Extraction of anthocyanins from grape by-products

Extracts from grape by-products contain bioactive substances such as anthocyanins which could be used as natural antioxidants or colorants. Researchers at Germany conducted studies to examine the feasibility of different emerging technologies such as high hydrostatic pressure (HHP), pulsed electric fields (PEF) and ultrasonics as potential extraction methods for bioactive substances from grape by-products. The effect of heat treatment at 70°C combined with the effect of different emerging novel technologies such as ultrasonics (35 KHz), high hydrostatic pressure (600 MPa) and pulsed electric fields (3 kV/cm) showed a great feasibility and selectivity for extraction purposes. After 1 h extraction, the total phenolic content of samples subjected to novel technologies was 50% higher than in the control samples. Therefore, the application of novel technologies increased the antioxidant activity of the extracts being the extractions carried out with PEF four-fold, with HHP three-fold and with ultrasonics two-fold higher than the control extraction. In addition, the extraction of individual anthocyanins was studied showing a selective extraction based on the glucose moieties linked to the anthocyanidins; anthocyanin monoglucosides were better extracted by PEF, whereas the acylated ones were extracted by HHP [Corrales M, Toepfl S, Butz P, Knorr D and Tauscher B, Extraction of anthocyanins from grape by-products assisted by ultrasonics, high hydrostatic pressure or pulsed electric fields: A comparison, Innov Food Sci Emerg Technol, 2008, 9(1), 85-91].

Limiting amino acids for growing goats fed a Corn grain, Soybean meal and maize stover based diet

Two experiments were conducted by researchers at P. R. China and Nigeria to determine limiting amino acids (AA) for growing goats fed a corn grain, soybean meal and maize stover based diet. In experiment 1, three 4-month-old Liuyang Black growing wether goats (10.0 ± 0.1 kg), fitted with ruminal, proximal duodenal and terminal ileal cannulae, were used to determine flows of AA into the duodenum and apparent intestinal AA digestibilities. These data were used to calculate amounts of essential amino acids (EAA) that should be infused into the duodenum to match the ideal AA pattern of muscle protein according to calculations, which suggested that 0.91, 0.77, 0.58, 0.52 and 0.44 g/d of lysine, methionine, leucine, arginine and threonine were required, respectively, to be supplemented to the duodenum. In experiment 2, four Liuyang Black growing wether goats (10.0 ± 0.5 kg and 4-month-old) fitted with duodenal cannulae were used in a 4x4 Latin square design experiment, and the four treatments were continuous duodenal infusion of a mixture of methionine, lysine and leucine at 0.77, 0.91 and 0.58 g/d, respectively (3EAA, from experiment 1), or replacement of 0.21 of methionine (-0.19 g methionine), lysine (-0.52 g lysine) or leucine (-0.56 g leucine), respectively with isonitrogenous glutamate infusion from the 3EAA mixture. Replacement of methionine, lysine or leucine reduced methionine concentrations in plasma. The magnitude of the change was greatest for methionine, followed by lysine and leucine. A general lack of statistical significance between AA replacement and 3EAA group on almost all measurements, except for plasma methionine concentration, was probably due to the small number of goats used. Nevertheless, for growing goats fed a corn grain/soybean meal/maize stover diet, methionine was likely the first limiting amino acid, followed by lysine and leucine [Shan JG, Tan ZL, Sun ZH, Hu JP, Tang SX, Jiang HL, Zhou CS, Wang M and Tayo GO, Limiting amino acids for growing goats fed a corn grain/soybean meal/maize stover diet, Anim Feed Sci Technol, 2007, 139(3-4), 159-169].
Digestibility of mulberry foliage, alfalfa hay and oat hay in sheep

