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Effect on digestibility of weaned kids of Sirohi goat fed with concentrates and mungbean straw (*Vigna radiata*)

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Abstract
The present research work entitled "Effect on digestibility of Weaned Kids of Sirohi Goat Fed with Concentrates and Mungbean straw (*Vigna radiata*)" was carried out to study the effect of concentrate and Mungbean straw (*Vigna radiata*) feeding on digestibility in terms of Sirohi goat kids. Twenty four Sirohi kids of one month of age were randomly selected and divided into three groups of each having eight kids at the goat farm of S.K.N. College of Agriculture, Jobner. Group T1 weaned at 60 days of age, T2 at 75 days and T3 at 90 days. The concentrate supplement given @ 1.5% of body weight and Mungbean straw *ad-libtum* to all kids during whole experimental period. Other management practices were similar for each groups. A digestibility trial was conducted at the last week of experiment. The dry matter, crude protein, ether extract, crude fibre, nitrogen free extract and total ash in concentrate mixture was 90.39, 19.26, 3.60, 6.22, 60.42 and 10.50 and Mungbean straw 92.45, 8.9, 1.3, 40.2 39.9 and 9.7 per cent, respectively. The average digestibility of DM in T1, T2 and T3 was 63.50±0.72, 60.27±1.93 and 56.80±0.52 percent, respectively which was significantly higher in T1 group than T2 and T3 groups. The digestibility of CP in T1, T2 and T3 was 64.10±0.026, 62.19±0.026 and 60.42±0.041 per cent, respectively which was significantly different (P<0.05) in T1 group than T2 and T3 groups. The digestibility of crude fiber (CF) in T1, T2 and T3 was 53.58±0.032, 51.33±0.047 and 50.27±0.072 per cent, respectively and was significantly higher (P<0.05) in T1 group than T2 and T3. The digestibility of ether extract (EE) in T1, T2 and T3 was 68.10±0.133, 66.44±0.124 and 64.49±0.115 per cent, respectively which was significantly higher (P<0.05) in T1 group than T2 and T3 groups. The digestibility of nitrogen free extract (NFE) in T1, T2 and T3 was 55.35±0.041, 53.57±0.041 and 52.15±0.037 per cent, respectively which was significantly higher (P<0.05) in T1 group than T2 and T3 groups.

Keywords: Sirohi goat kids, digestibility, weaning age, concentrate

Introduction
The goat "poor man's cow" has vast potential to be projected as the 'Animal of Future' for rural prosperity. In India goat husbandry is essentially an effort of millions of poor families, who rear small ruminants on "Crop Residues" and Common Property Resources". The total livestock population is 535.78 million in India as per Livestock census 2019 and showing an increase of 4.6 per cent over Livestock census 2012. The Goat population in the country is 148.88 million which was 27.80 per cent of total livestock population and showing an increase of 10.14 per cent over the previous census, (Anonymous, 2019) [1]. Goats are important animal in all over the world especially in subsistent agriculture of developing countries where more than 90 per cent of the world goat population is found. Rajasthan ranks second with its 57.7 million livestock population in the country and shares more than 11 per cent total livestock population of India. In Rajasthan the goat population was 20.84 million in 2019 and showed a decrease of 3.81 per cent over livestock census 2012. The state ranks first with 16.0 per cent share of the country in total goat population. Goat contributes to milk and meat production about 8.0 per cent to the state GDP and Sirohi is one of the important goat breed of Rajasthan which accounts for 60 per cent total goat population of Rajasthan. It is generally found in arid and semi-arid region and the most parts of Aravalli hills of Rajasthan. The breed is also known by different names such as Parbatsari, Ajmeri and Devgarhi. Sirohi goats are mainly reared for milk and meat production. The breed weight of kids remains about 1.5-3.0 kg at birth and reaches about 12 kg when weaned at 3 months. Goat production is a subsidiary livestock enterprise mainly for landless labour (especially women) and small and marginal farmers in India and other developing countries like Bangladesh, Pakistan and Nepal. Livestock sector of India is one of the biggest sectors in world.

