NUTRITIVE VALUE OF FRESH SULLA (*Hedysarum flexuosum)* AS A SOLE FEED FOR GROWING RABBITS

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ABSTRACT

For determining the nutritive value of Sulla (*Hedysarum flexuosum*), containing organic matter (OM) 84.3; crude protein (CP) 22.5; neutral detergent fibre (NDF) 49.0; acid detergent fibre (ADF) 34.3; acid detergent lignin (ADL) 10.8 % on DM basis, sixteen rabbits of Algerian white local population (individually caged) weaned at 35d old (mean body weight: 541±29g) were fed *ad libitum* fresh green Sulla as a sole feed during five weeks. The faecal digestibility of the Sulla was measured between 49 and 53 days of age on 12 rabbits. The digestibility of DM, OM, CP, NDF and ADF was 52.3; 52; 64.4; 35.5 and 28%, respectively. The average DM intake reached 114.2 g/d (125.6 g/kg $LW^{0.75}$), while the digestible CP intake was 17.7g/d (19.5 g/kg $LW^{0.75}$d) and that of digestible energy (DE) was 1.05 MJ/d (1.15 MJ/kg $LW^{0.75}$). These digestible nutrients intake allowed to meet not only the maintenance requirement, but also to support a growth rate of 18.9 g/d. The digestible energy concentration of the fresh Sulla was 9.2±0.15 MJ/kg DM, while the digestible crude protein concentration was 145±1.8g /kg DM. Harvested at young stage of growth, Sulla could be considered as a good and balanced fibre source for the growing rabbit and comparable to other good quality forages such as alfalfa and ryegrass.

Key words: Growing rabbit, digestibility, fresh Sulla (*Hedysarum flexuosum)*, growth performance, nutritive value.

INTRODUCTION

In lesser developing countries, particularly in Algeria and other maghrebian countries (Morocco, Tunisia), there is a need to identify suitable forages that will be incorporated in rabbit's diets and support low-cost meat production.

Sulla (*Hedysarum flexuosum* L., syn. *Sulla flexuosa*) originating from the western Mediterranean region and North Africa is one of these interesting local resources (Issolah *et al.*, 2011). In a previous study on this fodder at flowering stage and at the hay state, Kadi *et al.* (2011) estimated it's nutritive value by the regression method, with a digestible energy (DE) content of 8.9 MJ/kg DM and with a digestible crude protein (DCP) content of 71.1 g DCP/kg DM. Because its chemical composition is relatively balanced respect to DE and DCP levels (Kadi *et al.*, 2011), it is highly palatable for the rabbit, and therefore it can be used as a sole feed.

Therefore, we aimed to assess the feeding value of the fresh Sulla (*Hedysarum flexuosum*), whole plant, by conducting a growth and a digestibility trial to evaluate directly its nutritive value.

MATERIALS AND METHODS

Animals and feed

Sixteen rabbits of Algerian white local population weaned at 35 d of age (mean weight: 541±29) were used to assess the nutritive value of Sulla and its effect on growth. They were placed in wire mesh individual cages (56 x 38 x 28 cm) in flat deck disposition till 70 d old. The green forage of Sulla was

harvested manually, daily in the morning and spread out in the rabbitry. It was supplied the following day (24 h after harvesting) with the aim to reduce its moisture content which is around 85 % at this early stage of growth (Arab *et al*., 2009). Rabbits receive the forage *ad libitum* as sole feed. Permanent access to clean fresh water was available using an automatic watering trough.

The morphological stage of Sulla was classified as early bud according to the stage classification system for Sulla reported by Borreani *et al.* (2003). This morphological stage is defined by those authors as corresponding to appearance of first floral bud.

The experiment took place between April and May (T° from 15 to 23°C) for 5 weeks. Every morning throughout the assay period, both supply and refusal of Sulla were weighed to determine the daily intake. Live weights of the animals were recorded weekly and control of mortality was performed daily according to EGRAN recommendations (Fernández-Carmona *et al.,* 2005). After a 14 days adaptation period (49 d old), 12 rabbits were selected for the digestibility trial, following the European reference method described by Perez *et al*. (1995). One sample of Sulla was taken each day, at the moment of the distribution for rabbits, during the 4 days of collection. A sample of the day is then taken to the laboratory for determination of its dry matter.

