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Keaschall, K. E.; Moser, B. D.; Peo, Jr., E. R.; Lewis, A. J.; Crenshaw, T. D.; and Butler, Win, "'Dried Fat" for Growing-Finishing Swine" (1983). *Faculty Papers and Publications in Animal Science*. 665.
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"DRIED FAT" FOR GROWING-FINISHING SWINE^{1,2}

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Summary

Three trials were conducted to determine the effect of "dried fat" (fats absorbed on carriers) in diets for growing-finishing swine. In trial I pigs receiving diets containing 5% added fat gained faster (.74 vs .71 kg/d), consumed less feed (1.87 vs 2.43 kg/d) and had a better feed efficiency (2.52 vs 2.88) than pigs fed diets without added fat (all $P < .01$). Pigs given the "dried fat" treatments gained faster ($P < .01$) and more efficiently ($P < .01$) than pigs fed the nonfat carrier counterpart. "Dried fats" containing whey plus fat and wheat bran plus fat produced similar performance to that observed with pigs fed a conventional tallow diet. Pigs fed verxite plus fat had higher feed intakes and feed:gain ratios ($P < .01$) than pigs on the other two "dried fat" treatments. In trial II, diets with 5% added fat had higher ($P < .01$) average apparent energy and protein digestibilities than the diets without added fat. Each treatment containing "dried fat" resulted in higher ($P < .01$) apparent energy and protein digestibilities than did the nonfat counterpart. The verxite plus fat diet had a lower apparent protein and energy digestibility than the bran plus fat and whey plus fat treatments. The third trial was conducted to determine the interaction between protein and energy content of the diet. Five treatments contained 14% protein and five, 18% protein. "Dried fat" (HoMile 7-60) was added to provide 0, 4, 8, 12 and 16% added fat within each protein level. Average daily gain

and feed efficiency improved linearly ($P < .01$) as the level of added fat increased in the diet. Backfat increased ($P < .05$) as the level of fat increased in the diet. Pigs receiving the 14% protein diets had more backfat ($P < .01$) than those given the 18% protein diets (3.79 vs 3.52 cm).

(Key Words: Fat, Protein, Digestibility, Swine.)

Introduction

Research with swine has shown that as the energy concentration of the diet increases, feed intake will decrease without adversely affecting gain, thereby resulting in an improvement in feed efficiency. Hale et al. (1968) and Moser (1977) found that feed efficiency was improved with fat additions as low as 2%. Brooks (1972) reported that soybean oil, tallow and mixed fats were equally effective in improving feed efficiency. McDonald and Hamilton (1976) also observed improved feed efficiency of swine by dietary additions of tallow, rapeseed oil and soybean oil. Seerley et al. (1978) concluded that animal fat and poultry fat were equally effective in improving feed conversion of swine.

One of the major problems in adding fat to swine diets is the preparation and mixing of the diets. Fats such as tallow or lard must be melted before being blended into the diet. The melted fat must then be added slowly to prevent solidification of the fat before it is properly mixed. A number of commercially available so-called "dried fat" products have been reported to eliminate the physical problems of adding fat to diets. "Dried fat" products are composed of carrier substances that absorb and retain the fat. These are products that can be bagged and added to swine diets like conventional supplements. However, the availability of energy in these dried fat products is unknown.

The objectives of these experiments were to determine: 1) the effect of various fat sources

¹ Published as Paper No. 6768, Journal Ser. Nebraska Agr. Exp. Sta.

² Research supported in-part by Fats and Protein Research Foundation, Des Plaines, IL.

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and their carriers on weight gain, feed conversion and carcass characteristics of growing-finishing swine; 2) the apparent digestible energy of diets containing various fat sources and their carriers and 3) the interaction between protein and energy concentration of the diet.

Experimental Procedure

Trial 1. One-hundred-eight crossbred pigs averaging 9 kg were allotted to nine treatment groups of three pens/treatment and four pigs/pen in a randomized complete block design. The pigs were blocked on the basis of initial weight with equal numbers of barrows and gilts assigned to each treatment. Feed and water were provided ad libitum. Pigs were weighed and feed intake recorded biweekly. The pigs were taken off test when the average weight of the pigs in each pen was approximately 90 kg.

