The natural food colorants, carotenoids, are of great importance to human health. The scientists at Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada enhanced the efficiency of SC-CO$_2$ extraction of carotenoids from carrots, by using canola oil as a continuous co-solvent. The carotenoid content of the starting material was determined by traditional solvent extraction and carrot samples with different particle size and moisture content were extracted with SC-CO$_2$ at different temperature, pressure, canola oil concentration and CO$_2$ flow rate for 4 hours. Carotenoids were identified and quantified by HPLC analysis. The $\alpha$-carotene, $\beta$-carotene and lutein were the main carotenoids in the extracts. When canola oil was added as a co-solvent, the $\alpha$- and $\beta$-carotene yields were improved more than twice and lutein yield was more than four times higher compared to those obtained with SC-CO$_2$ extraction alone. Both increasing temperature and pressure had significant positive effects on the carotene yields except for that of lutein. Larger particle size had a negative effect on carotenoid yields. The $\alpha$- and $\beta$-carotene yields decreased with moisture while the lutein yield increased. Higher carotenoid yields were achieved after 4 hours of extraction at higher flow rate, while more carotenoids were solubilized in SC-CO$_2$ at lower flow rate. The highest carotenoid yields were obtained at 70°C, 55.1MPa, 5% canola oil concentration (w/w of CO$_2$), 0.25-0.5 mm particle size, 0.8% moisture content of feed material, and 2L/minutes CO$_2$ flow rate. Employing canola oil as a continuous co-solvent in SC-CO$_2$ extraction is a novel and efficient technique for the recovery of carotenoids from natural materials [Sun Mei and Temelli Feral, Supercritical carbon dioxide extraction of carotenoids from carrot using canola oil as a continuous co-solvent, J Supercrit Fluids, 2006, 37(3), 397-408].

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**Feed/Fodder**

**Tree leaves as complete feed for goat bucks**

The year-round shortage of animal feed demands search of new and nutritional sources. Fodder tree/shrub legumes leaves have the potential for alleviating some of the feed shortages and nutritional deficiencies. The scientists at Department of Animal Nutrition, Punjab Agricultural University, Ludhiana, India assessed the nutritive value of promising tree leaves as livestock feed. The preliminary screening of tree leaves (nine species) by *in vitro* gas production technique revealed that leaves of *Azadirachta indica* A. Juss., *Melia azedarach* Linn., *Morus alba* Linn. and *Leucaena leucocephala* (Lam.) de Wit could serve as promising, alternate feed resource for ruminants. Therefore, *in vivo* evaluation of these tree leaves (except *A. indica*) along with that of *Cedrela toona* Roxb. syn. *Toona ciliata* M. Roem. was assessed. Fresh tree leaves of each species, supplemented with mineral mixture and common salt, was offered *ad lib* as complete feed to three bucks (Beetle×Anglo Nubian×French Alpine; 6 years old of 56.7±1.12kg BW). The data were analyzed by using completely randomized design. Bucks relished all the tree leaves (except *C. toona*) as indicated by higher (*P*<0.05) voluntary DM intake and digestibility of nutrients. All the animals were in positive N-balance except those fed *C. toona*. The N-retention was maximum in animals fed *M. alba* followed by that in *L. leucocephala* and *M. azedarach*. However, the digestible crude protein (DCP)content of *M. alba*, *M. azedarach* and *L. leucocephala* was statistically comparable, while metabolizable energy availability was higher (*P*<0.05) from leaves of *M. azedarach* followed by that of *M. alba*, clearly indicated that leaves of *M. azedarach*, *M. alba* or *L. leucocephala*, supplemented with mineral mixture and common salt, could serve as an excellent complete feed for small ruminants [Bakshi MPS and Wadhwa M, Tree leaves as complete feed for goat bucks, Small Rumin Res, 2007, 69(1-3), 74-78].
Feed/Fodder

