Monitoring CP usage in dairy cattle rations by using milk urea as indicator in a nitrate vulnerable area

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ABSTRACT

Milk urea concentration (MU) has been used as an indicator of nitrogen metabolism in ruminants. In particular, linear relationships between MU and protein percentage in diet (CP) or nitrogen excretion have been reported. Thus, the objective of this research was to study the dietary protein utilization of lactating dairy cows of the area of Arborea (Oristano, Sardinia, Italy), recently declared vulnerable to nitrates, by using MU as an indicator. The average milk yield in the province of Oristano is the highest in Italy. The area of study includes 5500 ha of this province, with about 16000 dairy cows, distributed in 163 dairy farms. A database (1733 monthly controls in 155 farms with 86±52 heads per farms) for this area was created by using the information recorded by the local dairy herd organization (APA; Associazione Provinciale Allevatori di Oristano, Italy). In particular, aggregate mean monthly records per each farm in the year 2006 on milk production, MU and milk protein concentration were considered. August data were collected in 35 farms only. The mean optimal MU value of 23.5 mg/dl was calculated based on the average of the values 10.3 and 11.7 mg/dl of milk urea nitrogen proposed, for zero predicted surplus of N, by Hof et al. (1997) and Nousiainen et al. (2004), respectively. A reference optimal MU range of 21 to 26 mg/dl was defined assuming a physiological variation of 2.5 mg/dl around this mean. Thus, MU values lower or higher than the reference range were considered an indication of diets with deficient and excessive protein supply, respectively, possibly associated to low N utilization efficiency for milk production.

High seasonal variation and significant differences between farms were observed. Milk production in the area of study for the year 2006 was 30.6±3.6 kg/d per cow, with the highest production in the last part of the winter and the lowest in summer. Milk protein content was 3.31±0.12%, being lower in the summer than in the other seasons. MU was on average 22.7±4.2 mg/dl, with a peak in July. Of the 155 farms considered, 13% had a year mean of MU <21 mg/dl, 9.3% had it >26 mg/dl, the rest was within the optimal range of 21-26 mg/dl. None of the farms had a yearly mean MU above 30 mg/dl. On the basis of the yearly farms means of MU, in the area of Arborea a mean dietary CP of 14.7% of DM (range 13.9%-15.6% of CP, DM basis) was estimated on the basis of the relationship: CP (g/kg of DM)=99.8+4.5xMU(mg/dl)/2.144 suggested by Nousiainen et al. (2004).

Considering the monthly MU means for each farm, for 25% of the months the farms had MU<21 mg/dl and for 20% of the months the farms had MU >26 mg/dl.

Within each season the highest milk yield occurred when MU was between 22 and 23 mg/dl.

In conclusion, the utilization of MU as a nutritional indicator of dietary CP concentration suggested that in the farms of Arborea the possibility of reducing N excretion of lactating dairy cows by nutritional means is very limited. Indeed, the results indicate that for 25% of the months there was probably a shortage of CP in the diets.

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Effects of pelleting on rumen fermentability of different commercial concentrate mixtures

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ABSTRACT

Pelleting (PLT), as many other processing techniques, can influence feeds nutritional traits and, in particular, their effective digestibility or the rate of digestibility. Research has shown that PLT effects on dietary performance can differ depending on technology and feed composition. A study was conducted to assess the effects on in vitro fermentability of PLT technique as performed in a commercial mill industry. Six commercial concentrate mixtures were used, 3 formulated for cattle and 3 for swine. Concentrates were steam pelleted, into 6 mm pellets those for cattle, into 4 mm pellets those for swine. Samples of each concentrate mixture were taken before and after pelletization and ground in a knife mill to pass a 1 mm sieve. In vitro gas production was performed by the transducers technique in triplicate for 24 hours, with gas intermediate controls at 2, 4, 8 and 14h. Cumulative gas productions were fitted by the monoexponential model \( y=b-ct \). Rumen liquid donors were two non lactating dairy cows fed a 10:90 concentrate:grass hay diet. Chemical composition of concentrates was analyzed by NIR technique. Cumulative gas production data were statistically evaluated by concentrate and time by SAS MIXED procedure using pelletization concentrate and time as factors in the model. Gas production rate data were statistically processed by SAS GLM procedure using. Statistical significance of the differences between the initial (C) and pelleted (P) meal was declared at P<0.05.

Concentrates ranged from 20 to 70% starch and from 10 to 35% CP (% D.M.). The effects of pelletization were not negligible but variable and depending on the mix formulation and chemical composition. Two mixtures that had corn meal as almost unique component had their initial fermentability significantly improved by PLT, but this effect disappeared after 8 h of incubation for the 6 mm PLT, whereas it remained evident till the fermentation end (24h) for the 4 mm PLT. For concentrates with intermediate levels of starch the gas production of the P was higher vs C only in the 4 mm pellets but not in the 6 mm ones: these differences can be likely attributable to the differences in the pressures and temperature reached during the two kind of processes. When PLT was effective, increase in 24 h cumulative gas production attributable to pelletization ranged from 5 to 12%, and the fermentation rate was increased, too. Further research seem worth to better define the technological conditions able to modify the in vitro feeds fermentability, in terms of effective fermentability and of rate of fermentation, as well as the consequences on in vivo animal performance.
Chemical composition and nutritive value of winter legume-cereal mixture silages