There are 34 indigenous breeds of goats in the country along with non- descript animals as recognized by National Bureau of Animal Genetics and Resources (NBAGR, 2020) [13]. The goat is a browsing type animal and its feed containing of young leaves of trees and bushes. Farmers usually practice browsing and grazing for these animals without supplementing concentrates (Ghodake *et al*., 2012) [6]. Animal growth is the function of cell multiplication and its rate depends on balanced supply of protein and energy for optimized growth performance. At a younger age protein deposition favoured due to muscular development hence higher levels of dietary protein is required, while at maturity fat deposition takes place thus protein need reduces and energy requirement increases. Growth traits are extremely important in goat husbandry. Kids that grow faster reach market weight at an early age, which generally means that they need a shorter feeding period, have less risk of death loss and provide quicker returns. Faster growth potential of kid has high requirement of nutrients, especially with regards to protein for skeleton and tissue growth. Creep and supplemental feeding of kids are practiced to maintain high early growth and to attain early marketable weight. Improved livestock production could be achieved through cultivation of high quality forage (leguminous and non leguminous) adapted to local conditions as well as feeding concentrate. Concentrate feeds promote the fast growth of goat and contributing to higher overall efficiency of utilization of dietary energy as well as protein for body weight gains (Mandebvu and Galbraith, 1999) [11]. The goat milk is having much more importance due to its early digestible characters small fat globule size, high in Ca, Mg, K, P, vitamins A, B2, C and D. The milk of goat is high in medium-chain fatty acids. This is essential because these are not stored as body fat and provide an energy boost. They are connected to the prevention of heart disease and the treatment of many intestinal conditions, lowering bad cholesterol and increasing levels of good cholesterol. Goat milk is also of great importance to patients and infants who suffer from cow milk allergy (Jindal, 2013) [7]. This unique property of goat milk contributes to the sustainability of the dairy goat industry and goat is called "wet nursing mother". The time of weaning is an important phase for rearing kids, which is followed by a decrease or whole stagnation of weight gain. The force and extent of upset at weaning depend on several factors, mainly on the age and body condition of kids at the time of weaning, as well as on their nutrition previous to weaning. The weaning body weight gives the idea about the future performance of the young one. It also helps to goat growers in computing the nutrient requirement, proper age for breeding, doses of medicine, optimum slaughter age, dressing percentage etc. (Bhagat and Burte, 2015) [2].

Materials and Methods

The experiment was conducted at goat farm, S.K.N. college of Agriculture, S.K.N. Agriculture University Jobner, District Jaipur, (Rajasthan, India). Geographically Jobner is located 45.0 km west of Jaipur at 26^0 05' North altitudes, 75^0 28' East longitudes and at an altitude of 427 meter above sea level. Twenty four clinically healthy Sirohi goat kids of either sex approximately uniform weight or age group (one month) were selected. These kids were divided into three equal groups containing eight kids (N=8) in each group and the study was carried out for a period of twelve weeks. Groups T_1, T_2 and T_3 weaned at 60, 75 and 90 days, respectively. The experiment was conducted using randomized block design. Animals were penned in well-ventilated enclosures for the experiment in three pens. The experimental groups were randomly allotted to three weaning age. The dry fodder of Mungbean straw (*Vigna radiata*) was offered to all treatment groups *ad-libtum* and the concentrate feeding at rate of 1.5 per cent of body weight was started at the age of three weeks. The details of weaning age and concentrate supplementation to different treatments are given below.

Table 1: Weaning age and concentrate supplementation to different treatments

Treatment	Weaning age (days)	Level of concentrate of body weight (%)	Dry fodder (Mung bean)
T_1	60	1.5	*Ad-libitum*
T_2	75	1.5	"
T_3	90	1.5	"

Feeding Schedule

Concentrate and roughages were fed separately to each kid of all treatment groups. The concentrate was fed once in a day at 10:00 AM. Whereas the roughage (Mungbean straw) was offered at 10:30 AM and 4:00 PM to all treatment groups. Fresh and clean drinking water was available round the clock to all groups of kids.

Table 2: Distribution of Sirohi goat kids at the starting of experiment

Treatments	No. of animals	Average body weight (in kg)
T_1	8	10.60±0.053
T_2	8	11.15±0.092
T_3	8	11.18±0.092

Table 3: Chemical composition (dry matter basis) of concentrate mixture

Name of nutrient	Percent of nutrient
Total Digestible Nutrient (TDN)	75
Crude Protein (CP)	18
Crude fiber (CF)	10
Common Salt	1.0
Mineral Mixture (MM)	2.0

Digestibility trial

1. Intake of Mungbean (*Vigna radiata*) - Weighed quantity of Mungbean (*Vigna radiata*) was offered and refusals were weighed to calculate the intake.
2. Intake of concentrate- Weighed quantity of concentrate was offered and refusals were weighed to calculate the intake.
3. A digestibility trail was conducted in last week of experiment. The feed offered, refusals and faces voided were weighed and chemical analysis of feed, refusal and faces were done for dry matter, organic matter, ash, crude protein and crude fiber. The digestibility of the nutrients was calculated.