Experimental diets (table 1) consisted of a corn-soybean meal base. The initial diets were calculated to contain 18% protein, .75% Ca and .65% P and were fed from the time the pigs were put on test until they averaged 36 kg. From 36 kg to the end of the trial the pigs received diets containing 16% protein, .65% Ca and .60% P. Treatment 1 served as a control and treatments 4, 6 and 8 contained the various carriers without fat. Treatments 2 and 3 contained conventional fat sources; tallow and lard, respectively. The added fat for treatment 5 was choice white grease absorbed on whey⁶; that for treatment 7 was tallow absorbed on verxite⁷ and that for treatment 9 was animal fat absorbed on wheat bran⁸. Tallow (treatment 2), lard (treatment 3) and the three "dried fat" products (treatments 5, 7 and 9) provided 5% added fat to the diets.

⁶HoMilec 7-60, Product of Merrick Foods, Union Center, WI.

⁷Product supplied by Fats and Proteins Research Foundation.

⁸Bran 40-Product of Merrick Foods, Union Center, WI.

⁹Scanoprobe, Model No. 731, Ithaca Inc., 735 West Clinton Street, Ithaca, NY.

¹⁰Freeze Drier Model No. 10-145 MR-BA, Virtis Freeze-Mobile and Drying chamber, Virtis, Gerdner, NY.

¹¹Tecatoc Kjelttec System 1003 distilling unit and Kjelttec System 20 digester, Hoganas, Sweden.

¹²Model 1241 Adiabatic Calorimeter, Parr Instrument Co., Moline, IL.

Performance data and live backfat thickness were used as criteria of response. Backfat thickness was measured at the first and last rib and last lumbar vertebra with a Scanoprobe⁹. The average backfat of the three measurements was adjusted to a common weight basis (100 kg) using the formula of live weight (kg) divided by common weight (100 kg) times average backfat thickness. Data for all three trials were analyzed using orthogonal contrasts as described by Steel and Torrie (1960).

Trial 2. Fifty-four crossbred barrows with an average initial weight of 34 kg were allotted to nine dietary treatment groups in a randomized complete block design (blocked by initial weight). The dietary treatments were the same as the 16% protein diets used in Trial 1 except for the inclusion of .5% chromic oxide. Chromic oxide served as a marker for the indirect determination of apparent energy and protein digestibilities of the diets according to methods described by Lindahl (1959). Feed and water were provided ad libitum. Pigs were penned individually to prevent cross contamination of feces. Pigs were allowed to become accustomed to the pens and diets for 7 d before the 3-d collection period. Fecal samples were collected once daily on d 8, 9 and 10 by rectal stimulation. The fecal samples from each pig for the 3-d collection period were pooled and frozen for later analysis, as were samples of the diets.

The pooled fecal samples from each pig were thawed and mixed in a blender. Deionized water was added to the samples to allow for proper mixing. Aliquots were then taken from the total 3-d collection and freeze-dried¹⁰. After the samples were dry, the were individually ground through a Wiley mill equipped with a 30-mesh screen to reduce sampling error. Feed samples were also ground and set out with the fecal samples for a 24-h period to allow the moisture of the samples to equilibrate with that of the atmosphere.

Feed and fecal samples were analyzed for dry matter, N, energy and Cr concentration. Nitrogen content of dietary treatments and fecal samples was determined using a Kjelttec apparatus¹¹ by procedures described in AOAC (1980). Energy was determined using an oxygen bomb calorimeter¹² as described by Parr Instrument Company (1978). Chromium concentration was determined by atomic absorption spectroscopy (Williams et al., 1962).