Effects of partial replacement of dietary protein by a leaf meal mixture

The leaves of *Leucaena leucocephala* (Lam.) de Wit, *Morus alba* Linn. and *Azadirachta indica* A. Juss. are potential N supplements which can be used as N sources in supplementary feeds. These tree forages not only provide a cheap source of N, energy and micronutrients, but have also many other advantages like their widespread on-farm availability and easy accessibility to farmers, and above all the scope of adding variety to the diet. The tree leaves can be harvested, sun-dried and used in compounded protein supplements. The replacement of conventional ingredients by tree leaves will make such supplements cheaper than the commercial concentrates. However, the presence of anti-nutritional factors like mimosine in *L. leucocephala*, triterpinoid derivatives (azadirachtin, nimbidin) in *A. indica* and phenolics in most of the leaves limit their use as sole animal fodder. Farmers usually minimize and overcome these problems by feeding different leaves in mixtures in smaller quantities, which not only dilutes and reduces the problem of palatability and toxic effects but also extends feed base for animals. A mixture of fresh leaves (*Gliricidia sepium* (Jacq.)Walp., *L. leucocephala* and *Calliandra calothyrsus* Meisn.) or a leaf meal mixture (*L. leucocephala*, *M. alba* and *Tectona grandis* Linn. f.) were successfully used as strategic supplements in the diet of cows and goats, respectively. The scientists at Centre for Advanced Studies in Animal Nutrition, Indian Veterinary Research Institute, Izatnagar, Bareilly, India undertaken an experiment to scrutinize the effects of long-term feeding of *L. leucocephala*, *M. alba* and A. indica leaf meal mixture as a partial substitute to soybean meal in the diet on nutrient utilization and body weight changes of dry and gravid goats. During study the researchers examined the comparative nutrient utilization of indigenous non-descript goats (*n=12*) maintained on a basal diet of wheat straw supplemented with a concentrate based on either soybean meal (SBM) or *L. leucocephala*, *M. alba* and *A. indica* (2:1:1) leaf meal mixture (LMAM) prior to conception (pre-pregnancy) and during gestation (*n=8*) in a completely randomized design. Concentrate represented 42 and 72% of dry matter in diet before and during pregnancy, respectively. Apparently, the supplementation of wheat straw either with LMAM or commercial type concentrate containing soybean meal resulted in similar performance of goats; the leaf meal mixture could contribute up to 36% of the total dry matter intake in gravid goats without any adverse effect on their general health and reproductive performance [Patra AK, Sharma K, Dutta Narayan and Pattanaik AK, Effects of partial replacement of dietary protein by a leaf meal mixture on nutrient utilization by goats in pre- and late gestation, *Small Rumin Res*, 2006, 63(1-2), 66-74].

New barley animals feed

A new feed barley cultivar named ‘Herald’, has been developed by USA scientists. It is the first commercial-quality barley that provides a greater proportion of its phosphorus in a bioavailable form that can be more readily absorbed and used by fish and non-ruminant livestock, such as pigs. While tests have shown it to have about 10 per cent less total phosphorus than top-yielding feed barleys, it has more then three times as much phosphorus in a bio-available form. Thus less of it will be excreted in livestock manure and carried away in runoff from pastures or fields into waterways. The superior bioavailability of Herald’s phosphorus would spare growers the feeding of supplemental phosphorus needed for their animals’ health and its excellent yield would further guarantee their savings [Phil Bregitzer, Heralding a New Barley, *Agric Res Mag*, 2007, 55(3), 23].
Partial replacement of concentrates with jackfruit leaves in Black Bengal goat kids feed

The growth rates of Black Bengal goats raised in Tripura, India on native pasture are poor because the quality of pasture of the region is poor, hence, it is generally desirable to increase intake and digestion and thereby growth performance of kids through supplementation. Supplementation with concentrate is reported to increase production performance. Jackfruit (Artocarpus heterophyllus Lam.) is one of the most popularly grown trees in the hot and humid tropics. Green fruit is used as a vegetable, ripe fruit is consumed by humans and fruit waste is a potential ruminant feed. Jackfruit tree leaves are extensively used as ruminant feed in eastern and northeastern India. Jackfruit leaves are very highly palatable and contain 8% digestible CP (crude protein) and 58% TDN (total digestible nutrients). Therefore, the scientists at Centre of Advanced Studies in Animal Nutrition, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India and ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, Tripura West, India conducted studies to find out the effect of partial replacement of concentrates with jackfruit leaves on growth performance of kids grazing on native pasture of Tripura, India.

