1989 Swine Day Research Report

Animal Sciences Special Report 395
Agricultural Experiment Station
College of Agriculture
University of Missouri-Columbia
(Publication supported by the Frederick B. Miller Endowment Fund)

College of Agriculture

UNIVERSITY OF MISSOURI-COLUMBIA

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The goal of our swine research program is to provide information that will aid Missouri producers in improving productivity or reducing costs. This 1989 Swine Research Report is one of the many efforts of the Department of Animal Sciences, University of Missouri, to assist Missouri swine producers. We have attempted to briefly inform you of what we have done, what we have found and how you may use these results in your operation. We welcome your suggestions on how we can do a better job in communicating our research results.

The swine industry in Missouri is a significant contributor to the state's economy. Cash receipts for hogs exceed 550 million dollars. Missouri swine inventory of approximately 3 million head ranks Missouri 6th in swine production. Our swine group at UMC is dedicated to serving this very economically important Missouri swine industry by providing effective teaching, research and extension programs.

Listed within this report are those directly supporting our swine program this past year. We greatly appreciate this support.

Sincerely,

Gary L. Allee
Chairman

GLA/rlc

ACKNOWLEDGEMENT

Through Mr. Frederick B. Miller Trust the Department of Animal Sciences in the College of Agriculture is able to enrich the program of research, scholarships and development of livestock.

This publication of research topics concluded or in progress and/or lectures focus on current technology of interest to the Pork Producers in the industry. Presentation of research results will continue on an annual basis.

Participants from off-campus and from other faculties assemble with resident staff from the University of Missouri Animal Science faculty to review, discuss and update technology related to the industry opportunities and problems evaluations. This new knowledge base complements existing technology and provides Missouri producers the competitive advantage or opportunity to improve resource utilization for maximum production efficiency and profitability

COVER: New modified open front finishing facility for Swine Research at the pasture farm in Columbia.

COMPANIES AND ORGANIZATIONS CURRENTLY SUPPORTING UM SWINE RESEARCH - 1989

A. L. Laboratories, Inc., Englewood Cliffs, New Jersey
Biokyowa, Inc., Chesterfied & Cape Girardeau, Missouri
Diamond V. Mills, Inc., Cedar Rapids, Iowa
Estrogenix, Inc., Boulder, Colorado
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Hoffmann-La Roche, Inc., Nutley, New Jersey
Kraft, Inc., Marshall, Missouri
Lonza, Inc., Fair Lawn, New Jersey
Merck and Company, Inc., Rahway, New Jersey & Fulton,Missouri
Missouri Department of Agricutlure Marketing Division, Jefferson City, Missouri
Missouri Pork Producers Association, Columbia, Missouri
Missouri Soybean Merchandising Council, Jefferson City, MO
Monsanto Company, St. Louis, Missouri
National Dairy Council, Rosemont, Illionis
National Pork Producers Council, Des Moines, Iowa
NutriBasics Company, Highland, Illinois
Pfizer, Inc., Lee's Summit, Missouri
Pitman Moore, Inc., Terra Haute, Indiana
Roussel-Uclaf, Paris, France
United States Department of Agriculture, Washington, DC
Wilson Food Corporation, Marshall, Missouri
The Upjohn Company,, Kalamazoo, Michigan

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SPECIAL CONTRIBUTORS TO 1989 UMC SWINE DAY

Pork Chop Lunch	--	Cargill Nutrena Company Pfizer,Incorporated
Swine Day Proceedings and Activities	--	MFA, Incorporated Merck and Company, Inc. Diamond V. Mills, Inc. Biokyowa, Inc. Frederick B. Miller Endowment Moorman Manufacturing Company Wilson Foods Corporation
Guest Speaker	--	Frederick B. Miller Endowment Eli Lilly and Company Missouri Pork Producers Assn.
Coffee & Donuts	--	Pork Council Women

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The Feasibility of Group Marketing of Hogs*

by

V. James Rhodes and Charles L. Cramer
UMC Department of Agricultural Economics

As a general rule cooperatives perform best for producers where market competition is poorest. Except for fringe areas, market competition for hogs has been active in recent years and cooperative marketing of hogs has been limited. There is a possibility that market competition for hogs might deteriorate for Missouri producers, given the games of musical chairs being played in packing plant and buying point ownership. In the last few months the farm press has been full of stories saying that both packers and feed companies believe that their vertical integration into hog production in the next decade is essential; if not inevitable. While most of those stories seem to feed on one another's speculations, the possibilities of major vertical integration and further feed company and packer concentration do exist. Hence it is prudent for Missouri producers to consider their possible options in group marketing.

Two alternative approaches to group hog marketing need to be considered:

(1) a market search approach

(2) the committed volume supplier approach.

*A grant from the Missouri Pork producers Council partially funded this research.

Either approach involves the organization of interested producers and the commitment of some capital to hire a marketing specialist and (likely) to acquire the use of one or more assembly points. To be efficient such an organization needs to have the reasonable assurance it can market 75,000 or more hogs annually. We emphasize later that efficiency may not be enough to insure survival in today's competitive environment.

The market search approach involves a marketing specialist searching the market each day for the best opportunities. Given that different packers have somewhat different systems for paying for varying quality and given that producers vary in their quality mixes, the marketing specialist will be able to make matches. In addition to quality matching, the marketing specialist can be expected to advise on timing of sale. When markets are about to move, advice to move marketings forward or backward a few days can be worthwhile. This market search approach is like that followed until recently by MFA Livestock, although MFA did not put as much emphasis on timing. Moreover MFA volume largely flowed through buying stations while this approach projects more emphasis on moving truck loads straight to a packer dock.

The committed volume supplier approach would schedule specific volumes to a large buyer. In effect, the producer group would replace a packer buying station and would expect to capture those costs for its effort. By providing guaranteed volume for some weeks ahead and by providing special deliveries at times requested by the packer, the producer group may earn an additional premium.

Market Search

The market search approach is the more traditional method. Vista Pork in N.W. Iowa is an example, although it has not achieved the 75,000 hog volume essential for top performance. NFO apparently operates a number of points using the market search format. Michigan Livestock Exchange is one of the more successful livestock cooperatives using market search. Its membership has been rising in the 1980s. Several of its dealer points market more than 100,000 hogs a year and one exceeds 300,000. It markets about 70% of Michigan's hog production. Heinold is the best-known example of many dealers who search the daily market for the best opportunities.

While operating strategies must evolve within the competitive environment we suggest these initial operating characteristics:

* emphasize carcass merit selling and enlist members who consider that approach to be generally advantageous for their hogs.
* hire a skilled marketing specialist who knows hog yield characteristics and the format of each packer's carcass merit buying matrix so that he can evaluate bid prices better than most producers can.
* expect the marketing specialist to assist producers in market timing--whether on scheduling deliveries within a week or purchasing options several weeks or months ahead.
* members sign a marketing contract that may be terminated by either side after 30 days notice. Members agree to pay $10 a hog penalty for any slaughter hogs they market outside the group.

* members agree to project in the last week of each month their expected slaughter hog marketing during each of the next 3 months.
* move hogs direct from farm to packer dock whenever size of load and distance to packer permits. A producer will consult with the market rep at least 2 full days before he plans to ship. Producers may choose to haul their hogs to the packer dock.
* producers will provide a copy of each packer cut-out sheet to the marketing rep. If a producer has any questions about the fairness of the packer evaluation, the marketing rep will counsel with the producer and will join in the producer's complaint when he appears to have a legitimate case.
* each producer pays an annual membership fee plus a commission per hog marketed. Refunds voted by the directors from earnings are on the cooperative principle of being proportionate to volume marketed.

The success of any enterprise depends heavily upon the skill of its management. Assuming a well-managed operation, we project these performance attributes:

* net earnings of the organization on hog sales of 1 to 3%
* producers save time now spent in marketing
* producers realize that they have an organization in place that could be helpful to their survival if several local buyers were to close.

* the organization runs minimal risk of being bypassed by its members in the short run.
* initial capital requirements are low and organization risks borne by producers are small.
* the benefits are probably greater to those producers who are not close to (say, 40 miles) the dock of a large packer.

On the down side, the prospects of the daily search organization are not all rosy. Some producers will be discouraged by the low earnings. Other producers will be irritated when particular advice on market timing turns out to be wrong, or other mistakes are made by the marketing rep. There is no long term assurance that enough producers will remain with the organization to insure its long term viability. Even more sobering is the vulnerability of such a group to a squeeze play by the larger packers. If they choose to bid low for the organization's hogs for a few months, it cannot survive.

Committed Volume

The operating features of a committed volume supplier would not differ from the previous example except to reflect sales to a single buyer and a closer scheduling of deliveries. The following differences are suggested:

* the marketing agreement ought to require a 90 day consultation notice to permit closer scheduling. The producers should schedule deliveries by weeks for the first 4 weeks of their 3 month projection.

* the marketing rep would operate more as a coordinator of shipments. He would have little, if any, opportunity to time deliveries. If he is asked to advise on options and hedges, he would need to emphasize market outlook skills. Otherwise, such skills may be unnecessary. However, an important duty of the market rep might be to check on prices at alternative outlets in order to evaluate regularly how well the packer arrangement is working.
* It would be possible for a producer to fulfill a marketing rep role on a part-time basis, if the duties are mainly scheduling.

Performance attributes would likely be similar to the market search approach with the following exceptions:

* member problems will occur in a rising market when producers will seek to delay scheduled deliveries. Likewise producers will want to accelerate deliveries in a falling market. The organization will have to penalize such behavior in order to meet its scheduled commitments to the packer.
* the organization runs a greater risk of being bypassed by members. Any medium to large size member delivering regularly to the same buyer may decide that he doesn't need any intermediary organization to do what he can do on his own.

The same down side comments apply as those for the market search organization. The organization's performance would depend heavily upon the treatment received from the packer outlet. A small organization would have little power to ensure that it received continued fair treatment.

General Comments

1. It appears tougher to operate group marketing than group buying.[a] Input manufacturers regard a purchasing group as another outlet and are glad to do business as long as the group pays its bills. Meat packers may regard a new producer marketing group as a potential competitor to be nipped in the bud.
2. The basic idea of the committed volume supplier approach is to duplicate the marketing position of a large producer such as Tyson or National Farms.
3. There are more cooperative precedents for the market search approach. However, one cannot ignore the limited success of such groups. Michigan Livestock Exchange's success is more encouraging, but it may not be easy to imitate.
4. It is an extraordinarily uncertain period for beginning a marketing organization. From a positive viewpoint, growing concentration in meat packing and the rising threat of vertical integration presents a major opportunity for producers to organize cooperatively. Producers can see their individual vulnerability. However, from the negative viewpoint, it may take a major marketing organization to have the strength to play in the same game with the big boys. A small marketing organization like MFA Livestock apparently was just as vulnerable as an individual producer. The recent purchase by IBP of 40 hog buying

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[a] See V. J. Rhodes and Donald Van Dyne, "Farm Cooperatives Without Facilities," UMC Department of Agricultural Economics Paper 1988-15.

stations from Heinold illustrates how quickly a large packer can rearrange the procurement chess board. It also raises questions about Heinold's long term viability. The packing industry is still in disequilibrium. We may eventually see a pork packing industry dominated by 3 or 4 firms that largely have their individual procurement areas. However, there is likely to be considerable competition and several surprises along the way before that new equilibrium develops.

LITTER PERFORMANCE OF SOWS FED FAT SUPPLEMENTED DIETS DURING LACTATION IN THE SUMMER

R.O. Bates and J.C. Rea

Summary

A sow feeding trial was conducted to determine if supplementing lactation diets with 7.5% plant or animal fat during the summer would improve litter and rebreeding performance. Only litter performance is reported here. No significant differences were found among litters of sows consuming the control diet versus the diets containing either plant or animal fat source. The level of preweaning survival was high which left for little opportunity to show improvement.

Introduction

Hot summer temperatures often cause discomfort to lactating sows. Feed intake can be depressed and nursing pig performance can be adversely affected. The interval from weaning to subsequent farrowing can be lengthened as well. Several reports have shown that a fat energy supplement t levels of 10% of the diet can improve milk yield f the sows, increase litter weight at 21 days of age (Shurson et al., 1986) and decrease the days to estrus after weaning during hot temperatures (Cox et al., 1983). Developing diets that contain 10% fat can be difficult. Also differences between plant and animal sources of fat are not well documented. Therefore a study utilizing a Missouri commercial swine farm was conducted to evaluate lactation and subsequent reproductive performance of sows consuming diets containing plant or animal fat sources, at lower levels then previously reported, during the summer months. Only sow lactation performance will be reported at this time.

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[a]This project was funded, in part, by a Commercial Agriculture Applied Research Grant. We wish to express our thanks to Ham Hill Farms, Marshall for their cooperation in this study. Special thanks to the Missouri Soybean Merchandising Council, Jefferson City for donating the soybean oil and Freeborn Foods, Albert Lea, MN for donating the Mil-Ko-Lac 4-80 dried fat product.

Methods

Three lactation diets were compared on a commercial swine farm. A corn, soybean meal control diet was compared to two experimental diets that were formulated to contain 7.5% supplemental fat (table 1). The plant source of fat was soybean oil while the animal source of fat was a dried product that contained 80% choice white grease and 4% crude protein (table 1).

The study began July 22, 1988 and included 175 sows, the last of which weaned their litters on September 6, 1988. Females were randomly allotted to diet, within parity, upon placement into farrowing crates. Parity was designated as gilts, sows farrowing their second litter and sows farrowing their third or greater litter. Sows consumed their allotted diet from assignment to weaning. Days of lactation averaged 27 and ranged from 19 to 32. Data collected provided information on litter birth weight, piglet survival to weaning, number weaned, litter weaning weight and average daily feed consumed.

Results and Discussion

The results of this study are given in table 2. The addition of supplemental fat in the diet of lactating sows did not significantly influence any of the traits reported. This was surprising since previous reports indicated that preweaning survival (Moser and Lewis, 1980) and litter weight at weaning were improved (Shurson et al., 1986) when fat was added to the lactation diet. Several possibilities exist on why this occurred. Opportunities to show improvement were modest. High preweaning survivability allows for little room for improvement. Also, levels of fat fed in this study were lower (7.5% vs 10%) then other previous studies in which significant differences were reported.

Conclusion

A study to evaluate plant and animal fat in sow lactation diets was conducted on a commercial Missouri farm. No significant differences occurred for litter birth and weaning weight, preweaning survival, number weaned and feed consumed. Preweaning survival and number weaned were high leaving little room for improvement. Also fat additions in this study were lower then previously reported (7.5% vs 10%). It would appear that providing supplemental energy in lactating sow diets to improve nursing pig performance in the summer should be considered only when previous performance is worse than what is reported here.

Literature Cited

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Moser, B.D. and A.J. Lewis. 1980. Adding fat to sow diets- an update. Feedstuffs 52:36.

Shurson, G.C., M.G. Hogberg, N. DeFever, S.V. Radecki and E.R. Miller. 1986. Effects of adding fat to the sow lactation diet on lactation and rebreeding performance. J. Anim. Sci. 62:672.

