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Summary

The objectives of this experiment were to determine the effects of high oil corn (HOC) on the aerosol transmission of the porcine reproductive and respiratory syndrome virus (PRRSV), and the effects of HOC on PRRSV seroconversion in growing pigs. One hundred PRRSV negative gilts (25 kg) were housed in 1 of 2 mirror imaged rooms. Both rooms contained 10 pens with 5 pigs/pen, and each room had its own separate ventilation and manure handling systems. The study was arranged in a 2 x 2 factorial arrangement. The main effects consisted of a dietary energy source, (#2 yellow corn (CON) and HOC), and with or without a virus challenge (VC). A three-phase feeding program was used, and in each phase the CON and HOC diets contained the same lysine:calorie ratios. Animals were allowed to acclimate to their respective diets for two weeks before the VC was administered. At day 14, fifty pigs (pigs from 5 pens in each room) were inoculated with a tissue culture infectious doses (TCID) 50 of PRRS *virus 2367* (1×10^4) intranasally. Blood was collected twice weekly from day 7 to day 64 post-inoculation (PI) and analyzed for serum PRRSV concentrations via ELISA.

PRRSV serum antibody titers peaked for all treatments at day 50, and then declined thereafter. Serum antibody titers remained lower (P=.05) for animals fed HOC diet compared to those fed the CON diet. Animals fed the HOC diet experienced a delay (P=.03) in measurable PRRSV serum antibody titers compared to those fed the CON diet. Also, it took longer for the PRRSV negative pigs fed HOC to seroconvert than the PRRSV negative pigs fed the CON diet. This delay may be attributed to effects of HOC on dust reduction affecting the aerosol transmission of PRRSV, and/or the biological effect HOC has on PRRSV challenged pigs. The data from this study indicates that HOC delays the seroconversion of PRRSV challenged pigs, and may reduce the onset of PRRSV in growing pigs.

Introduction

Evidence has begun to accumulate in the swine industry to indicate that inclusion of certain fatty acids plays an important role in the regulation of the immune system. Manipulating diets with fatty acid additions, either directly or indirectly, affect the production or regulation of plasma and mononuclear cells. Research has shown that diets with greater concentrations of linoleic acid reflect a greater production of arachidonic acid. This production in arachidonic acid results in a product called prostaglandin-E_2 (PGE_2) which affects and mediates the inflammatory response. Feedstuffs such as HOC contain more energy than conventional corn and can contribute to the regulation of plasma and mononuclear cell activation.

Compositions of selected nutrients are presented in Table 1. The inclusion of HOC into swine rations not only affects performance but may now lead to altered immunological responses. The increase in linoleic acid in these genetically modified plants may contribute in altering production practices.

Several disease challenges face the industry today, the main one being Porcine Reproductive and Respiratory Syndrome virus (PRRSV). PRRS has many different clinical forms ranging from subclinical infections to secondary infections that has made it the most economically important disease of swine in the 1990's. Since respiratory and reproductive diseases are primary causes of economic loss in animal agriculture, this study was initiated to

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examine the effects that HOC has on immunologically challenged pigs.

Materials and Methods

The Southeast Research Farm in Beresford, SD housed the 100 randomly assigned gilts (25 kg) to a 36' X 40' partially slatted confinement building. This facility consisted of 2 mirror-imaged rooms with separate ventilation and manure handling systems (See Diagram 1). Both rooms contained 10 pens with 5 pigs/pen. Within the building, treatments were arranged in a 2 x 2 factorial (i.e., energy source [CON vs HOC], with or without a PRRSV challenge). A three-phase feeding program was used, and in each phase the CON and HOC diets contained the same lysine:calorie ratios (Table 2). The HOC variety DK 595 TC was formulated into diets to contain the same constant lysine to ME ratio as the #2 yellow corn diets. Feed and water were offered adlibitum throughout the trial. A 2-week acclimation period was allowed before administration of the VC to allow for blood and fatty acid profile adaptation. The VC consisted of an intranasal injection of TCID 50 of PRRS *virus 2367* (1×10^4). Blood samples were obtained by jugular veinipuncture twice weekly (Monday and Thursday) from day 7 to day 64 PI to evaluate serum chemistry. The PRRSV ELISA (Enzyme-linked Immunosorbent Assay) test kit, (HerdCheck®, IDEXX Laboratories, Westbrook, MA) was used to determine presence or absence of antibody to PRRS. By calculating the S/P (sample to positive) ratio for each sample, animals with S/P ratios less than 0.4 were classified as negative for PRRS antibodies and those greater than 0.4 as positive for PRRS antibodies. Statistical analyses were conducted using GLM procedures of SAS (1988) to evaluate differences in HOC and CON diets. For the VC period, the data were analyzed in comparison to the dietary treatments. Treatments were established to contrast main effects of energy source and immunological challenge. Growth performance data presented in Table 3 shows the economical benefit of the HOC diet in relation to the CON diet. Growth data from this trial was not statistically analyzed because the quarantine procedures did not allow for incremental weights to be obtained. The raw means were similar as previous studies conducted in industry.

