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A preliminary nutritional assessment of six genotypes of tef (*Eragrostis tef*) as potential forage sources

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Global climate changes are pushing the search for valuable, alternative crops highly resistant to drought and other stress conditions. In this context, some promising forage sources can be found within plant species native to the tropical areas. Tef (*Eragrostis tef* [Zucc.], *Poaceae*) is a warm-season C4 tropical grass, traditionally grown for grain in Ethiopia and is adapted to a wide range of climatic and geographic regions. The aim of the present study was to assess and compare the chemical composition and nutritive value for ruminants of six genotypes of tef, grown as warm-season fodder crops under the Central Italy climatic conditions. On the 1st of June 2016, six tef genotypes (namely tef06-08, tef11 and tef13-14) were sown at a density of about 420 plants m⁻² in a meso-Mediterranean climatic area (Viterbo, Lazio, Italy) with a total water input of about 3,500 m⁻³ ha⁻¹, over the natural rainfall regime. Each genotype was seeded on 10 × 1.5 triplicate plots to be cut at two pre-heading stages (ct1, ct2) and at heading (ct3), starting from 21st of July till the 3rd of August. Proximate analysis was carried out on a total of 72 ground (1 mm) dry sub-samples. The CP contents of tef11 and tef14 (15.5 ± 0.55 and 15.1 ± 0.48% DM, respectively) were higher ($p < .01$) than those of the tef08 and tef13 genotypes (13.7 ± 0.32 and 13.3 ± 0.43% DM, respectively). The CP content was also affected by the cutting date and was higher ($p < .01$) at ct2, but not for all the tested genotypes due to a significant ($p < .05$) genotype × cutting date interaction. The NDF content (68.4% DM, overall mean) was not clearly affected by the genotype or cutting date. On the contrary, ADF was the lowest ($p < .01$) in ct1 plants (32.3 ± 0.63% DM) especially for the tef07-08 and tef13-14 genotypes. In comparison to ct1 and ct2 plants, lignin was higher ($p < .01$) at heading (ct3, 8.8 ± 0.5% DM). Cutting date also affected the ash and fat content for which the highest values were recorded in the ct2 (ash, 10.2 ± 0.2% DM) and ct3 (fat, 1.9 ± 0.1% DM) samples. The findings of this preliminary assessment suggest that tef can be regarded as a promising forage species also in meso-Mediterranean environments. Both the genotype

selection and the agronomic practices (*i.e.*, time of harvest) may play a role in ensuring to achieve the best productive and nutritional performance of this grass species. The nutritive value for ruminants of the crude proteins of tef, deserves further investigations.

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Evaluation of polyphenolic content and antioxidant activity in agri-food wastes and by-products using chemical and physiological extraction

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EU-28 produces about 100 Mtonnes/year of food waste, of which 40% is generated from agri-food industries. Agri-food waste (AFW) and by-products may contain components that could be valorised for their bioactivity. However, the bioaccessibility of these products is highly variable and dependent on a wide range of factors, including food matrix characteristics. Thus, the aim of this study was to determine the total phenolic content and the antioxidant capacity of some by-products and AFW using two different extraction methods. Twelve samples of by products (grape marc, *Camelina sativa* cake, olive pomace and whey) and 12 samples of AFW (fruits and vegetables waste FVW, citrus pulp, strawberry and orange dried) were processed using: methanol extraction (chemical procedure) and *in vitro* physiological extraction simulating pig gastro-intestinal tract adapted from Regmi et al., 2009. Soy and wheat were included as controls. Afterwards, the polyphenolic content was assessed by Folin–Ciocalteu assay while antioxidant capacity was determined by 2,2-Azino-bis-3-ethylbenzothiazoline-6-sulfonic Acid (ABTS) assay. Results obtained showed that the chemical extracts of by-products and AFW contain different amount of polyphenols; in particular, as expected, the grape marc showed the highest significant (4.5% w/w; $p < .05$) polyphenolic content compared to all samples considered. Of note, *Camelina sativa* cake, olive pomace, FVW, orange and strawberry dried showed a polyphenolic content of 1.3, 0.7, 1.3, 1.6 and 1.3% w/w, respectively. The antioxidant capacity of grape marc exhibited a higher ($p < .05$) value of 573.6 µmol Trolox equivalent (TE)/g compared to the other samples considered. *Camelina sativa* cake, olive pomace, FVW, orange and strawberry dried showed an antioxidant capacity of 29.2, 11.0, 28.4, 16.3 and 31.0 µmol TE/g. The physiological extraction of grape marcs, *Camelina sativa* cake, olive pomace, FVW, orange, strawberry dried yielded a polyphenolic content of 3.6, 1.8, 3.2, 3.6 and 2.3% w/w, respectively. The

