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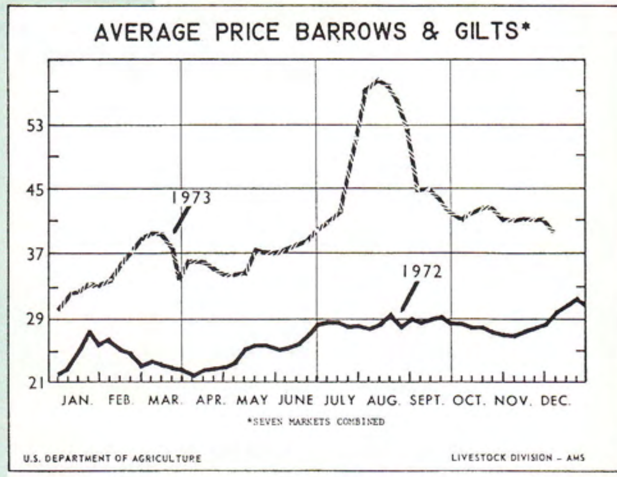
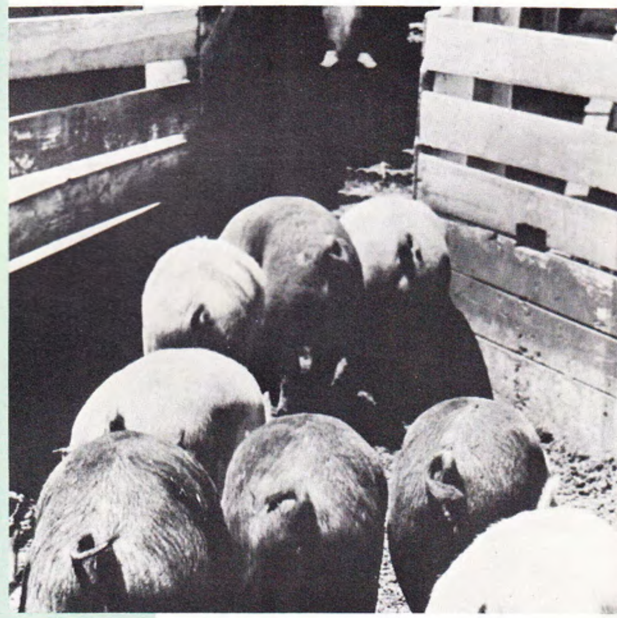


NEBRASKA SWINE REPORT



- Breeding
- Disease Control
- Nutrition
- Economics
- Housing

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Feed Prices and Protein Levels for Pigs

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In the past few years, much attention and research has been directed toward levels of protein for growing-finishing swine. Levels of protein for swine diets have been recommended based primarily on optimum performance (gain and feed conversion) and within an assumed range of grain and protein supplement prices.

When grain or protein prices move beyond the assumed range, questions arise as to the proper level of protein. In 1973, swine producers were faced with extremely high protein prices, but near normal grain prices. In 1974, the reverse may be true, with lower protein prices and high grain prices. Therefore, questions have been asked such as: Due to the increased price of grain or protein, is it more economical to lower the protein levels in my swine diets even though sub-optimal pig performance may result? Or, would it be more economical to pay the higher feed prices, feed higher levels of protein, and strive for maximum gains and feed conversions?

The objective of this article is to provide information which should help answer the question: Which are the most economical protein levels to feed in a situation of variable corn and soybean meal prices?

Basic Data

In order to answer the above question, gains and feed conversions must be obtained for pigs of different weights fed different protein levels which will be representative of the industry. The results of more than 20 such experiments were reviewed to determine the expected performance on different levels of protein.

Weighted averages of the performance of pigs on various protein levels are reported in *Table 1*. These are based on those studies which used protein levels and experimental procedures which were applicable to this analysis.

Economic Analysis

A break-even analysis was applied to the data in *Table 1* to determine the effect which corn and soybean meal prices have on the selection of protein levels in swine growing-finishing rations. The three weight groupings used are those shown in *Table 1*: 40-100 pounds, 100-170 pounds, and 170-250 pounds. This in no way suggests that producers should feed hogs to 250 pounds, but reflects the weight ranges for which data were available.

The results of the analysis are shown in *Figure, 1,* with one chart for each weight group. The lines in each chart represent break-even points, or divisions, between suggested protein levels. The spaces between the lines represent areas in which a given protein level is suggested.

The suggested protein levels shown on the charts represent those levels which produce the lowest cost of gain. Rations which resulted in slower gains were charged penalties for the added labor, utilities, buildings, and equipment costs which would be incurred if they were fed.

To use the charts, let's look at an example, using the 40-100 pound weight range. If corn is $2.00 a bushel, and soybean meal is $100 per ton, we arrive at point (a) via the dotted lines. This point is in the 16 percent area of the chart. Thus, at these corn and soybean meal prices, a 16 percent ration would take these pigs from 40 to 100 pounds at a lower cost than a 14 percent or an 18 percent ration would.

But, if soybean meal is $300 per ton and corn is still $2.00 a bushel, we arrive at point (b), which is in the 14 percent area. Thus, we would switch from a 16 percent to a 14 percent ration when the soybean meal price increased, from $100 per ton to $300 per ton, in order to put gain on the size of pig for the lowest cost.

If soybean meal is $175 per ton, and corn is $2.00 a bushel, we arrive at point (c), which is about on the boundary line between 16 percent and 14 percent. Thus, we are at a break-even point. A 16 percent or a 14 percent ration would result in about the same total cost of gain. Normally we would choose the higher protein ration (16 percent), because the animals would probably reach market weight sooner for the same cost. But, you may also want to consider one of the following alternatives in such a "border line" situation.

1. Consider feeding the higher protein ration (16 percent in the example) while the pigs are in the lower part of the weight range, and start feeding the lower protein ration when they reach the upper part of the weight range.

2. Consider feeding a ration with a protein level which is in between the two. In this example, a 15 percent ration would be appropriate for areas near "boundary line" between 16 percent and 14 percent rations.

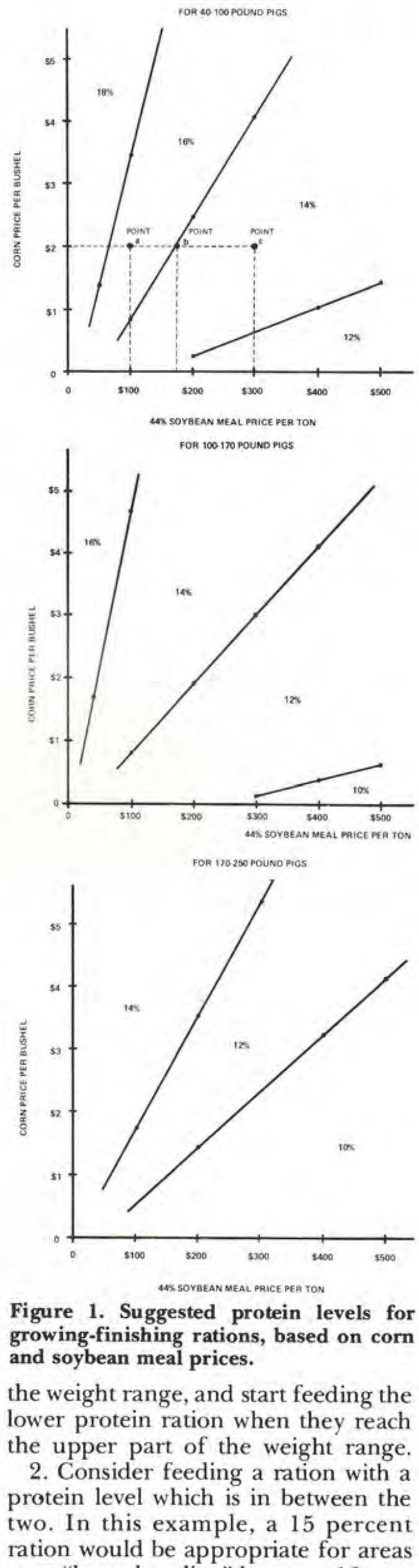

Figure 1. Suggested protein levels for growing-finishing rations, based on corn and soybean meal prices.

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Protein Levels

(continued from page 3)

3. If you will not have a new batch of pigs waiting for the facility, and if you have extra time to care for the pigs, you might choose the lower protein ration if you are close to a "border line".

The charts in *Figure 1* are intended as a guide for you to use in selecting protein levels. Variation in type of hogs, environment, management, protein source, etc. will affect individual decisions. But, the feed price flucuations which we are now realizing under our open market farm economy make it imperative that you consider corn and soybean meal prices when deciding on the protein levels of your swine rations.

The following points of explanation should be considered when reading the charts in *Figure 1:*

1. Pigs which are fed a lower protein ration will generally take longer to reach market weight. But, the added time may not be as great as you think. Based on the data in *Table 1*, pigs which are fed rations of 14 percent from 40-100 pounds, 12 percent from 100-170 pounds, and 10 percent from 170-250 pounds will take about seven days longer to go from 40-250 pounds than pigs which are fed rations of 18, 16 and 14 percent in each of the weight ranges.

The time required to reach market weight becomes a more important consideration when: (a) the hog market is trending upward or downward; (b) you have rigid production schedules to meet in your buildings; (c) you want rapid turnover; or (d) you want to maximize weight gains per facility unit.

2. The analysis presented in *Figure 1* does not answer the question of whether you should feed hogs or not. It assumes that you have made a decision to feed hogs, and it shows you what protein levels will allow you to get the hogs to market weight at the lowest cost.

3. The different protein levels shown may result in minor differences in carcass quality. It is doubtful if this would significantly affect the price a producer receives for his hogs.

4. The charts in *Figure 1* reflect added carrying costs of slower gaining hogs resulting from lower protein rations. Producers with loose production schedules and who have the extra time required can justify a slightly lower protein level than those shown in *Figure 1*.

5. The charts in *Figure 1* are based on rations which use soybean meal as the only protein supplement. More expensive protein sources would result in lower suggested protein levels than shown in *Figure 1*. The opposite is true for lower cost protein supplements.

6. Does the market hog price affect the protein level which you should feed? It does *only* if the protein level affects the number of hogs you market per year, or the weight at which they are marketed. The effects of an uptrending or downtrending market have already been mentioned.

If you have enough slack in your production system to hold hogs up to a week longer than normal, you could adjust your protein levels within the relevant ranges of *Figure 1* and still market the same number and weight of hogs as you normally would, and produce them for a lower cost. The analysis in *Figure, 1* is aimed at a producer in this situation. Thus, market hog price is not considered as a factor in the analysis.

Table 1. Average daily gain and feed per pound of gain as affected by weight of pig & protein level of ration.[a]

Weight range, lb.	Protein level, %	Avg. daily gain, lb.	Feed/ gain, lb.
40–100#			
	12	1.27	3.16
	14	1.38	2.58
	16	1.46	2.48
	18	1.51	2.53
100–170#			
	10	1.26	5.08
	12	1.65	3.56
	14	1.70	3.30
	16	1.73	3.39
170–250#			
	10	1.71	4.37
	12	1.80	3.92
	14	1.76	3.80

[a] Table values are weighted averages from applicable studies.

Alfalfa and the Gestation Diet

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North Platte Station

Favorable results in several preliminary studies using alfalfa extensively in growing-finishing and gestation diets prompted the following study of alfalfa in the gestation diet.

A diet composed of locally produced alfalfa hay plus added minerals and vitamins was fed as the complete pelleted gestation diet. The composition of the diet is shown in *Table 1*.

Initially we selected 20 crossbred gilts of Yorkshire, Hampshire, Duroc lineage from the North Platte Station herd to be placed on this study. Immediately after the animals were bred, we placed them on the gestation diet. We allowed them four pounds per animal per day throughout gestation.