Results and Discussions

The time frame for PRRSV seroconversion is shown in Graph 1. Animals that were fed the HOC diet experienced a three week delay ($P=.03$) in elevated PRRSV serum antibody titers compared to those fed the CON diet. This delay may be attributed to the increase in linoleic acid of the HOC diet. Since linoleic acid may increase the production of arachidonic acid, the mediated inflammatory response may be affected. This delay in inflammatory response will be reflected in altered cell-mediated immune mechanisms, that respond to cells that produce specific antibody, and/or cells that are able to eliminate the antigen (Diagram 2).

The serum antibody titers remained lower ($P=.05$) for animals fed the HOC diet compared to those fed the CON diet (Graph 2). The reduction in sample to positive titre results may also be attributed to the higher level of linoleic acid provided by the HOC diet.

Previous research at this station has shown a 40% reduction in dust particulate when HOC is used in the diet. This reduction in dust was significant ($P=.06$) in the time it took the non-challenged pigs to seroconvert. This also supports the theory of aerosol transmission of the PRRS virus from the challenged pigs. Not only does dust reduction influences the transmission of the PRRSV isolate, but it also contributes to potential improvement in growth performance.

The data indicates that HOC delayed the seroconversion of PRRSV challenged pigs, and may play a role in immunoenhancement in growing pigs.

TABLE 1. NUTRIENT

	Type of Corn		
	CON (#2)	HOC	HOC+
Oil %	3.54	6.36	8.70
CP %	7.60	8.10	9.00
Starch %	62.00	59.00	55.00
GE kcal.lb	1770.00	1845.00	1910.00
Lysine %	0.26	0.30	0.33
Tryptophan %	0.06	0.07	0.08
Threonine %	0.30	0.33	0.33
Meth + Cyst %	0.37	0.40	0.42
	Percentage of grain at 13% moisture		
Palmitic %	0.41	0.73	1.00
Stearic %	0.06	0.15	0.20
Oleic %	0.92	1.98	3.10
Linoleic %	2.15	3.24	4.20
Linolenic %	0.06	0.08	0.10

DuPont quality Grains, average of 1994 & 1995 values for CON (#2) and Optimum 80 & 140 corn
Type of HOC represents the increase in G.E. of a pound of moisture-free corn

TABLE 2. DIET COMPOSITION (LBS. PER TON OF EACH FEEDSTUFF IN THE COMPLETE DIET)

	Grower Diet, lbs		Finisher Diet, lbs.		Finisher 2 Diet, lbs.	
Ingredient	CON	HOC	CON	HOC	CON	HOC
#2 Yellow Corn	137.80	-	1485.60	-	1485.60	
High Oil Corn	-	1355.40	-	1467.90	-	1467.90
Soybean Meal, 44%	570.80	588.20	457.30	475.30	457.30	475.30
Dical Phosphade	24.20	24.20	20.90	20.90	20.90	20.90
Limestone	17.20	17.20	17.20	17.20	17.20	17.20
Salt	5.00	5.00	5.00	5.00	5.00	5.00
Vit/Min Premix	10.00	10.00	10.00	10.00	10.00	10.00
Calculated Levels						
CP,%	18.40	18.70	16.40	16.80	15.10	15.40
Lysine, %	1.00	1.02	.85	.88	.75	.78
Calcium	.70	.70	.65	.65	.60	.60
Phosphorus, %	.60	.61	.55	.55	.50	.50
Lys: Cal glys/Mcal ME	3.06	3.04	2.58	2.60	2.27	2.29

