Optimizing the incorporation rate of fresh leaves *of Ficus sycomorus* as a dietary supplement for sheep fed low-quality forages: effects on digestibility and zootechnical performance

Sanou Sita[1]*, Delma Barkwendé Jethro[1], Traoré Linda C. Gabriella[3], Djiguemde Michel[2], Sanon Hadja Oumou[1]

[1]*Centre National de Recherche Scientifique et Technologique / Institut de l'Environnement et de Recherches Agricoles (INERA), Laboratoire de Recherche en Production et Santé Animales 04 BP 8645, Ouagadougou 04, Burkina Faso*

[2]*Ecole Nationale de l'Élevage et de la Santé Animale (ENESA), Ouagadougou, Burkina Faso*

[3]*Université de Nazi Boni, Bobo-Dioulasso, Burkina Faso*

** Auteur correspondant : SANOU Sita, Tel (+226) 70 73 80 33/ (+226) 78 71 42 19, email zouwiss@yahoo.fr*

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1 ABSTRACT

The objective of this study was to determine the optimal incorporation rate of fresh leaves of *Ficus sycomorus* (sycamore fig) as a dietary supplement for low-quality forages. 20 adult Djallonké rams distributed into five groups receiving diets containing 0% (T0), 15% (T15), 30% (T30), 70% (T70), or 100% (T100) of *F. sycomorus* leaves for 74 days. The basal rations, consisting of *Pennisetum pedicellatum* (Deenanath grass) hay and *F. sycomorus* leaves, were supplemented with 100 g of cotton seed cake. The study assessed the chemical composition, the voluntary intake, the apparent digestibility and the weight evolution of the five diets. The results showed that the fresh leaves of F. sycomorus were richer in crude protein (109.5 g CP/kg DM) than the basic hay (43.6 g CP/kg DM), but the leaves of *F. sycomorus* also contained more crude ash (153 g CA/ kg DM). The incorporation of *F. sycomorus* leaves into the diets significantly improved nutrient digestibility ($p < 0.05$). The diet containing 70% of *F. sycomorus* showed the highest average daily gain (83 g/day/ kg $BW^{0.75}$) and the low feed conversion ratio (9 kg DM/kg gain), compared to 18 g/day/ kg $BW^{0.75}$and 35 g kg DM/kg gain respectively for the control. Beyond 70%, no significant improvement was observed. It is recommended the use of fresh *F. sycomorus* leaves at a maximum rate of 70% of total dry matter to optimize sheep fattening in the Sahelian zone. However, the 30% rate could also be interesting in case of low availability of *F. sycomorus* leaves.

2 INTRODUCTION

Ruminant feeding in dry tropical zones, particularly in Burkina Faso, is characterized by quantitative and qualitative limitations of forage resources, especially during the dry season. Cereal straws and bush hays, which form the basis of ruminant diets during this period, have very low crude protein contents, not exceeding 40 g/kg of dry matter (Nantoumé *et al.,* 2000). These levels are below the minimum required for proper digestive tract function and animal maintenance (Tendonkeng *et al.,* 2010). This protein deficiency severely limits forage digestibility and animal zootechnical performance. Browse species represent a promising alternative resource to overcome these nutritional deficiencies. Among these