Collection and preservation of faeces

Twenty four hours collection of faeces, collected in faecal bags was weighed by electronic balance. The faeces were mixed uniformly and a representative sample of about 10 per cent of the total faeces voided by each animal were taken for determination of dry matter in hot air oven and these oven dried samples were weighed and grinded to about 1 mm size and stored in tight polythene bags for further analysis.

Proximate analysis of feed samples
The samples of feed offered their residues left and faeces were analyzed for proximate constituents by procedures of AOAC (2005) at goat farm, S.K.N. Agriculture University Jobner, District Jaipur, and Animal Nutrition Laboratory Division of Animal Nutrition, Central Sheep and Wool Research Institute (CSWRI) Avikanagar (Tonk) during 2020.

Dry matter intake (DMI)
The dry matter intake of individual goat kid was calculated from the figures of the average dry matter intake during experimental period and expressed as DMI (g/d).

Digestibility of nutrients
A. Dry matter (DM)
About twenty grams of the powdered sample of feed and faeces voided during metabolic trial was taken in an already weighed Petridish and was kept in an electric oven for 24 hours at 100 50C. The dried samples were cooled in desiccators and weighed to constant weights.

B. Crude protein (CP)
Crude protein in various samples of feed and faeces was analyzed using semi auto analyzer Kelplus nitrogen estimation system (Pelican Equip). For this take 0.5 gm of sample and transferred it to the digestion tube. Add 10-15 ml of concentrated sulphuric acid and 5-7 gm of digestion activator to the sample. Then the digestion tube is loaded into digester and the digestion block is heated by maintaining the block temperature between 360ºC and 410 ºC. The sample turns colorless or light green color at the end of digestion. After digestion, the measured quantity of aliquot was distilled in automatic distillation system by adding 40 per cent NaOH by auto mode until brown color develops. Then the digested sample was heated by passing steam and the ammonia liberated was trapped into 4 per cent boric acid and mixed indicator (0.3 g of 67 bromocresol green and 0.2 g methyl red in 400 ml of 90 per cent ethanol). The distillate collected was titrated against 0.1 N sulphuric acid.

C. Ether extract (EE)
Estimation of ether extract in feed and faeces was done with the help of Soxhlet's apparatus. For this 2 g of oven dried powdered sample was taken in a thimble. This was placed in the extraction tube of Soxhlet's apparatus. The extraction tube was connected above with the water condensor and below with oil flasks through standard joints. The flask was then put on a hot plate. Extraction was carried out for six hours with petroleum ether (AR) of boiling point 40 to 60 ^{0}C, at the rate of eight extractions per hour. At the end of each extraction the flask was then disconnected, it's contents were dried in an oven and the flask along with fatty residue was weighed after cooling in a desiccators. The difference in the two weights denoted the amount of ether extract in the sample. The results were expressed on percentage basis. The ether extract was calculated as follows:

D. Crude fiber (CF)
The sample after extraction of the fat from the Soxhlet's apparatus was transferred from the thimble to 500 ml beaker. To this beaker 200 ml of 1.25 per cent sulphuric acid was poured. The contents were brought to boiling by placing beaker on an electric hot plate under round bottom reflux condenser flask. To ensure effective condensation of the solution running cold water was allowed to flow through the flask. After boiling for 30 minutes the contents of beaker were filtered through muslin cloth in Buchner's funnel. The residue on the cloth was washed to remove the acid and was transferred to the same beaker. About 200 ml of 1.25 per cent sodium hydroxide solution was then poured into the beaker and the contents were brought to boiling as before. After half an hour of boiling the contents were filtered through the same cloth and washed with hot water to remove all alkali. The residue was transferred to a crucible which was kept in a hot air oven at 100.5^{0}C for drying. It was then cooled in a desiccators and weighed. This was repeated until a constant weight was obtained. The contents were ashed in a muffle furnace ashing and cooling was continued till constant weight of ash was obtained.

E. Total Ash
Five grams of oven dried sample of feed or faeces was taken in a weighed vitrosil basin. It was placed in a muffle furnace and heated immediately at 600 ^{0}C till it obtained a uniform ash color free of black particles. It was then cooled in desiccators and weighed. The total ash value was obtained by subtracting the weight of the empty vitrosil basin from the weight of the basin containing the ash.