Following parturition, we gradually introduced the animals to a conventional lactation diet which after seven days was their complete ad libitum diet until their offspring were weaned at 21 days of age. We then placed the animals on a 14 percent corn-soy diet until they were bred, when we again

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The Effect of Diet on Reproductive Performance of Gilts

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The recent high prices of supplemental protein have caused many pork producers to feed diets with protein levels below those considered optimum for growth and feed efficiency. Producers usually realize that reductions in growth and efficiency will result, but feel that savings from reduced ration costs more than offset the reduced performance.

One factor generally not considered when lowering the protein content of growing-finishing rations is the effect on subsequent reproductive performance of gilts. Even though reproductive performance is of overriding economic importance, little research is available on the effects of restricted protein. The results of an experiment conducted at Nebraska provide some data relative to this point. The results indicate that restricted dietary protein during the growing-finishing phase may cause reduced reproductive performance.

Experimental

Two levels of dietary protein were fed to Gene Pool gilts between weaning (about 30 pounds) and 175 pounds. One group of gilts received a 10 percent protein diet (high lysine corn plus vitamins and minerals). A second group of gilts received a 14 percent protein corn-soybean meal diet. The gilts were fed in groups of 18 to 20 in open lots and were weighed and probed when they reached 175 pounds.

The experimental period was ended for all remaining gilts after 150 days on the diets. After removal from test, all gilts were fed a standard 14 percent protein corn-soybean meal diet. Estrous observations, to determine age at puberty, were made once daily with intact boars beginning at approx-

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Alfalfa Rations

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placed them on the alfalfa gestation diet. We again used the previous feeding and management regime. For the third litter of the original gilts, management was comparable to the previous two litters.

Performance of the animals and their offspring for the three successive gestations is reported in *Table 2*. As is shown in this table, the initial gestation period resulted in 19 litters from the original 20 gilts. Sixteen litters were farrowed in the second gestation. One of the original farrowing gilts failed to conceive and two litters were lost as a result of farrowing outside (frozen). The third gestation period resulted in the production again of 19 litters.

As noted in *Table 2*, there was a slight reduction in the birth weight of the pigs farrowed in the second gestation. This could be attributed partly to the winter months when dam maintenance requirements are somewhat greater. We allowed no compensation for winter feeding of sows. The animals were maintained throughout all gestations at a daily intake of four pounds per animal per day.

The first and third litters of the respective sows were farrowed under field conditions (two-sow farrowing houses), whereas the second litter was farrowed in a farrowing house. Although there was an increase in litter size farrowed and weaned as the gestations progressed, the third litters at weaning should have been larger than indicated. Heavy rains after farrowing the third litter drowned a number of pigs, which reduced litter size at weaning for this gestation.

Figure 1 indicates the animals' condition just prior to the third farrowing. The diet appeared sufficient not only for maintaining good condition, but also for satisfactory performance in three consecutive gestations reported here.

Table 1. Composition of Gestation Diet.

Ingredient	Percent
Alfalfa hay	96.75
Sodium Tripolyphosphate	2.50
Iodized salt	.50
Trace minerals[a]	.075
Vitamin premix[b]	.175
Total	100.00

[a] Calcium Carbonate Company, swine, 20% zinc.

[b] Contributed the following per pound of complete diet: Vitamin A, 1362 IU; vitamin D, 204 IU; Riboflavin,, 2.0 mg; niacin, 9.0 mg; calcium panthothenate, 4.0 mg; choline chloride, 10.0 mg; Vitamin B_{12}, 7.5 mcg.

Table 2. Performance of Dam and their offspring.

	Criteria				
Gestation	Litters	Live pigs born	Pig birth wt.	No. live pigs 21-da.	Live pig wt. 21-da.
One	19	9.68	2.66	7.84	10.34
Two	16	10.88	2.43	8.13	11.71
Three	19	12.50	2.75	8.39	11.10

Figure 1. Sows, showing condition just before farrowing.

Reproductive Performance

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Table 1. Performance of gilts fed 14% and 10% protein diets.

Trait	10% diet	14% diet
Number of gilts	68	137
42 day wt., lb.	28.7	27.8
Daily gain, lb./day[a]	1.19	1.39
Backfat probe, in.[a]	1.57	1.39
Age at puberty, day[a]	178.7	159.8

[a] Diet differences significant ($P < .01$)

imately 125 days of age. The performance of gilts fed the two diets is summarized in Table 1. Gilts fed the 10 percent protein diet grew slower and were fatter than gilts fed the 14 percent protein diet. The 10 percent diet was definitely a suboptimal diet for maximum lean growth.

The average age at puberty was 159.8 days for gilts fed the 14 percent protein diet and 178.7 days for gilts on the 10 percent protein diet. The average age at puberty reported in the literature is approximately 200 days for straightbreds and 185 days for crossbreds, indicating that the Gene Pool pigs reach puberty quite early compared to other breeds or crosses. The 18.9 days difference between the two diets is equivalent to approximately one estrus cycle in swine.

Early puberty is important in the gilt because of the positive relationship between the number of heat periods which have occurred and ovulation rate. Ovulation rate increases with each additional heat period in gilts up through about four, where it levels off. Therefore, the earlier a gilt reaches puberty the more heat periods will have occurred by breeding time when breeding is done on the basis of age.

Age at puberty is positively related to daily gain. However, the 19 days difference between the two diets was greater than could be explained by the growth rate differences between the diets. This indicates that the 10 percent protein diet had greater detrimental effects on age at puberty than on growth rate. Higher levels of dietary protein may be required for proper reproductive development.

Previous studies at Nebraska have indicated that the gain of meatier pigs is more severely reduced by a protein deficient diet than is the Gene Pool. Hence, a larger effect would also be expected in reproductive performance of meatier pigs.

Three groups of approximately 25 gilts were saved for breeding. A group was selected from the 10 percent diet on the basis of an index involving daily gain and backfat probe. The other two groups came from the 14 percent diet. One was selected from half the gilts on the basis of index value while the other group was randomly selected from the other half of the gilts. Because of the relationship between age at puberty and growth rate, it is necessary to consider the two 14 percent diet groups separately in evaluation of the litter size data.

The average number of heat periods expressed at breeding was 3.6 for the 10 percent selects, 3.9 for the 14 percent controls and 4.3 for the 14 percent selects. The average litter size obtained for the three lines was consistent with the number of heat periods expressed prior to breeding. The only significant difference obtained was for total number of pigs born per litter between the 10 percent select line (7.91) and the 14 percent select line (9.76). These results tend to indicate that nutritional regimes which delay reproductive development may have adverse effects on subsequent reproductive performance.

The number of gilts farrowing in each group is small and, coupled with the variability of litter size data, it is difficult to reach concrete conclusions. However, the consistency of the litter size data and the age of puberty data presented earlier should serve as indicators of likely consequences of reducing dietary protein levels in gilts.

In conclusion, the data indicate several factors relative to the effect of dietary protein level on subsequent reproductive performance in gilts.

1. Reproductive development is more drastically affected by low protein levels than growth rate.

2. Age at puberty was retarded when low levels of dietary protein were fed.

3. If reproductive development is sufficiently retarded, subsequent reproductive performance is decreased.

Table 2. Litter size data for gilts fed 14% and 10% protein diets.[a]

Trait	10% select	14% control	14% select
Number litters	23	21	21
Age at puberty, day	169.4[a]	162.5[a]	149.8[b]
Age at breeding, day	224.8[a]	223.4[ab]	218.7[b]
Total number born	7.91[a]	8.86[ab]	9.76[b]
Number born alive	7.78[a]	8.28[a]	8.95[a]
Number weaned	6.44[a]	7.00[a]	7.28[a]

[a] Means with different superscripts for each trait are significantly different ($P < .05$)

Feeder Pig Pricing Formulas

Larry L. Bitney
Extension Economist

How "fair" is the feeder pig pricing formula you are using? Are both the buyer and seller getting equitable returns for their labor, management and investment?

Feeder pigs are sold in a variety of ways in Nebraska—at auctions, through dealers, and directly from producers to finishers. The price of those sold direct is often determined by using a formula which is based on market hog price.

The objective of many of the formulas in use is to determine a feeder pig price which would be fair to both the producer and the finisher. An equitable sharing of profit is the goal. A simple formula is generally desired.

Several formulas used by Nebraska producers and finishers worked well during the years when the corn price rode at or near the government loan rate, the soybean meal price hovered around $100 per ton, and the market hog price stayed within a fairly narrow range.

But, in 1973, we saw soybean meal over $400 per ton in early summer, corn over $2.00 per bushel in the fall, and market hog prices topped $60. In addition, building and equipment costs increased sharply. As a result, many feeder pig pricing formulas became inequitable and obsolete.

What is an Equitable Feeder Pig Price?

An equitable feeder pig price is one which gives the producer and the finisher a market rate of return on their labor, management and capital. Their cash expenses for utilities, veterinary and medicines, etc., would be repaid. They would receive a return for the use of their hog production facilities to pay for them over a normal depreciable life. And finally, they should equally share the profit, or return above all costs, on the pig.

In order for a producer and a finisher to develop a true profit-sharing plan, they must wait until the pig is sold at market weight to reach a final settlement. This generally requires a contractual agreement whereby the finisher makes an initial payment to the producer when the pig is delivered, and a final payment when the market hog is sold. This is really the best arrangement between two established hog men who have fairly stable production schedules, who are not interested in reaping profits at the expense of the other party, and who want to be fair to each other. Unfortunately, most producers and finishers don't care to enter a contractual arrangement, and most feeder pigs which are priced by formula are priced on the basis of the current market hog price at the time the pigs are sold to the finisher.

What Determines Feeder Pig Price?

In developing a pricing formula, there are four basic factors which will affect the feeder pig price:

1. Market hog price
2. Feed price
   a) Grain
   b) Protein supplement
3. Weight of pig
4. Non-feed costs.

One of the four factors which is usually not a variable in feeder pig pricing formulas is non-feed costs. These costs include buildings and equipment, labor, veterinary and medicine, utilities, marketing, interest, and miscellaneous costs. These, as a group, only add up to ¼ or ⅓ of the total production costs. Also, they usually are not subject to violent price fluctuations in the short run. The non-feed costs have trended upward over time, and do make it necessary for us to review and revise our pricing formula every two years or so.

In addition, there is some seasonal variation in feeder pig prices which is not explained by the four factors alone. For example, when farmers are busy in the field during spring and early summer, feeder pig prices tend to be lower than the formula price. This seasonal factor is usually ignored in pricing formulas, however, as its magnitude is difficult to predict.

A Comparison of Pricing Formulas

Let's look at three formulas which have been used by Nebraska producers and finishers, and compare them with a profit-sharing plan which is based on current cost levels. I will explain each formula briefly and then compare them.

Formula 1.

The feeder pig price computed by this formula is based on the market hog price, the weight of the pig, and the price of corn. It is:

Weight of pig	Price of corn per bu.			
	$.90	$1.00	$1.10	$1.20
40	2.05	2.00	1.95	1.90
50	1.80	1.75	1.70	1.67
60	1.65	1.60	1.57	1.53

This formula is used as follows for a 40 pound pig and a $1.20 corn price—the factor which we use from the table for this situation is 1.90. Multiply this times the market hog price ($30/cwt. for example), and $57/cwt. is the result. Since we have a 40 lb. pig, multiply the $57/cwt. by 0.4 cwt., and we get $22.80 per head for the 40 lb. pig.

Formula 2.

The feeder pig price computed using this formula is based only on market hog price and the weight of the pig. The value per head for a 40 lb. pig is calculated as a percentage of the market hog price per hundredweight according to the following scale:

Up to $19.00—85%
$19.01 to $24.00—90%
$24.01 to $28.00—95%
Over $28.00—100%
15¢/# adjustment from 40# for weights from 35–45#
10¢/# adjustment over 45#

If the market hog price is $30, the price of a 40 lb. pig is $30. If the market hog price is $25., the price of a 40 lb. pig is 95% of $25., or $23.75. A factor is also provided to adjust the price for pigs which are lighter or heavier than 40 pounds.