TABLE 1. DIET COMPOSITION

Ingredient	Treatment ^a									
	1	2	3	4	5	6	7	8	9	
	Control	Tallow	Lard	Whey	Whey fat	Verxite	Verxite + fat	Bran	Bran + fat	
					%					
Corn (IFN 4-02-992)	75.21	68.89	68.89	72.28	66.00	72.42	66.13	69.16	62.89	
Soybean meal, 44% crude protein (IFN 5-04-604)	21.14	22.44	22.44	20.83	22.10	21.77	23.05	19.82	21.08	
Tallow (IFN 4-07-880)		5.00								
Lard (IFN 4-04-790)			5.00							
Whey (IFN 4-01-182)				3.34						
HoMile 7-60					8.34					
Verxite						2.14				
Verxite + fat							7.14	7.50		
Wheat bran (IFN 4-08-554)										
Bran 40									12.50	
Dicalcium phosphate (IFN 6-01-080)	1.42	1.47	1.47	1.34	1.39	1.45	1.50	1.09	1.14	
Limestone (IFN 6-02-632)	.63	.60	.60	.61	.57	.62	.58	.83	.79	
Salt (IFN 6-04-151)	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Trace mineral mix ^b	.05	.05	.05	.05	.05	.05	.05	.05	.05	
Selenium premix ^c	.05	.05	.05	.05	.05	.05	.05	.05	.05	
Vitamin premix ^d + ASP250 ^e	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Analysis										
Protein, %	16.71	16.54	16.14	17.10	16.77	16.49	15.97	17.04	16.14	
Ca, %	.69	.73	.75	.77	.71	.72	.76	.88	.81	
P, %	.60	.61	.58	.62	.61	.60	.61	.62	.60	
Gross energy, kcal/kg	3,941	4,237	4,252	3,983	4,263	3,896	4,145	3,936	4,270	

^aFed to pigs from 36 to 90 kg. An 18% crude protein diet with .75% Ca; .65% fed from 9 to 36 kg.

^bProvided the following in mg/kg of complete diet: Zn, 100; Fe, 50; Mn, 27.5; Cu, 5.0; Co, .5; I, .75.

^cProvided .1 mg of Se/kg of complete diet.

^dProvided the following per kg of complete diet: vitamin A, 3,300 USP; vitamin D₃, 440 IU; vitamin E, 22 IU; riboflavin, 2.2 mg; D-pantothenic acid, 13.2 mg; niacin, 17.6 mg; choline chloride, 770 mg; vitamin B₁₂, 22 µg; menadione sodium bisulfate, 2.2 mg; ethoxyquin, 4.4 mg.

^eChlortetracycline 110 mg; sulfamethazine 110 mg; penicillin 55 mg/kg of diet. Withdrawn 15 d before slaughter.

Trial 3. Sixty crossbred pigs with an average initial weight of 20 kg were allotted to 10 treatment groups in a randomized complete block design. Pigs were blocked on the basis of initial weight and sex. All pigs were individually fed and weighed biweekly. Pigs were taken off test when they weighed approximately 90 kg and carcass data were collected. Backfat was measured at the first and last rib and last lumbar vertebra. Loin eye tracings were made at the 10th rib and area was determined with a compensating planimeter. Subjective coloring, marbling and firmness scores were also taken.

Of the 10 dietary treatments used, the first five treatments contained 14% protein and the last five contained 18% protein. Within each protein level, a commercial "dried fat" product (HoMilec 7-60)⁶ was added to provide 0, 4, 8, 12 or 16% added fat. Because HoMilec 7-60 contains whey as a fat carrier, the amount of whey was equalized across diets. Lysine levels were also equalized within each protein level.

Results and Discussion

Trial 1. The main effect of added fat on performance and backfat thickness is shown in table 2. Average daily feed intake (ADFI) was

decreased and feed efficiency (F/G) was improved ($P<.01$) when pigs received diets containing 5% added fat. These findings agree with earlier research by Barrick et al. (1953), Rupnow and Ensminger (1961), Hale et al. (1968), Seerley et al. (1975; 1978), McDonald and Hamilton (1976) and Moser (1977).

Overall, average daily gain (ADG) was also improved (.71 vs .74 kg; $P<.001$) when fat was added to the diet but gain did not appear to be affected by treatment during the first 42-d of the trial. The observation is similar to earlier research by Hillier (1950) and Allee (1976). Moser (1977) observed improved gains with fat additions of 2, 5, 8 and 10%, but not with 13% added fat. In contrast, Seerley et al. (1964; 1975) did not report any improvement in gain with fat additions of 2, 4, 6, 8 or 9%. Brooks (1972) also reported no improvement in ADG when feeding levels as high as 10 and 20% added fat. Backfat thickness of pigs that received diets with 5% added fat was not significantly different from the backfat of pigs that received diets with no added fat.