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Abstract

Sustainable improvements in profitability of dairy farms can be also achieved by increasing the dietary amounts of on-farm grown forages. Winter legume-cereal mixtures are cropping systems compatible with corn silage production, have low N requirements and provide forages rich in crude protein (CP). However, the energy and protein value of forages is highly dependent from type and combination of plants and the present experiment has the aim to examine the nutritive value of ensiled mixed forages, composed by one legume (peas or vetch, P and V, respectively) and one cereal (barley or triticale, B and T, respectively). Mixture of seeds obtained from combinations of one legume and one cereal (P-B, P-T, V-B and V-T in ratios of 50:50 and 40:60) were sown at the beginning of November in eight 10 m² plots at the ERSA “Ricchieri F.” experimental farm (Fiume Veneto, PN, Italy). All forages were collected at the beginning of June and a sample of about 2 kg of fresh material was immediately put in mini-silos, which were stored at room temperature. After 45 days, all silos were opened and the ensiled samples were used for pH measurement, dried in a forced air oven at 40°C and milled (1 mm screen). Each ensiled forages was analyzed for the chemical composition and for the in vitro neutral detergent fiber and CP degradability (NDFD and CPD, respectively) with the DaisyII200 Ankom system (Tech. Co., Fairport, NY, USA). Data were analyzed with a two factorial model, which considered the cereal and legume types as factors and their interaction. The interaction between cereal and legume types was never significant and therefore only main effects was discussed. All forages were well ensiled as indicated by the low levels of pH measured after ensiling (3.9-4.2). Forages were quite similar in respect to the type of cereal (B vs T) and the only significant differences (P<0.01) were the higher CP content and the lower NDFD of B based forages than T mixtures (15.1 vs. 13.4% DM and 35.6 vs. 41.5%, respectively). These results were the consequence of a moderate predominance of legumes when they were associated with B, while the mixtures with T were more balanced. On the contrary there were several statistical differences between the types of legume mixtures. The V based forages had lower contents of DM and higher ash levels than the P forages mixtures (21.3 vs 33.3% and 11.4 vs 9.0% DM, respectively, P<0.01). These results indicated an immature vegetative stage and a wiggling behavior of the V forages at harvesting, which also showed a net predominance of the legume in respect to the cereal. In fact, P mixtures showed a more balanced development of cereal and legume than V forages, as was demonstrated by the lower content of CP (12.2 vs 16.3, % DM, P<0.01), NDF concentration (48.0 vs 53.3% DM, respectively, P<0.01) and by the higher starch content (28.8 vs 16.5, %DM, P<0.01). In vitro degradability data confirmed the high CPD of P based forages (55.4 vs. 46.0%), which also showed an higher NDFD (41.7 vs. 35.4%) than V mixtures. Overall, the estimated lactation net energy content of P based forages was around 20% higher than the V mixtures (5.15 vs 4.27 MJ/kg DM, P<0.01).

Winter legume-cereal mixtures (45:55 an average) differed mainly for the legume sources, having the forages containing P an equilibrate development of both plants, with an appreciable high energy value. Forages containing V were high in CP but showed a net predominance of the legume over the cereal.
Performance of growing-finishing Nero Siciliano pigs fed two different protein levels

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ABSTRACT

Productive performance as well as carcass and meat characteristics are influenced by different factors; among these, the quantitative and qualitative aspects of the feeding should be considered for the important correlation between genotype and nutritive requirements. Moreover, a feeding nutrients surplus could mean: high production costs, metabolic diseases, and lowering of quality of meat. The aim of this study was to evaluate the influence of two different protein levels of the diet on the productive performances of the Nero Siciliano pig in order to a better definition of the protein requirements for this autochthonous breed. The study was carried out on 20 “Nero Siciliano” pigs, 12 castrated males and 8 females, selected in a larger group of the animals living in extensive condition in the Nebrodi mountain areas (Messina – Italy). Animals were divided into two homogeneous groups for number (10 subjects), sex (6 males and 4 females), age (8 months) and live weight (43.94±3 kg) and housed in two collective loose pens of 1400m² in the Nebrodi mountains, where were reared in plein air system. Groups received a pelleted complete feed, rationed on the basis of 3% of the live weight, and they were denominated “Low Protein LP” (CP15%; Lysine 0.77%, as fed) and “High Protein-HP” (CP17%; Lysine 0.90%, as fed) in relation to the protein level of the two diets, which were isocaloric (3.1 Mcal of DE/Kg). The trial lasted 80 days. Pigs were slaughtered after fasting of 18 hours. Yield and lean percentages of the carcasses were determined, the latter by Fat-o-Meter (FOM). After 24 hours of refrigeration (4°C), the right half carcass of each animal for group was dissected according to the official method into lean cuts, fat cuts and bone cuts. Data were subjected to ANOVA considering two variables: protein level and sex. No significant difference was observed in relation to the variable sex. As regards in vitam performances in relation to the protein level of the diet, no significant difference for the Final Live Weight (LP 85.32 vs. HP 87.98 Kg; P=0.156) and Average Daily Gain (LP 510 vs. HP 531 g/d; P=0.22) was observed. Concerning post mortem performances, carcass weight (LP 67.00 vs. HP 69.00 Kg; P=0.20), yield (LP 78.58 vs. HP 78.47%; P=0.216) and lean meat – FOM (LP 42.26 vs. HP 42.17%; P=0.470) showed similar values. Half carcass weights at 4°C (LP 31.14 vs. HP 33.97 Kg; P=0.089) and carcass composition showed no significant differences, for the lean cuts (LP 52.22 vs. HP 50.49%; P=0.142), specifically for loin (LP 13.24 vs. HP 12.78%), ham (LP 18.01 vs. HP 17.65%), shoulder (LP 13.39 vs. HP 12.43%) and neck (LP 7.58 vs. HP 7.63%), for the fat cuts (LP 37.42 vs. HP 37.72%; P=0.420), specifically for belly (LP 15.83 vs. HP 16.77%), backfat (LP 14.37 vs. HP 14.09%), jowl (LP 3.53 vs. HP 3.45%) and flare fat (LP 3.68 vs. HP 3.41%), and for bone cuts (LP 9.86 vs. HP 9.51%; P=0.230), specifically for head (LP 7.68 vs. HP 7.31%), feet (LP 1.99 vs. HP 1.98%) and tail (LP 0.19 vs. HP 0.21%). Results, according to the observations of Acciaioli and Pianaccioli (2004) on performances of Cinta Senese pig fed different protein levels, show that a dietary protein level of 15% seems to satisfy the pig requirement without compromising performances and carcass composition. Moreover, low protein level in the diet means reduction of the amounts of nitrogen excreted both in faeces and in urine, therefore, benefits in terms of pollution control as well as in the cost of the diet.
Comparison of ACE inhibitor effect in cow, buffalo and goat milk by *in silico* and *in vitro* digestion of caseins