species, *Ficus sycomorus* (sycamore fig) stands out for its richness in crude protein and its availability during the dry season. Bromatological analysis results revealed that fresh *F. sycomorus* leaves have a crude protein content of 129.5 g/kg DM (Coulibaly *et al.,* 2025), higher than that of bush straws and cereal straws traditionally used. In addition to its availability, *F. sycomorus* leaves are appreciated by animals. Indeed, a feed preference test conducted on five browse species commonly used in southeastern Mali showed that this species ranked third among the most consumed as fresh leaves and second when offered in dry form (Coulibaly *et al.,* 2025). These results indicate that *F. sycomorus* has interesting potential as a dietary supplement in sheep rations. Although the nutritive value of browse species is recognized, their optimal incorporation rate in sheep rations is not sufficiently documented. Too low, an incorporation would not effectively correct protein deficiencies in basal forages, while excessive incorporation could lead to anti-nutritional effects related to secondary compounds such as condensed tannins or nutritional imbalances. Previous studies have shown that a tendency towards reduced digestibility can be observed even with low tannin contents, suggesting a complex relationship between chemical structure and biological activity (Novak *et al.,* 2020). This study aims to determine the optimal incorporation rate of fresh *F. sycomorus* leaves as a supplement to a diet based on low-quality forages for sheep. This research will contribute to the development of practical recommendations for farmers and agricultural extension workers in the Sahelian zone. It will also help to value local forage resources and improve sheep productivity, thereby contributing to food security and rural household income.

3 METHODOLOGY AND RESULTS

3.1 Experimental design: The study was conducted in Burkina Faso at the Research station of the Regional Directorate for Environmental and Agricultural Research of Saria (DRREA Centre), under the Institute of Environment and Agricultural Research (INERA).

The trial followed a completely randomized design with 20 Djallonke rams. The trial was conducted over 74 days, comprising periods for measuring voluntary intake, weight evolution and digestibility. The voluntary intake and weight evolution study lasted for 61 days, comprising a 14-day adaptation phase and 47 days of data collection. The adaptation phase was included to allow the rams to become accustomed to the new environmental conditions and new diets. The digestibility assessment was conducted over 13 days, comprising an 8-day adaptation phase and a 5-day data collection phase (Matumuini *et al.,* 2013). During the trial, the various feeds were distributed daily.

3.2 Experimental animals: The trial was conducted under controlled conditions on sheep (*Ovis aries L.*) of the Djallonké breed, Mossi variety (Photo 1, 2). Twenty (20) adults, entire male sheep aged between 18 and 36 months were used. They had an initial average live weight of 20.81 ± 3.81 kg, ranging from 14.5 kg to 27.7 kg. The animals were purchased from livestock markets (Yilou, Kamboinsé, and Saria). To ensure that the animals were in good health prior to the testing, they were vaccinated against pasteurellosis, pest of small ruminants and dewormed. The animals were then allocated to five (5) groups, each comprising four (4) animals. To discard the animals' weight effect on the results, the groups were established based on live weight homogeneity. The animals were placed in different compartments within the same building. Each compartment accommodated four animals which were grouped per treatment. The rams were kept in stabling.



Photo 1: Djallonké ram



Photo 2: Djallonké ram with faecal collection harnesses

3.3 Experimental diets: The animals received a basic diet made of *P. pedicellatum* (Deenanath grass) hay supplemented with cotton seed cake (Table 1). Cotton seed cake was added to the diets to prevent extreme weight loss, given the poor quality of hay used in the study. The *P. pedicellatum* hay was purchased from fodder sellers in Sakoinsé, a village located approximately 30 km from Koudougou. *F. sycomorus* leaves were collected from the village of Saria in the morning and distributed daily according to the incorporation rates of 15 ; 30, 70 and 100 per cent (Photos 3 and 4). Subsequently, 100 g of cotton seed cake was added to each ration. The various feeds were weighed daily using an electric balance with a capacity of 3 kg with an accuracy of 1 g before being placed in the feeders. The total daily diet distributed was calculated on the basis of the animals' live weight at a rate of 3.5% of live weight. The quantities of the various feedstuffs in the diet were determined based on their inclusion rates in the total diet. The animals had access to clean drinking water and salt licks *ad libitum*. The feed diets were randomly allocated to the different groups by drawing lots.