antioxidant capacity showed a similar trend to polyphenolic content after physiological extraction. The results obtained in this study indicate that AFW and by-products could be considered a promising bioaccessible source of antioxidants and phenolic compounds with industrial applications for the production of ingredients to functionalize feedstuffs for monogastric animal.

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The effect of duration of storage and storage method on chemical composition and *in vitro* digestibility of complete calf pellet

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An experiment was conducted to determine the effect of duration of storage and method of storage on the quality of complete calf starter pellet. Pelleting was done in order to facilitate the handling, storage, transport, and to improve the efficiency and palatability of feed. The calf starter ingredients were yellow corn (50%), soybean meal (24.5%), ricebran (25%), and premix (0.5%). The calf starter (65%) was then mixed with chopped corn straw (35%), and pelleted using expired milk powder as pellet binder to form a complete calf starter diet. Samples of the complete diet were stored in sealed polyethylene plastic bags, fibre sacks or plastic silos, and kept for either 0, 2 or 4 months before they were opened and analysed for proximate chemical composition, dry matter (DM), organic matter (OM), crude protein, ether extract, crude fibre and *in vitro* digestibility. The data were analyzed using a two-way ANOVA based on a 3 × 3 factorial design. Statistical analysis of the data showed significant differences only for duration of storage effect ($p < .05$). The DM of complete calf pellet on 0, 2, 4 months of storage were 87.94%, 89.20%, 89.36%. The DM and OM digestibilities of complete calf pellet at 0, 2, 4 months of storage were 68.50%, 66.31%, 66.94% and 69.09%, 66.67%, 66.39%, respectively. The proximate composition, DM and OM digestibility were not significantly different ($p > .05$) on main effect of storage method. It can be concluded that the chemical composition of complete calf pellet increased from 0 to 2 months of storage, while the

digestibility of complete calf pellet decreased. The methods of storage (polyethylene plastic bag, fibre sacks, and plastic silo) had no effect on the quality of the complete calf pellet for at least 4 months storage.

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Effects of rumen fluid pH on rumen activity and quality and technological properties of milk

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Excess fermentation and accumulation of short chain fatty acids (SCFA) in the rumen is a frequent result of feeding dairy cows with high-grain diets. This allows to sustain increasing milk yield but has risen the risk of rumen acidosis. This study investigated the effects of rumen pH on milk composition traits, coagulation properties, cheese yield, and rumination activity (RA) of dairy cows. Rumen fluid samples were taken through rumenocentesis from 100 Holstein Friesian cows (5 to 75 days in milk - DIM) without clinical signs of disease kept in 2 herds, to determine pH and concentration of SCFA. Within the day of rumenocentesis individual milk samples were also taken from each cow. Further, RA was monitored using a microphone-based monitoring system (Ruminact, Milkline) fitted on cows, to record the time spent ruminating from 2 days before to 2 days after rumenocentesis. Data were analyzed using a linear mixed model including the fixed effects of parity and DIM class, the quartile of rumen fluid pH (QpH) and the random effect of herd-test date and also of cow when repeated observations per cow were analyzed. Rumen pH (5.98 ± 0.37) averaged 5.52 to 6.46 in the first to fourth quartile, respectively, with 32% of cows with rumen pH < 5.8 . The concentration (mmol/l) of total ruminal SCFA and the proportion (%) of propionic acid on rumen fluid linearly increased ($p < .05$) as rumen pH declined, whereas that of acetic acid linearly decreased. Whereas the average time spent ruminating during the day was similar in cows of different QpH (on average 26%, but with a clear circadian variation), the circadian rumination pattern was influenced by rumen fluid pH, and the RA linearly increased ($p < .05$) in the daily interval 06:00 to 12:00 as rumen pH declined. Cows of different QpH did not differentiate for body condition score and test day milk yield (36.6 ± 8.0 kg/d). Likewise, QpH did not affect ($p < 0.05$) milk pH, somatic cell count (SCC), fat, protein, lactose and casein milk content.