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**ABSTRACT**

Angiotensin I-converting enzyme (ACE) is one of the key enzymes in the regulation of blood pressure. ACE converts a decapeptide, Angiotensin I, into the potent vasoconstrictor octapeptide, Angiotensin II, and inactivates the vasodilator bradykinin. ACE inhibitory (ACEi) peptides are encrypted in inactive form within the sequences of milk protein. These ACEi peptides may induce hypotensive effect when released during gastro-intestinal digestion. The aim of the research was to relate the activity of ACEi peptides with intraspecies and interspecies casein haplotype variability in *Bos taurus* (BT) and *Capra hircus* (CH) and interspecies in *Bubalus bubalis* (BB). The research included both *in silico* and *in vitro* analysis. The casein peptide composition of nine, five and one haplotypes in *B. taurus*, *C. hircus* and *B. bubalis* respectively was obtained by *in silico* gastrointestinal digestion using pepsin, chymotrypsin and trypsin. The Biopep database and literature ACE inhibition values for each casein peptide were utilized *in silico* to estimate the efficiency of ACE inhibition (EAI) for each haplotype in the three species. The EAI for each haplotype was calculated with the following formula: \( \text{IC}_{50} = \text{concentration of each peptide able to inhibit 50\% the ACE activity; } n = \text{number of peptides deriving from each haplotype).} \)

The *in silico* gastro-intestinal digestion released from 136 to 139 peptides for the BT haplotypes and 131 peptides for both BB and CH haplotypes. Of these total peptides only for 23 peptides IC\(_{50}\) values were in Biopep Database and literature. The 23 peptides within the haplotypes of the three species were as following distributed: one was found only in BB and two were found only in CH, one was shared by BB and CH, four were shared by BB and BT and 15 were shared by the three species. Within both BT and CH species the haplotypes differed only for same peptides with unknown ACEi values. Only in BT one haplotype differed from the other eight for an additional copy of QK peptide belonged to the 23 peptides with known ACEi values.

The values of the EAI by *in silico* calculation showed omissible variability between the nine BT haplotypes ranging from 0.448 to 0.449 and was 0.445 for BB haplotype, while resulted 0.319 for each of the five CH haplotypes.

The *in vitro* study was carried out to test the effect of complete casein peptides composition obtained by gastrointestinal digestion of casein from eight different Holstein Friesian genotypes on ACEi values. The ACEi values was estimated by Cushman and Cheung assay. A higher variability in the *in vitro* ACEi values between the eight genotypes was observed. Moreover, the peptides as above obtained, were fractionated by HPLC and their profile were observed for each genotype.
Forage quality and nutritive value of several warm-season grasses species in a Mediterranean area

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ABSTRACT

In Mediterranean area, fodder production is tightly reduced by climate conditions and the uneven seasonal variation in herbage production, which appear to be the major factors limiting the utilization of pasture and hence the profitability of different livestock systems. This issue might be overcome by introducing in Mediterranean environment species characterized by maximum dry matter production during warmer months. The warm-season grasses are C₄ species with germination characteristics, temperature requirements for growth and photosynthetic pathway different from cool-season grasses or C₃ species. In Mediterranean environment, growth of cool-season species occurs mainly in the cooler month, spring and autumn, while growth of warm-season species occurs mainly during the warmer period. Hence, the warm-season grasses species can provide green forage for livestock throughout the hot and dry Mediterranean summer, when cool-season grasses are less productive. The objective of this research was to assess the chemical composition and nutritive value of several warm-season grasses grown in Southern Italy and to evaluate whether their use would meet the nutritional requirements of animals to reduce the concentrate supplementation indoor. The research was carried out over a 4-year period in Policoro (MT), southern Italy (40°02’ N, 16°55’ E; 15 m a.s.l.). Seven warm-season grasses species (Chloris gayana, Eragrostis curvula, Panicum coloratum, Paspalum dilatatum, Pennisetum clandestinum, Sorghum almum and Sorghum spp. hybrid) together with a control specie (Festuca arundinacea) were chosen for studying their chemical composition, nutritive value and production of UFL per ha. Harvested biomass was collected at flowering stage to determine its fresh and dry matter (DM) yields. Sub samples were analysed for crude protein, crude fibre, ether extract, ash, neutral detergent fibre, acid detergent fibre, acid detergent lignin and organic matter digestibility. Forage units for milk (UFL) were estimated. The mean annual dry matter yields for higher yielding species showed values ranging from 16.4 to 21.1 t/ha, these being on average 28% higher than the control. Chemical composition, nutritive value and UFL production per ha were different among species. Pennisetum clandestinum and Chloris gayana showed the highest crude protein content compared to control specie (152.3 and 130.8 g/kg DM vs 127.3 g/kg DM). Pennisetum clandestinum exhibited lower fibre fraction and higher digestibility compared to other warm-season grasses. Production of UFL per ha of the warm-season species was, on average, 24% higher than the control (Festuca arundinacea), with Eragrostis curvula and Pennisetum clandestinum that showed the highest UFL production, these being on average 37.5% higher than Festuca arundinacea. Equally interesting were Sorghum almum and Chloris gayana, intermediate in terms of quality and UFL production. Results suggest that such species are attractive in that they have the potential to supply hay or grazing, as well as, energy and protein for animals reared in Mediterranean systems in summer when cool-season species are less productive.
In vitro pig digestibility of protein rich feeds processed by different systems

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ABSTRACT

In animal feeding, several protein-rich feeds, in addition to soy, are frequently processed prior to use, and such treatments can influence their nutritive value and their role in the diet. Therefore, for these feeds, it is important to consider the influence of some technological processing methods on protein digestibility.