Chemical analyses

The following analyses were performed at INRA (UMR 1289 TANDEM) on Sulla forage and faeces (12 samples) according to EGRAN harmonised procedures (EGRAN, 2001): humidity, crude ash, crude protein (N x 6.25, Dumas method, Leco apparatus), energy (adiabatic calorimeter Parr), and fibres (NDF, ADF and ADL) according to the sequential procedure of Van Soest.

Because only one diet was used in this study no mean comparison was possible. Results are only presented with mean and standard error.

RESULTS AND DISCUSSION

Nutritive value

The chemical composition and apparent digestibility coefficients of the Sulla consumed by rabbits are shown in Table 1. The crude protein content was very high (225 g/kg DM) for a fresh forage, and higher than that reported for dehydrated lucerne (200 g/kg DM), by Villamide *et al.,*(2010b). It is also the case of the gross energy content (17.8 MJ/kg DM) what is near to the value given by Perez *et al.* (1998) for Lucerne 19 (17.9 MJ/kg DM). Indeed, its NDF content was important (490 g/kg DM) and higher than the values reported for Lucerne (384 g/kg DM) or for wheat bran (460 g/kg DM) by Villamide *et al*.(2010b), that are nowadays the main fibre sources used in feed formulation for rabbit in Algeria. The ADF level of Sulla used here exceed 343 g/kg DM values reported by Villamide *et al*. (2010b) for Lucerne 18 (300 g/kg DM) and Perez *et al.* (1998) for lucerne 19 (298 g /kg DM). Whereas early stage forages contain less than 50 g ADL/kg (Gidenne *et al*., 2010), Sulla reached 107.6 g ADL/kg DM. This value is near that of *H.coronarium* harvested at the same stage of maturity and under similar climatic conditions (114 g/kg DM) reported by Arab *et al.* (2009).

The apparent digestibility coefficient of Sulla's protein was 64.4%, a normal value for forages and similar to the values reported in the bibliography for luceme hay (64%) (Fernandez-Carmona *et al*., 1998); but slightly lower than that of ryegrass (67 %) (Fernandez-Carmona *et al*.,2001). It corresponds to a digestible crude protein concentration of 145.1±1.75 g/kg DM basis. According to Villamide *et al.* (2010a), protein digestion in young rabbits is limited for forages. This apparent digestibility coefficient is much higher than that estimated by Kadi *et al*. (2011) for crude protein of the same plant as hay and at flowering stage (42.8% corresponding to a digestible crude protein concentration of 71.1 g/kg DM). This situation is partially due to the difference in protein content of Sulla used in the two essays (166.1 *vs* 225.1 g/kg DM) and that, in this trial, Sulla is harvested at earlier stage of maturity. According to Villamide *et al.* (2010b), an increase in the CP content of a feedstuff increases its digestibility because the proportional contribution of endogenous nitrogen to faecal nitrogen

decreases. Moreover, this also could be linked to the fact that proteins are associated with cell walls, as usually found in roughages, what limits their digestibility. Also, the quality of forages can vary greatly because of maturity and harvesting (Cervera *et al.*, 2010) as reported by García *et al.* (1995) for lucerne.

Table 1: Composition and digestibility coefficients of fresh Sulla (*Hedysarum flexuosum*) given as a sole feed for growing rabbits

	Sulla Composition (g/kg DM)*	Digestibility	
		Mean (%)	SE
Dry matter	579	52.3	2.31
Organic matter (OM)	843	52.0	2.26
Ash	157	-	-
Crude protein	225	64.4	1.13
Neutral detergent fibre	490	35.5	3.39
Acid detergent fibre	343	28.0	3.18
Acid detergent lignin	108	19.4	13.85
Energy (MJ/kg DM)	17.8	51.6	0.84
Dietary nutritive value			
DCP (g/kg DM)[1]		145	2.56
DE (MJ/kg DM)[2]		9.16	0.15

* Composite sample of Sulla offered during the digestibility period, [1] DCP: digestible crude protein. [2] DE: digestible energy.

