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Change in milk composition and fatty acid profile of dairy ewes depending on nature of two annual grasses species in sub-humid region of Tunisia

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Abstract. The objective of this synthesis is to investigate the forage production of two annual grasses species (green barley and triticale) and their effects on milk production, composition and fatty acid profile of dairy ewes in the Tunisian sub-humid area. The first regimen was based on green barley (GB) and the second regimen was based on triticale (T). The concentrate supply was 300 g/day/ewe for each group. The dry matter forage production was 2.4 and 5.4 t/ha for green barley and triticale respectively. Milk production was significantly higher for T group than GB one (540 vs 460 ml/day). Fat and protein content (g/kg) were higher for ewes fed triticale pasture than ewes fed green barley pasture (39.1 vs 33.6 g/kg of milk fat and 26 vs 24 g/kg of milk protein for T group and GB one respectively). Milk of ewes fed triticale had a higher percentage on poly unsaturated fatty acid (PUFA) than ewes fed green (6 vs 2.9% for T and GB respectively), on total unsaturated fatty acid (UFA) (28.7 vs 26.3% for T and GB respectively), on C18:0 (11 vs 8.5% for T and GB respectively), on C18:1 (23 vs 21.4% for T and GB respectively) and on C18:2 (3.5 vs 1.7% for T and GB respectively). Milk from ewes fed triticale had a higher linolenic acid (C18:3) proportion than milk from ewes of GB group (0.9 vs 0.5 % respectively). The milk CLA content was significantly higher for GB group than for T group (7.3 vs 3.2 % respectively). In conclusion, the cultivated triticale pasture seems conduct to higher production and healthier ewe's milk comparing to green barley except CLA percentage which the highest value was found in ewe's milk fed green barley.

Keywords. Grasses – Milk yield – Milk fatty acid profile – Sicilo-Sarde ewes.

Changement dans la composition du lait et le profil en acides gras de brebis laitières en fonction de la nature de deux espèces de graminées annuelles dans la région sub-humide de la Tunisie

Résumé. L'objectif de cette synthèse est d'étudier la production fourragère de deux espèces de graminées annuelles (l'orge et le triticale) et leurs effets sur la production laitière, la composition chimique et le profil des acides gras du lait de brebis laitières dans la région sub-humide de la Tunisie. Le régime (GB) est basé d'orge en vert et le régime (T) est à base de triticale. L'apport en aliment concentré est de 300 g/jour/brebis pour chaque groupe. La production de matière sèche de fourrage a été de 2,4 et 5,4 t/ha respectivement pour l'orge en vert et le triticale. La production de lait était significativement plus élevée pour le groupe (T) que le groupe (GB) (540 vs 460 ml/jour, respectivement). Les teneurs en matières grasses et en protéines (g/kg) étaient plus élevées pour le lait de brebis sur pâturage de triticale que le lait de brebis sur pâturage d'orge vert (39,1 vs 33,6 g/kg de matière grasse du lait et 26 vs 24 g/kg de protéines de lait pour le groupe (T) et (GB) respectivement). Le lait de brebis sur pâturage de triticale a un pourcentage plus élevé que les brebis sur pâturage d'orge verte en acides gras poly insaturé (AGPI) (6 vs 2,9% pour le groupe (T) et le groupe (GB) respectivement), en acides gras insaturés (AGI) (28,7 vs 26,3% pour le groupe (T) et le groupe (GB) respectivement), en acide stéarique (C18:0) (11 vs 8,5% pour le groupe (T) et le groupe (GB) respectivement), en C18:1 (23 vs 21,4% pour le groupe (T) et le groupe (GB) respectivement) et en C18:2 (3,5 vs 1,7% pour le groupe (T) et le groupe (GB) respectivement). Le lait de brebis sur pâturage de triticale (T) a la plus grande teneur en acide linoléique (C18:3) que le lait de brebis de groupe (GB) (0,9 vs 0,5% respectivement). La teneur du lait en CLA était significativement plus élevée pour le groupe (GB) que pour le groupe (T) (7,3 vs 3,2% respectivement). En conclusion, le pâturage sur triticale semble conduit à une amélioration de la production et de la qualité diététique du lait de brebis en comparaison avec la lait des brebis pâturant l'orge en vert, à l'exception de la teneur en CLA du lait laquelle a été plus élevée dans le lait de brebis conduite sur pâturage d'orge vert.