Applying the method proposed by Boisen (1991), HCl pepsin and pancreatin incubations, chosen among several as one of the most reliable (Spanghero et al., 1998), the crude protein digestibility was determined in vitro on five feeds: soybean seeds, soybean meal, field pea seeds, horse bean seeds and maize grain. The latter was chosen as standard feed with low protein and high starch contents. All the feeds underwent the following nine treatments: flaking, expanding and extrusion in industrial equipments; dry heating at 150°C for 15 min or for 30 min or at 150°C/30 min with addition of xylose at 1% w/w; addition of NaOH at 4% w/w; microwave irradiation (800 W) for 6 or 9 min.

The global mean of protein digestibility (dCP) of all the samples of feeds (raw or processed by different methods) registered a high digestibility with the exception of maize: 89.8, 91.6, 90.8, 86.8 and 76.1% for soybean seeds, soybean meal, field pea seeds, horse bean seeds and maize grain, respectively. Looking at the processing methods, it must be underlined that expansion and extrusion numerically improved protein digestibility in comparison with the corresponding unprocessed feed for all the five feeds. Considering the four proteic feeds, the highest dCP improvement was attained by expansion on soybean seeds (+7.3 percent units vs the crude feed). Flaking showed a less consistent effect. Maize registered the highest dCP improvement with flaking, expanding and extrusion, but it must be noticed that it had the lowest dCP starting value.

Considering the heat treatments, the trend is a negative effect on dCP. The available analyses reveal an increase in the fibre bound protein in the feeds treated at high temperatures and this might explain the lower digestibility of the protein fraction. Xylose worsened dCP in most feeds, whilst NaOH had a positive effect on it, except for soybean. Finally, the two treatments by microwaves had a slight positive influence on dCP.

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Digestibility and nitrogen balance of diets based on faba bean, pea seeds and soybean meal in sheep

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ABSTRACT

Three digestibility and nitrogen balance trials were carried out to estimate nutritive value of Faba bean (Vicia faba minor) and Pea (Pisum sativum) seeds in comparison to soybean meal in sheep. In each trial 3 diets fed 6 Sarda breed wethers using a two replicated 3x3 Latin Square design. The first trial consisted of 2 level of Faba bean: 20% (FB 20) and 38% (FB 38) as fed ingredient with 13.8% and 17% CP diet content on DM basis, respectively, vs a level of soybean meal (S1: 15.8% CP, DM basis). The second trial consisted in 2 level of Pea seeds: 23% (P23) and 48% (P48) as fed ingredient with 12.6% and 15.2% CP diet content on DM basis, respectively, vs a level of soybean meal (S2: 14.5% CP, DM basis). Medium quality natural meadow hay completed diets of the first and the second trial. In the third trial, animals were fed 3 isonitrogenous (CP % content - FB: 16.2, P: 16.5 and S: 16.4) and isocaloric diets. The diets consisted of good quality alfalfa hay and 3 mixed feeds characterized by the presence of only one of the 3 protein sources to study. Mineral-vitamin premix and different proportions of maize and dehydrated beet pulp supplemented mixed feeds. These 3 diets were formulated to fed lactating ewes in a successive experimental trial to verify their effects on milk production. The high content of Faba bean and Pea seeds, in the first two trials, didn’t show animal palatability problems. In the first trial, the highest organic matter digestibility % (OMD) resulted for FB38 diet (71.3A FB20, 75.8B FB38, 71.2A S1). Crude protein digestibility % (CPD) data showed the highest values in diets with the highest CP content: FB38 and S1 (73.3A FB20, 78.0B FB38, 76.8Ba S1); the same two diets showed the highest g/d retained N (7.7a FB20, 9.0b FB38, 9.2b S1). In the second trial, P48 diet showed highest OMD % (69.7A P23, 76.2a P48, 74.7B 67.5a S2) and g/d retained N (2.8 P23, 3.8 P48, 3.8 S2, g/d). In the third trial, CP % of pea diet showed the highest value (FB: 78.04a, P: 80.4b and S: 78.7ab) but in N balance the same diet showed the lowest retained N value (FB: 4.6, P: 3.4a and S: 5.4b, g/d). Also in OMD % pea diet showed the highest value and FB diet the lowest (FB: 75.7a, P: 77.5ab and S: 76.7a). In conclusion, in the present study, small differences, significant or not, in digestibility and N balance were observed among diets due to protein sources. Although further studies are necessary, Faba bean and Pea seeds appear to be valid substitutes of soybean meal in sheep considering some known limits to use this feed (OGM, solvent extr.), farm management (self sufficiency) or economic reason (debit balance).
Blood methionine concentration in dairy cows supplemented with rumen-protected methionine or two methionine hydroxy analogs