Table 1. COMPOSITION OF DIETS

Ingredient	Control	Soy Oil	Dried Fat
Corn, %	78.1	68.97	67.17
Soybean meal, %	18.0	19.5	19.5
Soybean oil[a], %	-	7.5	-
Dried fat[b], %	-	-	9.38
L-Lysine-HCL, %	.05	.18	.10
Limestone, %	.75	.75	.75
Dicalcium phosphate, %	2.0	2.00	2.00
T.M. salt, %	.5	.5	.50
Vitamin premix, %	.6	.6	.60
Calculated Analysis[c]			
Crude protein, %	14.6	14.4	14.7
Lysine, %	.80	.92	.88
Calcium, %	.89	.89	.89
Phsphorus, %	.70	.68	.68
Metabolizable energy (Kcal/lb)	1474.5	1602.5	1642.4

[a]Crude soybean oil; supplied by the Missouri Soybean Merchandizing Council.
[b]A commercial dried fat (Mil-KO-LAC 4-80) containing 80% ether extract and 4% crude protein; supplied by Freeborn Foods, Albert Lea, MN 56007.
[c]National Research Council (1988).

Table 2. LEAST SQUARE MEANS OF NURSING PIG PERFORMANCE AND SOW CONSUMPTION[a]

Treatment	Control	Soy Oil	Dried Fat
Litter birth weight, lb	30.9	31.6	28.3
Survival to weaning, %	95.8	91.0	91.6
Number weaned	9.7	9.2	9.0
Litter weaning weight, lb	104.9	108.9	108.2
Avg. daily feed consumption during lactation, lb	9.1	9.1	8.8

[a] Least square means within rows were not significantly different.

EFFECTS OF ADDED NIACIN IN GESTATION AND LACTATION DIETS ON SOW AND LITTER PERFORMANCE

D. J. Ivers, S. L. Rodhouse, T. L. Veum and M. R. Ellersieck

SUMMARY

A two year study utilizing 76 sows and 228 litters was conducted to evaluate the effects of adding 0 and 33 ppm niacin to a 14% crude protein corn-soybean meal-oat diet fed during gestation and lactation. Sows were grouped by age and randomly assigned to treatment groups. Sows remained on the experiment for five parities unless culled. Criteria consisted of sow performance and longevity, and litter performance to 21 days. No treatment differences (P>.10) were found in any of the sow or litter criteria evaluated. In conclusion, supplementation of a corn-soybean meal-oat diet with 33 ppm niacin during gestation and lactation did not improve sow or litter performance or enhance sow longevity.

INTRODUCTION

The production of pigs in confinement units has increased the incidence of problems associated with unsoundness, such as toe cracks, which could be produced by deficiencies of the vitamins biotin and(or) niacin. However, our recent work with biotin (Hamilton and Veum, 1984 and 1986) indicated that corn-soybean meal diets containing .17 ppm biotin provided by the feed ingredients are adequate for sows and finishing pigs. Observable deficiency symptoms of niacin include diarrhea, poor appetite and dermititis.

Niacin is a major component of the coenzymes nicotinamide dinucleotide, NAD, and nicotinamide dinucleotide phosphate, NADP. These two coenzymes are needed for the metabolism of carbohydrates, proteins and fats. Much of the niacin in corn and soybean meal is chemically bound and unavailable to the animal (Yen et al., 1977). However, approximately 60 mg of the amino acid tryptophan is required to synthesize 1 mg of niacin, an inefficient conversion ratio.

The objective of this study was to determine if niacin supplementation of a sow diet would improve sow and(or) litter performance.

EXPERIMENTAL PROCEDURE

Seventy-six sows were grouped by age and randomly assigned to treatment groups. The treatments consisted of a 14% crude protein corn-soybean meal-oat diet (table 1) containing either 0 or 33 ppm niacin. Sows were fed 4.4 lb per day during gestation and 4.0 lb plus 1.0 lb for each nursing pig during the 4 week lactation period. All sows remained on the same treatment (five parities maximum) unless culled due to reproductive or structural problems.

The sows were housed in individual gestation crates in a climate-controlled gestation house. On approximately day 107 of gestation, the sows were moved into farrowing crates.

Sows were weighed at breeding, day 60 of gestation, farrowing and weaning. Sows were evaluated at breeding and day 60 for hair condition and soundness. Litter performance criteria were the number of pigs born dead (mummies and still births) and alive, pigs weaned and pig weights at birth and 21 days of age.

RESULTS AND DISCUSSION

No treatment differences ($P>.10$) were detected in any of the sow or litter parameters measured (table 2). Culling rate was also similar as indicated by the number of sows remaining in each treatment group from parity 1 through 5. Our results are in agreement with Goodband et al. (1987), who showed that providing niacin at levels greater than 50 mg/day during gestation and 100 mg/day during lactation did not improve sow or litter performance in second parity sows. This lack of response to added niacin may be due to active microbial populations in the hind gut of sows which synthesize niacin.

In conclusion, these results indicate that niacin supplementation of a corn-soybean meal-oat gestation and lactation diet did not improve sow or litter performance.

LITERATURE CITED

Goodband, R. D., J. L. Nelssen, R. C. Thaler, L. M. Turlington and G. L. Allee. 1987. Effects of additional niacin during gestation and lactation on sow and litter performance. J. Anim. Sci. 65 (Suppl. 1): 138 (Abstr. No. 127).

Hamilton, C. R. and T. L. Veum. 1984. Response of sows and litters to added dietary biotin in environmentally regulated facilities. J. Anim. Sci. 59: 151.

Hamilton, C. R. and T. L. Veum. 1986. Effect of biotin and(or) lysine additions to corn-soybean meal diets on the performance and nutrient balance of growing pigs. J. Anim. Sci. 62: 155.

Yen, J. T., A. H. Jenson and D. H. Baker. 1977. Assessment of the availability of niacin in corn, soybeans and soybean meal. J. Anim. Sci. 45: 269.

TABLE 1. COMPOSITION OF BASAL GESTATION AND LACTATION DIET

Ingredients	Basal Diet, %
Corn	70.80
Soybean meal, 44%	12.70
Oats	10.00
Fat	2.50
Dicalcium phosphate	2.40
Limestone	.60
Vitamin premix[a]	.50
Trace mineral salt	.50

[a]Two vitamin premixes were used, providing 0 or 33 ppm niacin.

TABLE 2. EFFECT OF NIACIN ON SOW AND LITTER PERFORMANCE[a]

	Level of Niacin		
	0 ppm	33 ppm	SE
SOW PERFORMANCE			
Breeding weight, lbs.	447	451	11.0
Day 60 weight, lbs.	546	506	45.6
Farrowing weight, lbs.	535	539	11.2
Weight on day of weaning, lbs.	502	495	9.7
Number of sows at parity 1	36	36	-
Number of sows at parity 2	32	32	-
Number of sows at parity 3	25	28	-
Number of sows at parity 4	20	25	-
Number of sows at parity 5	15	17	-
LITTER PERFORMANCE			
Average birth weight, lbs.	3.4	3.4	.04
21 day weight, lbs.	13.4	13.4	.13
No. pigs born alive	10.1	10.7	.45
No. still births	1.18	1.21	.22
No. mummies	.20	.22	.08
No. pigs weaned	8.3	8.7	.27

[a]No differences (P>.10) due to niacin.

ENZYME HYDROLYZED FISH PROTEIN DIGEST FOR NURSERY PIGS

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SUMMARY

In two trials involving 248, three-week old weaned pigs, performance of pigs on an enzyme hydrolyzed fish protein digest product at 50 lbs per ton compared favorably to pigs on a control ration containing 100 lbs of feed grade fish meal.

INTRODUCTION

Producers and researchers continue to search for nutrition and management procedures to increase survival and performance of early weaned pigs. Many believe that due to the immature development of the digestive system of early weaned pigs there would be an advantage to a system providing "predigestion" of protein added to rations. This trial field tested one such product "Neo-Pro". It is designed to provide proteins that are broken down by an enzyme into available polypeptides to promote the development of lean growth.

MATERIALS AND METHODS

Two trials were conducted on a North Central Missouri swine farm using 248 three-week-old baby pigs. Pigs were weaned at 3-weeks of age and assigned to either treatment or control pens. All pigs received a pre-starter ration for 5-6 days.

In trail 1, 124 pigs were divided as shown in Table 1 into treatment and control groups. Nursery pens were raised wire floors over a gutter flush. Pen sizes were four by six feet. A total of 200 pounds of a pre-starter ration was fed 6 days before starting on test July 13, 1988. The trial ended August 3, 1988 (21 days).

Table 1. Experimental Design - Trial 1

	Neo-Pro			Control	
Pen	# Pigs	Total Wt.	Pen	# Pigs	Total Wt.
1	15	192	2	16	208
3	16	172	4	15	145
7	16	168	8	16	180
9	15	176	10	15	183

In trial 2 109 pigs were weaned on July 15, 1988, divided into treatment groups as shown in Table 2 and fed the pre-trial ration for 5 days. They started on test July 20. Pigs were fed the Neo-Pro or Control diet for 26 days and were weighed off August 10, 1988. Ration formulation for the two trials is shown in Table 3.

Table 2. Experimental Design - Trial 2

Pen	Neo-Pro	Pen Wt.	Pen	Control	Pen Wt.
1	13	180	2	13	190
3	14	193	4	13	144
7	13	159	8	13	152
9	13	188	10	13	190

Table 3. Ration Formulation

Ingredient	Control Diet, Lbs	Neo-Pro Diet, Lbs
Corn	1,027	1,077
SBOM (44%)	550	550
Fish meal	100	-
Neo-Pro	-	50
Whey	200	200
Limestone	10	10
DiCalcium	25	25
Trace mineral	5	5
Lysine HCl	2	2
$CuSo_4$	1	1
Corn oil	70	70
Vitamins	10	10
	2,000	2,000

RESULTS AND DISCUSSION

Results of trial 1 are shown in tables 4 and 5. Gains and feed efficiency were similar for both groups. Three pigs died in the treatment group but did not appear to be due to treatment.

Trial 2 results are shown in tables 6 and 7. Two pigs in the treatment group died but again this did not appear to be due to treatment. Pigs on "neo-pro" rations had slightly faster average daily gains. Pigs on the control ration had better feed efficiency. Performance of all pigs was acceptable. Pigs on Neo-Pro with less fish meal product, compared satisfactorily to control pigs.

Table 4. Pen Pig Performance - Trial 1

Pen	# of Pigs	Neo-Pro Initial Weight	End Weight	Gain	Pen	# of Pigs	Control Initial Weight	End Weight	Gain
1	15	192	446	254	2	16	208	468	260
3	16	172	430	258	4	15	145	384	239
7	16	168	421	253	8	16	437	437	257
9	15	176	381	205	10	15	427	427	244
		708	1,678	970			716	1,716	1,000

*Death loss: Pen 7 1 @ 15 lbs cause unknown.
Weight not included: Pen 7 1 @ 15 lbs, strep.
In End weight: Pen 3 1 @ 15 lbs, strep.

Table 5. Summary Trial 1

	Neo-Pro	Control
# Pigs	59	62
Starting weight, lb	11.42	11.55
End weight, lb	28.44	27.67
ADG	.81	.77
Total Feed*	1,633	1,559
Feed/gain	1.68	1.56

* 1,663 - 30 lbs estimated eaten by pigs that died.

Results from trial 2 are shown in Tables 6 and 7.

Table 6. Performance of Pigs in Trial 2

Pen	# of Pigs	Start Weight	End Weight	Gain	Pen	# of Pigs	Start Weight	End Weight	Gain
1	13	180	376	196	2	13	190	392	202
3	14	193	388	195	4	13	144	367	223
7	13	159	340	181	8	13	152	346	194
9	13	188	406	218	10	13	190	427	237
		720	1,510	790			676	1,532	856

Death Loss: Pen 3 1 @ 14 lb, strep.
Pen 7 1 @ 7 lb, strep.

Table 7. Trial 2

	Neo-Pro	Control
No. Pigs	51	52
Avg starting weight	13.58	13.00
Ending weight	29.61	29.46
ADG	.62	.63
Feed fed*	1,308	1,253
Feed/gain	1.66	1.46

* 1,328 - 20 lbs estimated eaten by pigs that died.

THE EFFECT OF GAVAGING BABY PIGS WITH MEDIUM CHAIN TRIGLYCERIDES ON PIGLET SURVIVAL AND GROWTH[1]

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SUMMARY

A study with 1092 pigs from 128 litters was conducted to evaluate the effects of gavaging newborn pigs with medium chain triglycerides (MCT) on piglet survival and weight to 21 days of age. Piglets within litters were paired by weight at birth, and one pig in each pair was assigned to either the control or the gavage group. The pairs were further classified as light (<2.85 lb.), medium (2.86 to 3.52 lb.) or heavy (> 3.53 lb.) classes. The gavaged pigs were dosed twice (10 ml/dose) with MCT[2] by feeding tube. Gavaging did NOT improve (P>.10) survival or growth of small piglets or of all weight groups combined.

INTRODUCTION

Piglet survival rate is of great importance in the swine industry. Through the years attempts have been made to improve piglet survival (Boyd et al., 1978a; Seerley et al., 1981; Pettigrew et al., 1986).

Glycogen, the piglet's immediate source of energy at birth, is almost depleted by the third day of life (Okai et al., 1978; Boyd et al., 1978b; Seerley et al., 1978). Most pre-weaning mortalities occur with small piglets (Pettigrew et al., 1986), which most likely have failed to nurse at birth (Hartsock et al., 1977).

Adding fat or edible oil to the sow diet during late gestation and(or) lactation increased pre-weaning piglet survival slightly, but not to the extent desired (Seerley et al., 1974; Seerley et al., 1981; Boyd et al., 1978b; Cieslak et al., 1980). Adding fat to the sow diet resulted in higher blood glucose levels in the piglets for up to 24 hr post birth (Boyd et al., 1978b).

Because the energy provided to the piglets through the sow's milk appears to increase the odds for survival, it could also be expected that providing energy directly to the piglet would increase survival, especially of the smaller piglets. The purpose of this experiment was to determine the effect of gavaging newborn pigs with medium chain triglycerides (MCT) on survival and weight to 21 days of age.

[1] Supported by the Agency of International Development through the U.S. Department of Agriculture, Washington, D.C.

[2] Captex 300 manufactured by Capital City Products, Columbus, OH. Composed of eight (33%) and ten (66%) carbon chain fatty acids, primarily from coconut oil.