During experiment fifteen Black Bengal goat kids of about 3 months of age and body weight ranging from 3.8 to 4.9 kg were randomly distributed into three groups of five. Kids grazed native pasture 8 hours/day. The kids in group I received supplementary concentrate (maize 35%, mustard cake 32%, rice bran 30%, mineral mixture 2% and common salt 1%) at approximately 2% of body weight. However, 25 and 50% of the concentrate was replaced with jackfruit leaves for groups II and III, respectively.

Total dry matter intake (DMI) was significantly higher in groups II and III than for group I due to greater forage consumption. Digestibility of CP (P<0.05) decreased and that of neutral detergent fibre increased (P<0.01) with increasing level of jackfruit leaves in the diet. Digestibility of ADF (acid detergent fibre) (P<0.01), hemicellulose (P<0.05) and cellulose (P<0.01) was higher in groups II and III than for group I due to greater forage consumption. Digestibility of CP (P<0.05) decreased and that of neutral detergent fibre increased (P<0.01) with increasing level of jackfruit leaves in the diet. Digestibility of ADF (acid detergent fibre) (P<0.01), hemicellulose (P<0.05) and cellulose (P<0.01) was higher in groups II and III in comparison to group I. Ruminal pH and total volatile fatty acid concentration were not significantly different among the groups; however, rumen ammonia-N concentration decreased (P<0.01) with increased level of jackfruit leaves in the diet. Similarly, plasma urea nitrogen and blood glucose levels were also reduced (P<0.05) with increasing level of jackfruit leaves in the diet. Average daily gain (ADG) was 47.33, 45.11 and 35.56 g/day in groups I, II and III, respectively. ADG and DMI/kg gain were not adversely affected when the level of replacement was restricted to 25%; however, at the 50% of replacement both parameters were adversely affected (P<0.05). From the results of this experiment, it was concluded that jackfruit leaves might replace 25% of the supplemental concentrate for growing kids grazing in native pasture of northeast India [Das A and Ghosh SK, Effect of partial replacement of concentrates with jackfruit (Artocarpus heterophyllus) leaves on growth performance of kids grazing on native pasture of Tripura, India, Small Rumin Res, 2007, 67(1), 36-44].
Digestibility and energy value of grape pomace for sheep

Grape pomace (GP), a remnant of the wine making process, is one of the most important residues of the wine industry. It consists of different amounts of grape, skin, pulp, seeds, and if not removed, stalks with very high lignin content. For white wine production, the juice is pressed directly following vintage and for red wine, the cracked grapes are left together with the pressed juice for several days in order to let the anthocyanines, located in the grape skin, penetrate into the juice, colouring it deeply red. The scientists at Germany investigate and compared the feeding value of two different types of fresh GP, white and red grape origin, on the basis of a digestibility study with sheep.

The white grape pomace had higher sugar, but lower fibre concentrations than the red wine pomace. Pomace was mixed with a basal diet and digestibilities were determined with adult wether sheep for the basal diet and the diets containing grape pomace. Faeces were quantitatively collected for 6 days following 14 days of adjustment to the diets. Inclusion of grape pomace in the diet significantly reduced digestibilities and the metabolizable energy intake (ME) content of the diet, these effects being more pronounced for red grape pomace than for white grape pomace. Digestibilities calculated by difference for the white (and red) grape pomace were 56% (32%) for organic matter, 8% (30%) for crude protein, 19% (6%) for crude fibre, 21% (15%) for neutral detergent fibre, and 7% (0%) for acid detergent fibre. The ME concentration was 8.3 and 5.8MJ/kg dry matter for white and red grape pomace, respectively. It was concluded that grape pomace can substantially vary in the feeding value for ruminants, depending on the technical details of the wine production process [Baumgärtel T, Kluth H, Epperlein K and Rodehutscord M, Note on digestibility and energy value for sheep of different grape pomace, Small Rumin Res, 2007, 67(2-3), 302-306].

Effects of feeding oilseeds on nutrient utilization by lactating ewes

Sheep milk is commonly used for cheese and yoghurt production due to its high fat and total solid contents. Several studies have demonstrated the benefits of supplemental fat from oilseeds in increasing health-promoting fatty acids, such as conjugated linoleic acid and omega-3 fatty acid in milk of sheep, goats and cows. Data on total tract nutrient utilization of ewes fed oilseeds are limited and therefore, the scientists at Department of Animal Science, McGill University, Canada studied to determine the effects of feeding diets containing canola seed, sunflower seed and flaxseed on intake and total tract nutrient utilization by lactating ewes.

