Cobellis G, Yu Z, Forte C, Acuti G, Trabalza-Marinucci M. Dietary supplementation of Rosmarinus officinalis L. leaves in sheep affects the abundance of rumen methanogens and other microbial populations. J Anim Sci Biotechnol. 2016 Apr 27;7:27.

Rumen microbiome has a great influence on ruminant health and productivity. Different plant extracts have been tested for their ability to modulate the rumen microbiome to improve feed digestion and fermentation. Among the evaluated plant extracts, essential oils, tannins, and saponins appeared to have positive effects on rumen protein metabolism, volatile fatty acids production, and methane and ammonia production. The objective of this study was to evaluate the effect of rosemary (Rosmarinus officinalis L.) leaves and essential oils on rumen microbial populations. Four ruminally cannulated sheep were used in a 4×4 Latin square design fed (21 d/period): 1) a control diet composed of alfalfa hay and concentrate pellet (CTR), 2) CTR supplemented with 7 g/d/sheep of rosemary essential oil adsorbed on an inert support (EO), 3) CTR with 10 g/d/sheep of dried and ground rosemary leaves (RL), and 4) CTR with 10 g/d of dried and ground rosemary leaves pelleted into concentrate (RL pellet). Abundance of total bacteria, archaea, protozoa, and some select bacterial species or groups was quantified using qPCR, while the community of bacteria and archaea was profiled using denaturing gradient gel electrophoresis. No difference in abundance was noted for total bacteria, protozoa, or Ruminococcus flavefaciens between the control and the treatments, but the rosemary leaves, either in loose form or in pellet, decreased the abundance of archaea and the genus Prevotella ($P < 0.001$). The rosemary leaves in loose form also decreased ($P < 0.001$) the abundance of Ruminococcus albus and Clostridium aminophilum, while the EO increased ($P < 0.001$) the abundance of Fibrobacter succinogenes. The community of bacteria and archaea was not affected by any of the supplements. Being able to affect the abundance of several groups of rumen microbes that are known to be involved in degradation of protein and fiber and production of methane and ammonia, rosemary leaves may be used to modulate rumen microbiome and its function.

Smeti S, Joy M, Hajji H, Alabart JL, Muñoz F, Mahouachi M, Atti N. Effects of Rosmarinus officinalis L. essential oils supplementation on digestion, colostrum production of dairy ewes and lamb mortality and growth. Anim Sci J. 2015 Jul;86(7):679-88.

The aim of this study was to evaluate the effect of rosemary essential oils (REO) and the forage nature on ewes' performances, immune response and lambs' growth and mortality. Forty-eight dairy ewes (Sicilo-Sarde) were fed oat-hay or oat-silage supplemented with 400 g of concentrate during pregnancy and 600 g during

postpartum. The experimental concentrate contained the same mixture as the control (barley, soybean meal and mineral vitamin supplement) more 0.6 g/kg of REO. Two groups were obtained with each forage (Hay groups: H-C and H-REO; Silage groups: S-C and S-REO). REO increased the dry matter (DM) intake, the nitrogen intake and retention being higher with the silage groups ($P < 0.05$). REO increased solid non-fat ($P = 0.004$) and fat contents of colostrum which was higher with hay ($P = 0.002$). REO decreased lamb mortality ($P < 0.05$) which averaged 21% for control groups and 6% for H-REO, while no mortality was recorded with S-REO. REO dietary supply improved forage intake and tended to ameliorate colostrum production; it could be a natural additive to improve ewes' performances.

Mugnaini L, Nardoni S, Pistelli L, Leonardi M, Giuliotti L, Benvenuti MN, Pisseri F, Mancianti F. A herbal antifungal formulation of Thymus serpillum, Origanum vulgare and Rosmarinus officinalis for treating ovine dermatophytosis due to Trichophyton mentagrophytes. Mycoses. 2013 May;56(3):333-7.

A number of herbal products with anti-inflammatory, antiseptic and antimycotic properties are available for dermatological usage. The successful treatment of 13 sheep affected by ringworm due to Trichophyton mentagrophytes with a mixture consisting of essential oils (EOs) of Thymus serpillum 2%, Origanum vulgare 5% and Rosmarinus officinalis 5% in sweet almond (Prunus dulcis) oil. The effectiveness of EOs and of the major components of the mixture (thymol, carvacrol, 1,8 cineole, α-pinene, p-cymene, γ-terpinene) against the fungal clinical isolate was evaluated by a microdilution test. Thirteen animals were topically administered with the mixture twice daily for 15 days. The other sheep were administered with a conventional treatment (seven animals) or left untreated (two animals). Minimum inhibitory concentration (MIC) values were 0.1% for T. serpillum, 0.5% for O. vulgare, 2.5% for I. verum and 5% for both R. officinalis and C. limon. Thymol and carvacrol showed MICs of 0.125% and 0.0625%. A clinical and aetiological cure was obtained at the end of each treatment regimen in only the treated animals. Specific antimycotic drugs licenced for food-producing sheep are not available within the European Community. The mixture tested here appeared to be a versatile tool for limiting fungal growth.