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ABSTRACT

Bioavailability of methionine (Met) of three commercial supplements was assessed in three lactating dairy cows by a standardized blood plasma test. A spot dose of rumen-protected D,L-Met (SmartamineMTM or SM; 65.4 g/cow/day), Met hydroxy analog (Alimet® or AL; 57.5 g/cow/day) and its iso-propyl ester (MetaSmart or MT; 88.5 g/cow/day) were fed daily (9:00h) by oral bolus, providing 50 g/cow/day of D,L-Met, to 3 cows in a Latin square design. Blood samples were obtained by jugular venipunctures the day before (day 0) and five days after (day 5) the treatment at 9:30h, 13:00h and 17:00h and plasma was harvested. On day 0, the Met concentration was similar among treatments. At day 5, the plasma Met was increased with a different response ($P<0.05$) among treatments: +285.8% for SM (89.67 versus 23.79 μmol/L, respectively), +167.2% (55.62 versus 21.60 μmol/L, respectively) for MT and +50.9% for AL (35.07 versus 23.19 μmol/L, respectively). According to our results, the MT and AL might be considered as a Met supplementation alternative to SM in view of the cost/effect (bioavailability) of products.
Organic farming: use of chickpeas (*Cicer arietinum*) in Maremmana young bull diets

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ABSTRACT

Development of feeding strategies based on the on farm available feed resources is one of the research efforts for organic livestock production. This problem is particularly relevant in marginal beef production areas of central and southern Italy, where traditionally local breeds are used and diets are based on home grown cereal with scarce or no use of expensive organic protein source. The present study aims to evaluate the effects of dietary inclusion of home grown chickpea (*Cicer arietinum*) on growth performance and carcass characteristics of Maremmana young bulls, organically farmed. The study was conduced in an extensive farm located in Viterbo province, in central Italy. Twelve Maremmana bulls (232 kg average live weight, 9 months of age) were allotted into two homogenous groups. The control group was fed the same diets used by the farmer prior to the experiment, based on barley meal (on average 1.6 kg/d, min 1.5, max 1.8), maize meal (on average 3.2 kg/d, min 1.3, max 4.5) and alfalfa hay (on average 6.4 kg/d, min 4.5, max 8.0); four diets were used throughout the study. The experimental group was fed diets in which barley meal was substituted by chickpea meal. The dietary content of chickpea ranged from 23 to 11% (as fed basis). The average hay/concentrate ratio of diets was 60/40. The nutritive characteristics of the diets were, on average, 0.82 vs 0.83 Meat FU/kg DM and 11.0 vs 12.7 CP %DM, for control and experimental diets, respectively. Diets were not designed to be isocaloric or isonitrogenous, but to assess the effect of dietary inclusion of a protein source on performance of Maremmana bulls. Animals were held in feedlot pens, were weighted at the age of 9 months and thereafter every two weeks until to the fixed slaughter weight of 630 kg. Carcasses were scored for carcass conformation and fat score, according to SEUROP grading system. Average growth curves were calculated by the regression of weights against time. The growth curves showed a good fit to a linear -regression model (control group R²=0.94, b=0.009455; experimental group R²=0.93, b=0.0112018). Chickpea-fed bulls showed higher live weight from the age of 410 days onward. This finding is consistent with the high average daily gain (945 vs 1120 g day⁻¹ for the control and experimental groups, respectively) and the younger slaughter age (675 vs 630 d) observed for chickpea-fed group. No differences were observed for carcass weight and dressing percentage (cold carcass weight/slaughter weight). Carcasses from bulls fed chickpea were graded as R (100%) in the SEUROP scale with a fat score of 3 (50%) and 4 (50%). Control carcasses were graded as R (40%) and O (60%) in the SEUROP scale with a fat score of 3 (50%) and 2 (50%). The higher fattening score of chickpea fed bulls suggests that some attention should be paid to the energy intake in last phase of finishing in order to prevent excessive fat deposition. Although, the chickpea cost was higher than that of barley, the estimated dietary costs were lower for chickpea-fed bulls, which reached slaughter weight 45 days before the control group. Overall, the use of home grown chickpea in organic diets for young bulls could be an advantageous choice for animal performance, feeding cost, crop rotation and sustainability.

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The milk urea content in dairy goat farms of Lombardy

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ABSTRACT

The measurements of milk urea concentration can be used as a diagnostic tool of protein feeding in the dairy cow, providing also accurate prediction of urinary N excretion. For the dairy goat only a few studies have considered the milk urea content in order to diagnose the protein nutritional status, and the sole indication we have found of a “normal” level is the one reported by of Brun-Bellut et al. (1991) who indicate a range of 28-32 mg/dl. The “normal” baseline for bulk cow milk urea concentration ranges from 17-26 to 21-30 mg/dl.

In this work we studied the trend of bulk milk urea level (MUL) during three consecutive years (2005-2007) in the dairy goat farms (n=118, on average) of Lombardy involved in the project “Quality of Goat Milk”. This project, funded by Lombardy Region, was carried out by the Technical Assistance Service for goat and sheep Farms (SATA) of Lombardy.

Bulk milk samples (n=2792) were analysed monthly (8 samples per farm and year, on average). Milk urea concentration was determined by differential pH-metry (EFA 2000 - Hamilton, Bonaduz, Switzerland). Milk fat, crude protein, casein (since July 2007) and lactose content were determined by an automated Fourier Transform infrared analysis (FT IR 6000, FOSS A/S, Denmark), while the counts of somatic cells were performed by means of flow cytometry with Fossomatic 5000 FC (FOSS A/S, Denmark). Data were statistically analysed by ANOVA, with year, month and farm as main effects, and by simple or multiple regression, using GLM and REG procedures of SAS (2000).

