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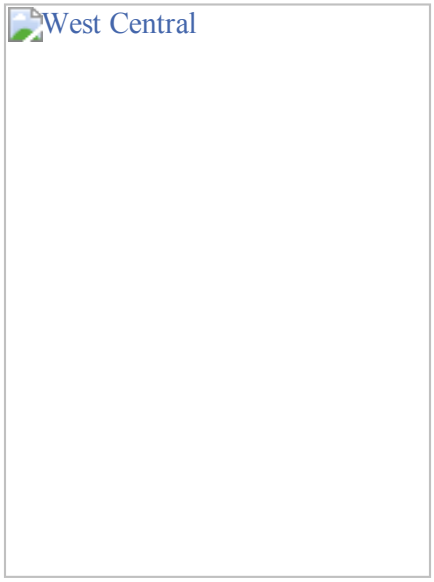
Exploring Essential Oils in Dairy Rations



The medicinal properties of plants have been explored for thousands of years. Now, plant-based additives may have potential for enhancing rumen function and improving production performance in lactating dairy cattle, in the form of essential oils (EO).

Essential oils are oily substances extracted from plant materials, usually by steam distillation. Some examples are allicin from garlic; eugenol from cloves; pinene from Juniper; capsaicin from hot peppers; thymol from thyme and oregano; limonene from dill; guaiacol from wood creosote; and cinnamaldehyde from cinnamon. Randy Shaver, PhD, Professor of Dairy Science and Extension Dairy Cattle Nutrition at the University of Wisconsin-Madison, says that, much like monensin sodium, essential oils potentially impact the rumen by inhibiting deamination and methanogenesis, resulting in lower rumen ammonia, methane and acetate production, while increasing propionate and butyrate production.

“Since the ban on feed-grade antibiotics and ionophores in Europe in 2006, essential oils have been widely used there as an alternative to monensin,” says Shaver. “Because they usually are not cost-competitive with monensin, they have not been implemented extensively at the farm level in the U.S.”

But a number of controlled research studies published in peer-reviewed, scientific journals do support the efficacy of essential oils. In a review of seven reports on EO supplementation in dairy rations, Shaver and his colleagues found that the additives numerically increased dry matter intake (DMI) and feed efficiency in six out of nine treatment comparisons. Milk yield and composition (fat and protein percentages) were increased numerically by EO in 8/10 and 6/10 treatment comparisons, respectively. DMI, milk yield and milk fat percentage increases were

significant in 1/9, 4/10 and 3/10 treatment comparisons, respectively. Other responses reported in some of the studies were increased ruminal organic matter and nitrogen digestibility; increased ruminal pH; reduced total volatile fatty acids; and increased total tract ADF digestibility and ruminal pH.

Shaver's own research team conducted a trial on a blended EO product containing natural and synthesized thymol, eugenol, vanillin, guaiacol and limonene. Forty multiparous Holstein cows were randomly fed either the EO supplement at 1.2g/cow/day, or a placebo supplement, from four weeks pre-freshening to 15 weeks postpartum. The researchers found that feed efficiency (milk/DMI) was unaffected during lactation weeks 1-5, but was greater for the EO-supplemented group during weeks 6-10 and weeks 11-15. Control cows returned to positive energy balance during lactation weeks 6-10, while EO cows remained in slightly negative energy balance through the end of week 15. "Other researchers have reported increased milk yield responses and a growing spread in the lactation curve in favor of EO supplementation at the point that our trial stopped," Shaver shares. "In hindsight, it would have been valuable to have continued the feeding trial longer to see if the benefits of the supplementation continued to increase."

Combining data from this trial and their previous literature review using the MIXED procedure of SAS to evaluate animal response to dietary EO supplementation for DMI, milk, fat and protein yields, Shaver and his colleagues found that DMI was unaffected by EO treatment. Milk, fat and protein yields were 1.2, 0.06 and 0.05 kg/day, respectively, higher for EO.

After evaluating essential oil products for several years, Peter Karnezos, PhD, Director of Sales and Marketing for The Old Mill Troy, North Troy, Vt., says use of EO in dairy rations requires a good bit of differentiation, in terms of how they are fed, and how they are selected. "The type, quality and consistency of the oils used; the concentration at which they are fed; and the basal diet into which they are incorporated all will influence their performance," he advises. For example, another analysis of a large pool of EO data suggests that the supplements were more likely to improve milk yield in early lactation when diets contained greater amounts of net energy for lactation (NEL); non-fiber carbohydrates (NFC) or digestible fiber.

"As a field of emerging interest, essential oils production is not yet completely standardized," says Karnezos. "It is important to research any EO product to make sure it is of very consistent quality that will deliver consistent results." He adds that feeding EO at too high of a concentration could result in overkill of the rumen bacterial flora. And, while neither has seen any influence on milk flavors from feeding EO, both experts agree it is a factor that should be monitored.

