72	41.16
Av.	64.84	4.18	37.10
±SE	2.63	0.16	1.41
T ₂			
8	53.49	3.44	30.55
9	62.71	4.03	36.50
10	63.94	4.05	36.84
11	66.40	4.17	37.99
12	66.40	4.19	37.86
13	70.83	4.40	40.20
14	75.62	4.72	43.27
Av.	65.63	4.14	37.60
±SE	2.61	0.15	1.47
T ₃			
15	54.33	3.42	30.19
16	54.33	3.47	30.81
17	64.70	4.08	36.93
18	65.92	4.11	36.93
19	65.92	4.19	37.49
20	66.23	4.25	38.23
21	72.64	4.53	41.34
Av.	63.44	4.01	35.99
±SE	2.55	0.16	1.53
P value	0.835	0.717	0.734

Cumulative intake of DM, DCP and TDN

The Cumulative intake of DM, DCP and TDN is presented in [Table-6]. The average cumulative DMI for the T1, T2 and T3 group was found to be 64.84 ± 2.63 , 65.63 ± 2.61 and 63.44 ± 2.55 kg/h/60 days, respectively. However, average DCP was found to be 4.18 ± 0.16 , 4.14 ± 0.15 and 4.01 ± 0.16 kg/head/60 days, for the groups T1, T2 and T3, respectively. The average cumulative values of TDN were found to be 37.10 ± 1.41 , 37.60 ± 1.47 and 35.99 ± 1.53 kg/head/60 days for the groups T1, T2 and T3, respectively. The Cumulative DM, DCP and TDN intake did not differ significantly between the groups.

Water ingestion of experimental Marwari sheep during digestion trial

The average water ingestion of experimental Marwari sheep during digestion trial is presented in [Table-7].

Table-7 The average water ingestion of experimental animals during digestion trial

Sr. No.	Kg/d			kg/kg DMI			g/kg W ^{0.75}		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	4.24	3.66	3.42	4.95	4.10	3.78	391.28	327.15	297.20
2	3.53	2.54	5.25	3.34	2.43	5.80	262.50	193.26	455.93
3	2.87	7.36	3.88	2.71	6.91	3.60	213.13	546.97	281.85
4	4.63	3.29	5.37	4.21	2.98	4.88	328.50	233.95	381.19
5	4.66	4.30	3.99	4.24	3.89	3.63	331.07	305.65	283.16
6	5.56	5.65	4.01	4.75	4.79	3.64	370.83	376.77	281.98
7	4.98	3.58	4.38	4.06	2.84	3.62	318.85	224.79	286.48
Av.	4.35	4.34	4.33	4.04	3.99	4.14	316.59	315.51	323.97
±SE	0.34	0.62	0.27	0.30	0.58	0.33	23.15	45.16	25.83
P value	0.814			0.782			0.259		

The average water ingestion of Marwari sheep during digestion trial was 4.35 ± 0.34 , 4.34 ± 0.62 and 4.33 ± 0.27 kg/d, for the groups T1, T2 and T3, respectively and when expressed as kg/kg DMI, it was found to be 4.04 ± 0.30 , 3.99 ± 0.58 , 4.14 ± 0.33 kg/kg DMI for the groups T1, T2 and T3, respectively. Whereas, when expressed as g/kg W^{0.75} water ingestion was recorded as, 316.59 ± 23.15 , 315.51 ± 45.16 and 323.97 ± 25.83 g/kg W^{0.75} for the groups T1, T2 and T3, respectively. Water intake was found to be non-significant between groups.

Body weight (kg) of animals at fortnightly intervals

The average body weight of animals at fortnightly intervals [Table-8] for the group T1 was 33.14 ± 1.81 , 33.36 ± 1.83 , 33.36 ± 1.78 , 33.29 ± 1.81 and 33.26 ± 1.78 kg on day one, after first, second, third and fourth fortnight, respectively. However, the average body weight at fortnightly intervals for the group T2 was 33.29 ± 1.80 , 33.50 ± 1.74 , 33.50 ± 1.77 , 33.43 ± 1.81 and 33.50 ± 1.81 kg on day one, after first, second, third and fourth fortnight, respectively. While, the average body weight at fortnightly intervals for the group T3 was reported as 32.21 ± 1.71 , 32.36 ± 1.68 , 32.43 ± 1.67 , 32.36 ± 1.68 and 32.43 ± 1.72 kg on day one, after first, second, third and fourth fortnight, respectively. The body weights did not differ statistically between the groups at fortnightly intervals. Similarly, no significant difference was found in the body weights within the groups of sheep at fortnightly intervals. Indicating that body weights of sheep were not adversely affect due to feeding of date palm leaves in TMR.

Table-8 Body weight (kg) of animals during entire length of experiment

Animal No.	Day 1	1 st fortnight	2 nd fortnight	3 rd fortnight	4 th fortnight
T ₁					
1	24.0	24.0	24.5	24.0	24.5
2	32.0	32.5	32.0	32.5	32.0
3	32.0	32.0	32.5	32.0	32.5
4	34.0	34.0	34.0	34.5	34.0
5	34.0	34.5	34.0	34.0	34.0
6	37.0	37.5	37.0	37.0	37.0
7	39.0	39.0	39.5	39.0	39.5
Av.	33.14	33.36	33.36	33.29	33.36
±SE	1.81	1.83	1.78	1.81	1.78
T ₂					
8	25.0	25.5	25.5	25.0	25.0

9	31.0	31.0	31.5	31.0	31.5
10	32.0	32.5	32.0	32.5	32.0
11	34.0	34.5	34.0	34.0	34.0
12	34.0	34.0	34.0	34.0	34.5
13	37.0	37.0	37.0	37.5	37.5
14	40.0	40.0	40.5	40.0	40.0
Av.	33.29	33.50	33.50	33.43	33.50
±SE	1.80	1.74	1.77	1.81	1.81
T ₃					
15	26.0	26.5	26.5	26.5	26.0
16	26.0	26.0	26.5	26.0	26.5
17	33.0	33.0	33.0	33.5	33.5
18	34.0	34.5	34.0	34.0	34.0
19	34.0	34.5	34.0	34.0	34.0
20	34.5	34.0	34.5	34.5	34.5
21	38.0	38.0	38.5	38.0	38.5
Av.	32.21	32.36	32.43	32.36	32.43
±SE	1.71	1.68	1.67	1.68	1.72
P value	0.898	0.882	0.895	0.898	0.898

Conclusion

The TMR comprising of either air dried or green date palm leaves replacing jowar hay at 40% DM equivalent basis, had no any adverse effect on voluntary feed intake and body weights of adult Marwari sheep. The three groups also did not differ from each other with respect to digestibility coefficients for dry matter, organic matter, crude protein, crude fiber, ether extract, neutral detergent fiber and acid detergent fiber.

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