MUL was influenced (P<0.001) by the year: the Least Square Means of MUL were 39.2, 39.9 and 41.2 mg/dl, for 2005, 2006 and 2007, respectively. The variability observed was very high (Range=68.8; SD=11.2) but it resulted independent from the level of production of the herds. For the last two years it was possible to divide the farms into two different systems of breeding: natural breeding season (NBS) (85% of the farms) vs controlled breeding season (CBS). With NBS the MUL increased after kidding season (Jan-Feb-Mar) from 34 to 40 mg/dl, reaching a peak from April to June (44) and then it decreased until November (37). The regression between MUL and the other milk chemical constituents (fat, crude protein, lactose) and SCC (expressed as linear score - LS), had always determination coefficients lower to 0.01. On the other hand, multiple regression analysis (Stepwise method) between casein (% CP) and crude protein, LS and urea, resulted statistically significant with a model R-square of 0.40 and partial R-square of the independent variables of 0.344, 0.033 and 0.026, respectively. The equation obtained is as follows:

\[ \text{Casein (\%CP)} = 2.51 \times \text{CP(\%)} - 0.28 \times \text{LS} - 0.024 \times \text{UREA(mg/dl)} + 68.5; (n=330, R^2=0.40; P<0.0001). \]

About 75% of the bulk milk urea content in dairy goat farms of Lombardy is higher than the standard level suggested by Brun-Bellut et al. (1991). The average CP content of the diets predicted from the average MUL registered, would be 18-19% on DM, applying the prevision equation proposed by Bonanno et al. (2008). This protein content is well above requirements and the implications in terms of N excretion and even animal welfare, are evident. Further research is needed in order to correctly diagnose the protein nutritional status of the dairy goat.
Evaluation of different models for the prediction of dry matter intake in lactating goats

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ABSTRACT

The prediction of voluntary dry matter intake (DMI) by animals is very important to formulate correct rations, to increase production and to guarantee animal welfare. Particularly, for lactating ruminants DMI is the main determinant of nutrients supply.

In this work we evaluated the precision and the accuracy of regression equations of some models for the prediction of DMI in dairy goats after the peak of lactation.

The independent variables of the considered models were live weight (LW), raw milk yield (RMY) or 3.5% fat corrected milk (FCM). The prediction equations are as follows:

- eq. 1 (INRA, 1988): \( DMI(g/d) = 13.3 \cdot LW(kg) + 305.2 \cdot FCM(kg/d) + 533 \);
- eq. 2 (Sauvant et al., 1991): \( DMI(g/d) = 13.3 \cdot LW(kg) + 305.2 \cdot RMY(kg/d) + 533 \);
- eq. 3 (AFRC, 1998): \( DMI(g/d) = 62 \cdot LW^{0.75}(kg) + 305 \cdot FCM(kg/d) \);
- eq. 4 (INRA, 2007): \( DMI(g/d) = 16.5 \cdot LW(kg) + 321.4 \cdot FCM(kg/d) + 423.3 \).

Equations 1 and 4 have been extrapolated from the nutrient requirements tables reported in INRA (1988; 2007) publications. Equations 1 and 2 differ only for the milk production independent variable; the AFRC equation is based on INRA (1988).

The dataset used to evaluate these equations consisted of 113 individual observations derived from 6 in vivo digestibility trials (18 diets), carried out with goats kept in metabolic cages.

The Model Evaluation System 3.1.3 software was used for statistical analysis. Observed (Y) and predicted (X) DMI were expressed as kg/d. Moreover, a multiple regression analysis (Stepwise method) was performed on the following independent variables: LW, LW\(^{0.75}\), RMY, FCM, days in milk (DIM).

INRA equation (2007) resulted the most precise (\( R^2 = 0.62 \)) and accurate (Lin’s accuracy, \( C_b = 0.999 \) and Root of Mean Square Error of Prediction, \( RMSEP = 0.216 \)) for the prediction of DMI; mean bias (\( MB = 0.012 \)), approximately the 0.5% of model predicted DMI, evidences a very slight underprediction of this model; \( RMSEP (9.3\% \ of \ the \ observed \ mean) \) was mainly due to random errors (percent of decompositions of MSE, \( U_R: 89.8\% \)) and partially to systematic bias (percent of decompositions of MSE, \( U_S: 9.9\% \)). INRA equation (1988) was as precise as INRA equation (2007) but it was less accurate (\( C_b = 0.927 \)), whilst the equation proposed by Sauvant et al. (1991) revealed a good accuracy (0.989) but a reduced precision (\( R^2 = 0.49 \)). The AFRC equation (1998) showed the worst accuracy (\( C_b = 0.907 \) and \( RMSEP = 0.259 \)) and, as a result, the RMSEP was mainly due to means bias (percent of decompositions of MSE, \( U_M: 32.1\% \)).

The equation determined by multiple regression analysis was the following:

\( DMI(g/d) = 4.74 \cdot LW + 329 \cdot FCM + 4.85 \cdot DIM + 558; \) (\( n = 113; \ R^2 = 0.72; \ RSD = 178; \ P < 0.001 \)).

The partial \( R^2 \) were: 0.61 (FCM, \( P < 0.001 \)), 0.10 (DIM, \( P < 0.001 \)) and 0.06 (LW, \( P = 0.14 \)).