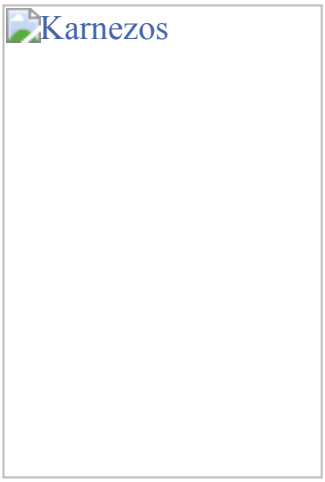
"There still is a lot we need to learn about essential oils," says Shaver. "Trials comparing them to ionophores, and evaluating them in combination with ionophores, would be very beneficial. It also would be helpful to see more evaluations of different EO products, fed at varied concentrations and in a number of basal diets."

CONSULTANT'S CORNER

How Essential Oils Can Fit Into U.S. Dairy Rations

By Peter Karnezos, PhD; Director of Sales and Product Development; The Old Mill Troy Inc.; North Troy, Vt.

Our company became interested in the use of essential oils (EO) in dairy rations as a result of the 2006 ban in the European Union of antibiotics and ionophores for growth promotion in livestock rations. Regardless of whether such a ban might be forthcoming in the U.S.,



we wanted some alternative options in our toolbox to provide to the feed manufacturers, nutritionists and dairy producers we serve.

High concentrations of essential oils have proven to have very powerful antimicrobial activity when evaluated *in vitro* and *in situ*. The product which we supply contains low concentrations of a combination of the essential oils eugenol (extract of clove) and cinnamaldehyde (extract of cinnamon), which has shown to have a positive effect on dairy cattle performance. A meta-analysis of 16 lactating-cow studies revealed that this formulation resulted in an average improvement of dry-matter intake of 3.3 lb/head/day and an increase in milk production of 2.42 lb/head/day, compared to non-supplemented controls.

Nutritionists and producers typically utilize this product to enhance pre-fresh, fresh-cow and early lactation intakes. The positive influence that it has on DMI and rumen bacterial flora helps transition cows minimize negative energy balance, and theoretically avoid a host of metabolic and infectious disease challenges that make up the fresh-cow disease complex.

Initially, the European manufacturer of our essential oil blend intended the EO product to replace monensin in dairy rations. However, field experience has shown that the two actually have a complementary effect when fed concurrently. By feeding the EO product, along with the normal rate of monensin, the EO elevates intake response, thus overcoming the DMI suppression that monensin typically causes.

The adoption of essential oils in U.S. dairy rations will, in my prediction, expand measurably in the future. This growth will be driven by the public's desire for food produced with natural methods; possible regulation changes for other products; and the potential for broader applications of EO. In addition to performance enhancement of dairy cattle, there is potential for EO to be used for the reduction of methane gas emissions; as a heat-stress-abatement tool; as an enhancement to calf milk replacers; as a tool to minimize shedding of fecally transmitted pathogens; and as a pre-slaughter supplement to reduce bacterial loads in the meatpacking industry. All of these potential uses will require additional research and possibly new formulations, but the possibilities for EO in livestock production are extremely intriguing.

FROM THE MATERNITY PEN

A Herd's Future Is In Its Calves

In just two short years, a heifer calf evolves from a newborn baby to a revenue-generating milk maker on a dairy. The contribution she makes over her lifetime — in terms of milk production and longevity — may be strongly influenced by preweaning nutrition.

Cornell University Professor of Animal Science Mike Van Amburgh, PhD, has evaluated numerous research studies investigating the later-in-life influence of calf nutrition, and has performed his own data analysis on the topic as well. Table 1 shows the increased milk yield that resulted from adult animals that were fed at least 50% more nutrients than traditional feeding programs as calves.

By performing regression analyses on the lactation data and growth rates from calves fed higher-nutrient versus traditional liquid calf rations, Van Amburgh determined that calves must double their birth weight by weaning (56 days) to realize the long-term benefits of enhanced early life nutrition.

The researcher concludes that “many milk replacers are not really replacing milk because they don’t contain the same nutrient levels, and they are rarely fed to equal the nutrient intake of whole milk.” He adds that “least cost” milk replacer rations should not be expected to provide much beyond maintenance energy; may compromise a young calf’s ability to mount an adequate immune response to disease challenges; and could end up costing the dairies more in the long run by failing to help maximize adult-animal performance. Read more of Van Amburgh’s analyses of calf nutrition and performance.