Formula 3.

This formula also is based only on market hog price and pig weight. A factor of 1.8 is multiplied times the market hog price to get a price per hundredweight for the pig. The factor is adjusted for pigs which are lighter or heavier than 40 pounds. For example, if the market hog price is $30/cwt., then the price per hundredweight for 40 lb. pigs is 1.8 x 30, or $54/cwt. The 40 lb. pig would be priced at .4 x $54/cwt., or $21.60 per head.

A Profit Sharing Plan

This formula, or plan, is based on a detailed production cost budget using 1973 non-feed price levels. The feeder pig price is determined by the criteria which I outlined earlier for an equitable feeder pig price.

The results of this plan are shown in *Table 1.* In *Table 1,* the feeder pig prices resulting from only one price of soybean meal ($200/T) and one pig weight (40#) are presented. I plan to publish a set of tables similar to *Table 1* for 20, 30 40, 50, and 60 pound pigs and for soybean meal prices ranging from $100-$400 per ton. Within each of these tables, feeder pig prices resulting from various corn prices and market hog prices are shown. The feeder pig prices in *Table 1* can be adjusted for different soybean meal prices by increasing the pig price 17¢ per head for each $10 per ton decrease in the soybean meal price below $200. In like fashion, the pig price would be decreased 17¢ for each $10 per ton increase in soybean meal price.

The feeder pig prices resulting from this profit sharing plan are used as a "standard for comparison" in an evaluation of the three pricing formulas described earlier.

Let's look now at how responsive each formula is to fluctuations in market hog prices. The first comparison, in *Table 2,* is based on $1.20 per bushel corn and $120 per ton soybean meal to show how the formulas perform under "traditional" feed prices.

In *Table 2,* formula 2 results in feeder pig prices which are very close to those of the profit sharing plan. The prices resulting from formulas 1 and 3 are generally lower, and the gap widens as the market hog price increases. Thus, formulas 1 and 3 are not as responsive to market hog price fluctuations as formula 2 and the profit sharing plan are.

Now, let's see how the formulas compare when feed prices are higher. *Table 3* shows the feeder pig prices which result when corn is $2.00 per bushel and soybean meal is $200 per ton.

Formulas 2 and 3 do not take changes in feed price into account, so they produce the same feeder pig prices as they did in *Table 2.* The feeder pig prices resulting from formula 1 and the profit sharing plan are lower in *Table 3* then they were in *Table 2,* due to the higher feed prices. Notice, however, that the pig prices are reduced about $4 per head at all market hog prices with the profit sharing plan, while the pig prices are reduced by amounts ranging from $8 to $2.50 using formula 1. Also notice that the pig prices resulting from formula 2 are not higher than those in the profit sharing plan, while they were nearly the same when feed prices were lower.

The effect which fluctuating feed prices have on feeder pig prices resulting from these formulas is pointed out further in *Table 4.*

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Table 1. Feeder pig prices based on a profit sharing plan.

Market hog price $/cwt.	Price of feeder pigs per head when soybean meal is $200/ton											
	Pig weight = 40 lb. Corn price $/bu.											
	.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00
14	11.01	10.33	9.64	8.96	8.27	7.58	6.90	6.21	5.53	4.84	4.16	3.47
16	13.26	12.58	11.89	11.21	10.52	9.83	9.15	8.46	7.78	7.09	6.41	5.72
18	15.51	14.83	14.14	13.46	12.77	12.08	11.40	10.71	10.03	9.34	8.66	7.97
20	17.76	17.08	16.39	15.71	15.02	14.33	13.65	12.96	12.28	11.59	10.91	10.22
22	20.01	19.33	18.64	17.96	17.27	16.58	15.90	15.21	14.53	13.84	13.16	12.47
24	22.26	21.58	20.89	20.21	19.52	18.83	18.15	17.46	16.78	16.09	15.41	14.72
26	24.51	23.83	23.14	22.46	21.77	21.08	20.40	19.71	19.03	18.34	17.66	16.97
28	26.76	26.08	25.39	24.71	24.02	23.33	22.65	21.96	21.28	20.59	19.91	19.22
30	29.01	28.33	27.64	26.96	26.27	25.58	24.90	24.21	23.53	22.84	22.16	21.47
32	31.26	30.58	29.89	29.21	28.52	27.83	27.15	26.46	25.78	25.09	24.41	23.72
34	33.51	32.83	32.14	31.46	30.77	30.08	29.40	28.71	28.03	27.34	26.66	25.97
36	35.76	35.08	34.39	33.71	33.02	32.33	31.65	30.96	30.28	29.59	28.91	28.22
38	38.01	37.33	36.64	35.96	35.27	34.58	33.90	33.21	32.53	31.84	31.16	30.47
40	40.26	39.58	38.89	38.21	37.52	36.83	36.15	35.46	34.78	34.09	33.41	32.72
42	42.51	41.83	41.14	40.46	39.77	39.08	38.40	37.71	37.03	36.34	35.66	34.97
44	44.76	44.08	43.39	42.71	42.02	41.33	40.65	39.96	39.28	38.59	37.91	37.22
46	47.01	46.33	45.64	44.96	44.27	43.58	42.90	42.21	41.53	40.84	40.16	39.47
48	49.26	48.58	47.89	47.21	46.52	45.83	45.15	44.46	43.78	43.09	42.41	41.72
50	51.51	50.83	50.14	49.46	48.77	48.08	47.40	46.71	46.03	45.34	44.66	43.97
52	53.76	53.08	52.39	51.71	51.02	50.33	49.65	48.96	48.28	47.59	46.91	46.22
54	56.01	55.33	54.64	53.96	53.27	52.58	51.90	51.21	50.53	49.84	49.16	48.47
56	58.26	57.58	56.89	56.21	55.52	54.83	54.15	53.46	52.78	52.09	51.41	50.72
58	60.51	59.83	59.14	58.46	57.77	57.08	56.40	55.71	55.03	54.34	53.66	52.97
60	62.76	62.08	61.39	60.71	60.02	59.33	58.65	57.96	57.28	56.59	55.91	55.22

Feeder Pig

(continued from page 7)

Table 4 shows that the formulas (2 & 3) which do not take feed prices into account produce pig prices which are "too high" if feed prices increase significantly. Formula 1 is very responsive to changes in corn price; in fact, it is too responsive if we measure it against the profit sharing plan.

Conclusion

1. Feeder pig pricing formulas which are the simplest to use (ones which use only the weight of pig and market hog price as variables) are perishable. That is, when the feed prices that they are based on change, they become inequitable and obsolete.

2. Due to an upward trend in non-feed costs, any feeder pig pricing formula should be reviewed and revised periodically.

3. Formulas which are a little more complicated to use, but which take feed price changes into account will result in equitable feeder pig prices even though feed prices change from those existing at the time the formula is developed.

4. Feeder pig pricing formulas will be most equitable if they are based on the market hog price at the time the pig reaches market weight, not at the time it changes hands as a feeder pig. This necessitates a contractual arrangement between the producer and the finisher.

Table 2. A comparison of feeder pig prices resulting from pricing formulas at "traditional" feed prices.

Market hog price $/cwt.	Feeder pig price per head (40#)			
	Formula[a] 1	Formula 2	Formula 3	Profit sharing plan[b]
16	$12.16	$13.60	$11.52	$13.24
20	15.20	18.00	14.40	17.74
30	22.80	30.00	21.60	28.99
40	30.40	40.00	28.80	40.24
50	38.00	50.00	36.00	51.49

[a] Based on $1.20/bu. corn

[b] Based on $1.20/bu. corn and $120/ton soybean meal

Table 3. A comparison of feeder pig prices resulting from pricing formulas at current feed prices.

Market hog price $/cwt.	Feeder pig price per head (40#)			
	Formula[a] 1	Formula 2	Formula 3	Profit sharing plan[b]
16	$ 9.60	$13.60	$11.52	$ 9.13
20	12.00	18.00	14.40	13.63
30	18.00	30.00	21.60	24.88
40	24.00	40.00	28.80	36.13
50	30.00	50.00	36.00	47.38

[a] Based on $2.00/bu. corn

[b] Based on $2.00/bu. corn and $200/ton soybean meal

Table 4. A comparison of feeder pig prices resulting from various pricing formulas at specified feed prices.

Corn price $/bu.	Feeder pig price per head (40#)[a]				
	Formula 1	Formula 2	Formula 3	Profit-sharing plan	
				$120/T soy	$200/T soy
1.00	$24.00	$30.00	$21.60	$29.67	$28.31
2.00	18.00	30.00	21.60	26.24	24.88
3.00	12.00	30.00	21.60	22.82	21.46

[a] Based on $30/cwt. market hog price

Feed Processing

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Pork producers have many choices regarding the physical form of the diets they feed. They have adopted processing methods which improve performance and reduce cost of gain. They have rejected many processing methods because anticipated performance advantages have not been enough to pay the processing cost. During periods of high feed prices, these decisions need to be re-evaluated to determine if feed savings would more than pay the added processing costs, thus reducing total costs.

This article reviews many of the available feed processing techniques which may be considered by pork producers to reduce costs of gain. When evaluating methods of feed processing, several factors should be considered. Primary considerations are processing costs and the effects on performance. This article deals with the performance differences due to alternate processing of the feed.

Complete Mix Feeding versus Free Choice Feeding

Pigs fed a complete mixed diet usually grow slightly faster than pigs fed a free choice diet. This is mainly due to greater control of nutrient intake by feeding a complete mixed diet. However, these advantages may be outweighed by the additional cost of grinding, mixing and handling. Little difference exists in feed efficiency between the two systems. A complete mixed diet lends itself to automation better than a free choice system. The free choice system requires greater supervision.

Whole versus Ground Corn or Milo

Pigs usually perform quite similarly whether fed whole or ground corn in a free choice system.

In a free choice system, pigs fed ground milo generally grow faster and more efficiently than pigs fed whole milo. Research results indicate that the differences are not great. Although there are no recent studies on the effect of feeding whole versus ground milo to the pig, one experiment has shown that pigs fed ground milo gained 4 percent faster and required 3 percent less feed than pigs fed whole milo. These differences must be weighed against the costs of grinding, handling and labor.

It should be noted that if a complete mix system is to be used, all ingredients, including corn and milo, should be ground or rolled. Whole particles, such as corn or milo, when mixed with other ingredients tend to separate and become unevenly distributed in the mixture.

Other Methods of Processing Milo

Several methods of processing sorghum grain for growing-finishing swine have been evaluated in Texas. Some of the results are shown in *Table 1.*

Pigs were fed a 16 percent protein diet from 70 to 120 pounds. Pigs were then finished on a 14 percent protein diet and slaughtered at 210 pounds.

Pigs fed dry ground milo gained slightly faster than those fed micronized or steam-flaked milo. Pigs eating steam-flaked milo gained somewhat more efficiently than pigs consuming dry ground or micronized milo. No significant differences were observed in carcass measurements.

Table 1. Effect of methods of processing grain sorghum on performance of growing-finishing swine.

	Dry ground	Micro-nized	Steam-flaked
Average daily gain lb.	1.92	1.83	1.81
Feed required/ lb. of gain, lb.	3.04	3.02	2.91

Roasted (cooked) Corn

Research results indicate no advantage in rate of gain for pigs fed roasted corn. Results are variable concerning the effect of roasting corn on feed efficiency. However, there seems to be a small advantage in feed efficiency for pigs fed roasted corn. This advantage does not appear great enough to allow purchasing of equipment solely to cook corn.

Pellet versus Meal

Pelleting of a growing and finishing diet usually increases average daily gain by 5 percent and may improve feed efficiency by as much as 10 to 12 percent. The volume of feed fed by most producers will probably not justify the cost of a pelleting machine. Also, the advantage of pelleting will probably not be great enough to warrant the cost of hauling feed to a pelleting machine. A pelleted diet may be more economical than a meal diet, if a complete ration is being purchased.

