the California Birth Defect Prevention Act of 1984, which mandates the filling of all "data gaps" relative to reproductive effects of pesticides registered in California; and the California Pesticide Contamination Prevention Act of 1987, which is resulting in the designation of pesticide management zones for areas with known groundwater contamination, restricting use of problem pesticides.

Despite their perceptions about growers' knowledge of these laws, PCAs felt the laws would affect pest management programs in the future—significantly (55.5%) or slightly (37.6%). Only 6.9% felt the laws would have no effect on the use of IPM. Generally, PCAs thought the use of IPM would be increased because of increased legal requirements and growers' increased awareness of pesticide hazards. However, 21.1% also thought some IPM programs would be discontinued because of loss of pesticides necessary for their implementation.

Conclusions

Over the last 8 years, the University of California and others in the public and private sectors have made significant headway in providing pest control advisers with practical IPM materials and techniques. The PCAs surveyed ranked UC Cooperative Extension as the primary source of information for identifying pests and pesticide use information, and a high percentage had at least one of the UC pest management books. A small number of PCAs have begun to use UC's IMPACT computer system, recently made available to them, to obtain IPM information. Efforts to develop and promote pest monitoring and sampling techniques have paid off, with a substantial portion of PCAs in any given crop using UC-recommended monitoring techniques.

PCAs believe recent legislation will increase growers' adoption of IPM. If so, and if PCAs, who are growers' chief advisers on pest control, continue to see UC Cooperative Extension as their most important source of pest management information, the use of information and programs developed by the University of California will grow in the future.

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Comparison of added fats in diets of lactating dairy cows

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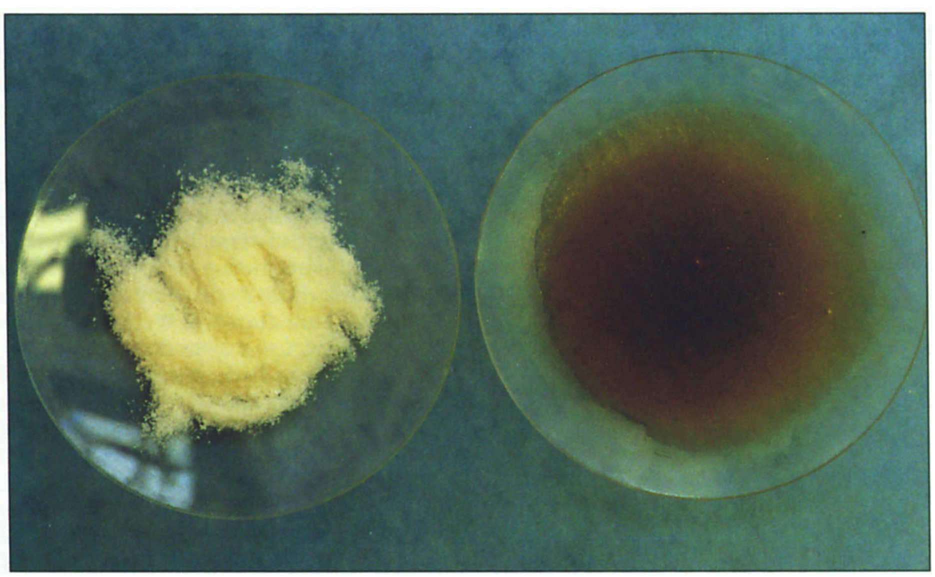
Type of fat—Alifet or grease—did not affect the production or composition of milk or feed intake of dairy cows during a 6-week study. Both types resulted in high feed intakes and similar milk yields.



Alifet (left), a commercial crystalline animal fat in a wheat starch carrier, is added to dairy cow rations in powder form. Liquid grease (right), a combination of waste animal fats and vegetable oils, contains more polyunsaturated fatty acids, believed to be harmful to rumen microbes.

Adding fat to the rations of high-producing dairy cows increases the energy density of the diet and increases milk production during early lactation, when the need for maximum energy intake is greatest. It is for this reason that fats (triglycerides) are frequently added to dairy rations to replace a portion of the cereal component. Ruminants, however, can tolerate only a limited amount of fat in their diets. Dairy rations normally contain between 3% and 5% fat (total ration basis), which is about 10% to 18% of the net energy intake for a dairy cow. (Humans may get 40% or more of their daily caloric intake from fats.) In cows, excess dietary fat has been associated with poor fiber digestion, which ultimately reduces feed intake and milk production.