Photo 3: Tree of *Ficus sycomoros*



Photo 4: Fresh leaves of *Ficus sycomoros*

Table 1 : Experimental diets

Diets	Basal ration composition (% DM)		Supplementation (g)
	P. pedicellatum hay	*F. sycomorus* leaves	Cotton seed cake
T0	100	0	100
T15	85	15	100
T30	70	30	100
T70	30	70	100
T100	100	0	100

3.4 Parameters measured

3.4.1 Voluntary intake: To measure the quantities voluntarily ingested, the refusal rate was set between 10 and 30% (Klein *et al.,* 2019). The feed offered and rejected was weighed daily for each animal in each group. Voluntary intake, expressed as Dry Matter Intake (DMI), was calculated by subtracting the amount refused from the amount offered, based on dry matter (DM). The animal mean weights, estimated from the weights at the beginning and end of the experiment, were used to express voluntary intake by kg of metabolic body weight, expressed in g/day/ kg $BW^{0,75}$.

$$IV = Qof - Qrf$$

Where *IV: Voluntary Intake*,
Qof: *Quantity offered*,
Qrf: *Quantity refused*

3.4.2 Apparent digestibility coefficients: To calculate the apparent digestibility coefficient, common in vivo method including total collection of faeces is used. Feeds (*P. pedicellatum*, *F. sycomorus*, and cotton seed cake) was weighed daily for each animal before distribution. Feed refusals were measured by component, per animal every morning before the next ration was offered. The faeces also were collected and weighed each morning before the feed was distributed. For each animal, 20% of the daily faecal output was sampled and the weight was recorded (P1). This sample was then dried in the shade for a week and weighed (P2) and subsequently stored in a plastic bag for bromatological analysis, as well as the samples of *P. pedicellatum*, *F. sycomorus* and cotton seed cake. The digestibility of the diet (dD) was calculated using the following formula:

$$dD = \frac{(I - F)}{I} * 100$$

Where *dD = diet digestibility,*
I = amount of DM ingested and
F = amount of DM excreted in faeces

3.4.3 Growth performance: Growth performance Evaluation is an important element to consider, as it determines feed quality for fattening animals. The growth performance indicator generally used in feeding trials is the average daily gain (ADG). To determine ADG, sheep were weighed at the beginning and end of the experiment, as well as once a week. An electric scale with a range of 99 kg and a precision of 50 g was used for this operation. ADG was determined using the following formula:

$$ADG(g/day) = (Final\ weight\text{ⓜ} - Initial\ weight)/(Number\ of\ \text{feding}\ days)$$

3.4.4 Feed conversion ratio: The feed efficiency of the rations was determined by calculating an indicator called the feed conversion ratio (FCR) which measures the amount of feed needed to achieve a given weight gain. The FCR thus evaluates an animal's feed conversion efficiency into final products. The lower the FCR, the more efficiently the animal transforms feed. FCR is calculated by dividing the total amount of feed consumed by the body weight gain over a given period. FCR, like ADG, plays an essential role in optimizing animal production.

$$FCR = (Quantity\ of\ feed\ ingested\ in\ kg\ dry\ matter)/(Final\ live\ weight ⓜ - Initial\ live\ weight)$$

3.5 Chemical analyses: Samples of the distributed and refusal feed and faeces collected daily were submitted to bromatological analysis. From these samples, dry matter (DM), organic matter (OM), crude protein (CP), crude ash (CA) and crude cellulose (CF) were determined. The Dry matter was determined after oven-drying 2 g of the sample for 24 hours at 103°C (Afnor, 1982; Bastianelli and Hervouet, 1998). For CA, feed samples were weighed and placed in an electric muffle furnace at 550°C for 4 hours, and the products obtained were weighed and expressed as relative dry matter values for each sample (Afnor, 1977). OM was obtained by subtraction: 100 – CA. Nitrogenous content was determined using the Kjeldahl method which involves mineralizing the samples with sulfuric acid (95%) at 480°C for 167 min in the mineralizer, distilling using a distillation apparatus and titrating the distillates (Iso, 1997). The crude protein (CP) contents were estimated from the nitrogen content of the samples and a factor based on the average nitrogen content of plants, which is 16%, using the formula (N × 6.25). CF was measured using fibersac (Afnor, 1993). The chemical composition of the rations was determined by taking into account the nutrient content of the constituent ingredients and their proportion in the rations.