Mulberry (Morus alba Linn.) trees are present in many regions of the world and are a potential source of protein for ruminant livestock. Foliage from mulberry trees, alfalfa hay and oat hay were fed by researchers at California, USA to wethers (goats) in two feeding trials to determine the whole tract digestibilities of main feed components, and the extent of rumen degradation and passage of dietary protein from these feeds. In Trial 1, each of five treatment diets was fed to five wethers (average 55 kg BW) to determine digestible energy (DE) and the digestibilities of the feeds and feed constituents using Cr₂O₃ as a feed marker. Intake was restricted to approximately 20 g DM/kg BW per day. The five diets consisted of alfalfa hay (AA), 1:1 alfalfa hay and oat hay mix (AO), dry mulberry foliage (MM), 1:1 mulberry foliage and oat hay mix (MO), and oat hay (OO). Each diet was fed individually to five wethers in a completely randomized design. Univariate analyses showed differences (P<0.05) among diets in DE, crude protein (CP) digestibility, and digestible crude protein (DCP). MM had DE and DCP values closer to AA than OO. Multivariate analyses detected significant differences between all five diets (P<0.0001) primarily due to acid detergent fiber (ADF) and CP digestibilities and DE. Although all diets were significantly different from each other, MM was closer to AA than OO in multi-dimensional space. Positive associative effects occurred in aNDF digestibility for MO (P<0.05), and CP digestibility for MO (P<0.05) and AO (P<0.01). Negative associative effects occurred in DCP for AO (P<0.10) and MO (P<0.05) and in DE for AO (P<0.10). In Trial 2, AA, MM and OO were each fed to four wethers in a completely randomized design. Daily rations were divided into 12 equal portions and fed every 2 h for 4 days to approximate steady-state conditions in the digestive tract. On day 4, the wethers were euthanized and their digestive tracts removed. Rumenal and abomasal digesta were collected and analyzed to determine extent of dietary protein degradation in the reticulo-rumen. Undegradable intake protein (UIP, g/kg CP) was similar in AA (260) and MM (242) but tended (P=0.06) to be higher in OO (352). Mulberry appears to be an excellent forage with many qualities comparable and in some cases superior to alfalfa. These results demonstrate the potential for mulberry as a strategic forage source in temperate as well as tropical regions of the world [Doran MP, Laca EA and Sainz RD, Total tract and rumen digestibility of mulberry foliage (Morus alba), alfalfa hay and oat hay in sheep, Anim Feed Sci Technol, 2007, 138 (3-4), 239-253].

Effect of grazing ryegrass/white clover pasture or Lotus corniculatus on odour of fat from lambs

An experiment was conducted by researchers at New Zealand for 111 days in the summer of 2002/2003 to compare the effect of grazing lambs on condensed tannin-containing Lotus corniculatus Linn. (cv. ‘Grasslands Goldie’) and perennial ryegrass/white clover pasture (PRG/WC; Lolium perenne Linn. / Trifolium repens Linn.) on the concentration of indole and skatole in rumen fluid, blood plasma and body fat and upon the odour of the fat. Rumen fluid and blood samples were obtained on days 0, 22, 58, 87 and 111 of the experiment. Fat from inter-muscular and tail-stub depots was obtained at slaughter.
During the experiment the mean concentration of indole and skatole in both the rumen fluid and blood plasma was lower for lambs grazing L. corniculatus compared to PRG/WC pastures. The concentration of skatole in the tail-stub fat was lower and less variable ($P<0.05$) in the lambs that had grazed L. corniculatus. No differences were observed in the odour of the inter-muscular fat from lambs that had grazed L. corniculatus compared to PRG/WC pasture, suggesting that the reductions in indole and skatole formation from grazing L. corniculatus were not large enough to produce a detectable difference in fat odour. The experiment was complicated by the on-set of drought conditions during the second half which resulted in a relatively lower level of crude protein in the L. corniculatus forage. It was concluded that CT-containing forages hold some potential to reduce the concentration of indole and skatole in the fat to provide consistently flavoured meat products from grazing systems [Schreurs NM, McNabb WC, Tavendale MH, Lane GA, Barry TN, Cummings T, Fraser K, López-Villalobos N and Ramírez-Restrepo CA, Skatole and indole concentration and the odour of fat from lambs that had grazed perennial ryegrass/white clover pasture or Lotus corniculatus, Anim Feed Sci Technol, 2007, 138(3-4), 254-271].

**Characterization of Quercus species as ruminant feeds**

Researchers at Animal Science Department, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran assessed the nutritive value of three species of oak trees leaves by chemical analysis as well as by an in situ and in vitro gas production method. The chemical composition (g/kg DM basis) of three species, Quercus persica Jaub. & Spach, Q. infectoria Olivier and Q. libani Olivier were 951, 927, 946 organic matter; 115, 92, 123 crude protein; 532, 540, 512 neutral detergent fibre; 317, 300, 331 acid detergent fibre; 98, 103, 95 lignin [lignin(sa)]; 8.9, 11.7, 19.2 water soluble carbohydrates; 78, 115, 104 total phenols; 73, 109, 100 total tannins; 14, 15, 12 condensed tannin; and 46, 87, 62 hydrolysable tannin. Protein precipitable phenolics were respectively 160, 190 and 230 (g/kg total phenols).