BEYOND BYPASS

Make the Most of Manure

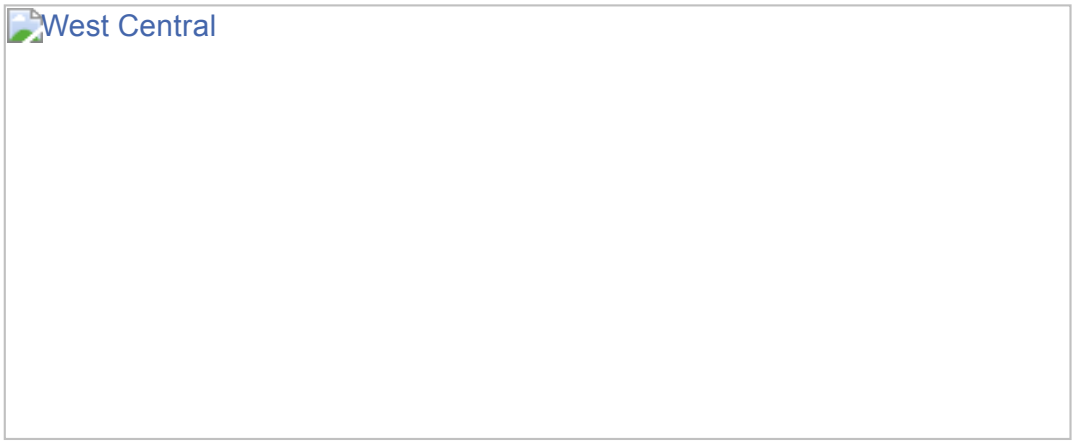
Manure — once a little-regarded byproduct of dairy production — now may be either a production-limiting liability, or a revenue-generating commodity for dairies.

Deanne Meyer, PhD, a researcher in the Department of Animal Science at the University of California-Davis, says handling manure to minimize costs and maximize revenue has become an important new management area on dairies.

Depending on the state and county in which a dairy is located, regulations already may dictate the volume of manure a dairy is allowed to create, and how it can be utilized. In Table 1, Meyer offers suggestions for achieving desired outcomes from manure-management modifications.

At the same time, manure could potentially become a cash cow. “Cap and trade systems for water and air emissions will provide new opportunities for revenue on dairies,” says Meyer. She says that in some parts of the country, credits for reduction in phosphorus, nitrogen or sediment may be available, and lowering “criteria pollutants” (particulate matter and nitrous oxide) and greenhouse gases also may have financial value one day. At the same time, governmental support of “green” or “environmentally friendly” energy production may make investment in methane digesters more cost-efficient.

Read Meyer’s in-depth discussion on manure and its potential merits.



QUALITY CORNER

Dietary Protein Supply and Nitrogen Efficiency

Many recent studies have sought to determine the optimum level of crude protein in lactating cow diets, and the efficiency with which feed nitrogen (N) is converted to milk components has received much attention. Some of these studies examined such influencing factors as the amounts of rumen degradable protein (RDP) and rumen undegradable protein (RUP); levels of fermentable carbohydrates and their effect on N capture by ruminal microbes; and the effects of supplementing potentially limiting essential amino acids. Most of these studies verify that as less protein is fed to the cow, or more favorable balances of amino acids constitute the metabolizable protein, less N is excreted (primarily via urine) by the cow. Each contribution of new knowledge, coupled with advanced nutrition modeling capabilities, make great tools for reducing feed protein inputs in dairy rations, increasing the percentage of that N that is captured as milk components; reducing N contribution to the environment; and improving the overall efficiency of N utilization by the cow.

One of the hypotheses that Penn State researchers aim to test thanks to a recent USDA grant is that diets with low crude protein and marginal metabolizable protein need to have the correct supply of essential amino acids to avoid losing milk production. Dr. Chuck Schwab has long promoted this very concept. The steps in Dr. Schwab's strategy include:

- Maximize microbial protein yield by feeding the rumen properly.
- Feed adequate but not excessive RDP.
- Feed high-lysine bypass protein supplements, with preference for supplements with a consistent distribution of RDP and RUP, where the digestibility of lysine in RUP has not been compromised.
- Feed rumen protected methionine supplements to achieve optimal ratios of lysine to methionine in the metabolizable protein.
- Avoid overfeeding RUP.

HAPPENINGS

Caitlin Stephenson has recently joined the SoyPLUS®|SoyChlor® team as a customer service representative at West Central's Ralston office. Caitlin is an Iowa State University graduate, with a degree in animal science. Her responsibilities will include working to fulfill SoyPLUS® and SoyChlor® orders, and working to assist with customer invoicing and logistics.

Caitlin comes to West Central with nearly ten years experience as a vet assistant at an area veterinary clinic. She can be reached at West Central by calling (800) 843-4769.

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