Digestibility is calculated by following formula

$$\text{Digestibility of nutrient} = \frac{\text{Intake of nutrient} - \text{Nutrient voided in faces}}{\text{Intake of nutrients}} \times 100$$

Statistical Analysis
Statistical analysis was carried out by standard statistical methods RBD and the calculation of ANOVA was done. This formula was given by Fisher and Yates (1950) [5]. Superscripts are used for significantly difference in means by DMRT method. Duncan's new multiple range test (DMRT) is a multiple comparison procedure developed by David B. Duncan in (1955) [4].

Result and Discussion
Intake and digestibility of feed on kids weaned at different age
A digestibility trial of seven days was conducted in the last week of experiment. The results obtained are given below-

1. Proximate composition of feed and fodder
The dry matter, crude protein, ether extract, crude fiber, nitrogen free extract and total ash content were 90.39, 19.70, 3.80, 6.22, 60.42 and 10.01 percent in concentrate mixture and 92.45, 8.90, 1.30, 40.20, 39.90 and 9.70 percent, respectively in Mungbean straw (Table 4). The similar composition of Mungbean straw was also same as reported by Khatik *et al*. (2007) [8], McMeniman *et al.* (1988) [12], Patel (1966) [14] and Reddy (1997) [16].

Table 4: Chemical composition of feed and fodder (DM basis)

Attributes	Concentrate mixture (%)	Mungbean straw (%)
DM	90.39	92.45
CP	19.70	8.9
EE	3.80	1.3
CF	6.22	40.2
NFE	60.42	39.9
ASH	10.50	9.7

2. Dry matter intake of kids

The average daily dry matter intake (DMI) of Sirohi kids in different treatments are presented in Table 5. The average daily total dry matter intake (TDMI) in T1, T2 and T3 group was 0.659±0.006, 0.595±0.004 and 0.567±0.004 kg/kid, respectively. The average TDMI was significantly (P<0.05) higher in T1 followed by T2 and T3 group. The DMI of concentrate in T1, T2, and T3 was 0.225±0.005, 0.212±0.003 and 0.218±0.002 kg, respectively in last week of experiment. The DMI of Mungbean straw in T1, T2 and T3 was 0.434±0.004, 0.282±0.002 and 0.349± 0.003 kg, respectively. The averages DMI per 100 kg body weight was higher in T1 (4.40±0.0006 kg) followed by T2 (4.20±0.0007 kg) and T3 (3.90±0.0004 kg) group.

The analysis of variance of data on daily dry matter intake given in Table 6 which indicated that daily DMI and DMI/100kg body weight was significantly higher (P<0.05) in T1 group as compared to T2 and T3 kids. Result regarding to daily intake and digestibility of CP was supported by findings of Kumar *et al.* (2017) [10]. Chai *et al*. (2015) [3] reported that early weaning positively affects internal organs related to metabolism.

Table 5: Average daily dry matter intake (per kid) under different treatments during trial period

Parameters	T_1	T_2	T_3
Mungbean straw	0.434^{a}±0.004	0.382^{b}±0.002	0.349^{c}±0.003
Concentrate	0.225^{a}±0.005	0.212^{c}±0.003	0.218^{b}±0.002
Total DMI	0.659^{a}±0.006	0.595^{b}±0.004	0.567^{c}±0.004
Total DMI /100 kg body weight	4.40^{a}±0.0006	4.20^{b}±0.0007	3.90^{c}±0.0004

Means having different superscripts in a row differ significantly (P<0.05%)

Table 6: Analysis of variance of data on DMI of roughage and concentrate

Source of variation	d.f.	Mean sum of square								
		DMI (kg/day)								
		Roughage			Concentrate			Total		
		SS	MS	F-cal	SS	MS	F-cal	SS	MS	F-cal
Replication	6	0.397	0.006	240.12	0.126	0.0209	2855.01	0.969	0.1615	477.03
Treatment	2	0.023	0.011	41.081	0.0004	0.0001	32.3545	0.027	0.0137	40.398