Liquid Feed

Rate of gain appears to be similar between pigs full-fed dry feed and liquid feed. Pigs consuming a dry full-fed diet have generally required less feed per pound of gain than pigs full-fed liquid feed. No significant differences usually exist in farm-to-market shrink, cooler shrink and carcass merit between dry and liquid fed pigs.

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Effect of Temperature On Boar Fertility

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This research was conducted by the author while employed at the Ohio Agricultural Research and Development Center, Wooster, Ohio.

The influence of season on reproductive activity in domestic animals has not been thoroughly investigated. Some herd records suggest that, at this latitude, high temperatures of summer do have an adverse effect on reproduction.

One such set of data is from the Iowa swine nutrition herd for the years 1954 through 1957. These data represent 1,453 matings distributed over 12 months each year. A low of 58 percent conception rate was reached for sows bred in August, ranging to a high of 86 percent for those bred in March. Such data suggest that the combined effects of high temperature on the sow and the boar result in lower conception rates.

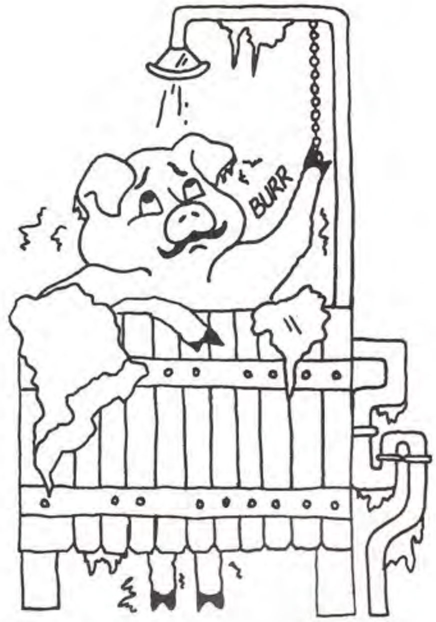
In France, researchers have observed a decrease in farrowing rate of gilts inseminated with semen from seven boars maintained outside and subjected to environmental temperatures as high as 95 degees Fahrenheit as compared to gilts inseminated with semen from seven control boars maintained in an air-conditioned building at 72 degrees Fahrenheit. The difference between the two groups occurred in the period between June and September when the outside boars were exposed to the summer heat.

Boar spermatozoa pass through a number of stages during and after formation in the testicle. At least 40 days is required for spermatogenesis to take place. During this period, factors such as nutrition, disease or environmental stress may have an adverse effect on the developmnet of spermatozoa which, in turn, may influence fertility.

Research Procedure

Using environmental control chambers, studies were started at the Ohio Agricultural Research and Development Center to determine the effects of heat stress on the reproductive performance of the boar. Measurement criteria were changes in semen quality and fertility of semen when used for artificial insemination of gilts.

In three trials, sixteen 12- to 18-month-old Duroc boars trained for semen collection were exposed to either 70 degrees (control) or 92 degrees (heat stressed) for a 72-hour period. Each trial was comprised of three periods: a two-week pre-exposure period, a 72-hour exposure period, and a 9- to 10-week post-



exposure period. Twice weekly, semen was collected from each boar and evaluated, and gilts were artificially inseminated during both the pre- and post-exposure periods.

Response of the boars to the two temperature regimens is shown in *Figure 1.* The average rectal temperature of all boars prior to the 72-hour exposure period was 100.6. During the 72-hour exposure period, the rectal temperature of the heat-stressed boars increased rapidly and remained significantly higher than the rectal temperature of control boars (average rectal temperature for the 72-hour exposure period, 102.5 *vs.* 100.5 respectively). Following the 72-hour treatment period, rectal temperature for the heat-stressed boars returned to near pre-exposure levels and was quite similar to rectal temperatures observed in control boars.

Pre- and post-exposure semen quality measurements are presented in *Figures 2 and 4.* Semen quality was similar and normal for all boars prior to the 72-hour exposure period. While the effect was not immediate, semen quality measurements were significantly lowered in the heat-stressed boars after the 72-hour exposure period.

The first evidence of a detrimental effect of elevated temperature occurred approximately 2 to 3 weeks after exposure. At this time there was a decrease in the total number of spermatozoa, percent motile spermatozoa, and an increase in percent abnormal spermatozoa. Semen quality continued to decline until 4½ weeks after exposure. Based on semen evaluation, there was then a gradual return to pre-

Feed Processing

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The initial cost of liquid feeding may be higher than dry feeding and feed separation may be a problem. Freezing temperatures could cause problems with liquid feeding. In liquid feeding, conditions conducive to spoilage are greater than in dry feeding.

Paste Feed

Paste feeding was studied at the Ohio Agriculture and Development Center. Paste feed is described as a mixture of 1 part dry feed with 1.3 to 1.5 parts by weight of water. This blend is not liquid but has enough water for pumping. Additional water must still be supplied to meet the pig's water requirement. Four growing-finishing trials involving standard mixed-protein feeds self-fed in dry (meal) versus paste form were reported. Pigs consuming the paste feed ate .57 and .46 pounds more per day during the growing and finishing period, respectively. In addition, paste fed pigs gained .22 and .18 pounds faster per day during the growing and finishing period, respectively. In seven of the eight growing-finishing periods, some improvement in efficiency of gain was reported for pigs fed paste feed. Pigs eating paste feed had a greater water to feed ratio.

Cooked Soybeans

Detailed information on cooked soybeans is reported in the 1970, 1971 and 1972 Nebraska Swine Reports.

Summary

The feed processing method and system used should be the one that is most profitable.

The feed processing method chosen should be the most economical for pork production. Some feed processing methods may allow higher daily gain and/or feed efficiency. But, these methods *may or may not* be more profitable, depending on such factors as cost of processing, type of processing equipment involved and type of automation desired in the feeding system.

exposure values by 8 to 9 weeks after exposure. In control boars, semen quality measurements remained relatively constant throughout the entire experiment.

The effect of elevated temperature on semen fertility, as measured by pregnancy rate in artificially inseminated gilts is presented in *Figure 5*. Fertility data paralleled semen quality measurements during the pre- and post-exposure period for control and heat-stressed boars. Pregnancy rate was considered normal for gilts inseminated with semen collected from both groups of boars during the pre-exposure and first two weeks post-exposure. However, beginning two weeks post-exposure the percentage of pregnant gilts was markedly reduced following insemination with semen from the heat-stressed boars. During the 5th and 6th week post-exposure, pregnancy rate was at the lowest point (56%) for gilts artificially inseminated with semen from heat-stressed boars. Eight weeks after treatment such an adverse effect on semen fertility had largely disappeared and pregnancy rate (77.8%) had returned to near pre-exposure levels.

No period of decreased reproductive performance, as measured by pregnancy rate of artificially inseminated gilts, was observed for control boars. Pregnancy rate was significantly different for gilts inseminated with semen from control and heat-stressed boars when evaluated for the entire post-exposure period (90 *vs.* 67%, respectively).

Conclusions

It is apparent that short-term temperature stress on the boar does have a detrimental effect on measures of semen quality as well as on fertility of the semen. Such adverse effects were not immediate, but were very evident 3 to 5 weeks after exposure, with a gradual return to near normal preexposure values by 9 weeks after heat stress. Thus, the ill effects of hot weather, or a period of elevated body temperature caused by sickness, on boar semen quality and fertility can be expected to be delayed as much as two to eight weeks after exposure. Such response to heat stress or illness can reduce pregnancy rate as much as 20 percent.

Restructured Pork... Dollars and Sense

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Possibly, the primary goal of the meat industry is the total use of skeletal muscle meat with maximum value. The average carcass yields about 30 percent prime cuts, such as chops and roasts, for which there is a ready and competitive market. Due to the competitive nature of primal cuts, the amount of profit related to them is fairly limited. The remaining 70 percent of the carcass consists of cuts that are less desirable, not uniformly tender or palatable, and do not have as great a consumer demand. These cuts, being less desirable, give the innovative processor an opportunity to capitalize on hidden profit potential.

The University of Nebraska has been evaluating a relatively new concept in meat processing referred to as flaked, formed, and sectioned meat. This process allows "less desirable" cuts and trimmings to be re-formed into "high value" fabricated chops or steaks.

In this process, tempered (partially frozen) meat is first flaked rather than being ground as it might be conventionally. Meat is not "squeezed" during flaking as it is during grinding, thus more water is retained in flaked meat, resulting in less shrinkage. Flaked meat also sticks together better than ground meat. This is referred to as cohesion and is a desirable attribute when re-forming meat.

The second step of the restructuring process is to mix the meat for uniformity, re-temper the flaked meat and then form it into a log (this can be various sizes and shapes) by the use of a press which applies 400 pounds per square inch to the product. Once the log has been formed, it is then sectioned into chops or steaks of various thickness, yielding identical servings from one end of the log to the other; something which can obviously not be done with a pork loin or other meat product.

One study has been done comparing flaked and ground meat as it was affected by processing temperature and particle size. *Table 1* shows that flaked products were liked more than ground products by a trained taste panel. Flaked products were more cohesive, tender and were better accepted overall as compared to ground products. When evaluating products manufactured at different temperatures *(Table 1)*, those manufactured at warmer temperatures were more cohesive and better accepted. The greater overall acceptability was due to the better color associated with warm flaked products. Colder products were found to be slightly more tender, although the difference was negligible statistically.

Panel members, when asked to evaluate products made from various particle sizes, *(Table 1)* generally pre-

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Jowl Abscess Prevention

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Cervical or "jowl" abscesses *(Figure 1)* of pigs can be a severe problem on some farms. The abscess is usually caused by a beta hemolytic Streptococcus of Lancefield Group E. The organism is picked up by the pig through the mouth from contaminated surroundings, moves to the tonsils and usually localizes in the lymph nodes of the throat region, particularly the mandibular nodes. If infection is heavy, the streptococci may move on to lymph glands in other parts of the body. These abscesses may be so small they cannot be detected in the live animal, or as large as baseballs. Ruptures of these abscesses contaminate surrounding areas.

Treatment usually consists of oxytetracycline administered in the feed at the rate of 50 grams per ton. There is a vaccine available that can be sprayed onto the tonsillar region of pigs.

Figure 1. Pig showing typical jowl abscess as seen in many feeding operations.

This study was started to evaluate the therapeutic effect of Tylosin, Sulfamethazine and Tylosin-Sulfamethazine combination for the control of jowl abscesses caused by Streptococci, Lancefield Group E, in swine.

Experimental Procedures

Ninety-six pigs were allotted by weight to eight pens, each pen containing six gilts and six barrows. The pigs were assigned to four treatment groups with two replications per treatment. The pens were 16 by 100 feet on native grass sod. Each pen contained a shelter, feeder and automatic waterer. A balanced corn-soy diet was fed ad libitum. Feed consumption was recorded after 49 and 98 days on study.

The medication treatments were started the day they were put on test. Treatments used were control—no medication, Tylosin—100 grams per ton, Sulfamethazine—100 grams per ton, and Tylosin-Sulfamethazine—100 grams each per ton.

On day five the pigs were orally innoculated with a broth culture of group E Streptococcus. This supplied approximately 40 billion organisms per pig. The infectious material was put in a metal water trough. Care was taken that each pig spent some time at the trough containing the culture.

Forty-nine days following exposure the pigs were weighed and the jowls palpated for abscesses. At 98 days the pigs were weighed again, tattooed and

Table 1. Taste panel scores for re-structured meats as influenced by temperature and particle size.[a]

Trait	Flaked vs. ground		Processing temperature		Partical size		
	Flaked products	Ground products	Warm	Cold	Small	Medium	Large
Cohesion	3.0	2.3	2.8	1.8	2.8	2.8	2.4
Tenderness	4.9	4.7	4.7	4.8	5.6	4.8	4.0
Overall acceptability	2.9	2.5	2.9	2.2	2.9	2.9	2.3

[a] Higher values indicate more desirable characteristics.