On the basis of this equation, the length of lactation seems to be another important factor to be considered in the DMI prediction also after the peak of lactation.
Determination of Silymarin “in vitro ruminal degradability” by HPLC/ESI/MS method

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ABSTRACT

Silymarin is a poliphenolic compound extract from Silybum marianum and Cynara cardunculus seeds, fruits and leaves, composed by the flavonolignans silybin and isosilybin (the most bioactive compounds), silydianin and silychristin. Silymarin complex is known for its hepatoprotective activities and for its antioxidant activity. Other properties are the inhibition of lipid peroxidation the stimulation of hepatic detoxification, the retrenchment of glutathione into the hepatocytes, the anti-inflammatory action and the increase of protein synthesis into the hepatocytes. Experimental trials in dairy cattle pointed out that ration silymarin supplementation improves animal productive performances and health status. Even if many information are available regarding pharmacodynamics and pharmacokinetic in humans and animals, only a few researcher evaluated ruminal behaviour of silymarin. The aim of the present work was the study of Silymarin in vitro ruminal degradability. The digestion phase was conducted as reported by Goering and Van Soest (1970) using flask containing 0.5 grams of standard alfalfa forage as bacterial substrate. Each flask was treated with about 3 or 15 mg of silymarin. Both flasks supplemented with 3 and 15 mg of silymarin were run in duplicate and incubated for 0, 2, 6, 12 and 24 hours, for a total of 20 unit. At the end of the digestion phase, flasks were frozen at -20°C and the content lyophilised. Each sample was then extract with methanol at environmental temperature, filtered and analyzed by HPLC-MS (HPLC: C18 column at 40°C, 1ml/min; MS: ESI neg., Capillar : 2.50, Cone: 28, Extractor: 2, Source: Temp. 150°, P: 80, Desolvation: Temp. 180°C, P: 600).

Flask containing an initial dose of about 3 mg of silymarin showed final content of 2.65, 3.19, 3.73, 3.94 and 2.75 at 0, 2, 6, 12 and 24 hours of fermentation respectively, while at the same intervals, flask initially treated with 15 mg showed a content of 13.75, 14.40, 20.39, 14.73 and 13.01 mg of silymarin. Despite some little variation from the initial flask content, these data demonstrate that silymarin is undegradable in rumen fluid after in vitro fermentation.
Effect of conjugated linoleic acid supplementation on energy balance and efficiency during transition period of dairy cows

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ABSTRACT

Transition period of high yielding dairy cows is often characterized by serious metabolic problems, often related to an excessive negative energy balance (NEB) status. NEB attenuation at the beginning of lactation seems useful to improve both health status and cow’s longevity. CLA (conjugated linoleic acid) is an isomers’ family quoted to reduce milk fat content (e.g. energy output) and seems also suitable to attenuate inflammatory phenomena. Aiming to reduce the severity of NEB around calving, 20 g/d of CLA (50% c9t11 and 50% t10c12 isomers; LUTA-CLA® 20P, BASF, Germany) were fed to 4 pluriparous cows from -28 to +28 days from calving to evaluate effects on performance, energy balance, energy feed efficiency (EFE) and metabolism. An analogous group fed with the same amount of fatty acids without CLA was used as control. Cows were monitored for: health, feed intake (DMI), milk production and rectal temperature (daily), milk quality and metabolic profile (twice a week). Feeds were analysed at each batch or monthly (corn silage) and EFE was weekly evaluated for each cow till 56 days in milk (DIM). Data were statistically analysed as repeated measures of variance model, including group, DIM and group by DIM interaction as fixed effects. In the first 28 DIM, cows fed the diet (0.88 UFL/kg DM and 14.3 CP, 18.5 starch, 39.0 NDF, all in % on DM) with CLA showed a trend for a lower BCS reduction (-0.26 vs -0.35 points; NS) and for a slightly higher DMI (19.25 vs 18.17 kg/d; NS) while their milk yield (34.2 vs 35.8 kg/d; NS) and fat content (3.9 vs 4.3%; P<0.05) resulted lower. However, the effect on milk fat grew till the end of treatment (2.8 vs 3.7% of CTR at 28th DIM). CLA cows showed also a lower rectal temperature between 0 and 21 DIM (38.7 vs 39.0°C; P<0.01) and, at blood level (first 7 DIM), higher glucose and lower BHB (P<0.10); similar level of positive acute phase proteins, while a better trend of negative ones (albumin and cholesterol within 1-28 DIM). In the first 3-4 weeks after calving, CLA determined a better NEB, as confirmed by the higher glycaemia, higher DMI, despite slightly lower milk yield and lower body losses. The higher DMI and/or the lower milk yield in CLA cows, probably, allowed a higher glucose availability and likely justified the better lipids oxidation with a lower ketone bodies production. With treatment end, CLA group maintained a lower milk yield level, but milk fat raised to a similar level of CTR within 10 days and DMI became slightly lower than CTR, thus NEB showed a very slight improvement. EFE was estimated with several methods. Despite at the beginning of lactation the absolute levels of EFE indices are influenced by body reserves mobilization, which is difficult to estimate, all EFE were lower in CLA within 7-28 DIM (P<0.05): milk efficiency (1.7 vs 2.0 kg corrected milk yield/kg of DMI), raw efficiency (0.82 vs 0.96 milk energy/feed energy) and net efficiency (1.15 vs 1.35 milk energy/[feed energy-maintenance energy]). Considering the mobilized body reserves, EFE difference between groups remained, but to a lower extent. Suspending CLA administration, EFE quickly raised for the milk fat increase and became similar to CTR one. Then, CLA determined an EFE worsening, likely for an energy expenditure increase, as previously observed in monogastrics. Despite more and wider trials are required, CLA seems to have promising effect in periparturient cows, e.g. NEB improvement immediately after calving. EFE worsening after 7th DIM could however suggest a shorter time of supplementation after calving.

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Effect of high oral doses of Nitrate on salivary recyrculation of nitrates and nitrites in young pigs

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ABSTRACT

Nitrate ingested with the diet is absorbed in the small intestine, recycled to the mouth, via the salivary gland, and reduced to nitrite by oral reducing bacteria. On the return to the stomach, the acid luminal environment improves its non-immune system mediated mechanism of defence against gastrointestinal and oral pathogens (Duncan et al., 1997). However, in previous research, we observed that in pigs with moderate dietary addition of nitrate (up to 150 mg/kg KNO₃) the recycling to saliva is modest. Our aim was to assess if higher levels of recycling of nitrate into saliva, and of conversion of nitrate to nitrite, can be obtained by supplying the feed with two high doses of nitrate, respectively for one or two weeks.