3.6 Statistical analysis: The statistical analyses were performed using R software (version 4.4.1). Descriptive statistics, including means and standard deviations, were calculated. The Shapiro–Wilk test and Bartlett's test were applied to assess normality and homogeneity of variances, respectively. When these assumptions were met, a one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test was used for pairwise mean comparisons. For datasets that did not satisfy normality or homogeneity requirements, non-parametric procedures were employed, specifically the Kruskal–Wallis test, using a significance threshold of 5%.

4 RESULTS

4.1 Chemical composition of feedstuffs: Chemical analysis results (Table 2) showed significant variation between the feeds used. Fresh *F. sycomorus* leaves were richer in crude protein (109.5 g/kg DM), than *P. pedicellatum* hay (43.6 g/kg DM). *F. sycomorus* leaves were also rich in minerals (164.9 g/kg DM) and had lower CF content (138.3 g/kg DM). Similarly, diets containing *F. sycomorus* leaves were richer in protein (Table 3).

Table 2: Chemical composition of feedstuffs (g/ kg DM)

Feedstuffs	DM	OM	CP	Ash	CF
P. pedicellatum (hay)	949.4±0.22^{a}	898.7±0.21^{a}	43.6±0.25^{a}	101.2±0.21^{a}	416.3±0.19a
F. sycomorus (fresh leaves)	302.0±0.00^{b}	835.0±0.37^{b}	109.5±0.27^{b}	164.9±0.37^{b}	138.3±0.05^{b}
Cotton seed cake	954.4±0.63^{ac}	945.0±0.20^{c}	249.7±0.24^{c}	54.9±0.20^{c}	250.6±0.16^{c}
p-value	0.03486	1.922^{e}-09	0.02732	1.922^{e}-09	0.02732

Mean values in the same column with a common letter are not statistically different at the 5% threshold

Table 3: Chemical composition of distributed rations (g/ day)

Diets	DM	OM	Ash	CP	CF
T0	889.4±183.93[a]	803.7±165.30[a]	85.6±18.61 [a]	57.1±7.70 [a]	341.6±73.56[a]
T15	910.7±122.16[a]	824.8±110.08[a]	83.1±12.07 [a]	69.7±6.87a	349±48.72 [a]
T30	896.1±106.10[a]	794.8± 93.37[a]	101.2±12.72 [a]	74.2±6.67[a]	292.1±35.53 [a]
T70	942.3±222.80[a]	861±202.79[a]	81.3±20.00 [a]	111.9±23.16[b]	305.8±74.15 [a]
T100	914.65±100.08[a]	840±91.60[a]	74.6±8.48 [a]	130.9±13.08[b]	341.6±29.60 [a]
p-value	0.6082	0.5956	0.1939	0.002642	0.1182

Mean values in the same column with a common letter are not statistically different at the 5% threshold

4.2 Voluntary intake of fresh *F. sycomorus* leaves: Voluntary feed intake values showed significant differences between rations ($p < 0.05$). Diets containing 100% of *F. sycomorus* leaves recorded higher fresh matter intake levels (190.6 g FM kg $BW^{0.75}$) than T70 (167.8 g FM/ kg $BW^{0.75}$), T30 (125.1 g FM/ /kg $BW^{0.75}$), T15 (97.5 g FM/ kg $BW^{0.75}$) and T0 (67.4 g FM/ kg $BW^{0.75}$). When this intake is reported to dry matter, intake of the T0 (100% hay) becomes comparable to that of the T100 (100% fresh leaves). However, for mixed rations (hay and leaf mixture), voluntary DM consumption was higher (Table 4). Leaf incorporation in the rations therefore improved DM intake of whole rations. However, no significant difference was noted between the different integration rates. Dry matter intake ranged from 68.3 g/day/ kg $BW^{0.75}$ to 71.33 g/day/ kg $BW^{0.75}$. Crude protein, crude ash and crude fibre intake of the feeds differed ($p < 0.05$ and $p < 0.01$). The ration T70 ration showed high crude protein intake and low crude fibre intake compared to the other rations (Table 5).