Table 2. Taste panel scores for properties of re-structured meat as influenced by temperature, cold blends and warm blends.[a]

Trait	Processing temperature		Cold blends		Warm blends	
	Warm	Cold	Not blended	Blended	Not blended	Blended
Cohesion	3.6	2.7	1.7	2.2	3.5	4.0
Tenderness	5.2	4.8	3.6	5.0	4.1	6.2
Overall acceptability	3.4	2.7	1.9	2.7	3.0	3.7

[a] Higher values indicate more desirable characteristics.

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ferred those products made of smaller components. Large particles made products less cohesive and less tender, as one might expect. Overall acceptability was also found to be lower for products made of large particles.

A second study was conducted to evaluate blends consisting of various particle sizes as influenced by processing temperatures. *Table 2* shows panel comparisons of blended products with non-blended products. In every case, regardless of processing temperature, products made with varying particle sizes were more desirable than products with only one particle size.

It can be concluded from these studies that flaking has definite advantages over grinding meat. Various temperatures can be used to develop products with different properties. Finally, manufacturing products that are blends of various particle sizes contribute greatly to the diversability of available restructured products.

The ability to produce a desirable re-structured (flaked-formed-sectioned) meat product has opened up a new concept for product development and provides total utilization of skeletal meat. If maximum utilization of lower demand meats is a major goal of the meat industry, then flaking can aid in producing meat items from these less desirable meats, offering the consumer more acceptable, higher value products.

removed from medicated feed. They were slaughtered five days later. Head condemnations by federal inspectors, hot carcass weight and swabs for culture were obtained.

Results

Table 1 shows the average weights of the pigs and treatment group assigned.

The pigs accepted the inoculum material very well. One Tylosin treated pig died 35 days following infection. The pig *(Figure 2)* had gained five pounds on test.

On necropsy, multiple abscesses were found in the pharyngeal and cervical region *(Figure 3)*. This material was cultured and a hemolytic Streptococcus was isolated.

Early performance and palpation results are shown in *Table 2*.

Palpation at 49 days did not indicate abscesses in pigs receiving Sulfamethazine or Tylosin-Sulfamethazine combination.

Table 3 shows the overall performance and slaughter data.

The performance of pigs receiving the Sulfamethazine and Tylosin-Sulfamethazine combination was very similar and superior to the controls or pigs receiving Tylosin alone.

Palpation for abscesses at 49 days did not identify all of the pigs which had heads condemned at slaughter. Since heads are not included in carcass weight, dressing percent does not indicate head condemnation. However, the lower dressing percentages in the control and Tylosin groups do indicate greater trim losses. Hemolytic Streptococcus organisms were recovered from swabs at slaughter.

Conclusions

The addition of Tylosin at 100 gm/-ton and Sulfamethazine at 100 gm/ton or Sulfamethazine alone at 100 gm/ton gave good control of jowl abscesses. These additions also improved performance of pigs at these rates. However, the addition of Tylosin had very little effect on performance or jowl abscesses.

Table 1. Average starting weights.

Treatment	Weight
Control	43.3
Tylosin	43.2
Sulfamethazine	43.3
Tylosin-Sulfamethazine	43.2

Figure 2. Tylosin pig died 35 days following infection. Note abscess in cervical region.

Figure 3. Necropsy revealed multiple abscesses in cervical region.

Table 2. Performance data (49 days) and percent pigs with abscesses that could be palpated.

	Experimental diets			
	Control	Tylosin[a]	Sulfa-methazine	Tylosin Sulfamethazine
Avg. weight lbs.	106.9	105.8	110.2	113.7
Weight range	84-134	74-132	90-140	90-153
ADG	1.30	1.30	1.36	1.45
FC	3.37	3.70	3.30	3.10
No. pigs with abscesses	17	19	0	0

[a] Based on 23 pigs

Table 3. Performance data (98 days) and heads condemned at slaughter.

	Experimental diets			
	Control	Tylosin[a]	Sulfa-methazine	Tylosin Sulfamethazine
Avg. weight (lbs.)	194.7	194.7	200.2	204.2
Weight range	161-226	164-240	170-250	176-233
ADG	1.56	1.54	1.61	1.65
FC	3.09	3.09	3.00	3.02
Dressing percent	72.9	72.9	74.4	73.8
No. heads condemned	18	19	3	5

[a] Based on 23 pigs

Swine Herd Health Program and Management

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Extension Veterinarian

Swine herd health has a close relationship to management, so both herd health and the management requirements of disease control will be covered here. The various stages of the swine life cycle, in outline form, follows.

Gilt Development

A. Sort gilts—200 to 240 lbs., or about 6 months old.

B. Select gilts with well developed external genitalia and with at least 12 nipples (not inverted).

C. Move to another pen—this and regrouping will induce estrus.

D. Feed 4-5 pounds of a 12-14 percent protein ration adequate in vitamins and minerals.

Leaving gilts on the finishing ration until 6 months of age allows culling of those that tend to become overly fat. Gilts with small, poorly developed vulvas may be sterile from incomplete or poorly developed reproductive organs.

Prebreeding—Gilts

A. Two weeks before breeding:

1. Increase daily ration to 6-7 pounds for *21 days only.*
2. Vaccinate for leptospirosis, erysipelas, mixed bacterin (pneumonia – enteric).
3. Spray for lice and mange with 0.06 percent Lindane, 2 percent Ciodrin or 0.5 percent malathion.

Flushing gilts by increasing the energy intake for two weeks before breeding has been shown to increase the number of eggs ovulated. The ration must be limited a few days after breeding, as too much energy reduces the number of surviving embryos.

Five types of leptospirosis vaccines are available. The local veterinarian's recommendations should be followed. They will depend on the results of blood tests of the herd and the types of lepto found in the area.

Spraying for lice and mange should be done routinely, except in SPF herds.

B. One week prior to breeding:

1. Repeat mixed bacerin vaccination.
2. Add 200 grams per ton of Aureomycin or Terramycin to ration.

The addition of antibiotics to the prebreeding gilt ration should follow the recommendations of the local practicing veterinarian. Antibiotics should be used only for specific reasons and at high (therapeutic) levels.

Breeding and Gestation

Boar:

Bring to the farm 60 days before breeding.

1. Isolate 30 days. Inspect legs; no mycoplasma arthritis, and good libido.
2. Swab three times for bordetella. (if desired and available)
4. Allow fence (woven wire) contact with gilts – 30 days.

SMEDI viruses cause stillbirths, mummification, embryonic death and infertility. The only procedure that can be recommended to control SMEDI viruses is exposure of the boar and gilts 30 – 45 days before breeding to give the gilts a chance to develop immunity to any new viruses the boar may by carrying.

Breeding and Gestation

Gilts:

1. Sort out after breeding.

2. Reduce ration to 4-5 lbs. 10,000 I.U. vitamin E per ton.

3. One week before farrowing start lactation ration.

A. 40,000 I.U. vitamin E.

B. Antibiotics.

a. Furazoladone – 150 grams per ton or

b. Neomycin – 100 grams per ton.

The addition of vitamin E has been recommended to reduce the incidence of MMA. The enteric antibiotics, furazoladone and neomycin, should be added to the gilt's ration one week before farrowing until one week after farrowing when baby pig scours is a problem.

Special Vaccinations for Sows During Gestation

Time prior to farrowing:

Erysipelas – 3 weeks.
Mixed bacterins – 3 weeks.
TGE – 6 weeks and 2 weeks.
Clostridium toxoid – 6 weeks and 2 weeks.

Erysipelas vaccination should be a routine procedure. Use of the other vaccines depends on the past disease history of the herd and the area.

Farrowing

A. A clean house.

1. High pressure sprayers – 2 GPM.
2. Disinfection.
   - Organic iodine.
   - Chlorhexidine (Nolvasan).
   - Chlorine bleaches.
   - Fumigation.

Cleaning and disinfection reduce the number of bacteria that cause infections in the newly born pigs, such as scours or navel infections.

B. A clean sow.

1. Wash sow.
2. Worm sow.
3. Spray sow for mange and lice.
4. Restrict diet at farrowing.

5. Clean drinking water—at all times until weaning.

Washing, worming and spraying sows reduces or eliminates the number of bacteria, worm eggs and external parasites to which the baby pigs will be exposed.

After Farrowing

1. Gradually increase lactation ration to full feed by fifth day.

2. Temperature—house 65°-70°F, pig nesting area 85°-90°F.

Baby Pig Management Procedures

Many producers routinely castrate, inject iron solutions, dock tails and clip needle teeth at 3 days of age.

Castration

1. Use sharp scalpel—hook blade.

2. Keep scalpel in container filled with disinfectant. Clean surgical area.

3. Be sure pigs are clean and dry before the operation. Place pigs in clean dry pen after operation.

4. Avoid early castration in herds having a history of scrotal or inguinal hernias. Wait until pigs are 5-6 weeks old and signs of the hernia are evident. Identify the gilts in litters having scrotal hernias and avoid keeping these gilts as replacements.

Iron Injections

1. Use good quality iron; follow manufacturer's recommendations.

2. Use a ¾ to 1 inch 18 to 20 gauge needle.

3. Inject iron into fold of flank or into neck muscles (not into ham—may cause discoloration or abscesses).

Docking Tails

1. Use a crushing-cutting type instrument to prevent hemorrhage.

2. Dock tails leaving a stub of ½ to ¾ inch.

3. Be sure pigs are clean and dry before operation and are placed in a clean dry pen after docking.

Clipping Needle Teeth

1. Use a sharp side cutter or large toenail trimmer.

2. Don't crush tooth or clip too close to the gum line.

3. Some litters should be clipped earlier than 3 days of age if fighting is a problem.

If all four of the above procedures are done at the same time, the docked tails indicate which litters have all the basic procedures completed.

Your local practicing veterinarian can furnish more detailed instructions. He can also advise you on the selection of instruments, disinfectants and injectable iron.

Procedures for Weaned Pigs

1. Erysipelas vaccination at 6-8 weeks of age.

2. Pasteurella bacterin vaccination.

Farrowing Schedules

Two litter—Spring and fall.

Four litter—March, June, September, December.

Six litter—Even months.

Ten litter—Breed for two weeks every five weeks.

A high level of management is required for the 6 litter and 10 litter per year schedules.

Bloody Dysentery Control

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Swine dysentery is one of the major problems in pork production. It is an infectious, transmissible disease characterized by dehydration, loss of weight and bloody mucoid diarrhea. Other common names are bloody scours, hemorrhagic dysentery or vibronic dysentery.

Many medications have been used in treatment of this disease. This study was conducted to observe the effectiveness of virginiamycin in the prevention of swine dysentery.

Experimental Procedure

Forty-eight feeder pigs were randomly allotted to eight pens of six pigs per pen. Sex was equalized within each of the pens. Littermates were distributed between pens.

Each earthen pen was equipped with an individual shelter, feeder and waterer. The feeders and waterers were located at the opposite end of the pen from the shelters. The shelters contained individual catalytic heaters.

The pigs were maintained on a 16 percent corn-soy diet for the duration of the study. The pigs were weighed individually at seven day intervals and the total feed consumed by each pen was recorded for the same interval.

Feed was withheld from the pigs for a 12-hour period prior to artificially infecting them with intestinal contents of pigs showing gross and microscopic evidence of swine dysentery. Medication of the 16 percent corn-soy diet was started 11 days after artificial infection. Pigs that died during the course of the study were necropsied to determine the cause of death. The intestinal tract was examined grossly and by indirect stain for presence of vibrio and spirochetes, as well as being cultured for salmonella.