EXPERIMENTAL PROCEDURE

The experiment included 128 litters, farrowing from June 1987 to May 1988. At birth, piglets within a litter were placed in one of three weight classes: light, <2.85 lb; medium, 2.86 to 3.52 lb; heavy, > 3.53 lb, utilizing a total of 1092 piglets. Piglets within classes were paired by weight (difference in weight no greater than .44 lb) and randomly assigned to either control or gavage groups. The gavaged pigs were orally dosed twice (10 ml/dose) with MCT by feeding tube. The first dose was given within 18 hr of birth and the second 12 hr later. The pigs in the control group received no sham treatment. Litter size was kept as uniform as possible by piglet transfer. Carpet remnants and heat lamps were used in the piglet area. The environmentally regulated farrowing building had concrete slatted floors. Sows ranged in age from one through nine parities. Piglet survival, weights and cause of death (starved, crushed or other) were recorded at 3, 7 and 21 days of age.

RESULTS AND DISCUSSION

While there was no difference in the total number of pigs that died in each treatment (table 1) during the 21 day period, more gavaged piglets in the light weight class died of starvation than of crushing, while the opposite occurred with the control pigs (table 2).

Pettigrew et al. (1986) found that 8 doses (2 ml each) of corn oil during the first 2 days post birth delayed piglet mortality suggesting some use of the energy provided. In our experiment it appears that the extra energy from MCT may have made it possible for some small pigs to get away from the sow and avoid crushing during the first days after birth. However, more of the small gavaged pigs died of starvation later, suggesting that dosing with MCT only delayed the occurance of mortality.

In the heavy weight class however, more control pigs died from starvation or crushing from birth to 21 days ($P<.10$) than gavaged pigs (table 2). This suggests that dosing with MCT may help keep heavier pigs alive to 21 days. There were no parity effects on survival to 3, 7 or 21 days.

The only difference in piglet weight in any of the weight classes was obtained at 21 days of age in the medium weight class (table 3), where the gavaged pigs were heavier than the control pigs (12.36 lb vs 11.97 lb, $P<.01$). This difference does not appear to the result of gavaging because there were no differences in weight at either 3 or 7 days of age. There were no weight differences within parities, except for the first parity where gavaged pigs were heavier than control pigs (12.58 vs 11.92 lb, $P<.01$) at 21 days.

Overall piglet survival and weight to 21 days for the control and gavage groups were similar ($P>.10$) (87.0% and 12.25 lb versus 87.9% and 12.36 lb, respectively).

In conclusion, the gavaging of newborn pigs with MCT did not improve piglet survival or growth to 21 days of age.

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TABLE 1. Number of pigs, cause of death and survival rate to 21 days.

	Control	Gavage
No. pigs that started the experiment	546	546
Starved	37	42
Crushed	27	14
Other	7	20
No. pigs that survived to 21 days	475	480
Survival rate %	87.0	87.9

TABLE 2. Piglet mortality from birth to 3, 7 and 21 days.

	Pig Weight Classes					
	< 2.85 lb		2.86-3.52 lb		>3.53 lb	
	Control	Gavage	Control	Gavage	Control	Gavage
Number of pigs at beginning of experiment	122	122	236	236	188	188
Number of pigs that died by 3 days of age						
Starved	12	15	1	0	1	2
Crushed	10	6	3	2	1	3
Other	0	0	0	1	0	2
Total	22	21	4	3	2	7
Number of pigs that died by 7 days of age						
Starved	16	20	4	5	4	3
Crushed	11	7	6	3	4	3
Other	0	0	0	1	0	3
Total	27	27	10	9	8	9
Number of pigs that died by 21 days of age						
Starved	18[a]	28[a]	11	10	8[b]	4[b]
Crushed	13[a]	7[a]	8	4	6[b]	3[b]
Other	4	1	3	6	0	3
Total	35	36	22	20	14	10

[a]Values with the same superscript within a row are different ($P<.05$).
[b]Values with the same superscript within a row are different ($P<.10$).

TABLE 3. Pig weight means at birth, 3, 7 and 21 days for each weight

	Pig Weight Classes					
	<2.85 lb		2.86-3.52 lb		>3.53 lb	
	Control	Gavage	Control	Gavage	Control	Gavage
Number of litters[a]	62	59	104	103	72	72
Birth Weight, lb	2.31	2.31	3.23	3.23	3.98	3.98
Weight at 3 days, lb	2.98	2.86	3.89	3.87	4.64	4.62
Weight at 7 days, lb	4.40	4.18	5.50	5.52	6.39	6.38
Weight at 21 days, lb	10.25	10.25	11.97*	12.36*	13.62	13.31

[a]Means of the number of litters that included pigs for each of the weight classes.

*Values are different (P <.01).

EFFECT OF RECEIVING DIET ANTIBIOTIC ON SUBSEQUENT HEALTH AND PERFORMANCE OF THE PURCHASED, COMMINGLED FEEDER PIG

G. W. Jesse and J. Lopez

SUMMARY

During the summer of 1988 one hundred and forty-four feeder pigs averaging 46.6 lbs were utilized in a 98 day growing-finishing (G-F) study to compare the effects of including an antibiotic in the receiving diet for the first 28 days. The treatments compared were no feed grade antibiotic versus including CSP250 or neomycin or neoterramycin. Overall performance for the 98-day study was not significantly affected by dietary treatment. However, the antibiotic-fed pigs did gain significantly faster ($P<.05$) during the 28-day medication period.

INTRODUCTION

The feeder pig industry continues to be an important segment of the total swine industry in Missouri and other swine producing states. According to the Animal Health Division of the Missouri Department of Agriculture (Missouri Farm Facts, 1988), 489,130 feeder pigs were shipped out-of-state during 1987. It has been estimated that fifty percent of Missouri's feeder pigs are exported; hence, during 1987 Missouri produced nearly 1,000,000 feeder pigs. This represents approximately one fifth of the total hogs produced.

Management of the purchased feeder pig upon arrival at the finisher's facility is extremely important. Feeder pig receiving diets are thought to play a very important role in getting the newly purchased pig off to a good start. Feeder pig buyers not only want to know the preferred antibiotic to use but also the recommended length of time to include the antibiotic in the diet.

The objectives of this study were twofold; first, to compare the health and performance of purchased feeder pigs fed a corn-soybean meal diet with or without an antibiotic for the first 28 days. Secondly, to compare the health and performance of purchased feeder pigs fed one of three different antibiotics (CSP250, Neomycin, Neoterramycin) for the first 28 days of the G-F period. These three antibiotics were chosen since they either have different modes of action or are known to be effective for a specific disease. The sulfa containing drug (CSP250) was selected since it is known to be effective at treating atrophic rhinitis infected pigs. Neomycin is a drug which works primarily in the gut; hence, it was felt that this antibiotic would be most effective at fighting enteric problems. Neoterramycin was chosen as a drug that should be effective at combatting both respiratory and enteric diseases since it acts systemically.

PROCEDURES

On June 14, 1988 one hundred and forty-four feeder pigs averaging 46.6 lbs were purchased via the Alton Sales Company at Alton, Missouri. These pigs represented six different farms of origin. The experimental design shown in table 1, was a randomized complete block with the treatment being feed-grade antibiotic.

The pigs for this study were selected on Monday evening, June 13 upon their arrival at the barn and penned according to owner. On Tuesday afternoon the pigs were eartagged, individually weighed and given an ivermectin injection. Dietary treatment was determined at this time and designated by the use of four different colors of ear tags. During the pigs' market stay they were off feed and water (fasted). On Tuesday evening, after approximately 24 hours at the market, the pigs were transported 350 miles overnight, by truck, before delivery to the University of Missouri Southwest Center at Mount Vernon arriving at approximately 7:00 a.m. on Wednesday, June 15.

The test facility was an open-front barn that included 30 pens of identical design. The floor and the pen dividers were solid concrete and the back wall opened to allow for natural ventilation. Each 5'x 15' pen was equipped with one nipple waterer and a one-hole self feeder. A thermostatically-controlled overhead sprinkler system was available for cooling the pigs when the temperature exceeded 80 degrees F.

Upon arrival the pigs were weighed and assigned at random, within sex, to pen. All pens contained six head with four replicates having an equal number of barrows and gilts. However, due to an uneven number of barrows and gilts, two replicates had more gilts than barrows. All pigs were ad libitum fed a 16% crude protein (CP) corn-soybean meal receiving diet in meal form for the first 28 days. As shown in table 1, four receiving diets were compared which included a control diet (no antibiotic) and three diets with antibiotics. Antibiotics compared included CSP250, Neomycin and Neoterramycin. All antibiotics were included at a level recommended by the manufacturer. These levels are shown in table 1. On day one all pigs were dewormed using dichlorvos.

On day 28 all pigs were switched to a non-medicated 14% CP corn-soybean meal diet which was fed for the duration of the study. The entire trial was 98 days in duration.

Pig weights and feed consumption by pen were determined every 14 days. The data for the main treatment (dietary antibiotic) were compared by analysis of variance as a randomized complete block with pen being the experimental unit. Treatment means were separated using Fisher's Least Significant Difference. Performance by source was analyzed using the individual pig as the experimental unit.

RESULTS AND DISCUSSION

As shown in table 2, the control pigs were slower gaining (P<.05) during the the first and fourth two week periods (d 0-14 and 42-56) as compared to all three antibiotic treatment groups. Average daily gain for the controls was also significantly less during the first 28 days which corresponds to the period that antibiotics were included in the diet. Although the control pigs were slower growing, feed conversion did not differ by treatment which appears to be the result of a reduced feed intake by the control pigs with this difference being significant (P<.05) for the first 28 days (table 3).

In general, health of the pigs was excellent except for one source (D) as shown in table 4. These pigs were slower growing throughout the entire 98 day G-F period. A diagnostic report on four of these pigs revealed atrophic rhinitis to be the primary cause of their poor performance.

Practically speaking, those pigs fed an antibiotic-supplemented diet gained .1 lbs per day faster than the control pigs. Hence, based upon a 180 lb gain during the G-F period those pigs fed an antibiotic for 28 days required approximately 7 days less time to reach a market weight of 230 lbs. Assuming a non-feed cost of 18 cents per day, this amounts to $1.26 savings in cost of gain. On the average, the antibiotic-containing receiving diets were $10.00/ton higher priced; hence, with an average feed consumption of 86 lbs per pig the antibiotic cost was approximately $.43 per pig. Therefore, one can conclude that the net result of providing an antibiotic in the feed for the first 28 days was $.83 per pig.

TABLE 1. EXPERIMENTAL DESIGN

Treatment	Antibiotic	No. Pigs	No. Pens
1	Control	36	6
2	CSP250	36	6
3	Neomycin	36	6
4	Neoterramycin	36	6

Level of feed grade medication was as follows:
CSP250 = 250g/ton via a 10 lb premix
Neomycin = 200g of neomycin sulfate which provided 140g of neomycin/ton; provided via 2 lb of Neomix AG100
Neoterramycin = 100g of oxytetracycline plus 100g of neomycin sulfate/ton via 10 lb of Neoterramycin 10-10

TABLE 2. AVERAGE DAILY GAIN AND FEED EFFICIENCY

Variable	Period,d	Treatment			
		Control	CSP250	Neomycin	Neoterramycin
ADG,lbs	0-14	.96^{a}	1.30^{b}	1.26^{b}	1.18^{b}
	14-28	1.32	1.54	1.51	1.55
	0-28	1.14^{a}	1.42^{b}	1.38^{b}	1.36^{b}
	28-42	1.35	1.48	1.43	1.43
	42-56	1.51^{a}	1.71^{b}	1.83^{b}	1.72^{b}
	56-70	1.78	1.59	1.76	1.83
	70-84	1.84	1.83	1.83	1.83
	84-98	2.04	2.08	1.87	2.08
	0-98	1.54	1.65	1.64	1.66
F/G	0-14	2.07	1.91	1.92	1.97
	14-28	2.44	2.43	2.45	2.41
	0-28	2.28	2.19	2.21	2.21
	28-42	3.12	3.15	3.14	3.26
	42-56	3.28	3.12	3.03	3.05
	56-70	3.14	3.59	3.41	3.30
	70-84	3.62	3.82	3.82	3.91
	84-98	3.62	3.58	3.98	3.58
	0-98	3.12	3.11	3.16	3.12

^{a,b}Means within a row not having a superscript in common are different (P<.05).

TABLE 3. FEED INTAKE PER PEN, LBS.

Period,d	Treatment			
	Control	CSP250	Neomycin	Neoterramycin
0-14	167	209	205	195
14-28	272	316	311	313
0-28	439^{a}	525^{b}	516^{b}	508^{b}
28-42	353	392	379	380
42-56	410	448	467	431
56-70	465	466	504	490
70-84	556	572	587	556
84-98	616	623	613	599
0-98	2840	3029	3067	2966

^{a,b}Means within a row not having a superscript in common are different (P<.05).

TABLE 4. AVERAGE DAILY GAIN BY SOURCE, LBS.

Source	No. Hd.	Period			
		0-14	14-28	0-28	0-98
A	25	.97[b]	1.48[c]	1.22[b]	1.66[c]
B	25	1.28[c]	1.43[bc]	1.35[bc]	1.62[bc]
C	41	1.34[c]	1.68[d]	1.51[d]	1.72[c]
D	10	.60[a]	1.02[a]	.81[a]	1.37[a]
E	20	1.18[c]	1.30[b]	1.24[bc]	1.50[b]
F	23	1.24[c]	1.54[cd]	1.39[cd]	1.62[bc]

[a,b,c,d]Means within a column not having a superscript in common are different ($P<.05$).

EFFECT OF WATER FLOW RATE FROM NIPPLE DRINKERS ON WEANED PIG PERFORMANCE

JOHN LOPEZ AND G. W. JESSE

SUMMARY

During the fall of 1988 (Aug 11-Sept 8) 108 feeder pigs (54 barrows and 54 gilts) weighing approximately 16.3 lbs were used to determine the effects of water flow rate (70ml/min or 700ml/min) from nipple drinkers on weaned pig performance. Dependent variables measured were average daily gain (ADG), feed intake (FI), feed efficiency (FE) and nipple contact (NC). Only during the second week of the study was a difference in ADG identified. No weekly differences were found in FI or FE. All pigs within the study were able to maintain adequate performance even though pigs restricted of water intake (70ml/min) spent over 200% more time at the drinkers than pigs receiving 700ml/min.

INTRODUCTION

The effect of flow rate of nipple drinkers on weaned pig performance is currently being investigated by several midwestern universities as part of a cooperative study (NCR89). The impetus for this investigation was primarily the result of field observations noting that nipple waterers often times are not delivering an adequate amount of water. Most believe this is due to the lack of a routine management procedure. After all, water flow rate is not as visible as feed disappearance.

The effect of restricting water flow rate would seem likely to cause a decrease in feed intake and hence in growth rate and feed conversion; however, research data is not readily available to document this outcome. Furthermore, it seems reasonable to expect a greater deleterious effect on the nursery pig as compared to the growing-finishing (G-F) pig since the younger pig normally consumes a greater amount of feed on a percentage of body weight basis than the G-F pig. Concurrently, one should expect this pig's water requirement to be greater.

The objectives of this four-week nursery study were twofold. First, to determine the effect of two different water flow rates (70 ml/min vs 700 ml/min) and secondly, to determine the effect of number of pigs (6 vs 12) per pen in conjunction with adequate or restricted water flow rate on performance.