Effects of tannins on in vitro gas production, in vitro organic matter digestibility (OMD), metabolisable energy (ME) and effective DM digestibility were assessed by polyethylene glycol (PEG) tannin bioassay. Among species, Q. libani had the highest gas production. This species also had the highest ($P<0.05$) increase in gas production, OMD and ME due to the addition of PEG. Using this in situ method the soluble component (A), insoluble but fermentable component (B), the degradation rate of B (c), the potential degradability (A + B) and the effective degradability of the oak leaves were influenced ($P<0.05$) by species, PEG treatment and interaction of species and PEG treatment. Adding PEG to Quercus species suggests that these feeds have potential as small ruminant feeds [Yousef Elahi M and Rouzbehan Y, Characterization of Quercus persica, Quercus infectoria and Quercus libani as ruminant feeds, Anim Feed Sci Technol, 2008, 140(1-2), 78-89].

**Effects of Aspergillus oryzae extract and a Saccharomyces cerevisiae fermentation product on intake, body weight gain and digestibility in buffalo calves**

An *Aspergillus oryzae* fermentation extract and a *Saccharomyces cerevisiae* culture product were added to a pelleted calf starter, respectively; at 6.0 and 26 g/kg of dry matter (DM) to determine effects on faecal score, DM intake, body weight (BW) gain and in vivo digestibility by researchers at Italy. Treatments were control groups with the control starter alone (CS) or with free access to ryegrass hay (CSh) and combinations with the fungal supplemented starter (ExpSt and ExpSH). Forty buffalo calves (12 male, 28 female; 10 calves per treatment) were started on the experiment at 10 days of age and for 12 weeks. Faecal scoring was conducted twice weekly and DM intake was measured weekly. Every 2 weeks, BW gain was recorded and grab faecal samples were collected to examine for the presence of intestinal parasites and *Salmonella*. At the end of the experimental period, on a subset of 20 calves (i.e., five per
Partial substitution of concentrates with maize silage in organic dairy cow rations

The general goal of organic dairy farming is to minimize purchased concentrate use and focus on milk production from forages. The aim of the study conducted by the scientists of University of Natural Resources and Applied Life Sciences, Vienna, Austria was to examine the influence of a partial substitution of purchased concentrates with home-grown maize silage on feed intake, milk production and feed efficiency in rations for organic dairy cows. In the experimental treatment group (E), two-thirds of average herd concentrate intake was replaced with 2.7 kg maize silage on a dry matter (DM) basis.

In treatment E, total DM, energy and protein intake were significantly reduced compared to the control treatment group (C). Daily milk yield decreased in E by 11% and milk urea content was significantly lower. Calculated milk production from forage was significantly higher (91 versus 71%) in treatment E. Efficiency of dietary nitrogen (N) utilization (calculated as milk N as a percentage of N intake) was slightly improved in E and protein and energy balance (calculated as intake as a percentage of requirements) were closer to zero than in C. Thus the study indicated a potential to reduce levels of concentrates and substitute them with maize silage in

Nutritive value for ruminants of green tea grounds as a replacement of brewers’ grains

Four wethers (goats) were used in a 4×4 Latin square to study the fermentation quality, digestibility and nitrogen balance of totally mixed ration (TMR) silages which included wet green tea grounds (WGTG) by researchers at Department of Animal Feeding and Management, National Institute of Livestock and Grassland Science, Nasushiobara, Tochigi, Japan. Experimental treatments were control (no WGTG added, CTG), 50 g/kg (low level, LTG), 100 g/kg (medium level, MTG) and 150 g/kg (high level, HTG) of TMR dry matter (DM) as WGTG. The WGTG were substituted for wet brewers grains (WBG) in experimental TMR. All TMR silages were ensiled for 45 days and irrespective of the WGTG addition, they were well preserved with low pH and ammonia-N contents, and high lactic acid content. The voluntary feed intake of TMR silage was not affected by WGTG inclusion (P=0.486). Digestibilities for LTG and MTG treatments were not different from CTG. However, the digestibility of DM, organic matter, crude protein and energy were slightly lower for the HTG treatment, compared to CTG (P<0.05). With progressive increases in WGTG concentrations, the nitrogen intake and fecal nitrogen increased (P<0.05), but the urinary nitrogen and retention nitrogen were not different among treatments. No differences among treatments were observed in pH level and total volatile fatty acids concentrations. However, the rumen ammonia-N contents tended to decrease with increasing level of WGTG (P=0.063). The study suggests that a WGTG level of 150 g/kg of the diet DM can be recommended for silage based TMR [Chuncheng Xu, Yimin Cai, Naoko Moriya and Masuhiro Ogawa, Nutritive value for ruminants of green tea grounds as a replacement of brewers’ grains in totally mixed ration silage, Anim Feed Sci Technol, 2007, 138 (3-4), 228-238].