Ruminant digestion of fats present in typical feedstuffs is depicted in figure 1. Much

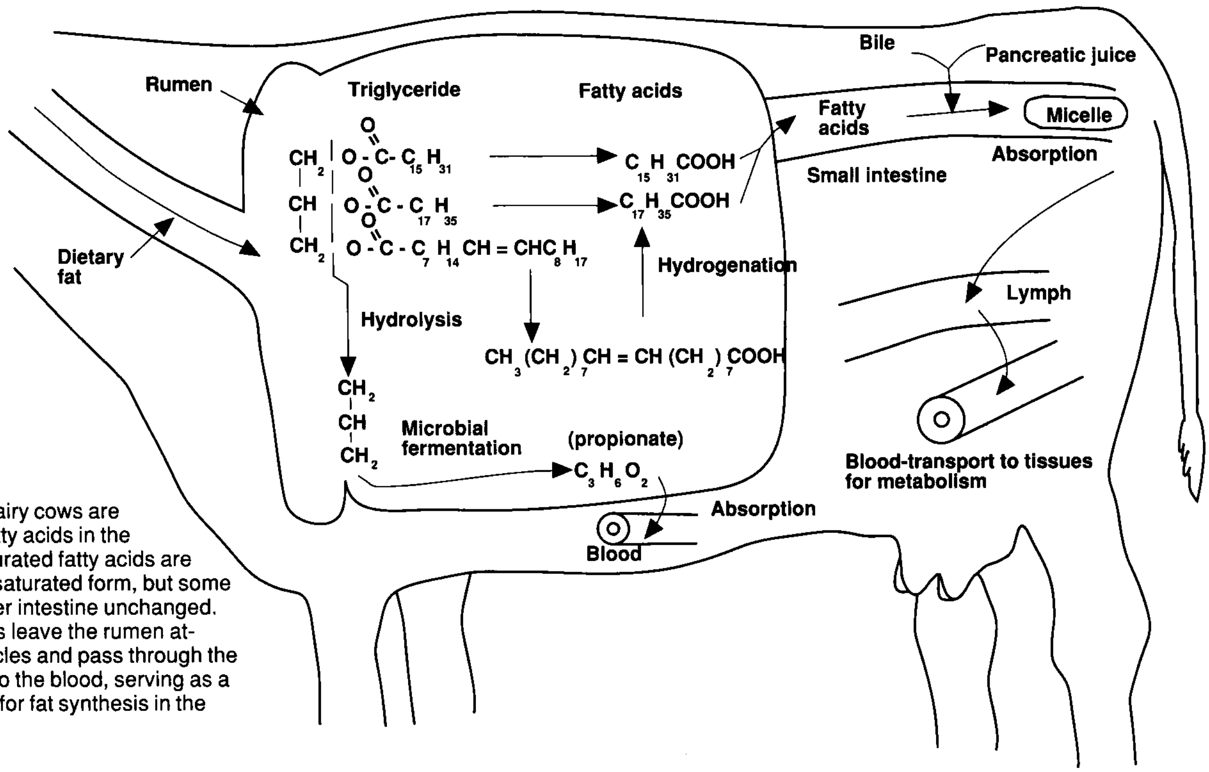


Fig. 1. Fats fed to dairy cows are broken down into fatty acids in the rumen. Most unsaturated fatty acids are there changed into saturated form, but some escape into the lower intestine unchanged. Saturated fatty acids leave the rumen attached to feed particles and pass through the digestive system into the blood, serving as a source of energy or for fat synthesis in the mammary gland.

of the fat is broken down to fatty acids and glycerol, with subsequent change of unsaturated fatty acids to saturated fatty acids. A small amount of fat may escape the rumen to the lower digestive tract. Although a high proportion of the unsaturated fatty acids is saturated (hydrogenated) by microbial action, hydrogenation may be less complete when high-concentrate diets are fed, resulting in greater amounts of unsaturated fatty acids in the rumen. The challenge is to include high levels of fat in the diet of dairy cows to achieve maximum milk production and not adversely affect rumen metabolism.

The commercial product Alifet is reported by its manufacturers to be inert in the rumen. This suggests that it will have little effect on the microbial population of the rumen. Possible reasons for Alifet's inert properties are the fatty acid component and their esterification. A high degree of saturation and long-chain fatty acids result in a fat with a high melting point, often referred to as a "hard" fat. If the fat is hydrolyzed in the rumen, the saturated fatty acids (C16 and C18) are not readily soluble in rumen fluid. Finally, fatty acids in the triglyceride form (esterified) are less harmful to rumen microbes than are free fatty acids (non-esterified).

Alifet is a crystalline animal fat consisting of 92% crude fat in a wheat starch carrier. In powder form, it is easier to weigh and handle than liquid fat. Liquid fat, on the other hand, may improve palatability by reducing dustiness when other wet feed ingredients are not included.

Compared with the grease used in our experiment, Alifet contained more saturated (C16 and C18) and less unsaturated (C18:1, C18:2, and C18:3) fatty acids (table 1). Grease is a combination of animal fats and/or restaurant greases, mainly vegetable oils. In past years, the latter product contained more animal fats than vegetable oils, but with recent concerns about saturated fats in human diets, there has been a shift to a greater proportion of vegetable fats in grease. The vegetable fats contain more of the mono- (C18:1) and poly-unsaturated (C18:2 and C18:3) fatty acids, believed to be more harmful to the rumen microbes than fatty acids from animal fats such as tallow. The differences in fatty acid compositions of fats are shown in table 2.

We conducted a short-term experiment to evaluate the effects on milk yield, milk composition, and feed intake when either grease or Alifet were included in the diet of lactating cows.