We performed two trials. In trial 1 (acute dose) we used 6 piglets 42d old. All piglets received one dose of nitrate added in 100g of a commercial diet (2.45 % KNO₃). We collected blood plasma and saliva at 0, 1 and 6 hours from the meal. In trial 2 (chronic dose) we used 6 piglets 42d old divided in two groups (3 subjects each), fed for two weeks with a basal diet or with the basal diet added with 1.22% of KNO₃. Every week we collected blood serum and saliva (d7 and d14).

In trial 1, the nitrate concentration in serum and saliva increased after nitrate ingestion (averagely about 15 times, 1h+6h Vs 0h, P<0.01), while the orthogonal contrast between 1h Vs 6h showed a significant reduction of nitrate in both the samples after 6h (~49% and ~47% respectively, P<0.01). Moreover, after nitrate ingestion, salivary concentration of nitrite increased (+7 times, 1h+6h Vs 0h, P<0.01), but the orthogonal contrast between 1h Vs 6h showed a significant increase of salivary nitrite concentration after 6h from the nitrate ingestion (+48%, P=0.01).

In trial 2, for the whole period of the trial, the piglets did not show any signs of disease. There was a significant effect of the diet on the nitrate and nitrite concentration in serum and saliva. In blood serum, from d0, nitrate after 1 week of trial peaked in the treated group (12 times the control), then it decreased, but maintained the same ratio respect to the control. In saliva, nitrate concentration increased from d0 to the end of the trial (8 times the control). Conversely salivary nitrite was higher after 1 week of trial (7 times the control) but decreased significantly after 2 weeks of nitrate ingestion to 4.5 times the control.

Considering the ratio between nitrate and nitrite in the saliva, it is interesting to speculate about the different adaptation in the acute and chronic trials. With the acute dose, the conversion rate of nitrate into nitrite increased with the time, in the presence of a progressive clearance from nitrate. This could indicate that nitrate-reducing microflora rapidly adapts to the high salivary concentration of substrate. Conversely, in the chronic treatment, there are some evidences that the ability of microflora to reduce nitrate is suffering as time goes on, as indicated by the increasing ratio between nitrate to nitrite, according with the data of Xia et al. (2003). Our data show that pigs tolerate very well high doses of nitrate for short time, with a rapid and consistent increase of nitrate in blood, and a sufficient presence of nitrites in saliva, but decreasing in time. The reasons of the variation of oral conversion of nitrite after a continuous nitrate supplementation should reserve additional research attention.
Effect of tryptophan supplementation on the expression of some regulatory genes of fundic mucosa in weaned pigs

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ABSTRACT

Some additives are implicated in gastric function and in the regulation of important pathways of activation of physiological process throughout the mRNA synthesis for proteins production. The hydrochloric acid secretion is located in the fundus, where the parietal cells possess the gene array to regulate this physiological function, important for the activation of the digestive enzymes and for the non-specific barrier against the pathogens. The expression of different genes implicated in acid secretion can be down- or up-regulated by the luminal presence of specific nutrients in the gut. Tryptophan (Trp) covers multiple physiological roles in the young animal. Its involvement in the immune response against pathogen infection is recently well demonstrated. Moreover, there are evidences that Trp plays a key role in the activation of gastric acid secretion and on H+/K+ ATPase possibly throughout the activation of the Calcium Sensing Receptor (CaSR), also located in the fundic mucosa, and that it is sensible to aromatic amino acids, like tryptophan. H+/K+ ATPase is the main responsible for acid secretion into the stomach and catalyses electro neutral exchange of cytoplasmic H+ and external K+ coupled with ATP hydrolysis. These two genes can be associated to explain the rate of activity of gastric fundic mucosa to produce HCl. Moreover, a recent study demonstrated positive correlation between dietary Trp and the gene expression of ghrelin, an important neuropeptide that increases feed intake and weight gain of weanling pigs. However, in the weanling pigs, the sanitary conditions often strongly affects the function of the gastro-intestinal tract. In the piglet we investigated the effect of tryptophan dietary supplementation over standard requirements, on the expression of regulatory genes of fundic mucosa and theirs relationship with the individual susceptibility for E. coli F4ac (ETEC). We used 64 crossbred pigs, weaned at 21d of age and balanced for litter and body weight. Pigs were first divided in 2 groups: a group of healthy animals (B), and a group of animals to be orally challenged with ETEC (d5 post weaning). Within the challenge group, half of the challenged pigs received a basal diet without Trp supplementation (BCh) and the other group the basal diet + 1 kg/t pure L-Trp (TrpCh). Pigs were slaughtered on d4 or on d18 post-challenge. After slaughtering, the analysis of the presence of the receptor to ETEC in the small intestine determined whether piglets were susceptible (s+) or not (s−) to the adhesion of ETEC. In contrast with some literature data, our results showed that ghrelin gene expression was not affected either by the Trp level supplied with the diet or by the ETEC infection. Moreover the susceptibility to ETEC and the Trp level did not affect the H+/K+ ATPase gene expression, while the challenge reduced the expression of this gene (B Vs BCh+TrpCh, -34%, p<0.05). We analyzed also the CaSR gene expression. Among the pigs susceptible to ETEC adhesion, the TrpCh group had a lower CaSR gene expression than the BCh group. On the basis of our results we conclude that the infection with ETEC affects the gastric genes expression in young pigs, probably due to the change in the intestinal homeostasis. Moreover in this study, different doses of Trp do not affect the ghrelin gene expression, probably because in the B diet the Trp was already sufficient to activate the mRNA synthesis for this peptide. Further studies with low doses of Trp are requested to well understand the relationship between Trp and genes related with gastric acid secretion in young pigs.