PROCEDURES

A 28-day experiment was conducted utilizing 54 barrows and 54 gilts weighing approximately 16.3 lbs. The pigs for the study were university-raised crossbreds of Yorkshire, Landrace and Duroc descent. Pigs were weaned at an average of 4 weeks of age and directly assigned at random within weight group and sex to one of four treatments replicated three times. Treatments 1 and 2 consisted of 4'x 4' pens with 6 pigs/pen and 1 nipple drinker/pen adjusted to deliver either 70 or 700 ml/min, respectively. Treatments 3 and 4 consisted of 4'x 8' pens with 12 pigs/pen and two nipple drinkers/pen each adjusted to deliver either 70 or 700 ml/min, respectively. All nipple drinkers were mounted at a 45 degree downward slope approximately 2 to 3 inches higher than the average height of the pigs' back. Nipple drinkers in all pens were allowed to drip for 4 hours at the beginning of the study. The flow rate and the height of the nipple drinkers were adjusted twice weekly. The feed provided throughout the study was an 18% crude protein corn-soybean meal diet. The diet was fed using two and four one-hole Smidley feeders in the 4'x 4' and 4'x 8' pens, respectively. Animals were housed in an environmentally-regulated building with 100% concrete slats.

Individual pig weights and pen feed intake were determined on a weekly basis. On the day prior to weighing, the pigs in one pen of each treatment (four pens within the same replicate) were observed for NC from 7:00 a.m. thru 11:00 a.m. to determine total minutes of contact with the nipple waterer(s). Room temperature was recorded after the daily NC observation period. Weekly observations were pooled to determine treatment means.

The data were analyzed as a randomized complete block design using analysis of variance (Snedecor and Cochran 1980). Means were separated according to Fisher's LSD using a protected F (Steele and Torrie,1980).

RESULTS AND DISCUSSION

As shown in table 1, differences in average daily gain (ADG) were observed only during the second week ($P<.05$). During this period, ADG for treatment 2 (6 pigs/700 ml) was significantly higher than any of the other three treatment groups. Although not different ($P>.05$), treatment 2 tended to have a higher ADG than the other treatments with the exception of week 3. This suggests that less animal to animal contact and an adequate water supply is conducive to rate of gain.

Weekly feed intake (FI) and feed efficiency (FE) observations between treatments were not significantly different ($P>.05$). Average FI for treatment 2 was 10.8% higher ($P<.05$) than 4 (12 pigs/700 ml). In addition, there was a trend for treatment 2 to exhibit a higher average FI than treatments 1 or 3. It is possible that less competition of pigs at a preferred feeder and an adequate water supply enabled animals to increase their FI.

Since only one replicate was observed for NC, an analysis could not be conducted; however, table 2 illustrates that pigs in treatments 1 and 3 (6 pigs/70 ml and 12 pigs/70 ml, respectively) spent more time in contact with the nipple drinker than pigs in treatments 2 and 4 (6 pigs/700 ml and 12 pigs/700 ml, respectively). Obviously this is attributable to pigs staying longer at the drinker to obtain their water intake.

TABLE 1. AVERAGE DAILY GAIN, FEED EFFICIENCY AND FEED INTAKE PER PIG, LBS.

Item	Period	TREATMENTS 1	2	3	4
ADG	WEEK 1	.22	.24	.20	.15
	WEEK 2	.61^{b}	.74^{a}	.55^{b}	.57^{b}
	WEEK 3	.37	.44	.57	.60
	WEEK 4	1.67	1.71	1.54	1.41
	AVG.	.72	.79	.72	.70
F/G	WEEK 1	1.53	1.71	1.98	2.15
	WEEK 2	1.47	1.50	1.53	1.59
	WEEK 3	4.52	4.42	2.83	2.71
	WEEK 4	1.19	1.19	1.27	1.44
	AVG.	1.68	1.71	1.67	1.74
FI	WEEK 1	2.51	2.88	2.73	2.31
	WEEK 2	6.36	8.00	6.03	6.42
	WEEK 3	11.48	12.65	11.44	11.17
	WEEK 4	14.00	14.43	13.86	13.85
	AVG.	8.58^{ab}	9.48^{a}	8.51^{ab}	8.45^{b}

[a,b]Means within a row with different superscripts are different ($P<.05$).

TABLE 2. NIPPLE CONTACT TIME[a]

Item	Period	TREATMENTS (MIN./4 HOURS) 1	2	3	4
NC	WEEK 1	21.4	7.4	24.4	13.3
	WEEK 2	14.4	8.0	38.3	10.3
	WEEK 3	23.2	9.4	63.1	16.4
	WEEK 4	21.1	9.2	97.4	14.1
	AVG.	19.9	8.5	55.8	13.5

[a]Nipple contact time was not statistically compared.
NC = Nipple contact time.

EFFECTS OF TRANSPORTING AND MARKETING OF FEEDER PIGS ON CELL-MEDIATED IMMUNE FUNCTION.

Y. NIWANO[1], B. A. BECKER[2], G. W. JESSE[3], and H. D. JOHNSON[1]

SUMMARY

A study was conducted to evaluate an expression of the cell-mediated immune response in feeder pigs which were handled, marketed and transported for 36 hr. Ten pigs (controls) remained in home pens. Blood samples were obtained on d 1, 3 6, 13, and 21 after marketing and transport. The number of circulating peripheral blood lymphocytes and blastogenic responses of whole blood (W) and isolated (I) peripheral blood lymphocytes to T-cell mitogen phytohemagglutinin (PHA) were determined. No significant differences in responses of I-lymphocytes to PHA were found between treatments. In contrast, responses of W-lymphocytes to PHA revealed a 60% and 50% reduction on d 1 and 3, respectively. On d 6 and 13 the degree of suppression gradually lessened and by d 21 no differences were found. Changes in lymphocyte numbers paralleled changes of blastogenic response of W-lymphocytes. The data suggest that the cell-mediated immune response of feeder pigs is suppressed for several days after marketing and transportation and that such reduction is attributable to decreased number but not function of circulating lymphocytes.

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INTRODUCTION

Major health problems associated with the handling, marketing and transporting of feeder pigs are respiratory distress and diarrhea, with specific pathogenic sources varying with reports (Jesse et al. 1983). A survey of midwestern buyers of feeder pigs attributed up to 4% death loss due to pneumonia, scours and flu. Brumm et al. (1982) and Brumm and Peo (1985) reported deaths in research trials that ranged from less than 1% to 8.3% and Jesse (1982) reported less than 1% death loss with major diseases being atrophic rhinitis, pasturella pneumonia and mycoplasma pneumonia. Biehl et al. (1985) similarly reported a 5% death loss among commercial pigs and Straw et al. (1983) reported a death loss of 5.3% and 6.3% loss among comingled pigs.

A variety of factors enhance susceptibility to disease during this cycle of pig production including breed, intensive management, duration and conditions of transport, climatic extremes and comingling of pigs from different disease environments. Differences in environmental temperatures have shown to effect incidence of gastroenteritus virus (Shimizu, 1978). Pigs maintained at 30±2°C showed no signs of the disease while pigs at 20±2°C and 4±1°C had a high incidence of diarrhea. Rapidly fluctuating temperatures were more detrimental than any constant, yet extreme temperature (Shimizu et al., 1978). Knowledge of the physiology and immunological changes occurring in pigs during marketing and transportation would provide a key to understanding the increased susceptibility to and incidence of diseases associated with handling, marketing and transporting of feeder pigs. Thus, we conducted an experiment to evaluate cell-mediated immune function in transported and marketed feeder pigs.

EXPERIMENTAL PROCEDURE

Experimental Animals

Twenty-crossbred pigs, averaging 22.7 kg and approximately 9 wks of age, were used in this study.

Treatment

Ten control pigs remained in home pens with food and water available ad libitum. 10 pigs were purchased from a commercial salebarn and experienced standard marketing conditions. Pigs were then transported to Columbia, MO. Marketing and transporting occurred over a 36 hr period.

Blood Collection

20 ml blood (10 ml in a heparinized tube, and 10 ml in a anti-coaggulant free tube) were collected by jugular veinpuncture on days 1, 3, 6, 13, and 21 after relocation.

Isolation of Peripheral Blood Lymphocyte

Pig venous blood samples were collected in heparinized tubes, and peripheral blood lymphocytes were isolated by density gradient entrifugation on a Ficoll-Isopague gradient (Histopaque, Sigma Chemical Co., St. Louis, MO). Pig peripheral blood lymphocytes appeared as a white band between the plasma and Histopaque at an apparent density of 1.077 g/ml. Isolated lymphoocytes were then resuspended in Hepes-buffered RPMI 1640 supplemented with 0.5mM L-glutamine, penicillin G potassium (100 units/ml) and gentamicin (50 ug/ml). This supplemented medium will be referred to as RPMI 1640 throughout this paper. After washing the lymphocytes three times in RPMI 1640, lymphocyte numbers were estimated by using a Coulter counter (Model ZIP, Coulter Electronics Inc., Hiaheah, FL). Lymphocyte viability was evaluated by a Trypane blue exclusion test. Lymphocytes were suspended in RPMI 1640 to a final concentration of 2 x 10 viable cells/ml.

Isolated Lymphocyte and Whole Blood Culture

Peripheral blood lymphocyte suspensions ($1x10^6$ cells/well) were cultured in quadruplicate in 96 well flat-bottomed microplates (Falcon 3072, Oxnard, CA). Each well contained 50 ul of cell suspension, 50 ul of PHA solution or medium alone (controls), and 20 ul of fetal bovine serum. In the experiment with whole blood culture, samples of heparinized whole blood were pipeted into sterile culture tubes and diluted 1:10 in RPMI 1640. Diluted whole blood samples were cultured in the same way as in the isolated lymphocytes. That is, each well contained 50 ul of diluted whole blood, 50 ul of PHA solution or medium alone, and 20 ul of fetal bovine serum. Preliminary experiments in our laboratory indicated that optimal final dilutions of PHA of this lot were 1:1400 and 1:280 for isolated lymphocyte culture and whole blood culture, respectively. The cultures were incubated at 37°C in 5% CO/95% Air. After 72 hr of incubation, 1 uCi of H-thymidine dissolved in RPMI 1640) was added to the culture and the cells were incubated for an additional 16 hr. The cells were harvested onto glass fiber filter paper by using a semiautomatic cell harvester (Skartron Inc., Sterling, VA) with physiological saline as a washing solution. Filter paper discs were air-dried and ^{3}H-thymidine incorporation was determined by liquid scintillation counting. Background dpm by unstimulated lymphocyte cultures were subtracted from dpm obtained from PHA-stimulated cultures.

Lymphocyte Counts

Leukocyte blood cell counts were determined by using a Coulter Counter (Model ZIP Coulter Electronics Inc., Hiaheah, FL). Total lymphocyte count was determined based on total leukocyte count and the proportion of lymphocytes estimated from the differential leukocyte count of 200 cells on Giemsa-stained slides of whole blood.

Termination of Serum Parameters

Anti-coagglulant free whole blood was centrifuged at 1,800 x g for 30 min. Serum was removed and stored at -20°C until used. Serum cortisol was measured by the radioimmunoassay with solid phase technique (Diagnostic Products Co., Los Angeles, CA).

Statistical Analysis

A two-tailed Student's t-test was used to determine the significance of differences.

RESULTS

Blastogenic Response of Isolated Lymphocyte to PHA

Phytohemagglutinin (PHA)-induced blastogenesis of isolated peripheral blood lymphocytes, as measured by ^{3}H-thymidine uptake, revealed no significant differences between the treatments throughout the experiment (Figure 1).

Blastogenic Response of Lymphocyte in the Whole Blood Culture to PHA

Figure 2 shows PHA-induced blastogenesis of lymphocytes in whole blood. H-thymidine uptake by lymphocytes in whole blood of the marketed/transported pigs revealed a 60% ($P<0.01$) and 50% ($P<0.01$) reduction on d 1 and 3, respectively, compared to that of the control pigs. On d 6 and 13 the degree of suppression gradually lessened and by d 21 no differences were found.

The Number of Circulating Blood Erythrocytes, Leukocytes, and Lymphocytes

Effect of marketing and transportation on the whole blood cell count in the circulating blood is summarized in Fig. 3. Leukocytes of the marketed/transported pigs revealed about 50% reductions ($P<0.001$) on d 1 and 3 as compared to that of the corresponding control pigs. On d 6 the degree of reduction in the leukocyte number was lessened to 30% ($P<0.001$) and after d 13 no differences were found. This depression in the number of leukocytes was mainly due to a depression in the number of lymphocytes. Based on these results, the suppression of PHA-induced blastogenesis of lymphocytes in the whole blood culture was probably attributable to decrease in the number of lymphocytes. Significant correlation between the two parameters of the marketed/transported pigs, PHA-induced blastogenesis of lymphocytes in the whole blood culture and the number of circulating blood lymphocytes ($P<0.001$) was found.

Serum Cortisol Concentrations

To evaluate if such suppression shown in Figures 2 and 3 was related to serum glucocorticoid levels, cortisol concentration was measured (Figure 4). On d 1 the marketed/transported pigs showed a higher cortisol level than the control pigs although this difference was not significant. After d 3, cortisol concentrations of both groups were almost the same level.

DISCUSSION

The primary significance of this study was that marketing and transporting of feeder pigs caused suppressed PHA-induced lymphocyte blastogenesis in whole blood and this immunosuppression lasted for several days. Such a suppression might be manifested at either of three levels; 1) reduced lymphoid cell population per se., 2) functional impairment of total T-cell population; and/or 3) changes in plasma factor(s) which is able to modulate T-cell responsiveness to PHA. Our results indicated that this suppression was probably due to reduced number of circulating blood lymphocytes which paralled the changes in the lymphocyte blastogenesis in the whole blood rather than functional impairment of T-cell responsiveness to PHA because no significant suppression was observed in the PHA-induced blastogenesis of isolated peripheral blood lymphocytes. In addition, plasma factor(s) might not be involved directly in this suppression since supplementation of serum from the marketed/transported pigs caused no significant depression in the PHA-induced blastogenesis of peripheral blood lymphocytes obtained from a healthy pig donor (data is not shown).

Endocrine regulation of immune events has been discussed for understanding how stress affects the immune response. A wide variety of hormones are released by stress, such as adrenocorticotrophin (ACTH), beta-endorphin, and glucocorticoids. All of these hormones have been demonstrated to affect a variety of immune events. Among these hormones, glucocorticoids have received attention due to their immunosuppressive actions which include reduction in lymphatic tissue mass and a depression in the number of circulating lymphocytes (Siegel and Beane, 1961; Fauci, A.S.,1975; McCauley and Hartmann, 1982; Slade and Hepburn, 1984). One possibility, therefore, is that such reduction in the number of lymphocytes observed in this study was caused by the elevated level of blood glucocorticoids level. To evaluate this point, serum cortisol, which is the major adrenocortical hormone, was measured. Serum cortisol concentrations in marketed/transported pigs tended to be higher on d 1 after marketing and transport but after d 3 concentrations had returned to levels similar to those of the control pigs. Serum cortisol concentrations were not measured during marketing and transportation; however, since elevated level of cortisol during exposure to transportation stress has been demonstrated elsewhere (Spencer et al., 1984; Becker et al., 1985), we postulate that this type of immune suppression observed in feeder pigs marketed and transported during a 36 hr period is mediated by this hormone.