The effects of the nine dietary treatments on pig performance are shown in table 3. Pigs fed the "dried fat" treatments consumed more ($P<.025$) feed and had a higher ($P<.01$) F/G

TABLE 2. MAIN EFFECT OF ADDED FAT ON PERFORMANCE OF GROWING-FINISHING SWINE

Item	Treatment ^a		CV
	Control	5% added fat	
No. of pigs	48	60	
Avg initial weight, kg	8.68	8.72	
Avg final weight, kg	93.15	93.77	
Average daily gain, kg			
0 to 42 d	.64	.64	
42 d to termination	.74	.80	
0 d to termination ^b	.71	.74	2.95
Average daily feed intake, kg			
0 to 42 d	1.43	1.27	
42 d to termination	2.37	2.23	
0 d to termination ^b	2.03	1.87	3.08
Feed/gain			
0 to 42 d	2.20	1.98	
42 d to termination	3.20	2.78	
0 d to termination ^b	2.88	2.52	2.32
Backfat, cm	2.59	2.67	7.15

^a18% crude protein diets with .75% Ca; .65% P fed from 9 to 36 kg; 16% crude protein diets with .65% Ca; .60% P fed from 36 kg to termination.

^b $P<.001$.

TABLE 3. EFFECT OF FAT SOURCES AND CARRIERS ON THE PERFORMANCE OF GROWING-FINISHING SWINE

Criteria	1 Control	Treatment								CV
		2 Tallow	3 Lard	4 Whey	5 Whey + fat	6 Vexxite	7 Vexxite + fat	8 Bran	9 Bran + fat	
No. of pigs	12	12	12	12	12	12	12	12	12	
Initial avg weight, kg	8.7	8.7	8.7	8.8	8.6	8.6	8.8	8.7	8.8	
Final avg weight, kg ^a	93.3	94.2	94.1	92.0	93.2	93.4	93.1	93.9	94.3	
Average daily gain, kg										
0 to 42 d	.64	.62	.65	.67	.64	.63	.65	.65	.65	
42 d to termination	.76	.78	.84	.75	.78	.72	.80	.73	.79	
0 d to termination ^{bc}	.71	.73	.77	.72	.73	.70	.74	.71	.74	2.95
Average daily feed intake, kg										
0 to 42 d	1.42	1.25	1.20	1.46	1.26	1.42	1.38	1.40	1.27	
42 d to termination	2.34	2.19	2.14	2.34	2.12	2.35	2.44	2.43	2.19	
0 d to termination ^{bcd}	2.01	1.86	1.78	2.02	1.80	2.03	2.04	2.06	1.86	3.08
Feed/gain										
0 to 42 d	2.22	2.01	1.85	2.17	1.96	2.26	2.11	2.15	1.95	
42 d to termination	3.08	2.81	2.54	3.14	2.71	3.26	3.06	3.30	2.75	
0 d to termination ^{bcd}	2.81	2.56	2.32	2.82	2.47	2.95	2.75	2.92	2.51	2.32
Backfat, cm	2.64	2.79	2.59	2.82	2.74	2.34	2.57	2.51	2.67	7.15

^aPigs were taken off test when average pig weight was between 90 and 95 kg.

Orthogonal comparisons:

^bTreatment 1, 4, 6, 8 vs 2, 3, 5, 7, 9 ($P < .001$).

^cTreatment 2, 3 vs 5, 7, 9 ($P < .025$).

^dTreatment 5 vs 7, 9 ($P < .01$).

^eTreatment 7 vs 9 ($P < .01$).

^fTreatment 2, 3 vs 5, 7, 9 ($P < .025$).

^gTreatment 1 vs 4, 6, 8 ($P < .06$).

^hTreatment 4 vs 6, 8 ($P < .02$).

than those receiving diets containing conventional fats. This significant difference was mainly due to the excellent performance of the pigs given the lard treatment and the poor performance of the pigs given the verxite + fat treatment. The performance of pigs fed the whey + fat and bran + fat treatments was similar to that of pigs receiving the tallow treatment.

In comparing the treatments containing "dried fat" with the nonfat counterparts, weight gain and feed conversion were improved ($P < .01$) with the added fat in each instance. The ADFI of pigs that received the whey + fat and wheat bran + fat was lower than for pigs that received the nonfat counterparts. Pigs that received the verxite and those that received verxite + fat had similar feed intakes, but pigs that received verxite + fat gained faster ($P < .002$) and more efficiently ($P < .001$). None of the differences in backfat thickness were significant. These results are similar to those reported by Moser (1977), who found no adverse effects of fat on backfat when the fat addition was less than 13% of the diet. Earlier research by Seerley et al. (1964) also revealed no adverse effect on backfat thickness from addition of either 4 or 8% fat. In contrast, Allee (1976) reported increased backfat thickness in pigs fed diets containing either 3 or 9% fat. Brooks (1972) reported increased backfat when feeding 10 and 20% fat diets.

