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Prediction of some Tunisian roughages voluntary intake by "Noire de Thibar" ewes

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SUMMARY – The present study aims at predicting the voluntary intake of different roughages by ewes. Rations based on Egyptian clover **(***Trifolium alexandrium*), oat (*Avena sativa)*, barley (*Hordeum vulgare*) "Souihli", barley "Manel", vetch (*Vicia sativa*)-oat silage, and vetch-oat hay were distributed ad libitum twice a day during different periods of 4 weeks each to 6 black-thibar ewes (age = 4 years and body weight = 57 kg). Ewes' regimen was enriched by 10 g/Kg $LW^{0.75}$ of concentrate and by 30 g/animal daily of a commercial mixture of minerals and vitamins. Chemical composition (DM, CP, NDF, and CF) was determined for each roughage. Ruminal degradability of these roughages was determined using the technique of nylon bags and was modelled as: $Dg = a + b (1-e^{-ct})$, where Dg is the ruminal degradability in time t and a, b and c are constants. The CP and NDF contents ranged from 7.6 to 19.1% DM and from 42.0 to 58.3% DM, respectively. For the Dg parameters, the fraction "a" ranged from 5.2 to 23.5; the fraction "b" ranged from 51.1 to 71.2 and "c" ranged from 0.0114 to 0.0570. There were significant differences ($p<0.05$) among roughages with regard to immediately soluble fraction "a", insoluble but degradable fraction "b", and fraction rate of degradation "c". The voluntary intake of roughages ranged from 784 g DM to 1104 g DM daily. Average silage intakes were 918 g DM daily. This low value may be related to the quality of roughage conservation. Roughage intake can be predicted based on chemical characteristics. The NDF and the CB contents with ruminal degradability parameters explained 34% of the total variation of roughage intake by Black-Thibar ewes (DMI g/Kg $LW^{0.75}$ = -1470.46 + 5.93 CF + 10.39 NDF + 12.73 NDS + 2.15 a + 2.82 b

Keywords: Roughage, ruminal degradability, voluntary intake, prediction, ewes.

RESUME – *"Prédiction de l'ingestion volontaire de quelques fourrages tunisiens par les brebis Noire de Thibar". L'objectif de cette étude est la prédiction de l'ingestion volontaire de différents fourrages par les brebis Noire de Thibar. Des rations basées sur le trèfle d'Alexandrie (*Trifolium alexandrium*), l'avoine (*Avena sativa*), l'orge (*Hordeum vulgare*) "Souihli", l'orge "Manel", l'ensilage de vesce (*Vicia sativa*)-avoine et foin de vesce-avoine, ont été distribuées à volonté 2 fois par jour pendant des périodes de 4 semaines chacune à 6 brebis (âge moyen = 4 ans et poids vif moyen = 57 kg). Les rations ont été complétées chaque jour par 10 g/Kg $P^{0.75}$ de concentré et par 30 g/brebis de CMV. La composition chimique (MS, MAT, FND et FB) a été déterminée pour chaque ration. La dégradabilité des différents fourrages dans le rumen a été déterminée par la méthode des sachets de nylon et a été représentée par : $Dg = a + b (1-e^{-ct})$, Dg étant la dégradabilité ruminale à un temps t et a, b et c étant des constantes. Les teneurs en MAT et FND ont varié respectivement de 7,6 à 19,1% et de 42,0 à 58,3% de MS. Les paramètres de dégradabilité ont aussi varié de 5,2 à 23,5, de 51,1 à 71,2 et de 0,0114 à 0,0570 respectivement pour "a", "b" et "c". Ces paramètres dépendaient ($p<0,05$) de la nature du fourrage. L'ingestion volontaire des fourrages oscillait de 784 à 1104 g MS par jour et était faible pour l'ensilage de vesce-avoine (918 g MS par jour). Cette faible ingestion est imputée à sa qualité de conservation. La prédiction de l'ingestion des fourrages à partir de leur composition chimique et leurs paramètres de dégradabilité est possible. Ainsi l'équation de prédiction est MSI g/Kg $P^{0.75}$ = -1470,46 + 5,93 FB + 10,39 FND + 12,73 NDS + 2,15 a + 2,82 b avec un coefficient de détermination de 34%.*

Mots-clés : *Fourrage, dégradabilité ruminale, ingestion volontaire, prédiction, brebis.*

Introduction

Data on roughages' chemical composition and nutritive values are well known in Tunisia (Sansoucy *et al*., 1980, Nefzaoui and Chermiti, 1989; Abdouli and Kraïem, 1990) while those on their intake by animals are scarce. The determination of voluntary intake of roughages is expensive and time consuming. The knowledge of voluntary intake of various roughages is needed for efficient ration formulation. The objectives of this study were to determine the voluntary intake of some common roughages by ewes under Tunisian conditions and establish prediction equations.