Table 4: Voluntary FM and DM intake of rations as a function of the incorporation rate of fresh *F. sycomorus* leaves in the ration

Diets	FM g/ animal	FM g/ kg $BW^{0.75}$	DM g/ animal	DM g/ kg $BW^{0.75}$
T0	682.1±141.17[b]	67.4±1.42[a]	647.6±136.28[a]	63.9±1.57[b]
T15	996.7±112.27[ab]	97.5±2.43[b]	697.4±73.54[a]	68.3±2.16[a]
T30	1274±147.70[ac]	125.1±4.38[c]	726.1±80.71[a]	71.3±3.27[a]
T70	1670.21±430.64[cd]	167.76±13.81[d]	698.03±182.26[a]	70.19±7.10[a]
T100	1801.78±92.89[d]	190.62±2.41[e]	584.83±18.41[a]	61.93±2.13[b]
***p*-value**	0.001	0.001	0.452	0.014

Mean values in the same column with a common letter are not statistically different at the 5% threshold.
FM = Fresh Matter; BW^0.75 = Metabolic weight; DM = Dry Matter.

Table 5: Nutrient intake of rations according to incorporation rate of *F. sycomorus* leaves (g/ kg $BW^{0.75}$)

Diets	DM	OM	Ash	CP	CF
T0	63.93±1.57[ab]	57.49±1.41[ab]	6.02±0.23[b]	4.78±0.28[d]	25.01±0.90[b]
T15	68.30±2.17[ab]	60.91±1.95[a]	6.98±0.16[ab]	5.67±0.38[a]	23.71±0.67[ab]
T30	71.34±3.27[a]	63.16±2.93[a]	7.77±0.36[ac]	6.51±0.19[b]	21.98±1.33[a]
T70	70.19±7.10[ab]	61.35±6.24[a]	8.41±0.91[c]	7.71±0.41[c]	16.58±2.27[c]
T100	62.08±1.10[b]	53.52±1.73[b]	8.12±0.24[c]	8.22±0.30[c]	9.73±0.34[d]
p-value	0.015	0.008	0.003	0.000	0.001

Mean values in the same column with a common letter are not statistically different at the 5% threshold

4.3 Digestibility of the different diets used: The digestibility results showed that the values of dry matter (dDM), organic matter (dOM), mineral matter (dCA), crude protein (dCP) and crude fibre (dCF) differed ($p < 0.05$) between the diets. The dDM, dOM, and dCP of T70 treatment were higher ($p < 0.05$) than other treatments. Incorporating fresh *F. sycomorus* leaves at 70% of the basal ration led to an improvement in the digestibility of rations. However, a decrease in dCP was observed for the diets containing 15% and 30% fresh leaves of *F. sycomorus*, corresponding to T15 and T30 treatments (Table 6).

Table 6: Ration digestibility with different incorporation levels of *F. sycomorus* leaves (%)

Diets	**dDM**	**dOM**	**dAsh**	**dCP**	**dCF**
T0	50.54±5.16^{a}	56.04±1.47^{a}	37.56±4.38^{a}	44.91±0.83^{a}	61.42±0.25^{c}
T15	53.08±0.10^{a}	56.40±0.59^{a}	16.77±7.23^{b}	22.15±1.24^{b}	55.26±0.42^{a}
T30	53.27±5.27^{a}	58.01±4.25^{a}	10.74±15.18^{b}	29.82±12.27^{b}	54.52±3.51^{a}
T70	66.18±3.78^{b}	70.44±4.61^{c}	34.75±1.27^{b}	59.81±6.24^{c}	56.74± 4.25^{a}
T100	52.91±4.24^{a}	63.41±1.47^{b}	7.38±2.92^{c}	42.88±4.95^{ab}	28.33±1.01^{b}
***p*-value**	0.03655	0.046	0.036	0.014	0.000

Mean values in the same column with a common letter are not statistically different at the 5% threshold.