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Bloody Dysentery

(continued from page 15)

Results

As shown in *Table 1*, deaths occurred in both treatment 1 and 2. These two treatments had similar growth rates and feed conversions. However, it should be recognized that the lower level of virginiamycin did reduce the percentage of deaths. There was an improvement in the pigs receiving the higher level of virginiamycin with respect to growth rate and the elimination of deaths. There appeared to be a slight improvement in feed conversion as the level of virginiamycin was increased. There were no losses in the pigs receiving the virginiamycin at 50 grams per ton.

All pens of pigs showed some evidence of diarrhea following inoculation. One pen of control (treatment 1) showed evidence of a mild diarrhea for only two days. All other pens of control pigs showed more severe diarrhea than the other pigs. There were five deaths in pigs on the control diet. Two more control pigs became chronic and gained very little during the feeding period but did survive.

Pigs receiving treatment 2 showed evidence of diarrhea almost to the degree of pigs on treatment 1. There was one death from the pigs on treatment 2. No pigs became "chronic."

The pigs receiving treatment 3 showed a much lower incidence of diarrhea and no death loss was recorded during the 70-day feeding period.

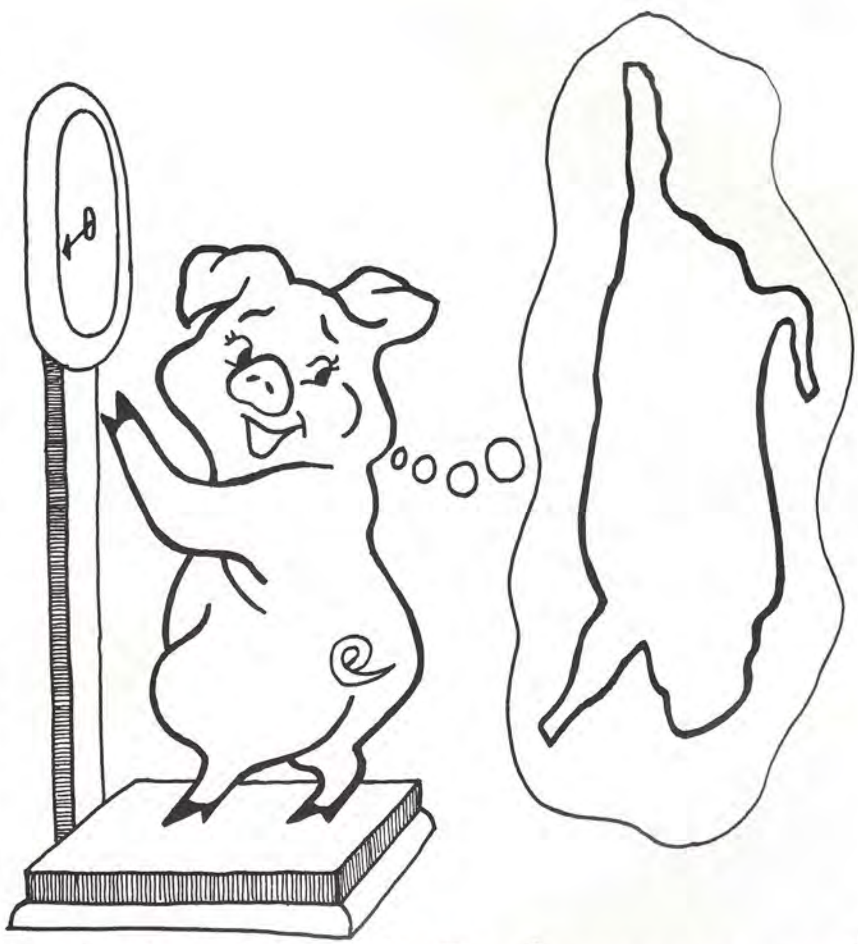
Conclusion

In this study, virginiamycin fed continuously at 50 grams per ton of feed was effective in the prevention of swine dysentery. Weight gain and feed conversion was increased over the controls. When virginiamycin was fed continuously at 25 grams per ton the death loss from swine dysentery was decreased as compared to the control but incidence of scours was essentially the same as the controls.

Table 1. Performance data of pigs on virginiamycin study.

	Treatments		
Criteria	Control 1	25 gm/ton 2	50 gm/ton 3
No. pigs	24	12	12
Initial wt., lb.	36	36.2	37
Final wt., lb. (70 days)	119.8	122.2	142.8
Total gain, lb.	83.8	86	105.8
Avg. daily gain, lb.	1.20	1.22	1.52
Feed/gain	3.12	3.05	3.02
Mortality, no.	5	1	0
Duration of study, da.	70	70	70

Treatments were:
1—control—no virginiamycin added.
2—contained 25 gm. virginiamycin/ton.
3—contained 50 gm. virginiamycin/ton.



Relationship of Performance and Carcass Characteristics in Swine

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Carcass characteristics of pigs slaughtered in the United States have changed markedly during the last 20 years. Initial industry efforts to develop a "meat type" hog in the 50s and major emphasis on "meatiness" in the 60s has reduced lard production from 35 pounds per carcass in 1950 to 17 pounds in 1973. While there is no question that the industry has profited from these changes, production objectives are continually called into question. Achieving proper balance between improvements in carcass merit, reproduction rates and pig performance is a challenge to all pork producers.

Making profitable decisions about emphasis in breeding programs is important to the industry. The availability and use of pertinent information can reduce the risk of making these decisions. The purpose of this report is to describe the relationships among performance and carcass traits in modern hogs.

Performance and carcass records of individual barrows from test pens during the first 6 tests conducted at the SENEK Swine Test Station were used in this study.

Two tests were conducted each year starting in the fall of 1970. Pigs for the fall tests were received at the station south of Wymore, Nebraska, in late September each year. Pigs for the spring test were received in late February and early March. Pens of four pigs (usually 3 boars and 1 barrow) were placed on test following a "warm up" period at the station of at least a week.

For the first two tests, pigs were placed on test when the pen averaged 55 lbs. For the last four tests, pigs went on test when the pen averaged 60 lbs. All pigs were fed the standardized test rations. Barrows were removed from test when they reached 200 lbs. during the first three tests and 210 lbs. during the last three tests. Barrows generally were slaughtered within a week of coming off test.

George A. Hormel and Company in Fremont slaughtered all barrows. Plant personnel collected and recorded carcass data and reported to the station.

With few exceptions, all barrows with complete records were used in this study. Landrace (3) and Berkshire (1) barrows were eliminated because there were too few to establish breed averages.

The average performance and carcass characteristics of barrows by breed are shown in *Table 1*. These averages have been adjusted for year and season differences. Where the means are different, the differences are indicative of the tested barrows. These averages represent true breed differences only to the extent that the tested barrows represent their breed. The breeds were significantly different for rate of gain on test (ADG), carcass length, carcass backfat thickness (backfat), loin eye area (LEA) and ham and loin percent (H & L %). Because there were large differences in age on test among pens, the observed differences in age at 220 pounds and age at slaughter were not significantly different for the six breeds studied.

Table 2 shows the year-season means for the traits studied. Year-season means which were adjusted for breed differences were significantly different for days at 220 pounds, backfat, LEA, age at slaughter and H & L %. Season and year differences were not significant for ADG or carcass length. In age at 220, a strong time trend and seasonal differences were apparent. In each case, spring pigs were older at 220 pounds than pigs the previous fall. Also, age at 220 was decidedly poorer each year. For backfat thickness, both seasonal and yearly differences are apparent. Barrows in fall tests had less backfat than barrows in the preceding and subsequent spring tests. The annual reduction in backfat was quite marked.

Trends in LEA were not apparent. The major difference in the LEA means was the larger LEA in the fall 1971 test. H & L % showed improvement over time. With the exception of the fall 1972 test, each test had a higher H & L % than the previous. The observed year and seasonal differences in H & L % were consistent for all breeds. Similarly, the breed differences were consistent for year and season.

The relationship among the traits studied are shown in *Table 3* as correlations. The effects of breed and test period have been removed.

The relationships observed among the traits are generally as expected, but often much smaller. Pigs which grew faster on test had less H & L % and LEA and more backfat than slower growing pigs, but the correlations were not large. Pigs with a larger H & L % tended to have less backfat and more LEA. These two correlations, –.39 & +.39, are strong and important. The correlations between length and the other traits were quite low. Longer pigs grew only slightly faster and had slightly less fat.

The importance of several of the most important correlations lies in the fact that they were not larger. Faster growing pigs were fatter and had less H & L % and LEA. But the critical question is how much fatter or how much less H & L % and LEA? Once translated into pounds, inches and percent, a proper perspective is gained. An increase of 0.1 in ADG on test would result in less than 0.02 inch increase in backfat, a reduction in LEA of 0.05 sq. inch and a reduction of 0.17 percent in H & L %.

The correlation between H & L % and backfat is not as large as usually expected. Classic research with the backfat probe indicated this relationship to be about –.7. There are two important differences. The first is that live backfat probe is not the same as carcass backfat. Live backfat probe is taken over the center of the loin. Carcass backfat is measured over the backbone. The second important distinction is that H & L % in this study was determined from hams and loins trimmed and weighed on a packing house cutting line, while the research hams and loins were trimmed in research laboratories. There is little question that the research trim was more uniform and the weights more accurate. However, "research trims and weights" are not available to the industry. Pork kill line data is available.

The information reported here describes the phenotypic relationship among performance traits of growing-finishing pigs. It is based on data similar to that available to pork producers when they make decisions about breeding stock. The pork industry must give critical consideration to these types of data when making changes in production objectives.

Table 3. Correlations among barrow traits.

	H&L %	LEA	Backfat	Length	Age at 220
ADG	–.17	–.14	.24	.06	–.74
Age at 220	.17	.15	–.14	–.16	
Length	.11	–.04	–.14		
Backfat	–.39	–.25			
LEA	.39				

Table 1. Breed averages.

	No.	ADG**	Day 220	Sl. wt.	Length**	Backfat**	LEA**	H&L %**
Duroc	123	2.02	152.3	216	29.9	1.29	5.05	41.6
Hampshire	86	1.91	156.6	214	30.4	1.19	5.69	43.0
Poland	16	1.83	157.8	210	29.5	1.18	5.58	41.5
Spot	28	1.84	155.4	215	30.1	1.30	5.44	42.3
Yorkshire	74	1.96	154.8	215	30.6	1.32	5.00	41.1
Chester	49	1.84	159.8	216	29.5	1.34	5.13	41.4

** Breeds significantly different ($P < .01$)

Table 2. Year-season averages.

	No.	ADG	Day 220**	Sl. wt.**	Length	Backfat**	LEA**	H&L %**
Fall, 1970	56	1.87	146.1	209	29.8	1.30	5.21	40.5
Spring, 1971	58	1.89	157.1	215	30.2	1.35	5.13	41.6
Fall, 1971	55	1.97	155.8	222	30.0	1.27	5.73	42.0
Spring, 1972	56	1.90	156.9	212	30.2	1.29	5.16	42.3
Fall, 1972	83	1.91	159.0	214	30.1	1.20	5.32	42.9
Spring, 1973	68	1.88	161.7	214	29.8	1.21	5.33	42.5

** Test periods significantly different ($P < .01$)

UGFs—The UFOs of Swine Nutrition

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UGFs (Unidentified Growth Factors) are as difficult to identify and establish as being real as are UFOs (Unidentified Flying Objects).

There are many reports of gains and feed conversion of swine being improved when sources of UGFs are added to diets supposedly completely balanced for all nutrients. In other instances, researchers report no benefits from the UGF sources.

Although the contradiction concerning their effect on animal performance exists, most swine nutritionists feel that UGFs are real. What UGFs are is pure speculation. They may be nutrients, body stimulants, substances that act like antibiotics or compounds that magically add balance to make the animal body function more efficiently.

Major sources of UGFs are considered to be corn distillers solubles, dehydrated alfalfa meal, dried whey, fish solubles and various by-products of industrial fermentation processes.