These results are the first we have reported in a series of studies we have conducted examining the stress of marketing and transporting feeder pigs in an attempt to understand the events that lead to greater disease susceptibility during this phase of the feeder pig handling. The data does show an effect on immune function that would make the feeder pigs more susceptible to disease. We are further investigating when immune function becomes impaired and the physiological mechanisms by which it occurs.

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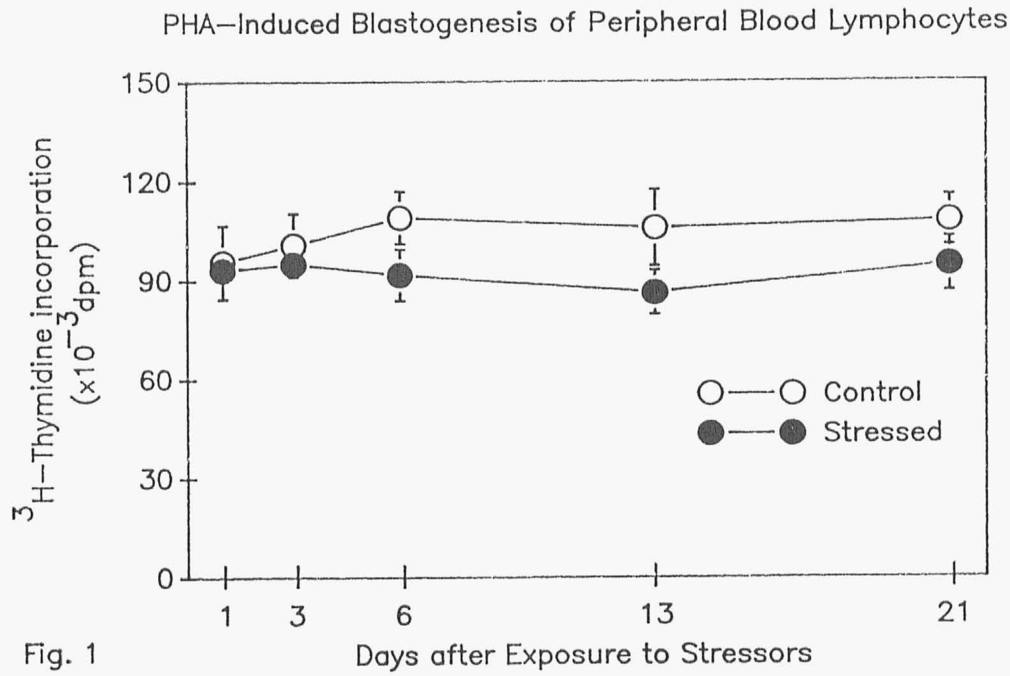

Fig. 1

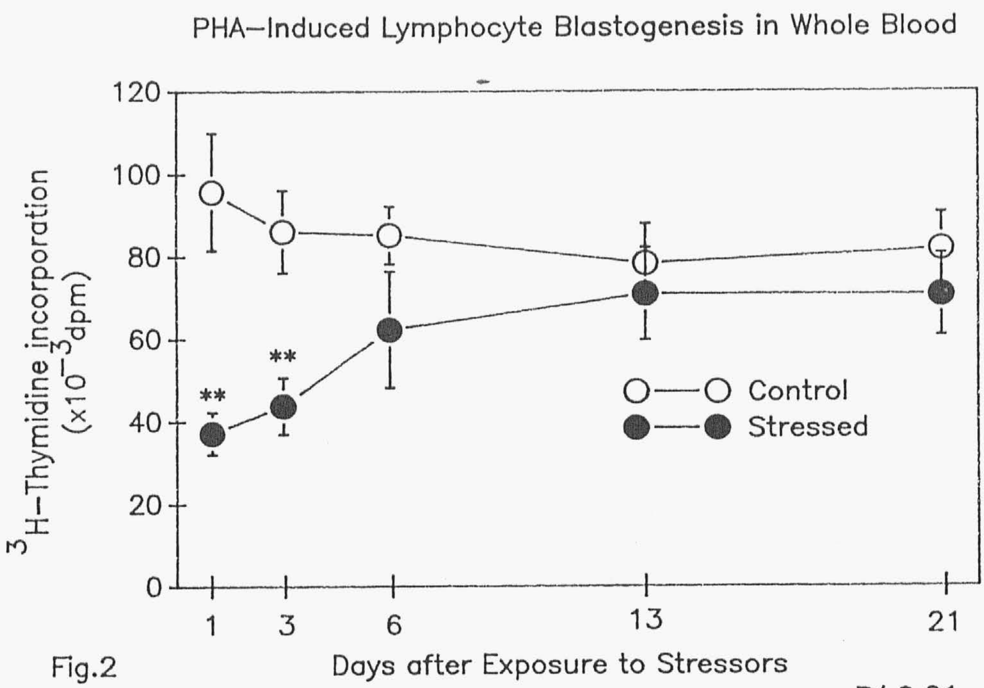

Fig.2

** P< 0.01 vs Control

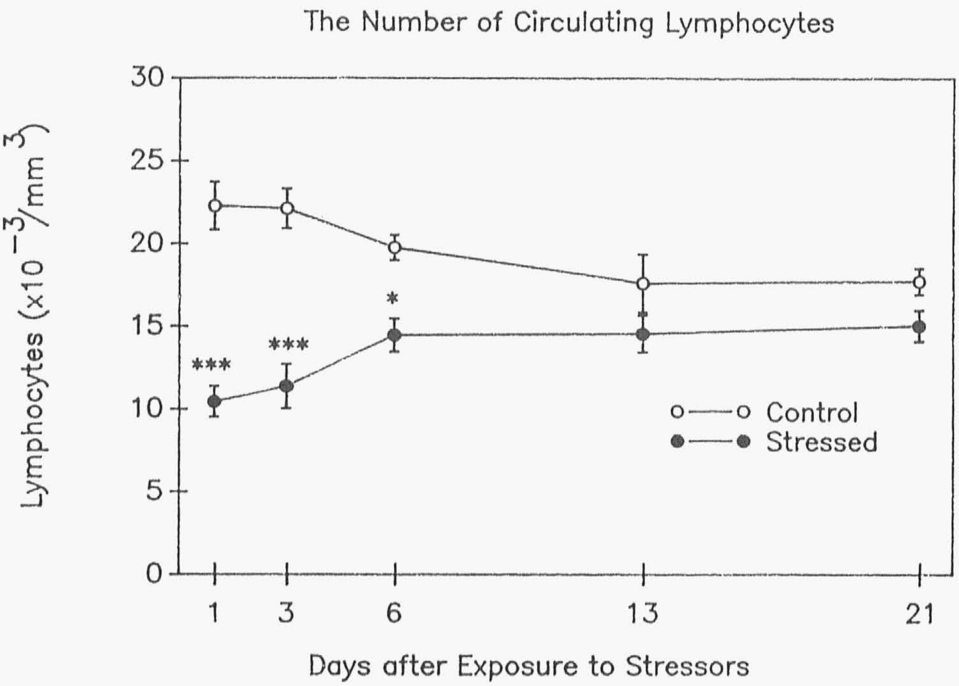

Fig. 3

* P< 0.05, *** P< 0.001 vs Control

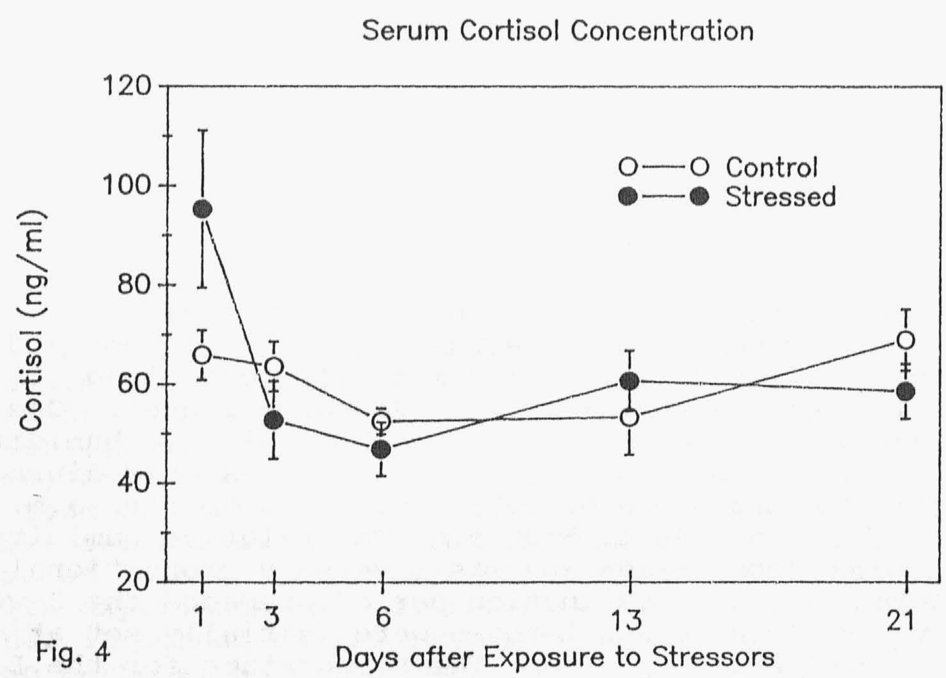

Fig. 4

PERFORMANCE OF FINISHING HOGS EXPOSED TO A THERMONEUTRAL TEMPERATURE VS A COLD DIURNAL TEMPERATURE

JOHN LOPEZ AND G. W. JESSE

SUMMARY

Two trials consisting of 48 crossbred finishing hogs per trial (24 barrows and 24 gilts) were used to determine the effects of a constant (control) 68°F temperature compared to a cold diurnal temperature (23 to 46°F) on performance. Initial weight was approximately 185 lbs. Relative humidity was approximately 55% for both rooms. Dependent variables measured were average daily gain (ADG), feed efficiency (F/G), feed intake (FI) water disappearance (WD), respiration rate (RR) and rectal temperature (RT). Pigs in the cold environment gained 27.5% slower and were 43% less efficient than the control pigs. Water disappearance (WD) was not different between treatments. In addition, RR was reduced and RT increased for animals in the cold temperature.

INTRODUCTION

The influence of bioclimate on animal production has been recognized by the animal industry for many years. Individual environmental factors as well as the combined assessment of all environmental influences on animal production needs to be clearly understood in order to provide an environment to improve animal production (Ames and Ray, 1983). Animal environmental research is needed to better understand the animal:environment interactions to accurately predict the performance level of animals exposed to various environmental influences and allow producers to adjust according.

PROCEDURES

Twenty-four barrows and 24 gilts per trial weighing approximately 185 lbs were divided equally into two groups and randomly assigned to one of two environmentally-controlled chambers in Unit C of the Animal Science Research Center. One chamber was kept at a constant (C) 68°F with a relative humidity of approximately 55%. The other chamber included a cold diurnal temperature (L) reaching a low of 23°F from 12:00 to 5:00 a.m. and a high of 46°F from 2:00 to 5:00 p.m. The relative humidity in this room ranged from 35-75% and was inversely proportional to room temperature. A 7 day acclimation period preceded the 3 week official study. Both the C and L rooms were initially set at 68°F during the acclimation period. The temperature for the L room was allowed to drop 3.6°F every day until 46°F was achieved and thereafter allowed to fluctuate according to the planned diurnal pattern. Following the 7 day acclimation period pigs were weighed on test. Individual pig weight and pen feed consumption were determined on day 7, 14 and 21. Water disappearance per two pens was recorded at 8:00 a.m. on a daily basis. Respiration rate (RR) per minute and rectal temperature (RT) were obtained twice daily on Tuesday and Thursday of each week starting at 12:00 a.m. and 2:00 p.m. These times correspond to the periods of the low and high temperatures in room C.

The pigs utilized for this experiment were university-raised crossbreds of Yorkshire, Landrace and Duroc descent. Each chamber contained twelve 4'x 4' pens which were used to house two barrows or two gilts each; hence, each chamber contained six pens of barrows and six pens of gilts (see figure 1). All pens were provided with one watering cup and a one-hole self feeder. A 13% crude protein corn-soybean meal ration without additives in meal form was fed to all pigs ad libitum. Each chamber contained six water meters which enabled the recording of WD for two adjoining pens, i.e., a pen of barrows and a pen of gilts. Each chamber (C and L) received 11 hours of light from 7:00 a.m. to 6:00 p.m..

The data were analyzed as a completely randomized design. Analysis of variance was conducted (Snedecor and Cochran, 1980) and means were separated according to Fisher's Least Significant Difference using a protected F (Steele and Torrie, 1980).

RESULTS AND DISCUSSION

As shown in table 1, ADG was significantly greater ($P<.05$) for the control (C) pigs every period except week 2. Feed intake for the C pigs during week 2 was slightly less than the first week. On the other hand, the L pigs increased FI during this period. Overall, the L pigs grew 27.5% slower than the C pigs.

Pigs in the cold environment had a poorer ($P<.05$) F/G for every period of the study (table 1). Overall the L pigs were 43.4% less efficient compared to the C pigs. As expected, the L pigs required a great deal of energy to maintain body temperature; hence less energy was available for gain.

Differences in performance for temperature by sex were not prevalent throughout the study (table 2). During week 2 and for the entire study (average) ADG for the L gilts was significantly lower ($P<.05$) than the other 3 treatment groups. At the same time, both sexes in the L room had higher F/G values than those in room C. A comparison within the same sex and across treatments shows the barrows and gilts in treatment L were 33.8 and 52.8% less efficient for average F/G, respectively. It appears that gilts experience more difficultly during cold stress than barrows since in normal environmental conditions gilts are more efficient than barrows. No differences for treatment by sex were observed for FI (table 2). In a comparison within the same sex the L barrows and gilts consumed 8.6 and 3.4% more feed than those in room C. Although not different ($P>.05$) gilts in both treatments ate less feed than barrows.

Rectal temperature (RT) during the a.m. and p.m. were consistently higher for the L pigs and in most cases significantly greater (P<.05; table 3). Animals below their lower critical temperature exhibit a higher heat production as a result of an increase in FI (table 1). This in turn appears to result in a higher RT. Morning (a.m.) and p.m. RT were combined to obtain a daily RT (table 3). Differences (P<.05) were observed for every period except week 3. The L pigs may have begun to acclimatize to the cold environment during this period.

Throughout the entire investigation the L pigs consistently had lower a.m. and p.m. RR than the C pigs. Comparing changes of RR from a.m. to p.m. within the same trial the pigs in the L room for both trials increased their RR slightly. The lower RR during the a.m. by the L pigs is possibly an attempt by the cold animals to reduce heat loss and hence, also suggestive for the higher RT. No differences by sex were found.