Material and methods

Chemical composition of used roughages

Four of the most common roughages in Tunisia were used to feed Black-Thibar ewes. There were green roughages: Egyptian clover (*Trifolium alexandrium*), oat (*Avena sativa*), barley (*Hordeum vulgare*) "Souihli", barley (*Hordeum vulgare)* "Manel" and conserved roughages: hay and silage of vetch (*Vicia sativa*)-oat. Chemical analyses were conducted to determine contents of roughages in dry matter (DM), crude protein (CP) (AOAC, 1985), crude fibre (CF) (AOAC, 1985) and neutral detergent fibre (NDF) (Van Soest, 1982). Rumen degradability of the different roughages was derived following: $Dg = a + b\ (1\text{-}e^{-ct})$ (Orskov and Mc Donald, 1979) where "a" represents the immediately soluble fraction, "b" is the fraction potentially degradable, and "c" is the rate of "b" (in % per hour). Constants "a" and "b" are expressed in % of DM. Chemical composition of the used roughages is given in Table 1.

Table 1. Chemical composition of roughages

Roughages	DM (in %)	OM (% DM)	CP (% DM)	CF (% DM)	NDF (% DM)	NDS (% DM)
Green roughages						
Egyptian clover	11.2	86.2	19.1	21.3	42.0	58.0
Oat	17.5	89.9	11.5	28.7	54.0	46.0
Barley "Souihli"	16.1	89.2	10.4	27.7	55.0	45.0
Barley "Manel"	13.0	86.5	11.2	24.1	51.0	49.0
Conserved roughages						
Vetch-oat silage	29.0	89.5	7.6	26.0	47.0	53.0
Vetch-oat hay	89.2	93.0	8.2	25.2	56.0	44.0

DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fibre; NDF: Neutral detergent fibre; NDS: Neutral detergent soluble fraction.

Animals

Twelve ewes of the Black-Thibar "Noire de Thibar" breed were used over a 135 day (3 x 45 days) experimental period. Ewes were 4 years old and averaged 56.7 kg (standard deviation = 7.9 kg) of live body weight at the beginning of the essay. Animals were divided into two groups of 6 ewes each and were maintained in individual boxes. Two rations were distributed at the same time and each group (6 ewes) received one of these two rations over a period of 45 days. The first 15 days were for adaptation and then data were collected over the remaining 30 days on an individual basis (n = 30 per ewe per roughage or mixture of roughages). Roughages were given in two meals (at 8h and at 15h). Rations were completed by a concentrate in function of weight, that is 10 $g/BW^{0.75}$ (89% DM, 15% CP and 8% CF) that included 30 g/animal of commercial mixture of minerals and vitamins on a daily basis. Water was ad libitum. Concentrate was added to meet basic requirements and maintain a normal microbial activity in the rumen.

The ruminal degradability was determined on two other ewes (age = 5 years and average weight = 50 kg) using the technique of incubation on nylon bags. Measures were taken on 3, 6, 24, 48, 72, and 96 hours and four bags were used for each roughage or mixture of roughages.

Statistical analysis

Means of chemical composition and ruminal degradability were compared using a one way ANOVA. Prediction equations were derived by linear regression (SAS, 1988).

Results and discussion

Ruminal degradability

Parameters "a", "b", and "c" estimated for ruminal degradability varied (P<0.05) with roughages (Table 2) and their mode of distribution to ewes. The highest value (23.5) among all roughages was observed for vetch-oat silage while the lowest value (5.2) was observed for green oat. This constant was only 17.8% for vetch-oat hay which is lower than that reported by Carro *et al*. (1991) and Khazaal *et al*. (1993). This difference might be explained by the NDF content. The latter authors used a hay with a lower content in NDF (48.5%) than that of this study.