James PJ, Callander JT. Dipping and jetting with tea tree (Melaleuca alternifolia) oil formulations control lice (Bovicola ovis) on sheep. Vet Parasitol. 2012 Oct 26;189(2-4):338-43.

The in vivo pediculicidal effectiveness of 1% and 2% formulations of tea tree (Melaleuca alternifolia) oil (TTO) against sheep chewing lice (Bovicola ovis) was tested in two pen studies. Immersion dipping of sheep shorn two weeks before treatment in both 1% and 2% formulations reduced lice to non detectable levels. No lice were found on any of the treated sheep despite careful inspection of at least 40 fleece partings per animal at 2, 6, 12 and 20 weeks after treatment. In the untreated sheep louse numbers increased from a mean (± SE) of 2.4 (± 0.7) per 10 cm fleece part at 2 weeks to 12.3 (± 4.2) per part at 20 weeks. Treatment of sheep with 6 months wool by jetting (high pressure spraying into the fleece) reduced louse numbers by 94% in comparison to controls at two weeks after treatment with both 1% and 2% TTO formulations. At 6 and 12 weeks after treatment reductions were 94% and 91% respectively with the 1% formulation and 78% and 84% respectively with the 2% formulation. TTO treatment also appeared to reduce wool damage in infested sheep. Laboratory studies indicated that tea tree oil 'stripped' from solution with a progressive reduction in concentration as well as volume as more wool was dipped, indicating that reinforcement of active ingredient would be required to maintain effectiveness when large numbers of sheep are treated. The results of these studies suggest significant potential for the development of ovine lousicides incorporating TTO.

Hawken PA, Fiol C, Blache D. Genetic differences in temperament determine whether lavender oil alleviates or exacerbates anxiety in sheep. Physiol Behav. 2012 Mar 20;105(5):1117-23

Growing concerns about the risk of addiction to benzodiazepines have led to increasing interest in alternative therapies to treat anxiety and depression. Lavender oil (Lavendula augustifolia) is reportedly anxiolytic in a number of species but little is known about how it affects individuals that are more or less anxious when faced with a stressor. In this study, we used changes in locomotor activity and the plasma concentrations of cortisol to test whether lavender oil would reduce behavioral and endocrine correlates of anxiety in calm and nervous sheep exposed to an isolation stressor. During the non-breeding season, 'calm' or 'nervous' female sheep from the UWA temperament flock were exposed to a mask containing either 1 mL of 10% lavender oil (calm: n=8; nervous: n=8) or peanut oil (calm: n=8; nervous: n=8). After 30 min, each sheep was isolated for 5 min and then returned to the group. Blood was sampled prior to the mask, prior to isolation, 1 min and 30 min after isolation to profile changes in the plasma concentrations of cortisol. Agitation score, locomotor activity and vocalizations were recorded as correlates of anxiety associated with the isolation stressor. Irrespective of whether they were exposed to lavender oil, calm sheep had a lower agitation score ($P<0.001$), crossed the central lines of the isolation box less frequently ($P<0.001$), expressed fewer vocalizations ($P<0.001$) and had lower plasma concentrations of cortisol immediately after isolation ($P<0.001$) than nervous

sheep. Exposure of calm sheep to lavender oil decreased the agitation score ($P<0.001$), frequency of vocalizations ($P<0.05$), decreased the number of crosses of the central lines of the isolation box ($P<0.05$), and the plasma concentrations of cortisol prior to isolation ($P<0.05$) (after mask application) compared to calm control sheep. Exposure of nervous sheep to lavender oil increased the frequency of vocalizations ($P<0.05$), the number of sheep attempting to escape ($P<0.05$) and the plasma concentrations of cortisol 30 min after isolation ($P<0.05$) compared to nervous control sheep. We conclude that genetic differences in temperament determine whether lavender oil alleviates or exacerbates the behavioral and/or endocrine correlates of anxiety in sheep.

Giannenas I, Skoufos J, Giannakopoulos C, Wiemann M, Gortzi O, Lalas S, Kyriazakis I. Effects of essential oils on milk production, milk composition, and rumen microbiota in Chios dairy ewes. J Dairy Sci. 2011 Nov;94(11):5569-77.