The apparent digestibility coefficient of Sulla's energy was 51.6 %, in the norms generally recorded with forages and that vary from 45 to 65 % (Villamide *et al*., 2010a). This energy digestibility corresponds to 9.2 MJ/kg DM with an standard error of 0.15 calculated by the equation proposed by Villamide (1996) for estimation of the energy values of feed ingredients by direct method. The energy value obtained in this assay is slightly higher than that reported for the same forage but at advanced maturity stage and determined by regression method by Kadi *et al.* (2011) (9.2 *vs* 8.9 MJ/kg DM basis). In addition to the difference of harvest stage, the difference can be explained by the method of determination and high levels of soluble fibre. According to Villamide *et al*. (2003), the estimations from the multiple regression method under evaluate the dietary DE and DCP values. In addition, drying and pelleting may alter the nutritive value (Lebas *et al.,* 1975).
Furthermore, NDF and ADF digestibility was high (35.5 and 28% respectively) suggesting, as suspected by Kadi *et al.* (2011), that Sulla should contain fibre fractions that are highly digestible for the rabbit, such pectins (Gidenne *et al.*, 2010). Thus, the Sulla contains cell wall polysaccharides that could be valuable for the rabbit.

Growth trial

Throughout the experiment, the health status of rabbits was good since no rabbit died. The average daily weight gain (Table 2) decreased from 26.5 g/d in the first week to 11.1 g/d in the fourth week with an average of 18.9 g/d and a high dispersion (coefficient of variation near 70%). In the last week (70 d old), most of rabbits lost weight (-8.4±2.4 g/d). This impairment might be explained by the highest levels of fibre in the Sulla at this stage of maturity (flowering) especially ADF which reached 381 g/kg DM (Kadi et al, 2011). Indeed, above fibre level of 180-210 ADF g/kg, fattening rabbits are not able to maintain DE intake, and high-fibre diets (over 350 g ADF/kg DM) impair the average daily gain and feed conversion rate by 30 and 50%, respectively (De Blas and Mateos, 2010).

The Sulla had a high palatability for rabbits as indicated by the high voluntary dry matter intake (114 g/d Table 2). According to Fraga *et al.* (1991), fresh forages stimulate stomach growth, which accounted for subsequent higher feed intake capacity compared to rabbits fed only pellets. In fact, Singh *et al., (*1997) observed even higher DM intake (145 g/d) in rabbits fed fresh robinia leaves (*Robinia pseudoacacia*). Average daily intake of DCP (17.7 g) and digestible energy (1045.3±65 kJ/d)

permitted a substantial growth (18.9±3.3 g/d). Digestible CP intake for a forage comes mainly from the ingestion of leaves where the proteins of forage plants are concentrated. This DCP intake was higher than the value of 11.2 g/d reported by Deshmukh *et al.* (1993) for fresh mulberry (*Morus alba*) leaves even with same crude protein content (22.1 g/kg DM for mulberry leaves and 22.5 g/kg DM for Sulla used here).

Table 2: Mean body weight, feed conversion, nutrient intake of rabbits fed fresh Sulla as a sole feed

	Mean ± SEM	Range
Number of rabbits	16	-
Initial body weight (35d)	541 ± 29	404 – 746
Final body weight (70 d)	980 ± 59.4	632 - 1303
Average daily weight gain (g)	18.9 ± 3.3	6.2 - 36.9
Dry matter intake (DMI) (g/d)	114.2 ± 7.1	69.5 – 133.9
DMI/kg $LW^{0,75}$ (g/kg d)	125.6 ± 15.4	98 – 169
Feed conversion ratio	6.5 ± 1	5.1 - 9.1
DCP intake (g/kg $LW^{0,75}$)	19.5 ± 2.4	15 - 26
DE intake (kJ/d)	1045.3 ± 65	925 - 1225
DE intake (kJ/kg $LW^{0,75}$/d)	1149 ± 141.2	898 - 1542

Average DE intake was much higher than that recommended by Xiccato and Trocino (2010) for maintenance of body weights of rabbits (1149 *vs* 430 kJ/day/kg $LW^{0.75}$), what permitted not only to widely cover the maintenance requirements but also to achieve a substantial growth.

Feed conversion ratio value exceeded on average 6 and ranging from 5.1 to 9.1 (Table 2). It deteriorates with stage of maturity of the Sulla. Compared to data obtained with rabbits fed forage as sole feed, our values were widely better than the 11.6 reported by Singh *et al.* (1997) with rabbits fed *Robinia pseudoacacia* leaves, or the 17.7 reported by Raharjo *et al.* (1988) with rabbits fed rice bran.

CONCLUSION

The nutritive value of the fresh Sulla (*Hedysarum flexuosum*) collected at early stage of maturity is relatively high (9.2±0.15 MJ DE/kg DM and 145.1±1.7g DCP/kg DM) and it could be considered as good and balanced fibre source as alfalfa and ryegrass for the growing rabbit.

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