4.4 Growth performance and feed conversion ratio: Weight gains and ADG obtained with the incorporation of fresh leaves of *F. sycomorus* in the different rations were different ($p < 0.05$). Distribution of fresh leaves of *F. sycomorus* in association with *P. pedicellatum* hay, resulted in an increase (Table 7). The ADG of T70 treatment and T30 treatment (75.79 g/ day) were higher than other treatments. The lowest ADG was obtained with the control diet without fresh leaves of *F. sycomorus* (18.03 ± 6.01 g/day). The feed conversion ratios (FCR) results showed significant differences between the diets ($p < 0.05$). Incorporation of *F. sycomorus* leaves into the diets resulted in a decrease in FCR. Overall, FCR obtained with rations containing *F. sycomorus* leaves were lower compared to the control T0. The best FCR were noted with the T70 diet (9.19 kg DM/kg BW), followed by the T30 diet (9.49 kg DM/kg BW). An increase in FCR was observed for the diets containing fresh leaves of *F. sycomorus* beyond the incorporation rate of 70%.

Table 7: Weight growth performance of sheep according to the incorporation rate of fresh leaves in rations and the feed conversion ratio of these rations

Diets	**Initial weight (kg)**	**Final weight (kg)**	**Weight gain (kg)**	**ADG (g/day)**	**FCR (kg DM/kg gain)**
T0	21.62±5.47^{a}	22.47±5.38^{a}	0.84±0.28^{a}	18.03±6.01^{a}	35.31±11.68^{b}
T15	21.85±4.19^{a}	23.94±3.75^{a}	1.09±0.95^{a}	23.20±20.39^{a}	16.76±5.05^{a}
T30	20.30±2.52^{a}	23.86±3.18^{a}	3.56±0.90^{bc}	75.79± 19.35^{b}	9.50±1.73^{a}
T70	19.36±4.78^{a}	23.26±5.74^{a}	3.90±1.28^{b}	82.97±27.34^{c}	9.19±1.83^{a}
T100	19.18±1.89^{a}	20.83±1.45^{a}	1.65±0.72^{ac}	35.10±15.36^{d}	22.28±8.15^{ab}
***p*-value**	0.818	0.876	0.000	0.000	0.008649

Mean values in the same column with a common letter are not statistically different at the 5% threshold

5 DISCUSSION

5.1 Chemical composition of feedstuffs and Diets: Chemical analysis results of fresh leaves of *F. sycomorus* showed difference between feedstuffs used in the diets. The DM content of fresh leaves of *F. sycomorus* was 30% (< 50% DM). This result is similar to those reported (< 50% DM) by Mebirouk-Boudechiche *et al.* (2015) for fresh leaves of other fodder tree species in Algeria. The high water content of fresh leaves of *F. sycomorus* could impact voluntary dry matter intake. The crude protein content of fresh leaves of *F. sycomorus* (109.591 g/kg DM) was higher than that recorded by Traoré *et al.* (2025) on the same species (94 g/kg DM). However, the crude protein content of *F. sycomorus* leaves was lower than those recorded by Dione et al. (2022) in fresh leaves of *Balanites* aegyptiaca (166.2 g/kg DM), *Azadirachta indica* (156.5 g/kg DM), and *Piliostigma reticulatum* (182.1 g/kg DM) and by Idrissou (2015) in fresh leaves of *Leucaena leucocephala* and *Gliricidia sepium*. However, the CP content observed for *F. sycomorus* remains higher than that of *P. pedicellatum* hay (Savadogo, 2002), bush straws, and cereal straws (Nantoumé *et al.,* 2000). This result shows that *F. sycomorus* leaves can potentially be used to fill the nitrogen deficit of this type of forage, whose crude protein content do not exceed 4% DM (Nantoumé *et al.,* 2000; Sanou *et al.,* 2022). Due to its relatively high crude protein content, *F. sycomorus* leaves can be an important supplement for ruminants during the dry season, when herbaceous forage has low nutritional value. The crude ash content of *F. sycomorus* leaves (164.9 g/kg DM) is higher compared to that of *P. pedicellatum* hay and cotton seed cake. Like other browse species, *F. sycomorus* leaves are rich in mineral. This is in agreement with literature data reporting the richness of browse species in mineral (Klein *et al.,* 2019). The CA content of *F. sycomorus* leaves is higher than that of many browse species cited by Dioné et al. (2022) such as *Acacia ataxacantha* (153.2 g/kg DM), *B. aegyptiaca* (145.7 g/kg DM), and *Securidaca longepedunculata* (101.9 g/kg DM). It is reported by several authors that the leaves of some browse species have good content of calcium and phosphorus (Klein *et al.,* 2019; Dione *et al.,* 2022). Thus, the consumption of these species would mitigate the risks of mineral deficiency associated with dry herbaceous forages, which are poor in phosphorus, copper, zinc, selenium, manganese, and sodium (Klein *et al.,* 2019; Brouckaert, 2024).