TABLE 1. Fatty acid profiles of Alifet and grease

Fatty acid	Alifet	Grease
	g/100 g fat	
C8	—	.08
C10	.03	.02
C12	—	.16
C14	3.73	1.79
C16	26.15	20.64
C16:1	2.69	4.16
C18	35.46	12.25
C18:1	31.61	43.79
C18:2	.03	15.39
C18:3	.30	1.72

TABLE 2. Fatty acid profiles of selected fats*

Fatty acid	Corn oil	Cottonseed oil	Tallow	Grease	Chicken
			g/100g fat		
C8	—	—	.02	.09	.01
C10	—	.07	.08	.09	—
C12	—	.09	.32	.67	—
C14	1.23	.75	3.44	2.38	.69
C16	11.32	22.75	25.58	17.96	25.79
C16:1	.48	.50	4.95	4.15	9.67
C18	2.19	2.33	15.14	12.05	4.32
C18:1	26.17	17.86	40.94	46.84	42.02
C18:2	56.85	55.55	8.53	12.84	16.60
C18:3	1.76	.10	1.00	2.93	.90

* Fatty acid profiles as determined in our laboratory.

Jack Kelly Clark

Alifet, a commercial animal fat product in powder form, is normally added to dairy cow rations to provide a higher energy intake, but co-author Treasure Shell demonstrates that cows like it straight, too. Experiments evaluating the effects of added fats on milk yield, milk composition, and feed intake were conducted by students in a dairy production course at UC Davis to provide them with hands-on research experience.

TABLE 3. Ingredient and chemical composition of rations

Item	Alifet	Grease
Ingredient*:		
Alfalfa hay, chopped	50	50
Beet pulp	10	10
Molasses	8	8
Alifet	4.4	—
Grease	—	4
Cottonseed meal	9.5	9.5
Corn, cracked	15.9	16.3
Dicalcium phosphate	1	1
Sodium bicarbonate	.7	.7
Trace mineral salt	.5	.5
Chemical°:		
Crude protein	18.3	18.9
Acid detergent fiber	21.5	21.3
Neutral detergent fiber	32.8	32.8
Ether extract§	6.0	5.0
Calcium	1.00	1.09
Phosphorus	.50	.55

* Ingredient composition on an as-is basis. Since Alifet is approximately 92% fat, more was added to equal fat from grease.
° Chemical constituents are % on 100% dry basis.
§ Ether extract is an estimate of total crude fat content.

TABLE 4. Performance of cows fed Alifet and grease rations

Item	Alifet	Grease
Milk, kg/day	27.2	26.3
Dry matter intake, kg/day	21.6	22.6
Dry matter intake,* %BW	3.67	3.77
Milk composition, %		
Fat	3.38	3.40
Protein	3.08	3.10
Casein	2.21	2.21
Lactose	4.78	4.78
Solids-not-fat	8.65	8.69
Total solids	12.01	11.98

* Dry matter intake expressed as % of body weight.

Methods

Eight milking Holstein cows were used—four first lactation and four second or later lactation cows. Cows were paired by lactation number, milk yield, and days in milk. We used a cross-over design with two 3-week periods. In the first period, four cows received the Alifet diet, and four the grease diet. In the second period, diets were switched, so that all cows received both diets during the experiment.

Diets were formulated to be equal in crude protein, acid detergent fiber, neutral detergent fiber, and crude fat, although the Alifet diet contained more fat (table 3). The major difference was the source of fat. Cows were fed using Calan electronic doors twice a day, which allowed measurement of individual feed intakes.

Cows were milked twice daily, and yields were recorded. Milk samples were collected from each cow during week 3 of each period and analyzed for fat, total protein, casein, lactose, solids-not-fat, and total solids content. Cows were weighed weekly.

Results

Cows fed Alifet produced approximately 2.2 pounds (1 kg) more milk per day than cows fed grease, but the difference was not statistically significant. Dry matter intakes were not significantly different. Feed intakes of all cows were good, ranging from 3.67% to 3.77% of body weights. This result suggests that neither type of dietary fat adversely affected rumen microbes. Milk fat, protein, casein, lactose, solids-not-fat, and total solids were not affected by fat source. The overall results indicate that there were no differences in performance of cows due to the fat source.

It should be noted that studies of this length are sufficient to evaluate effects of diet on milk composition, but are too short to adequately appraise milk yield and feed intake. Another factor to consider is use of these fat sources in early lactation, when milk production and feed intake are maximum and the need for dietary energy is greatest. The results obtained during an early-lactation study would provide the best comparison of the two fat sources. Trials appraising the digestibility of Alifet are also needed.

Edward J. DePeters is Associate Professor; Kim D. Rager, Marilyn K. Pontius, Laura C. Hart, and Brian K. Hamilton are Animal Science undergraduate students; and Treasure M. Shell and Scott J. Taylor are Staff Research Associates, all in the Department of Animal Science, University of California, Davis. *The authors wish to thank C. Hamilton and B. Cook of Calva Products, Inc. for donation of the Alifet product.*

The project reported here was conducted by students in the upper division dairy production course (ANS 114) at UC Davis. It was one of four student group projects conducted during the spring quarter of 1988 to provide students with practical research experience in animal nutrition, reproduction, genetics, and health.