TABLE 3. GROWTH PERFORMANCE

	Control Normal	Control Challenged	HOC Normal	HOC Challenged
Number of Head	25	25	25	25
Starting Weight, lbs.	57.0	57.0	57.0	57.0
Ending weight, lbs	245.80	257.10	252.10	253.30
Average daily gain, lbs	1.82	1.97	1.91	1.89
Average daily feed intake, lbs	5.58	6.03	5.82	5.76
Feed/Gain, lbs	3.06	3.07	3.05	3.06

Graph 1. PRRSV Seroconversion

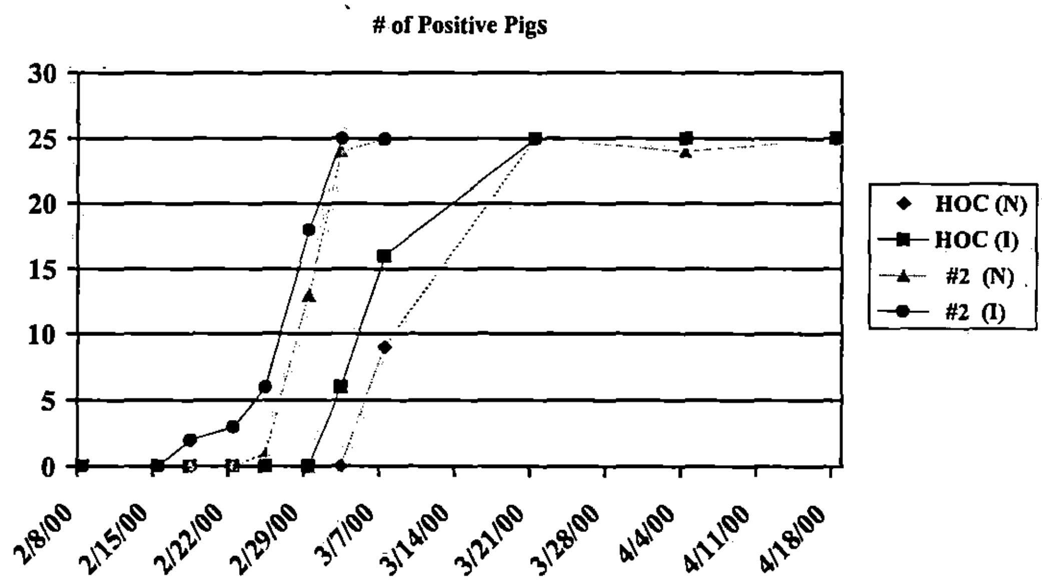
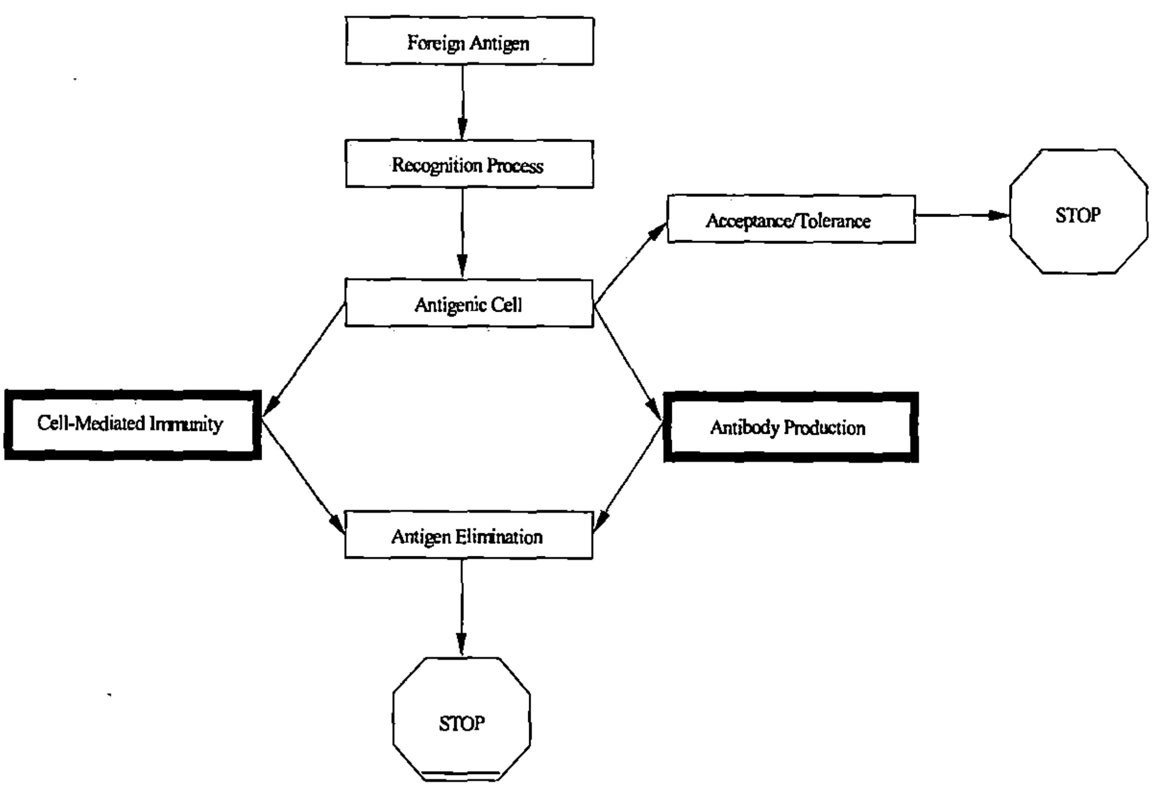