Significant at 5% level

3. Crude protein and digestible crude protein intake

The average crude protein intake (CPI) showed in Table 7 and analysis of variance of data in Table 8. The daily CP intake in T_1, T_2 and T_3 group was 0.19±0.003, 0.17± 0.002 and 0.16±0.002 kg, respectively. The mean CPI/100 kg body weight was 1.28±0.0003, 1.22±0.0011 and 1.13±0.0003 kg, respectively. The CP intake in group T_1 was high in comparison to T_3 and T_2 (P<0.05). The average daily DCP intake (DCPI) was 0.12±0.002, 0.11±0.001 and 0.10±0.003 kg in T_1, T_2 and T_3, respectively. The mean DCPI/100kg body weight was 0.82±0.008, 0.76±0.002 and 0.68±0.004 kg, respectively and it was highest in T_1 followed by T_2 and T_3 groups. Kumar *et al.* (2013) [9] reported that the CP intake per unit body weight and CP percentage were similar between control and treatment groups. However Sharifi *et al.* (2013) [17] suggested that the apparent digestibility of dietary CP level was not significantly different between the treatments (P > 0.05).

Table 7: Average daily intake of CP and DCP (kg) under different treatments during digestibility trial

Parameters	T_1	T_2	T_3
Crude protein intake(CPI)	0.19^{a}±0.003	0.17^{b}±0.002	0.16^{b}±0.002
CPI/100 kg BW	1.28^{a}±0.0003	1.22^{b}±0.0011	1.13^{c}±0.0003
DCP intake	0.12^{a}±0.002	0.11^{b}±0.001	0.10^{c}±0.003
DCP intake/100 kg BW	0.82^{a}±0.008	0.76^{b}±0.002	0.68^{c}±0.004

Means having different superscripts in a row differ significantly (P<0.05)

Table 8: Analysis of variance of daily intake of CP and DCP

Source of variation	d.f.	Mean sum of squares			
		CPI/day	CPI/100 kg BW	DCP intake/day	DCP intake/100 kg BW
Treatment	2	0.001	0.643	0.005	0.250
Period	6	0.014	0.033	0.001	0.028

Significant at 5% level

4. Digestibility coefficient of feed nutrients

Apparent Digestibility: The average digestibility coefficients of various nutrients in different experimental groups are presented in Table 9, and the analysis of variance in Table 10. The average digestibility of DM in T1, T2 and T3 was 63.50±0.72, 60.27±1.93 and 56.80±0.52 percent, respectively. The digestibility of CP in T1, T2 and T3 was 64.10±0.026, 62.19±0.026 and 60.42±0.041 per cent, respectively which was higher (P<0.05) in T1 followed by T2 and T3 group. The digestibility of CF in T1, T2 and T3 groups was 53.58±0.032, 51.33±0.047 and 50.27±0.072 per cent, respectively and was highest in T1. The digestibility of EE in T1, T2 and T3 was 68.10±0.133, 66.44±0.124 and 62.49±0.115 per cent and digestibility of NFE was 55.35±0.041, 53.57±0.041 and 52.15±0.037 per cent, respectively. The digestibility of all nutrients was highest in T1 followed by T2 and T3. These

results in agreement with Prasad *et al*. (2019) [15] who concluded that the feeding of semi-solid broiler goat kids concentrate diet improved growth rate and early rumen development in kids.

Table 9: Average nutrient digestibility coefficient of feed

Nutrients	Treatments		
	T_1	T_2	T_3
DM	63.49^{a}±0.197	60.27^{b}±0.114	56.80^{c}±0.118
CP	64.10^{a}±0.026	62.19^{b}±0.026	60.42^{c}±0.041
CF	53.58^{a}±0.032	51.33^{b}±0.047	50.27^{b}±0.072
EE	68.10^{a}±0.133	66.44^{b}±0.124	64.49^{c}±0.115
NFE	55.35^{a}±0.041	53.57^{b}±0.041	52.15^{c}±0.037

Means having different superscripts in a row differ significantly (P<0.05%)

Table 10: Analysis of variance of nutrients digestibility

Source of variation	df	Mean sum of square				
		Dry matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract
Treatments	2	89.529	27.110	26.060	22.806	20.397
Replication	7	6.745	0.918	4.676	1.350	0.444

Significant at 5% level

Conclusion

From the overall results and discussion of the present investigation, it was concluded that the digestibility performance of kids weaned at 60 days was better than 75 days and 90 days weaned kids. Development and condition of rumen was good at 60 days. Therefore, it is recorded that kids may be weaned at 60 days of age, as it spares the milk for human consumption, liberate the doe for further breeding and ultimately farmers earn more profit.

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