The effect of the addition of an essential oil (EO) preparation (containing a mixture of natural and nature-identical EO) on the performance of dairy ewes of the Chios breed was investigated. Eighty lactating ewes were allocated into 4 equal groups in a randomized block design, each with 4 replicates of 5 ewes housed in the same pen. The 4 groups were fed the same total mixed ration allowance, the roughage being a mixture of corn silage, lucerne hay, and wheat straw, and the concentrate based on cereals and oil cakes. Control ewes were fed their daily allowance of total mixed ration without any EO. The other 3 groups were supplemented with EO at levels of 50, 100, and 150 mg/kg of the concentrated feed, respectively. Individual milk yield was recorded daily and feed refusals were recorded on a pen basis weekly during the first 5 mo of lactation. Milk samples were analyzed for chemical composition, somatic cell count, and urea content. Rumen samples were analyzed for pH, NH(3)-N content, and protozoa, cellulolytic, hyper-ammonia-producing, and total viable bacteria counts. Results showed that inclusion of EO increased milk production per ewe, the effect being dose dependent [1.565, 1.681, 1.876, and 2.119 L/d (standard error of the difference ± 0.176) for the control, 50, 100, and 150 mg of EO/kg of concentrate diets, respectively], and thus improved feed utilization. Although the inclusion of EO did not affect milk composition, it lowered urea concentration and somatic cell count in milk samples at the highest supplementation level compared with the control. Total counts of viable and cellulolytic bacteria and protozoa were not influenced by EO supplementation; however, counts of hyper-ammonia-producing bacteria were decreased at the 2 highest supplementation levels compared with the control group. Rumen pH was not affected by EO supplementation, but rumen NH(3)-N was reduced at the highest EO supplementation level, and acetate rumen concentrations tended to decrease and propionate to increase in a dose-dependent manner. In conclusion, EO supplementation may improve feed utilization and performance of the high-

yielding dairy Chios ewes; however, the underlying mechanisms leading to this improvement merit further investigation.

Callander JT, James PJ. Insecticidal and repellent effects of tea tree (Melaleuca alternifolia) oil against Lucilia cuprina. Vet Parasitol. 2012 Mar 23;184(2-4):271-8

Laboratory studies were conducted to assess the effect of tea tree oil (TTO) from Melaleuca alternifolia (terpinen-4-ol chemotype) against different stages of the Australian sheep blowfly Lucilia cuprina. When applied to wool, 3% TTO formulation repelled gravid female L. cuprina and prevented oviposition for six weeks. Formulations containing 1% TTO caused 100% mortality of L. cuprina eggs and 1st instar larvae and 2.5% TTO caused mortality of most second and third instar larvae in agar feeding assays. In experiments where third instar larvae were dipped in TTO formulations for 60s, concentrations of up to 50% TTO gave less than 50% kill. TTO at concentrations of 0.5%, 2% and 5% was strongly repellent to third instar larvae and caused them to evacuate treated areas. Inclusion of TTO in formulations with diazinon, ivermectin and boric acid reduced mortality in comparison with the larvicides used alone, at least partially because of avoidance behaviour stimulated by the TTO. Addition of TTO to wound treatments may aid in wound protection and myiasis resolution by preventing oviposition by L. cuprina adults, insecticidal action against L. cuprina eggs and larvae, stimulating larvae to leave the wound and through antimicrobial and anti-inflammatory properties that aid in wound healing.

Tabassam SM1, Iqbal Z, Jabbar A, Sindhu ZU, Chattha AI. Efficacy of crude neem seed kernel extracts against natural infestation of Sarcoptes scabiei var. ovis. J Ethnopharmacol. 2008 Jan 17;115(2):284-7.

This study was aimed to evaluate the efficacy of crude aqueous-methanol and aqueous extracts of neem (Azadirachta indica) seed kernel against sarcoptic mange of sheep. Crude aqueous-methanol (AME) and aqueous extracts (AE) of neem seed kernel (NSK) were prepared and formulated as 10% and 20% ointments (w/w), using Vaseline as vehicle. Forty-two lambs of Pak Karakul breed, having natural infection of sarcoptic mange were divided into seven experimental groups. Skin scrapings and clinical examination were carried out at scheduled intervals after treatment. Ivermectin (positive control) completely cleared infesting mites from animals after 10 days and 20% AME after 16 days. While, clinical mange was completely cured after 16 and 20 days with ivermectin and 20% AME, respectively, under field conditions. Only the higher concentration (20% AME) of NSK extracts completely cured the clinical

mange, suggesting a dose-dependent response. Our results consolidate the belief that use of folk remedies can provide an effective and economic way of combating sarcoptic mange in sheep.

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