Diagram 2. Essential features of the immune responses



Graph 2. Average S/P ratio with respect to diet

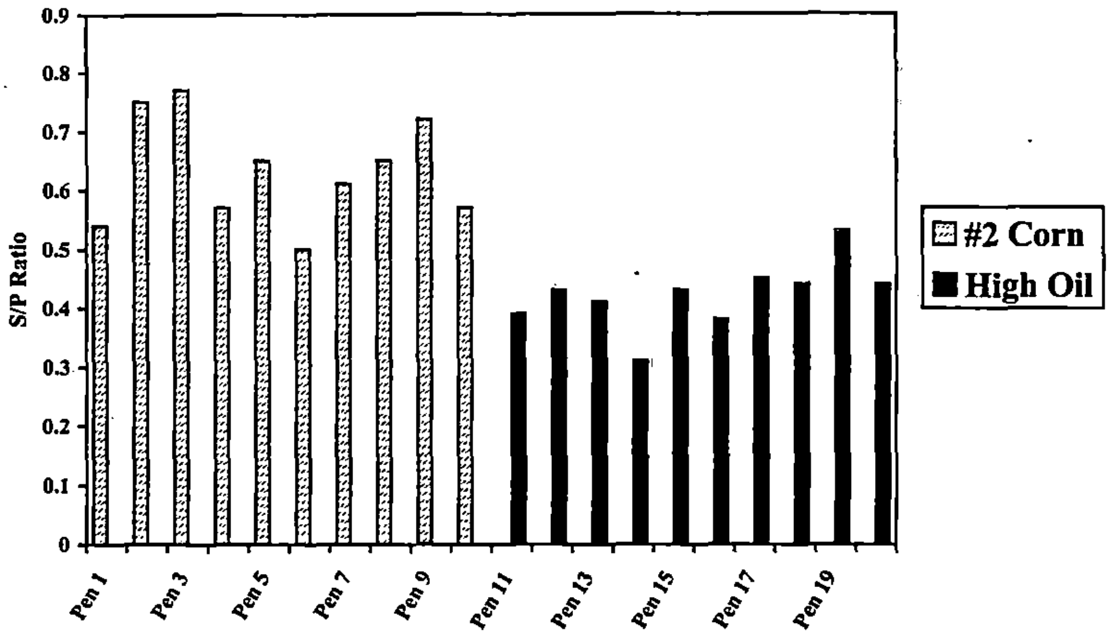


Diagram 1. Barn Layout