During experiment sixteen lactating ewes were used to determine the effects of oilseed supplementation (i.e., canola, sunflower and flaxseed) on dry matter (DM) intake and total tract nutrient digestibility. Ewes were fed diets containing no oilseed (C), canola seed (CS), sunflower seed (SF), or flaxseed (FS). Oilseed supplementation had no effect on DM intake or total tract fibre digestibility. Ewes fed FS had a higher (P<0.05) DM digestibility than those fed CS or C. Oilseed supplementation improved (P<0.05) total tract digestibility of C18:1 while total fatty acid digestibility was improved (P<0.05) by feeding FS and SF. It was concluded that oilseed supplementation had no effect on DM intake or nutrient utilization by lactating ewes [Zhang RH, Mustafa AF and Zhao X, Effects of feeding oilseeds on nutrient utilization by lactating ewes, Small Rumin Res, 2007, 67(2-3), 307-311].
The extraction of juices and essential oils from citrus fruit yields several by-products, some of which have been used for a considerable time in animal and especially in ruminant diets. Feeding with these by-products results in reduced feeding costs and disposal problems. Of these by-products, the most widespread is citrus pulp consisting of a mixture of peels, inside portions, seeds and culled fruit which represent approximately 50-65% of the whole fruit by weight depending on the variety of fruit, the processing methods used and the influence of environmental factors. The chemical-nutritional composition of citrus pulp indicates that it has a high nutritive value owing to high content of readily fermentable carbohydrates. However, the protein content is modest, and of low digestibility and biological value.

Citrus pulp can be used in animal feeding either fresh or after ensilage or dehydration. The use of fresh citrus pulp, even if for a limited period of time, coinciding with the citrus fruit season, is at present the most widespread form used for animal feeding. The scientists at Italy investigated the possibilities and limitations of the partial replacement of cereal grains with citrus pulp by solar energy (solar-dried citrus pulp, SDCP) in diets for fattening lambs and to evaluate their effects on lamb growth and carcass and meat quality. Twenty-seven Italian Merino male lambs, equally divided into three groups, were used to evaluate the effects of the dietary incorporation of SDCP on growth and carcass and meat quality. The diet consisted of oat hay and concentrate, with a hay/concentrate ratio of 30/70. The concentrates of the SDCP-0, SDCP-30 and SDCP-45 groups were formulated to incorporate 0, 30 and 45% of SDCP, respectively, as partial replacement of cereal grain. The lambs were slaughtered after 80 days of feeding (at 150 days of age) and carcass and some meat quality parameters were measured. No significant differences were found in final live-weights and average daily gains among the groups. Lambs in the SCP-45 group showed impaired (P<0.001) feed conversion efficiency, lower (P<0.05) carcass weight and lower (P<0.05) dressing percentage compared with the other two groups. Carcass compactness was found to be significantly higher (P<0.05) in groups SDCP-0 and SDCP-30 compared to group SDCP-45. The histological dissection of the pelvic limb evidenced a higher (P<0.01) adiposity in the SDCP-0 and SDCP-30 groups. Chemical analysis of meat did not differ significantly among the groups. Physical analysis of the meat showed higher (P<0.05) redness value and higher (P<0.05) chroma value in the SDCP-0 and SDCP-30 groups. Based on the results it may be concluded that SDCP can be incorporated in concentrate mixtures for fattening lambs at levels equal to 30% without adverse effects both in growth and slaughter performances as well as in carcass and meat quality and, at this replacement level, it appears also to be economically convenient [Caparra P, Foti F, Scerra M, Sinatra MC and Scerra V, Solar-dried citrus pulp as an alternative energy source in lamb diets: Effects on growth and carcass and meat quality, Small Rumin Res, 2007, 68(3), 303-311].

**Combined ultrasound-laccase assisted bleaching of cotton**

Laccases have found various biotechnical and environmental applications, among which colour removal from both liquors and materials (bleaching) is of particular interest. Combined ultrasound/hydrolytic enzymes (e.g. cellulases, pectinases, amylases) applications provided reduction in the consumption of enzymes, shorter process time, less fibre damage and greater uniformity of the treatment. Therefore, the scientists of Portugal and Spain worked...