The three carriers without fat (whey, verxite and wheat bran) had no effect on ADG or ADFI when compared with the corn-soybean meal basal diet. However, pigs fed the control diet had a better feed conversion ($P < .06$) than the average of pigs that received the carriers without fat. In comparing the carriers without fat, the whey treatment resulted in better ($P < .02$) feed efficiency than the verxite and wheat bran treatments. Verxite is an inert bulky mineral substance containing no available energy, which could explain the poorer feed efficiency. Because wheat bran contains less digestible energy than whey and corn, the energy concentration in the wheat bran treatment was also low. There were no significant differences in backfat thickness among any of the pigs fed treatments with added fat.

In comparing the two conventional forms of fat, pigs that received diets with 5% lard gained significantly faster and more efficiently than pigs fed diets containing 5% tallow. There was no difference ($P > .10$) in either ADFI or backfat

thickness between pigs given tallow and lard. When comparing the "dried fat" products with one another, no difference was found in either ADG or backfat thickness among the pigs receiving the three products, but ADFI and F/G were higher for pigs receiving the verxite + fat than for pigs receiving the other dried fat products. The gross energy of all three treatments containing dried fat products varied slightly, but the digestible energy from the verxite product apparently was not as high as for the other treatments.

Trial 2. Apparent energy and protein digestibilities were significantly improved when 5% fat in conventional or "dried" form were added to the diet (table 4). The average apparent energy digestibility of all diets containing supplemental fat was 81.5% compared with 76.8% for diets without added fat. A similar improvement in apparent protein digestibility was also observed (76.5 vs 70.8%) when fat was added to the diet. In each set of diets, the treatment with fat resulted in a higher energy and protein digestibilities than did the nonfat counterpart.

There were no differences in apparent energy and protein digestibilities between the control diet without added fat and the average digestibilities of the three carriers without fat. However, differences in digestibilities between the three carriers did exist. The verxite without fat diet (treatment 6) had a lower ($P < .02$) apparent energy and protein digestibilities than the whey and bran diets (treatments 4 and 8).

The average apparent energy and protein digestibilities were not different between the average of the "dried fat" treatments and the conventional fat (tallow and lard) treatments. There were no differences in digestibilities within the conventional fat treatments, but there were differences within the "dried fat" treatments. The verxite + fat treatment was lower in both apparent energy and protein digestibilities than the other two "dried fat" treatments (table 4). There was a trend for the whey + fat treatment to be higher in energy digestibility than the bran + fat treatment. Protein digestibility was higher ($P < .10$) for the whey + fat treatment than for the bran + fat.

The increase in energy digestibility is similar to that reported by Greeley et al. (1964a), who found a linear increase in apparent energy digestibility with additions of 0, 4, 8 and 12% added fat. The increase in diet digestibility was quite predictable because fat is a highly diges-

TABLE 4. EFFECT OF FAT SOURCES AND FAT CARRIERS ON DIGESTIBILITIES OF DIETARY ENERGY AND PROTEIN

Item	Treatment									CV
	1 Control	2 Tallow	3 Lard	4 Whey	5 Whey + fat	6 Verxite	7 Verxite + fat	8 Bran	9 Bran + fat	
Energy digestibility, % ^{abc}	78.25	81.29	83.49	79.23	84.48	72.32	77.67	77.22	80.57	6.71
Protein digestibility, % ^{abde}	72.65	76.66	75.59	73.74	79.37	65.92	74.03	70.84	77.02	5.06

Orthogonal comparisons:

^aTreatment 1, 4, 6, 8 vs 2, 3, 5, 7, 9 ($P < .01$).

^bTreatment 6 vs 4, 8 ($P < .02$).

^cTreatment 7 vs 5, 9 ($P < .11$).

^dTreatment 7 vs 5, 9 ($P < .03$).