In an attempt to establish whether or not certain products contained UGFs, the NCR-42 Committee on Swine Nutrition (12 states in the North Central region, which includes Nebraska) participated in a cooperative study to evaluate dehydrated alfalfa meal and corn distillers dried grains with solubles—dried whey, and fish solubles—as sources of UGFs. The sources were added at various levels to a simple corn-soybean meal 14 percent growing-finishing diet fed to pigs starting at a weight of about 50 pounds. The overall results are shown in *Table 1*. Gains and feed conversion were depressed when dehydrated alfalfa meal was added to the basal diet. Similar results were observed with corn distillers dried grains with solubles and dried whey at the 7.5 percent and 5.0 percent levels of addition for the respective UGF sources.

Two studies have been completed recently at the Nebraska Station to evaluate industrial fermentation products as sources of UGFs for G-F swine. In the first experiment (Nebraska Experiment 71410) Zymaferm was fed at levels of zero and 3 pounds per ton with and without 20 grams per ton of chlortetracycline. Thus, we were able to evaluate if UGF source would give a response equal to or greater than that obtained with an antibiotic or if there was an interaction between the two. The results are shown in *Table 2*.

Pigs fed the basal diet plus Zymaferm and chlortetracycline gained faster and more efficiently dur-

Table 1. Sources of UGF's for G-F swine.[a]

	SOURCE OF UGF										
	Dehy alfalfa meal, %[b]			CDDG/s, %[b,c]			Fish solubles, %[b]			Dried whey, %[b]	
Criterion	0	2.5	5.0	0	2.5	5.0	0	3.0	7.5	0	5.0
Average daily gain, lb.	1.65	1.61	1.61	1.61	1.63	1.58	1.68	1.63	1.69	1.65	1.69
Feed/gain, lb.	3.37	3.42	3.50	3.44	3.47	3.47	3.25	3.33	3.15	3.27	3.23

[a] From NCR-42 Committee on Swine Nutrition. 1970. JAS 31:900.
[b] Level added to diet; protein level of diet maintained at 14%.
[c] Corn distillers dried grains with solubles.

ing the first 28 days than those fed the other diets. During the last 42 days of the test, pigs fed the unsupplemented basal diet gained faster but with similar feed conversion compared with those fed the UGF product or the antibiotic alone. Gains of pigs fed the antibiotic alone or in combination with the UGF were quite depressed during the last 42 days. Over the entire period, pigs fed the unsupplemented basal diet gained the fastest, whereas those fed the basal plus Zymaferm and cholortetracycline required 4 percent less feed per pound of gain.

One would expect young or light weight pigs to respond better to UGF and antibiotics. The suggestion that this occurred when the UGF and antibiotic were fed in combination merits further research.

Results from the most recent experiment conducted on UGFs at the Nebraska Station (Nebraska Experiment 73404) are presented in *Table 3*. Again, the results suggest that the young pig responds to UGFs since those fed Pryferm gained 3 percent faster and required 8 percent less feed than those fed the unsupplemented basal diet during the first 56 days. For the second 56 days, average gains were the same for both groups of pigs, but those fed Pryferm required 4 percent more feed per pound of gain. Overall, the pigs fed Pryferm from start to market weight gained 4 percent slower but required 6.4 percent less feed per pound of gain than those fed a 14 percent corn-soybean meal diet balanced to meet the known nutrient needs of the pig.

No one really knows if UFOs exist, but every day we hear reports that they do; others say they do not. At this stage, the results of our research as well as that of others also indicates that the same can be said for UGFs. Thus, the cost/potential benefit ratio must be carefully evaluated in considering UGF sources for swine diets.

Table 2. Effect of Zymaferm and antibiotic on gains and feed conversion of G-F Swine.[a]

Criterion	Basal	Basal + 3 lbs/ton Zymaferm[b]	Basal + 20 gms/ton CTC[c]	Basal + 3 lbs/ton Zymaferm + 20 gms/ton CTC
Av. daily gain, lb.				
1st 28 days	1.39	1.34	1.20	1.49
Last 42 days	1.83	1.84	1.72	1.73
70 day test	1.66	1.64	1.52	1.64
Feed/gain, lb.				
1st 28 days	3.70	4.17	3.85	3.23
Last 42 days	3.85	3.85	3.85	4.00
70 day test	3.78	4.01	3.85	3.62

[a] Peo, E. R., Jr., P. D. Platter and B. D. Moser. Nebraska Experiment 71410. Data based on average of 2 pens of 6 pigs each/treatment. Int. wt. 65 lbs. Pigs housed in a completely enclosed building ⅔ slatted floor.

[b] Zymaferm and grant-in-aid support courtesy BZD Livestock Products, Inc., Lincoln, Nebraska.

[c] Chlortetracycline; courtesy American Cyanamid Company, Princeton, New Jersey.

Table 3. Effect of Pryferm on gains and feed conversion of growing-finishing swine.[a]

Criterion	Basal[c]	Basal + Pryferm[b] to 125 lbs– then Basal	Basal to 125 lbs– then Basal + Pryferm	Basal + Pryferm to mkt. wt.
Av. daily gain, lb.				
1st 65 days	1.30	1.40	1.33	1.31
2nd 56 days	1.49	1.37	1.48	1.38
112 day test	1.40	1.38	1.40	1.34
Feed/gain, lb.				
1st 56 days	3.23	2.96	3.33	3.11
2nd 56 days	3.72	3.87	3.84	4.08
112 day test	3.48	3.38	3.55	3.27

[a] Peo, E. R., Jr., T. Stahly and B. D. Moser. 1973. Nebraska Experiment 73404. Data based on average of 2 pens of 8 pigs/treatment. Int. wt. 40 lbs. Pigs housed in completely enclosed unit, ⅔ slatted floor.

[b] Pryferm courtesy Dawes Laboratories, Inc. Chicago. Fed at rate of 5 lbs/ton of complete diet.

[c] 14% corn-soybasal.

Save Your Breath

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Agricultural workers are often confronted with situations which can damage normal respiratory functions. Dusts, fumes and sprays are commonplace. New agricultural chemicals pose increased risks. Yet agriculture has been slow to adopt protective measures.

Livestock Confinement

Pork producers should be aware of the health hazards which exist when manure storage facilities are improperly managed.

Extreme danger exists when anaerobic pits containing animal waste are agitated or pumped out. This includes any dropping pit that is used for animal waste storage for any period of time. If an oxidation ditch containing waste is allowed to remain idle for a period of time, a toxic gas problem may occur when the ditch is restarted. In all of these instances, the major problem is gas evolution. When these waste accumulations are agitated, hydrogen sulfide, carbon dioxide, methane and ammonia are the principal gases of concern, with hydrogen sulfide being the most dangerous.

Table 1 shows a range of concentrations of these gases that have been found in ventilated swine-confinement units. The Threshold Limit Values (TLV) shown are the maximum recommended concentrations a worker can be exposed to continuously for an 8-hour day/40-hour work week.

Hydrogen sulfide can kill! It is reported that breathing 1,000 ppm (0.1%) hydrogen sulfide will result in instant death, while breathing 500 ppm (0.05%) for half an hour will also result in death. Under certain conditions, these concentrations can be present in animal waste storage areas, so

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Save Your Breath

(continued from page 19)

these areas must always be treated as if they are dangerous. Hydrogen sulfide has the characteristic odor of rotten eggs; however, you cannot depend on your nose! This gas rapidly paralyzes the olfactory nerves and it is reported that when it reaches dangerous levels, it smells like roses. Human and animal deaths in confinement units have been attributed to hydrogen sulfide.

Ammonia or methane toxicity should not be a human problem in animal waste areas. Ammonia concentrations normally are not high enough to be dangerous. Eye watering occurs at 50 ppm and usually occurs in a poorly ventilated swine and poultry operation. A methane hazard is a remote possibility. However, a methane explosion hazard does exist in tightly closed unventilated areas. Methane and ammonia are lighter than air.

Table 1. Gases and concentrations found in ventilated swine confinement units.

Gas	Concentration	TLV[a]
	ppm	ppm
Carbon dioxide (CO_2)	600-1,800	5,000
Ammonia (NH_3)	0.4-35	50
Hydrogen sulfide (H_2S)	0.09	10
Methane	....	1,000

[a] Threshold Limit Values for daily 8-hour exposure as established for humans by the American Conference of Governmental Industrial Hygiene.

Carbon dioxide is heavier than air and will accumulate in animal waste storage areas. Normally, carbon dioxide concentrations that are harmful to health will cause breathing difficulty and, therefore, provide adequate warning. Unfortunately, hydrogen sulfide is heavier than air and where carbon dioxide accumulations occur, hydrogen sulfide may accumulate.

Under no conditions, unless prescribed safety equipment is used, should anyone enter a waste storage pit while it is being agitated or being emptied. One should not even be near the area unless it is well ventilated. The pit is safe to enter only after it has been washed and well ventilated. Remember, if concentrations are high enough, only one breath of hydrogen sulfide can cause death. Even at lesser levels, unconsciousness can occur and result in the operator falling into the pit and drowning. When working around these types of facilities, *never work by yourself.*

Respiratory Equipment

In many cases, the respiratory hazard can be reduced by the use of adequate safety equipment. The choice of equipment depends upon the type of contamination and the length of exposure.

Several types of respiratory equipment may be of practical use to pork producers.

Mechanical filter respirators protect against airborne particles, including chemical, mineral, field and barn dusts, chaff, pollen and non-toxic paint spray. They consist of a soft rubber facepiece with one of several types of mechanical filters attached.

Chemical cartridge respirators protect against light concentrations of gases, vapors and sprays by using a chemical filter to purify inhaled air. They differ from mechanical filter respirators in that they use small cartridges containing chemicals to remove contaminants. Cartridge respirators are not designed for use against gases that are extremely toxic even in small concentrations, such as manure or silo gases—nor should they be used for contaminants their cartridges are not designed to handle. They must never be used in oxygen deficient places.

Gas masks consist of a facepiece and a canister of chemical filtering material which removes toxic gases, sprays, vapors or particles from the air. The canister is strapped to the chest or back and connected to the facepiece by a flexible tube. The chin-type gas mask is a smaller capacity unit and the canister is integral with the facepiece. Because of its capacity, the gas mask can be used for much heavier concentrations of contaminants than can the cartridge respirators (concentrations of gases and vapors up to 2 percent by volume compared to 0.1 percent for cartridge types). Also, canisters have a longer service life than cartridges. But, as with all air purifying devices, there must always be enough oxygen to sustain life.

Self-contained breathing apparatus provides respiratory protection in any concentration of toxic gases and/or condition of oxygen deficiency. The user is independent of surrounding air because he is breathing with a system with its own oxygen supply.

Information Available

Further information is available from many sources. State Extension specialists in safety or pesticide usage, chemical manufacturers and dealers, dealers in respiratory protective devices and other agricultural authorities can provide information or advice on respiratory protection. Also, much information about the equipment, uses and limitations, can be found in manufacturers' sales literature. When you buy a device, read the instructions carefully and follow them to the letter.

The Ancient Pig in a Contemporary World

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For literally thousands of years the pig has remained unchanged—being able to adapt to nature under a wide range of conditions. Unrelenting advances in technology during modern times—particularly confinement housing—have not been completely to the advantage of the pig.

The acknowledged advantages of confinement production are generally listed as (1) reducing the restrictive influence of weather on performance, and, (2) enhancing labor efficiency. As with many technological advances, one advantage is gained at the risk of creating a disadvantage. In this case, a disadvantage or problem caused by many forms of confinement is its effect on the pig's feet, legs and other areas of its anatomy. The surface on which the pig walked before confinement was resilient and relatively non-abrasive—characteristics generally absent in confinement system floors.