Feed/ Fodder

**Nutritional value of animal feed grade wheat for mutton production**

The utilization of abundantly available animal feed grade wheat (AFW) as a replacement for conventional and costly cereal supplement in lamb feeding to lower the cost of mutton production was explored by the scientists of Central Sheep and Wool Research Institute, Avikanagar, Rajasthan, India.

Thirty-five growing lambs divided into five equal groups and were fed diets containing 0, 118, 235, 353 or 470g/kg AFW replacing equal quantity of maize. The diets were fed in the form of composite feed mixture, which had a roughage (Prosopis cineraria Druce) leaves to concentrate ratio of 25:75. Dry matter intake (DMI) was not different in these groups, ranging from 35 to 42g/kg body weight, while AFW inclusion linearly (P<0.05) reduced DMI. The digestibility coefficients of dry matter (DM), organic matter (OM), crude protein (CP) and cellulose were not affected by AFW addition, whereas neutral detergent fibre and acid detergent fibre digestibility coefficients were reduced (P<0.05). The digestible CP content (142.7-162.7 g/kg diet) increased (P<0.01) linearly with increased AFW inclusion levels. However, AFW additions did not affect metabolizable energy (ME) value of diet (10.2-10.5 MJ/kg diet DM). Digestible CP intake was similar but digestible DM and OM intake tended to decrease (P<0.05) linearly when expressed in terms of g/kgW0.75. ME intake (MJ/d) was not different among the diets but showed linear (P=0.041) reducing trends with increasing AFW levels in diet. The efficiency of ME and N utilization for unit gain was also not affected by AFW incorporation. N retained as g/d, percentage of intake and percentage of absorbed ranged from 15.4 to 19.5g, 49.7 to 60.3% and 62.6 to 74.6%, respectively. Intake and utilization of dietary N was not affected but urinary N excretion reduced (P<0.05) linearly by AFW. Daily microbial N (MN) flow estimated by urinary purine derivative excretion was significantly (P<0.01) higher for lambs fed a diet with AFW 235 g/kg (3.05 g MN) and 353 g/kg (2.51 g MN) compared to without AFW diet (1.31 g MN). MN when expressed as g/kg digestible organic matter intake and microbial protein g/kg digestible organic matter apparently fermented in rumen followed a similar trend. During the growth trial, lambs fed diets containing AFW (353 g/kg), which replaced 75% maize had higher total gain (14 kg, P<0.05) and average daily gain (ADG 154 g, P<0.05). However, feed efficiency (feed consumed/kg live weight gain) was not different. Rumen pH and microbial enzyme activities studied 4h post feeding revealed that AFW did not affect rumen pH, which ranged from 5.95 to 6.30. Similarly, carboxymethyl cellulase and xylosidase enzyme activities were not different among treatments, but AFW inclusion linearly (P=0.03) increased carboxymethyl cellulase enzyme activities. The amylase enzyme activity differed significantly (P<0.05) and was highest (22.6 IU) in groups where AFW replaced maize completely. It was concluded that, in lambs reared under intensive system for mutton production on high concentrate diets, conventional and costly energy supplements like maize can be replaced up to 75% with a low-cost animal feed grade wheat to economize on cost of production. However, more studies are required to confirm these inclusion levels for greater economic returns [Tripathi Manoj K, Karim Sheikh A, Chaturvedi Om H and Verma Dwarika L, Nutritional value of animal feed grade wheat as replacement for maize in lamb feeding for mutton production, J Sci Food Agric, 2007, 87(13), 2447-2455].