^eTreatment 5 vs 9 ($P < .10$).

tible energy source. Tribble (1975) reported an increase in apparent energy digestibility with the addition of fat to diets for growing swine. However, he did not observe an increase in apparent energy digestibility with the addition of fat to the diet of finishing pigs. The increased protein digestibility due to the addition of fat confirms earlier research by Lowrey et al. (1958) and Asplund et al. (1960). Both groups of researchers reported that the addition of fat to swine diets increased apparent protein digestibility. Clawson et al. (1962) and Greeley et al. (1964a) reported nonsignificant numerical increases in apparent protein digestibility when fat was added to swine diets.

Apparent energy and protein and digestibilities of swine diets were improved with the addition of 5% fat. Fat in the form of "dried fat" products was equally effective in increasing the apparent nutrient digestibility by swine as liquid fat when compared with diets without fat. However, diets containing verxite with and without fat resulted in lower apparent protein and energy digestibilities. The verxite product appeared to be a poor carrier for fat, whereas wheat bran and whey were effective carriers that did not reduce diet digestibility.

Trial 3. As shown in table 5, pigs fed the 14% protein diets tended to gain faster than pigs fed 18% protein diets. There were no significant protein $\times$ fat interactions for any of the response criteria. Average daily gain increased ($P < .01$) linearly as the level of added fat increased in the diet. The increase in ADG from added fat confirms data described in Trial 1. Moser (1977) reported a quadratic effect of added fat on ADG. Gains improved with 2.5, 5.2, 7.9 and 10.5% added fat in the diet and then declined with 13% added fat. In contrast, Seerley et al. (1964) did not observe any response in ADG when 2, 4 or 8% fat was added to swine diets.

Daily feed intake was influenced by protein and fat level. Pigs fed the 14% protein diets consumed more ($P < .10$) feed than those fed diets containing 18% protein. Earlier research by Clawson et al. (1962) and Greeley et al. (1964a) showed that ADFI and ADG were not different between protein levels ranging from 13 to 19 and 16 to 18%, respectively, in the presence of added fat. Seerley et al. (1964), however, found a response to fat and protein levels in both ADG and ADFI. Pigs fed low protein diets (12.5%) consumed more feed than pigs fed high protein diets (14.4%). Feed intake

TABLE 5. PERFORMANCE OF PIGS FED DIFFERENT LEVELS OF "DRIED FAT"^a AND PROTEIN

Criteria	Protein level		Avg effect of fat
	14%	18%	
Daily gain, kg ^{bc} % fat			
0	.88	.83	.86
4	.87	.83	.85
8	.93	.90	.92
12	.96	.93	.95
16	.97	.95	.96
Avg effect of protein	.92	.89	
Feed Intake, kg ^{bde} % fat			
0	2.45	2.30	2.38
4	2.23	2.18	2.21
8	2.26	2.18	2.22
12	2.21	2.06	2.14
16	2.09	2.00	2.04
Avg effect of protein	2.25	2.14	
Feed efficiency ^{bf} % fat			
0	2.45	2.30	2.38
4	2.56	2.65	2.61
8	2.44	2.42	2.43
12	2.31	2.24	2.28
16	2.15	2.10	2.13
Avg effect of protein	2.45	2.44	

^aHoMile 7-60.^bLinear fat effect ($P < .05$).^cCV = 10.97%.^dProtein effect ($P < .10$).^eCV = 10.50%.^fCV = 10.70%.

decreased linearly ($P < .01$) as the fat level of the diet increased. Barrick et al. (1953), Clawson et al. (1962), Seerley et al. (1964; 1978) and Greeley et al. (1964a) all reported a decrease in feed consumption when fat was added to the diet. Moser (1977) found a high negative correlation ($r = -.99$) between feed intake and energy level of the diet.

Feed efficiency was not affected by protein level. However, increasing levels of added fat caused a linear improvement ($P < .01$) in F/G (table 5). Brooks (1972) reported that F/G was negatively correlated ($r = -.95$) to energy concentration of the diet. McDonald and Hamilton (1976) also reported improved feed conversion when various types of fats were added to swine diets.

Mitchell et al. (1965) reported that the need

for lysine increased as the energy concentration in the diet increased. They estimated the lysine requirement for a 19-kg pig to be .23%/1,000 kcal metabolizable energy. The average gross energy of the 14% protein diets used in this study was 4,238 kcal/kg and the lysine content was .79%. Assuming that 80% of the energy was metabolizable, the lysine level in the diet would be .233%/1,000 kcal ME. Therefore, one would not expect an improvement in feed efficiency by increasing the protein level because the lysine requirement (first limiting amino acid) had been met with the 14% protein diets.