Water disappearance (WD) was not different (P<.05) between treatments throughout the entire study. Although not different, animals in the L room used 6% less water. Generally speaking, an increase in FI will coincide with a higher water intake. However in this case, it did not happen. Perhaps the lower RR for the L pigs reduced body water loss due to respiration; hence the WD was not directly proportional to FI.

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Control Room

B G	**G** B
B B	**G** G
G B	**B** G
B B	**G** G
B G	**G** B
G G	**B** B

Cold Room

G G	**B** B
B G	**G** B
B G	**G** B
B B	**G** G
G B	**B** G
G G	**B** B

Figure 1. Pen design and arrangement
Bold letters = Trial 1; Standard type = Trial 2.
B=barrows; G=gilts.

TABLE 1. AVERAGE DAILY GAIN, FEED EFFICIENCY AND PEN FEED INTAKE FOR TEMPERATURE, LBS.

		Temperature	
Item	Week	Control	Low
ADG	1	2.55^{a}	1.63^{b}
	2	1.86	1.76
	3	2.45^{a}	1.59^{b}
	Avg.	2.29^{a}	1.66^{b}
F/G	1	3.24^{a}	5.52^{b}
	2	4.29^{a}	5.18^{b}
	3	3.66^{a}	5.35^{b}
	Avg.	3.57^{a}	5.12^{b}
FI	1	111.64^{a}	116.74^{b}
	2	108.10^{a}	120.63^{b}
	3	120.22	118.78
	Avg.	113.32^{a}	119.78^{b}

^{a,b}Means within a row with different superscripts are different ($P<.05$).

TABLE 2. AVERAGE DAILY GAIN, FEED EFFICIENCY AND PEN FEED INTAKE FOR TEMPERATURE BY SEX, LBS.

		Treatment			
		Control		Low	
Item	Week	Barrows	Gilts	Barrows	Gilts
ADG	1	2.65	2.45	1.77	1.54
	2	1.83^{a}	1.88^{a}	2.03^{a}	1.49^{b}
	3	2.42	2.49	1.73	1.47
	Avg.	2.30^{a}	2.27^{a}	1.84^{b}	1.50^{c}
F/G	1	3.27	3.20	5.25	5.76
	2	4.32	4.27	4.76	5.56
	3	3.75	3.57	5.28	5.42
	Avg.	3.63^{a}	3.50^{a}	4.86^{b}	5.35^{b}
FI	1	118.20	105.08	121.77	112.33
	2	108.91	107.29	130.22	111.83
	3	122.95	117.50	126.45	111.91
	Avg.	116.70	109.95	126.15	112.02

^{a,b,c}Means within a row with different superscripts are different ($P<.05$).

TABLE 3. RECTAL TEMPERATURE, °F.

Item	Week	Temperature Control	Low
A.M.	1	102.30[a]	102.50[b]
	2	102.41	102.56
	3	102.43	102.50
	Avg.	102.40[a]	102.52[b]
P.M.	1	102.27[a]	102.45[b]
	2	102.34[a]	102.61[b]
	3	102.38[a]	102.61[b]
	Avg.	102.32[a]	102.56[b]
Daily	1	102.30[a]	102.48[b]
	2	102.38[a]	102.58[b]
	3	102.41	102.56
	Avg.	102.36[a]	102.54[b]

[a,b]Means within a row with different superscripts are different (P<.05).

TABLE 4. RESPIRATION RATE BY TRIAL[a], MIN.

Item	Trial	Week	Temperature Control	Low
A.M	1	1	47.08	22.00
		2	51.00	20.16
		3	47.56	22.00
		Avg.	48.52	21.36
A.M	2	1	33.48	23.24
		2	32.16	26.40
		3	33.80	24.40
		Avg.	33.16	24.72
P.M.	1	1	42.80	25.44
		2	39.40	26.72
		3	45.56	23.00
		Avg.	42.60	25.12
P.M.	2	1	33.48	25.44
		2	33.80	24.52
		3	32.40	24.76
		Avg.	33.24	25.36

[a]All means within a row are different by treatment (P<.05).

TABLE 5. DAILY WATER DISAPPEARANCE, GAL/4 HEAD

		Temperature	
Item	Week	Control	Low
WD	1	9.02	8.71
	2	8.50	8.32
	3	9.33	8.20
	Avg.	8.95	8.41

[a]All means within a row are different (P<.05).

PREDICTED RESPONSE TO SELECTION FOR MATERNAL TRAITS IN COMMERCIAL SWINE HERDS

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Summary

Predictions are made for genetic response to selection of replacement gilts in commercial swine herds. Traits considered are number born, litter 21 day weight and days to 220. Selection of replacement gilts resulted in an early plateauing pattern of response. Continued selection pressure on gilts did not result in added response in the absence of genetic improvement of purchased boars. Successful genetic improvement in the commercial herd can be best achieved by identifying a source of seedstock which has compatible goals and which consistently utilizes an effective program for genetic improvement of traits important to the commercial producer.

Introduction

Despite their obvious importance, perceptions of low expected response limit the emphasis placed on reproductive and maternal traits in selection programs in swine seedstock herds. Recognizing this limitation in seedstock available for purchase, commercial producers compensate by utilizing crossbreeding programs and selection for sow productivity. Crossbreeding programs are useful for improving reproductive and maternal traits. This paper will focus on the amount of response expected to result from selection of replacement gilts based on sow productivity in commercial swine herds.

Procedures

The genetic structure of the swine industry is often described as a pyramid. Genetic improvement originates in nucleus herds at the apex of the pyramid and is disseminated downward to commercial herds possibly through one or more intermediate multiplier levels (fig. 1). If the rate of genetic improvement at the nucleus level and the genetic structure of the system being examined are known, genetic change at the commercial level can be predicted using equations presented by Bichard (1971) and Guy and Smith (1981).

Genetic change in sow productivity (measured as litter weight at 21 days) will be predicted for a model system involving a commercial herd which produces its own replacement gilts and purchases boars from a nucleus herd. The nucleus herd emphasizes genetic improvement for growth and leanness and does not attempt to make genetic improvement for sow productivity. Replacement gilts are selected from litters with heavy 21 day litter weights. It is assumed that the nucleus and commercial herds initially have equal genetic merit for sow productivity. Purchased boars are selected for excellence in growth rate and leanness and are expected to be of average genetic merit for sow productivity.

Results

Approximately 6% of the gilts produced must be retained for replacements if sows are replaced after six farrowings. If these gilts are selected from the top 20% of all litters for 21 day litter weight their dams are expected to have a genetic superiority of 5.3 lbs. for this trait. Continuous selection on this system will result in the pattern of response shown in figure 2. The genetic potential of the commercial herd exceeds the static genetic level of the nucleus herd but quickly plateaus. The increase in genetic merit due to selection of replacement gilts from heavy litters equals the genetic superiority of the dams after one generation of selection, 5.3 lbs.

Similar selection practiced for litter size would be expected to result in a .35 pig per litter increase. Selection of replacements from among the fastest growing 20% of gilts would be expected to reduce days to 220 by about five days. Each of these predictions is based on the assumption that only one trait is emphasized in gilt selection. Emphasis on multiple traits will reduce the response for any particular trait.

Discussion

Selection practiced on one sex in a herd in which the other sex is purchased can result in an improvement in genetic potential but does not result in continually accumulative genetic change. Response plateaus after a small increment of improvement and selection must be continually practiced in order to maintain that increment of improvement. Long-term genetic trend in any herd which purchases one or both sexes of replacement breeding stock is determined by genetic change in the herd providing the breeding stock.

An analagous situation which more dramatically shows what is happening would be that of a dairy producer selecting to increase milk production by saving replacement heifers born to his highest producing cows. However, assume the producer is mating his cow herd to Hereford bulls. The first generation of offspring are 1/2 Hereford, the second generation 3/4 Hereford, the third generation 7/8 Hereford and so on. Despite the selection that is practiced within herd, the ultimate trend is determined by the breeding stock which is purchased.

The same is true in the swine herd. Despite the within herd selection for sow productivity or other traits, the genetic merit of the herd will not increase appreciably without increasing the merit of the purchased boars. That is not to say that the effort required to record data in the commercial herd is wasted. It may be sufficiently useful for culling poor producers and from a non-genetic standpoint to be worthwhile. It is questionable that predicted increases in genetic merit justify recording traits in commercial herds.

In nucleus herds selection for reproduction, performance and sow productivity traits can be effective in increasing genetic merit. To be defined as a nucleus herd, a substantial proportion of all replacement breeding stock of both sexes must be selected from within herd. Successful genetic improvement in the commercial herd can best be achieved by identifying a source of seedstock which has compatible goals and uses a consistent genetic improvement program. The commercial producer should make a commitment to pay a fair price for quality seedstock.

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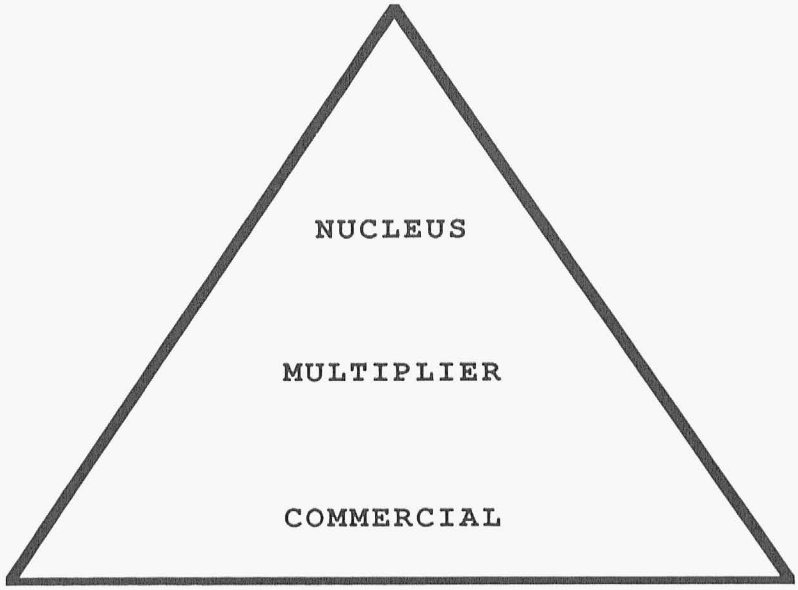

Figure 1. Genetic Pyramid Structure of the Swine Industry

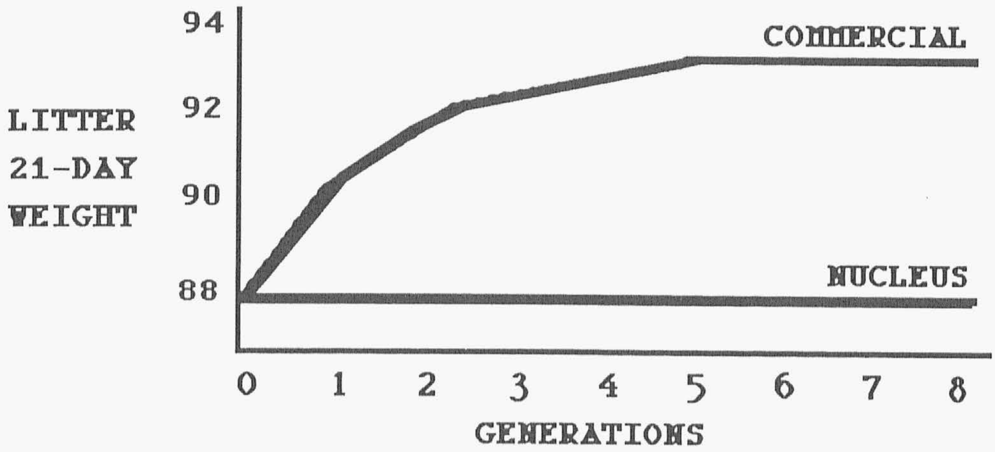

Figure 2. Response to Selection of Superior Gilts in a Comercial Swine Herd with no Improvement of Purchased Boars

BREEDING PROGRAM SURVEY OF COMMERCIAL SWINE PRODUCERS

R.O. Bates

Summary

A survey was conducted to assess the breeding programs of commercial swine producers. The majority of respondents had more than 50 sows, produced their own replacement females and utilized a rotational crossbreeding program. Over 93% of the respondents thought that performance testing was important to insure genetic progress; however, 42.4% were not presently using performance tested boars. Important factors considered when choosing seedstock suppliers were reputation, breeds and lines available, health and performance testing programs.

Introduction

Missouri ranks sixth in the production of slaughter hogs, while also a leader in the registration of purebred swine. To better understand the genetic needs of the commercial swine industry it is necessary to know the current status of breeding programs and the selection of replacement seedstock. During the winter of 1987-88 a survey was conducted of commercial swine producers who attended county and regional extension meetings.

Methods

The survey contained 14 questions to assess the size of the respondent's breeding herd, the breeding program used as well as the criteria used in selection of replacement seedstock. The survey was given to pork producers attending extension meetings related to pork production. There were 59 questionnaires completed. The majority of producers responding were located north of the Missouri river.

Results and Discussion

Tables are presented which summarize the responses given. The title of each table pertains to the question asked and the percentage response for each possible answer is given. There were several questions in which respondents could have more than one answer. For those questions the percent response totals more than 100%.

The majority surveyed had sow herds of 1-99 head (table 1), while 23.7% had herds greater than 100. Therefore 72.9% were marketing 500 or more pigs per year. Most producers developed their own gilts; however, 32.2% did buy some or all of their replacement females. Predominantly, independent purebred breeders were the source of replacement herd boars (table 3).

The Yorkshire, Duroc, Hampshire and Landrace breeds were most often designated as breeds represented in the sow herd (table 4); however, the Chester White and Spotted breeds were well represented. The Duroc, Hampshire, Yorkshire and Chester White breeds were most often represented as being sires of market hogs. As may be expected Yorkshire and Landrace were breeds used to compose the sow herd. It is interesting to note that the Hampshire breed was utilized almost equally in the sow herd and in the production of market hogs.

Rotational crossbreeding programs were most often used. Surprisingly, terminal crossbreeding programs were the second most often used. Terminal crossbreeding systems, by definition, require that both replacement gilts and boars be purchased.

Questions summarized in tables 6 through 11 inquired about the performance backround of boars purchased and what selection criteria was used. Of those responding only 57.6% purchased boars that were performance tested (table 6). Growth rate was the most important selection trait (table 7) while litter weight was the least important. Surprisingly, backfat ranked 8th out of tenth, even though backfat is an important component of carcass value programs. Seedstock suppliers were chosen based on their reputation, breeds available, health program and status and testing program.