A study was designed to determine if different types of slats would reduce the type of claw injuries recorded in previous studies from this Station. Seventy-two pigs averaging 26 pounds were allotted, 18 per pen, to pens with floors that had either concrete, steel or aluminum slats and to an outside dirt lot. The three slatted pens were totally slatted. The concrete slats were five inches wide with a one-inch slot. The steel and aluminum slats were three inches wide with a three-quarter-inch slot. The study was started June 5, 1972, and ended September 27, 1972.

While all eight claws were scored for type and degree of injury, only the four rear claws were measured. The measuring technique described in the 1973 Nebraska Swine Report was again used. *Table 1,* which compares claw length, indicates that steel and aluminum slats affect claw length in a similar way and that pigs reared on these two types of slats had longer claws than pigs reared on the other two surfaces. The claws of pigs reared on soil classified as Dickinson sandy loam (no vegetation) were shorter than those reared on either metal slats, but somewhat longer than those reared on concrete slats. Pigs reared on concrete had claws shorter than those reared on the other three surfaces and the difference appears relatively large. The combined difference in length between outside and inside claws confirms other studies that show the outside claw is significantly larger than the inside claw.

Figure 2. Injury score of five (ulcerated) on a pig reared on aluminum slats.

Claw width data is summarized in *Table 2.* While pigs reared on aluminum slats had the longest claws, the reverse was the case when measuring width. In general, there does not appear to be a direct relationship between surface or slat type and length and width. However, since the longest claws in this study (aluminum slats) were also the narrowest, this type of relationship appears to be present.

Even though the pig's claw is asymmetrical, the lack of symmetry may be considered relatively equal between claws. Using this assumption one may use the length/width data to calculate area or square inches. *Table 3* summarized claw dimension in terms of square inches. The rear claws of pigs reared on concrete slats are 8.6 percent smaller than those reared on soil or steel slats, and 7.2 percent smaller than those reared on aluminum slats. *Table 3* also indicates the discrepancy in area when combining outside versus inside claws. The difference suggests that the outside claws have an area 16.6 percent greater than the inside claws.

Scoring System

The same five-category scoring system was used as in the 1973 Nebraska Swine Report. With this system, a normal claw receives a score of '1,' the most severe lesion (ulcerated claw) receives a score of '5.' The single greatest score per claw was used in the summary rather than a combination or average of two or more types of lesions.

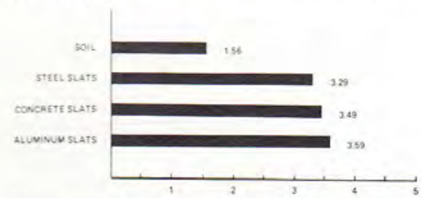

Figure 1. The effect of slat type or soil on claw injury level.

A summary of the degree of injury to either front or rear claws and inside or outside claws appears in *Table 4.* Injury score difference between outside and inside claws for all claws is 10.2 percent. Since the rear outside claws have 16.6 percent more area than the inside claws, it appears that there is a certain relationship between disproportionate claw size and lack of injury balance or distribution between the two claws. However, it should be remembered that only the back claws were measured, while front and rear were scored for injury. If we compare the rear outside injury score with the rear inside score we find that the degree of injury to the outside claw is 17 percent greater than to the inside claw.

The effect of slat type or soil on claw injury level is shown in *Figure 1.*

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Table 1. Average rear claw length.[a/b]

	Soil	Steel slats	Concrete slats	Aluminum slats	Average
Outside claw, inches	1.81	1.88	1.70	1.92	1.83
Inside claw, inches	1.63	1.72	1.48	1.72	1.64
Average	1.72	1.80	1.59	1.82	
Difference, inches	.18	.16	.22	.20	

[a] Both right and left claws combined.
[b] 114-day test period.

Table 2. Average rear claw width.[a/b]

	Soil	Steel slats	Concrete slats	Aluminum slats	Average
Outside claw, inches	1.22	1.13	1.19	1.10	1.16
Inside claw, inches	1.09	1.07	1.09	1.04	1.07
Average	1.16	1.10	1.14	1.07	
Difference, inches	.13	.06	.10	.06	

[a] Both right and left claws combined.
[b] 114-day test period.

Table 3. Effect of slat type or soil on total rear claw dimension (square inches).[a]

	Right rear leg		Left rear leg		
	Outside claw	Inside claw	Outside claw	Inside claw	Average
Soil, sq. in.	2.20	1.72	1.81	2.18	1.98
Steel slats, sq. in.	2.14	1.81	1.87	2.11	1.98
Concrete slats, sq. in.	2.03	1.62	1.61	1.99	1.81
Aluminum slats, sq. in.	2.11	1.77	1.83	2.10	1.95
Average, sq. in.	2.12	1.73	1.78	2.10	

[a] Length x width.

Table 4. Relationship between front or rear and outside or inside claws and level of injury.[a]

Claws	Front	Rear	Average
Outside	3.10	3.19	3.14
Inside	2.99	2.65	2.82
Average	3.04	2.92	

[a] The greater the value, the greater the degree of injury.

Ancient Pig

(continued from page 21)

Aluminum slats caused more injury to the claws than concrete, while concrete slats caused more injury to the claws than steel slats. However, the relative difference in injury score between slat types appears small. When comparing the injury score of pigs reared on slats with those reared on soil, it is obvious that the surface contact area may be the major factor in claw injury. Even though concrete slats have a greater wearing effect on claws, the data suggest that surface characteristics other than abrasiveness are involved in level of claw injury. Since a lack of resilience is common among all of the slats compared, this characteristic must be suspected as a possible claw injury factor.

Summary

There were only slight differences in injury levels to pigs' claws when reared on either steel, concrete or aluminum slats. However pigs reared on concrete slats had smaller claws (less area) than those reared on steel or aluminum slats or soil. This suggests that factors other than the abrasiveness of concrete, and its resultant wear on claw tissue, are responsible for claw injuries or lesions. It now appears quite probable that resilience is the characteristic absent in most confinement floor surfaces which may be required to reduce claw injury, the surface must also be durable and economical.

There is almost certainly a natural tendency for the outside claw to be larger than the inside claw. In confinement this trait works to the pig's advantage, since opportunity for trauma and lesions is apparently greater than in non-confined systems. Because of the response at the floor/animal interface, the greater discrepancy in claw size will apparently result in proportionately greater injury. Claw injury may not influence gain or feed:gain in some cases. However, since pigs with sore feet may stand or walk in an abnormal manner to relieve their discomfort, undesirable leg characteristics often result. This suggests that the overall problem is not the same for the pig destined for the breeding herd as for the pig going to market.

Selection Indexes

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The goal in the selection of replacement breeding stock, from a genetic improvement point of view, should be the selection of animals which will bring about the greatest improvement in profitability (reduction in cost of production).

To accomplish this goal, one must consider the performance of an animal for more than one trait. The overall economic picture in a swine operation is influenced by several different aspects of performance. For example, an increase in the number of pigs weaned per litter reduces the sow cost per pig, improved growth rate decreases overhead costs and reduces feed costs because of its association with efficiency, and reductions in fat thickness increase carcass value.

It must be remembered that the more traits considered in the selection of replacements, the less will be the genetic improvement for any specific trait. Therefore, only traits which do affect profitability should be considered.

Rarely is a producer able to find an individual which is superior for all aspects of performance. This results in the dilemma of how best to evaluate information for different traits from different individuals where one individual is superior for one aspect of performance but not all.

Traits are measured differently (pounds, inches, etc.), they do not contribute equally to profitability and are influenced genetically to a different degree. All these factors make the evaluation of information from different traits difficult. One available procedure is the use of a selection index.

Theory of an Index

A selection index is a numerical expression which combines an individual's performance for several traits into one value for each animal. The index value basically ranks the individuals with respect to their overall merit for the traits included. If properly constructed, the index identifies the individuals expected to make the greatest genetic improvement in overall merit for the herd. The construction of an appropriate selection index involves the consideration of several factors.

1. *Economic importance of each trait.* Traits vary in their contribution to profitability. The economic importance of a trait will vary from herd to herd depending on the costs associated with each herd and the present level of performance. If feed costs differ between herds, the economic value of growth rate is different for the two herds. Also, increasing the number of pigs weaned per litter from 10 to 11 does not reduce the costs per pig as much as increasing from 5 to 6 pigs weaned.

2. *Variability of each trait.* Differences among individuals must exist for a specific trait if any change is to be made. Some traits are more variable than others and this must be considered.

3. *Degree of genetic influence for each trait.* The expected improvement from selection is dependent upon the degree to which a trait is genetically determined. Therefore, consideration of the heritability of each trait is important.

4. *Relationships among the traits.* If relationships among the traits are not considered, too much emphasis may be given to one aspect of performance at the expense of others.

Inclusion of each of these factors for each trait in the proper mathematical formulation results in the appropriate weighting to be applied to each trait in the index.

Example Indexes

Construction of an index appropriate for all situations is impossible because parameter estimates are not identical for all situations (e.g. economic values). However, using average values of the various parameter estimates will yield indexes which may be applicable over a wide range of circumstances. At a minimum, these indexes will place emphasis in the proper direction for the traits considered.

Estimates of the economic value per unit, heritability and standard deviation for number of pigs weaned in the litter a pig was raised in, postweaning average daily gain, age at 220 pounds and probe backfat thickness are given in *Table 1*. The traits chosen represent traits from each of the three main classifications of swine traits (reproduction, performance and carcass), and traits for which producers would most likely have information available.

Table 1. Parameter estimates for swine traits.

Trait	Unit of measure	Economic value per pig	Heritability	Standard deviation
Number weaned	pig	$ 3.00	0.05	2.50
Avg. daily gain	lb./day	$10.00	0.30	0.18
Age at 220 lb.	day	$ 0.12	0.35	15
Backfat probe	inch	$ 3.60	0.50	0.15

Two measures of growth rate (average daily gain and age at 220 lb.) are included, but only one will be used in any particular index. The index involving number weaned, daily gain and backfat probe can be expressed in the following manner.

$I = 5 \times \text{(no. weaned)} + 110 \times \text{(gain)} - 40 \times \text{(probe)}$

The index value computed has no absolute meaning and should not be compared to index values calculated from any other index. Index values are not comparable between indexes. Comparisons can only be made among index values calculated from the same index. The individual with the highest index value would be expected to produce the greatest improvement in overall merit when overall merit is defined in terms of these three traits.

The weighting of 5 for number weaned and 110 for gain does not mean gain has 22 times as much emphasis on the index value. It is impossible to compare weightings to determine relative emphasis because traits are measured in different units. Examination of the weightings for number weaned (3) and age at 220 lb. (−1) in the second index should illustrate this point. Also any constant multiple of all weightings in a given index could be used without affecting the ranking of the individuals. The values 2.5, 55 and −20 or 1, 22 and −8 would be just as appropriate as the ones used. The resulting index values would differ in magnitude, but the ranking of the individuals would be identical for the three sets of weightings.

When age at 220 pounds is used as a measure of growth rate, the following index results.

$I = 300 + 3 \times \text{(no. weaned)} - \text{(age)} - 20 \times \text{(probe)}$

The constant value 300 is included in this index so that the resulting index values are not negative. A constant value, of any size, can be used with any index without affecting the ranking of individuals. Use of any constant desired should illustrate the inappropriateness of comparing index values calculated from different indexes.

Note that in this index the measure of growth rate receives negative emphasis in contrast to the index involving daily gain where it received positive emphasis. The reason is the way in which the traits are defined. The desirable directions of change would be to increase daily gain but decrease age at 220 pounds. The emphasis placed on each trait in the two indexes is compatable with the desired direction of change.

Summary

1. A selection index is an expression which combines information from several traits into one value such that individuals can be ranked for overall merit.

2. A selection index is the most efficient method of selecting several traits.

3. Comparisons cannot be made between index values calculated from different indexes.

4. The weightings for the traits in a given index can be many possible sets as long as the relative magnitudes are not changed.

5. The addition of a constant value to an index does not affect the ranking of individuals.