Backfat increased ($P < .01$) as the level of added fat increased in the diet (table 6). Pigs fed the 14% protein diets had more backfat than the pigs fed the 18% protein diets. Seerley

TABLE 6. EFFECTS OF FAT SOURCES AND FAT CARRIERS^a ON CARCASS BACKFAT AND LOIN EYE AREA

Criteria	Protein level		Avg effect of fat
	14%	18%	
Backfat, cm ^{bcd} % fat			
0	3.63	3.48	3.56
4	3.48	3.38	3.43
8	3.86	3.73	3.80
12	3.83	3.45	3.64
16	4.14	3.58	3.86
Avg effect of protein	3.79	3.52	
Loin eye area, cm ^{2e} % fat			
0	28.0	25.8	26.9
4	27.4	28.3	27.8
8	27.3	25.7	26.5
12	24.7	27.2	26.0
16	25.5	25.2	25.4
Avg effect of protein	26.5	26.4	

^aHoMile 7-60.^bEnergy effect (P<.05).^cProtein effect (P<.01).^dCV = 10.72%.^eCV = 11.86%.

et al. (1964) reported that pigs fed a high protein diet (14.4%) produced carcasses with a significantly higher percentage of lean cuts, a larger loin eye and less backfat than pigs fed a lower protein diet (12.5%). Allee (1976) found that when diets were formulated on a calorie-protein basis, the loin eye area increased and the backfat decreased compared with pigs receiving diets that were not adjusted for the increased energy concentration. In contrast, Clawson et al. (1962) and Greeley et al. (1964b) did not observe any effect of different dietary protein and energy levels.

Overall, addition of dietary fat increased backfat thickness; however, the first increment of added fat resulted in a numerical decrease in backfat. This finding is unexplainable, but could be related to an energy sparing effect on protein thereby allowing animals to express their genetic capacity towards leanness. Higher levels of fat probably exceeded energy demands for lean tissue production and energy was deposited as fat. This effect appeared within each protein level. Moser (1977) reported a

similar finding. In his study, low levels of added fat (2.6 and 5.2%) decreased backfat thickness, whereas 13% added fat increased backfat thickness. It appears that small amounts of fat (up to 5%) can be added to growing and finishing swine diets without adversely affecting carcass composition.

Neither protein nor fat level significantly influenced loin eye area (table 6). There were no significant differences in color, firmness or marbling scores due to the main effects of either fat or protein.

The addition of dietary fat from "dried fat" products was effective in improving ADG and F/G for growing and finishing pigs, but increased backfat thickness when fed at higher levels. "Dried fat" eliminated the handling problems of adding fat to swine diets. The added fat, even in the "dry" state, was effective in reducing the dust in the diet. Pig performance was not improved by increasing dietary crude protein levels from 14 to 18% in the presence of added fat. However, carcass characteristics appeared to be improved with the higher protein level.

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The 20th annual Cornell University Agribusiness Executives Program is scheduled for June 6–17, 1983 at the New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14853. Interested parties should contact: Dr. R. D. Aplin, Agribusiness Executives Program, Cornell University, 305 Warren Hall, Ithaca, NY 14853, (607)256-3068.

An International Symposium on Animals as Waste Converters will be held November 30–December 2, 1983 at the Agricultural University at Wageningen, Netherlands. Papers are invited and an abstract (in English) should be sent to the organizing committee by June 1. For information please contact: Dr. E. H. Ketelaars, Secretary of the Organizing Committee, Zodiac, P.O. 338, 6700 AH Wageningen, Netherlands.

NEW BOOKS

The proceedings of the 9th Technical Conference on Artificial Insemination and Reproduction and Inseminator Training Mini-Conference that was held April 29–May 1, 1982 is available. For information on obtaining a copy, please contact: The National Associ-

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ERRATUM

Vol. 56, No. 2, p. 286 entitled “ ‘Dried Fat’ for Growing-Finishing Swine” by K. E. Keaschall, B. D. Moser, E. R. Peo, Jr., A. J. Lewis and T. D. Crenshaw. On page 293, table 5, the data reported for feed efficiency that are in error are as follows: line 1 under feed efficiency^{bf} %fat, that reads: 2.45, 2.30, 2.38 should read: 2.80, 2.80, 2.80.