The "b" parameter was similar for the 2 barley breeds ("Souihli" and "Manel") but differed (p<0.05) from those of the other roughages. The lowest value (51.1% DM) was observed for the vetch-oat silage and the highest value (71.2% DM) was measured on the green barley "Souihli". That of hay was 65.7% DM which is greater than that reported by Khazaal *et al*. (1993). Rates of degradability of the fraction "b", estimated by the parameter "c", were high for the green roughages except for that of oat. The latter has an important NDF content (54% DM). That is, oat conducted under Tunisian conditions should be collected at earlier stage for use in ewes feeding.

Table 2. Ruminal degradability derived following: $Dg = a + b\ (1-e^{-ct})$

Roughages	a	b	a+b	c
Green roughages				
Egyptian clover	10.4^{bc}	605.5^{ab}	75.9^{ab}	0.0443^{ab}
Oat	5.2^{c}	63.0^{ab}	68.2^{b}	0.0246^{bc}
Barley "Souihli"	6.3^{c}	70.0^{a}	76.4^{ab}	0.0570^{a}
Barley "Manel"	7.3^{bc}	71.2^{a}	78.5^{ab}	0.0440^{ab}
Conserved roughages				
Vetch-oat silage	23.5^{ab}	51.1^{b}	74.6^{ab}	0.334^{abc}
Vetch-oat hay	17.8^{a}	65.7^{ab}	83.5^{a}	0.0114^{c}
MSE	1.46	2.19	1.44	0.003

a,b,c: Means within the same column with different superscripts are different (p<0.05); MSE: Mean standard error.

Potential voluntary intake of roughages

The concentrate distributed was totally consumed by ewes and voluntary intake of roughages varied from 784 to 1104 g DM/day (Table 3). The highest quantity was observed for the barley "Souihli" and the lowest for the Egyptian clover. The intake of green roughages was relatively lower than the most commonly found quantities except for "Souihli" witch has an important content in water. The intake of silage was only 918 g DM/day. This might be explained by the quality of the silage that depends on the vetch proportion, the timing of the harvest, and the conservation technique (Dulphy and Michalet-Doreau, 1981). The mean quantity of voluntary consumed hay was around 1024 g DM/day. However, a great variation (MSE= 26.2) was observed in the consumption of hay in function of the leaf/stem ratio.

Prediction of voluntary intake of roughages

Prediction equations of voluntary intake of roughages are given in Table 4. The use of only NDS content as an explanatory variable was not informative and explained around 6% of the total variation of voluntary intake. Adding the soluble fraction a and the potentially degradable fraction b accounted for an additional 4% of the intake variation (R^2 = 9.9%). The use of CF content improved substantially the prediction (R^2 = 32.4%) of the voluntary intake by animals while the inclusion of the NDF content did not further improve the prediction (R^2= 33.4%).

Table 3. Mean voluntary intake of roughages (DM)

Roughages	g DM/day	MSE
Green roughages		
Egyptian clover	784[d]	21.4
Oat	821[d]	9.6
Barley "Souihli"	851[d]	7.6
Barley "Manel"	1104[a]	7.1
Conserved roughages		
Vetch-oat silage	918[c]	11.1
Vetch-oat hay	1024[b]	26.2

a,b,c: Means within he same column with different superscripts are different ($p<0.05$).

Table 4. Prediction of voluntary intake of roughages by ewes (n = 6)

Variable	Equations	R^2 (%)	SE
DMI ($g/BW^{0.75}$)	45.63 – 0.28 NDS + 0.18 b	5.9	0.40
	15.5 – 0.22 NDS + 0.41 a + 0.52 b	9.9	0.39
	-402.94 + 5.61CF + 2.32 NDS+1.86 a + 2.59 b	32.4	0.12
	-1470.46 + 5.93 CF + 10.39 NDF + 12.73 NDS +2.15 a + 2.82 b	33.4	0.11

Conclusion

Chemical composition of the roughages used in this experiment was variable. Ruminal degradability parameters, especially the immediately soluble fraction, varied with roughages and their mode of distribution. Furthermore, voluntary intake of rations by Black-Thibar ewes did depend on the type of roughage. The green barely "Souihli" was the most consumed while the Egyptian clover was the least consumed among all distributed roughages. Prediction of voluntary intake by ewes is efficient when both chemical composition of roughages and parameters of ruminal degradability were included in the prediction equation.

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