5.2 Voluntary dry matter intake of rations used: Voluntary fresh matter intake (VFMI) of fresh leaves of *F. sycomorus* was higher in the T100 diet (190.6 g FM/ kg $BW^{0.75}$) than for the T0 diet (67.4 g FM/ kg $BW^{0.75}$). However, when this intake is reported as DM, the intake of the T100 diet (61.9 g DM/ kg $BW^{0.75}$) was comparable to that of the control T0 (63.9 g DM/ kg $BW^{0.75}$). This result is explained by the high water content (70%) of fresh leaves of *F. sycomorus*, which increases FMI and limits DMI and thus nutrient intake. This observation was highlighted by Cissé (2015) on *F. sycomorus* leaves integrated at 25% and 50% in the diets. Consequently, the distribution of fresh forages as the sole feed can limit nutrient intake and affect the zootechnical performance of animals consuming them. Overall, voluntary DM intake (VDMI) of diets increased according to different incorporation levels of *F. sycomorus* leaves. However, no significant difference was noted between the different integration rates. Increasing the incorporation rate of fresh leaves beyond 70% resulted in a decrease in VDMI (T100). This results a plateau effect for fresh leaves of *F. sycomorus*. The voluntary intake observed in this study differs from those reported by others on the same species or other browse species (Matumuini *et al.,* 2013; Cissé, 2015; Nantoumé *et al.,* 2018). Differences noted in ration intakes are linked to several factors, including the rate of incorporation in the diet, the type of browse species, animal breed, live weight and the other feedstuffs of the diet.

5.3 Digestibility of the different diets: Feed digestibility is one of the most important factors in diet nutritive value evaluation (Besharati *et al.,* 2022). Apparent digestibility of DM, OM, and CP increased with increasing incorporation rates of fresh leaves of *F. sycomorus*

in the diets. This improvement was greater with the T70. This result could be partially explained by high crude protein intake as shown in the results. This observation is consistent with literature data showing that due to the nitrogenous matter contained in browse species, their incorporation in the diets allows for better microbial digestion of crude fibre in the rumen (Klein *et al.,* 2019). Crude protein content of browse species are generally higher than or equal to the minimum required rate (7-8% DM) for proper rumen function and adequate ruminant nutrition (Van Soest, 1994). The study shows that use of fresh leaves of *F. sycomorus* during the dry season as a supplement to low-quality forages could improve their digestibility. Improving animal diet quality in the dry season through complementarity between grass and fodder trees has already been emphasized by other authors (García *et al.,* 2017). The use of browse species to improve animal diet quality during the dry season has already reported by other authors (García *et al.,* 2017). However, *F. sycomorus* leaves contain secondary compounds such as saponins, flavonoids, alkaloids, tannins, steroids, terpenoids, and cardiac glycosides which give them antimicrobial power (Muhammad *et al.,* 2023). Despite the presence of tannins in *F. sycomorus* leaves the protein digestibility of diets was not decreased. Incorporation of *F. sycomorus* leaves up to 70% in the diets was not induce a negative effect on digestibility. This result agrees with the hypothesis that at moderate levels, tannins can present benefits (Nascimento *et al.,* 2021; Besharati *et al.,* 2022). However, beyond 70% of leaves integration in the diet, a decrease in dCP was noted. This suggests that with the T100 diet, the amount of tannins consumed reached the threshold to induce a negative effect on digestibility.