Overwhelmingly on-farm performance testing and central testing were practices that were perceived as tools that would enhance genetic progress, with 93.1% choosing one of those two answers (table 8). However, 42.4% were presently using boars that were not performance tested. This inconsistency may be due to 60.5% not having a seedstock producer near by that could verify his testing and health program (table 9). There appears to be a need to have some verification procedures for performance testing and selection programs (table 10). The Nebraska-SPF program was the most recognized performance testing organization and program (table 11).

Conclusion

Of those completing a survey pertaining to commercial pork production, 72.8% had 50 or more sows. Rotational crossbreeding programs were most often used and replacement boars were usually purchased from independent suppliers. Growth rate was the most often listed trait used when purchasing boars and seedstock suppliers were chosen based on their reputation, breeds and lines available, health and performance program. The majority (93.1%) of the respondents indicated that performance testing would insure genetic progress within the industry; however, only 57.6% were presently using performance tested boars. This may be due 60.5% indicating that they did not have a seedstock supplier in their area with a verified health and performance testing program.

Table 1. NUMBER OF SOWS IN HERD

Answer	Percent Response
Less than 50	27.1
50-99	49.2
100-500	18.6
501-1000	5.1
More than 1000	0.0

Table 2. SOURCE OF GILTS

Answer	Percent Response
Home Raised	67.8
Purchased	6.8
Home Raised and Purchased	25.4

Table 3. SOURCE OF BOARS

Answer	Percent Response
Home Raised	8.5
Purebred Breeders	45.8
Purebred Breeders Also Selling Crossbred Boars	44.1
Companies	11.9
Other	3.4

Table 4. BREEDS REPRESENTED IN SOWS AND SIRE BREED OF MARKET HOGS

Breeds	Sow Percent Response	Market Hog Percent Response	Percent Change[a]
Berkshire	0.0	1.7	_[b]
Chester White	32.2	28.8	10.6
Duroc	62.7	52.5	16.3
Hampshire	45.8	44.1	3.7
Landrace	35.6	11.9	66.5
Poland	3.4	3.4	0.0
Large White	18.6	16.9	9.2
Spotted	20.2	23.7	-17.3
Yorkshire	67.8	39.0	42.4
Duroc-Hampshire F_1	-	10.2	_[c]
Other Breeds	3.4	-	_[c]
Other Crosses	-	3.4	_[c]
Hybrids	10.2	8.5	16.7

[a] In respect to breed representation of sow
[b] Division by zero not defined
[c] Not listed in both categories

Table 5. CROSSBREEDING SYSTEM USED

Answer	Percent Response
Rotation	51.7
Terminal	22.4
Rotaterminal	17.2
Unplanned	8.6

Table 6. BACKGROUND OF BOARS USED

Answer	Percent Response
Performance Tested	57.6
Not Performance Tested	42.4

Table 7. CRITERIA USED IN CHOOSING SEEDSTOCK SUPPLIERS AND BOARS

Suppliers		Boars	
Criteria	Percent Response	Criteria	Percent Response
Reputation	45.8	Growth Rate	71.2
Breeds and Lines Available	40.7	Feet and Legs	52.5
Health Program	39.0	Feed Efficiency	49.2
Health Status	37.3	Visual Reproductive Traits	42.4
On-Farm Testing	33.9		
Test Station Participation	33.9	Conformation	40.7
Guarantee	16.9	Litter Size	33.9
Evidence of Genetic Change	15.3	Loin Eye	33.9
Selection Program	11.9	Backfat	30.5
Prices	11.9	Index Score	20.3
Location	11.9	Litter Weight	16.9
Service Program	11.9		
Large Supply	10.2		
Farmstead Appearance	10.2		
Breeder's Personality	5.1		
None of these	1.7		

Table 8. ONE PRACTICE THAT WILL INSURE GENETIC PROGRESS IN THE SWINE INDUSTRY

Answer	Percent Response
On-Farm Testing	58.6
Central Testing	34.5
Shows and Conferences	6.9

Table 9. IS THERE A SEEDSTOCK PRODUCER IN YOUR AREA THAT HAS VERIFIED HIS TESTING, SELECTION AND HEALTH PROGRAM?

Answer	Percent Response
Yes	39.5
No	60.5

Table 10. SHOULD TESTING AND SELECTION PROCEDURES USED BY SEEDSTOCK PRODUCERS BE VERIFIED?

Answer	Percent Response
Large Need	36.7
Some Need	57.1
No Need	6.1

Table 11. WHICH PERFORMANCE TESTING ORGANIZATION OR PROGRAM ARE YOU AWARE OF?

Answer	Percent Response
Nebraska - SPF	51.1
National Swine Improvement Federation	26.7
S.T.A.G.E.S.	22.2
E.B.V. Program	22.2

COMPARISON OF MARKET HOG CHARACTERISTICS OF PIGS SELECTED BY FEEDER PIG FRAME SIZE OR CURRENT USDA FEEDER PIG STANDARDS

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SUMMARY

Two feeder pig grading systems were tested. Forty-five barrows were selected using current USDA feeder pig standards (U.S. No. 1, No. 2 and No. 3). Simultaneously, 45 barrows were selected using three frame sizes (large, medium and small). Feeder pigs were objectively measured for skeletal dimensions. Pigs were slaughtered at 220, 250 or 280 lb live weight. Carcass measurements were taken and one side was processed into trimmed wholesale cuts. The trimmed four lean cuts were separated into soft tissue and bone. The skinless belly and the soft tissue from the four lean cuts were separately ground and chemically analyzed for protein, moisture and ether extractable constituents. Data from each system were analyzed separately in a 3 x 3 factorial by least-squares means. The sensitivities of the two systems were compared by the methods of Bradley and Schumann (1957). Pigs selected as U.S. NO. 1, No. 2 or No. 3 differed ($P<.05$) at slaughter for last rib backfat, fat depth, longissimus area, percent trimmed four lean cuts, USDA carcass grade, percent fat trim and lean in the untrimmed four lean cuts. In the frame size system, large frame size pigs at slaughter had less last rib backfat, fat depth, and percent ether extractable lipid in the five primal cuts than small frame size pigs ($P<.05$). In addition, large frame size pigs had longer carcasses, with greater percentage trimmed four lean cuts and superior USDA carcass grades than the small frame size pigs. Bradley and Schumann test of sensitivity showed that selection by frame score was more sensitive than current feeder pig standards for discriminating feeder pig foreleg length, body depth, ham width, carcass length and carcass radius length. No increase in sensitivity ($P>.10$) was noted for composition or growth traits over the current standards.

INTRODUCTION

There appears to be a need for examining the grading system for feeder pigs with the intent to develop a grading system which will identify feeder pigs on the basis of their predicted production efficiency and carcass merit. A descriptive and accurate system of grouping feeder pigs according to their slaughter endpoint characteristics would be highly beneficial to the pork industry. Such a grading system would provide clear communication between pig producers and slaughter hog producers. The objective of this study was to compare market hog characteristics of pigs selected by the current USDA feeder pig grading standards to pigs selected by frame size.

EXPERIMENTAL PROCEDURES

Two feeder pig grading systems were tested. Forty-five barrows were selected in a 3 x 3 factorial using current USDA feeder pig standards (U.S. No. 1, U.S. No. 2 and U.S. No. 3) and three slaughter endpoints (220, 250 and 280 lb). Simultaneously, 45 barrows were selected in a 3 x 3 factorial with three frame sizes (large, medium and small) and three slaughter endpoints. Pigs were subjectively scored and selected by a panel of five evaluators (two Missouri Department of Agriculture and three USDA Agricultural Marketing personnel) from the daily consignments of southern Missouri auction barns. Frame size was evaluated as a composite evaluation of height and body length in relation to maturity.

Pigs were fed a 16% crude protein fortified corn-soybean meal diet ad libitum until they averaged 125 lb, and then fed a 14% crude protein diet throughout the remainder of the trial. Pigs were removed from test on an individual basis within 5 lb of their target endpoint. Pigs were conventionally slaughtered and prior to evisceration, carcasses were measured for heart girth and width at the widest portion of the shoulder. Carcass measurements were obtained and carcass composition was calculated by adding the components of the belly, four-lean-cut soft tissue and fat trim.

Analyses of variance and covariance were used to determine the effects of USDA feeder pig grade and weight group or frame size and weight group. All differences ($P<.05$) in main effects were identified using a protected LSD rule on differences adjusted for unequal subclass numbers (SAS, 1985). Tests of statistical sensitivity were compared by the methods of Bradley and Schumann (1957). This test was employed to determine if feeder pig frame scores discriminate slaughter characteristics as well as current feeder pig grade standards.

RESULTS

<u>Feeder Pig Measures</u>. These objective measures were adjusted by using initial weight as a covariate and are reported in table 1. Selection by frame score was more sensitive in discriminating foreleg length, body depth and ham width than the current standards.

<u>Growth Data</u>. Table 2 shows the effects of pig type and classification on average daily gain and days on test. Selection by frame score was not more sensitive in discriminating growth traits than selection by current standards. However, large-frame pigs were on test fewer days ($P<.05$) than medium- or small-frame pigs.

<u>Carcass Characteristics</u>. Presented in tables 3 and 4 are the effects of body type or classification on carcass characteristics. Selection by frame score was more sensitive in discriminating

carcass length and radius length than the current standards. No other traits were identified as being more discriminating when pigs were selected by frame scores.

CONCLUSIONS

The study was designed to compare market hog characteristics of pigs selected by the current USDA feeder pig grading standards to pigs selected by frame size. Under the conditions of this experiment the following conclusions can be made: 1) ADG was not affected by frame size or USDA feeder pig grade; 2) subjectively large, medium and small frame size feeder pigs had different skeletal dimensions (length, height and bone circumference) at time of selection. In addition, these differences in skeletal dimensions were observed at slaughter; 3) pigs selected by current USDA feeder pig grades differed in body length, shoulder width and bone circumference ($P<.05$) at time of selection. However, these differences were not apparent at slaughter; 4) assessment of potential carcass traits of feeder pigs is more difficult than feeder cattle; 5) biologically, swine breeds exhibit less mature size variation than cattle, and feeder pigs are marketed at younger developmental maturity than feeder cattle; 6) selection of feeder pigs by skeletal size was more sensitive in discriminating linear carcass traits (i.e. length), however, systems designed and employed in these studies did not improve on the effectiveness of current USDA Feeder Pig Grade Standards in estimating carcass composition, cutability or pig growth.

TABLE 1. LEAST-SQUARES MEANS[a] FOR FEEDER PIG MEASURES

Item	USDA				Frame size				Sensi-tivity[a]
	No. 1	No. 2	No. 3	√EMS	Large	Medium	Small	√EMS	
Foreleg length, in	9.1	9.2	9.1	.52	9.6[x]	9.1[y]	8.5[z]	.30	*
Body length, in	23.3[c]	22.6[c,d]	22.2[d]	.84	23.3[x]	22.6[y]	21.3[z]	.99	NS
Heart girth, in	25.9	26.1	26.0	.55	26.0	26.1	26.2	.59	NS
Body depth, in	7.9	8.1	8.0	.31	8.2	8.1	7.9	.39	*
Shoulder width, in	6.8[c]	6.5[d]	6.4[d]	.30	6.7	6.7	6.7	.21	NS
Ham width, in	6.4	6.4	6.3	.39	6.4	6.4	6.7	.45	*
Forecannon circumference, in	5.0[c]	4.9[c]	4.8[d]	.21	5.0[x]	5.0[x]	4.8[y]	.15	NS

[a]Covariant = initial weight.

[b]Bradley and Schumann (1957) sensitivity statistic for testing equal effects of feeder pig scoring systems (P<.05).

[c,d]Means, in a row, that do not have a common superscript differ (P<.05).

[x,y,z]Means, in a row, that do not have a common superscript differ (P<.05).

TABLE 2. LEAST-SQUARES MEANS FOR GROWTH TRAITS

	USDA				Frame size				
Item	No. 1	No. 2	No. 3	$\sqrt{EMS}$	Large	Medium	Small	$\sqrt{EMS}$	Sensitivity[a]
Initial wt, lb	67.5[c]	59.1[d]	58.6[d]	9.96	67.7[x]	61.9[x]	54.0[y]	8.42	NS
Days on test[b]	123.0	120.0	119.3	17.50	114.9[y]	125.6[x]	130.0[x]	13.40	NS
ADG,[b] lb	1.57	1.57	1.63	.22	1.65	1.54	1.48	.15	NS

[a]Bradley and Schumann (1957) sensitivity statistic for testing equal effects of feeder pig scoring systems (P<.05).
[b]Covariant = initial weight.
[c,d]Means, in a row, that do not have a common superscript differ (P<.05).
[x,y]Means, in a row, that do not have a common superscript differ (P<.05).

TABLE 3. LEAST-SQUARES MEANS FOR CARCASS LINEAR MEASURES

	USDA				Frame size				
Item	No. 1	No. 2	No. 3	$\sqrt{EMS}$	Large	Medium	Small	$\sqrt{EMS}$	Sensitivity[a]
Last rib backfat, in	1.14^{b}	$1.22^{b,c}$	1.38^{c}	.26	1.14^{y}	$1.26^{x,y}$	1.34^{x}	.20	NS
Fat depth, in	1.18^{c}	$1.46^{b,c}$	1.69^{b}	.39	1.22^{y}	1.46^{x}	1.54^{x}	.34	NS
Longissimus muscle area, in^2	4.88^{b}	4.29^{c}	3.91^{d}	.45	4.70	4.70	4.45	.57	NS
USDA carcass score	2.49^{c}	$3.05^{b,c}$	3.83^{b}	1.30	2.53^{y}	$2.99^{x,y}$	3.40^{x}	1.12	NS
Carcass length, in	32.0	31.7	31.3	1.28	32.3^{x}	31.9^{x}	30.5^{y}	.91	*
Radius length, in	5.2	5.2	5.1	.23	5.4	5.1	5.1	.19	*
Heart girth, in	39.5	39.7	40.4	1.24	39.6^{y}	40.4^{x}	40.9^{x}	.89	NS

[a]Bradley and Schumann (1957) sensitivity statistic for testing equal effects of feeder pig scoring systems (P<.05).

[b,c,d]Means, in a row, that do not have a common superscript differ (P<.05).

[x,y]Means, in a row, that do not have a common superscript differ (P<.05).

TABLE 4. LEAST-SQUARES MEANS FOR CARCASS CHARACTERISTICS

	USDA				Frame size				
Item	No. 1	No. 2	No. 3	$\sqrt{EMS}$	Large	Medium	Small	$\sqrt{EMS}$	Sensi-tivity[a]
Trimmed four lean cuts,[b] %	61.3[e]	58.2[e,f]	55.6[f]	4.48	60.2[x]	58.6[x]	56.4[y]	2.90	NS
Bone,[c] %	11.1	10.7	10.2	1.30	11.4	10.9	10.6	1.08	NS
Fat trim,[c] %	8.5[f]	11.5[e,f]	14.1[e]	4.67	9.4	11.0	12.0	3.39	NS
Soft tissue,[b] %	73.8[e]	71.2[e,f]	68.9[f]	4.06	72.4	71.3	70.5	3.02	NS
Ether extract,[c] %	32.6[f]	37.8[e,f]	40.9[e]	7.01	32.8[y]	37.3[x]	37.0[x]	4.41	NS
Moisture,[c] %	52.5[e]	48.6[e,f]	46.6[f]	5.39	52.6[y]	49.0[x]	49.2[x]	3.24	NS
Protein,[c] %	14.3[e]	13.1[e,f]	12.1[f]	1.60	14.1	13.4	13.3	1.14	NS

[a]Bradley and Schumann (1957) sensitivity statistic for testing equal effects of feeder pig scoring systems (P<.05).
[b]Percent of side.
[c]Percent of untrimmed four lean cuts.
[e,f]Means, in a row, that do not have a common superscript differ (P<.05).
[x,y]Means, in a row, that do not have a common superscript differ (P<.05).