Mots-clés. Graminées – Production laitière – Acides gras du lait – Brebis Sicilo-Sarde.

I – Introduction

Due to the evolution of consumers' demand, more attention has been given to traits related to food safety, health and nutritional value. Animal products like milk play an important role given the impact of its fatty acid (FA) content on human health. In fact, fat nutritional aspects have been assuming an increasing importance as positive or negative predisposing factors for human health. Many others research showed that dietary factors such as the nature of forages, including pasture, and the supplementation of dairy rations with protected or unprotected vegetable or fish oil can substantially increase CLA content in milk of ruminants (Chilliard *et al.*, 2001). Compared with total mixed ration (TMR) diets, pasture-based diets have resulted in higher concentrations of unsaturated long-chain FA and CLA in milk (Kelly *et al.*, 1998). A substantial increase of milk fat CLA contents in dairy cattle after turning out to pasture were showed later in a series of experiments (Stockdale *et al.*, 2003; Kay *et al.*, 2004). Dhiman *et al.* (1999) observed a highly positive effect of fresh lush green pasture on CLA content.

The objective of this synthesis is to investigate the forage production of two annual grasses species (green barley and triticale) and their effects on milk production, composition and fatty acid profile of dairy ewes in the Tunisian sub-humid area.

II – Materials and methods

The experiment was carried out in the dairy experimental farm of the National Institute of Agricultural Research of Tunisia (INRAT) on 40 Sicilo-Sarde breed ewes. The average date of parturition was January 17th; lambs were weaned at 45 days of age. At this stage, ewes were divided into two homogeneous groups, 20 ewes each, according to age, parity and milk production (560 ml/day). Ewes of two groups were conducted during the day (from 10:00 to 15:00) on triticale and green barley pasture with rotational grazing system with a stocking rate of 20 ewes/ha. Indoors, ewes were lodged per groups which were complemented with 300 g of concentrate. The experiment lasted 70 days.

Ewes were milked daily at 06:30 and 16:30. Individual milk yield was recorded twice a month during the whole experimental period and individual milk samples (20 ml) were taken and kept (4°C) for analysis. Other milk samples were used for analysis of fatty acids composition. Grass weight was determined before entering each paddock by cutting 5 quadrates (1 m²) of pasture at 6 cm above the ground; total grass production was calculated according to sample weights and the paddock area. This operation occurred 5 times during the experimental period. After desiccation, the samples for each month were pooled and two sub-samples were taken for chemical analyses. The mean daily grass availability was calculated as the ratio of paddock grass production by ewes' number and by number of days spent in the paddock. Milk fat and protein were analyzed using a MilkoScan 4000 (Foss Electric, integrated Milk Testing). Methyl esters of FA were analyzed by gas chromatography (GC) (Shimadzu, Japan). The GC was equipped with flame ionization detector (FID) and Omega Wax fused silica capillary column (30 m × 0.25 mm i.d.); (Omega Wax; temperature limits: 50 °C - 280 °C; Oven: 50 °C (2 min) to 250 °C at 4 °C/min, hold 15 min). Chemical composition of foods was determined. Grass and concentrate samples were dried at 60 °C in a forced-air oven, ground through a 1-mm screen, and analyzed for DM (105 °C in a forced-air oven for 24 h) mineral content (450 °C for 8 h), crude fiber (Weende) and CP (Kjeldahl).

Data of milk yield, composition and fatty acid profile (twice a month for two and a half months), were analyzed as repeated measures using the mixed procedure of SAS (2000). The statistical model included: experimental diet, time of sampling and their interactions as fixed effects. Data recorded during pre experimental period (milk yield and composition) were used as covariates and included in the model.