5.4 Growth performance and feed conversion ratio: The distribution of *F. sycomorus* leaves as feed for sheep for a duration of two (2) months had no adverse effects on animal nutritional and health status. On the contrary, it resulted in a higher weight gain compared to the ration consisting of *P. pedicellatum* hay alone. This means that *F. sycomorus* leaves can serve as a basal feed for sheep if the resource is available. The highest ADG were noted with the mixed diets T30 and T70. The ADG of 83 g/day obtained with the T70 is comparable to that (81 g/day) observed by Kondombo and Nianogo (2001). The ADG recorded with the T30 ration (75.79 g/day) is similar to that reported (76.25 g/day) by Sangaré *et al.* (2005). ADG recorded in our study are higher than those reported by Idrissou (2015) and by Sanogo *et al.* (2020) on Djallonké sheep. However, ADG recorded in our study remain low compared to those obtained in other studies. Indeed, Sidibé *et al.* (2019) recorded an ADG of 86 g/day on Djallonké sheep fed with 50% cotton seed cake and 50% peanut haulms. Similarly, Nantoumé *et al.* (2018) recorded ADG of 137.75 g/ day on Djallonké sheep fed with a ration composed of 50% fresh *F. sycomorus* leaves and 50% cotton seed cake. This difference observed in weight performance is attributable to the diets distributed in these studies, which would probably be richer in nutrients, especially crude protein. Feed conversion ratios (FCR) were 9.49 with T30 and 9.19 with T70. These FCR is within the range of 7.6 to 12.5 reported by Kamissoko *et al.* (2006). However, they are lower than the FCR (10 to 13) reported by Kondombo and Nianogo (2001) with diets based on legume haulm, cotton seed cake and wheat bran. FCR for rations T30 and T70 are also lower than the 37 reported by Sanou et al. (2022) on Djallonké sheep fed with sorghum straw and supplemented with 100 g of cotton seed cake. The difference between our results and those of these authors could be related to the diet components, but also to animal age. Some authors indicate that FCR increases with animal age (Sangaré *et al.,* 2005). Knowing that the lower the feed conversion ratio, the more efficient the diet, we can say that diets with 30% or 70% *F. sycomorus* leaves are more profitable.

6 CONCLUSION

This study highlighted the beneficial effect of incorporating fresh leaves of *F. sycomorus* into animal diets. The optimal incorporation rate of fresh leaves of *F. sycomorus* as a supplement to low-quality forages for sheep is 70% of total dry matter. At this rate, *F. sycomorus* leaves improve digestibilities of DM, OM and CP compared to the control diet. The results confirm that fresh leaves of *F. sycomorus* constitute a protein source to traditional dry season forages, which are hay and cereal straws. Its incorporation at 70% allows for an ADG of 83 g/day and a FCR of 9 kg DM/kg gain, demonstrating the efficiency of this local forage resource for sheep fattening. This study contributes to the valorisation of local forage resources and improving sheep productivity, thus strengthening food security and rural household income in the Sahel. For breeders in the Sahelian zone, it is recommended: to use fresh leaves of *F. sycomorus* at 70% of the ration for sheep fattening in the dry season. Otherwise, an incorporation rate of 30% also gives good weight performance in case of low availability of the resource. In perspective, future research should focus on evaluating the effect of different incorporation rates on meat quality. Given the potential nutritive value of browse species, it would be pertinent to develop domestication and selection work to increase its availability and accessibility for local livestock systems.

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