PREDICTIVE EQUATIONS FOR ESTIMATING BELLY COMPOSITION IN PORK CARCASSES

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SUMMARY

Data from 260 pork carcasses and bellies were collected and analyzed to develop equations to predict belly composition. Pigs were conventionally slaughtered, carcass measurements collected, and one belly was removed. Each belly was skinned and soft tissue thoroughly ground, mixed, and a composite sample taken for fat, protein and moisture analysis. Stepwise multiple regression analysis was employed to determine the carcass or belly measures that best identified the variation in percentage lean, fat, protein and moisture. Higher coefficients of determination were reached with ribbed carcass measurements than with measurements from unribbed carcasses. Longissimus muscle area and fat depth were included in all equations using measurements from ribbed carcasses. Average backfat thickness was used in all equations.

INTRODUCTION

The belly represents 12 to 15% of the pork carcass weight (Freeden et al., 1975), and when this cut is cured and sold as sliced bacon, it contributes significantly to the value realized from the carcass. Bacon is a high-fat meat item and because of current concern about the level of fat in the diet, the ability to identify levels of fat in bacon produced commercially is of great importance.

Many of the studies to date have selected bacon slices for lean and fat determinations and have assumed that those samples were representative of the entire belly. Johnson et al. (1984), however, used the entire untrimmed belly for evaluation and reported that specific gravity of one side of the carcass was the single measurement that was most closely related to percentage lean. In addition, they reported an equation with fat depth at the center of the longissimus muscle at the 10th rib and USDA carcass muscling score to be the most practical in estimating percentage lean. The objective of the present study was to identify carcass and(or) belly measurements that best predict not only belly lean percentage but also belly chemical fat, protein and water percentages.

PROCEDURES

Two-hundred and sixty barrows and gilts were weighed and conventionally slaughtered at the UMC abattoir. Carcasses were chilled and split. Carcass measurements and evaluations that were obtained included hot carcass weight, carcass length, average and last rib backfat thickness, USDA muscling score and USDA carcass grade. Carcasses were separated into primal cuts (loin, Boston shoulder, picnic shoulder, ham and belly). Longissimus muscle area and fat depth were obtained at the 10th rib.

Spare ribs and related cartilage were removed from the belly. The belly was then cut perpendicular to the long axis between the 10th and 11th rib, and belly thickness was measured at the midpoint (including skin). The belly was skinned, weighed, coarsely ground and a composite sample was obtained. The sample was subsequently analyzed for percentage chemical fat, crude protein and moisture. Percentage lean was calculated [100 x (belly weight - chemical fat weight) / belly weight].

Statistical analyses performed on the data included means and stepwise regression analysis. Two models were used for the stepwise regression analysis. Model I included those variables obtained from an unribbed carcass. Model II included Model I variables plus longissimus muscle area (LMA) and fat depth at the 10th rib (FD) typical of a ribbed carcass. R^2 values were evaluated to determine the optimum equations.

RESULTS AND DISCUSSION

Table 1 shows mean, maximum and minimum values of the variables used in this study. Simple correlation coefficients are presented in Table 2. Carcass weight, all backfat measures and USDA carcass grade were negatively correlated with percent protein, water and lean and positively correlated with percentage ether extract.

The optimum equations for each trait and each model are listed in Table 3. Equations using variables from ribbed carcasses (LMA and FD included) had higher R^2 values thus explaining more of the variation in each of the belly traits. Prediction of percentage lean was increased 7% (62 to 69%) when LMA and FD were included in the model.

When LMA and FD were excluded from the model, weights of both the carcass and skinned belly were included. It appears that weight is a significant factor in predicting belly composition of unribbed carcasses. However, carcass weight was excluded from the model when LMA and FD were used. Contrary to Johnson et al. (1984), USDA carcass muscling score was not included when predicting percentage lean in either Model I or II. Sex was included as a variable in one equation (Model I), however, it was not included when traits from ribbed carcasses were used.

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TABLE 1. MEAN, MAXIMUM AND MINIMUM VALUES FOR SELECTED PORK CARCASS AND BELLY MEASUREMENTS

Item[a]	Mean	Minimum	Maximum
LW, lb	237.0	201.6	298.0
CW, lb	167.5	139.5	212.0
SB, lb	13.3	8.4	23.1
CLEN, in	31.4	27.4	34.2
LRBF, in	1.12	.60	2.10
MUS	2.2	1.0	3.0
USDA	2.26	.05	7.40
BTH, in	1.41	.80	2.50
AVGBF, in	1.32	.87	2.53
LMA, in^2	4.7	2.9	7.6
FD, in	1.21	.40	2.80

[a]LW=live wt, lb; CW=chilled carcass wt, lb; SB=skinned belly wt, lb; CLEN=carcass length, in; LRBF=last rib backfat thickness, in; MUS=carcass muscling score; USDA=USDA carcass grade; BTH=belly thickness, in; AVGBF=average backfat thickness, in; LMA=longissimus muscle area, in^2; FD=fat depth at 10th rib, in.

TABLE 2. CORRELATION COEFFICIENTS BETWEEN SELECTED LIVE HOG AND CARCASS CHARACTERISTICS AND BELLY COMPOSITION

	Percent (N=260)			
Item	Protein	EE[a]	Water	Lean
Sex (barrow=0, gilt=1)	.33[b]	-.26	.24	.26
Live wt	-.28	.29	-.29	-.28
Chilled carcass wt	-.27	.31	-.32	-.30
Skinned belly wt	-.61	.64	-.64	-.64
Carcass length	.27	-.26	.25	.26
Longissimus muscle area	.47	-.44	.42	.44
Average backfat thickness	-.71	.73	-.72	-.74
Last rib backfat thickness	-.67	.70	-.70	-.70
Fat depth at 10th rib	-.79	.80	-.78	-.80
Belly thickness	-.56	.56	-.55	-.56
Carcass muscling score	.41	-.42	.41	.42
USDA carcass grade	-.68	.71	-.70	-.71

[a]EE=ether extractable constituents.
[b]Correlation coefficients greater than .165 ($P<.01$).

TABLE 3. REGRESSION EQUATIONS FOR ESTIMATING PERCENTAGE PROTEIN, FAT, WATER AND LEAN IN FRESH PORK BELLIES

	Independent variable[a]							
Item	Intercept	AVGBF	CW	SB	SEX	LMA	FD	R2
				UNRIBBED				
Protein, %	15.50	- 3.14	.03	- .35	.72			.62
EE, %	23.38	15.10	-.09	1.56				.62
Water, %	60.36	-11.71	.06	-1.18				.61
Lean, %	76.62	-15.11	.09	-1.58				.62
				RIBBED				
Protein, %	14.20			-.17		.45	-2.41	.67
EE, %	28.94	6.50		.86		-1.85	6.82	.69
Water, %	55.83	-5.34		-.68		1.35	-4.97	.66
Lean, %	71.06	-6.50		-.86		1.85	-6.82	.69

[a]See Table 1 for acronyms.

CONTROLLED REPRODUCTION

August R. Rieke

SUMMARY

Estrus was effectively synchronized in gilts to correspond with estrus of sows following weaning in a confinement swine production facility. This close synchronization of estrus and mating of sows and gilts subsequently allowed for the induction of parturition in these pigs, with farrowing occurring in a 2 to 3 day period. The closeness of farrowing allowed for closer observation of sows during farrowing. Pigs could more easily be cross-fostered which resulted in more uniform litter size and pigs of more uniform weight at weaning.

INTRODUCTION

Control of the time of estrus and the time of parturition is of practical importance to optimum scheduling of events in confinement swine enterprises. Control of estrus to a period of 4 or 5 days allows for the introduction of gilts into the sow herd on a timely basis. The control of parturition would allow for closer observation of sows during farrowing with less labor, improved crossfostering of pigs, and more uniform pig weights at weaning. This study was conducted to demonstrate that technology has been developed to control the time of estrus and parturition in a confinement swine system.

PROCEDURES

Twenty five gilts which had previously exhibited estrus were selected to be fed 15 mg of Altrenogest (Regumate) mixed in .45 kg of feed/head/day for 18 consecutive days. This feeding regimen allowed for estrus to be expressed during a previously scheduled breeding period at the Swine Research Complex. In subsequent trials, 10, 10 and 9 gilts were selected and fed as above to allow for estrus to be expressed during three scheduled breeding periods. Sows were weaned 4 days prior to the next scheduled breeding period. Gilts and sows were checked daily for estrus and bred on each day of estrus.

All animals were moved to farrowing quarters on day 109 of gestation. They were assigned to groups of approximately 10 animals to farrow on day 113 or 114 of gestation.

Parturition was induced by prostaglandin $F_2\alpha$ ($PGF_2\alpha$) treatment as described by Gall and Day 1987. Gilts and sows were observed closely for signs of impending parturition following treatment with $PGF_2\alpha$ including constant observation for 12 hours on the calculated day of farrowing.

RESULTS

Feeding Regumate effectively suppressed estrus in all gilts. Upon withdrawal of the compound, gilts expressed estrus 4 to 8 days, average 5.6 days, post-treatment (Table 1). In general the gilts expressed estrus within a 3 day period within a trial, but varied between trials as to the first day of estrus following withdrawal of Regumate. Estrus was synchronized to a well defined time during the normal breeding period.

Sows exhibited estrus 4.8 days post weaning (range 4 to 7 days) as shown in Table 2. This in effect synchronized estrus to a 3 day period which corresponded to the time of estrus expressed by the synchronized replacement gilts added to each trial. All sows and gilts were mated within a range of 4 to 8 days post-weaning.

Conception rates at the first post-treatment estrus in gilts were 56, 90 and 78% for trials 1, 2, and 3, respectively. Sows had conception rates of 80% in trial 2 and 65% in trial 3 at the first post-weaning estrus.

A total of six females in all trials farrowed before their due dates and were not treated with $PGF_2\alpha$. One gilt in trial 1 did not respond to treatment and farrowed 3 days after her due date. As shown in Table 4 the remaining females were treated with $PGF_2\alpha$ and farrowed within 3 days post-treatment. The mean and standard deviation of the interval to farrowing was 25 ± 8.5 hours when computed across all animals and all trials.

These results illustrate a controlled reproduction program whereby a group of replacement gilts can be synchronized to breed at the same time as a group of post-weaning sows so that time of parturition can be controlled to a 2 day period in a breeding group of gilts and sows.

LITERATURE CITED

1. Gall, M. A. and B. N. Day. 1987. Induction of parturition in swine with prostaglandin $F_2\alpha$, estradiol benzoate and oxytocin. Theriogenology 27:493.

Table 1. Estrus Synchronization of Gilts Fed Regumate

	Days after last feeding					
Trial	4	5	6	7	8	Avg
1	2	21	2			5.0
2			1	5	4	7.3
3	1	5	3			5.2
4			6	3		6.3
Total	3	26	12	8	4	5.6

Table 2. Estrous Synchronization in Sows

	Days after pigs weaned					
Trial	4	5	6	7	8	Avg
2	5	3	1	1	2	4.8
3	11	3	2		2	4.4
4	6	5	1	3	3	5.1
Total	22	11	4	4	7	4.8

Table 3. Number of pigs farrowing following $PGF_2\alpha$ treatment

	Interval from $PGF_2\alpha$ injection to farrowing		
Trial	0-23 h	23-34 h	>34 h
1	1	8	4
2	8	6	0
3	10	6	0
4	6	13	0
Total	25	33	4

SWINE--LIVE ANIMAL EVALUATION

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Supervisor Livestock Measurements

Live animal testing is designed to help swine producers select herd sires and replacement gilts that can produce market hogs that gain rapidly and efficiently and provide acceptable products for the consumer. Swine producers are becoming more conscious of the importance of a good swine selection and breeding program. In order to maximize genetic improvement, breeding stock must be selected on performance records.

The On-Farm Performance Testing Program is available to Missouri swine producers on a fee basis and is designed to give purebred producers, as well as commercial producers, the performance information they need. This service is available upon request through the University Extension Office and Area Extension Livestock Specialists.

The timely collection of records is essential. If a producer has the time and commitment to collect records, study the results and use them for within herd selection, he will make genetic improvement.

Backfat, loineye area and days adjusted to 230 lbs are important carcass and production traits. Producers should be selecting for leanness, as well as more muscle, together with an animal that will ultimately reach market weight in as few days as possible.

A comparison of results for 1978 and 1985 through 1988, shown in table 1, indicates that a large number of producers are using ultrasonics to record backfat thickness and loineye area. It also indicates that most emphasis is placed on the herd sire. Although more animals were tested in 1978, producers continued to test large number in 1988.

The total number of animals measured in 1988 increased by 1,068. Backfat increased by .02 inch while loineye area remained unchanged. Days to 230 increased by 9 days.

During 1987 we instigated measurements for % muscle adjusted to 160 lbs carcass weight and figured the information for cooperating breeder's use. Since most breeders produce their own female replacements, and add only boars to change the genetic base, most of the improvement on genetic change will come from the paternal side of the pedigree. There were 980 boars and 262 gilts measured for % muscle in 1987. In 1988 there were 3,019 boars and 568 gilts measured for % muscle. The results are in table 2.

Table 1. Swine Sonoray Comparison Overall Averages for 1978, 1985, 1986, 1987 and 1988

Year	Year No. Head	Avg Weight	Avg B.F. 230#	Avg LEA 230#	Avg Days 230#
1978	6,327	226	.85	5.66	166
1985	4,621	242	.74	5.92	163
1986	4,820	241	.78	5.89	164
1987	4,929	241	.77	5.82	160
1988	5,997	241	.79	5.83	169

Table 2. A Comparison of Purebred Boars and Gilts for 1987 and 1988 on Backfat Loineye Area and Days - 230# and % Muscle on 160# Adjusted Carcass Weight

Year	Sex	Total Head	Avg Wt	Avg B.F. 230#	Avg LEA 230#	Avg Days 230#	Avg % Muscle 160# Carc.
1987	Boar	980	241	.78	5.81	165	57.12
	Gilt	262	224	.81	5.69	172	55.50
1988	Boar	3,019	238	.76	5.92	162	57.83
	Gilt	568	228	.84	5.75	173	56.80

BACK COVER: New individual farrowing house units at the pasture farm in Columbia

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