III – Results and discussion

1. Forage production and chemical composition

Herbage production, chemical composition and nutritive value of green barley and triticale were reported in Table 1. The grass amount produced by the green barley during the first month of trial was 13.27 t fresh matter or 2.35 t DM/ha, while the triticale production was higher with 23.9 t fresh matter or 5.1 t DM/ha. For both species, an increase in herbage production was noted for the second month of trial with 24.2 t fresh matter, which corresponds to 5.7 t DM/ha and for the green barley grass production was 14.3 t of fresh matter or 2.5 t DM/ha. The dry matter forage production average was 2.4 and 5.4 t/ha for green barley and triticale respectively.

Organic matter (%) was higher for triticale than green barley with 93% vs 88.3% respectively. The crude fibre content was slightly higher for triticale than green barley (27.2% vs 26.3% respectively). While crude protein content was higher for green barley with 13.4% in comparison with triticale grass with a respective content of 10%. The crude protein was not below the level at which it could be considered deficient for ruminant nutrition (Norton, 1994).

Table 1. Forage production and chemical composition of diets

	Triticale	Green barley	Concentrate
Forage production (t DM/ha)	5.4	2.4	-
Dry matter (%)	23.7	22	93.5
Organic matter (%)	93	88.3	96
Crude fibre (%)	27.2	26.3	7.4
Crude protein (%)	10	13.4	15.8
Ash (%)	7	11.7	4
UF (kg/ DM)	-	-	1

2. Milk yield, composition and fatty acids profile

Milk yield per ewe per day, milk composition and fatty acids profile are reported in Table 2. Milk production was significantly higher for (T) group than (GB) one (540 vs 460 ml/day). Fat content (g/kg) was significantly higher for ewes fed triticale pasture than ewes fed green barley pasture (39.1 vs 33.6 g/kg respectively). While milk protein content didn't differ significantly between groups. In fact respective protein content was 26 vs 24 g/kg for (T) group and (GB) one respectively. These results may be explained by the fact that fat milk content depends of grass fibre which is digested in the rumen and which is directed towards the production of acetic acid which is the precursor of the milk fat. But for milk protein content, it depends of energy intake which was similarly for the two groups (Bocquier and Caja, 2001). For milk fatty acids profile. Stearic acid (C18:0) was significantly higher for (T) group than (GB) one (11 vs 8.5% respectively). Oleic acid (C18:1) was also higher for (T) group with 23% in comparison with (GB) one with 21.4%. The same tendency was observed for linoleic acid (C18:2 (n-6)) and linolenic acid (C18:3 (n-3)). In fact, C18:2 (n-6) content was significantly higher with 3.5% vs 1.7% for (T) group and (GB) one respectively. Milk from ewes fed triticale have a higher linolenic acid (C18:3 (n-3)) proportion than milk from ewes of (GB) group (0.9% vs 0.5 % respectively). Milk from ewes fed triticale have a higher percentage than milk from ewes fed green barley on poly unsaturated fatty acid (PUFA) with 6% vs 2.9% for (T) and (GB) respectively. Total unsaturated fatty acid (UFA) also was higher for (T) group than (GB) one with 28.7% vs 26.3% respectively. Conversely, CLA content was significantly higher for milk ewes fed green barley (GB) than for milk fed triticale pasture (T) one (7.3% vs 3.2 % respectively).

Table 2. Effect of grass species on milk yield, composition and fatty acids profile

	T	GB	ESM	Pr.>F
Milk yield (ml/day)	540	460	36	*
Fat yield (g/kg)	39,1	33,6	3	*
Protein yield (g/kg)	26	24	2	NS
C18:0	11	8,5	0,3	*
C18:1	23	21,4	0,6	*
C18:2 (n-6)	3,5	1,7	0,03	**
C18:3 (n-3)	0,9	0,5	0,02	**
UFA	28,7	26,3	0,7	NS
PUFA	6	2,9	0,5	***
SFA	64,5	66,8	1	NS
CLA	0,32	0,73	0,08	***

*P<0.05, **P<0.01, ***P<0.001, NS: non significant.

IV – Conclusions

The cultivated triticale pastures lead to a higher forage production during vegetative period in comparison with green barley. Besides triticale pastures seems conduct to produce healthier ewe's milk with higher content of PUFA, linoleic acid (n-6) and linolenic acid comparing to green barley except CLA percentage which the highest value was found in ewe's milk fed green barley.

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